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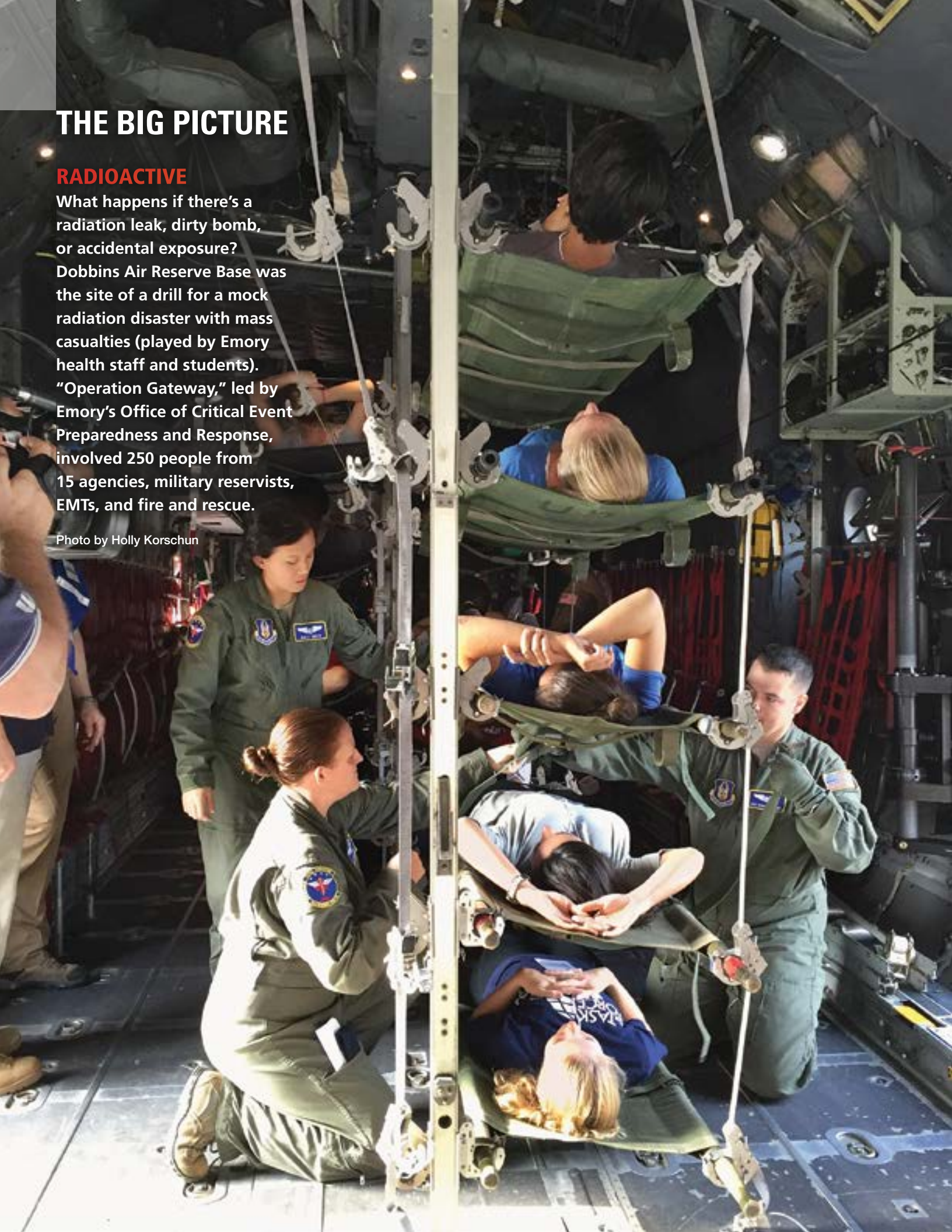
THE BIG PICTURE

RADIOACTIVE

What happens if there's a radiation leak, dirty bomb, or accidental exposure?

Dobbins Air Reserve Base was the site of a drill for a mock radiation disaster with mass casualties (played by Emory health staff and students). "Operation Gateway," led by Emory's Office of Critical Event Preparedness and Response, involved 250 people from 15 agencies, military reservists, EMTs, and fire and rescue.

Photo by Holly Korschun



Fighting Superbugs



DAVID STEPHENS
Interim Dean, Emory School
of Medicine

Drug-resistant “superbugs” are multiplying, causing infections that are unable to be treated with our normal arsenal of antibiotics.

A recent example: the September case of *Klebsiella pneumonia* that killed a Nevada woman after resisting a total of 26 different antimicrobial drugs.

Antibiotic-resistant infections, including Gram-negative bacteria, *C. difficile*, and *S. aureus* (MRSA), kill 23,000 people in the United States each year and sicken many others.

As an academic health center, we carefully monitor these dangerous infections. The clinical microbiology laboratory at Emory University Hospital, directed by pathologist Eileen Burd, examines more than 800 cultures a day to determine which bacteria are making patients sick and how best to treat them.

Let me share how just one of these cases led to an important discovery.

In the fall of 2013, Burd and her team noticed something strange in a sample taken from a kidney transplant patient. A strain of Gram-negative bacilli, *E. cloacae*, had infected the patient and was proving resistant to most of the usual antibiotics, so the team tried a “last-ditch” drug, colistin. At first, colistin appeared to work, killing off most of the bacteria. On closer inspection, though, it seemed that a small number had survived.

Microbiologist David Weiss, head of the Emory Antibiotic Resistance Center (ARC), was called in to consult. He found that the bacteria had mounted “stealth” resistance—a small colony, which normally would have gone undetected, remained. Even more troubling, these survivors appeared to expand in the presence of colistin. Weiss is now studying these “persisters.”

Collaboration between front-line patient care teams and laboratory scientists led to this fortuitous discovery. Due to such alliances, and the ARC (whose researchers can be seen on pages 14 to 23), Emory has emerged as a leader in the battle against superbugs and antibiotic resistance. This is a fight we must win.



Download our iPad app (search under **Emory Health magazines.**) Bonus features are online at emorymedicinemagazine.emory.edu.

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“ We had to maintain the baby on the placental circulation, providing oxygen to the fetus for as long as we could, so it gave us a window of time to breathe for the baby.”

STEVEN GOUDY
Pediatric otolaryngologist

FEATURES

A Future Without Antibiotics? 14

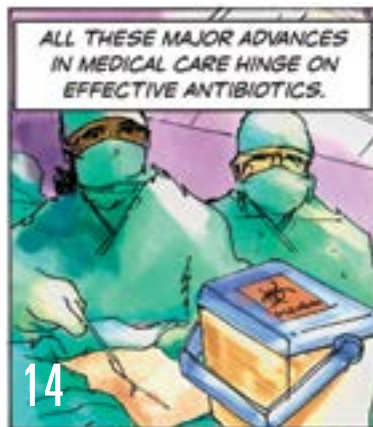
Millions of people a year become infected with bacteria that are resistant to most current antibiotics. Scientists at the Emory Antibiotic Resistance Center—our own Superbug Squad—are working to find solutions before it's too late.

Caring for the Poor 24

An inside look at the challenges of public safety net hospitals, like Atlanta's Grady Memorial, in providing mental health care to patients.

The Lifeline 28

The birth of Megan Blay's daughter was anything but normal—doctors kept baby and mother connected by umbilical cord while they performed a complex procedure to save young Emma's life.



THE BARE BONES

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AND MORE

Investing in Discovery 34

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Last Word: Operating Room Talk? 36

Medical resident Allyson Herbst discusses the sexism that remains pervasive in medical training.

Emory President Claire Sterk kicked off her February 8 inauguration with several academic symposia.

Letters

“Sepsis Survival Skills” (Emory Medicine, Fall 2016) by Quinn Eastman was a very good read. Thank you for highlighting this important health issue. The more the word sepsis is used, the more people will learn about it, and the more lives that will be saved.

Marijke Vroomen Durning, RN, Sepsis Alliance
Montreal, Canada

Thank you for the information on living with menopause. The article was very intellectually stimulating. As a man, it is sometimes difficult to understand when women complain of hot flashes and have mood swings. My wife is far from that stage but articles like yours prepare me for the future.

Mathias Tanyl Agbor, unit charge nurse, MICU
Emory University Hospital Midtown, Atlanta

I very much enjoyed “Learning to Love Our Bugs” (Emory Medicine, Fall 2016) with its brilliant illustrations. It eloquently highlights the importance of the gut microbiome in the pathogenesis of several diseases and new therapeutic approaches using our gut’s own bugs to help cure or manage them. I see patients with gastrointestinal (GI) disorders—including irritable bowel disease, autoimmune GI diseases, reflux, constipation, bacterial overgrowth, and dyspepsia—and in all of those conditions, the gut microbiome is central to the progression or perhaps the etiology of the disorders. Although our bugs’ interactions with our diet, bile acids, genetics, and environmental influences are not yet known, I think we are getting closer to the impact of our other organ—our microbiome—on our health.

Baha Moshiree, MD
University of Miami

Once there was an entire industry based on destroying our natural bacteria (douches) and now there is an entire industry (probiotics) based on allowing them to thrive! I was especially heartened to see that human microbiota is being looked at as a factor in ALS; my mother was a patient at the Emory Clinic for ALS, and this article just illuminates how much there is left to explore.

Sara Wilkinson
Athens, GA

“Learning to Love Our Bugs” provided a unique insight into something about which all of us need to become educated. Thanks for this great article, it is one of the more educational pieces that I have seen in your magazine.

Robert Nerem, PhD
Professor Emeritus, Parker H. Petit Institute for Bioengineering and Bioscience
Georgia Institute of Technology



Joe Grillo holds up his dad, Jerry’s, *Emory Medicine* cover story on the microbiome, “Learning to Love Our Bugs,” in the waiting room during his regular visit to Emory Orthopaedics.

We like to hear from you. Send us your comments, questions, suggestions, and castigations. Address correspondence to Emory Medicine magazine, 1762 Clifton Road, Suite 1000, Atlanta, GA 30322; call 404-727-0161; or email mary.loftus@emory.edu.

People Are Talking

“When you have a trauma, it’s in the front of the picture of your life. It never goes out of your picture, but over time, you don’t want it to be in the front anymore.”



Emory Professor of Psychiatry and Behavioral Sciences **Nadine Kaslow**, on CNN, about terrorist attack survivors.

“Ethics is rarely about what’s right and wrong. It’s often about two rights in conflict.”



Paul Root Wolpe, director of the Emory Center for Ethics and professor of medicine, on medical ethics cases, in *Atlanta* magazine.

“Our recruiter couldn’t keep up with the calls. That’s why it’s exciting to come in every day. You have all of these people coming in to help, but they don’t have to; they are volunteers. So you better get up and get to work!”



Sri Edupuganti, medical director of Emory’s Hope Clinic, about the overwhelming response to a call for volunteers to test the Zika vaccine, on CNN.

Early Risks to Heart Health



Burning the candle at both ends. Spreading yourself too thin. A number of old adages remind us that energy and endurance are finite resources.

Emory cardiologists recently showed that cells that repair our blood vessels and other tissues also behave like limited resources, and that stress on the circulatory system early in life may deplete its regenerative capacity later.

Professor of Medicine Arshed Quyyumi and colleagues at Emory's Clinical Cardiovascular Research Institute have been studying circulating progenitor cells, or CPCs, for many years.

These rare cells in the blood are key indicators of regenerative capacity. They're capable of becoming endothelial cells, which line blood vessels, as well as red and white blood

cells. When harvested from the bone marrow and delivered in sufficient numbers, they improve the capacity of the heart to repair itself after a heart attack.

CPCs also seem to be an indicator of cardiovascular health. People with more cardiovascular risk factors, such as diabetes, high blood pressure, or high cholesterol, tend to have lower numbers of these cells as they age. And heart disease patients who have lower numbers of CPCs have a much higher risk of dying over the next few years.

In studies that included younger people, Quyyumi's team found some contradictory results: levels of these cells actually tended to go up with cardiovascular risk. That makes sense, because physical or mental stress stimulate CPCs to emerge from the bone marrow.

In a paper published in *Circulation Research* in 2016, the Emory team wove these strands together by combining two groups of study participants: mostly healthy university employees from Emory and Georgia Tech with a large database of hospitalized patients undergoing cardiac catheterization.

For people younger than 40, risk factors were associated with increased CPC counts, but for older people in their 60s, risk factors and cardiovascular disease were associated with lower progenitor cell counts. This suggests that time, by itself, does not deplete CPCs, but unhealthy living does.

"Circulating progenitor cell levels do not decline with healthy aging," the authors concluded. "Risk factor exposure at a younger age stimulates progenitor cell mobilization, whereas continued exposure is associated with lower progenitor cell levels in later life." —*Quinn Eastman*

BY THE NUMBERS *\$540 million*

Researchers in Emory's Woodruff Health Sciences Center (WHSC) received more than \$540 million in research funding in 2016, or nearly 94% of the university total, with \$364.9 million in federal funding, including \$322.2 million from the NIH. The WHSC includes the schools of medicine, public health, nursing, Yerkes National Primate Research Center, Winship Cancer Institute, and Emory Healthcare. The School of Medicine received nearly \$348 million, the Rollins School of Public Health received \$94.8 million, Yerkes National Primate Research Center received \$79.1 million, and Nell Hodgson Woodruff School of Nursing received \$15.1 million (and was ranked first among nursing schools for NIH funding). ■

MISSING SOCIAL SIGNALS

Autism and Eye Contact

Young children with autism do not avoid eye contact on purpose, found a new study by researchers at Marcus Autism Center, Children's Healthcare of Atlanta, and Emory School of Medicine.

Instead, they make less eye contact because they miss the significance of social information contained in others' eyes.

While reduced eye contact is a well-known symptom of autism spectrum disorder, used in early screening and diagnostic instruments, why children with autism look less at other people's eyes has not been known.

This study, reported in the *American Journal of Psychiatry*, helps answer that question. "This is important because we're disentangling very different understandings of autism," says Jennifer Moriuchi, an Emory graduate student. "Depending on why you think children with autism are making less eye contact, you might have different approaches to treatment and different ideas about the brain basis of autism."

Two explanations have been proposed: One, that children with autism avoid eye contact because they find it stressful or negative. The other, that children with autism look less at others' eyes because social cues from the eyes are not perceived as particularly meaningful or important.

The new research, conducted on the day children were first diagnosed, shows that young children with autism do not actively avoid eye contact.

Together with Drs. Ami Klin and Warren Jones, Moriuchi studied how 86 two-year-old children with and without autism paid attention to other people's eyes. Children with autism watched a series of carefully made videos. "Before each video, we flashed a small picture to capture the



child's attention, and when they looked to where the picture had been, they found that they were either looking directly at another person's eyes or looking away from the eyes," Moriuchi says. "When we did this repeatedly, we found that young children with autism continued to look straight at the eyes. Like their peers without autism, they didn't look away from the eyes or try to avoid the eyes in any way."

