

We live in a world
where we are all connected by
the air we breathe,
the water we drink,
the food we eat,
and by airplanes
that can bring disease
from anywhere
to anywhere in a day.

— CDC Director **Tom Frieden**

We can fear,
or we can care.

— Emory Healthcare Chief Nurse Executive **Susan Grant**





AUG. 21, 2014 - Medical missionary Kent Brantly beams as he leaves Emory's isolation unit, thanking the medical team who cared for him during his recovery from Ebola virus. 8

The best care includes compassion



JOHN FOX

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CHRISTIAN LARSEN

Dean, Emory School of Medicine
VP for Health Center Integration
Board Chair, Emory Clinic

In August, two American missionaries who contracted Ebola while working in a Liberian hospital—Dr. Kent Brantly and Ms. Nancy Writebol—were flown back to the US to be cared for at Emory University Hospital. Our entire team, under the leadership of Dr. Bruce Ribner, worked around the clock preparing the hospital’s special isolation unit for the country’s first Ebola patients. We knew we could provide a high level of care that would improve their chances for a positive outcome and that we could do it safely, in a manner that would protect others.

Brantly, who arrived on Aug. 2, and Writebol, on Aug. 5, were met by a cadre of highly trained doctors, nurses, medical technologists, and other staff who had prepared for years for just such a scenario. The team members all volunteered to work in the isolation unit (and several even cancelled vacations to do so). In fact, they had trained to handle pathogens much more virulent, and more contagious, than Ebola.

Nevertheless, we received a lot of phone calls and emails from people who were understandably anxious. Some were scared, others merely curious. Was there a possibility that Ebola could spread? We were able to offer assurances that the likelihood of an outbreak occurring here was virtually nonexistent. Upon Brantly and Writebol’s arrival, and again with the admission of our third patient with Ebola, the worldwide media response was immediate. A silver lining to all of the publicity was that it raised awareness of the help desperately needed in West Africa. Although this response has begun, there is much more to do in terms of providing aid to those on the front lines of this outbreak.

After nearly three weeks, both Brantly and Writebol were determined through extensive testing to be virus-free and were able to leave the hospital and rejoin their families. We’d like to recognize the preparation, collaboration, courageous work, and dedication it took for that day to arrive, and to express our thanks to everyone involved.

At the press conference on the day of Dr. Brantly’s discharge, much of the unit’s clinical team stood behind him and his wife, Amber. “Today is a miraculous day,” he said. “I’m thrilled to be alive, to be well, and to be reunited with my family.” Saying that he was speaking also for fellow missionary Nancy Writebol, released two days earlier, Brantly thanked the hospital and its medical staff: “You treated me with such expertise, yet with such tenderness and compassion, I will never forget you and all that you have done for me.” He then hugged each member of the team.

During the Q&A, a reporter asked Dr. Ribner if the hugging was meant to send a message, and he replied, “Yes, that strong feelings developed over that three-week period of time.” It was a vivid reminder that the clinical aspect of care is vital, but we must also acknowledge the abiding value of compassion.



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Emory Medicine is published three times a year for School of Medicine alumni, faculty, and staff, as well as patients, donors, neighbors, and other friends of Emory Healthcare. Produced by the Woodruff Health Sciences Center Communications Office, the magazine is made possible by support from the medical school dean and the Robert W. Woodruff Health Sciences Center Fund.

Please send correspondence to **Emory Medicine**, 1762 Clifton Road, Suite 1000, Atlanta, GA 30322; call 404-727-0161 or email mary.loftus@emory.edu.

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NEW AND NOTEWORTHY

On Our Radar 2

2| **By the Numbers:** Metabolic summer camp 3| What can be learned from animal parenting 3| **The Big Idea:** An AIDS-free generation? 4| Operating rooms go green 4| Depression can be a fatal illness 5| **You Be the Doctor:** A sheep in wolf's clothing 5| Update on using virtual reality exposure therapy to lessen PTSD 5| Autism and tummy troubles 6| Increasing microbial diversity 7| The incredible power of nanoparticles 16| **In the News:** Ebola, the developing story

FEATURES

Surviving Ebola 8

Emory University Hospital's special isolation unit and its infectious disease team, under the leadership of epidemiologist Bruce Ribner, were called into service after a decade of preparation to care for the first Ebola patients in the US. 

Disrupting the Balance 20

As humans encroach on animal habitats, diseases are jumping across species.

Q&A with infectious disease physician Aneesh Mehta on Ebola 22

Amazing Deliveries 26

These tiny miracles and their mothers survived against daunting odds.

AND MORE

Investing in Discovery 32

32 | Windows of Opportunity 33 | Gifts of Note

From the Executive VP 33

Wright Caughman weighs in from the Woodruff Health Sciences Center

Last Word: The Fear Factor 34

Being frightened of plague-like diseases is natural, but reason must win out.

An editorial by Nadine Kaslow

Thank you for “Brave Hearts” (Spring 2014). I found it a quietly powerful piece, though I don’t know anyone personally (or more likely just think I don’t) who has been a heart recipient or donor. A beautiful marriage of photo and text. It really brought home the life-changing, life-granting nature of a procedure that we risk taking for granted, close to 50 years after the first. Beyond any ooohs or ahhs, it made me pull out my wallet and double-check my driver’s license. There can’t be too many more important titles than “Organ Donor.”

David Raney 99G

Lilburn

The cover story in Spring 2014, “The Anatomy of Fear,” is really compelling. I like the cover illustration of the brain as a snake, and how this is further explored on the page with the snake and the mouse opposing each other.

The piece itself, detailing Kerry Ressler’s work on the biology of fear, trauma, and PTSD, was a great read.

Michael Konomos, MS CMI

Medical illustrator, lead multimedia developer
Emory School of Medicine

What a great issue of *Emory Medicine* just landed on my desk! The articles on diabetes, DDT, cholesterol, heart disease in women, and the list goes on, were great and can touch anyone who picks up this magazine.

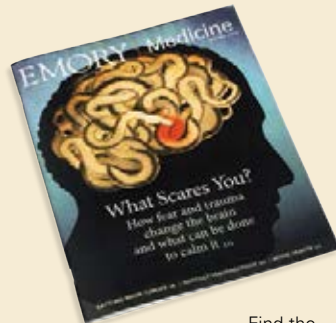
Debbie Carlisle

Director of Development Records
Emory University

Thank you for including the favorable article by (intern) Nicholas Goodwin about my film “Blowing Smoke” in *Emory Medicine*. I realized my class’s 40th anniversary is coming up next year.

Alan Blum 75M

Gerald Leon Wallace, MD, Endowed Chair in Family Medicine
University of Alabama
Director of the Center for the Study of Tobacco and Society
Tuscaloosa, Alabama



Find the Spring 2014 issue online
emorymedicinemagazine.emory.edu

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.

By the numbers

20} summers of Metabolic Camp at Emory

28} campers from around the world

2} camp alumni trained as dietitians now volunteer

1} attendee first in Spain to be diagnosed with PKU

1} in 10,000 babies born in US have PKU

Arts, crafts, & tracking nutrients

Just like most summer camps, a big part of Emory’s Metabolic Camp centers on food—cooking, sharing creative recipes, and eating together, while participating in traditional activities like crafts, sports, and field trips.

But eating is a serious matter for these teen campers, who have metabolic disorders such as phenylketonuria (PKU) or maple syrup urine disease. As little as one gram of protein can cause irreversible brain damage or death. Metabolic disorders are usually detected through newborn screenings, and children who are diagnosed must follow a low-protein diet for life, consisting of a specialized medical formula, fruits, and vegetables.

“Most of these girls can’t attend other camps because of their special dietary needs. This camp allows them to interact with other children and feel less isolated while learning things that can save their lives and the lives of their future children,” says camp director Rani Singh, a biochemical nutritionist and professor of human genetics. Campers also participate in research, screenings, and classes in nutrition, reproductive health, and genetics.

Camp guest Victoria Veiga of Madrid, the first person in Spain to be diagnosed with PKU at 13 months old, is now 50 and has three adopted children. Her father, a software programmer, still helps her manage the intricacies of her diet by tracking nutrients with a program he developed. “My family is very supportive,” she says, “but it’s also nice to be around others who have PKU, and share information with them.” ■



Parenting across species: Ever watched a bear protecting its cub, a giraffe bending a tree limb down so its calf can eat the leaves, or a dog prodding a wayward pup to stay with his littermates, and been reminded of their human counterparts? Human and animal parenting share many nervous system mechanisms, found Yerkes National Primate Research Center researchers Larry Young and James Rilling in a review article in *Science* about the biology of mammalian parenting. The same molecules that prepare the uterus for pregnancy, stimulate milk production, and initiate labor also activate specific neural pathways to motivate mothers to nurture, bond with, and protect their offspring. They also found that variation in parental nurturing can affect brain development, thus affecting future social behaviors. “With this comprehensive review, we can see nervous system correlations across species that result in positive and negative parental care,” Young says. The goal: to pinpoint and facilitate behaviors that will benefit (human) generations to come. ■

Emory hospitals rank among best in state: *U.S. News & World Report* has ranked Emory University Hospital the No. 1 hospital in both Georgia and metro Atlanta in its 2014-2015 Best Hospitals guide for the third year in a row. (Emory University Hospital includes Emory Wesley Woods Geriatric Hospital and Emory University Orthopaedics and Spine Hospital.) Emory University Hospital Midtown ranked fourth in Georgia and third in metro Atlanta. Emory Saint Joseph’s Hospital ranked 11th in Georgia and seventh in metro Atlanta. *U.S. News* uses three weighted factors to rank hospitals, including hospital structure, reputation, and outcomes. For more, go to health.usnews.com/best-hospitals. ■

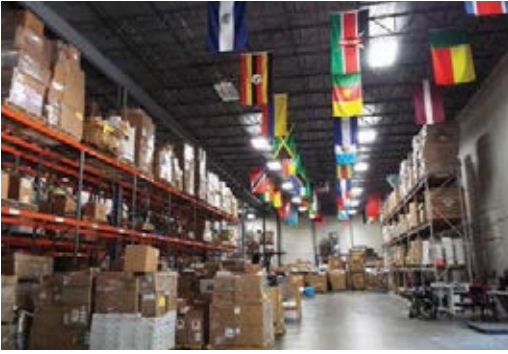


THE BIG IDEA

An AIDS-free generation?

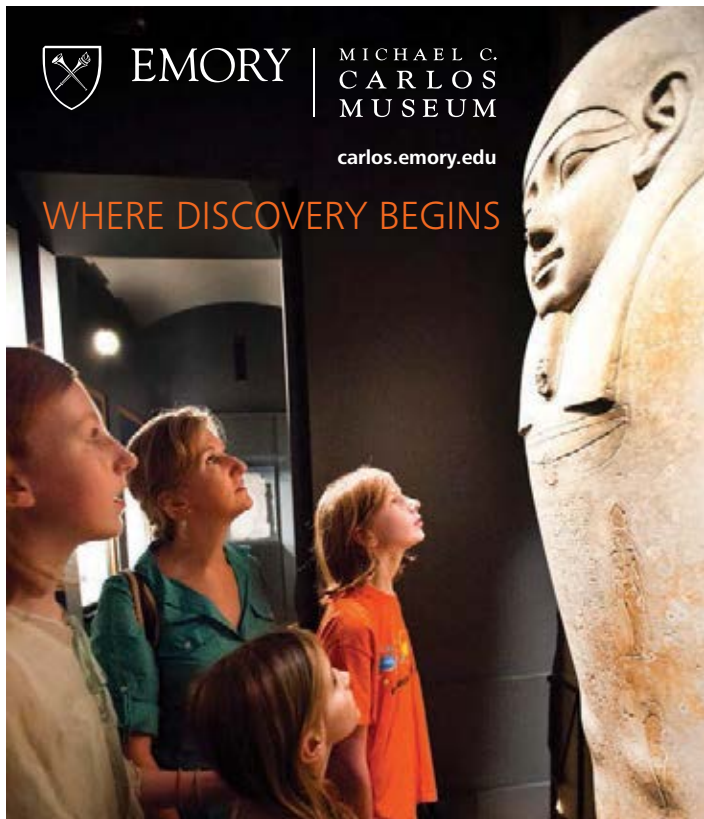
All adults and adolescents should be tested at least once for HIV, with repeated testing for

those at increased risk, recommends an interdisciplinary panel of experts assembled by the International Antiviral Society-USA (IAS-USA). The experts created a list of best practices for doctors, with the aim of achieving an AIDS-free generation, which was based on a review of 17 years of data and was published online in the *Journal of the American Medical Association*. (About 2.3 million new HIV infections occurred worldwide in 2012, 50,000 in the US). Other recommendations for doctors: be alert to the possibility of HIV infection and if suspected, pursue diagnostic testing immediately; start HIV-infected patients on antiretroviral therapy right away; give antiviral pre-exposure prophylaxis and counseling on risk reduction to uninfected patients at high risk; provide harm reduction services (like needle exchanges and drug treatment programs) to patients who inject drugs; provide post-exposure prophylaxis to patients exposed to HIV from a known infected source. Emory’s Carlos del Rio, professor of medicine and chair of global health, was co-chair of the IAS-USA panel. “We are at a time where scientific advances in HIV interventions and treatments could stop HIV transmission,” says del Rio, who co-directs the Emory Center for AIDS Research. “The success of both biomedical and behavioral HIV prevention measures depends on clinicians’ abilities and willingness to implement them.” ■



Donated surplus medical supplies at the MedShare warehouse in Decatur.

