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doctor
on board?



Ten who answered the call for help.

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in Pilots





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MINNESOTA MEDICAL ASSOCIATION

JUNE 2011

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Photo by Scott Walker

My mother was clearly
my dad's first love,
but flying was
a close second.

Romancing the Sky

In 1958, my father fired the commercial airlines. Having been caught in a traffic jam en route to Chicago's Midway Airport for a business trip, he stood helpless at the gate watching his flight take off. Vowing never again to be dependent on United Airlines' schedule, he went directly from Midway to enroll in private pilot lessons. Thus began my father's 40-year romance with flying.

My dad pursued flying with the same intensity he approached everything in his life. After getting his private pilot's license, he obtained a commercial and instrument certificate. After renting single-engine Cessna 172s for years, he purchased a single-engine Cessna 210, which was soon replaced by a twin-engine Cessna 310 with the name 310DM ("Delta Mike"). He fastidiously maintained his airplanes and his pilot skills. Discovering that he could get a hot air balloon certification by just having a private pilot's license, he obtained one and would whimsically brag about it to anyone who would listen, although he went up in a hot air balloon only once and as a passenger.

Thumbing his nose at United Airlines' regimented schedules, he flew his plane for business wherever and whenever he could. Flying was also the mandatory means of transport for our family trips. I remember two-day excursions from Chicago to California to visit my sister at college, during which we stopped at such picturesque spots as Amarillo and El Paso. The monotony of droning engines and endless southwestern desert that was so painful for me seemed lost on my dad as he plotted vectors and talked to air traffic controllers. He was definitely closer to heaven at 8,000 feet.

This idyllic marriage of man and

plane was interrupted when my dad had an episode of coronary insufficiency at the age of 57 and his medical certification was pulled until he could prove his safety as a pilot. Suddenly, the previously routine flight physicals with his friend Dr. Brown turned into a battle Galactica with the FAA. Initially denied recertification, my dad challenged the FAA ruling for years, all the while continuing to fly with a licensed, hired pilot in the seat next to him so he could maintain his skills. When he finally emerged victorious and was once again airborne, he had navigated most of the shoals of aviation medicine covered in this month's issue. He went through two more battles for his medical certification, one after a coronary bypass at age 75 and another when he went into permanent atrial fibrillation; thereafter, he subjected himself to exhaustive, emotionally tense cardiac evaluations twice a year so that he could keep flying. When he went down with Cessna 310DM at the age of 84, he had just passed his flight physical.

My mother and father had been married for 62 years when they died on that flight. It was a storybook marriage sealed by love and respect. My mother was clearly my dad's first love, but flying was a close second.

For those who catch the bug, flying is magical—a rapturous mixture of spectacular vistas, mechanical mastery, and perceived freedom. Beginning commercial pilots work for minimal wages to do it. Aviation docs weather paperwork and the routine of aviation physicals to support it. And pilots like my dad spend time, money, and emotion to hear "Cessna 310 Delta Mike cleared for take-off."

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Charles R. Meyer, M.D., editor in chief, can be reached at cmeyer1@fairview.org



Issue Calls for Reasoned Discussion, Not Politics

I would like to respond to my colleagues Dr. John Wagner and Dr. Meri Firpo, who wrote the article “Stem Cell Research in Minnesota Here Today, Gone Tomorrow?” (May, p. 34). These authors are experts in their fields, and I respect them. But I object to their characterization of those who oppose the type of research they want to do, that is, research involving embryonic stem cells and somatic cell nuclear transfer. Their comments were politically charged and not helpful. We need, instead, to have a reasoned discussion about closing objectionable avenues of research. Such a discussion ought to include consideration of these issues:

1. The ethical considerations of doing research on the cells created by somatic cell nuclear transfer. Somatic cell nuclear transfer results in a cellular human being. But it is classified as a *thing* and is, therefore, used by other people for their own purposes. We need to remember that the Nuremberg trials were not held to determine whether research that doctors under the Nazi regime did was promising nor if it had the potential to help ill people. It was held to determine if the subjects of the research had been properly treated and whether informed consent had been obtained from them. Since then, the international community has worked to ensure that research is conducted with adequate respect for the rights of the human test subjects.

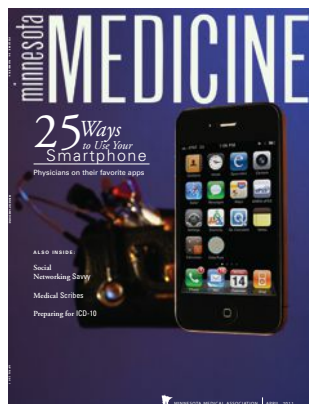
2. The evidence on the potential of adult stem cell therapies. Recipients of adult stem cell therapies have testified before Congress about their effectiveness in

treating spinal cord injuries, diabetes mellitus, and bone marrow diseases.

3. The fact that use of embryonic stem cells has thus far resulted in no cures for any diseases. Embryonic stem cell research has yet to result in cures, yet funding from government and private sources has not been meager.

This commentary characterized those who oppose stem cell research using embryonic stem cells and somatic cell nuclear transfer as a vocal minority. It ignores the fact that many who are in this camp have come to this position after looking at the research and wrestling with tough ethical questions. We need to allow discourse about an issue as important as this to continue, and we need to avoid characterizing people with opposing views as undiscerning. We need to do the right thing.

James J. Joyce, M.D.
Sleepy Eye, Minnesota



A One-Star Doc Responds

Like Dr. David Thorson (April Viewpoint, p. 18), I am a “one-star doc” as determined by the Medica Premium Designation program. I received my one star for “quality” (whatever way that was measured) but failed on “cost.”

After enlisting my overworked staff to sort through the patient information gleaned from the Medica website and pull the corresponding charts, I began to wade through the information about the 28 patients who exceeded the expenditure “norms” for my specialty. It quickly became obvious that the reason I lost my cost star was because of coding errors

made by Medica. For example, I found that for several patients, Medica assigned incorrect diagnostic codes to their problems. In other cases, Medica assigned only one diagnostic code when the patients’ expenses were generated by more than one problem. These coding errors were made despite the fact that I had submitted the correct codes.

I, and others no doubt, am being doubly penalized by Medica. First, I have been labeled by a major third-party payer as too expensive based on their flawed data. Second, to correct the mistake caused by Medica’s own incompetence, I am required to fill out and submit “reconsideration requests” for each patient. These insults are further magnified by the fact that this misinformation is made public for all Medica subscribers to see. Would you go to a one-star doc when there are others with two stars?

Although the MMA has registered its displeasure with this flawed program, I do not see any evidence that the MMA or any of our other medical societies that are supposed to be looking out for our welfare have done anything more than stage a token protest about this unfair and onerous program. Thorson concludes that the “MMA will continue to monitor this issue and press Medica to fix the flaws in its system.”

I think that this is not enough.

Jack E. Hubbard Ph.D., M.D.
Neurologist, Burnsville

WHAT'S ON YOUR MIND?

Health care reform? An article you've read in a recent issue? A problem in your practice?

Send your thoughts to Letters at *Minnesota Medicine*,
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WE WANT TO HEAR
FROM YOU!



Photo courtesy of Clayton Cowl

Clayton Cowl, M.D., became interested in hot air ballooning while doing his residency at the University of Iowa.

helps you recognize things you otherwise might not be perceptive about.”

Cowl combined his vocation and avocation in the mid-1990s. Drawing on his background in epidemiology, he analyzed the records of 495 hot air balloon crashes recorded by the National Transportation Safety Board between 1964 and 1995 to figure out which factors were most responsible for injuries and fatalities. He found contact with power lines was the most significant predictor of a fatality. “It wasn’t just electrocution,” he says of the cause of the deaths. In most cases, contact with power lines caused the basket to overturn; in others, it severed the cables that attached the basket to the balloon, causing pilots and their passengers to fall to their deaths.

The resulting article, which was published in the *Journal of the American Medical Association* in 1998, prompted changes in the way balloons are made. Today, he says, nearly all balloon manufacturers use Kevlar cables, which are nonconductive, rather than steel ones. “It really changed the industry,” he says of his work. ■

■ Hot Air Ballooning

View from a Thousand Feet

Clayton Cowl has combined his hobby with his profession to make hot air ballooning safer.

| BY KIM KISER

“It was like levitating,” Clayton Cowl, M.D., says of the first time he went up in a hot air balloon. An internal medicine resident at the University of Iowa in Iowa City at the time, Cowl had completed ground school for flying aircraft, when he met a commercial balloon pilot who took him on a ride. “It was a magical sense of being able to have a panoramic 360-degree view of the world going by very slowly,” he says of that flight in the fall of 1992.

Cowl, who is chief of the Aviation and Aerospace Medi-

cine Section at Mayo Clinic, went on to get his private balloon pilot rating and eventually his commercial rating from the Federal Aviation Administration. Today, he flies hot air balloons year-round, taking part in competitions in Minnesota, Iowa, and Wisconsin, and community events. One of the balloons he pilots is the Wells Fargo Bank balloon, an orange, gold, and white upside-down tear-drop-shaped vessel that’s the height of a seven-story building when inflated.

Cowl, who also flies fixed-wing aircraft, says piloting a

balloon takes a different mindset. In a plane, he says, you know you can get from airport A to airport B and back in a certain amount of time. In a balloon, the wind determines your speed and direction. “With each flight, the wind will be a little bit different. Your speed can change, the wind can change,” he explains.

Flying a balloon also requires keen observation. “Ballooning tends to notice things like direction of the wind or things about the earth that other people in their busy lives don’t notice,” he says. “Flying

■ Medical Training

Flight Fellows

Mayo offers the nation's first fellowship in aerospace medicine.

| BY KIM KISER

James McEachen, M.D., is living a double life. A former flight test engineer, he now serves as a flight surgeon in the Air National Guard in Des Moines. He is also finishing up a fellowship in interventional radiology at Mayo Clinic. In July, McEachen will merge his interests as he becomes the first physician to begin Mayo's aerospace medicine fellowship.