When varying levels of socially meaningful eye contact were presented, however, children with autism did look less at others' eyes than their peers without autism did.

This isn't meant to contradict the personal experiences of adults and older children with autism who report feeling anxious in response to eye contact, the researchers say. "For children with autism, social signals can be confusing," Jones says. "And as children grow up to be adults, those signals can become even more challenging to understand. This research highlights the opportunity to target the right underlying concerns as early as possible." ■

Don't Twist My Arm



A leg up. Putting your foot in your mouth. Strong arm. Back-handed compliment.

Listening to metaphors involving arms or legs loops in a region of the brain responsible for visual perception of those body parts, scientists have discovered.

The finding, recently published in *Brain & Language*, is more evidence for "grounded cognition"—the idea that comprehension of abstract concepts in the brain is built upon concrete experiences, a proposal whose history extends back millennia to Aristotle.

When study participants heard sentences that included phrases such as "shoulder responsibility," "foot the bill," or "twist my arm," they tended to engage a region of the brain called the left extrastriate body area (EBA). The same level of activation was not seen when participants heard literal sentences containing phrases with a similar meaning, such as "take responsibility" or "pay the bill."

The study included 12 right-handed, English-speaking people, and blood flow in their brains was monitored by functional MRI.

"The EBA is part of the extrastriate visual cortex, and it was known to be involved in identifying body parts," says senior author Krish Sathian, professor of neurology, rehabilitation medicine, and psychology at Emory.

Sathian's research team had previously observed that metaphors involving the sense of touch, such as "a rough day," activate a region of the brain important for sensing texture.—Quinn Eastman



Meet Claire Sterk Emory's 20th President

Claire Sterk, former Emory provost, took the helm of the university this fall, becoming its first female president.

Sterk has been a member of the Emory community since 1995, when she was appointed to the faculty of the Rollins School of Public Health. She has served as the Charles Howard Candler Professor of Public Health, chair of Behavioral Sciences and Health Education, associate dean for research, and senior vice provost for academic affairs. She was named provost and executive vice president for academic affairs in 2013.

On September 1, she succeeded James Wagner, who retired after 13 years as president.

"Claire Sterk is a confident leader, an accomplished academic administrator, and a respected researcher," says John Morgan, chair of the Emory Board of Trustees and of the presidential selection committee. "She has a sophisticated knowledge and understanding of Emory and is passionate about leveraging Emory's considerable strengths and assets to enhance its global reputation and reach."

Sterk is a native of the Netherlands, where she earned her PhD in sociology from Erasmus University in Rotterdam and her doctorandus degree in medical anthropology from the University of Utrecht. She is an international leader in the fields of public health and anthropology.

At Emory, Sterk has held faculty appointments in anthropo-

gy, sociology, and women, gender, and sexuality studies, in addition to public health. Her primary research interests are addiction, mental health, and HIV/AIDS, with a focus on community-based interventions. She has held several professional leadership positions, including president of the Alcohol, Drug, and Tobacco section of the American Sociological Association and board member of the Society for Applied Anthropology.

"One of the treasures of Emory is to have the academic health center, which allows for training opportunities for students and for discovery and advances in health and healing," Sterk says. "Our academic health center cares for those who are ill, fosters prevention and wellness, and engages in groundbreaking research that improves the lives of people around the world."

Stuart Zola, former director of Yerkes National Primate Research Center, has been appointed interim provost and executive vice president for academic affairs. ■

She understands both the challenges and opportunities that exist for our health sciences schools and centers and for Emory Healthcare."

JON LEWIN

Executive Vice President for Health Affairs, Executive Director of Woodruff Health Sciences Center, CEO of Emory Healthcare

Double Trouble

Lt. Col. Dave Hofstetter, 68, is an avid bicyclist, former lacrosse player, and motocross rider, who completed dozens of sky-diving missions during his two decades of service as a helicopter pilot for the US Army.

Now retired from the military, he still takes an annual bicycle trip through locales in France, Italy, or Argentina with a dozen of his former West Point classmates and their spouses. Dave and his wife, Corrine, a flight attendant for Delta, enjoy the challenge and the camaraderie. “It’s not the

Tour de France,” he says. “We ride about 20 miles a day, interrupted frequently by beer and wine stops.”

Due to Hofstetter’s athletic and adventurous nature, he’s put a lot of wear and tear on his body. He’s had 15 surgeries, including six hip replacements, five shoulder operations, and two double-disk back surgeries.

Despite his numerous surgeries, Hofstetter says, he’s not someone who goes to the doctor for every cough or cold. “It’s the military mindset—tough it out,” he says. But when he experienced an irritating cough over a few weeks that wouldn’t go away, he decided to have it checked

“At first, I thought it was pneumonia, but tests came back inconclusive, so I reviewed his health history and decided we should do a full battery of tests, including looking at his lungs.”

DR. MARK HOGAN

Emory Johns Creek Hospital

out. “I told Corrine, let’s go to Emory Johns Creek ER, it’s just around the corner from our house in Alpharetta,” he says. “They can pull up a list of my current medications. I expected to get a prescription and go home.”

Dr. Mark Hogan was on duty, and remembers Hofstetter well. “At first, I thought it was pneumonia, but tests came back inconclusive,” he says. “So I reviewed his health history and decided we should do a full battery of tests, including a CT angiogram of his lungs.”

Hofstetter was surprised when they came back into the room and handed him a hospital gown. “After they did all the tests, they came back in and said, ‘You’re not going anywhere,’” he says.

Can you guess, careful readers, what was discovered during the tests that called for Hofstetter’s immediate admission to the hospital?

Hofstetter had a pulmonary embolism in each of his lungs. These blood clots, which often travel from elsewhere in the body, lodge themselves in the arteries of the lungs and can block blood flow. Symptoms include shortness of breath, chest pain, and a cough, but most pulmonary embolisms are sub-clinical. “Most people never know they have them,” Hogan says. “It’s a case of look and you will find.” Nevertheless, if a clot is large or if there are multiple clots, they can be fatal.

Hofstetter’s existing clots were dissolved with blood thinners. He was checked thoroughly for blood clots elsewhere and got the all clear. “I had never had any issues with blood clots before,” he says. “They broke these two up, and everything was fine and dandy.”

He became a Patient Family Advocate for Emory Healthcare, and is looking forward to his next bicycle trip. “I am able to do all the things I do,” he says, “because of what the medical professionals are able to do.” ■



Rep. Tom Price Picked for Health and Human Services Secretary



In late November, Rep. Tom Price (R-GA), a former Emory School of Medicine faculty member and Grady Hospital physician, was named by President-elect Donald Trump as his pick for Health and Human Services (HHS) secretary.

The six-term Republican congressman would lead HHS, which has an annual budget of more than \$1 trillion and includes agencies such as the Centers for Medicare and Medicaid Services, the FDA, the NIH, and the CDC. Price represents Georgia's sixth district, which includes many of Atlanta's northern suburbs, and was appointed chair of the House Budget Committee at the end of 2014. Before his election to Congress, Price was an orthopedic surgeon. He came to Georgia for his orthopedic surgery residency at Emory, entered private practice in 1984, and was one of the founders of Resurgens Orthopedics, becoming involved in politics through the Medical Association of Georgia. While a member of the State Senate, he became an assistant professor at Emory, from 2002 to 2015. He was also medical director of the Orthopedic Clinic at Grady Hospital, overseeing the training of resident doctors. ■

A Perfect Storm: When thunderstorm asthma strikes

Thunderstorm asthma—a rare event in which raindrops break pollen grains into particles tiny enough to be inhaled—can be deadly. The wind and fast-moving rain mixed with pollen from seed plants allow the fragmented particles to bypass the body's natural defense systems and find their way into the lungs.

Cities from Atlanta to Australia have experienced this phenomenon in recent years. In the most recent incident in November in Sydney, Australia, thousands of people flooded emergency rooms struggling for breath and several died.

Stefanie Sarnat, associate professor of environmental health at Emory, has studied the occurrence in Atlanta. She says it most often strikes in areas with high humidity when specific conditions are met, such as compromised air quality (like increased pollen) and a large population that is susceptible to asthma. A small increase (about 3%) in ER visits for asthma occurs after every thunderstorm, Sarnat adds, because asthma sufferers' symptoms are inflamed, but large-scale outbreaks are rare.

Thunderstorm asthma usually affects people with an allergy to grass pollens, says Jennifer Shih, an Emory physician and medical director of the pediatric allergy clinics. It can be worse in those that also have asthma. In fact, in one study that looked at an earlier event in Australia in 1997, 96% of those affected proved sensitive to grass pollen upon testing. "This phenomenon is literally the culmination of

a perfect storm," Shih says. "Grass pollen is usually too large to enter the small airways of the lungs and is filtered out by the nose. In thunderstorm asthma, stormy winds and moisture can cause the pollen to rupture into tiny particles, small enough to be inhaled. The outflow winds of a thunderstorm can then concentrate these tiny particles at ground level, where people breathe them in and they cause an acute asthma attack in those who are allergic to grass pollens." ■

In thunderstorm asthma, stormy winds and moisture can cause the pollen to rupture into tiny particles, which are small enough to be inhaled into the small airways."

DR. JENNIFER SHIH



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—Joel Zivot, bioethics student and Emory anesthesiologist

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Cure for the Common Cold?



Who wouldn't want to avoid a cold, if they could? All those days of sniffing and sneezing, feeling achy and tired, and searching drugstore shelves for over-the-counter remedies.

Now, it seems, a vaccine against rhinoviruses—the predominant cause of the common cold—may be achievable.

Researchers showed in the 1960s that it was possible to vaccinate people against one variety of rhinovirus. But because there were more than 100 varieties of rhinoviruses, the quest for a vaccine seemed futile.

Emory researcher and Associate Professor of Pediatrics Martin Moore, however, believes the immune system might be up for the challenge.

Moore and colleagues found that vaccines that combine dozens of varieties of rhinovirus were effective in stimulating antiviral antibodies in monkeys, in findings they reported in *Nature Communications* on September 22.

“We think that creating a vaccine for the common cold can be reduced to technical challenges related to manufacturing,” says Moore, director of the Emory Children’s Center for Childhood Infections and Vaccines.

The team produced a vaccine that showed promising results in

clinical trials on rhesus macaques. The vaccinated monkeys were able to produce antibodies against many types of rhinoviruses. They are following up on these results with more research and hope to move soon to human trials.

“It’s surprising that nobody tried such a simple solution over the last 50 years,” Moore says. “We just took 50 types of rhinovirus and mixed them together into our vaccine, and made sure we had enough of each one.” —*Quinn Eastman*

Call Ripley's! Emory Saint Joseph’s Hospital cardiothoracic surgeon Douglas Murphy has achieved a world record after completing his **2,000th** robotically assisted mitral valve surgery.



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The Mind-Body Connection

HYSTERIA. HYPOCHONDRIA. NERVOUS FITS. For decades, people who battled a cluster of symptoms—from blindness to paralysis to seizures—with no discernable physical cause were dismissed by the medical establishment as malingering, attention seeking, or worse.

As the field of psychiatry progressed, however, a number of “conversion disorders” were recognized as emotional stress being converted to physical symptoms. They are now known as functional neurological symptom disorders. And the symptoms, including those that are stress or trauma related, are treated as physical ailments—which they are.

“What’s going on is, in fact, changes in the brain,” says Mark Hyman Rapaport, chair of Emory’s Psychiatry and Behavioral Sciences Department. “And the good news is that with appropriate diagnosis, one can get better.”

Barbara Klein suffered the “shame and stigma” of having such a condition, which took years to be properly diagnosed.

“You are really alone until you find someone with compassion,” she says. “People, even medical professionals, were very dismissive. They told me to snap out of it, that it was all in my head. People would say, ‘What do you have to be depressed or anxious about? Your husband loves you, you have a beautiful home.’ It was a very scary time.”

Klein’s physical symptoms included seizure activity and, ultimately, an inability to speak. She was misdiagnosed with Huntington’s disease, depression, “all sorts of things,” she says. “Doctors tried one medication after another, especially ‘happy pills.’ Much of that time is a haze.”

Finally, she found a doctor who conducted a detailed physical and mental health evaluation.

“He told me that childhood trauma I had experienced kicked in my fight-or-flight response, which had been stored up inside me and was now making me sick. It needed an outlet,” she says. “I understood that. It was real, and we needed to fix it.”

Klein and her husband, Mark, are partnering with Emory

to sponsor a series of Mind-Body conferences.

“This conference series is about ethics, collaboration, and the union of scientific inquiry with humanistic study,” says Rapaport. “There is a real need to fund research in this area.”

The first Klein Mind-Body Conference was in 2015, and a larger gathering, the Partners in Treatment Innovation for Functional Neurological Disorders conference, will take place March 3 and 4 at the Emory Brain Health Center.

“The conference deals with stigma, diagnosis, treatment challenges, and cost to families and society,” says Phyllis Rosen, a conference organizer and Emory clinical social worker, and brings together international experts from psychiatry, neurology, education, health care, anthropology, sociology, bioethics, patient advocacy, and neuroscience.

“There are thorny issues and value conflicts that arise at the neurology-psychiatry interface,” says Karen Rommelfanger, an Emory neuroethicist and director of the conference series. “The number of these patients rivals the number of patients with ALS and MS, but until recently they had no advocacy organization or formal funding mechanism. In fact, there is no standard curriculum around functional neurological disorders nation-

wide, yet every neurologist is likely to encounter one of these patients early in their training and certainly in their careers.”

The Emory Brain Health Center also is planning to establish a pilot multidisciplinary clinic for patients with functional neurological disorders. About 30% of patients with seizure disorders and 10% with movement disorders fall under this diagnosis, Rapaport says.

“There remains an amazing amount of prejudice and stigma about diseases of the brain, where our memories, thoughts, speech, feelings, and creativity reside,” he says. “Diseases of this, our most complex organ, are so frightening to us.”

Klein remembers well the relief of finding out that what she had was real and that help was available.

“When someone gets cancer, they are put on a prayer list, people bring by food, there are support groups,” she says. “We need to extend this compassion to people with mental diseases as well. They must not be shunned.”—*Mary Loftus*



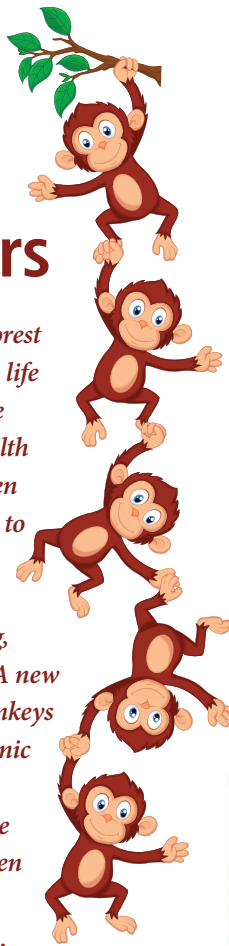
Social Climbers

The richest and poorest Americans differ in life expectancy by more than a decade. Health inequalities are often attributed to access to medical care and differences in habits, such as smoking, exercise, and diet. A new study in rhesus monkeys shows that the chronic stress of life at the bottom can alter the immune system, even in the absence of other risk factors.