Operating rooms go green: Hospitals produce an estimated 6 billion tons of waste annually—that’s 33 pounds per bed per day. Emory hospitals are doing their part to reduce those numbers by starting new recycling programs in their operating rooms. “ORs create a tremendous volume of waste,” says Jane Duggan, assistant professor of anesthesiology and head of the OR Green Team at Emory University Hospital Midtown. “Much of it is clean waste and can be recycled.” Medical and hazardous waste recycling companies collect and recycle used medical equipment, including laparoscopic devices, arthroscopic/orthopaedic devices, and energy devices, as well as clean plastic containers, plastic wrap, and cardboard boxes used to package surgical and sterile supplies. Emory Healthcare also will continue to reduce waste by partnering with MedShare, which sends surplus medical supplies to underserved hospitals and clinics worldwide. ■



Suicide sometimes the result of “energized despair”:

Publicity about Robin Williams’s recent suicide brought home the fact that depression can be fatal. On average, 700 Americans will kill themselves each week, making suicide the 10th most common cause of death in the country. Those with depression, a history of drug and alcohol abuse, and medical problems are especially at risk, says Nadine Kaslow, vice-chair of Emory’s Department of Psychiatry and Behavioral Sciences and president of the American Psychological Association. “There is almost never ‘one’ reason why people die by suicide, but a combination of factors that can push them to a place of energized despair,” she says. Williams, reported to have been in the early stages of Parkinson’s disease, is a tragic reminder that “anyone can become suicidal, no matter how funny, comical, and happy they may seem,” says Kaslow. “No one is immune.” ■



Depression in young women increases risk of heart disease, death:

Women ages 55 or younger are twice as likely to have a heart attack, need open-heart surgery or a stent, or to die (from any cause), if they suffer from moderate

or severe depression, found a study published in the *Journal of the American Heart Association*. The same increase in risk did not hold true for similarly aged men, or women older than 55. For young women, depression appears to be as powerful a risk factor for heart disease as diabetes and smoking, says study author Amit Shah, an assistant professor of both epidemiology and cardiology at Emory. “Part of the additional hurdle is the stigma in seeking care in the first place,” he says. A proven antidote for lessening the risk of both depression and heart disease? Exercise. ■

You be the doctor

The Deceptive Case of the 'Sheep in Wolf's Clothing'

A normally healthy African American woman in her mid-30s suddenly began experiencing high fevers, weight loss, severe headaches, and night sweats to the point that her nightgown was soaked. Perhaps most alarming, knots had begun to emerge on her neck. Her doctor recommended an ultrasound that revealed more than 13 swollen lymph nodes, most on the left side of her neck, with a large nodule in her thyroid gland. More testing showed that her thyroid activity was normal; a fine needle biopsy of the lymph nodes and thyroid mass was inconclusive. She was referred to Clyde Partin, director of Emory's new Special Diagnostic Services Clinic. Blood work showed a high sedimentation rate, which suggests significant systemic inflammation and can indicate abnormal conditions such as infection, an autoimmune disease, or even cancer.

One possibility was lupus, but she tested negative for lupus antibodies. Even though she had no pets, she was tested for cat scratch fever, which has many of the same symptoms (especially the swollen lymph nodes) but that titer also was negative. "I was concerned about a lymphoma," says Partin, who arranged to have one of her lymph nodes removed.

In this case, the pathologist helped solve the mystery. All the special markers matched a rare syndrome called Kikuchi-Fujimoto disease, a self-limiting disorder that typically affects the cervical lymph nodes and is often mistaken for something far more serious (one medical journal called it a "sheep in wolf's clothing.") Most episodes of Kikuchi clear up in three months with no medication, which is exactly what happened to Partin's patient. ■

"I've had people who told me, 'I don't know why I fought so hard to survive if this is my life now.'" —Professor Barbara Rothbaum on

living with PTSD, "This Emotional Life," PBS.



Therapy for PTSD: Short doses—as little as five sessions—of virtual reality exposure therapy reduces post-traumatic stress disorder symptoms in veterans, found researchers led by Professor of Psychiatry and Behavioral Sciences Barbara Rothbaum, in a clinical trial involving Iraq and Afghanistan combat veterans with PTSD. The results were especially

significant when the therapy was combined with the antibiotic d-cycloserine. (Interestingly, alprazolam, commonly known as Xanax, impaired recovery from symptoms when administered with the therapy). Virtual reality exposure therapy involves being immersed for 30 to 45 minutes in computer-simulated environments similar to those vets experienced in combat with the sights, sounds, and smells of battle, such as explosions, helicopters flying overhead, and smoke. ■

Autism and tummy troubles: Children with autism are more than four times as likely to experience general gastrointestinal discomfort as their peers, three times as likely to have constipation and diarrhea, and twice as likely to have abdominal pain, found researchers from Emory School of Medicine, the Marcus Autism Center, and Children's Healthcare of Atlanta, in a study published in the journal *Pediatrics*. "Our findings corroborate a history of anecdotal reports and case studies suggesting increased risk of GI concerns in autism," says coauthor William Sharp, director of the Pediatric Feeding Disorders Program at Marcus Autism Center and assistant professor of pediatrics. In many cases, say the researchers, the children may not be able to communicate these problems or pains directly, and the only indication might be an emergence or escalation of problem behaviors like self-injury, aggression, or irritability. ■



Regaining **balance**

Fecal transplants heal infections by increasing microbial diversity



THE HUMAN GUT IS ITS OWN ECOSYSTEM, HOSTING CLOSE TO A THOUSAND MICROORGANISMS, MANY OF WHICH ARE HELPFUL AND NECESSARY. When you take antibiotics, some of the beneficial germs can be wiped out, leaving you more vulnerable to diarrheal infections—infections, in some cases, that are antibiotic resistant and life-threatening.

Fecal transplants are proving to be a highly effective, antibiotic-free tool to cure *Clostridium difficile*, known as *C diff*, often a health care acquired infection that is more common among the elderly or those who take frequent antibiotics.

Colleen Kraft, medical director of Emory’s clinical microbiology laboratory and assistant professor in the Department of Pathology and the Division of Infectious Diseases, started the intestinal microbiota program to treat and understand these infections. “Now that we as a medical community have a better understanding of the damage we do to the intestinal microbiota with antibiotic therapy, this understanding became the motivation to restore the balance to improve health,” Kraft says.

In a fecal transplant, a sample is taken from a healthy donor,

mixed with saline, and transplanted into the small intestine or colon of the ill patient, where the good bacteria repopulates and restores the healthy microbiota. Tanvi Dhere, director of inflammatory bowel diseases at the Emory Clinic, performs the transplant via colonoscopy and follows up with the patients in the Emory GI clinic. There have been 81 fecal transplants since the program began in 2012.

Donors need to meet stringent requirements, including not having school-aged children, not traveling internationally, and not having taken any antibiotics for at least one year; the sample is screened for HIV/AIDS, hepatitis, STDs, parasites, and more. Patients are offered the option of having a family member screened for donor eligibility, but few have requested this after the standardized donor program was started.

Pathology residents Ryan McCormick and Drew Davis are two of Emory’s donors.

“During clinical rotations, we saw *C diff* cases on the wards,” Davis says. “It’s important to recognize how bad conditions like *C diff* and colitis actually are.”

“For the record, I don’t think it’s as gross as it sounds,” McCormick says, laughing. “My reason for donating is to have more direct involvement in patient care.”

Kraft and Dhere are enrolling participants for a clinical trial in which they will examine the microbiome of the sample at the mucosal level. “A patient’s gut microbiome is changed after undergoing

Of the 336,000 *C diff* cases in the US each year, 14,000 result in death, often because the standard course of antibiotic treatment failed.

a fecal transplant,” Dhere says. “We want to know what specifically is allowing patients to recover.”

Collaborative research with other departments is ongoing, including a study with the Department of Surgery on the efficacy of fecal transplants in treating pouchitis, a gastrointestinal condition that may require chronic antibiotics and affects more than 40% of patients with ulcerative colitis who have had a colonic resection. The team, led by Virginia Shaffer, has been granted an investigational new drug designation from the FDA. Fecal transplantation is also showing promise for treating *C diff* in organ transplant recipients, who must take drugs to keep their immune systems from rejecting the transplanted organ.

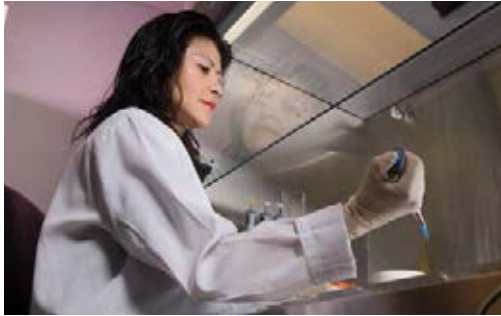
The intestinal microbiota program has a success rate of more than 90%. “We receive a lot of thank-you cards from patients and their families,” Dhere says. “The quality of life that patients get after the procedure speaks volumes for this treatment.”—*Natalie Duggan*

The **incredible potential** of nanoparticles

Chemotherapy and radiation are clearly broad sweeps, killing cancer cells at a high cost to healthy cells. But what if a nanoparticle could carry a drug directly to the tumor site, work around any obstacles, and bind to the cancer cells—and only the cancer cells—before dispensing its medication?

Targeted, multifunctional nanoparticles

are a reality, although they have only been tested using tumor cells and tissues from human patients in mice so far. Ideally, the nanoparticle could serve multiple roles, delivering imaging agents and medications and allowing the monitoring of treatment response. “Only a nanoparticle can deliver



two drugs together to the same tumor cell at the same time, which offers an opportunity to kill drug-resistant tumor cells,” says Lily Yang (left), professor of

surgery and the Nancy Panoz Chair of Surgery in Cancer Research.

Nanomedicine uses particles as small as antibodies or viruses to create molecular imaging probes and drug-carriers for *in vivo*

delivery. Imaging with nanoparticles may help expose cancer before health has deteriorated, says Yang, and could help guide surgeons in their efforts to detect, treat, and remove tumors.

Yang has worked with Shuming Nie, of the Coulter Department of Biomedical

Engineering at Emory and Georgia Tech, and radiologist Hui Mao, on the use of nanoparticles to illuminate tumor boundaries and cancer cells.

As a translational researcher with the Winship Cancer Institute, Yang’s research focuses on developing multifunctional, tumor-targeting nanoparticles. Yang and colleagues have developed a magnetic iron oxide nanoparticle platform for molecular tumor imaging and targeted cancer therapy that is able to detect primary and metastatic tumors in breast, pancreatic, and ovarian cancers in animal models. Using such a specific targeting mechanism allows the detection of cancer cells that have spread from the tumor but are still too small to be visible. “Personalized therapy is necessary for effective cancer treatment,” Yang says. “And nanoparticles offer one of the best chances we have for truly personalized therapy.” —*Mary Loftus*

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Surviving Ebola

By MARY LOFTUS

When medical missionary Dr. Kent Brantly emerged from the back of a Grady ambulance on Saturday afternoon, August 2, clad in a full-body protective suit and holding onto his EMS escort for support, he became the first Ebola patient to set foot on American soil. He walked slowly and steadily toward the back of Emory University Hospital, where the special isolation unit's infectious disease team was awaiting his arrival. Outside, media satellite trucks lined Clifton Road, reporters were doing live feeds in front of the hospital, and television helicopters hovered overhead. Inside, however, the mood was calm and focused.

VIDEO STILL COURTESY OF WSB



WHAT IT TAKES | WHAT WE LEARNED | HOW IT CAN HELP

THE ISOLATION UNIT WAS “KIND OF LIKE HAVING AN INSURANCE POLICY. YOU CAN COMPLAIN THAT YOU DIDN’T COLLECT ON YOUR POLICY ALL THESE YEARS OR YOU CAN SAY—AS IN THIS CASE—‘BOY, WE’RE LUCKY WE’VE BEEN SUPPORTING IT BECAUSE NOW WE REALLY NEED IT.’ ” —DR. BRUCE RIBNER

Despite the fact that Brantly was walking on his own, he was a very sick man. He had acquired the deadly Zaire strain of Ebola while working with patients at a Liberian hospital, and the disease was pillaging his body, causing a life-threatening metabolic imbalance and heart arrhythmia. “I was focused on putting one foot in front of the other,” he said later.

Emory’s medical team had been in communication with Brantly’s doctors in Monrovia, as well as the medics caring for him on the private jet flight back to Georgia.

“Let me just say we were cautiously optimistic,” says isolation unit medical director Bruce Ribner. “We’ve always had a strong feeling that the 50% to 90% fatality rates associated with this disease are not what we’d anticipate here.”