The impetus for the two-year fellowship came from J. Richard Hickman, M.D., former chair of the Division of Preventive, Occupational, and Aerospace Medicine at Mayo, who had also served on the medical staff at Brooks Air Force base. "He saw an opportunity to grow aeromedically," says Lawrence Steinkraus, M.D., who was hired to help start the training program and who serves as its director.

The Mayo program is the only aerospace medicine fellowship in the United States. The Air Force and Navy both have residency programs, as

do Wright State University in Dayton, Ohio, and the University of Texas Medical Branch in Galveston.

As part of the fellowship, McEachen will go through flight training at the University of North Dakota—a requirement for completing a residency or fellowship in aerospace medicine; earn an M.P.H. degree from the University of Minnesota; and do flight physicals and rotations in cardiology, psychiatry, and other fields at Mayo. He'll also work with the Air Force, Federal Aviation Administration, and NASA and learn about aeromedical evacuation, investigating aircraft accidents and reconstructing accident scenarios, the effect of high altitude on the body, and space travel.

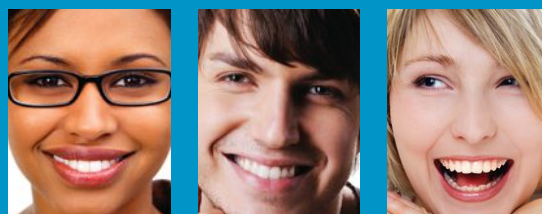
McEachen is especially interested in diagnosing and treating patients remotely—whether on an airplane, in space, or at a remote location on the ground. "If a person traveling on an aircraft be-



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tween New York and Tokyo becomes critically ill over the Pacific, are there better options available to treat them en route? In a more extreme example, if a person on a lunar space mission has acute cholecystitis, what do you do?" he

says. "And if a person who lives in a remote part of Montana does not have access to a clinician's office, are there better tools I can use to diagnose and treat them at their location? This is where aerospace medicine is going." ■



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Photo by Jeff Ernewein courtesy of Life Link III

■ Medical Air Transportation

Air Care

Minnesota's medical air transport services bring critical care anywhere it's needed.

| BY HOWARD BELL

On the ground, their medical centers compete. In the air, the medical directors of Minnesota's three air transport services collaborate. Some of them have known each other for decades. Life Link III's R.J. Frascone, M.D., and Mayo One's Daniel Hankins, M.D., interned together at St. Paul-Ramsey Medical Center in 1974. Each was the best man at the other's wedding. North Memorial Air Care's Marc Conterato, M.D., and Hankins have collaborated with Frascone on research. "We're all friends, and we all talk to

each other," Hankins says.

All are board-certified emergency medicine physicians who've seen air transport in Minnesota grow from novelty to necessity. The medical directors meet several times a year to review cases, share concerns, and tweak patient care protocols. In between, they talk by phone. "Our medical protocols are pretty similar," Frascone adds. "And we all have similar concerns and challenges."

The challenges of bringing the critical care capability of a hospital to the field is what they say they like most about their jobs. "Air emergency

transport is a totally different animal from hospital emergency medicine," says Conterato. "In the ER, you've got good lighting, lots of tools and drugs, additional staff, and plenty of room. Strip all that away in a helicopter where lighting and temperature can be suboptimal, you're in a noisy environment, and you're providing tertiary level care at 3,000 feet in a space half the size of a ground ambulance compartment. You can't use a stethoscope when you're wearing a helmet. You can't hear anything anyway with the rotor noise."

Flying the Desk

Although they spend most of their time flying their desks (in Minnesota, a physician is not required to be on board a medical helicopter), the medical directors are medically and legally responsible for the care a patient receives during transport. But they do go on occasional missions to remind themselves of the challenges their crews face. Conterato says nearly all 40 of his emergency physician partners "look at me like I'm insane to want to go up."

Most of the work Conterato and his fellow air transport medical directors do, however, involves developing and updating the protocols that guide crew members through every conceivable transport scenario. They are not usually in direct radio contact with crews. "It's

Life Link III

Owned by a consortium that includes Regions Hospital, Allina Health System, Children's Hospitals and Clinics of Minnesota, Fairview Health Services, Hennepin County Medical Center, Sacred Heart Hospital of Eau Claire, St. Cloud Hospital/CentraCare, St. Luke's Hospital of Duluth, and St. Mary's Medical Center in Duluth

Year started: 1985

Fleet: Five helicopters (Bell 407s) and three leased planes (two jets and one turboprop)

Missions flown in 2010:

Helicopter – 2,049

Plane – 182

Medical directors: R.J. Frascione, M.D. (Regions Hospital, St. Paul), medical director; William Heegaard, M.D. (Hennepin County Medical Center, Minneapolis), assistant medical director; Chris Delp, M.D. (St. Luke's Hospital, Duluth), co-medical director; and Gary Foley, M.D. (St. Mary's Hospital, Duluth), co-medical director

Location of helicopters: St. Paul, Hibbing, Alexandria, Blaine, Hutchinson, and Rice Lake, Wisconsin

important that crews take care of patients on standing orders in case radios or cell phones don't work," Frascione says, adding that "online" medical direction while a crew is airborne happens only when they are truly stumped.

The medical directors also review records from all critical care runs to make sure the protocols were followed and that adequate documentation was kept, and they help hire the crew and make sure they're properly trained. In addition, they share responsibility with the pilots for ensuring their fleets meet safety standards prescribed by the Federal Aviation Administration (FAA) and the Commission of Accreditation for Medical Transport Systems, whose board of directors Hankins previously chaired.

Research is another part of the job. Under Frascione's medical direction, Life Link III has studied the effect of onboard noise levels on newborns inside neonatal isolettes. They've also researched the effectiveness of a device that monitors brain waves to study the adequacy

of pain medication in unconscious patients. Currently, Life Link is researching the use of ultrasound for diagnosing collapsed lungs. "Life Link III has published more studies than anyone else in the world on the use of ultrasounds in helicopters," Frascione says.

North Memorial has researched patient temperature control during transports and with Mayo, inducing hypothermia in resuscitated cardiac arrest patients. Mayo has studied the use of packed red blood cells and plasma on helicopters; the "autolaunch" of helicopters, using passerby information rather than waiting for the arrival of first responders to begin the process of dispatching helicopters to the trauma scene; and the transport of harvested organs and suicidal patients.

High-Level Care

Most important, the medical directors see to it that patients receive high-level care. Although the conditions crew members work in are austere, the technology at their disposal is state-of-the-art. Medical helicopters carry more

drugs and equipment than a typical ground ambulance.

"Helicopters are flying critical care units," Frascione says. Instead of having about 20 drugs on board like a ground ambulance, helicopters carry around 60, along with sophisticated ventilators and blood and plasma, which aren't normally carried in a ground ambulance. They may also carry intra-aortic assist pumps; ultrasound devices; equipment for inserting chest tubes and monitoring pressure inside central veins, arteries and brains; and portable lab analyzers.

The critical care nurses and paramedics on board have a higher skill level than the typical ground ambulance crew, according to Frascione. Critical care flight nurses are trained and licensed to administer drugs such as vasopressors, dopamine, IV nitroglycerin, and steroids that are normally not administered in a ground ambulance. "These are bright, high-performing people at the top of their fields who are dealing with the sickest of the sick in less-than-ideal conditions," Frascione says. →



Photo courtesy of North Memorial

North Memorial Air Care

Year started: 1985

Fleet: Five helicopters (Augusta 109Cs)

Requests in 2010: 3,000

Medical directors: Marc Conterato, M.D., associate medical director, and G. Patrick Lilja, M.D., medical director for North Memorial Ambulance and Helicopter Emergency Medical Service

Location of helicopters: Lakeville, Bemidji, Brainerd, Princeton, and Redwood Falls

Air Transport in Minnesota

In the last 25 years, air medical transport has become an essential part of Minnesota's emergency medical system. Here's how it works:

At the scene of an accident, first responders such as a sheriff or the EMS ground crew decide whether to dispatch a helicopter, which helicopter service to call (usually the one with the closest aircraft), and to which hospital to send the patient, according to R.J. Frascone, M.D., medical director for

Life Link III. All three of Minnesota's air transport services—Mayo One, Life Link III, and North Memorial Air Care—base helicopters across the state.

Most air transports involve picking up patients at a community hospital and taking them to a tertiary care center. Patients who must be transported from one hospital to another one more than 200 miles go by medical planes, which don't do scene-to-hospital transports.

Pilots make the call about whether to fly if the weather is bad. Mayo One cancels about 800 dispatches per year out of 3,000 requests, according to Daniel Hankins, M.D., co-medical director of Mayo One. Hankins says poor visibility and ice on the rotor blades are the biggest weather-related hazards. Mayo pilots now use night vision goggles, he says. And new EMS helicopters with self-deicing blades just became available and will be used in Minnesota as fleets are updated.

At 13 helicopters, Minnesota's medical air transport

fleet is lean and cost-efficient compared with those in other states. Pennsylvania, for example, has 70 helicopters. (Medical helicopters cost \$5 million to \$6 million each.) "Minnesota has excellent air medical coverage," Frascone says, "but we don't tolerate dueling helicopters."

As for safety, Marc Conterato, M.D., associate medical director of North Memorial Air Care, says Minnesota has never had a fatality or serious injury caused by a medical helicopter accident. "All three helicopter services have outstanding safety records."—H.B.

Air transport units are especially important in rural Minnesota, where small hospitals may not be staffed or equipped to handle time-critical emergencies such as severe trauma; stroke, where time is brain; or myocardial infarction, where time is muscle. Trauma, heart attacks, strokes, and obstetric/neonatal emergencies are the most common reasons for transports. "Every week our helicopters save a life that probably wouldn't have been saved without air transport," Conterato says. He recalls a situation that happened just weeks ago, when an inattentive driver smashed into a parked semi at 60 miles per hour. Both his legs were crushed. "His legs were bleeding heavily and his blood pressure dropping fast. He needed the resources of a Level One trauma center to survive," Conterato says. "The crew helped apply tourniquets and got him to our trauma

center in 35 minutes. He survived."