*The research confirms animal studies suggesting that social status affects the way genes turn on and off within immune cells. The new study, which ran in the November 25 issue of *Science*, shows that the effects are reversible.*

By studying adult female rhesus monkeys at Emory's Yerkes National Primate Research Center, the team found that infection sends immune cells of low-ranking monkeys into overdrive, leading to inflammation, but improvements in social status or support can turn things around.

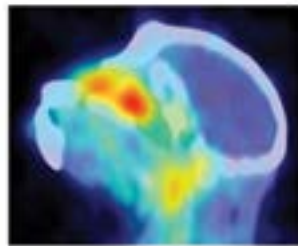
If similar molecular mechanisms underlie the link between social status and health in humans, interventions that improve a person's support network could be just as important as drugs for mitigating the health costs of low status, says co-author Mark Wilson, Emory professor of psychiatry and behavioral sciences and part of Yerkes' Division of Developmental and Cognitive Neuroscience.—Lisa Newburn



THE BIG IDEA

Antibody treatment controls HIV-like infection in monkeys

In a study that is being called a game-changer by the HIV research community, scientists from Emory and the National Institute of Allergy and Infectious Diseases (NIAID) have achieved sustained control of SIV (the simian version of HIV) in infected monkeys given an antibody on top of standard antiviral drugs.



Scientists at Emory and the National Institutes of Health (NIH) have achieved sustained remission of SIV, the simian form of HIV, in infected monkeys.

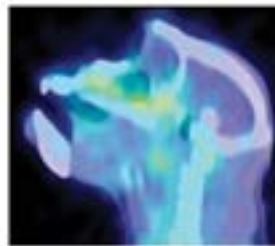
The antibody, currently used to treat inflammatory bowel disease, was designed to stop susceptible immune cells from entering intestinal tissues—a hot spot of damage during acute HIV and SIV infection. It was used along with antiretroviral drugs during and after drug treatment.

When the antiretroviral drugs were stopped, SIV did not re-emerge in monkeys that had been given the antibody. If it works on humans with HIV in the same way, this could be a step toward a “functional cure,” which would allow patients to stop taking their antiretroviral drugs without the virus rebounding.

The paper, published October 13 in *Science*, received reactions of “fascinating,” “a

complete first,” “striking,” and “too amazing to be real” by other researchers in the field.

A team led by immunologist Aftab Ansari and colleagues at Yerkes National Primate Research Center infected eight rhesus macaques with SIV, treated them with antiretroviral drugs, and then infused them with an antibody similar to an



FDA-approved drug for Crohn's disease and ulcerative colitis, vedolizumab, that targets a receptor on immune cell surfaces. More than nine months after the antiretroviral drugs and antibody treatments were stopped, all eight animals had low or undetectable levels of SIV in their blood. In seven SIV-infected control animals that received a placebo, the virus rebounded to high levels within two weeks of stopping antiretrovirals.

“This comes from an idea I had many years ago: stopping CD4+ T cells from circulating into the gut may offer protection during acute infection,” says Ansari, a professor of

pathology and laboratory medicine. “But precisely how it works in regulating viral replication is still far from clear. The antibody therapy appears to have helped reconstitute the entire immune system.”

This was the first consistent demonstration of post-treatment immune control in monkeys infected with SIV, without previous vaccination.

“The results knocked us out, they were so stunning,” says co-author Anthony Fauci, an immunologist who heads the National Institute of Allergy and Infectious Diseases (NIAID).

More than a million people in the U.S. and about 35 million worldwide are living with HIV. Long-term post-treatment control of HIV has been reported in only a handful of people treated soon after infection.

A pilot clinical trial testing the safety of vedolizumab and its effect on people with HIV has begun at NIAID. The trial, which hopes to enroll 20 people, is mainly a safety assessment, but participants will go off antiretrovirals, and then the researchers will closely monitor them to see whether their HIV levels rise or remain suppressed.

“This finding could become a blueprint for an alternative therapy for HIV, so someone would not need to continuously take antiretroviral drugs,” Ansari says. ■



Pathologist Aftab Ansari



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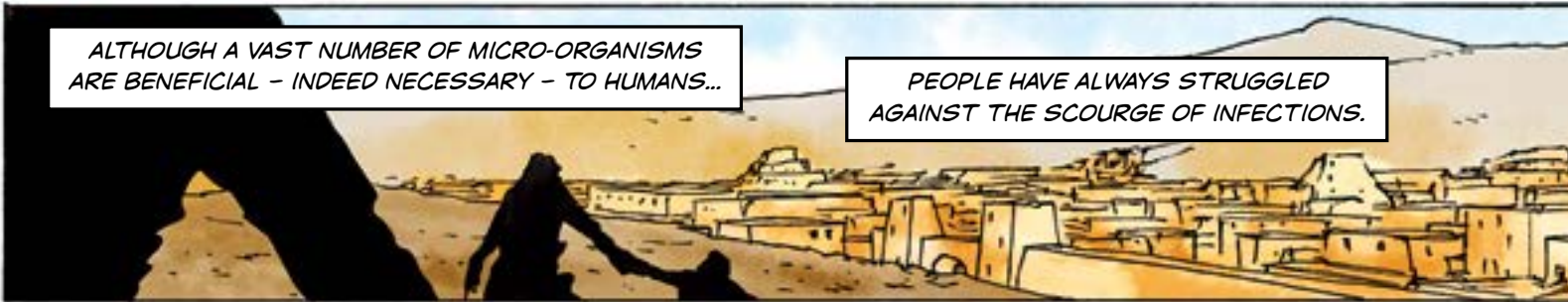


BACTERIA ARE EVERYWHERE.

AND THEY HAVE BEEN WITH US

-AND INSIDE OF US-

SINCE THE VERY BEGINNING.



ALTHOUGH A VAST NUMBER OF MICRO-ORGANISMS ARE BENEFICIAL - INDEED NECESSARY - TO HUMANS...

PEOPLE HAVE ALWAYS STRUGGLED AGAINST THE SCOURGE OF INFECTIONS.



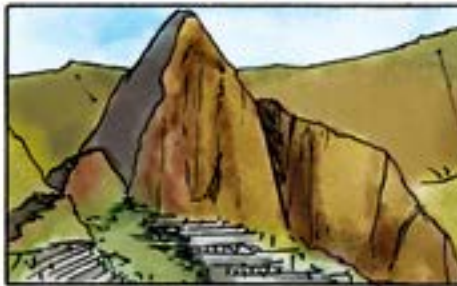
DIVERSE "REMEDIES" WERE EMPLOYED...

MOLDY BREAD AS A POULTICE FOR WOUNDS IN ANCIENT EGYPT.



THEY ALSO USED HONEY, LARD, AND LINT.

HERBS AND BOTANICAL COMPOUNDS WERE PREVALENT IN CHINA...



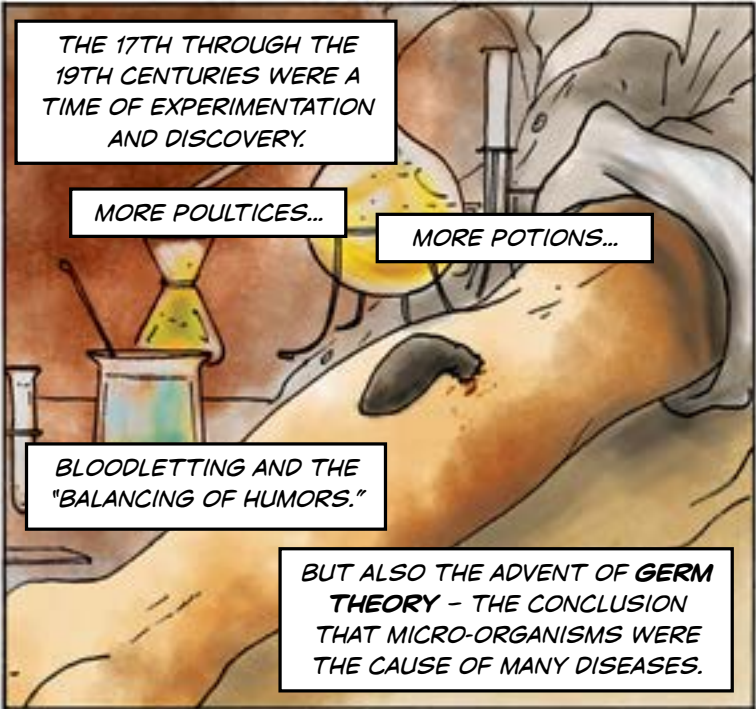
BUT ALL WERE HIT OR MISS AND WORKED WHEN NOW-KNOWN METABOLITES OR CHEMICALS WERE PRESENT.

WHICH WAS RARE.



ROMAN AND MEDIEVAL TIMES SAW THE DEVASTATION OF THE BUBONIC PLAGUE, CHOLERA, AND SYPHILIS.

ALL BACTERIAL DISEASES.



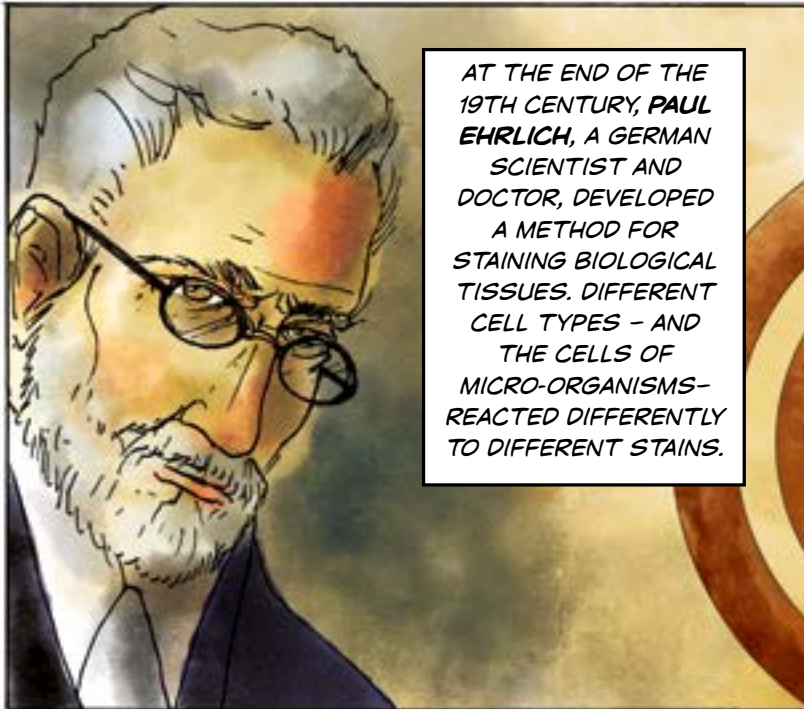
THE 17TH THROUGH THE 19TH CENTURIES WERE A TIME OF EXPERIMENTATION AND DISCOVERY.

MORE POULTICES...

MORE POTIONS...

BLOODLETTING AND THE "BALANCING OF HUMORS."

BUT ALSO THE ADVENT OF GERM THEORY - THE CONCLUSION THAT MICRO-ORGANISMS WERE THE CAUSE OF MANY DISEASES.



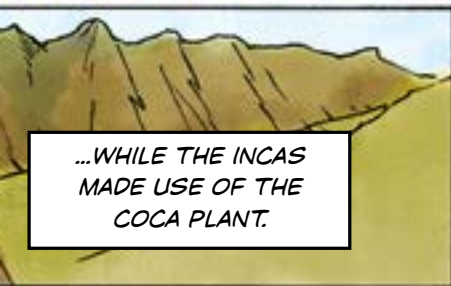
AT THE END OF THE 19TH CENTURY, PAUL EHRLICH, A GERMAN SCIENTIST AND DOCTOR, DEVELOPED A METHOD FOR STAINING BIOLOGICAL TISSUES. DIFFERENT CELL TYPES - AND THE CELLS OF MICRO-ORGANISMS- REACTED DIFFERENTLY TO DIFFERENT STAINS.

A Future Without Antibiotics?

GRAPHIC STORY BY Jonathan Roy ■ PROFILES BY Mary Loftus



INFECTIONS THAT SPREAD EASILY AS PEOPLE CROWDED INTO CITIES.



...WHILE THE INCAS MADE USE OF THE COCA PLANT.



THIS LED EHRLICH TO REASON THAT DISEASE-CAUSING ORGANISMS COULD BE TARGETED.

The possibility that our most commonly prescribed drugs, which we've relied on for nearly eight decades to kill infections, will stop working—indeed, in some cases, already have—is nearly unfathomable.

Each year, more than 2 million people in the United States become infected with bacteria that are resistant to antibiotics and about 23,000 of them die. “Unfortunately this problem is going to get worse before it gets better, and more people will die,” says microbiologist David Weiss, director of Emory’s Antibiotic Resistance Center. “If you can die from a scrape or a common infection, honestly, everyone’s life is going to change a lot.”

Commonplace illnesses and routine surgeries would once again become life-threatening, and chemotherapy, organ transplantation, and other tools of modern medicine would be off the table.

On these pages we have asked graphic artist Jonathan Roy, author of *Smallpox Zero*, to depict the past, present, and possible future of antibiotics, and we also profile several Emory Antibiotic Resistance Center researchers—our own Superbug Squad.

“We’re standing on the precipice of a post-antibiotic era,” says Emory ethnobotanist Cassandra Quave, who is searching for medicines in ancient remedies and promising plants. “We just haven’t fallen off yet.”