Ribner, an infectious disease expert with a disarming wit and slightly rumpled appearance, had been actively preparing for such a scenario for more than a dozen years, nearly from the time he’d been hired as head epidemiologist for Emory Hospital.

The hospital’s isolation unit was built under contract with the Centers for Disease Control and Prevention (CDC) in 2002, largely in case one of its employees was exposed to a highly lethal, contagious disease in the field or in a lab.

At that time, there was just one facility in the US that could handle patients with these types of diseases, and that was a back room in the Army Medical Command installation at Fort Detrick, Maryland.

“It was kind of the old Soviet model—two beds in the back, not attached to any medical facility. You put the patients there to isolate them and contain the disease, and if they got better, great,” Ribner says. “The CDC decided they needed something better.”

Emory Travel Well medical director and CDC consultant Phyllis Kozarsky, who was involved in the early planning stages, remembers a patient she saw in Atlanta in the 1990s that vividly illustrated the need for such a unit: A CDC staffer came to her



Director Bruce Ribner checks on the condition of a patient with Ebola in Emory Hospital’s isolation unit, built to treat patients with highly lethal infectious diseases.

clinic with a 104-degree fever after working with small mammals in the jungles of South America. “We suspected a hemorrhagic fever but didn’t have anywhere to care for him,” she says. “My nurse actually put a mask on him and one on herself and ran him in a wheelchair down the sidewalk of Peachtree Street to [then-Crawford Long] hospital, and took him up to the fifth floor to a room used for TB patients. We were fearful for him, for us, and for the hospital.” His wife drove his blood samples to the CDC for testing.

Fortunately, the patient survived

and his disease didn’t spread, but no one wanted to leave the handling of the next such incident to chance.

12 years of preparation

So Ribner, Kozarsky, and a core group of Emory and CDC experts meticulously planned and designed a serious communicable disease unit, which was built in a back wing of Emory University Hospital on Clifton Road, just down the road from CDC headquarters.

“We placed it where there could be easy control of ingress and egress and modifications to air handling,” Ribner says. “We wanted it to be reasonably peripheral, not to have to bring patients through hallways and on elevators.”

Ribner gathered an infectious disease team that stayed up to date on procedures for handling illnesses that posed a high threat of contagion (severe acute respiratory syndrome, anthrax, biotoxins). They were trained in the use of personal protective equipment like Tyvek suits and ran drills for a dozen different scenarios—a symptomatic CDC staffer flown in from an outbreak, a lab tech with a finger prick, a soldier with a high fever. “We designed it for something hideously contagious, like SARS,” Ribner says.


The result was a fully equipped isolation unit, able to deal with biosafety level 4 pathogens and ready to be activated and staffed at a moment’s notice. “It would have been really challenging to develop something like this on the fly,” he says.

The unit has been used only a few times over the years—once for a patient with Marburg hemorrhagic fever symptoms, another with SARS symptoms, although neither patient developed those illnesses. It also housed clinical trial volunteers who

Emory University Hospital

Special Isolation Unit

▶ **want more?** TOUR THE UNIT

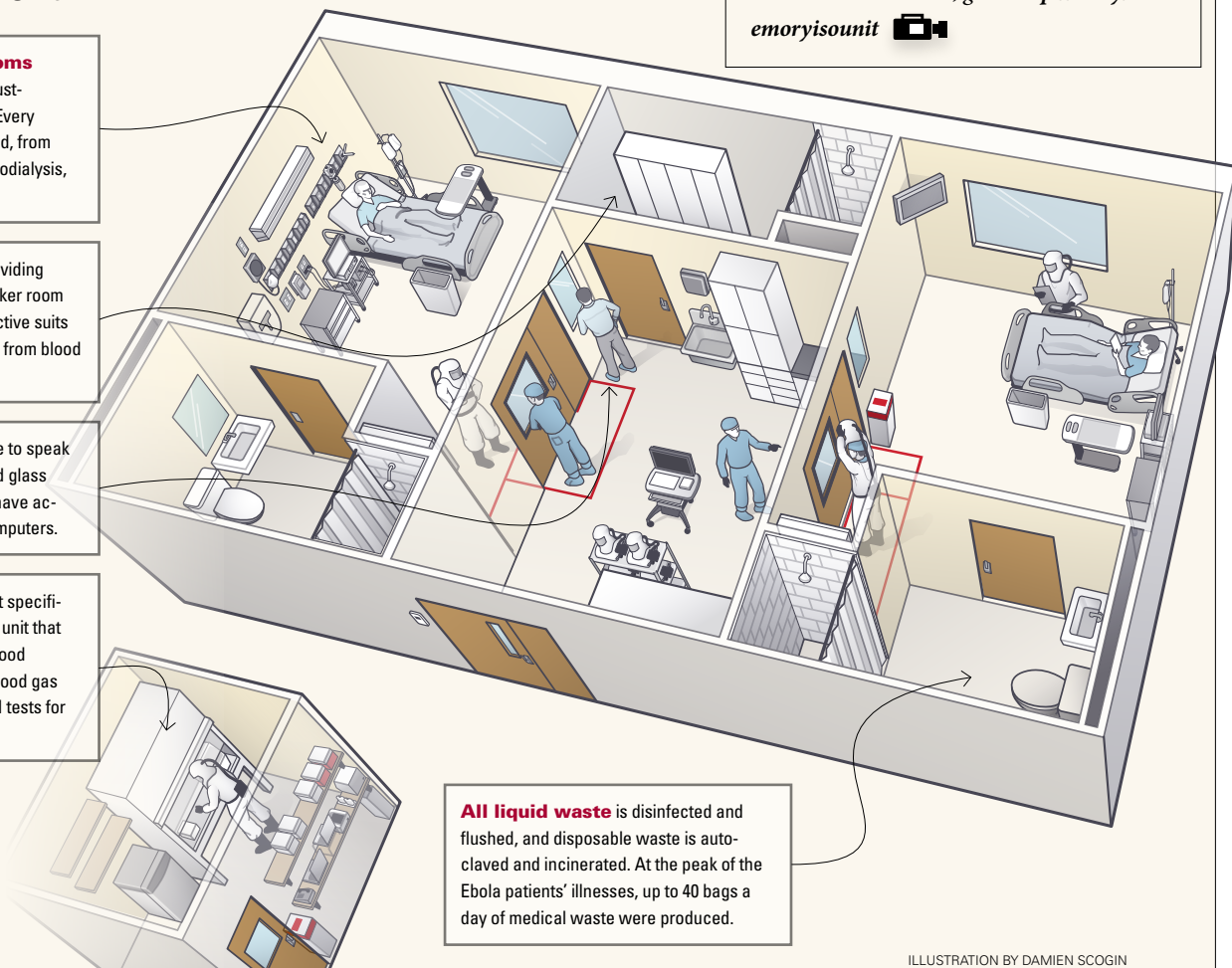
To see inside Emory hospital's isolation unit with Dr. Bruce Ribner, go to <http://bit.ly/emoryisounit> 

The private patient rooms resemble ICU rooms, with adjustable beds, IVs, and monitors. Every procedure a patient could need, from mechanical ventilation to hemodialysis, can be performed in the unit.

Medical staff who are providing direct patient care use the locker room to change into full-body protective suits and masks, which shield them from blood and bodily fluids.

Family members are able to speak with patients through standard glass windows in the unit; patients have access to phones and laptop computers.

A dedicated lab was built specifically for use with the isolation unit that has the capacity to perform blood counts, routine chemistries, blood gas measurements, urinalysis, and tests for a variety of infectious agents.



All liquid waste is disinfected and flushed, and disposable waste is autoclaved and incinerated. At the peak of the Ebola patients' illnesses, up to 40 bags a day of medical waste were produced.

ILLUSTRATION BY DAMIEN SCOGIN

Emory's special isolation unit was built in cooperation with the CDC to treat patients with lethal, contagious diseases acquired in the field or in a lab. It is one of four such high-level biocontainment units in the US. The other three are at the NIH in Maryland, Rocky Mountain Laboratories in Montana, and the University of Nebraska Medical Center. The units are set up to contain SARS, smallpox, tularemia, plague, viral hemorrhagic fevers, and drug-resistant illnesses, among other infectious diseases.

Emory's six-room unit consists of two patient rooms that resemble ICU hospital rooms, two connected patient support rooms with toilets and showers, a large anteroom in the middle, a staff dressing room with lockers and shower, and a biosafety cabinet for specimen processing. A lab dedicated to the unit was established just outside the suite.

The air pressure in the unit is negative, so the air flows from the hallway to the anteroom to the patient room (this

means the doors don't need to be sealed, since airflow goes into the patient rooms, not out.) The rooms have 20 air changes per hour, so that all infectious particles are rapidly removed, and air from the unit is HEPA-filtered before being sent out through the exhaust system.

There is a vestibule where select staff members, highly trained in infection control, suit up before entering the room. A plate glass window and communication system allows non-suited health care workers and family members to safely observe and visit with the patients from as close as a few inches away.

All disposable waste is autoclaved (sanitized with pressurized steam) and then incinerated, from Tyvek suits to food trays. Liquid wastes are disinfected with bleach or detergents for more than five minutes and then flushed down the toilet. Equipment that is not disposable, like the powered air purifying respirator (PAPR), is disinfected. ■



Five infectious disease doctors, 21 nurses, two pathologists, and five medical technologists make up the core Emory Healthcare team (several of whom are shown above) that provides round-the-clock care to Emory's Ebola patients. While the patients are contagious, their direct caretakers wear full-body Tyvek suits, hoods, and double gloves. Still, said patient Kent Brantly, their kindness was never shrouded: "You cared for me with such expertise, yet with such tenderness and compassion. I will never forget you."

had been given highly contagious diseases, like norovirus, for research purposes.

To devote resources to such a rarely used, specialized unit is "kind of like having an insurance policy," Ribner says. "You can complain that you didn't collect on your policy all these years or you can say—as in this case—'Boy, we're lucky we've been supporting it because now we really need it.'"

'We've got a doctor who's infected'

By late July, the deadly Zaire strain of Ebola was spreading steadily across West Africa. Unlike earlier outbreaks in more rural areas, the virus was showing up in urban centers with concentrated populations and already overburdened health care systems.

The CDC had dozens of "boots on the ground" in the affected countries and was

preparing to dispatch 50 more emergency responders. The agency's emergency operation center—its "battle room," filled with computers and real-time maps of the outbreak—was monitoring the situation and supervising its field teams.

The hospital's infectious disease team watched and waited. "We are very attuned to how to manage it should any CDC staffer become ill," says Kozarsky. "I was in contact with a number of them, and hearing what was happening there was very sobering."

The US State Department contacted Ribner on Monday, July 28, and asked to tour the isolation unit. Two days later, they called and said, "We've got a doctor in Liberia who's infected, you've probably read about him in the press. We'd like to fly him back to your unit."

Ribner checked with Emory colleagues, senior staff, and administrators. "They immediately said yes," he says.

Hospital officials knew they might receive some negative reactions. The fact that this was Ebola, the subject of the terrifying 1994 best-seller *The Hot Zone* and the most virulent of the hemorrhagic fevers, meant that the press corps, and the public's dire imaginings, would be out in full force.

Ribner started getting a "tsunami" of hate mail before the first patient had even arrived—people angry that he was "bringing Ebola" to Atlanta.

"It's not like this is a new virus that just mutated, that we know nothing about," he says. "The CDC has been dealing with Ebola for 40 years. It was only a matter of

time before it came to our shores. We were actually very lucky. Someone could just have stepped off the plane at Hartsfield and collapsed with it.”

More sick than anticipated

The team had three days to prepare. “We’d been planning for 12 years, what would we do if?” says Ribner. “We were finally going to get to do it.”

Phoenix Air ambulance service flew Brantly to the US in a tent-like isolative pod, landing at Dobbins Air Reserve Base in Marietta and then transferring him by ambulance to Emory on Saturday, Aug. 2.

Three days later, 59-year-old Nancy Writebol would follow, arriving on Tuesday, just past 1 p.m. She was carried in on a stretcher to the isolation unit’s second room within view of her friend and fellow missionary, Brantly, who waved and tried to catch her eye.

The level of virus in Brantly and Writebol when they arrived, on a scale of 1 to 10, was a 10, said unit physician Marshall Lyon.

One danger of Ebola is heartbeat irregularities caused by dehydration from the constant diarrhea. In fact, there are frequent reports of Ebola patients dying after sitting up and clutching their chests, leading experts to believe that many victims may actually die of cardiac arrest.

Brantly was experiencing arrhythmia when he arrived. “We did not anticipate how metabolically abnormal both these patients would be when they came to us,” Ribner says.

Brantly and Writebol had been given an experimental treatment, ZMapp, before they left Liberia, which binds the virus in the blood with neutralizing antibodies, providing passive immunity. ZMapp had proven successful in clinical trials with primates.

That treatment was continued while the patients were at Emory, Ribner says, but he believes aggressive “supportive care” remained the key to their recovery.