Studies show trauma patients transported by helicopter have a 25 percent higher survival rate than those transported by ground ambulance, according to Hankins. "It's not just the speed of the aircraft that makes the difference. It's also the equipment on board and the skills of the crew," he says, adding that helicopters

are "very effective at bringing tertiary care to a community hospital setting."

About 80 percent of patients who receive air transport services are picked up at the nearest community hospital, where ground ambulances have taken them, and transported to tertiary care centers. Patients with severe trauma, heart attacks needing catheterization, strokes needing interventional

radiology, and complex medical problems with multiple comorbidities such as respiratory or multiple-organ failure will be transported directly from the scene to a tertiary care center.

An Evolving Subspecialty

Back in the 1980s when civilian air medical transport was new, most air medical di-

Mayo One

Year started: 1984

Fleet: Four helicopters (three EC145s and one back-up BK-117) and two Beechjet planes

Missions flown in 2010 (all aircraft): 1,700

Medical directors: Daniel Hankins, M.D., Scott Zietlow, M.D., and David Claypool, M.D.

Location of helicopters: Rochester, Mankato, and Eau Claire, Wisconsin



Photo courtesy of Mayo Clinic

directors were emergency doctors who “learned as we went along,” according to Hankins. “It was on-the-job training.” Conterato credits G. Patrick Lilja, M.D., medical director, of North’s ambulance and helicopter services, for teaching him the ropes. He says they still work together to develop protocols and review cases.

Although air medical transport is not officially a subspecialty of emergency medicine, pre-hospital emergency medicine is. In 2007, the Institute of Medicine (IOM) recommended that all medical directors of medical air transport services complete an emergency medicine residency and preferably a fellowship in pre-hospital emergency medicine. Regions Hospital and Hennepin County Medical Center offer such fellowships. Mayo is planning one. “When I first started practicing emergency medicine,” says Conterato, “one or two places in the country offered pre-hospital fellowships. Now around 30 do.”

Subspecialty board certification in pre-hospital emergency medicine will be offered beginning in 2014. Meanwhile, the Air Medical Physician Association

(AMPA), which Hankins helped create, has already raised the bar on medical director training. The 400-member organization sponsors a critical care air transport medicine conference each year and has a preconference on how to be an effective air medical director. It also has developed an air medical director core curriculum and published a textbook, *Principles and Direction of Air Medical Transport*. AMPA seminars are offered as part of other critical care and emergency medical conferences.

Hankins currently serves as president of the Association of Air Medical Services, which provides a forum for personnel from all disciplines involved in helicopter EMS to share information and improve the safety and quality of care.

The increase in educational offerings and training requirements is a commentary on the future of air transport. Helicopters, Hankins says, “will become an increasingly more vital safety net for rural Minnesotans who have time-dependent emergencies that need expeditious care at large referral hospitals.” ■

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■ Flight Physicals

Pilot Practices

A look at the doctors who specialize in caring for aviators. | BY SUZY FRISCH

It's a unique niche of medicine that pulls together allergists, anesthesiologists, sports medicine specialists, family physicians, even gynecologists: making sure pilots are healthy enough to fly.

As aviation medical examiners (AMEs), these physicians are certified by the Federal Aviation Administration (FAA) to conduct flight physicals. Many do it because they share a love of flying with their patients. Randle Corfman, Ph.D., M.D., a reproductive endocrinologist and medical director at the Midwest Center for Reproductive Health in Maple Grove, for example, is a pilot himself who flies to see patients in North Dakota, northern Minnesota, and Wisconsin. As one of about 80 AMEs in the state, he does flight physicals as a way to give back to the aviation community. "I do flight physicals out of courtesy and a responsibility to my colleagues who enjoy flying as much as I do," he says. "Most of my practice is based on flying airplanes to see patients; if I lost my license, my livelihood would be at stake. It's the same for many of them."

Corfman, who has been flying since 1983, has been the AME for Park Rapids, Minnesota, for 10 years. He conducts about three to five exams a month at the local airport. "Our true responsibility is to not issue a certificate to someone we wouldn't fly with ourselves," says Corfman, who jokes with his pilot patients that he's probably the only gynecologist to ever examine them.

The Flight Physical

To fly a plane, aviators need a pilot's license and a medical certificate. That involves getting a physical from a doctor who is an FAA-certified AME. Commercial airline transport pilots need first-class medical certificates from senior AMEs with two to three years of experience.



These pilots must receive physicals every year until age 39. At 40, they need a flight physical every six months. Second-class certificates are for commercial pilots including those who fly charters or do crop dusting, or who serve as navigators or first officers on commercial flights. They need a flight physical every year. The third-class certificate covers recreational and private pilots. Before age 40, they must have a flight physical every five years; after age 40, they need one every two years.

A flight physical doesn't stray terribly far from a traditional physical. It generally involves an AME determining whether a pilot meets the FAA's physical and psychological standards. "The bottom line we and the FAA are interested in is this: Does this pilot have a medical condition that has a reasonable probability of incapacitating him when he's flying?" says James Lakin, M.D., an allergy and immunology physician with Minnesota Allergy and Asthma

Consultants in Burnsville, who has been doing flight physicals for a decade.

In addition to covering their medical history and evaluating any changes to pilots' physical or mental health, the AME does routine checks of height, weight, blood pressure, and urine. The physical also includes extensive hearing and vision testing, including tests for visual acuity and colorblindness. The physicians also test for the eyes' range of motion and reflexes, and do an electrocardiogram on pilots older than 35 years of age. For commercial airline transport pilots, EKGs are required annually after age 40.

If an AME finds a problem during the exam, the pilot's medical certificate can either be deferred or denied. Neither happens often. Of the 421,610 exams performed in 2008 in the United States, 3 percent of pilots had their certificates deferred and .15 percent had them denied, according to the FAA.



Photo courtesy of Randle Corfman

Randle Corfman, M.D., flies to see patients in Minnesota, North Dakota, and Wisconsin and does flight physicals as a way to give back to the aviation community.

tificate is deferred or denied, it may not be the end of his or her flying career. Often pilots can satisfy the FAA by seeing a specialist and having their condition stabilized through treatment. The government, rather than the AME, then takes over monitoring and approves the pilot's medical certificate. "They have to go through certain hoops, but the FAA can work with them and get them going again," says Erik Kanten, M.D., a family physician who works out of Riverview Health Care's facilities in Crookston, Fertile, and Red Lake Falls and does flight physicals in Crookston.

A former pilot, Kanten devotes 5 to 10 percent of his practice to flight physicals. He enjoys talking shop with his fellow aviators, many of whom are agriculture pilots. Understanding that they need to keep flying to make a living, Kanten recommends that his pilot patients see him in the fall or winter. That way, if they have medical issues, they can get them resolved before the start of the growing season. "I keep them flying if I can," he says.

Philip Sidell, M.D., a family physician and senior aviation medical examiner at Morningside Family Physicians in Edina, has been involved in aviation medicine for more than 20 years. When he defers or denies a medical certificate it's usually for one of four problems, with medications being the biggest culprit. The others are cardiac issues, including arrhythmias, atrial fibrillation, coronary artery disease, and angina; diabetes; and sleep apnea.

Medications for neurological conditions, such as those used for treating ADHD or seizures, will keep pilots from flying. Recently, the FAA has permitted use of mild antidepressants under strict observation in certain circumstances. Use of other medications such as insulin and antihistamines can lead to deferrals or denials because of concerns about side effects.

Yet even when a pilot's medical cer-

A Soaring Practice

Many of the doctors who do flight physicals say their aviation practices have gotten busier in recent years, as other AMEs have retired or stopped doing exams and because there aren't a lot of physicians stepping in to take their place.

According to Lakin, some doctors are deterred from becoming FAA-certified because of the training required. Initial certification involves spending a week at the FAA Civil Aerospace Medical Institute in Oklahoma City, primarily learning how to complete the FAA's paperwork for medical certificates, which can be extensive. Physicians are evaluated on how accurately they fill out the detailed forms. In order to maintain their certification, physicians must participate in continuing education every three to six years.

Doctors who want to become AMEs must first contact their regional flight surgeon. (Minnesota belongs to the Great

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Lakes Region, which is based out of Chicago.) Physicians apply to be an AME for a specific city, and they do flight physicals only in that location so they're not competing with each other and so there's a good geographic distribution. If there is a need for an AME in a community, they typically will be approved for training. Although physicians from any specialty can become AMEs, about 75 percent come from internal medicine and family medicine, according to the FAA.

The FAA gives preference to physicians who are also pilots when they are accepting new applications, says Lakin, mostly because those physicians appreciate pilots' working conditions. "Being a pilot, you are able to understand a lot better what effects a given medication or disease might have in the flight environment," he explains. "It's a totally different environment with totally different demands on the human physiology. You have a much better perspective on evaluating each pilot when you have this background."

A former U.S. Navy physician, Lakin

is a senior FAA flight surgeon and AME who has been flying for 40 years. He sees four to five pilots a week and also treats scuba divers in his practice. He says he does flight physicals more to interact with his fellow pilots than because it's highly lucrative.

"The aviation community is very unique; it's men and women who are very dedicated to their profession and they are professional to their toes. It's a lot of fun to be able to work with these folks, and I feel that I am doing a service to the community as a whole," Lakin says. "It's professionally rewarding, and it's very interesting medicine." He says with his pilot patients, he gets to see decompression sickness, issues with changes in pressure, and the impact of pressure changes on the cardiopulmonary system—conditions rarely seen in a regular medical practice.

Sidell, who is following in the AME footsteps of his late father, Franklin Sidell, M.D., enjoys interacting with pilots as well. He also likes that doing flight physicals gives him a break from dealing with

insurance red tape. Most policies do not cover flight physicals because they are considered a work requirement, so the pilots end up paying out of pocket.

Over the years, Sidell built his practice by word of mouth; today, doing flight physicals constitutes about 70 percent of his practice. He attracts aviators from as far away as Australia, Hawaii, and New Mexico. His practice, Morningside, ranks in the top 3 percent nationwide in terms of the number of flight physicals conducted annually.