Eileen Burd, professor of pathology and laboratory medicine and director of clinical microbiology at Emory University Hospital

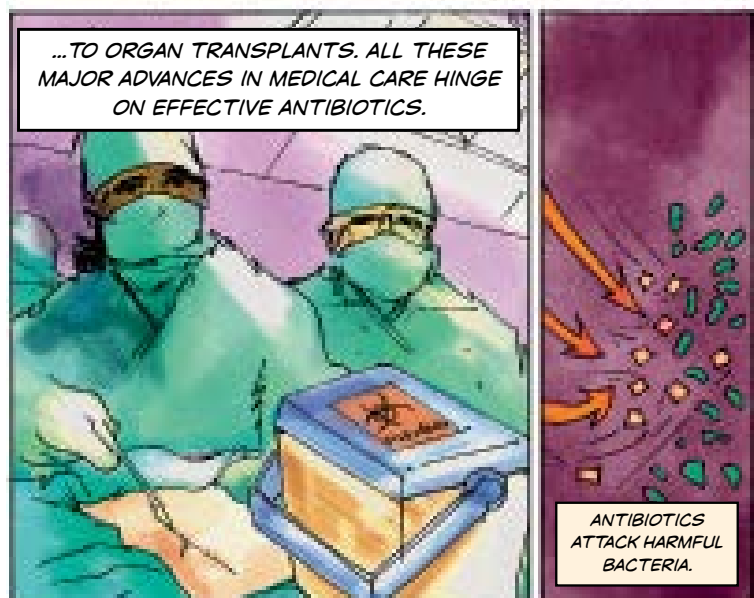
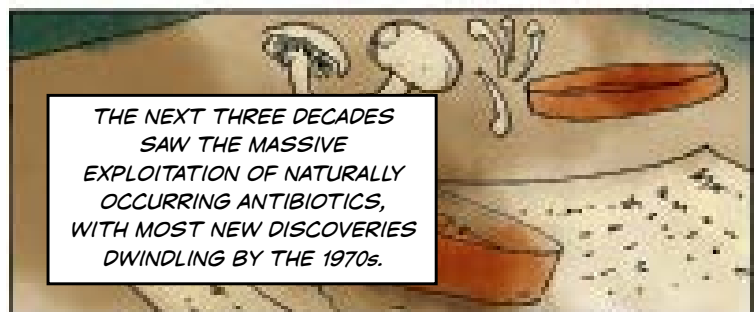
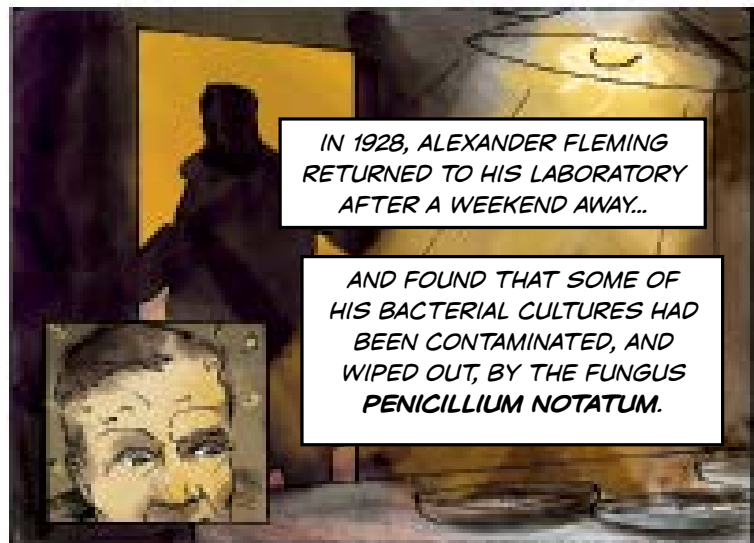
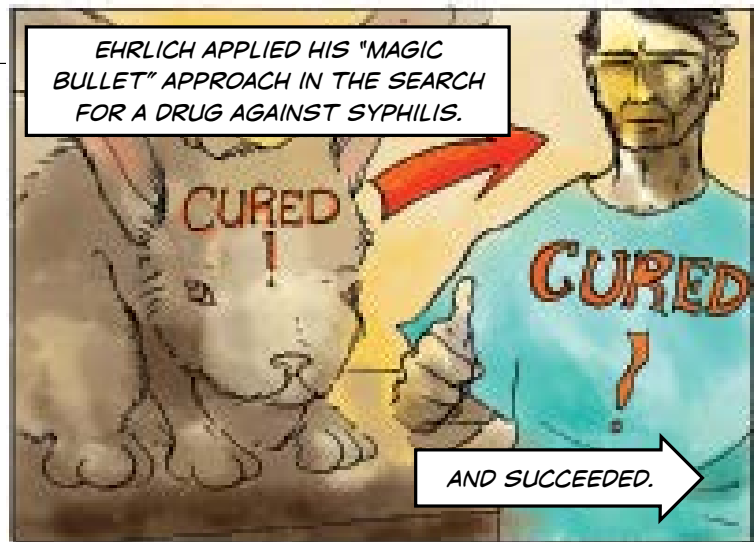
WHO I AM: I've been a clinical microbiologist for almost 20 years. My second youngest brother died of *Haemophilus influenzae* meningitis when he was three years old and I was six. I never cease to be amazed at how such tiny organisms can cause devastating disease.

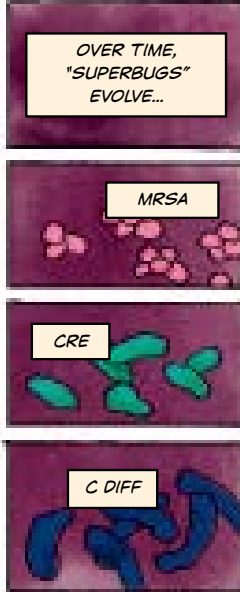
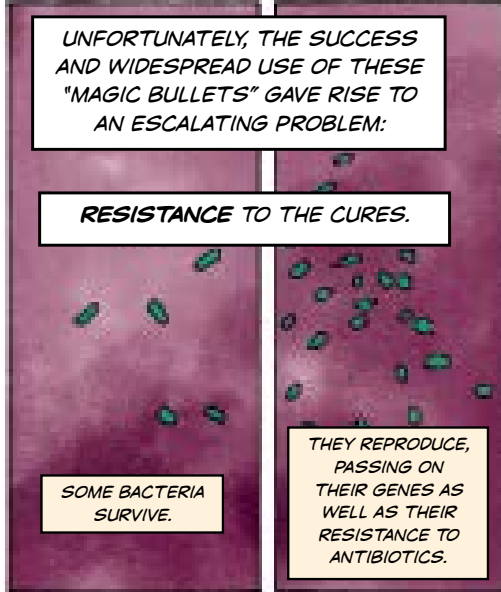
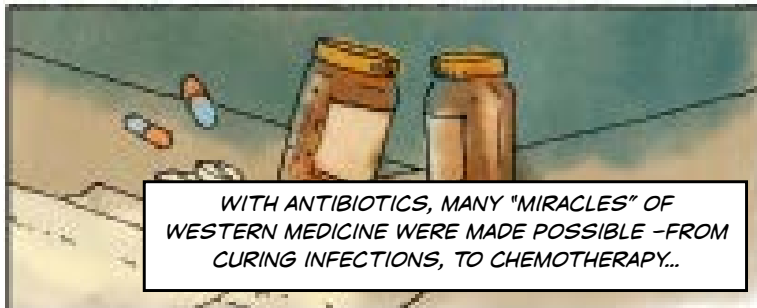
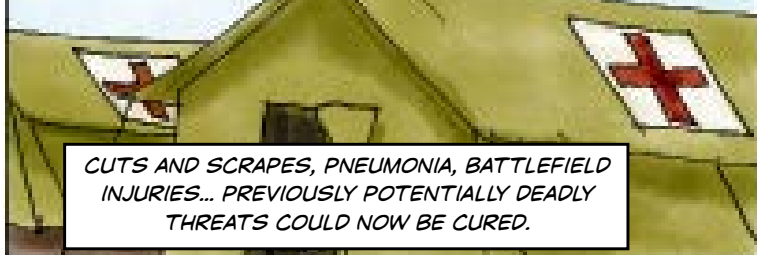
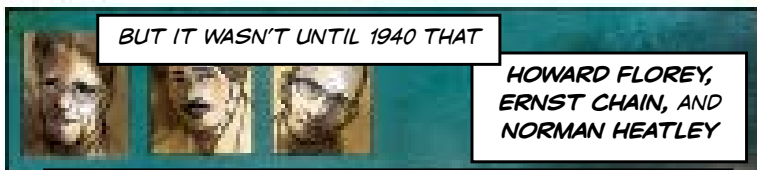
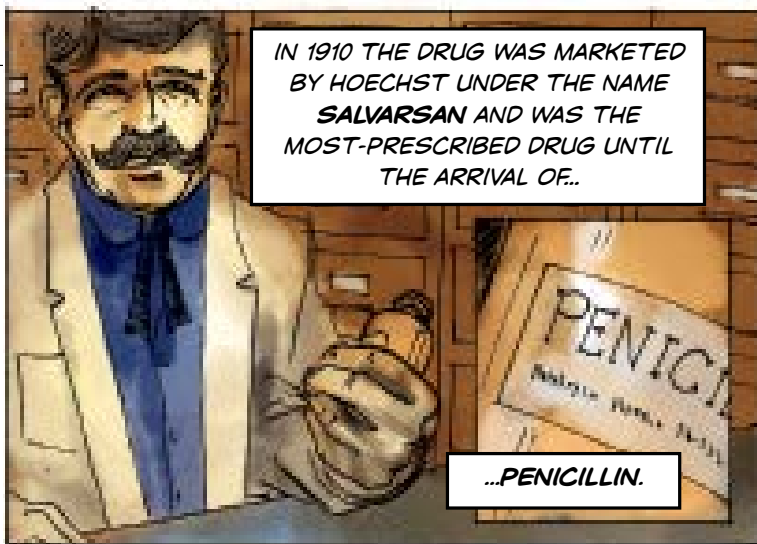
WHAT I DO: Now more than ever, the clinical microbiology laboratory is on the front line and plays a vital role in helping to heal people. My primary role as a clinical microbiology laboratory director is to ensure that my laboratory is using the best technology available to generate accurate, rapid, and cost-effective antimicrobial susceptibility test results. If antibiotic therapy is informed by these results, it should be effective most of the time and lessen the use of unnecessary antibiotics. If I encounter an unusual antibiotic-resistance phenomenon in the laboratory, I want to explore it further. This has happened on several occasions in the past few years.

CHALLENGES: Clinical microbiology laboratories are highly regulated. This is necessary to ensure that quality results are obtained from all microbiology laboratories regardless of where they are located around the country, but sometimes inhibits our flexibility and responsiveness. Also, because of high research and development costs and lower profits for manufacturers if resistance eventually develops, there are fewer new antibiotics in production.

FEARS: Resistance to at least one first-line antibiotic is now common and pan-resistant bacteria do exist. Infections that require the use of more toxic last-resort antibiotics are arising more frequently, and many of the antibiotics that have been developed over the last 80 years are useless in some situations. Unless new ways to kill pathogenic bacteria are discovered, it is feared that infections will return us to the days before antibiotics existed.

SOLUTIONS: International coordinated efforts are needed immediately. There need to be more clinical laboratories to identify the right antibiotics to treat infections, and tracking of cases so that data can be shared and authorities can make informed decisions about where to target their policy measures. Research is needed to fill in the gaps in our understanding of antibiotic resistance. Physicians need to prescribe antibiotics only when needed and infection control measures must be practiced universally.





Christine Dunham, structural biologist, assistant professor of biochemistry

WHO I AM: I'm a basic scientist interested in how macromolecules work. We use interdisciplinary techniques including X-ray crystallography to take snapshots (or something like a picture) to answer what these proteins and nucleic acids look like and how they're regulated.

WHAT I DO: We study two aspects of antibiotic tolerance. The first focuses on the ribosome, a major antibiotic target that bacteria acquire resistance to. In collaboration with Professor Graeme Conn's lab at Emory, we've been studying the molecular basis for antibiotic resistance. The second focus is how different cellular environments control bacterial proliferation and persistence.

CHALLENGES: It has been known since the 1940s, when we identified penicillin to treat staph infections, that although penicillin kills a large percentage of the bacteria, a very small population survive. These bacteria have not acquired mutations but, for some unknown reason, they are tolerant; we call them "persisters." These bacteria are genetically identical to the bacteria that were killed—they just changed their behavior to become tolerant to antibiotics. This is extremely interesting from a biological standpoint but equally terrifying.

FEARS: Without effective antibiotics, modern medicine is compromised. Most operations require the use of antibiotics to prevent infections. All biomedical advances we've made in the past 100 years rely on antibiotics. The number of people who die from bacterial infections is, I believe, being underreported. For example, my grandmother had a stroke and went to the hospital, where she got MRSA and ultimately died of pneumonia. Still, on her death certificate it says she died of a stroke. The immunocompromised, young, old, and pregnant will be the first to be impacted when effective antibiotics become scarce.

SOLUTIONS: There needs to be a resurgence in antibiotic research, which is beginning to happen. We need to revisit the mechanism of action of specific antibiotics that were removed from the clinic but were really effective at killing bacteria—we may be able to reduce their toxicity by changing their chemistry. The medical field discusses personalized medicine but personalized antibiotic treatments have not been emphasized to the same extent. We should all be advocating for appropriate antibiotic treatment. If someone goes to a doctor, they should resist antibiotics at all costs unless it is clear the infection is bacterial. Then, the type of bacterial infection should determine the antibiotics prescribed.



James Hughes, co-director of the Emory Antibiotic Resistance Center and professor of medicine and public health at Emory

WHO I AM: I'm a physician trained in internal medicine and infectious disease, and was director of the National Center for

Infectious Diseases at the CDC and a Rear Admiral and Assistant Surgeon General in the US Public Health Service before coming to Emory.

WHAT I DO: Investigate emerging antimicrobial resistance at the interface of human health, animal health, and environmental health.

CHALLENGES: Overcoming the lack of public and policymaker understanding of the seriousness of the threat of multidrug resistance and the urgency of addressing it. The WHO tagline for World Health Day in 2011 captures it: "No action today, no cure tomorrow."

FEARS: We are at risk for returning to the pre-antibiotic era when patients died of untreatable infections caused by superbugs. Imagine the implications this would have for seriously ill patients who need cancer treatment, organ transplantation, management of autoimmune disorders, or ICU care.

SOLUTIONS: Surveillance, infection prevention and control efforts, judicious antibiotic use through stewardship, development of rapid diagnostic tests for use at the bedside or in the clinic, new antibiotics and alternative therapeutic approaches, improved delivery of available vaccines and development of new vaccines, improved sanitation and hygiene, educational efforts, public-private partnerships (including academic institutions), and sustained political will to address this challenge.