Supportive care for Ebola patients in-

cludes controlling fever, balancing fluid and electrolyte levels, providing respiratory support, and treating for complications. “The whole idea is constant monitoring, excellent nursing, frequent vital signs, and treating problems as they arise,” says team



Kent Brantly (above) was in Liberia as a medical missionary with Samaritan’s Purse; **Nancy Writebol** (below) was volunteering at the same Liberian hospital through SIM. After acquiring Ebola, they were flown back to the US and treated at Emory Hospital.



physician Jay Varkey. “Basically, we try to keep them alive long enough for their body to fight the virus on its own.”

Took every precaution

Dr. Kent Brantly, 33, was fervently hoping that his body would rally to fight the virus.

When he, his wife, Amber, and their two children went to Liberia in October 2013 on a two-year assignment with the Christian charity Samaritan’s Purse, Ebola was “not on our radar. We moved to Liberia because God called us to serve the people of Liberia,” Brantly said.

This March, at a picnic with friends, they heard that Ebola cases were appearing in Guinea and had begun to spread to

Liberia. In June, the hospital at which Brantly and Writebol worked received its first Ebola patient. During July, the number of Ebola patients increased steadily.

Brantly said he and other caretakers at ELWA (Eternal Love Winning Africa) Hospital followed strict World Health Organization (WHO) and CDC guidelines for safety, “taking every precaution to protect ourselves from this dreaded disease.”

On July 20, as the epidemic spread, Brantly took Amber and his children to the airport to fly back to the US to attend a wedding. He returned to work, planning to join his family shortly. Dressed in sweltering protective gear, he continued to provide medical care, hold patients’ hands, and sing to them as they lay dying. “In the first month and a half, we had one survivor out of 45,” he said.

Three days later, he awoke feeling ill. He stayed isolated in his house, but thought the odds were that he had malaria or some other illness, especially after his first test for Ebola came back negative. The second Ebola test, however, was positive.

“I lay in my bed in Liberia for the following nine days, getting sicker and weaker each day. I prayed that God would help me to be faithful even in my illness,” Brantly said, “and I prayed that in my life or in my death, He would be glorified.”

Caring in isolation

The core Emory medical team that provided direct care to Brantly and Writebol—five infectious disease doctors, 21 nurses, two pathologists, and five medical technologists—had all volunteered to work in the isolation unit. They came together immediately when it was activated before Brantly’s arrival, canceling vacations and rehearsing everything from donning and doffing the personal protective gear to starting IVs while double-gloved.

Carolyn Hill, unit nursing director, said that in the midst of preparing, the serious-

ness of what they were about to undertake hit home. “I had to withdraw and take a moment to myself,” Hill says. “This was real—every decision had to be well thought out and executed perfectly. It wasn’t just the patients’ lives at stake, it was everyone on the team. You felt the weight. There were two possible outcomes—it went well, both patients survived, and no one was contaminated. Or something really bad happened.”

The nurses quickly discovered that normal 12-hour shifts were untenable with the level of intensive, one-on-one care that Brantly and Writebol needed. They switched to three 8-hour shifts with three nurses present around the clock—one dedicated to each patient, and one in the anteroom between patient rooms.

Team members took their own temperatures twice a day and recorded the results, even on their days off, to make sure they weren’t symptomatic.

Part of the intensity of the care was that medical staff having direct contact with either patient wore full-body personal protective equipment—disposable Tyvek suits, shoe coverings, gloves, masks, and PAPR (powered air purifying respirator, a helmet and face guard that filters and circulates air).

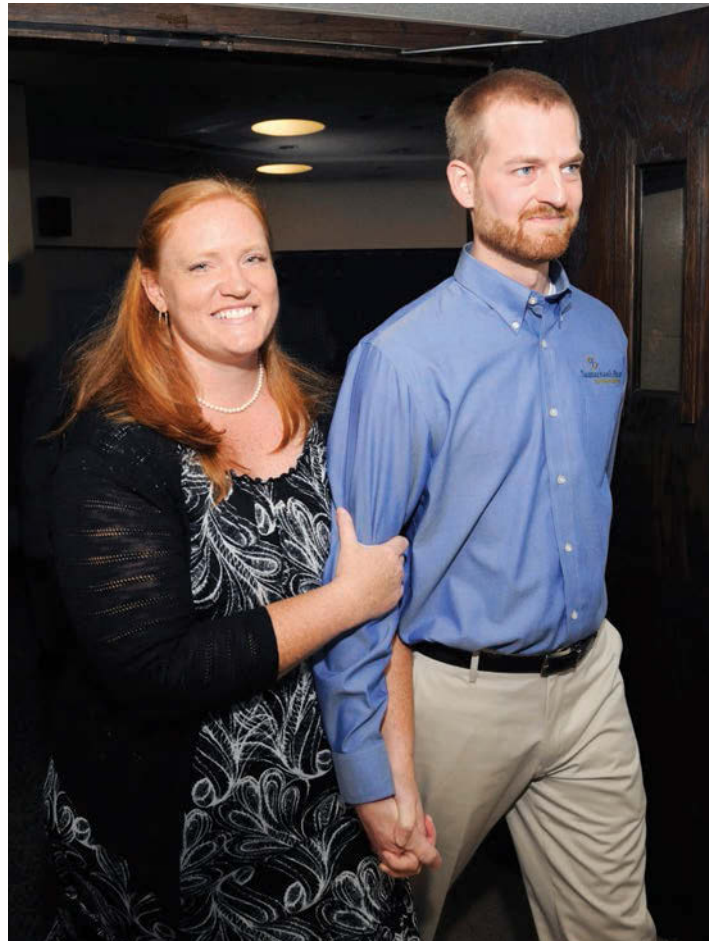
The “spacesuit,” says Ribner, is actually more than is needed for protection from Ebola, since the virus is not airborne. “But wearing masks, goggles, and face shields for a lot of hours is not very comfortable,” he says. “With PAPRs, you get a nice breeze blowing on your face.”

Everything leaving the patient rooms was sterilized. All disposable items were double-bagged and sterilized in an autoclave before being incinerated—from disposable dining trays to Tyvek suits. Nurses showered and changed after each shift. There was frequent hand washing and disinfecting.

“You have to be very detail-oriented to work on a unit like this. Just to take every-

thing off, there were approximately 20 steps you had to follow,” says Sharon Vanairsdale, the clinical nurse specialist for the unit. “We didn’t hesitate to hold each other accountable. Nobody took it personally.”

Family members were able to visit and speak with Brantly and Writebol through glass windows. “There were tears,” says Hill, “especially the first time they saw each other.”



Both Kent Brantly (above, leaving Emory Hospital with his wife, Amber) and Nancy Writebol are allowing medical information about them to be used to help others.

Turning points and Krispy Kreme

After the first week, it became clear that the worst was over. The nurses knew their patients were feeling better when they asked for showers and real food: Krispy Kreme doughnuts, Starbucks coffee, and pizza. Modern conveniences, including iPads and laptops, were available for communication with family and friends. And there was the

occasional Nerf basketball competition between Brantly and his care team.

Then came the day when each patient’s viral level tested low enough that they were able to have contact with their families. The nurses sterilized Brantly’s wedding ring for Amber so she could give it back to him, then cleared a path on the floor with bleach for their first hug.

After extensive testing that showed they posed no threat of contagion to the public,

Writebol left quietly on Aug. 19, after 17 days in the unit, and Brantly left two days later. The morning of Aug. 21, the care team lined up as Brantly, smiling broadly and dressed in a blue dress shirt and khakis, walked down the hallway, giving high fives and dancing an impromptu jig that drew cheers from the group.

Standing hand in hand with Amber, Brantly addressed a room packed with reporters as the care team lined up behind him. “Today is a miraculous day. I’m thrilled to be alive and well and reunited with my family,” he said. Brantly thanked the doctors and nurses who cared for him throughout his illness, and urged that increased efforts be made to provide international assistance. “Please continue to pray for Liberia and the people of West Africa, and encourage those in positions of leadership and influence

to do everything possible to bring this Ebola outbreak to an end,” he said. Ribner also spoke, saying it was “the right decision to bring these patients back to Emory for treatment. What we learned in caring for them will advance the world’s understanding of how to treat Ebola. We are grateful for the successful outcome in their cases, but we never take success for granted.”



Isolation unit nursing director **Carolyn Hill**, medical director **Bruce Ribner**, and pathologist **Charles Hill** (far right) confer just outside the sliding glass doors to Emory University Hospital's special isolation unit, where a third American aid worker infected with Ebola was admitted on Sept. 9.

'We're crying out to everybody'

As the summer progressed, the outbreak intensified in West Africa, expanding exponentially. By late September, there were 6,574 cases and more than 3,091 deaths (WHO), making this the largest, most deadly Ebola outbreak in history. Liberian families with sick relatives were driving from clinic to clinic in search of open beds; others were dying in the streets.

In the middle of Writebol and Brantly's stay, what at first appeared to be a small group of protesters had gathered on the sidewalk in front of the hospital, carrying signs, singing, and praying. In fact, they were Liberian Americans there to thank the missionaries and the hospital: "We are praying for you," "You Are Our Heroes," and "Pray for Liberia," read the hand-lettered posters.

"We are here to show our gratitude," said one young woman.

"We're really helpless, that's why we're

crying out to everybody," said another.

The medical team was eager to share what they had learned with colleagues here and around the world, consulting by phone and submitting journal articles. (Dr. Brantly is a coauthor on one.)

"My hope is that by providing excellent care here, we learn processes that can be translated and expanded to other countries," Varkey said.

On Sept. 5, another American doctor with Ebola, Rick Sacra, was flown from Liberia to the biocontainment unit at Nebraska Medical Center. Brantly flew to Nebraska to donate blood for Sacra's treatment in an effort to "jumpstart" his immunity. His blood type was a perfect match.

Emory's isolation unit was cleaned and disinfected, and the care team went back to their regular assignments but stayed in contact. Some even formed a kickball team they named, tongue firmly in cheek, "Can't Touch This."

Then they learned that another American aid worker infected with Ebola in Africa would be flown back to the US, arriving at Emory Hospital on Sept. 9.

They knew exactly what to do. The isolation unit was immediately reactivated.

"People keep saying this is the new normal, but there's nothing normal about it," says nursing director Carolyn Hill, standing just outside the unit one morning in mid-September. "Each case takes just as much concentration and attention to detail as the first."

As efficient and unflappable as ever, Hill walks down the hall and speaks reassuringly to another small knot of hopeful relatives.

Then she has a quick meeting with Ribner and pathologist Charles Hill, makes sure everyone has put in their lunch orders, and begins reviewing the nursing shift schedule, the now familiar weight settling back onto her shoulders. ■

“Ebola appears to kill in a clever way. Early on, it strategically disarms your immune system, allowing the virus to replicate unchecked until it invades organs all over your body. Most patients die of shock.”

—**Dr. Sanjay Gupta**, *CNN Health*, April 15

“As human beings, we all hope that if we were in need of superior health care, our country and its top doctors would help us get better. We can either let our actions be guided by misunderstandings, fear and self-interest, or we can lead by knowledge, science and compassion. We can fear, or we can care.”—*Emory Healthcare*

Chief Nurse Executive Susan Grant, Washington Post, Aug. 6

“The problem isn’t that Ebola is highly infectious—it’s not. It’s that the stakes are so high.”

—*CDC Director Tom Frieden, Twitter, Aug. 2*

“My hope is that by providing excellent care here, we learn processes that can be translated and expanded. In my opinion, in a fair and just world, if these processes are really key to improving survival in a disease like Ebola, countries that are developing can institute them.”

—**Dr. Jay Varkey**, *Emory infectious disease doctor, Time magazine, Aug. 10*

“My wife knew what she was getting into when she married an infectious disease doctor... She said, ‘Great, that’s what you’ve been dreaming of for 12 years.’ ”

—**Dr. Bruce Ribner**, *director of Emory’s special isolation unit, CNN.com, Aug. 1*

“It’s like fighting a forest fire. Leave behind one burning ember and the epidemic could re-ignite. That ember could be one case undetected, one contact not traced or health care worker not effectively protected, or burial ceremony conducted unsafely.”—*CDC Director Tom Frieden,*

Huffington Post, Aug. 7

“I have to admit, a lot of people saw this as Noah’s Ark. They thought, ‘You are not going to have any activity there, you’re just wasting your time with all that.’ ”

—**Dr. Bruce Ribner**, on the special isolation unit, *Time magazine*, Aug. 10

**“Welcome home!
We’re glad
you’re here.”**

— written on whiteboard in isolation unit by Emory nurse **Jill Morgan** to greet *Dr. Kent Brantly* on his arrival, *NBC News Prime-time Special*, Sept. 5

“After a rigorous and successful course of treatment and testing, the Emory Health-care team has determined that both patients have recovered from the Ebola virus and can return to their families and community without concern for spreading this infection to others,”

— **Dr. Bruce Ribner**, unit director, *NBC-News.com*, Aug. 21

“Please continue to pray for Liberia and the people of West Africa, and encourage those in positions of leadership and influence to do everything possible to bring this Ebola outbreak to an end.”