Sidell, who does about 2,000 flight physicals a year, sees many of the same pilots regularly, and even though he is not their primary physician, he uses those visits as an opportunity to talk with them about their overall health. "By their perception, we can be scary because we hold the key to their career," he says of the role of AMEs. "But if you have a problem, you need someone who will help you rectify the problem. If you have an issue, we work through it." ■



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■ Altitude Research

Pressure Work

Researchers are studying the physiologic effects of altitude.

| BY TROUT LOWEN

Anyone who has flown on a commercial airline has no doubt heard these words: “In the unlikely event of a loss of cabin pressure, an oxygen mask will drop down. Place the mask over your nose and face. Put your mask on first.”

Those instructions haven’t changed substantially in decades, and neither have the emergency oxygen systems onboard airplanes. The yellow “Dixie cup” mask and the method of oxygen delivery is much the same as it was when it was introduced on commercial flights during the early 1950s. But that may soon change, thanks in large part to the work of Mayo Clinic physicians.

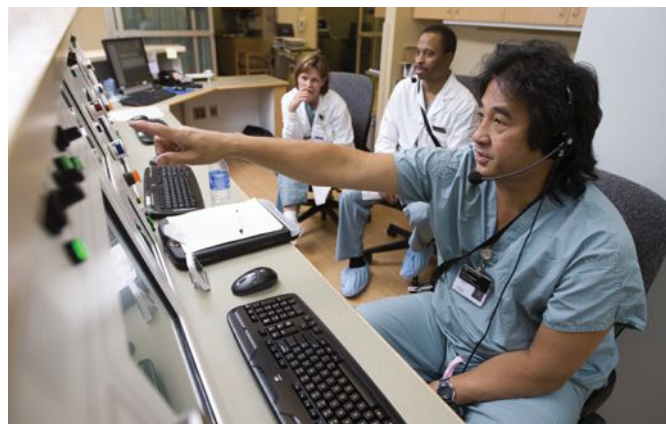
For the past two years, researchers in the Division of Preventive, Occupational, and Aerospace Medicine have been working with aircraft manufacturers and engineering firms to test new types of emergency oxygen systems for the next generation of commercial aircraft. One system will be operational on Boeing’s new 787 Dreamliner, which is scheduled for delivery later this year.

Mayo Clinic’s history of altitude and aviation-related research dates back to the 1930s, when its scientists and physicians first began studying the effects of high altitude and G forces on the body. That research led to the creation of the first oxygen masks and G-suits worn by pilots, and advances such as the “oxygen tent” and delivery of supplemental oxygen to the patient through a mask. It also contributed to the physiologic principles of what today is known as hyperbaric and altitude medicine. In fact, in an article published in the *Journal of the American Medical Association* in 1939, Mayo physicians Walter M. Boothby, Charles W. Mayo, and Randolph Lovelace II laid out indications for treatment with 100 percent oxygen.

Today, Mayo researchers conduct much of their work, including testing of new emergency oxygen systems for aircraft, using a 3,800-square-foot facility installed in 2007 that has both hyperbaric (compression) and hypobaric (decompression) chambers.

The facility is primarily used to provide hyperbaric oxygen therapy for patients with a wide range of illnesses and injuries including nonhealing diabetic ulcers and soft-tissue injuries including those resulting from radiation therapy and surgery. But with its hypobaric capabilities, it also serves as a laboratory for physicians and researchers studying the physiologic effects of altitude on air travelers and high-altitude climbers.

When the chamber was built, Mayo officials had anticipated working with NASA on research related to a manned mission to



Top: Chamber operator Jim Campos with Raymond Shields, M.D., and Julie Dyslin, a certified hyperbaric technologist, observing an altitude simulation session.

Bottom: The triple-lock bi-directional chamber has both hyperbaric and hypobaric/altitude simulation capabilities. In 2007, it was moved from Brisbane, Australia, to the Mayo Clinic Rochester campus.

Photos courtesy Mayo Clinic

Mars. But the economic downturn and cutbacks in space exploration shifted priorities, says Paul Claus, M.D., medical director of the Altitude and Hyperbaric Medicine Program. Still, he says, Mayo plans to be ready when the climate for space exploration changes. “We’re not going anywhere,” he says. “We have a piece of equipment that will last 50 years.”

Safe Travels

In the meantime, researchers are using the facility to do research that will benefit the traveling public. Clayton Cowl, M.D., a pulmonary specialist, chief of the Aviation and Aerospace Medicine section and principal investigator for aviation and aerospace research, says understanding the effect of hypoxia and preventing it during flight are increasingly important to public safety because of the large number of air travelers.

As airlines seek to cut fuel costs and find less-crowded airspace free from adverse weather conditions, they are flying at higher average altitudes than ever before, which Cowl says can pose health risks to some chronically ill or elderly travelers. Add a mechanical mishap, and the situation can become deadly: In 2006, the cabin of a Boeing 737 operated by Helios Airways failed to pressurize. Everyone, including the pilots on board, succumbed to hypoxia, and the plane flew on automatic pilot until it

Traveling with Oxygen

Physicians should consider prescribing supplemental oxygen for patients who will be flying if they

- Use oxygen at baseline altitude
- Have a baseline PaO₂ < 70 mmHg
- Are NYHA Class III or IV
- Have angina Class III or IV
- Have cyanotic congenital heart disease
- Have primary pulmonary hypertension
- Have severe anemia or cardiovascular disease with baseline hypoxemia.

Source: American College of Chest Physicians Expert Panel on Patient Travel (2010)

ran out of fuel and crashed outside of Athens, Greece, killing all passengers and crew members.

Cowl recently used Mayo's hypobaric chamber to simulate different altitudes and to gauge the rate of oxygen flow needed in a prototype oxygen mask and delivery system to prevent hypoxia (the amount is different for different people). He tested 38 subjects, ranging in age from 18 to 61 years. All were free of cardiac, pulmonary, and other conditions that could have caused problems during the test. Cowl monitored the subjects' blood oxygen levels and other parameters at different flow rates and different altitudes and did tests while they were breathing normally, hyperventilating, and performing various tasks to assess their mental acuity. He plotted the data to determine the average responses and padded those averages to ensure flow rates would be adequate for all passengers, regardless of their age or health status. "The FAA requires that you identify a 'traveling population,' so it can't just be young, healthy, military fighter pilots that you're testing," he says.

Cowl says airlines are trying to minimize the amount of oxygen they carry because they are concerned about extra weight, as that means extra fuel costs. "We have to know, in a new system, how much flow you need at 40,000 feet, at 30,000 feet, at 20,000 feet because the flow rates would presumably decrease as you get down to that goal of 10,000 feet, at which point most people don't need oxygen," he says. "If you are flying over the Himalayas, you may not be able to descend to 10,000 feet above sea level very quickly."

Although the FAA doesn't require private planes to carry emergency oxygen as it does commercial aircraft, more aircraft manufacturers are interested in doing so, given the risk. This summer, Cowl will work with AVOX Systems Inc. on the development of in-plane oxygen systems for private aircraft.

The Body in Flight

In addition to what it has provided for industry, the testing done by Cowl and his research team has also yielded data that indicate that more people should travel with supplemental oxygen.

Most air travelers don't realize that at a cruising altitude of 40,000 feet, the plane's cabin isn't fully pressurized. In fact, the air pressure is closer to what you might find at the top of a 7,000-foot mountain than to that at sea level, Cowl says. That creates problems, especially when combined with the stress of flying and the exertion of lugging heavy bags through the airport.

The passengers most at risk are not those with chronic or severe disease who are already likely to be traveling with oxygen. It's those who may not normally use it or even know they need it such as those with moderately severe obstructive lung disease, pulmonary fibrosis, or with subclinical or asymptomatic coronary artery disease. Consequently, primary care physicians need to be aware of the risks and know how to advise their patients, Cowl says. "A lot of doctors don't think about their elderly and not-so-elderly patients with respiratory illnesses who want to travel, mostly because the conversation about travel doesn't come up in the medical history." Cowl and colleagues wrote a guide for patients about traveling with oxygen that was published online in 2010 by the American College of Chest Physicians (ACCP). It is available free on the ACCP website, www.chestnet.org/accp/patient-guides/traveling-oxygen.

Altitude Adjustment

In addition to the work they are doing in Rochester, Mayo researchers have traveled to remote locations to learn how the body adapts to high altitudes. Bruce D. Johnson, Ph.D., recently completed a three-year attempt to identify factors that determine how well an individual can acclimate to high altitudes and to identify predictors for altitude illness.

Johnson's findings are of interest to the U.S. government, which operates a research station at the South Pole as well as to NASA and the military. Altitude sickness has been a problem for some troops arriving in Afghanistan, he says. In the most severe cases, it can result in pulmonary or cardiac edema, or even death. "They're interested in who's at risk, how they can acclimatize people, how you can get them ready for work at high elevations," he says.

Next year, Johnson will study noncompetitive climbers ascending Mount Kilimanjaro in Tanzania to determine why some people acclimate to altitude better than others. (In addition to work he does in the field, Johnson uses the hypobaric chamber and the Mayo Clinic fitness center for research. But, he says, it is difficult to mimic conditions such as humidity and temperature.)

Johnson says his high-altitude research has broad applications—especially for people with chronic conditions such as lung disease and heart failure. "A lot of what we do in studying altitude physiology in healthy people has carryover to patient populations," he says. "We try to blend the two." ■



David C. Thorson, M.D.
Chair, Board of Trustees

Photo by Steve Wewerka

Building Health Care Homes

We want to provide health care home services to all of our patients.

When the Minnesota Legislature passed the health care reform act in 2008, I was most enthused about the portion of the law that encouraged the development of health care homes (or medical homes) throughout the state.

As a primary care physician, I am all too familiar with the fragmented nature of care delivery and the difficulty it poses for patients. For that reason, our practice, Family Health Services Minnesota, decided to add health care home services. We are currently conducting pilots at two of our clinics.