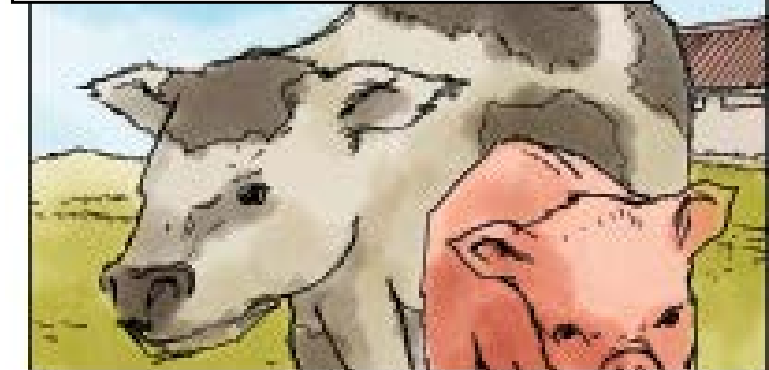
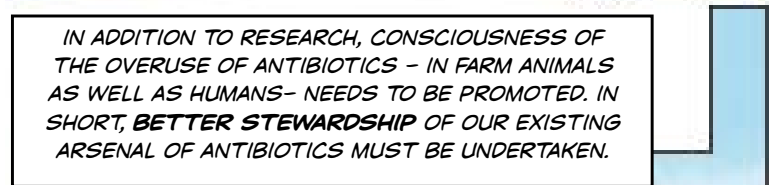
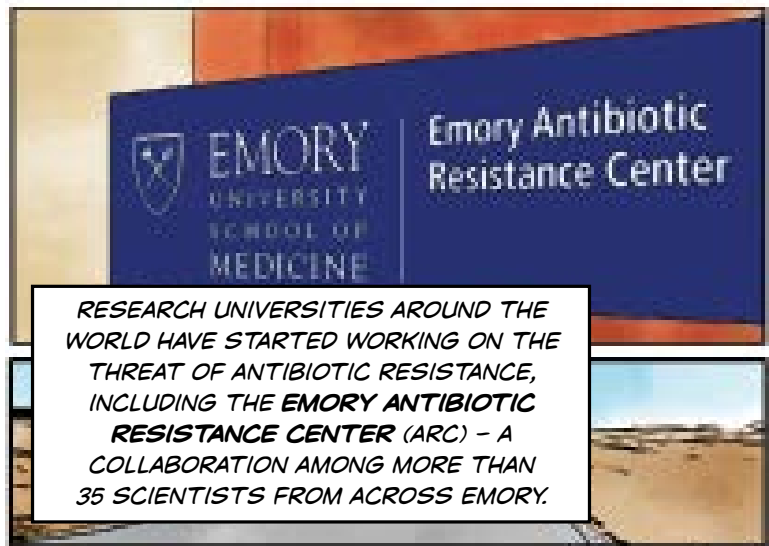
Jesse Jacob, associate professor of medicine and Hospital Epidemiologist at Emory University Hospital Midtown.

WHO I AM: As an infectious diseases clinician, I lead Emory's Prevention Epicenter, a CDC-funded program that seeks to make health care delivery safer through improved hand hygiene and better use of personal

protective equipment (gowns, gloves, and the higher-level gear used for infections like Ebola).

WHAT I DO: I study patterns of infections, why they happen, and how they can be prevented in health care settings. I am particularly interested in multi-drug-resistant pathogens, particularly CRE (a strain of *E. coli* seemingly resistant to all known antibiotics), and how they are transmitted.

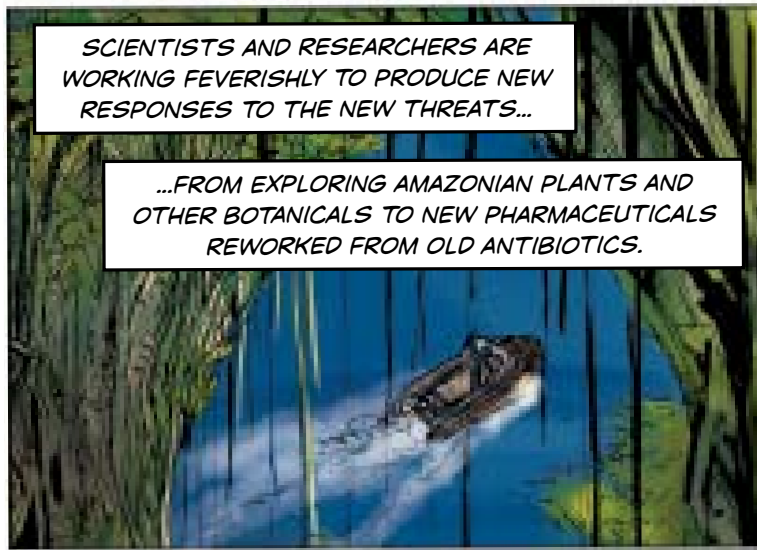
CHALLENGES: One of the most basic ways to prevent infections is hand cleaning, but for busy nurses, doctors, and other health care workers this





WILL WE REVERT TO APPLICATIONS OF MOLDY BREAD? SLATHER OUR WOUNDS WITH LARD AND HONEY?

IT IS A FRIGHTENING PROSPECT. DISEASES LIKE PNEUMONIA, AND EVEN MINOR CUTS COULD LEAD TO DEATH AGAIN.



SCIENTISTS AND RESEARCHERS ARE WORKING FEVERISHLY TO PRODUCE NEW RESPONSES TO THE NEW THREATS...

...FROM EXPLORING AMAZONIAN PLANTS AND OTHER BOTANICALS TO NEW PHARMACEUTICALS REWORKED FROM OLD ANTIBIOTICS.



AS THE WORLD HEALTH ORGANIZATION'S TAGLINE DECLARES: "NO ACTION TODAY, NO CURE TOMORROW."

is challenging because they do it so often, yet there are still many missed opportunities. Antibiotic resistance is a hidden problem that people don't really see unless they have a personal experience, and even then it's often tied to other events. For example, if you have a serious infection after surgery or chemotherapy, the antibiotic-resistant infection is often not the focus—it's the cancer.

FEARS: Not being able to treat patients with antibiotics that work. It's a world where simple infections could once again kill.

SOLUTIONS: Better awareness, more data, better funding. The work of Emory's Antibiotic Resistance Center is helping to inform the whole spectrum of antibiotic resistance, from bench to bedside. Once we define the scope of the problem and what can be done, we'll need support to put the solutions in place.



Cassandra Quave, curator at the Emory University Herbarium, assistant professor of dermatology.

WHO I AM: As a medical ethnobotanist, I study how people use medicinal plants for health and search for new bioactive compounds. I've done field research with traditional healers in the Peruvian Amazon as well as rural regions of Italy, Albania, and Kosovo.

WHAT I DO: I work in the early discovery space for new antibiotics. My research group evaluates the bioactivity and chemical makeup of plants used for the treatment of infectious disease in traditional medicine. During the past five years, I've gathered hundreds of therapeutic shrubs, weeds, and herbs and taken them back to Emory for a thorough chemical analysis. We are looking for new chemical scaffolds that can either act as new antibiotics or improve the effectiveness of existing antibiotics.

CHALLENGES: Securing funding to explore "outside the box" ideas on how natural products and plant extracts interfere with different bacterial systems. We need to stop the reckless use of antibiotics as growth-promoters in agriculture and their misuse in hospitals and veterinary clinics.

FEARS: The impact antibiotic resistance will have on the most at-risk patients—young children, the elderly, cancer patients, surgical patients—as well as my own family, friends, and students. In just a generation, the communal memory of the challenges of the pre-antibiotic world has vanished. It's hard to imagine a world where small medical issues, such

as minor cuts or throat infections, can become deadly, but this is a very real possibility if things don't change.

SOLUTIONS: We need to focus on the development of better diagnostics and therapeutics and to push the limits of our imagination past current strategies. In addition to looking for new antibiotics, we need to invest significant effort into other approaches that could achieve restoration of balance in the patient/host. In my lab, we focus on the discovery and development of compounds that block the production of bacterial virulence factors, such as toxins, that damage tissues and the immune system. This could potentially disarm the bacteria and allow the immune system and classic antibiotics to clear the infection. We've gotten all of the low-hanging fruit, and now we're going to have to work a lot harder. We have to go to the ends of the earth—the ocean, the ice shelf, the rain forest—anywhere we possibly can to find new natural drugs.

Bill Shafer, professor of microbiology and immunology, co-director of the Emory Antibiotic Resistance Center

WHO I AM: When I was nine, I developed a post-surgical infection that was cured with an antibiotic. My mother, an army nurse in England in the 1940s, told me about caring for wounded soldiers after surgery at



a military hospital—before penicillin, many of her patients would die from infection; after penicillin, the death rate dropped substantially. Initially, the hospital did not have enough penicillin, so staff would collect the urine from a soldier who had been treated, recover the penicillin

crystals, and re-administer them to a different patient. I did my doctoral dissertation on methicillin resistance and toxin production by *Staphylococcus aureus* (staph). My PhD adviser suggested I continue to work on antibiotic resistance because one day it would be a "big thing."

WHAT I DO: For the past three decades, we have examined *Neisseria gonorrhoeae* (the bacteria that causes gonorrhea), and *S. aureus* (staph) for their ability to resist both classical antibiotics and host-derived antimicrobials. I am working on the mechanics by which bacteria develop resistance to antibiotics. Our work deals with drug efflux pumps (transport proteins) within cells. Our hypothesis is that if we can cripple the pumps, it would be possible to keep antibiotics in clinical practice that might otherwise be lost.

CHALLENGES: I work in a very supportive environment, with colleagues dedicated to biomedical research. I do worry that federal funding for basic research, which provides tomorrow's cures, will wane. Will we have enough scientists in 10 or 20 years to continue the efforts?

FEARS: Simply put, the impact on public health (not to mention to economics) will be enormous. In the 1990s I used to tell Emory medical students

to talk to physicians who were in medical school before WWII because they were the last group of doctors in the pre-antibiotic era. I suggested this because these students were likely to be the first generation of physicians in the post-antibiotic era.

SOLUTIONS: Effective stewardship programs, educating the public and health care providers as to when antibiotics should be used, providing incentives to industry to make antibiotic development a priority, ramping up surveillance and diagnostics efforts, and a sustained effort in basic research. All of this will be costly for sure, but the consequences of not investing are too horrible to contemplate.



David Weiss, microbiologist, director of the Emory Antibiotic Resistance Center, associate professor of medicine

WHO I AM: I attribute my love of biology to childhood trips to the Central Park Zoo and the Museum of Natural History. I later became fascinated with how microscopic life-forms can overcome our powerful immune system and cause so much human suffering.

WHAT I DO: I'm director of the Emory Antibiotic Resistance Center (ARC), a network of more than 35 faculty members that receives more than \$10 million a year in research grants. We approach the problem of antibiotic resistance in novel and multidisciplinary ways, to find new methods to stop bacteria from causing disease.

CHALLENGES: The problem of antibiotic resistance threatens our entire medical system. It's unfortunately going to get worse before it gets better. In addition to developing new drugs and using them wisely, we ultimately need to identify ways of preventing bacteria from becoming resistant to antibiotics.

FEARS: My greatest fear is that once we again gain the upperhand over drug-resistant bacteria, we will repeat the mistakes that brought us to this point. We must not become complacent.

SOLUTIONS: There is no single or simple solution. Our efforts must be multi-pronged and collaborative, involving diverse experts, including researchers, doctors, and educators, as well as the public. Funding and support for research must be increased. ■

To learn more about Emory's work on antibiotic resistance go to emry.link/UoMtuP



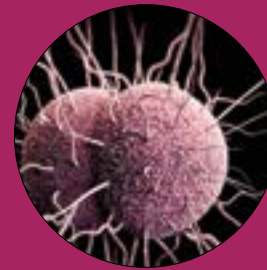
***Clostridium difficile* (C. diff)**

250,000 infections per year require hospitalization or affect hospitalized patients, with 14,000 deaths and \$1 billion in medical costs annually.



Carbapenem-resistant *Enterobacteriaceae* (CRE)

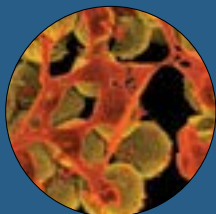
Of 140,000 health care-associated *Enterobacteriaceae* infections per year, more than 9,000 are caused by CRE, a strain resistant to nearly all antibiotics, resulting in 600 deaths.



Neisseria gonorrhoeae

Gonorrhea, the second most common reportable infection in the U.S., is developing resistance to cephalosporin antibiotics, the last-line treatment for this infection. Of 820,000 cases per year, 30% demonstrate resistance to at least one antibiotic.

Urgent Level Threats and Serious Level Threats



Methicillin-resistant *Staphylococcus aureus* (MRSA)

More than 80,000 invasive MRSA infections lead to 11,285 related deaths per year. Severe MRSA infections most commonly occur during or soon after inpatient medical care. Overall rates of invasive MRSA have dropped 31%, largely due to improved medical procedures in central-line maintenance.



Drug-resistant *Streptococcus pneumoniae*

More than 1.2 million cases a year are drug resistant to amoxicillin and azithromycin (Z-Pak), resulting in 19,000 hospitalizations, 7,900 deaths, and medical costs in excess of \$96 million. Pneumococcal conjugate vaccine (PCV) protects against 13 strains of *Streptococcus* and reduces antibiotic-resistance by blocking the transmission of resistant strains.



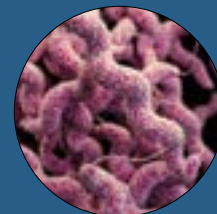
Drug-resistant Tuberculosis (TB)

Tuberculosis is among the most common infectious diseases and causes of death worldwide. Of more than 10,000 TB cases in the US, about 10% were resistant to antibiotics, resulting in more than 50 deaths. The major factors driving TB drug resistance are incomplete or wrong treatment, transmission to uninfected persons, inadequate drug supply, and lack of new drugs.



Fluconazole-resistant *Candida*

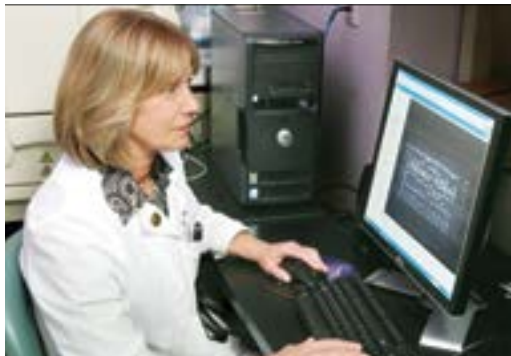
Out of 46,000 patients with *Candida* yeast infections per year, 3,400 have bloodstream infections of drug-resistant *Candida* and 220 die during their hospitalizations. These infections tend to occur in the sickest of patients.



Drug-resistant *Campylobacter*

Campylobacter causes more than 1.3 million infections, 13,000 hospitalizations, and 120 deaths in the U.S. each year; 310,000 (25%) of these are drug-resistant. *Campylobacter* spreads from animals to people through contaminated food, particularly raw or undercooked chicken and unpasteurized milk. Antibiotic use in farm animals can result in resistant *Campylobacter* that can spread to humans.

Q&A on Antibiotic Resistance Threat



MONICA FARLEY is principal investigator for the Georgia Emerging Infections Program, a CDC-funded surveillance network focused on invasive bacterial pathogens, influenza, and foodborne diseases. She is an Emory professor of medicine in infectious disease, a physician at the Atlanta VA Medical Center, and a faculty researcher at the Emory Antibiotic Resistance Center.

Q How does antibiotic resistance change the decisions you make as a doctor?