— **Dr. Kent Brantly**, *LA Times*, Aug. 21

“We have the unique opportunity to look at a disease that we don’t usually see here. From these two patients, if they agree to participate in research down the road, we will be able to really look in-depth at the pathogenesis and the immunological response to Ebola in ways that can’t be done in Africa.”

— **Dr. Aneesh Mehta**, *Emory infectious disease doctor*, *Time magazine*, Aug. 10

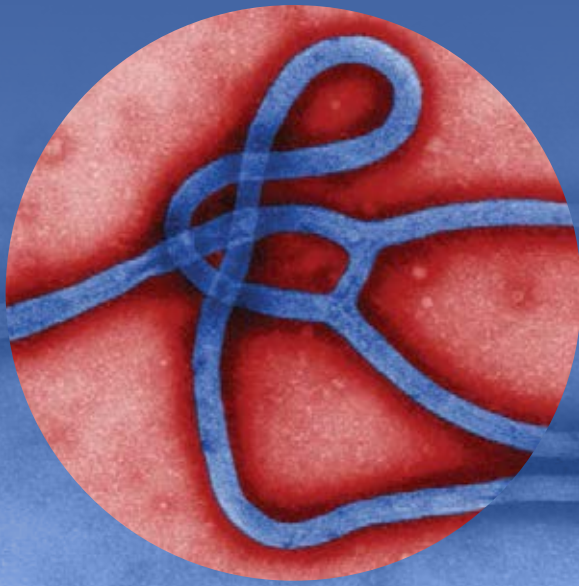
“There was not a nanosecond of hesitation when the call came in. We simply said ‘yes,’ and ‘when?’ Our Chief Medical Officer, our Chief Nursing Officer, and I said, OK, it’s time to gather the troops and prepare.”

—*Emory University Hospital CEO* **Bob Bachman**, *WSBT 2*, Aug. 11

“Today is a miraculous day. I am thrilled to be alive, to be well and to be reunited with my family.”

—**Dr. Kent Brantly**, *CNN*, Aug. 21

Ebolavirus

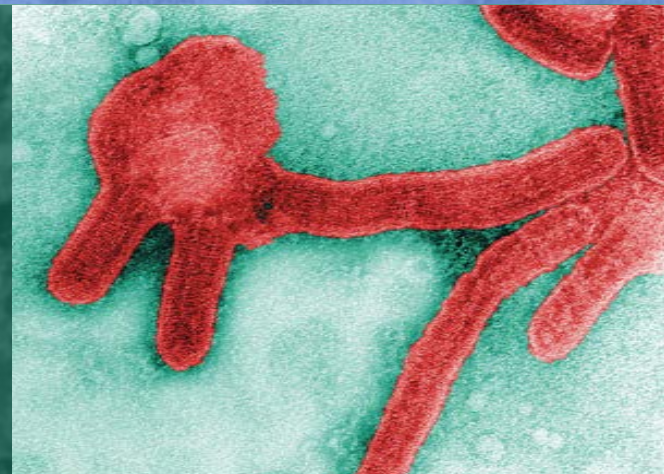


1

Ebola—Zaire is the most deadly strain of Ebola, with a mortality rate of 50% to 90%. The five known subtypes of Ebola—EBOV (Zaire), Sudan, Tai Forest, Bundibugyo, and Reston (only affects animals)—are named for the regions in which they were discovered. There is no proven treatment or vaccine for the virus, which attacks the body's immune system, hijacks cells, and weakens blood vessels, leading to shock and multiorgan failure.

2

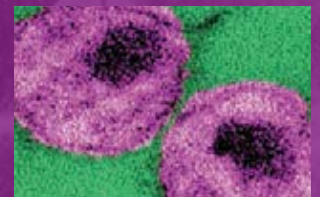
Hemorrhagic Fevers — Ebola is a type of hemorrhagic fever, along with Marburg, Lassa, dengue, Rift Valley, and yellow fever. Viral hemorrhagic fevers are RNA viruses whose survival is dependent on animal or insect hosts. Ebola hemorrhagic fever initially makes the leap from an animal reservoir (most likely bats) to a human, and can then be passed from human to human through direct contact.



3



vs.



Ebola

Ebola is spread through bodily fluids, such as blood, vomit, urine, saliva, and diarrhea, and requires direct contact. If you recover, you no longer have the virus and are likely to be immune to that strain.

Influenza

Influenza is airborne, which means it can spread through sneezes, coughs, and tiny droplets on doorknobs or other surfaces. Many more people have died from seasonal flu than Ebola.

HIV/AIDS

HIV/AIDS is bloodborne, like hepatitis B and C, and is spread largely through sexual contact or shared needles. Once you have HIV/AIDS, you almost always have it for life, but most of those infected survive and live full lives by taking antiviral drugs.



Vice President for Global Health **Jeff Koplan**, former director of the Centers for Disease Control and Prevention (CDC), oversaw the CDC's response to previous Ebola outbreaks in Africa during his tenure as director from 1998 to 2002. He shares his thoughts about the treatment of Americans with Ebola at Emory University Hospital and the current outbreak in West Africa.

Creating the isolation unit at Emory University Hospital 12 years ago, through a CDC grant:

The initial thought was to have it available for CDC staff who might be exposed to pathogens in the lab or while working out in the field. When you have colleagues who are putting themselves at risk, you do what you can to minimize that risk and be prepared for any untoward events that might occur. There are four such isolation units in the country now, and all four are in proximity to institutions working with biosafety level 4 agents and the increased risk associated with that.

The selection of Emory University Hospital: It was a first-rate institution close by. There's also been a long, close working relationship between Emory and the CDC, especially with Emory's Department of Microbiology and the Division of Infectious Diseases in the Department of Medicine. Many CDC staff trained at Emory, and many Emory infectious disease staff have spent time at the CDC. A large number of CDC staff serve as adjunct faculty at Emory.

Whether all major hospitals should build similar isolation units: Probably not, but all hospitals should think about what they would do if they have a patient present with infectious disease symptoms. Where they would put them, airflow, etc. Regarding space allocation for hospital beds, you have to balance out the practical aspects of hospital needs—the rare vs. the day to day.

Why the current Ebola outbreak is so much worse than previous outbreaks: The countries have changed, it's 13 years later, there is more development and better roads, people have more means of transport and more business dealings. It's one of the rare downsides of progress and development, that diseases are more readily

transmitted over longer distances, to urban and more densely populated areas.

Best way to contain the outbreak in Africa: Old-fashioned, tried-and-true public health practices—case identification, isolation, contact tracing, close observation and more isolation, watching contacts for symptoms. And finding every contact—not just every case, but every contact. You can't miss anyone, 85% is not enough, "most" isn't enough.

Why people are so afraid of an Ebola outbreak here: Ebola has received a fair amount of publicity even before this outbreak. People see it as the



Koplan as an EIS officer at the CDC in the 1970s, working on smallpox eradication efforts in Bangladesh.

epitome of the 21st century plague, even without zombies helping it along. Movies have played up this fear. But now, we aren't trying to promulgate fear, we're taking a rational, thoughtful approach that's at odds with what the public has seen and heard for 15 years in movies like *Outbreak*, *Contagion*, etc. Ebola is scary and has been portrayed in its scariest light, so that fear is understandable.

Treating the two Americans with Ebola: We have a very good hospital here, and it exists to care for ill persons. If these were US soldiers, would we say, "no, you can't return home for care?" These are missionaries, soldiers in their own way for peace and health, our countrymen who were trying to make the world a better place. They deserve to be treated with compassion and the best health care we can offer when they want to come back home. ■

Ebola Outbreak in West Africa

Suspected and confirmed case counts as of Sept. 30, 2014



Case Count: 1,199
Deaths: 739
Fatality Rate: 62%



Case Count: 3,834
Deaths: 2,069
Fatality Rate: 54%



Case Count: 21
Deaths: 8
Fatality Rate: 38%



Case Count: 2,437
Deaths: 623
Fatality Rate: 26%

Data Source: World Health Organization



Disrupting the Balance

With habitat loss, zoonotic diseases that leap from animals to people, like Ebola, are on the rise

By CAROL CLARK

While virologists study pathogens like Ebola by zooming in on them with an electron microscope, disease ecologist Thomas Gillespie climbs 100-foot trees in the tropical forests of Africa to get the big picture view. He tracks pathogens in the wild to learn how they adapt to changing environments and jump between species.

It is physically challenging work that often takes him into remote forests where the wildlife has not yet learned to fear people. During one outing, Gillespie was turned into a human yo-yo while he was ascending a tree with a rope and harness. “Chimpanzees have 10 times the strength of a man and they can be curious and playful,” he says. “I once had an adult male chimpanzee grab my rope and bounce me up and down.”

Wild primates pose a special risk for zoonotic diseases—those transmissible from animals to humans—because of our close genetic relationship. HIV/AIDS and Ebola are the most dramatic examples of diseases linked to wild primates, but many other viral, bacterial, fungal, and parasitic pathogens found in apes and monkeys can be passed to humans.

“The bottom line is that the majority of emerging infectious diseases are coming from wildlife and most of that wildlife is in tropical forests,” says Gillespie, a professor in Emory’s Department of Environmental Sciences and the Rollins School of Public Health. “We can’t afford to just focus on one pathogen or one animal. It’s really important to get a general understanding of the interactions of different species and how changes in the environment are driving zoonotic disease transmission.”

Gillespie is investigating undisturbed forests, as well as sites where logging and other human activity is under way. He gathers fecal and blood samples from people and animals for analysis while also scouring the forest floor and treetops to learn about the diversity of pathogens in the environment. The data can then be mapped spatially and over time to connect the dots of disease ecology.

For one ongoing study in Uganda, Gillespie and his collaborators are following primates in and around fig trees, hanging out near these ancient forest giants and observing the tableau of life feeding among the branches and on the ground below.

Fig trees are a keystone species of rainforest ecosystems. Climate change is playing havoc with the seasonal fruiting of other types of trees. But fig trees have co-evolved with specific pollinators—fig wasps—and because of their complex interaction, there is always a fig tree fruiting somewhere in the forest, providing a critical, consistent food source for fruit bats, primates, and ground dwellers like the bush duiker, a shy antelope that darts amid the forest shrubbery.

Fruit bats, associated with an array of deadly viruses, including Nipah, Ebola, and Marburg, are especially specific in their diet. “They’re looking for ripe fruit,” Gillespie says, “and that’s a rare resource in the environment.” And it’s becoming even more rare. Logging companies are cutting down huge swaths of African forests. Mining operations are moving into new terrain. Villages are expanding, and homes and food crops are eating into the wilderness. All these factors bump up the odds that fruit bats will be living near people and that the bats will be joined by a variety of other animals while they are feeding from a tree.

“Most viruses can only last outside of a host for minutes or hours, not days,” Gillespie says, “but now we have this changing landscape of food availability. That raises the probability that a gorilla or chimpanzee will eat a piece of fruit that a bat has just defecated on or has bitten into and discarded.”

Diseases and parasites could be transmitted in this manner. Ebola is one of the rare ones, extremely difficult to find, much less study, in the wild. But Ebola looms large in the public imagination because it is hemorrhagic, capable of causing massive bleeding, and because of its high fatality rate. It is also frightening because it is so mysterious, popping up out of the forest to kill voraciously then disappearing again for years.

The virus was first identified in 1976, following an outbreak in a remote hamlet of Zaire (now the Republic of Congo) near the Ebola River. Subsequent outbreaks have also been associated with forested backwaters and have quickly burned themselves out. That is, until the current outbreak in West Africa.

Ebola has now made the leap from rural, forested regions to Africa’s urban areas, where many people live in crowded conditions with poor sanitation.

One of the biggest mysteries is where the virus has hidden between these outbreaks. Evidence of Ebola antibodies, and remnants of Ebola RNA, have been found in the blood of three species of fruit bats, making them prime suspects as the Ebola reservoir: An organ-



“Any time we alter a pristine natural system there are going to be **unintended consequences**,”

—disease ecologist **Tom Gillespie**, on pathogens that jump between species

ism that can carry the pathogen without dying or even becoming sickened by it.

“Fruit bats are the best guess as to the reservoir, but until a live virus is found in their blood, we cannot be sure,” Gillespie says. “What we do know is that bats are an important part of the equation. And gorillas, chimpanzees, and some other animals, like the bush duiker, can get infected with Ebola.”

During the past decade, human Ebola outbreaks in Gabon and Congo have been accompanied by reports of gorilla and chimpanzee carcasses in surrounding forests, and epidemiological studies have connected encounters with dead gorillas, chimpanzees, and bush duikers to human cases. “A hunter might find a dead gorilla in the forest,” Gillespie says, “and instead of saying, ‘I shouldn’t butcher this animal and eat it, it may have died of an infectious disease,’ he throws up his hands and says, ‘Thank you, God, for this gift!’ ”

Fruit bats are also hunted for food in many parts of Africa. But you don’t have to be a hunter going deep into a forest to catch Ebola. Now that fruit bats are feeling the squeeze of fewer food sources, they may choose to roost under the eaves of a home, feasting on trees in the village orchard as children play below.

Widespread education about what is safe to eat and what is not, and how to identify animals that may have died from an illness, is becoming a vital part of preventing the spread of these diseases.