I am excited about implementing the health care home model and strongly believe in its benefits, but I would feel a lot more comfortable forging ahead if I knew that all of Minnesota's payers were fully committed to financially supporting our efforts. We want to provide care coordination services, the foundation of health care homes, to all of our patients, but we are only paid for services we provide to those who are insured by a state-sponsored health plan and have one or more complex, chronic conditions. This is a problem.

Medicare will begin paying for care coordination services for patients later this fall as part of a federal demonstration project. But private health insurers are another story. State law says insurers that serve the fully insured small-group market should pay for the services, but it is not clear that they have been. And more than 40 percent of Minnesotans are covered by companies that self-fund their health plans; these plans are regulated by federal law and, therefore, are not required to support the health care home model outlined in state law.

Although I and other physicians believe Minnesota's private health plans support the concept of health care homes, we are concerned about whether they are marketing it to employers so that these services can become a standard benefit.

As a clinic leader pushing for this change, I was glad to learn that the MMA, along with the Minnesota Academy of Family Physicians, the MN Chapter of the American Academy of Pediatrics, and the MN Chapter of the American College of Physicians, recently met with Commissioner of Health Ed Ehlinger, M.D., to discuss some of the challenges facing health care home development. During that meeting, we learned that some lawmakers are also concerned about private-payer support for health care homes and that earlier this year, the Commissioners of Health and Human Services wrote a letter to all health plans in Minnesota asking for specific information about state certified health care homes in their networks, the number of commercial enrollees in those health care homes, and their payments to health care homes. I look forward to see the results and am glad the MMA is keeping the pressure on the state, the private health plans, and employers to make health care homes a benefit for all.

In summary, I am excited about the changes we are making in our practice. As physicians, we can improve the care experience for our patients and reduce unnecessary visits, tests, and procedures. We believe becoming a health care home is one way to do this. But we can't do it alone. We need the financial support not only of the state and federal governments but also of the commercial payers to really make it happen.

State's Major Payers Now Participate in Online Credentialing

Credentialing information can now be sent to all major health care payers in the state through the Minnesota Credentialing Collaborative's (MCC) secure website.

The Minnesota Department of Human Services (DHS), the last major payer to participate, began accepting applications and updated credentials for certain providers through the online service in May. (Details about how to use the credentialing service with state-sponsored health care programs are available at www.dhs.state.mn.us/provider/MCC.)

"The MMA has worked hard to reduce the credentialing burden for its members, and the addition of DHS will further streamline the process and reduce unnecessary administrative work," says George Lohmer, the MMA's chief financial officer and secretary-treasurer for the MCC.

Credentialing Simplified

The MMA, Minnesota Hospital Association, Minnesota Council of Health Plans, and Minnesota Medical Group Management Association launched the online credentialing system in 2009 in response to a need to reduce the administrative burden and cost of credentialing to physicians and other providers.

A subscription to the MCC

(www.MNCred.org) allows providers to electronically submit credentialing information and updates to Minnesota-based health plans and hospitals. A subscription costs \$25 a year. There is no limit to the number of applications that can be sent during a year.

The online credentialing system replaces a cumbersome process by which physicians had to complete a paper application for each organization at which they wished to be credentialed. Because of illegible entries, missing information, and errors, as many as half of initial applications were returned, requiring practitioners to start over with the process.



Payers in the MCC

- Behavioral Healthcare Providers
- BlueCross and Blue Shield of Minnesota
- HealthPartners
- Medica
- Metropolitan Health Plan
- Minnesota Department of Human Services
- PreferredOne
- PrimeWest Health
- Sanford Health Plan
- South Country Health Alliance
- UCare



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Court Sides with Clinic in Legal Fight with Malpractice Insurer

The Owatonna Clinic has prevailed in a legal battle against its malpractice insurer, which had denied payment for a claim.

The U.S. Court of Appeals for the 8th Circuit ruled in favor of the clinic in May when it affirmed the U.S. District Court's ruling on the case, which centered on whether the insurance company could deny a malpractice claim strictly on procedural grounds.

The Case

The case, *Owatonna Clinic, Mayo Health System v. Medical Protective Company*, called into question what constitutes adequate notice that a clinic may file a malpractice claim with an insurance company under a claims-made type of policy. Approximately 95 percent of professional liability policies in Minnesota are claims-made policies. Under such policies, a claim must be made during the policy period or the extended reporting period.

In this case, Medical Protective Company (Med Pro) issued a claims-made professional liability insurance policy to Owatonna Clinic in 1999. The policy required the clinic to provide written notice when a medical incident might result in liability. It also requested that details such as the names and addresses of the injured parties, witnesses to the event, and the time, place, and circumstances of the incident

be included.

In 1999, Owatonna Clinic notified Med Pro in writing of an incident that it believed could result in a liability claim. It also verbally provided the names of parties involved and details about the incident. When a lawsuit ensued against Owatonna Clinic in 2005, Med Pro denied coverage, stating that the clinic had not provided adequate notification such as written notification of the name and address of the patient in question.

Owatonna Clinic brought a breach-of-contract claim against Med Pro in U.S. District Court. The Court sided with Owatonna Clinic, citing "the substantive adequacy of the notice" it provided to Med Pro.

Med Pro appealed the U.S. District Court's decision to the 8th Circuit, arguing that a strict compliance standard

should be used when interpreting provisions of claims-made policies.

Form versus Substance

Last August, the MMA, along with the Minnesota Hospital Association and American Medical Association, filed an amicus brief in support of Owatonna Clinic that argued that a strict compliance standard would be unfair because it would elevate form over substance and allow insurers to reject claims strictly on procedural grounds. "It was important for the MMA to weigh in on this in order to ensure that physicians remain able to easily file insurance claims without the worry that ambiguous or seemingly less significant provisions in the insurance policy could lead to their claim being denied," says Karolyn Stirewalt, J.D., policy counsel for the MMA.

The 8th Circuit agreed and affirmed the U.S. District Court's holding. The appeals court stated, "It is in keeping with general Minnesota jurisprudence that rejects technical and narrow objections to the existence of coverage, especially when it comes to matters of notice. ... When the substantive adequacy of the notice is in issue (as it was in this case) ... the law of Minnesota places a burden of inquiry on the insurer when it has notice of facts that would raise a likelihood of a claim, and we are satisfied that this case falls within the ambit of that principle."

"This is an outstanding result," Stirewalt says. "An adverse holding would have seriously impacted both Minnesota physicians and facilities that have claims-made medical malpractice liability policies."



© Yuriy Panyukov - Fotolia.com

MMA in Action

Here are some of the recent ways MMA staff and members have been working for physicians in Minnesota.

■ In early May, Dave Renner, MMA director of state and federal legislation, met with Rep. Tara Mack, R-Apple Valley, to negotiate changes to her proposal to amend the chiropractic practice act, such as removing the term “chiropractic physician.” Following the meeting, Rep. Mack agreed not to pursue the bill this session.



Dave Renner

• Dave Renner can be reached at drenner@mnmed.org

■ Members of the MMA’s member relations team and several family physician volunteers staffed a booth at the Minnesota Academy of Family Physicians’ Spring Refresher April 14-15 to educate attendees about joining and getting involved in the MMA.



Karolyn Stirewalt

■ MMA Legal Counsel Karolyn Stirewalt represented the MMA at a Death Data Quality Advisory Group meeting hosted by the Minnesota Department of Health.

The group’s objective is to improve accurate reporting of causes of death. Stirewalt also represented the MMA at the Minnesota Board of Medical Practice meeting May 14. • Karolyn Stirewalt can be reached at kstirewalt@mnmed.org

■ The Minnesota Medical Association Alliance, a membership organization for spouses and partners of physicians, held their annual meeting May 4-5 in Roch-

ester. Approximately 25 members heard talks on ways to respond to the obesity epidemic among children.

■ MMA President Patricia Lindholm, M.D., gave a presentation about the MMA’s physician well-being activities to the Ethics and Medical Legal Affairs Committee in May. The committee discussed current legislation relating to stem cell research and minor consent for medical treatment. • Patricia Lindholm can be reached at plindholm@mnmed.org



Patricia Lindholm, M.D.

■ On May 4, MMA President-Elect Lyle Swenson, M.D., Past-President Benjamin Whitten, M.D., Mark Liebow, M.D., and MMA Policy Director Janet Silversmith met with Blue Cross and Blue Shield of

Minnesota leadership to address issues including health care homes, provider tiering, and consultation code coverage

■ Eric Dick, MMA manager of government affairs, attended a House Agriculture Committee hearing on May 11, during which a proposal to expand the availability of raw milk products was debated. The MMA and the Minnesota Chapter of the American Academy of Pediatrics sent letters to committee members opposing such an expansion because of the significant health risks associated with the consumption of raw milk and raw milk products. The legislation was tabled for consideration next year. • Eric Dick can be reached at edick@mnmed.org



Eric Dick



Photo by Steve Weverka

The MMA Board of Trustees approved free membership for all Minnesota medical residents, students, and fellows at its May 21 meeting. Keith Stelter, M.D. (left) chair of the MMA Membership and Communications Committee, presented the recommendation, and MMA Board Chair Dave Thorson, M.D., (right) led the discussion about it.



Midnight *Runner*

Photo courtesy of Clifford Steer

A researcher by day, Clifford Steer flew bank checks and military explosives around the country by night.

| BY CARMEN PEOTA

Clifford Steer, M.D., knows what it's like to burn a candle at both ends. While doing a fellowship in hepatology at the National Institutes of Health (NIH) in the late 1970s and 1980s, Steer moonlighted two to three nights a week. But he wasn't working in hospital ERs or urgent care centers. He was flying cargo planes up and down the East Coast.

Steer, now a professor of medicine, genetics, and cell biology at the University of

Minnesota, would take off from Baltimore Washington International Airport at 11 p.m., fly most of the night, come home and sleep a couple of hours, and then get up and go to work at the NIH. Most often, he was hauling canceled bank checks during those late-night flights.

Before electronic fund transfers, banks relied on pilots, many of whom were trying to log hours in the cockpit, to return millions of cashed checks to them. "It's a multibillion

dollar business that people don't even know exists," Steer says. "It was Pony Express flying in the sense that you had to be at a certain airport at a certain time. No matter what the weather was, you flew. No matter what the condition of the airplane was, you flew."