It's changing the playing field. Isolating bacteria and testing them for antibiotic resistance can sometimes take 24 to 48 hours—too long to wait if someone is sick and needs treatment. We have to make a good guess before we know the results. Twenty years ago, if someone had a suspected staph infection in a cut on their leg, we could assume it would be treatable with cephalosporin or something similar. Now we can't really say that. We have to assume it will be MRSA. It also means we have to treat many more infections with vancomycin, which is now standard for MRSA-type infections. Vancomycin is a compromise, because it doesn't work as fast as the drugs we would have used in the past.

It's the same for pneumonia. If someone develops pneumonia in the hospital, we have to assume it's a bad bug. We can't use the same drug we'd use for someone just coming in from the community. It's also influenced how we treat meningitis. Now we usually need more than one drug, maybe even three.

If the lab tells us we can use one of the older drugs, we will switch back. But we have to assume we're dealing with a resistant infection, unless proven otherwise, in hospital settings. The antibiotics that are left are often the ones we least want to use—ones that are more toxic or harder to tolerate.

Q Is colistin, which was in the news a lot last year because of emerging resistance, in that category?

That's right. Colistin attracted some attention because it's a drug of last resort. It was often used in the early days of antibiotics but was put on the shelf for decades because less toxic alternatives were developed. Now we've had to revisit it.

Q How is antibiotic resistance going to affect medicine?

Around the time I was starting my career (in the 1980s), there was a declaration that infectious disease as a specialty was going to end because we had effective antibiotics. Over the last few decades, everything has flipped and we're seeing the steady emergence of resistance to antibiotics that were once dependable. Common infections that are usually not very serious, like a

scrape on the skin that gets infected, can be increasingly resistant and more difficult to treat. Importantly, this extends to more serious infections in the hospital setting, to people who would likely not have survived their infections in the pre-antibiotic era. Bone marrow transplants, solid organ transplants—we would not be able to do these successfully if we did not have effective antibiotics. This phenomenon is threatening the advances we have made in the last 50 years.

Q What areas of medicine are going to be affected the soonest?

This really affects all areas of medicine. Resistant infections are more likely to be seen in the health care environment. Certainly there are concerns for people who are immunocompromised, such as organ transplant patients or people undergoing chemotherapy for cancer. But it won't be limited to them. It will impact anyone with lots of medical problems. Patients who have experienced a stroke. Patients with long-term catheters in place, or in nursing homes. They tend to have a lot of antibiotic exposure. These are the patients in whom we may see persistent colonization with antibiotic resistant bacteria, leading to recurrent urinary tract infections, for example.

Q When do you think we're going to be "out of options" for many—or even most—infections?

It's now a rarity to encounter isolates for which there are no effective treatments. But without action, it could happen in the next decade. A report from the British government predicted a potential for 10 million deaths per year by 2050. We're not just going to wait for it to happen—this was a main driver for the creation of Emory's Antibiotic Resistance Center.

Q What is meant by antibiotic stewardship?

Because development of new antibiotics is slower than we need it to be, we want to preserve the value of antibiotics that are still effective. That means: don't use antibiotics against viral infections. Choose the narrowest spectrum antibiotics—don't expose other organisms to selective pressure if we don't have to. It means the right dosing, and shortening courses of antibiotics

from 10, 14, and 21 days down to 5, 7, or 8 days for pneumonias and other common infections. Every day an antibiotic is in use against an organism that causes disease, we have to balance its effects against others that may become resistant. We may have to go beyond antibiotics, to find compounds that stimulate the immune system, or work with standard antibiotics to make organisms susceptible again.

Q What are some consequences of antibiotic overuse?

Antibiotic use can change the whole microbial flora in the body, sometimes for months or years. The change in intestinal flora can result in colonization and disease caused by *C. diff*, which is difficult to treat and can be life threatening. We've also seen this with VRE (vancomycin-resistant enterococci), a Gram-positive bacteria that is carried in the gut and is usually a minor part of flora. When a patient's internal balance is destabilized, VRE can become a major part and can spread to linens or bed rails. This is how antibiotic use in one patient can affect another who is vulnerable.

Q Why are so many antibiotic-resistant infections seen in hospitals?

It's partly because of the routine use of antibiotics. A recent study of health care associated infections, which the Emerging Infections Program (EIP) was involved in, found that 50% of people in hospitals on any given day were on antibiotics. It didn't matter whether they were in intensive care or not. There's a danger from health care providers going from patient to patient, carrying bacteria on their hands or on items. Jesse Jacob and others at Emory have been looking at this systematically, in collaboration with Georgia Tech. They have a studio mock-up of a hospital room so they can ask: What changes to the environment reduce contamination?

Q How do clinicians test for antibiotic resistance?

In almost all cases, if a patient is hospitalized and an infection is suspected, we will take a sample from the blood, urine, lungs, or pus from an abscess—wherever the problem is. We get a specimen, we put it on an agar plate, and we're able to grow it out and obtain a single colony. That way we know that it's just one kind of bacteria. Then we subject the bacteria to a panel of different antibiotics. It can be susceptible, intermediate (takes more drug to kill it,) or flat-out resistant. With multiple-drug-resistant organisms, this means not only individual antibiotics, but entire drug families. Unfortunately, most of the standard panels don't include the less common drugs that we have to sometimes use now. If we need to look further, we can do manual testing for resistance or send the sample to a reference lab, but it takes more time. What's newer are molecular diagnostics. Instead of growing the bacteria on an agar plate, we sequence the DNA. It's either

direct from the specimen or we amplify part of the bacterial DNA and get a profile. With whole genome sequencing, we can predict the type of bacteria, and also antibiotic susceptibility, based on the resistance genes. As part of the EIP, all isolates for certain types of infections, such as food-borne infections, are subjected to whole-genome sequencing.

Q Are DNA-based tests faster?

Theoretically, yes. In the EIP, the sequencing is not done in real time but after the fact. Still, there are some good examples. *C. diff* and gonorrhea are mostly diagnosed by molecular tests. We can get the results back in three to four hours. Respiratory infections are increasingly being diagnosed by molecular test panels. Similar panels are being developed for intestinal pathogens. They're useful for hard-to-grow organisms like mycoplasma.

Ten years from now, molecular diagnostics will be the norm in the clinical microbiology lab. We have to keep up with the technology and the resistance patterns. And, even if you know all the resistance genes, what happens if a new gene emerges? There will always be a component of culture.

Q Some Emory researchers have found sneaky bacteria that are "heteroresistant"—only part of their population is resistant to an antibiotic, confusing diagnostic tests. Have more examples of this been found?

We're planning to investigate this across all 10 national sites of the EIP. How widespread is it? We want to take a closer look, not only at colistin heteroresistance, which is what Eileen Burd and David Weiss's lab studied, but at other critical antibiotics, such as carbapenems. We've seen similar heteroresistance with *Pseudomonas*, and it may switch on and off, further confusing laboratory testing. Much more work needs to be done to understand this phenomenon.

Q What's next for the Emory Antibiotic Resistance Center?

We'd like to strengthen the connection between clinical and basic researchers. When the clinical lab takes a culture from the patient's throat, urine, or blood, it usually stops there. They report what they found back to the clinic, but we don't learn more about those bacterial isolates. What we are planning to establish is an "investigational clinical microbiology lab," led by Sarah Satola. It will allow us to routinely and serially collect isolates and perform detailed characterization of the mechanisms of resistance, tying that to clinical and demographic information. Did this patient have a stroke? Does he have diabetes? Was there antibiotic exposure? It's very powerful to be able to say that we're seeing this mechanism of resistance in certain populations, or in people who have particular medical problems. Our objective is to tighten the pipeline of communication.—*Quinn Eastman*



Her psychiatric social worker didn't know why. It could have been lack of money or not having a way to get there, but Juanita's mental stability seemed to hinge on a shopping trip to Target.

"I think she needs some bras," a member of Grady Hospital's Assertive Community Treatment team tells her colleagues as they go through, one by one, a long list of names staring at them on the whiteboard. "It's made her increasingly anxious."

"I'll get you some money," the team's leader said. Another team member jumps in, volunteering to take Juanita to Target the next day.

MENTAL HEALTH: THE CONTINUING CRISIS IN **Caring For the Poor**

Excerpt from A Spirit of Charity by Mike King

The next name on the team's board is Peggy, who has temporarily stopped taking her antipsychotic medications, a team member reports. Peggy presented herself at Grady Hospital's ER two days before with a urinary tract infection, and she claimed the ER nurses told her that her medications probably caused her infection.

"I had to sit down with her and go over her discharge papers to show her that's not what they were saying," the psychiatric nurse presenting the case tells the team. The next team member who sees her should follow up that she is taking both her psychiatric meds and the antibiotic she was prescribed for her infection.

Two down. The team has about 58 names to go—all patients with similar stories revealing precarious control over their illnesses.



To me, an outside observer who agreed as a condition of attending the meeting not to use the real names of clients, the team's ability to succeed with many of the patients seems equally precarious, especially given how fragmented and unresponsive the American health care system can be for the chronically mentally ill.

There are success stories, to be certain. The team cheers news of a new job for one of the patients, or a new, more stable living arrangement for another. Robert has reconciled with his brother, who says he'll give him another chance. Rose got her old job back. Jackie's estranged daughter has moved back to town, and she sees her once a week.

But even these patients are one unlucky break away from trouble. Something as random as an argument with a family member, a late Social

Security check, an arrest for disorderly conduct, a frustrated municipal court judge who is tired of dealing with them can put them in jeopardy.

The team effort employed at Grady has been around for years. It was first successfully used in Wisconsin and based on a simple, but expensive premise: Chronic, severe mental illness requires more than short-term hospital stays, periodic outpatient group therapy, and daily medications. It involves frequent, supportive contact that ensures patients don't get sidetracked by what most of us would consider minor setbacks, like needing to go shopping. Most importantly, patients must be willing to agree to frequent interventions in order to participate in the program.

Grady has three Assertive Community Treatment teams that meet every weekday. Combined, they have a patient load nearing two hundred—by far the largest of any program like it in Georgia. Funding for the program comes from a variety of sources such as state and local grants, mostly, but also from Medicaid, if the patients are eligible for coverage.

Unfortunately, many aren't. They could be, but Georgia won't allow it. So the program stays permanently underfunded, forcing Grady to absorb the cost.

Picking up the pieces

The goal for each team is to see patients at least three times a week. These encounters are designed to determine if the patients are taking the medications they need, keeping their appointments, having any luck at



This piece is an excerpt from Atlanta journalist Mike King's recently published book, *A Spirit of Charity*, about the struggles of public hospitals.

finding work, and living somewhere that doesn't exacerbate their serious mental conditions.

The Grady program is handling an ever-increasing load. When the state system for caring for the poor and uninsured mentally ill essentially collapses, as it did in Georgia over the last ten years, it predictably falls on public hospitals and nonprofit charities to pick up the pieces.

If there is one medical condition where American medicine and public health policy has failed the poor and uninsured most, it is in mental health care. Despite numerous scandals and journalistic investigations over the years, public officials have rarely put forth efforts to comprehensively deal with it. Think of the last time a political campaign—any political campaign at any level—had a platform promising to fix the obvious failures in mental health financing or services for the poor.

What little progress that has been made on the subject has been to destigmatize chronic depression, bipolar disorders, schizophrenia, addiction, substance abuse, and other conditions as something more than just bad behavior. But “main-streaming” those disorders has largely been limited to patients who

voluntarily submit to treatment and are covered by insurance when they need it.

Underlining the point, in the 1980s and 1990s, as mental health advocates began to make headway in demanding insurance companies cover psychiatric conditions the same way they cover other health issues, there was a surge in for-profit and private psychiatric hospitals opening to accommodate the demand.

Usually covered treatment began with a hospital stay to reestablish a medication regimen, followed by outpatient visits for psychotherapy, counseling, and medication compliance. How long the hospital stay was and how long outpatient care lasted depended largely on what was allowed under the patient's benefit plan. This is still largely the mod-

public mental health services and expect our hospitals to take on the responsibility.”

Moreover, the promise of the 2010 health care reform law to provide coverage for more of the poor and uninsured—either through expanding Medicaid or through private plans that denied them coverage in the past—has also failed to materialize for many of these patients.

About twenty states, including Georgia, have refused to expand Medicaid coverage to residents who make too little to afford private insurance and too much to qualify for Medicaid under current guidelines. That effectively shuts out most of the uninsured mentally ill from the benefits of the new law. And it shifts much of the burden of paying for the care they inevitably need from the state onto public hospitals who have to treat them on an emergency basis.

The American Mental Health Counselors Association estimates that about one million Americans in need of mental health and substance abuse treatment did not receive it in 2014 because their states refused to expand Medicaid to cover them; more than 230,000 of these low-income and vulnerable patients reside in Georgia.

Over the last fifty years, the states and federal government have attempted to shift the burden of public health funding from one to the other

“Behavioral health for the poor is one of our most serious challenges, not just from the standpoint of what works and what doesn’t, but because the numbers are overwhelming, and our system for paying for it has been cobbled together in crisis.”

DR. BRUCE SIEGEL, president and CEO of America’s Essential Hospitals,

el used today for insured patients who need help coping with their illness.

But for the poor and uninsured, it is a much different world.

Private psychiatric hospitals and some acute-care hospitals with psychiatric beds may accept uninsured patients, often only to stabilize them and discharge them to their own care. But for the most part, these patients become the responsibility of the state mental health system, regional public health districts, the local public hospital, and, increasingly, the local jail and criminal justice system.

“Behavioral health for the poor is one of our most serious challenges, not just from the standpoint of what works and what doesn’t, but because the numbers are overwhelming, and our system for paying for it has been cobbled together in crisis,” said Dr. Bruce Siegel, president and CEO of America’s Essential Hospitals, which represents most of the nation’s largest safety-net hospitals. “Many states have simply defaulted on

with neither seemingly willing to accept the responsibility for coordinating care for a vulnerable and difficult-to-treat segment of society.

And while there is no winner in this standoff between federal and state health officials, there is no question who is harmed the most. The losers can easily be found on the streets of major cities, in county jails, and in overcrowded public hospital psychiatric wards.

The dismal record spans more than a century of public-policy indifference, stingy funding, unintended consequences, and fundamental misunderstanding of the nature of mental illness itself.

High cost of services

Unlike other chronic health conditions—such as heart disease, kidney disease, or even cancer, where symptoms are easy to diagnose and surgical treatment and medications can mitigate the impact of malfunctioning organs—chronic, serious bipolar disorders and schizophrenia manifest themselves in behavioral patterns that often are not easy to detect and even harder to control.

Insurance companies around the country report that they are having difficulty complying with the requirement written into the 2010 ACA that they treat mental illness on a parity with any other chronic medical condition they cover.