Just as people are encroaching on wilderness, pathogens are expanding their range into human habitats. “We’re changing the environment in ways that may be promoting Ebola,” Gillespie says. “As the human population grows and the demand for resources pushes us into new areas, we’re going to see more diseases emerge.” ■

What We Learned

Q&A with **Aneesh Mehta**, one of the infectious disease doctors who cares for Emory's Ebola patients

By QUINN EASTMAN

What kinds of research data will be available from the Ebola patients?

Our primary focus was treatment and helping the patients recover. However, now that that goal has been reached with the first two patients, both have expressed interest in improving outcomes for others.

With their permission, we would like to look at their Ebola-specific immune responses. Obtaining this information may support the development of better therapeutics, diagnostics, and hopefully someday, vaccines.

In particular, we want to examine their memory B cells and plasma cells. We would want to know more about the antibodies those cells produce. How much neutralizing antibody is there? What affinity do the antibodies have for the virus? Is there any antibody-dependent cytotoxicity?

This is similar to the research the Emory Vaccine Center was able to perform during the 2009 H1N1 flu outbreak. We learned that some people developed antibodies that are remarkably cross-reactive to

different flu strains.

Also, there is little data available on Ebola-specific T cells, even though T cells are thought to be critical for antiviral responses. It has been possible to do some of this research on Ebola survivors in Africa, but to really probe the parts of the immune system responsible, we need fresh cells.

To what extent was Emory involved in providing experimental therapies, such as ZMapp antibodies?

We were not involved in the initial decision to seek out and give ZMapp. However, we obtained enough for the first two patients to be able to finish the course they had started. Beyond that, we simply don't have enough information to judge whether it was effective.

To be honest, I think supportive care, including the ability to provide fluids and nutrition and correct electrolyte problems, had the largest impact on these patients' improvement. We observed that both patients experienced severe diarrhea and vomiting, which led to electrolyte abnormalities, especially low potassium levels.



One of the more dangerous consequences of electrolyte imbalances can be irregular heart rhythms, even cardiac arrest.

But replacing their electrolytes wasn't as simple as drinking Gatorade or eating bananas. Careful monitoring and both oral and intravenous electrolyte replacement were necessary.

We also observed significant leakage of fluid into their tissues and low levels of liver-supplied proteins in the blood, probably because of viral damage to the liver. This might lead to problems with blood clotting, for example. In a large well-equipped hospital, it is possible to give separated blood products such as platelets and plasma, which is not possible in smaller rural hospitals. Still, you can get some clot-promoting vitamin K from good nutrition.

What kinds of lab tests were available within the isolation unit?

It was planned to have a small lab inside the unit. But we quickly realized that it would become too crowded, so we and our pathology colleagues established a lab in an office right outside. That made it possible

for us to have access to several very useful instruments:

- CBC (complete blood count) measurements
- Instrument that measures blood gases like oxygen, carbon dioxide, pH
- Clinical chemistry analyzer that assesses electrolyte levels and liver and kidney function
- Urinalysis test strip reader
- Bedside PT-INR blood clotting test
- BioFire film array— This gives a quick yes or no answer to the question: Is Ebola virus present? It tests for other sensitive pathogens as well. But the CDC test is still the gold standard.

Helpfully, some of the machines can take a sealed blood tube and puncture it for you, reducing the risk of spills or stray droplets. For others, the instruments needed to fit inside a biosafety cabinet with a laminar flow hood.

How did doctors decide when it was OK for the first two patients to leave, once they had recovered to the point that they were ready?

Even after our patients' symptoms resolved, they had low but detect-

Ebolavirus

This tubular virion of Zaire Ebola is about 90 nanometers in diameter and up to 1400 nm long, and consists of a viral envelope, a matrix, and a nucleocapsid, with glycoprotein spikes protruding from its surface.

VIRAL ENVELOPE

Glycoprotein

Lipid bilayer

MATRIX

NUCLEOCAPSID

The virus begins its attack by attaching to host receptors through its **GP** (glycoprotein, above and detail, right). The **lipid bilayer** buds off from the host cells. Structural proteins linking the viral envelope with the core make up the **matrix**, important in virus

assembly. The **nucleocapsid** is a series of viral proteins attached to the viral RNA. The virus replicates not by division but by using a combination of host and virally encoded enzymes to produce multiple copies of itself, which self-assemble in the host cell.

This model was created by the Emory Visual Medical Education team

able viral levels for several days. Before discharge, the consensus was that a patient had to have levels of Ebola virus that were below the threshold of detection of the CDC-approved test twice in a row.

In Africa and Europe, other tests for Ebola such as tests for viral proteins/antiviral antibod-

ies have been employed, but the CDC's test (RT-PCR) for the virus is more sensitive.

How did the medical team's use of personal protective equipment evolve over time?

We followed the CDC guidelines for treating patients infected with Ebola, which included contact

and droplet precautions. That means gloves, gown, eye protection, and facemask.

There is an option to scale up if conditions warrant, such as coughing up blood, vomiting or diarrhea. We decided to start at a higher level of precaution based on the condition of the patients at the time. After the

patients were stable, we scaled back to standard contact and droplet precautions.

Many of the staff found that face shields tended to fog up, and the PAPRs (powered air purifying respirators) were more tolerable when they had to work in the unit for hours at a time. It's actually very comfortable. It feels sort of like wearing a bicycle helmet, but with a fan on top blowing in filtered air.

One important thing is that we established procedures to make sure that every time someone was putting on or removing their protective equipment, another team member observed them.

Do people who survive Ebola infection develop protective antibodies?

Generally, we think people who recover from infection develop immunity to the virus. It's important to keep in mind that there are five different strains of Ebola, and if there is protection, it's likely to be only for that strain.

A previous study of an outbreak of Ebola in Gabon showed that people who survived tended to have strong antibody responses and those who died did not, for example. However, another study published last year showed that only about half of the survivors of an outbreak in Uganda have detectable antibodies against viral proteins.

So a lot of survivors may have antibodies, but how protective their antibodies are, that is unknown. T cells may

account for some immune protection too. The antibodies and the cells that make them may fade from the blood after a few years go by. That's one of the reasons why we want to bring our patients back—to track their antibodies and immune responses over time.

Could a survivor carry the Ebola virus in the body for several years, as with HIV?

Ebola is not like HIV or other retroviruses. There is no latency. There is no integration. Once you've cleared it, it's gone.

Retroviruses make a DNA copy of their RNA genome, and can insert that DNA into the chromosomal DNA in host cells. Ebola virus has an RNA genome but does not have the enzymes retroviruses have (reverse transcriptase and integrase) that allow them to integrate into host cells.

There is some evidence that the virus can persist in semen for weeks or months, even after it's gone from the blood. A possible explanation is that the prostate is an immune-privileged site, like the eye. But there is no information to say that the virus replicates in the prostate, and there is no epidemiological data that virus present in semen can lead to an infection.

Could Ebola evolve to become even more contagious, becoming more durable in the external environment, for example?

Ebola is a simple envelope virus. Like many other viruses, it grows by budding out of the host cell's membrane and taking some of the membrane

with it. So you can make the envelope disintegrate with detergent or alcohol.

Compare this to norovirus, a leading cause of gastrointestinal illnesses, which is notorious for being hard to get rid of. Norovirus is more stable because it's a "non-enveloped" virus. You need stronger disinfectants and

we saw, the fluid loss can lead to irregular heart rhythms.

On a cellular level, the virus attacks the linings of blood vessels, which can lead to hemorrhage. The virus infects immune cells such as dendritic cells and macrophages, leading to systemic inflammation, sometimes called a "cytokine



Infectious disease physicians **Jay Varkey**, **Aneesh Mehta**, and **Marshall Lyon** talk with Kent Brantly, the first patient with Ebola to be treated in the US, on the day of his release from Emory Hospital's isolation unit.

more thorough procedures for viruses in this category.

It would be very difficult to transform Ebola, via mutation, into a virus that was significantly more stable in the external environment.

Why is Ebola so dangerous then?

Once infection is achieved, the virus rapidly replicates and overwhelms the body's defenses. Symptoms such as vomiting or diarrhea lead to shedding of virus, so that it is easy to transmit to caregivers or family members when hygienic practices do not prevent it. As

storm." At the same time, it shuts down the interferon pathway, which is important for antiviral responses. The inflammation can bring about a condition resembling septic shock, involving a dangerous loss of blood pressure.

One paper that looked at the evolution of Ebola and its relative, Marburg virus, calculated that they mutate at a rate that is 100 times less than either influenza or HIV. Is that reassuring?

Actually, there's a lot of new information on that question. A *Science* paper published in

August sequenced dozens of Ebola virus samples obtained from patients in Sierra Leone. It's not mutating quite as fast as flu or HIV, but according to this more recent analysis, the virus is collecting mutations about twice as quickly as it did while circulating in animals for the last decade.

I think this is a reflection that Ebola is very well adapted to its natural host—bats. In humans, it just kills them too quickly.

In terms of viral evolution, it looks like each strain stays in its lane. You don't see reassortment like with flu. You don't see so much interaction with the immune system, leading to genetic drift and shift. By this measure, flu is a much more successful virus than Ebola.

It's not yet known if any of the genetic changes that have appeared in the virus involved in the current outbreak have contributed to its virulence. One main explanation for the current outbreak's severity is that this is the first time it has reached such densely populated areas in West Africa.

Where does Ebola come from?

The main hypothesis is that Ebola's reservoir is fruit bats, which can migrate between communities and across international borders. In previous outbreaks, there was a concern about wild game meat, but the latest evidence from Guinea suggests it was not a factor this time. In human-to-human transmission, it appears that close caregivers and relatives are the most vulnerable, and funerals are a particular point of risk. ■

‘The World is Looking to Us’

President Obama visits CDC, thanks Emory Healthcare team, announces expansion of international Ebola response



President Obama announces a major deployment of medicine, equipment, and 3,000 troops to help fight Ebola in Africa.



Emory Healthcare team members (left to right) **Charles Hill**, director of the molecular diagnostics lab, **Carolyn Hill**, isolation unit nursing director, and **Bruce Ribner**, infectious disease physician and unit medical director, meeting with President Barack Obama Sept. 16 at the CDC.

Choosing the CDC’s Atlanta headquarters as his backdrop, President Barack Obama announced on Sept. 16 that he would significantly expand US efforts to combat the Ebola outbreak in West Africa, and called on other countries to do the same.

“Faced with this outbreak, the world is looking to us, the United States, and it’s a responsibility that we embrace,” Obama said.

Obama met privately for a roundtable discussion with members of the Emory Healthcare team that provided care to the American aid workers treated for Ebola in Emory Hospital’s isolation unit.

“I have got to commend everybody at Emory University Hospital,” Obama said.

“I just had the opportunity to meet with Drs. Gartland and Ribner, members of their team, and the nurses—sorry doctors, but having been in hospitals, I know they are the ones really doing the work. I had a chance to thank them for their extraordinary efforts in helping to provide care for the first Americans who recently contracted the disease in Africa. The first two of those patients [Kent Brantly and Nancy Writebol] were

released last month and continue to improve, and it’s a reminder for the American people that should any cases appear in the US, we have world-class facilities and professionals ready to respond, and we have effective surveillance mechanisms in place,” he continued.

Obama noted that he had met with Kent Brantly that morning in the Oval Office prior to his trip to Atlanta. “We are incredibly grateful to him and his family for the service he has rendered to people who are a lot less lucky than all of us,” he said.

“It was an unforgettable experience,” said pathologist Charles Hill, a member of the Emory Healthcare team who met with Obama. “Several members of the group were dealing with urgent medical care issues on their cell

phones right up until the President entered the room. The President asked questions, mostly regarding what we had learned and what lessons could be applied to the outbreak in Africa. Overall, he spent about 25 minutes with us in discussion.”

US Secretary of Health and Human Services Sylvia Burwell and National Security Adviser Susan Rice also spoke with the group. ■



Obama hugs Emory nurse **Carolyn Hill**.

Amazing Deliveries

Childbirth can be tough even in the best of circumstances, but these moms experienced life-threatening emergencies that made their happy endings all the more meaningful

By MARLENE GOLDMAN



Arabella: A powerful presence

Edita Tracey, an accountant unwinding after a high-stress tax season, was eight months pregnant and at a Buckhead hair salon this past April when the back pains started. Then came dizziness and chest pain.

“I couldn’t drive my car, and my husband was in Chicago on a business trip. I waited 30 minutes,” says Tracey, whose 2-year-old daughter, Savannah, was at her grandmother’s house in Buckhead. “But the pain was like none I’d ever had, and that’s why I called 911.” She doesn’t remember what happened after the EMTs arrived.

Omar Lattouf, a cardiothoracic surgeon at Emory Midtown Hospital, and his wife, Emory pharmacist Lina Lattouf, had been invited to dinner that evening by a former patient—a dignitary from Jordan he had operated on six months earlier. They were about to be seated at La Grotta in Buckhead when Northside Hospital ER called for an urgent consult.