For Steer, it wasn't the business, the chance to accumulate flying hours, or even the extra money that compelled him to forfeit so much sleep and risk his life in inclement weather. He simply wanted to fly. "Whether they paid me or didn't pay me made no difference," he says. "They gave me the opportunity to fly, and I took it."

It was dangerous work. Steer recalls flying through the edge of a hurricane and multiple thunderstorms. One time, after coming through a "horrific" storm, he landed and discovered he had only a gallon of gasoline left in the tank. "It was beyond white knuckles," he says.

Yet Steer loved it. He liked the notion that he was doing something different from the norm, and he liked that he was pushing himself. "It was a very exciting thing," he says.

At First, Fear

Only a few years earlier, flying planes was not even on Steer's radar. He was consumed by his

Clifford Steer in front of his Beechcraft Baron 58 at Frederick Airport in Maryland circa 1980.



medical training; he ran for exercise (he did the very first New York Marathon) and he was a sports car enthusiast (he once owned two Jaguar XKEs).

His career as a pilot might never have gotten off the ground had he not met a medical student during his residency at the University of Minnesota who asked him if he'd ever been up in a small airplane. Steer admitted he hadn't, and the student invited him to go flying. Steer recalls going to the South St. Paul airport and getting into a two-seater Tomahawk. He also recalls the feelings he had as they flew—and they weren't positive. "The thing I remember most about the flight was how scared I was because I

enough. He wanted to learn everything about it.

So when Steer moved east for the NIH fellowship in 1976, he was on the lookout for any way to pursue his newfound passion. In addition to flying bank checks during the week, he worked as a flight instructor on the weekends and continued his own training, earning certificate after certificate. "I have everything there is that even the most senior Delta Airlines pilot would have, including the ATP [Airline Transport Pilot] certificate, the Ph.D. of flying." He sold his sports cars and bought his first plane, a twin-engine Beechcraft Baron 58 in the early 1980s. ↪

had no control over my destiny," he says. "There I was at 2,000 feet. He was flying, and if something happened to him, I would not be able to handle the situation."

It was anything but love at first flight. In fact, Steer was so bothered by the experience that he decided he needed to do something about it. Rather than avoid small planes altogether, he decided to take flying lessons. His idea was to learn just enough to ensure that he wouldn't feel so apprehensive in a small airplane ever again. Two lessons turned into more, and "then I got bitten by the bug," he says. Learning a little about piloting was not

Clifford Steer at a Glance

Education: M.D., University of Minnesota

Residency: Internal medicine, University of Minnesota Medical Center, Fairview

Fellowship: National Institutes of Health, Section on Diseases of the Liver

Career: After completing his fellowship, Steer spent 14 years at the NIH. In 1989, he joined the University of Minnesota as a professor in the departments of medicine and genetics, cell biology, and development.

Research Interests: Steer's laboratory is currently working on use of the Sleeping Beauty transposon in gene therapy; use of ursodeoxycholic acid (UDCA) for treating a range of diseases, and characterizing the role of microRNAs in gene regulation.

Bear Bile Expert: Earlier this year, during a lecture for a lay audience, Steer promised the crowd that he could convince them that a substance found in human and animal bile, UDCA, is the most remarkable drug in the world. He proceeded to explain that UDCA inhibits apoptosis, or cell death. He believes it has tremendous potential for treating diseases such as Huntington's and Parkinson's.

Steer noted that UDCA, or "urso" as he calls it, is abundant in the bile of bears and other animals that hibernate, which is what prompted scientists like him to study it. They believe it is what prevents muscle atrophy and other degenerative processes while bears take their long winter naps. For centuries, bear bile has been used in Chinese medicine. Because of his interest in UDCA, Steer has been contacted by reporters covering controversy about conditions in bear "farms" in China. Steer says he has tried to avoid politics while explaining why the Chinese are so interested in bear bile and why others might want to be as well.—C.P.

Then Addiction

At one point, Steer contemplated leaving medicine to take a job flying corporate jets. He decided not to, in part because he had invested so much time and effort into becoming a doctor and in part because he realized that a career as a professional pilot was a tenuous one. “It just takes a kitten to scratch your cornea, and you can’t fly. What do you have then?” he says.

Steer readily admits flying had become an addiction. “If you don’t have your fix, it becomes uncomfortable.” So until he was 40 years old, he doctored and researched by day and flew by night. But in the late 1980s, both his career and personal life took a turn. Steer got married, and he and his wife Pat, a nurse, decided to move back to Minnesota to be closer to family. Steer was offered a professorship in the department of medicine at the university.

Back in Minnesota, Steer gave flying lessons. But he soon missed the kind of flying he had done out East. With Pat’s blessing, he started hunting for a flying job, again seeking one that wouldn’t interfere with his work at the university.

He eventually saw an ad in the newspaper that piqued his curiosity. It read, “Wanted: experienced pilots.” Steer called the number and applied. It turned out that the ad was for Arrowhead Airways, one of only two private companies in the United States that flew hazardous cargo for the Department of Defense. Steer was offered a job on the spot, provided he could pass a federal security clearance.

Once again, Steer found

himself moonlighting, this time carrying class A explosives to military bases around the country. “We flew into airports that don’t exist,” he says. “We were met by military personnel with loaded machine guns. We always had to park the planes at the farthest end of the airport because of what we were carrying. And we were always met by the fire department because we were flying explosives.”

Steer had his closest brush with death on one of those trips. It was close to midnight in late November, and he was in a twin-engine plane with the president of the company, who was asleep in the back. They were flying at an altitude lower than what Steer would have liked in order to avoid strong winds when they encountered a severe ice storm. First one engine and then the other lost power. The air intakes had iced up. “I was at 4,000 feet 60 miles from land over Lake Michigan. I knew I was going to die,” he says. His co-pilot woke up and while Steer glided the plane, he worked to activate the alternative air intakes. They eventually were able to restart one engine and climb high enough to get out of the storm. But they had been a mere 2,000 feet above Lake Michigan.

Family Guy

Although that experience didn’t end his flying career, it prompted a change in his thinking. “All I could think of was how upset Pat was going to be. We were newlyweds.” That concern intensified with the births of his three children. (He notes that the money he once spent on airplanes now goes for college tuition.)

Steer’s night flying ended when Arrowhead Airways was

“We flew into airports that don’t exist.”

—Clifford Steer, M.D.

sold and moved to Florida in 1994. To get his flying “fix” now, he gives lessons for free.

Interestingly, those who know him well say Steer is anything but a dare-devil or risk-taker. Pat Steer says that “exacting” and “safety-conscious” are better descriptors—she says her husband is the type of guy who always drives at or under the speed limit. As she sees it, Steer likes flying because it’s a mental and technical challenge. She says he’s on a constant quest for knowledge, which is perhaps not surprising, given his academic career.

Pat Steer says her husband’s most remarkable quality is his ability to readily shift gears. “He easily comes in and out of what he’s doing. He has the ability to change focus and be right with you.” That clearly served him well as he juggled two careers successfully for so many years.

A friend and former colleague at the University of Minnesota Medical School, with whom Steer once co-owned an airplane, says he doesn’t think Steer’s obsession with flying is particularly unique. “I think most pilots are fairly passionate about their flying,” says Cary Mariash, M.D., now medical director of Methodist Research Institute at Indiana University Health. Mariash says that because it takes dedication and persistence to get and maintain a pilot certificate. “You probably end up weeding out those who are not that interested.”

A Grounding Experience

Both Mariash and Steer say a big part of the appeal of piloting a plane is that it requires their full concentration, allowing them to leave behind their medical careers. As Steer puts it: “When you’re flying the airplane, your focus is on flying the airplane.”

Steer says flying has provided him a window on a world he’d otherwise wouldn’t have known. He speaks fondly of the other pilots he’s met. Relationships with those aviators may be part of what has kept Steer grounded as he climbed the ladder of academic medicine, reaching full professorship early in his career. “When you’re among pilots, you’re a pilot,” he says. “They don’t care whether you’re an MD or a Nobel Prize winner or anything like that.” **MM**

Carmen Peota is managing editor of *Minnesota Medicine*.

Is there a *doctor* on board?

By Jeanne Mettner



Ten physicians share their stories about mid-air medical emergencies.

For physicians heading off on a vacation or looking forward to getting home after a long conference, hearing the call for a doctor on an airplane can evoke a variety of responses. Those who spend their days and nights dealing with emergencies might be quick to stand up and confidently offer to help; others, concerned that they may not be able to handle a situation outside their specialty, may slump in their seats and secretly wish they had become anything but a physician.

Regardless, it's not unlikely that physicians will one day hear those words and find themselves serving as first responders on an airplane. MedAire, a company that provides on-the-ground medical assistance for commercial airlines around the world, reports that more than 19,000 in-flight emergencies occurred among the airlines they served in 2010, of which about 470 required a premature landing. As only a third of commercial airliners in the world use MedAire, that number likely is a gross underestimate of all the in-flight emergencies that occurred. What's more, airlines are not required to report emergencies unless they prompt the pilot to divert the flight. "There is no central data repository for the number of in-flight emergencies, and no one agency or organization has been put in charge of keeping track of those figures," says Claude Thibeault, M.D., medical advisor to the International Air Transport Association, an international trade body for the airlines, and former chair of the Aerospace Medical Association's Air Transport Medicine Committee. Although numbers are not firm, we know that in-flight emergencies happen often enough that a physician is likely to encounter one.

Minnesota Medicine recently asked readers to tell about situations they've confronted while flying, and to describe what they did and what they learned—about themselves and about what they would do the next time around.

"I had that *rush of adrenaline, the butterflies, the whole thing.*"

In 1996, David Bjork, M.D., and his wife were traveling to Disney World with two of their daughters and members of their high school choral group for a series of concerts and contests. Ninety minutes into the flight from Minneapolis to Orlando, the airline attendant called for a doctor. "I immediately got into this mode like I was going into a football game to take someone's place," recalls Bjork. "I had that rush of adrenaline, the butterflies, the whole thing."