They complain that how to best diagnose and treat mental conditions is constantly evolving, making it difficult for insurers, especially HMOs, to provide adequate staff to meet what has turned out to be an unanticipated demand among newly insured patients.

In California, considered the “pace car of parity” for coverage of men-

tal illness, Kaiser Permanente, which insures 7.5 million members in the state, was fined for not providing timely care to mentally ill patients. Its defense was that it did not have the staff and the paperwork requirements in place to monitor compliance with the law. (It does now, the company said.)

While there is no surgical procedure to deal with severe mental illness, fortunately there are drugs to control it. But treatment involves strict compliance and a supportive environment for those afflicted with the most serious forms of these illnesses. For many individuals, especially the poor, the supportive environment simply doesn't exist and must be taken up by the public health system.

Grady CEO John Hauptert said the cost of behavioral health services for hundreds of severely mentally ill patients is one of the biggest threats to the bottom line of the state's largest safety-net provider. The high cost of services Grady must provide—especially to those patients who return time and again for inpatient care because they can't take care of themselves—crowds out the hospital's ability to provide care for poor and uninsured patients with other conditions.

Even if Georgia had agreed to the Medicaid expansion, Grady would still have been hard-pressed to provide the volume and intensity of services these patients need, Hauptert said, because direct state funding for mental health services has been reduced across the board.

Nationally, per capita public health spending on mental health services by the state was roughly \$120 in 2013. Georgia spent less than half of that, according to data compiled by the Kaiser Family Foundation. It's little wonder then that state and local governments reimburse Grady for only about half of the cost of the services it provides for the uninsured mentally ill.

Boarding patients in the ER

More than 25 patients a day come to Grady's ER with psychiatric symptoms as their primary diagnosis. The hospital's inpatient behavioral health unit has almost tripled in size since 2012. It routinely has 80% occupancy and is often too full to take patients from the ER.

Public hospitals around the country report problems similar to Grady's, with other emergencies being crowded out of ERs because of the volume of mentally ill and substance abuse cases, Siegel said.

The American College of Emergency Physicians in 2014 reported that 84% of their members said they routinely have to "board" psychiatric patients in the ER—meaning the patients spend at least a day in the ER before a bed on a psychiatric ward became available.

Many of those waiting patients—more than 90% of them, the ER physicians said—were considered so ill that caring for them in that setting distracted the staff and resulted in reduced services to other ER patients.

Moreover, there is a shortage of beds set aside specifically for emergency psychiatric care in many urban areas. Patients who get admitted may not be able to stay as long as they need to get stabilized and provided with an outpatient treatment plan.

This crisis in deciding who is responsible for treatment and social services for the chronically mentally ill is but the latest iteration in what can best be described as the country's most serious failure in ensuring health care for the poor. ■

EMORY AT GRADY



■ Grady Memorial Hospital opened on June 1, 1892, with 18 employees and 100 beds. The hospital had one operating room and an amphitheater for students and staff. In 1899, the daily cost for a patient was \$1.09. ■ Shortly before World War I, the hospital completed the construction of separate white and black hospitals, clinics, nurses' quarters, and emergency rooms. ■ Because of its separate facilities, the hospital was coined "the Gradies," a name that would stick until desegregation, almost 50 years later.

■ From 1915 to 1917, the newly formed Emory University School of Medicine was located across the street from Grady. ■ When Emory's founders, including Coca-Cola magnate Asa Candler, endowed the medical school with \$250,000 to build laboratories for its basic science departments, Emory's first- and second-year medical students were moved to the Druid Hills campus. ■ In the years ahead, the School of Medicine expanded rapidly, as did Emory's health care component—adding five hospitals, a large clinic, and several satellite clinics—but third- and fourth-year medical students continued much of their clinical training at Grady.

■ Now, close to 628 Emory medical faculty and 368 Emory residents and fellows provide care at Grady, full or part-time. ■ Together, Emory physicians provide about 80% of patient care at Grady, in collaboration with Morehouse School of Medicine doctors and private practitioners.

■ Grady has a regional perinatal center for high-risk mothers and babies, a neonatal intensive care unit, a diabetes center, a teen center, the Georgia Poison Center, a rape crisis center, a regional burn center, a sickle cell center, a comprehensive treatment program for HIV/AIDS, a level I trauma center, a stroke center, and the Georgia Cancer Center for Excellence.



“One of Emma’s favorite things is to be outside,” says Megan Blay.



the Lifeline

When Emma Blay was still in the womb, doctors discovered a mass blocking her airway. They decided to perform a complex surgery during which her mother would be her life support.

BY Elizabeth Johnson ■ MEDICAL ILLUSTRATIONS BY Satyen Tripathi

Megan Blay thought she knew exactly how the birth of her second child was going to go. Her natural water birth would be a sort of redemption after having her labor medically induced with her firstborn, Lola.

In late summer 2015, Blay was fully immersed in the details of her birthing plan—she had selected a hospital that supported water deliveries, near her family’s home in Acworth, Ga., and her husband, Adam Linville, and her physician would be the only people in the delivery room with her.

At a regular checkup midway through her second trimester, however, she learned that something wasn’t quite right. The doctor saw an abnormality on the ultrasound near the fetus’s mouth. His initial suspicions were cleft pallet or cystic mass, but he recommended a follow-up with a specialist.

He also brought up an ex utero intrapartum treatment (EXIT) procedure as a possibility for Blay’s delivery, if in fact there was a large mass blocking her baby’s airway.





APRIL LANDRY, MD

Pediatric otolaryngologist, Children's, Emory assistant professor of otolaryngology



STEVEN GOUDY, MD

Pediatric otolaryngologist, Children's, Emory associate professor of otolaryngology



MATTHEW CLIFTON, MD

Pediatric surgeon, Children's, Emory associate professor of surgery



KARA PRICKETT, MD

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JANE ELLIS, MD, PhD

Medical director, Emory Regional Perinatal Center, Grady, Emory associate professor, Gyn/Ob

Blay had never heard of it. She went home and frantically researched EXIT procedures online, spending days looking through online groups and comment boards and finding mothers who had been through the procedure.

Babies born using EXIT are partially delivered—just their head and shoulders—through a standard cesarean section. The bottom half of the baby stays inside the uterus, continuing to receive oxygen through the umbilical cord and warmth and protection from the placenta. This allows pediatric otolaryngologists to unblock the baby's airway and get them stabilized enough to complete the delivery. Throughout this process, the mother is under general anesthesia.

"I did the research and then immediately put it in the back of my mind," Blay says.

She found a maternal-fetal specialist in Atlanta and scheduled an appointment to get a second opinion. After appointments with the maternal-fetal specialist and another Atlanta doctor who was natural-birth friendly, it was determined that her baby likely had a cyst around her mouth that could safely be drained and treated following a natural birth.

To err on the side of caution, however, she was encouraged to visit Emory physicians at Children's Healthcare of Atlanta Egleston so its team could review Blay's MRI and ultrasound.

Not wanting to take chances but with renewed optimism, Blay made the 37-minute drive to Atlanta one more time for an appointment with pediatric otolaryngologists Steven Goudy and Kara Prickett. At this point, it had been 16 weeks since the initial discovery of her baby's suspected cyst and Blay was well into her third trimester.

At this appointment, she received the most devastating news yet. The fetus's airway was blocked due to a mass that had formed on her tongue. The pediatric surgeons began planning for an EXIT procedure.

"I left that appointment feeling very, very emotional," Blay says. "I resented the doctors because that was not the delivery I wanted. The birth plan I had worked so hard to develop with my obstetrician was perfectly simple but there were a lot of little things that I really, really wanted. I realized I only had a couple of weeks to let all of these things go."

With four weeks left until Blay reached full term, Goudy and Prickett immediately started meeting with a team that included maternal-fetal physician Jane Ellis and more than 30 other physicians, nurses, anesthesiologists, and technicians that would be needed to successfully plan and carry out the delivery.

"Once we all met as a team and decided that yes, this is a life-threaten-

ing delivery for the baby and obviously for the mom as well, then we started talking about managing the breathing, because that's really the whole reason for the EXIT procedure," Goudy says. "We had to discuss how we maintain the baby on the placental circulation, providing oxygen to the fetus for as long as we can, so it gives us a window of time to breathe for the baby, once he or she is born. We're talking about a finite time frame of 15 minutes to 40 minutes at the most."

Support system

A mother and fetus are part of an efficient exchange system, in which the placenta—considered a temporary organ made up of blood vessels and membranes—transfers oxygen and nutrients from the mother's blood to the fetus, and waste products from the fetus to the mother. The EXIT procedure takes advantage of this system as long as possible, allowing babies with malformations of the mouth, tongue, throat, or trachea to continue receiving oxygen and nutrients from their mother during the operation.

Fortunately, the Emory team had recent experience in performing this rare and highly specialized procedure—just a few months earlier, they had successfully delivered another baby with life-threatening airway issues. Ryan Montgomery was diagnosed in utero

with blockage atresia of his trachea and his airway was not developing properly.

While planning the Montgomery operation, the pediatric and obstetric surgeons determined that Grady Memorial Hospital was the best place to perform an EXIT procedure delivery due to its larger operating rooms, designed to handle acute trauma patients. “Grady is well positioned because its NICU takes care of very, very sick babies,” Goudy says. “In Ryan’s case, he had to be resuscitated before we transported him to Egleston. That’s one of the complexities of how we’re caring for these patients—our hospitals are not next door to each other. Having said that, I think we have a pretty good system set up.”

Medical team members were preparing for baby Montgomery’s

birth when his mother went into labor prematurely. They performed a quick dress rehearsal in the operating room at Grady that morning.

An intricate dance

Planning for EXIT procedures requires an intricate choreography—having the proper equipment at the ready and coordinating the care of two patients simultaneously. The mother is the primary patient and the baby is second.

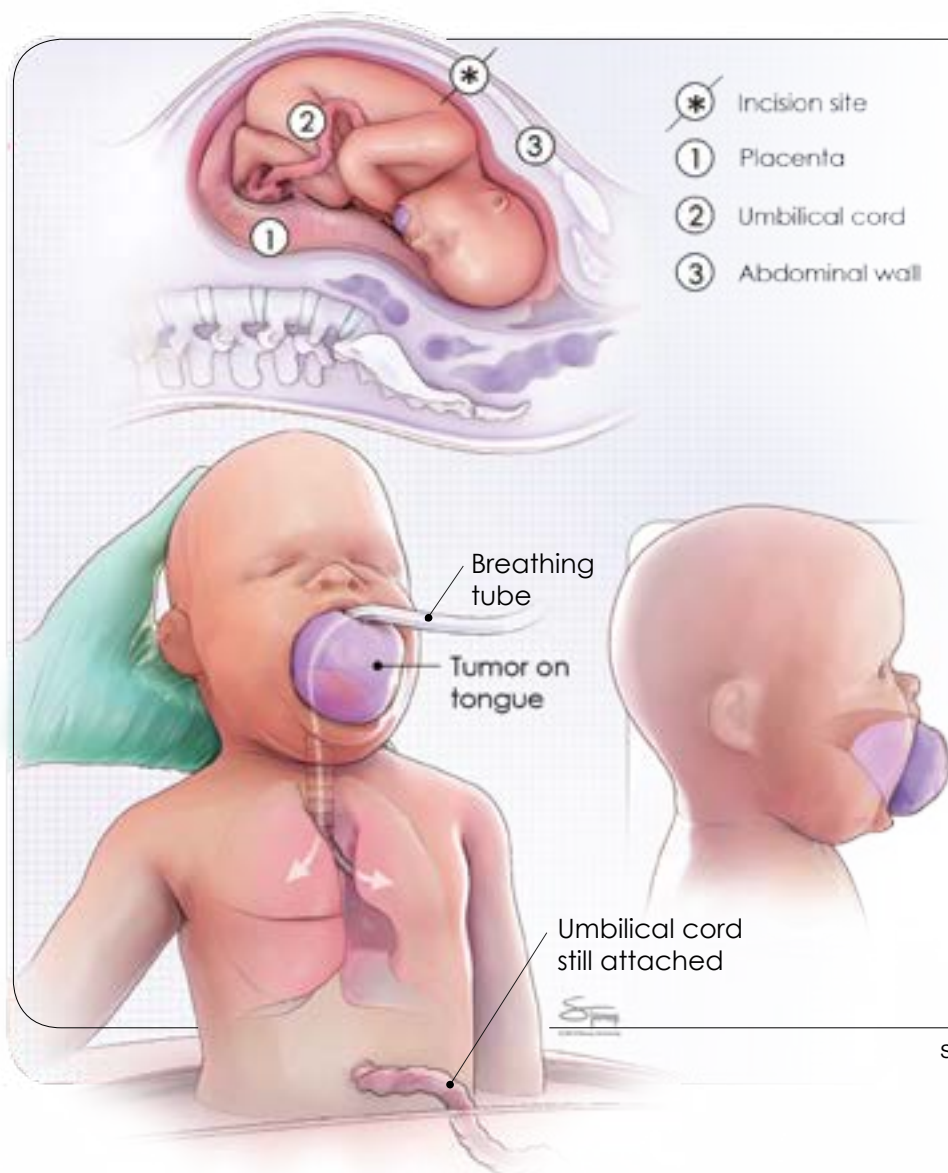
“Each patient has a team acting as their spokesperson,” Prickett says. “We had 35 to 40 people in meetings ahead of both of these deliveries, focused on how everything would work. We decided who was going to direct traffic in this packed operating room. The neonatologists were also involved because they’re the ones responsible for the baby’s care

once we have secured the airway and fully delivered the child.”

Grady had the equipment and resources needed to monitor the mother’s condition before and after the procedure, as well as nurses who are used to postpartum care. But because Grady is not primarily a children’s hospital, the team had to borrow surgical equipment from Children’s at Egleston to care for the babies immediately following birth.

The vast majority of physicians at Grady have Emory faculty appointments and almost all of the physicians at Children’s at Egleston are Emory faculty, so there were institutional connections throughout the system that made the complex series of handoffs flow seamlessly, Prickett says.

“The neonatology team that staffs the NICU at Grady is the same group



Ex Utero Intrapartum Treatment (EXIT) Procedure

An incision was made in the mother’s abdomen and the baby was partially delivered, remaining attached to the mother’s circulatory system through the umbilical cord.

A breathing tube was inserted to open the baby’s airway. Once the airway was secured, the umbilical cord was clamped and cut.

After delivery, the tumor was safely removed.

Satyen Tripathi, Emory Visual Medical Education Team

that cares for the babies at Children’s at Egleston,” Prickett said. “It’s just a matter of who is scheduled to be where on any given week, but we were all in the same meetings, planning for the delivery of both the Montgomery and Blay babies.”

During this period, Prickett and Goudy also spent time with Blay and her husband, showing them around the facilities at Egleston and helping them get as comfortable as possible with their baby’s new delivery plan—a plan that was likely the baby’s only chance for survival.