Viewing Edita Tracey’s CT angiogram on his iPhone5, Lattouf was astounded. In his 29 years of practice, he had never seen anything like it—a massive foot-long tear in her enlarged aorta and blood pooling around her heart. “Then they told me that she was also having contractions,” Lattouf says.

He called the OR at Emory University Hospital Midtown, high-risk obstetricians, an anesthesiologist, the intensive care unit, his surgical team, perfusionists, and nurses. Within five minutes everyone was on the way to the hospital.

Two surgical units—more than 20 people in all—had assembled just a half hour later and were waiting in a pair of operating rooms when Tracey was airlifted to Emory Midtown. Lattouf and her Northside physician took personal responsibility for the air ambulance in order to bypass a protocol that prohibits transporting near-term pregnant women. “The risk of her aorta blowing out was much higher than the risk of her having the baby during a



Ken and Edita Tracey with their two daughters, Savannah and Arabella, enjoying time together at home, which they no longer take for granted after a near-fatal medical crisis during her pregnancy.

ten-minute helicopter ride,” Lattouf says.

The surgical team, led by Emory obstetrician John Horton, knew that the full-sleep anesthesia given to the mother would be racing toward the baby, and that they had to move quickly.

In 30 seconds they had the infant out—a healthy, screaming 6-pound, 12-ounce baby girl who, Lattouf says, filled the OR with her presence. “I made up my mind then that if this woman didn’t survive, I probably was going to have to quit heart

surgery because I couldn’t live with myself if that baby didn’t have a mother,” he says.

The odds were not good. Lattouf had just told a weeping Ken Tracey, who had taken an emergency flight home from Chicago, that his wife had a 50% chance of surviving. With his wife still in surgery, he met his youngest daughter for the first time. “It was surreal,” he says, “seeing my brand new baby daughter and worrying if Edita would make it or if I would be a single father of two.”

Back in the OR, Lattouf was facing one of the most challenging surgeries of his career. “She had fluid around her heart and this huge tear and I couldn’t guarantee anything. I had done more than 10,000 heart procedures but nothing like this,” he says. “I was scared and knew we had to do it right the first time. It was a life-changing operation for me.”

Over the next eight hours, the surgery team opened Tracey’s chest and put her on a heart-lung bypass machine. “We basically had to reconstruct everything,” Lattouf says, including the aortic arch and the blood vessels that went to Tracey’s arms and brain.

“With every stitch, that newborn baby commanded the room and overpowered everyone there,” Lattouf says. “We all knew we had to ensure that she had the future she deserved.”

After the operation, Tracey suffered other complications—a seizure and high blood pressure. But she woke up the next day in the intensive care unit and was able to hold her daughter for the first time. The relief was palpable as Tracy recognized her husband and her sisters.

One of the first medical staff members she saw was anesthesiologist Sophia Fischer, who asked if Tracey remembered her from an earlier encounter. “I came to the US 15 years ago from Bosnia via Germany,” Tracey says, “and I took some entry-level English classes with Dr. Fischer at Kennesaw State University.”

Arabella is now three months old, smiling

“The risk of her aorta blowing out was much higher than the risk of her having the baby during a 10-minute helicopter ride.” —DR. OMAR LATTOUF

and making happy baby noises. Tracey occasionally stops by to visit Lattouf and is under the care of Emory Midtown’s high-risk OB cardiologist, Dan Sorescu, who has since learned more about her family history. Tracey’s father died young from what was suspected to be a burst aorta, probably the result of stress during the war in Bosnia, high blood pressure, and possibly Marfan syndrome, a genetic disorder that affects the body’s connective tissue and can cause aortic enlargement.

Sorescu, who sees every pregnant woman with a heart condition at Emory

Midtown, says Edita Tracey’s and her baby’s survival may be “the most dramatic case I’ve ever seen. Not only is the mortality rate high for such an aortic dissection, pregnancy also increases the risks since pregnant women have very soft tissues that can rupture easily.”

Tracey’s experience prompted her sisters to have heart checks, and a children’s cardiologist has given Arabella and Savannah a clean bill of health.

The emergency delivery and surgery seem hazy now, almost like a dream to Tracey. “Sometimes we forget about

how important the little things are until something major happens,” she says. “I still can’t lift Savannah, but I can hold the baby. I’m so fortunate to be here with them. I’m back at work, but I’ve learned to slow down. My advice is to follow your own instincts. If you have pain that you’ve never had before, call your doctor. I’m so grateful for all my doctors and the staff who cared for me.”

“That’s our job,” Lattouf says. “That’s what we do and what society expects of us. We take care of patients and give them back to their families.” ■

Avery and Brantley: The dynamic duo

When she was 14, an automobile accident paralyzed Ashley Patton from the waist down. Being in a wheelchair, however, didn’t stop her from leading an active, independent life.

When Ashley became pregnant with twins at age 21, she and her husband, Alex, a former Marine who is also a twin, were excited. “We called them Baby A and Baby B,” she says.

But soon Ashley’s morning sickness became so bad that she was hospitalized and needed medication and IV fluids.

Then, six months into her pregnancy, she had an episode where she couldn’t catch her breath. “My stats were going crazy, my blood pressure was dropping, and my

“The clot presented a potentially fatal medical problem. While still within mom, the preterm but viable twins couldn’t survive without her.” —DR. JOHN HORTON

oxygen was low,” she says.

Referred to specialists at Emory Midtown, she was diagnosed with a three-inch blood clot that had traveled from her legs into her heart. Dangling in both the right and left atria, it was moving with every

heartbeat. If it broke free, it could cause a stroke or even death.

After a consult with critical care medicine, pulmonary medicine, high-risk obstetrics, cardiac anesthesia, and cardiology specialists, the group decided to proceed with a Caesarean section and open heart surgery. The staff cleared two operating rooms,

gathered three surgical teams and two teams of adult and neonatal intensivists.

“We had one mom, three lives, and three operations,” cardiothoracic surgeon Omar Lattouf says.

“I went to pre-op and there were 20 or



Alex and Ashley Patton play with twins Avery and Brantley at their home near Lake Lucerne. The boys love trucks, balls, and dinosaurs.

30 doctors figuring out what to do,” recalls Patton. “They told me I needed open heart surgery, but they wanted to do a C-section first to deliver the babies early because the twins would have a better chance than if they had to go under anesthesia. It was a hard choice but I trusted the doctors.”

As a part of the Obstetrics Rapid Response Team at Emory Midtown, obstetrician John Horton is routinely involved in urgent and emergency Caesarean sections. But this case was more complex, he says, and needed multiple medical teams working together to save mother and babies.

“The clot presented a potentially fatal medical problem. While still within mom, the preterm but viable twins couldn’t survive without her,” he says. “Ashley needed a pump to circulate her blood during heart surgery, but that might not have been enough for the growing twins. Because of the heavy sedation required for heart surgery, our OB team had to be very efficient, very quick to get the babies

out while still keeping the mom safe.”

In the first OR, the obstetricians quickly delivered the twins. Neonatologist Ann Critz was waiting to take over their care. Avery weighed in at 1 pound, 12 ounces, and Brantley, 2 pounds, 3 ounces. They would stay in neonatal intensive care for several months.

In the second OR, Ashley was put on a heart-lung machine. The surgical team opened her chest and, in what Lattouf says was one of the most complicated surgeries in his almost three decades of practice, he removed the clot from both sides of the heart.

“It was like someone shoots a bullet and you have to go in and grab that bullet before it hits the target,” Lattouf says. In a third surgery, the surgeons placed a stent.

Lattouf, who specializes in thrombosis, says there are many causes of clot formation, including pressure from a pregnancy on the inferior vena cava (the large vein that carries deoxygenated blood from the lower

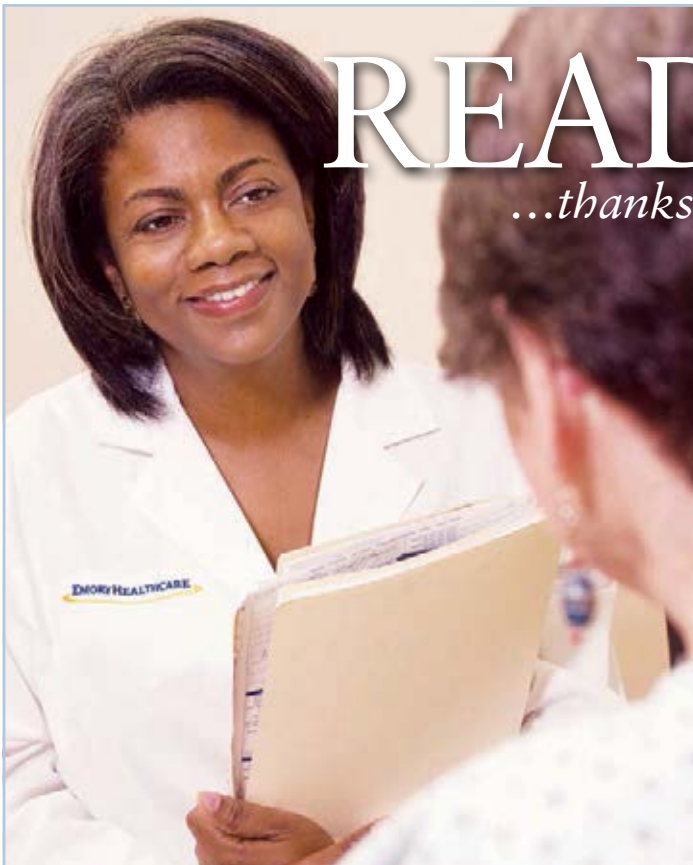
body into the right atrium of the heart). Being sedentary can also be a factor.

“In fact, deep vein thrombosis and pulmonary embolisms are among the most frequent causes of death in pregnant women,” he says.

Ashley Patton was able to hold Brantley two days after her surgery, and Avery two weeks later. Another surgery followed to drain fluid from her heart, and more recently, she was put back on blood thinners, this time probably for life, after another clot was discovered in her lungs.

Fraternal twins Avery (Baby A) and Brantley (Baby B) are now nearly 3, and the Pattons’ Buford home is filled with trucks, balls, and other toys. Avery is laid back and happy to look at books and entertain himself, while Brantley, their “wild child,” is curious, constantly on the move, and into everything.

“It was an amazing experience,” Ashley says. “I’ve had lots of challenges in my life, but they’ve made me who I am today.” ■



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EMORY

Tyler: Tiny but determined

Lillian Calloway was just 24 weeks pregnant, barely to the point of her baby being able to live outside the womb, when her contractions began on June 13. She was partially dilated by the time she got to the emergency department at Emory Midtown.

The maternal fetal medicine team prolonged her pregnancy with medication for a few days, but when Calloway developed a fever and the baby's heart rate increased, obstetrician Cherie Hill knew that mother and baby were in jeopardy.

"She had developed chorioamnionitis, an infection in the amniotic fluid that surrounds the baby," Hill says, noting that the risk of infection increases when the cervix dilates early, and sometimes after the water breaks, because of vaginal exposure to bacteria. "We couldn't allow her to stay pregnant any longer."

The baby delivered quickly, weighing in at 15.8 ounces. He was intubated to help him breathe, and whisked to the neonatal intensive care unit (NICU) by the neonatal resuscitation team, which attends all high-risk deliveries at Emory Midtown. "The biggest concern about babies born so

early is that their lungs aren't developed. They also don't feed well, and there can be bleeding into the brain," Hill says.

The obstetrics team also was concerned about Calloway, who had begun bleeding heavily but had not discharged the placenta—not uncommon in such early term deliveries. The team moved to the operating room to remove her placenta and scrape the uterine lining, using ultrasound guidance.

Calloway was at particularly high risk

time Calloway saw Tyler, he was a day old and so tiny that he could fit into one hand.

It wasn't until about a month later that she actually got to hold him.

"When I first saw him in the nursery, I didn't think he was going to make it," she says. "He was so small and weighed less than a pound." But by late July, he was breathing on his own and gaining weight.

Hill has delivered more than 500 babies during the past five years, but says it's

never easy tending to extremely sick patients who deliver so early in their pregnancies.

"It's all a collaborative effort between the physicians, the nurses, the anesthesiologists, the NICU, and the blood bank," she says. "The outcomes are better because we have a process in place and immediate access to a specially equipped cart with supplies to handle bleeding emergencies."

"Our team approach is innovative," she adds, "but I hope someday it will become the standard of care everywhere."

Tyler is now breathing on his own but is expected to remain in the NICU for another few months before going home to join siblings Toure, 2, and Jessoure, 1, who has learned to say the word "baby" since visiting her new brother. ■



Obstetrician Cherie Hill, an assistant professor in the medical school, often has to balance the health of a mother with the early delivery of a child. Premature infants delivered at Emory Midtown are cared for in the NICU.

because of two prior Caesarean sections. "The placenta sometimes attaches to the scar on the uterus left by an earlier C-section and can cause additional bleeding so we needed ultrasound to make sure we got it all," Hill says.

With the bleeding under control, Calloway recovered quickly and was discharged two days later from the hospital. The first

Emory University Hospital Midtown's neonatal intensive care unit (NICU), which opened in 1981, was the first in the Southeast. Its level III unit has 36 beds and the staff cares for an average of 600 premature or critically ill babies each year.

windows

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Find your window.