The patient turned out to be one of the students, who had type 1 diabetes and was in the midst of a hypoglycemia-induced seizure. The boy could not take in any food or drink to stabilize his blood sugar. However, Bjork found intravenous dextrose solution in the plane's medical kit and administered it promptly. The boy recovered by the time the plane landed in Orlando and was able to participate in all of the choral festivities.

"For a moment, there was this question of whether to direct the pilot to land at the nearest airport or to stay on course," Bjork says. "In the end, we continued the flight, but it was a tense few minutes. I felt like I had 300 eyes looking at me saying, 'Don't you dare divert this plane because we want to get where we are going.'"

Bjork has been called to assist in several other in-flight emergencies since then, although none have been as memorable as the first one. Now in his 29th year practicing medicine, when the call goes out he knows to ask for the plane's emergency medical kit and do what he can. "Usually, when this kind of thing happens, my wife nudges me in the side and says, 'Get going,'" he says. "You just have to do what you're trained to do and let it unfold."

"It requires you to rely almost solely on your experience and impressions rather than on all the technology and testing that's usually available in the clinic."

— Charles Andres, M.D.

"I couldn't hear a thing."

Two years ago, Charles Andres, M.D., was on his way from Paris to Mumbai with his wife when the French-speaking co-pilot experienced a sudden onset of lower, left-quadrant abdominal pain. Because Andres had lived in France for three years after college, he was able to communicate with the pilot. He discovered that she had never experienced this discomfort previously and that pregnancy was a possibility. "Once I showed my license, they opened up the medical pack, which pretty much provided all the equipment we needed for that particular case," recalls Andres, a semi-retired emergency medicine physician at Cuyuna Regional Medical Center in Crosby. "I do remember that the stethoscope was just awful. It was like the kind you get your kids when they want to play doctor. I couldn't hear a thing."

After examining the woman in what Andres describes as "tight quarters," he began to suspect that she had a kidney stone. The information about the medications in the medical kit was in French, and Andres was not confident about using them. So he used an application on his iPhone to identify the drugs and obtain proper dosage information. Andres administered an oral, dissolvable narcotic, along with an injectable nonsteroidal anti-inflammatory, then sat with the woman for a couple of hours before returning to his seat. "I checked in on her periodically; but when we landed, I ended up getting off the plane before she did," he explains. "I never found out ultimately what happened; it would be nice to know how things turned out."

Andres says that tending to a passenger or crew member in-flight can make you feel like you are flying by the seat of your pants. "It requires you to rely almost solely on your experience and impressions rather than on all the technology and testing that's usually available in the clinic, and that can make you feel incredibly uncomfortable," he says. "But we are obligated." His advice to physicians who hear the question "Is there a doctor on board this aircraft?" "Go find out what you can do—now."



According to the International Air Transport Association's Operational Safety Audit program, all planes carrying more than 100 passengers on flights lasting more than two hours must be equipped with at least one medical kit for use by doctors or individuals with appropriate qualifications or training. The kit should include the following:

- Stethoscope
- Sphygmomanometer
- Airways, oropharyngeal
- Syringes
- Needles
- Intravenous catheters
- Antiseptic wipes
- Disposable gloves
- Sharps disposal box
- Urinary catheter
- System for delivering intravenous fluids
- Venous tourniquet
- Sponge gauze
- Tape adhesive
- Surgical mask
- Emergency tracheal catheter (or large-gauge intravenous cannula)
- Umbilical cord clamp
- Nonmercury thermometers
- Basic or advanced life support cards
- Bag-valve mask
- Automatic external defibrillator (required on U.S. carriers)
- Flashlight and batteries

In addition, the kit should include the following medications: epinephrine, injectable antihistamine, dextrose, nitroglycerine tablet or spray, analgesic, injectable anticonvulsant sedative, injectable antiemetic, bronchial dilator inhaler, atropine, adrenocortical steroid, diuretic, medication for postpartum bleeding, sodium chloride, aspirin, and an oral beta blocker.

“My first response was that I didn’t want to get involved.”

In 1982, Allan Solum, M.D., and his wife were traveling from Munich, Germany, to Minneapolis when he encountered his first-ever in-flight medical emergency. Less than an hour after takeoff, the announcement came that a doctor was needed. “To tell you the truth, my first response was that I didn’t want to get involved,” says Solum, a family physician at the Paynesville Area Health Care System. “I looked up and down the aisle several times, and when no one responded, I pressed the button.”

The ailing passenger was a college-aged male, who was lying on a collapsible bed near first class. He was pale and sweaty, and was massaging his abdomen and vomiting. “He admitted that he had been drinking too much and sleeping too little,” Solum recalls. “I examined him, poked and prodded him a bit, and looked for focal and rebound tenderness.” Solum concluded that the man had nothing more than a bad hangover.

The captain called Solum to the cockpit and asked if he should divert the flight to London or even go back to Munich. Solum said that after examining the patient, he didn’t think an emergency landing was necessary. “I was kind of surprised at the authority they gave my decision,” he recalls. “I think if I would have said, ‘Turn the plane around and go back,’ they would have done just that—at tremendous expense and inconvenience to the other passengers.”

Solum continued to check on his patient, and when they landed in Minneapolis 12 hours later, the two men walked off the plane together, shook hands, and parted. “In retrospect, I learned that a physician is always a physician, whether you are in the clinic or in the air,” he says. “We can’t hold back and hide just because we are on vacation; we have skills and expertise that can change the outcome of a medical situation—whatever that situation might be.”

“In retrospect, I learned that a physician is always a physician, whether you are in the clinic or in the air.”

—Allan Solum, M.D.

“I ... have ... chest ... pain.”

On a flight from Minneapolis to Tokyo in 2005, Greg Plotnikoff, M.D., an internal medicine physician at Abbott Northwestern Hospital in Minneapolis, had just returned to his seat after tending to a passenger who was hit by an errant snack cart when he felt a soft tap on his shoulder. He turned around and found a Turkish man in his early 70s who was clearly distressed. “Are you a doctor?” he asked in strained English.

“Yes,” Plotnikoff responded.

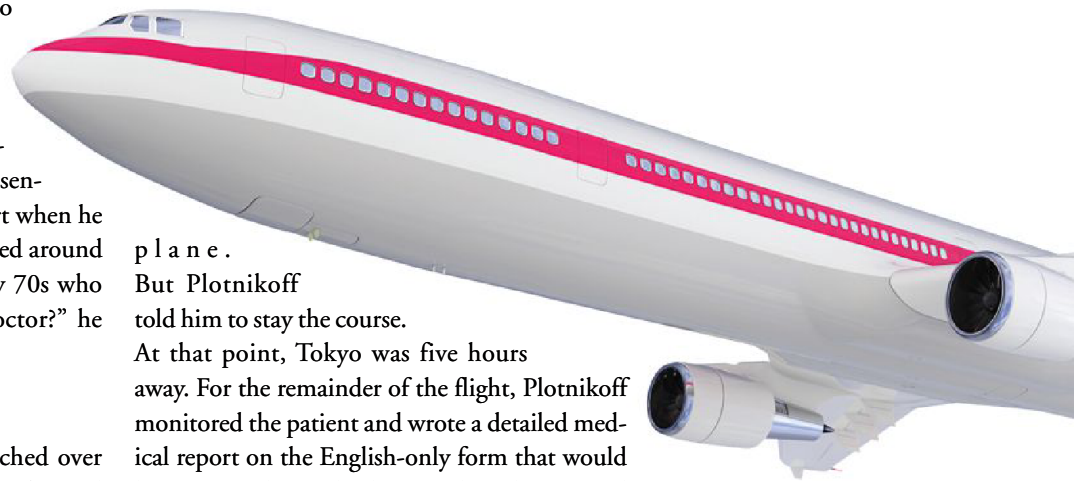
“I ... have ... chest ... pain.”

Plotnikoff’s mind raced. He reached over the seat and took the man’s pulse. It was fast and irregular. The plane was packed, and he worried about where he could further evaluate the passenger. Business class had one remaining open seat, so the flight attendants moved him there, and Plotnikoff opened the plane’s medical kit.

Getting the information about his history and medications was complicated, Plotnikoff says, “because the man’s English was not ideal.” He learned that the man, who was bound for Singapore, had no cardiovascular history. He was alone, hypotensive, and had irregular tachycardia. Plotnikoff gave the patient an aspirin, laid him flat in the seat, and did a one-lead electrocardiogram, which revealed atrial fibrillation with normal ST and T waves.

Plotnikoff’s assessment was that the man needed rate control with digoxin, fluids, and oxygen support. Before administering intravenous digoxin, however, he wanted confirmation of his differential diagnosis and treatment plan. But contacting a medical consultant on the ground meant he had to enter the cockpit. To do that, Plotnikoff needed to provide a copy of his passport and medical license and attest to the severity of the man’s illness and that he had no previous relationship with the patient. After confirming his treatment plan with a consultant from Mayo Clinic, Plotnikoff administered the digoxin, fastening the IV bag onto a hanger placed on the overhead bin. “At that point, the man went into normal sinus rhythm, his blood pressure came up, and his chest pain went away,” Plotnikoff says.

The pilot had asked if he should divert the



plane.

But Plotnikoff

told him to stay the course.

At that point, Tokyo was five hours away. For the remainder of the flight, Plotnikoff monitored the patient and wrote a detailed medical report on the English-only form that would be given to the medical team when they arrived in Japan.

About five hours later, the plane landed in Tokyo. Plotnikoff, who speaks medical Japanese, began explaining the situation to the medical crew. “It was the worst hand-off I could have imagined; there was no interest in the patient’s history, no interest in what happened on the plane, no interest in my report or my differential diagnosis and the next steps; the only interest was in getting [the patient] to the hospital,” Plotnikoff recalls. “Here’s an elderly Turkish gentleman who had no intention of going to Japan, who didn’t speak any Japanese, being handed over to people who didn’t speak English. It was horrifying.”