“I really only had a week to understand everything that was happening,” Blay says. “I had been in denial from the first doctor’s appointment when an EXIT procedure was mentioned. I think that made the shock factor a little

body with sterilized wipes in preparation for the surgery.

The rest of the day was nothing more than a blur. “I initially didn’t want to be put under general anesthesia. I fought that a little bit but the doctors told me we had to, in order to keep my heart rate stable and anxiety levels normal,” she says. “Looking back, I’m so glad that I wasn’t able to see everything because of how intense the surgery was.”

Busy birth day

Emma Linville was born just after 9:00 a.m. on January 20, 2016, by cesarean section. While Emma was still being supported by the placenta and the umbilical cord, half in and half out of her mother’s abdomen, Goudy and Prickett pushed the growth in her mouth aside so they could see her larynx and

pediatric surgery at Emory, and April Landry, assistant professor in Emory’s Department of Otolaryngology, Head and Neck Surgery.

“Delivery via EXIT procedure is really different because you’re using the circulation of the mother, anticipating that there is going to be a problem once that is no longer available. You’re forced to make decisions rapidly,” Goudy says. “You have to have somebody working an IV for the baby so we can give them medicines to make them not breathe. As soon as the baby wakes up and starts breathing, the placental circulation shuts off. It requires coordinating all of those things in a rapid sequence.”

Immediately after Emma was delivered and stabilized, she was taken from the operating room to the Angel II Neonatal Transport ambulance and

“Delivery via EXIT procedure is really different because you’re using the circulation of the mother, anticipating that there is going to be a problem once that is no longer available. You’re forced to make decisions rapidly.” DR. STEVEN GOUDY, otolaryngologist

worse; I had not prepared myself mentally and I just kept asking, ‘Why is this happening to me? Why is this happening to my child?’ ”

She vividly remembers the night she and her husband arrived at the hospital. She was 39 weeks along, but Ellis and the obstetrics team had determined that it was time. She was scheduled to deliver the next day.

“It was extremely nerve-racking,” Blay says. “I felt a little bit like a test subject because there were so many people coming in and out of my room to ask questions—anesthesiologists, the pediatric surgeons who were going to perform the surgery on my daughter, nurses, even some people who were just curious about my case.”

Blay and her husband attempted to sleep that night but she remembers the clock’s slow creep toward 6:00 a.m., when nurses began coming into the room. She was instructed to clean her

insert a breathing tube.

“The mass was contained within the front part of the tongue,” says Prickett. “We pulled it forward and that left room to pass the breathing tube behind it and down into the airway.”

If they had not been able to safely insert the tube, Goudy says, they would have performed a tracheotomy on the baby to bypass the blockage.

Ellis, who led the mothers’ care team in both of the recent EXIT procedure cases at Grady, said it is a sight to see the delivery/operating rooms for these procedures. “It takes a village,” Ellis said. “At least 30 people were involved, ranging from equipment representatives, operating room staff, and ultrasonographers, to surgeons, nurses, and more.” Other key members of the EXIT procedure team included Matthew Clifton, surgical director for extracorporeal membrane oxygenation (ECMO) for Children’s at Egleston and associate professor of

rushed to Egleston, where a medical pediatric team waited to remove the golf ball-sized teratoma from her tongue. (It was only after Emma was delivered that doctors officially diagnosed the mass.)

Time to heal

Nearly a year later, Blay still tears up remembering the flood of emotions from that morning. She would not see her newborn for two days while she lay in a recovery room at Grady.

Blay’s husband, Adam, and his parents stayed with Emma while Blay was at Grady with her parents.

“While those two days were extremely hard, I ended up being grateful for that time,” Blay says. “It gave me the opportunity to deal with the entire process, the emotional and physical pain that I had undergone. Adam visited, of course, but it was nice to be able to tell my story to the nurses. Every time

a new nurse came in they would ask where my baby was, and I was able to talk through everything.”

Once Blay was cleared to leave the hospital, she joined the rest of her family at Egleston, where they stayed in rooms reserved for the parents of newborns in the NICU. They left the hospital only briefly over the next two weeks to go home and nap.

“There was a point where I just really needed to get away from the beeping and other sounds of the hospital,” she says.

They were fortunate to live within driving distance of Egleston. According to the pediatric surgeons, the process leading up to and following an EXIT procedure often requires families to relocate for months to be near their care team.

“It’s a big deal for people, to be able to keep the burden of this procedure and the recovery process close to home,” Goudy says. “With the resources of Emory, Children’s, and Grady all in one place, there is no reason Atlanta families should not be able to have access to the best possible maternal-fetal care available.”

Emma’s recovery went well. Doctors received test results confirming that her tumor was benign. She remained on a feeding tube for three weeks, at which point Blay was able to begin breastfeeding her.

Prickett had to explain to Emma’s parents that her mouth would remain permanently open for a short period, because that’s how it had developed.

“You would never guess by looking at Emma now that she had this massive tumor on her tongue at birth,” Prickett says. “She’s doing great, and a year later the follow-up is very minimal for her. We just want to make sure that nothing grows back where the tumor was.”

Blay says she never let herself consider the worst-case scenario, but looking back she realizes that Emma is lucky to be alive.

Her early diagnosis, and the skill of the medical teams, made what was a

difficult, risky situation go as smoothly as possible. For this, she and her family are extremely grateful.

“Emma is such a playful, outgoing baby. She loves to get into everything and wants to put everything in her mouth. She’s crawling really well and

one of her favorite things is to be outside, playing in the grass with her big sister,” Blay says, holding her daughter close as they sit in a favorite chair, with Emma peacefully nursing.

Finally, Blay realizes, everything is exactly as she had envisioned it. ■



windows

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Find your window.



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28 CARING FOR BABIES THROUGH SURGERY

Emory is a leader in child health-related research, education, and patient care, with advances such as in utero and EXIT surgical techniques and expertise in maternal and perinatal care. Through partnerships with Grady Memorial Hospital, Children's Healthcare of Atlanta, and loyal donors, more children survive challenging diagnoses and live healthier lives.

To support pediatric initiatives, contact Margaret Lesesne Adams, director of development, at 404.778.4632 or margaret.lesesne@emory.edu

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27 TRAINING DOCTORS AT ATLANTA'S HISTORIC 'CHARITY' HOSPITAL

Emory's relationship with Grady Memorial Hospital—one of the largest public hospitals in the Southeast—began in the early 1900s, and today Grady is a main hub for clinical education of Emory medical students, residents, and fellows. Scholarships and fellowships help attract the highest achievers to train at Emory, and funding allows medical students the freedom to treat underserved people, explore new treatments, and expand their educational opportunities.

To support the Emory doctors in training at Grady, contact Andrew P. Christopherson, director of development, at 404.727.8253 or andrew.christopherson@emory.edu.



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11 REDEFINING PSYCHIATRIC TREATMENT

Functional neurological disorder is one specialty of the Emory Department of Psychiatry and Behavioral Sciences. Its faculty are dedicated to the highest quality education of psychiatric residents and medical students, discovery of new knowledge of causes and treatments for psychiatric disorders, and integration of the latest advances in neuroscience, psychology, social sciences, and psychoanalysis. Donors help provide innovative and compassionate patient care, advance neuropsychiatric research, and support top faculty.

Contact Phyllis Rosen, senior associate, philanthropy and community relationships, 404.727.8254 or prosen@emory.edu

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14 STRENGTHENING SHIELDS AGAINST SUPERBUGS

The Emory Antibiotic Resistance Center (ARC) works to prevent antibiotic resistance and preserve the power of antibiotics for generations to come. Gifts to Emory ARC support research projects, drive the development of new antibiotics, and help Emory train the next generation of scientists.

To find out more, contact Akudo Anyanwu, director of development, at 404.727.6416 or akudo.anyanwu@emory.edu

GIFTS OF NOTE

The Rett Syndrome Research Fund is giving \$574,000 to support pediatric neurologist Daniel Tarquinio's research into Rett syndrome, one of the few neurological disorders for which dramatic symptom reversal has been demonstrated in the lab. Caused by mutations on the X chromosome on a gene called MECP2, Rett syndrome is recognized in infancy and almost always seen in girls. Tarquinio, an Emory assistant professor of pediatrics, began caring for patients with Rett syndrome in 2007 and is known for his development of Rett-specific growth charts and his specialization in epilepsy.



Florida-based Axiom Bank made a second \$100,000 contribution to the Emory Neuromodulation and Technology Innovation Center (ENTICE), including Robert Gross, MBNA Bowman Chair and Emory professor of surgery, to support developing new treatments for neurological and psychiatric conditions such as epilepsy, Parkinson's disease, and depression. "Axiom Bank is proud to support noble causes," says Axiom President and CEO Dan Davis. "We hope this donation to ENTICE enables Emory to continue its important work in the field of brain health, and look forward to supporting this incredible organization in the future." ENTICE is a collaborative effort among the Emory departments of neurology, neurosurgery, and psychiatry and behavioral sciences, and Georgia Tech scientists and biomedical engineers.

The Rollins Foundation endowed a clinical scholarship in honor of trustee Henry B. Tippie, and Emory School of Medicine named Assistant Professor of Surgery Carla Haack the first



or yoga into the workplace and assess results among participating staff members. The Tippie Clinician Scholar designation acknowledges her exemplary contributions to patients and her field while supporting her growth as an academic researcher.

Wilton Looney and his daughter Sylvia Dick gave \$200,000 to the



Carlyle Fraser Heart Center at Emory University Hospital Midtown in memory of his wife Martha Looney (1918-2016), who helped establish the center and benefited from its care. The couple was married 74 years, and Martha Looney was praised as a quiet philanthropist who strove to make the world a better place for everyone. The heart center, named for Wilton Looney's mentor at Genuine Parts Company, is one of the country's leading cardiac treatment and research facilities.

John Brock, his wife, Mary, and their three children renewed their support of the John and Mary Brock Diagnostics and Discoveries Fund to Benefit Patients, which provides support for the work of Seavey Clinic director David Roberts. The Brocks also continued philanthropic support of the Brock Family Child and Adolescent Mood Disorders Program (CAMP) Fund, which allows treatment of uninsured patients who are unable to afford clinical services for their children. CAMP blends basic science, translational science, research, and a patient care clinic to facilitate the development of innovative clinical

Tippie Clinician Scholar. Haack is a rising young faculty leader who is co-principal investigator with Chris Larsen on a research project to integrate a structured discipline of self-care through meditation

programs for child and adolescent depression, anxiety, and bipolar disorders.

The Klein family contributed \$2.5 million to help Emory psychiatrists and behavioral scientists focus on mental disorders that produce physical symptoms, such as blindness, paralysis, and an inability to speak. The gift underwrites the upcoming Partners in Treatment Innovation for Functional Neurological Disorders confer-



ence at Emory's Brain Health Center, a forum for experts from around the world to share their latest breakthroughs. "A generous gift like this from the Kleins has such a powerful

impact for our local communities of patients, families, and clinicians, and also the potential to help individuals nationally and globally," says conference co-director Karen Rommelfanger, assistant professor, departments of Neurology and Psychiatry and Behavioral Sciences.



The Simons Foundation Autism Research Initiative (SFARI) gave \$446,158 to Emory Autism Center as part of the largest national autism study. The Simons Foundation Powering Autism Research for Knowledge (SPARK) connects individuals with a diagnosis of autism and their biological family members to research opportunities. The SPARK initiative is designed to better understand autism and accelerate the development of new treatments and supports.

OPERATING ROOM TALK?

A female medical student finds sexism is still rampant in medicine

When I was a third-year medical student in New York two years ago, there was a resident physician who took obvious pleasure in making me squirm. I had just started hospital rotations and over lunch we were discussing possible areas of specialization, including internal medicine and obstetrics/gynecology. “Do you like vagina?” he asked me.

Later that week, while we checked in on patients, he told me, “You’re not wearing make-up today. Maybe you should rethink that choice.”

A few months after that, I was in the operating room with an all-male surgical oncology team. Their skill during long hours of surgery was impressive, but their “bro talk” was disgusting and ostracizing. Over the exposed hepatoduodenal ligament of one anesthetized patient, the attending surgeon’s eyes widened and locked with mine. He cried out to the assisting resident surgeon, “Splay it open like a Russian whore!” and waited for my reaction. I somehow found the wherewithal to return his gaze and reply, “I assume the whore in question is a man, no?” I didn’t ask him for a letter of recommendation.

Sadly, these were not isolated experiences. The medical profession offers plenty of regular indignities and structural biases against women. While sexist banter during surgery may seem mostly harmless, the extent and frequency of it, and the aggression toward women it communicates, is a real problem. There are also insidious, subtle signals that female physicians contend with daily. My young female colleagues and I are constantly mistaken for nurses. We are referred to as “girls” by patients and medical colleagues alike, while our male counterparts are “young men” or just “men.”

The most disheartening sexist assumptions are the ones I make, though—I find myself asking patients, “Who is your primary care doctor, and do you have his phone number?” Even as a physician myself, I have internalized the idea that the profession still belongs to men.

Yes, there are more women in medicine than ever before. But studies estimate that between 30% and 70% of female medical school faculty experience gender-based discrimination. A culture like that has serious detrimental effects on women.

Those who experience gender discrimination report lower career satisfaction. Female physicians have a higher rate of major depression than women with doctorates in other fields. Overall, men commit suicide four times more often than women; female physicians, though, kill themselves at a rate equal to male physicians.

I eventually chose to specialize in internal medicine. As I interviewed for residency across the country, I was discouraged by how few female department chairs of medicine I encountered: In 12 interviews, I met only one. Just 12% of internal medicine department chairs nationally are women, according to the Association of American Medical Colleges. Of the 294 surgical department chairs across U.S. medical schools, only 1% are women, and only 22% of full-time professors. Even in more female-friendly fields, like obstetrics, the disparity is clear: 83% of residents entering ob/gyn are women, but only 22% of department chairs are.

Female physicians do not advance or get promoted like men do. In the 1990s, women began graduating from medical school at rates roughly equal to men, and this was supposed to lead to equal representation in academic leadership. That hasn’t happened. Women now make up 46% of medical school applicants, students, and residency trainees, but only 38% of medical school faculty, 21% of full professors, and 16% of deans. This is progress, but it’s too slow.

And, if you are a female doctor who does manage to advance your career, you can expect to be paid less. A study of some of the most prominent public medical schools published this summer found that female doctors working there are paid 10% less a year—an average of \$20,000—than their male counterparts. How can we treat our patients fairly when we don’t equally respect each other?

Allyson Herbst is an Emory resident in internal medicine. This essay first appeared in PostEverything at [washingtonpost.com](http://www.washingtonpost.com).



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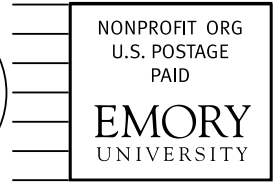




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