PAGE **26** **SPECIAL DELIVERIES**

Whether doing double-duty in removing a blood clot from a new mom's heart just after she delivers twins, treating a patient in labor with a tear in her aorta, or caring for critically ill or premature infants, teamwork by health care heroes in the delivery room can result in sweet endings to terrifying beginnings.

For more information or to support healthy deliveries at Emory University Hospital Midtown, contact Gabrielle Stearns at 404.727.2512 or gabrielle.stearns@emory.edu.

PAGE **8** **CONTAINING EBOLA**



Emory University Hospital's special isolation unit, and its medical team of infectious disease doctors, nurses, and lab technicians, came into service recently when the first two Ebola patients cared for in the United States stayed there for nearly three weeks in August before testing virus free and being reunited with their families. Such high-level isolation units are rare—Emory Hospital's is one of only four in the country.

Gifts to the Emory University Hospital Fund for Excellence will honor the teams caring for these patients. To support the experience of patients battling infectious diseases, contact Jonathan Russell, director of development, at 404.727.9567 or jrusse5@emory.edu.

You also may wish to make a gift to the Tami Fisk Fund, named in honor of a faculty physician at Emory School of Medicine who spent much of her career teaching and providing care in developing countries. To support the Emory infectious disease fellowship program and fellows who travel to conduct research and deliver care in extreme conditions around the world, contact Jonathan Russell at 404.727.9567 or jrusse5@emory.edu.

PAGE **5** **EMORY'S "DR. HOUSE"**



From a middle-age man suffering mysterious bouts of dizziness, to a young woman with a cluster of unexplained ailments that may or may not be related, to a retiree who was misdiagnosed with a terminal illness, patients turn to Emory's new Special Diagnostic Services clinic, directed by Clyde Partin, Emory's own "Dr. House."

To support the Emory Special Diagnostic Services Clinic and the work of Partin, contact Stacia Brown, senior director of development, at 404.727.9030 or stacia.brown@emory.edu.

PAGE **6** **FIGHTING INFECTION**



Older people who spend time in health care settings or people who take frequent antibiotics are more prone to life-threatening bacterial infections such as *C. diff*. Emory experts are treating these patients with transplants of healthy bacteria.

To support advances that combat bacterial infections, contact Jonathan Russell, director of development, at 404.727.9567 or jrusse5@emory.edu.

GIFTS OF NOTE



Woodruff Fellowship funding helped **Michelle Ludwig OSM O5MPH** pay for her Emory education. Now a radiation oncologist working with underserved patients at Baylor College of Medicine in Houston, Ludwig has arranged to help other students through a bequest of more than \$150,000 that will provide scholarship support. The amount equals Woodruff funding given to her as a student at the School of Medicine and Rollins School of Public Health. "I tell my

patients that they need to have a will and medical directive, and I made a New Year's resolution to do that and pay back my scholarships," she says. "The Woodruff Fellowship allowed me to come to Emory, where I learned to be a creative problem solver and compassionate physician and become comfortable in treating underserved populations. Robert Woodruff wasn't even in medicine, but this is his legacy."

As a patient, Loraine Williams of Atlanta was so impressed with the dedication, skill, and compassion of physicians Vasilis Babaliarios, Stephen Clements, and Ira Horowitz that she made a significant gift and bequest in their honor. Along with existing funds given in honor of her late husband, a long-time Emory trustee, Williams' gift will establish the **Thomas R. Williams Professorship in Medicine**.



Doris Reilly of Marietta celebrated her successful cancer treatment at Winship Cancer Institute by running the 2014 Big Sur International Marathon, raising more than \$10,000 to support the research of her surgeon, Viraj Master. An associate professor of urology, Master focuses on kidney cancer and has studied the effect of inflammation, the shape of bones around the prostate gland, patient literacy, and how low-fat diet and exercise influence a patient's recovery.

Reilly's gift included matching funds from her company, FHM Insurance.



After sharp joint pains made **Alex Johnson** skip cross-country running practices at Etowah High School, he was diagnosed with juvenile rheumatoid arthritis. Sampath Pahalad, chief of the pediatric rheumatology division, helped get him back on his feet. To help fund Pahalad's research, Johnson organized a one-mile Run for RA that raised \$1,200 from participants ages 5 to

65. "As of right now, there is no cure for my disease, but there's always hope," says Johnson, now a college freshman interested in biology. "It's cool that one doctor can make a difference in so many lives."

Through the 12th AIDS Vaccine 200 (AV200) Ride, **Action Cycling Atlanta** raised \$163,100 to fund research on preventive and therapeutic HIV vaccines at the Emory Vaccine Center, the nation's largest and most comprehensive academic vaccine research center. This two-day, 200-mile bike ride has raised more than \$1.8 million in total, and funding also benefits the AV200 Fellows, a group of graduate students and postdoctoral researchers representing the next generation of HIV researchers.

From the Woodruff Health Sciences Center

It's what we do



WRIGHT CAUGHMAN

Executive Vice President for Health Affairs

I hope you have had a chance to see the ongoing national media coverage of Emory's leadership role in the global fight against the Ebola virus. By caring for three Ebola patients so far, we have helped to develop knowledge and protocols that are now being used to combat the virus in West Africa and other regions.

As the Ebola epidemic continues unabated and international health authorities urgently call for more fiscal and human resources in the hardest-hit nations, it is rewarding to know that we at Emory have helped to save lives from the disease and to provide hope at a time when it is sorely needed. When the time came to do the right thing, our faculty and staff were amply prepared and selflessly driven to do so. In a press conference upon his discharge from Emory University Hospital, Dr. Kent Brantly spoke eloquently about his recovery from the Ebola virus and about the extraordinary Emory team who helped to make that recovery possible. This inspirational outcome resulted from the efforts not only of the outstanding physician and nursing team who stood behind him, but also from all the talented and dedicated staff and faculty behind the scenes.

Caring for such seriously ill patients requires an impeccably trained, well synchronized, and deeply compassionate team of professionals. Our Emory team is just that. Let us not forget that, even when there is no spotlight, we care for patients every day whose illnesses are perhaps less newsworthy but every bit as serious to them and their families. Every day, the most critically ill patients in the region turn to us for help, and every day we give them the world-class care they need to regain their health. It's what we do. It's who we are.

The Fear Factor

When fear is more dangerous than the original threat

By NADINE KASLOW

What is it about plague-like pandemics that scare us so? When the odds of dying from a car accident, a lightning strike, even second-hand smoke, are greater (at least in the US) why do rare, infectious diseases loom large in the public's collective nightmare?

The truth is, odds don't factor into what frightens us. Our rational mind isn't the one calling the shots at that point.

Anxiety can sometimes be a constructive response, as it inspires caution and careful analysis of a situation before jumping in feet first, but as anyone who has experienced overwhelming anxiety knows, it is not necessarily a response based on logic, facts and figures, or even reality.

And so it is with the reactions to fatal or potentially fatal epidemics: the plague, Ebola, HIV/AIDS, West Nile virus, severe acute respiratory syndrome (SARS), the list goes on and on. Oftentimes people respond with panic and fear and suspicion ... even superstition, paranoia, or a moral absolutism that is alarming in its own right.

Psychological and sociological epidemics often occur parallel to the medical one. The victims are stigmatized, discriminated against, even demonized. Those around the victims may follow not only guidelines recommended by the authorities, but go far beyond that: my children can't be in class with your children, we don't want a health clinic in our village, you aren't allowed entry back into the country under any



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circumstances. Misconceptions emerge out of fear and anxiety—the less people know, the more they panic. We saw this around victims of AIDS, SARS, and recently, Ebola.

Disease outbreaks are, indeed, terrifying, and often involve mass casualties. And there's no denying that some diseases, like hemorrhagic fevers, have the potential to kill in horrific ways.

There is something supremely unsettling about the invisibility of these germs,

and the way they proliferate, that invokes our deepest, most primal survival instincts: The world is unsafe. If you get too close to things that are risky, something terrible could happen.

Infectious diseases, in their relentless march from host to host and exponential eagerness, seem to underscore what we have known all along, but, whistling past the graveyard, try to ignore. We are vulnerable, we are mortal, we will all die.

When our emotions and fears take over, we have difficulty making rational decisions. We become anxious or angry and unable to process information.

Experts might be trying to get out the facts in a clear and concise manner, but if you're already in an emotionally labile place, you're not hearing them. So—and public health communicators have realized this—you have to combine feelings and facts, to acknowledge people's fears, to recognize that it's understandable to feel anxious.

Facts do win out, in the end. When was the last time anyone except for the most alarmist among us worried that the person sitting next to us on the subway or serving our salad had AIDS? And yet, there was a time when outraged townspeople burned down a family's home over this fear.

We are all a part of a world that has frightening aspects. There are and will continue to be wars, beheadings, pandemics, terrorist attacks, car accidents, plane crashes, unexpected loss, unexplained illness.

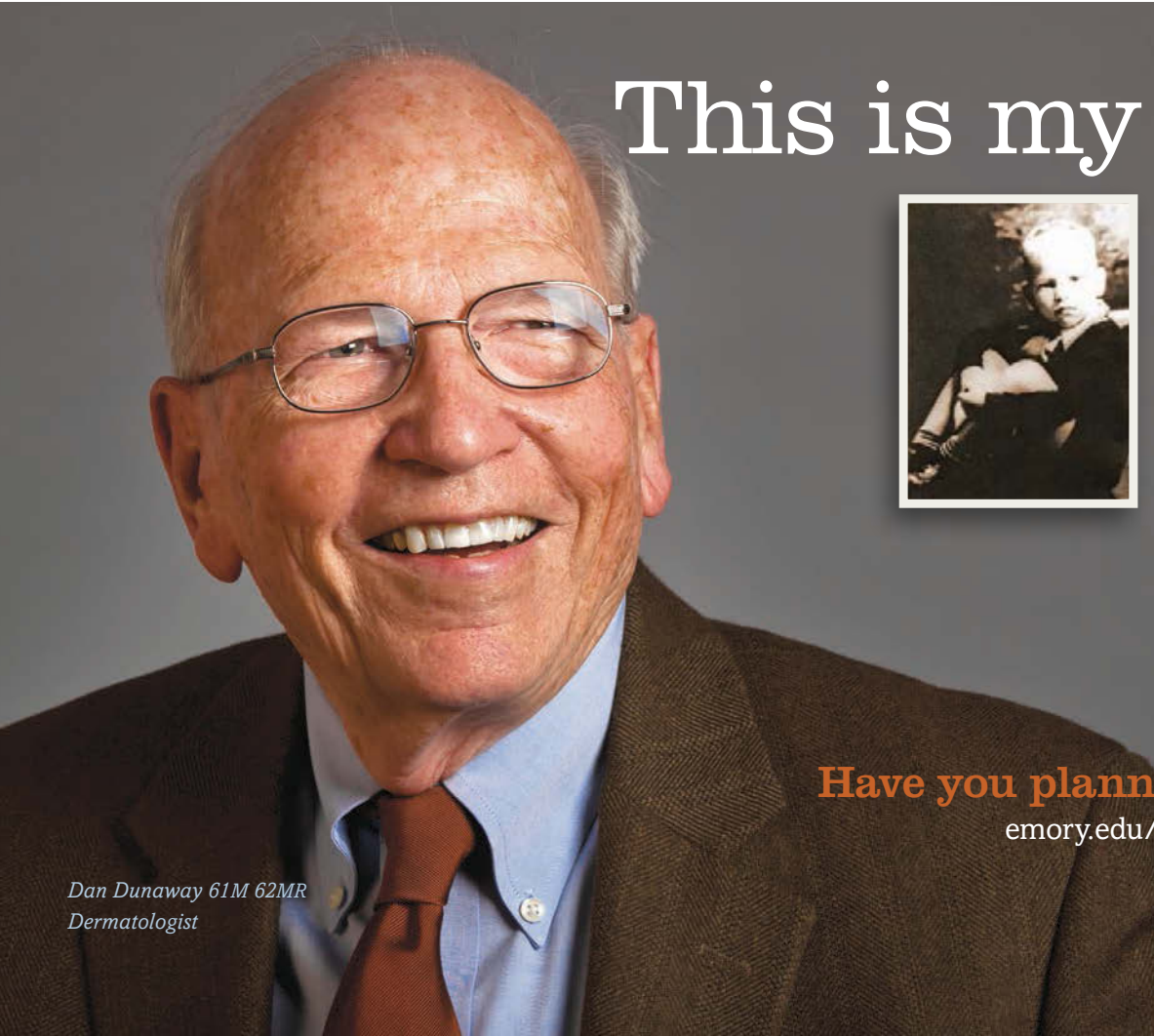
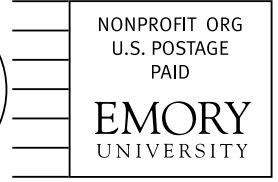
In the face of such amorphous threats, try to listen calmly—with open mind and open heart—to your rational side. I can assure you, more people have died from misguided decisions based on fear than from the original stimulus itself. ■



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