The next day, Plotnikoff called the hospital to check on the man. “They said they gave him another aspirin and sent him on to Singapore,” he says. “I was astonished.”

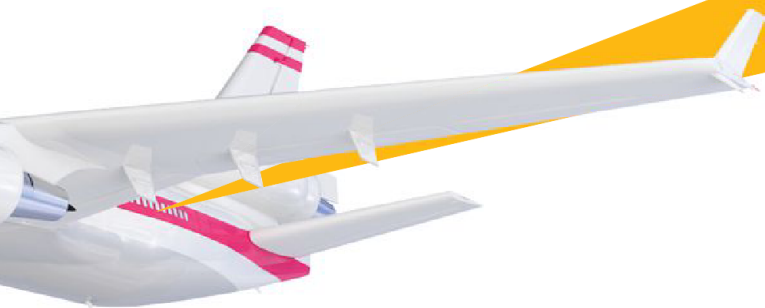
Plotnikoff advises fellow physicians to have a template for clinical decision-making in the event of an emergency that covers worst-case scenarios. He also says to not hesitate contacting medical support on the ground to review the assessment and treatment plan. “It took me a while to convince the pilots that I should be allowed to enter the cockpit, but the on-ground peer was worth it,” he says.

“It was the worst hand-off I could have imagined; there was no interest in the patient’s history, no interest in what happened on the plane.”

—Greg Plotnikoff, M.D.

“Whenever I’m going on a plane now, I bring my own stethoscope and a small first aid kit.”

—Elizabeth Koffel, M.D.



“What am I going to do if this guy *crashes?*”

“She was all alone.”

Flying to New Orleans for a medical conference a decade ago, Laurie Drill-Mellum, M.D., was asked if she could assist a woman in her late 70s who was experiencing shortness of breath. The woman, who had congestive heart failure and was on her way to see her son in Louisiana, had just been released from a hospital in the Twin Cities. She was dependent on oxygen and was traveling without it.

Drill-Mellum, an emergency medicine physician with Ridgeway Medical Center in Waconia, examined the woman and told the flight attendant she needed oxygen. But the tanks on board were small. “We calculated that we’d only have enough oxygen for a two-hour flight,” she says. The duration of the flight was three hours. “The attendants asked me if this could become serious, and I said, ‘Yeah.’”

Once the attendants conveyed the gravity of the situation to the pilot, he diverted the plane and landed in Nashville. The decision upset the woman tremendously, which made Drill-Mellum feel both guilty and sad. Says Drill-Mellum: “In her hierarchy of needs, it didn’t matter to her whether something bad happened to her. She was very clear about that. She was all alone, wheeled on this plane without the oxygen she desperately needed. All she wanted to do was go home, and instead I was sending her to a strange hospital in a strange city. I had no choice. She wasn’t in extremis, but she could have been if we kept her up in the air.”

When Drill-Mellum said goodbye to the patient at the airport, she felt the woman would be fine as long as she received the oxygen she needed. She never heard from her again.

Although Drill-Mellum deals with emergencies all the time, she understands that other physicians might feel apprehensive when a call goes out for a doctor. She advises fellow physicians who find themselves in such a situation to take a moment to collect themselves before taking action: “When you are facing a difficult situation, take a deep breath and relax before standing up to do what you need to do.”

Elizabeth Koffel, M.D., was in her last year of medical school at the University of Minnesota when she responded to her first in-flight emergency two years ago. Heading back to Minneapolis after doing a two-month elective in Puerto Rico, Koffel felt obligated to respond when the pilot’s repeated calls for a doctor went unanswered.

Warning the crew that she had not yet received her medical degree, Koffel was directed to a man in his early 50s. He was sweaty, his right arm was tingly, and he was drifting in and out of what seemed to be a sleepy state. Because she was not yet a doctor, Koffel could not gain access to the medical kit (she would have needed to give her medical license number to access it). All she could do was take the patient’s history, examine him, and dispense aspirin and oxygen.

The man didn’t have a personal history of cardiovascular disease. But Koffel, who kept monitoring his pulse during the flight, was concerned. “I kept thinking, ‘What am I going to do if this guy crashes?’ It was terrifying. I knew I could do CPR, but it was such a tiny space.” Because they were close to Minneapolis, the flight was not diverted and when they landed, paramedics whisked the patient off in a wheelchair.

Koffel is now a first-year resident in internal medicine at Abbott Northwestern Hospital. She says the experience has changed her approach to travel. “Whenever I’m going on a plane now, I bring my own stethoscope and a small first aid kit,” she says. “It’s always in the back of my mind when I’m in flight that this could happen again.”

“We had no way to intubate her.”

While on board a January 2011 flight from Minneapolis to Miami, the first leg of a trip to Peru for a medical mission, Melissa Clark, M.D., a pediatrician with Metropolitan Pediatric Specialists in Burnsville, noticed something was amiss. Three rows in front of her, people were gathered in the aisle, and a tall, burly man was bending down, tending to someone. The flight attendants looked worried. Clark didn't think to immediately awaken her traveling companion, Lisa Callies, M.D., whom

she had just met and who was accompanying her on the mission. Instead, she walked up the aisle and introduced herself to the person at the center of the attention—a woman in her 60s.

The woman had experienced a brief, unresponsive episode, during which she stopped talking, couldn't focus her eyes, and didn't respond to questions. She was traveling to Miami with her sister and two adult daughters. Clark learned that she had metastatic breast cancer and that the trip was

her “last hurrah.”

When Callies, an internist with Abbott Northwestern Hospital in Minneapolis, joined them, she discovered the passenger also had a history of atrial fibrillation. Because the woman was still feeling lightheaded, Callies took her pulse and found it was irregular. Her blood pressure was low, too.

Callies cleared out a row to make room for the woman to lie down, then went to call the medical responders on the ground. Clark stayed with the

woman and held her hand. “She was telling me, I'm so glad you're here. I'm so glad you are going to help me,” Clark recalls.

Ten minutes later, the woman went into full cardiac arrest. Callies immediately rejoined Clark and with the help of a former EMT on board began resuscitation efforts. Then the frustration began. First, the plane's automated external defibrillator, a piece of equipment required on all U.S. flights, couldn't sense the woman's heart rhythm, and

Stephen Husted, D.O., had embarked on what he thought was a well-deserved vacation when he boarded a plane in Minneapolis that was bound for Orlando, Florida, several years ago. An hour into the flight, his wife (a pediatric neonatologist) elbowed him in the ribs, prompting him to take off his headphones. She had heard the announcement.

“They're looking for a doc,” she said.

“Well, you're a doc,” he replied.

“I don't think the emergency involves a neonatal infant,” she countered.

Husted, an electrophysiologist with Mercy Metropolitan Cardiology Consultants in Coon Rapids, went to the

front of the airplane and saw a 40-something man whom the airline attendant noticed in passing was “not looking so good.” The man admitted he was having chest pain. For Husted, such patients were familiar territory.

With the help of a nurse who had also responded to the pilot's announcement, he got to work. The plane had an extensive medical kit, which included heart monitoring equipment. He attached two leads to the man's chest to assess his heart rate and rhythm. “Normally with an electrocardiogram in the clinical setting, you'd have 12 leads, but even with two, the monitoring setup showed remarkable electrocardiographic changes that

were consistent with this man having an acute heart attack,” recalls Husted. “The biggest thing I began to worry about at that point was his heart going into electrical chaos—ventricular fibrillation. Many people die before they can reach the hospital.”

Husted administered aspirin, intravenous beta blockers, and morphine for pain relief—all of which were in the medical kit. When asked if he wanted to reach Mayo Clinic's on-ground medical consultants by satellite phone, he declined, thinking that he would be talk-

ing to a fellow or someone in training.

After learning that Husted was a cardiologist, the pilot asked him if he wanted him to land at the nearest airport, which happened to be Atlanta. Husted told him to land. “By all means, I thought this was the real deal,” he said of the patient's suspected heart attack. The plane landed almost immediately.

But the patient wasn't out of the woods. The Atlanta emergency medical response team took an agonizing 30 minutes to get the man off

“I began to worry about ... his heart going into *electrical chaos.*”

Callies could not override it. Second, the emergency medical kit contained medications that would have been appropriate for restoring heart rhythm, but they could only be delivered intravenously, which was next to impossible since the woman had just undergone chemotherapy and had no central line access or adequate vein to cannulate. Third, the endotracheal tube and laryngoscope, which were listed in

the contents of the unopened medical kit, were nowhere to be found. “The woman had been vomiting, so she had no clear airway, and now we had no way to intubate her,” recalls Callies. “I was totally at a loss.”

In a last attempt at resuscitation, Callies, Clark, and the former EMT performed CPR with chest compressions only. The plane was diverted to Orlando and landed almost immediately. “EMS stormed the

plane as fast as the pilot could park it and within 10 seconds had scooped the woman off the plane,” Clark recalls. She was doubtful the passenger would survive.

Two months later, Clark was traveling to Mexico with her family when a call for a doctor came over the plane’s PA system. “My first reaction was ‘Come on!’ Then my heart began to race, I started breathing fast, I had this fight-or-

flight response,” she recalls.

The call ended up being for a passenger with a migraine headache, and someone else volunteered to tend to the passenger before she could. “That reaction made me realize what I already knew: I will always be a little different because of what I experienced. But I’m glad I was there to help,” she says.

“EMS stormed the plane as fast as the pilot could park it and within 10 seconds had scooped the woman off the plane.”

—Melissa Clark, M.D.



the plane. “I tried to explain to them that I was a Minneapolis cardiologist, that this man needed to get to a cardiac center for primary angioplasty; but I really felt they didn’t take me seriously,” Husted recalls. “I was worried that this man was going to have to be resuscitated right there on the plane in front of his wife and kids.”

A month later, the wife

of Husted’s mid-air heart patient emailed him to tell him her husband was doing well and to thank him for his help.

When Husted returned home, he spoke to his cardiology group and hospital staff about his experience. He emphasized the quality of the medical kit on the Northwest Airlines flight he was on. “I thought it was reassuring for

physicians to know that they can have the medical equipment and resources to respond to these cases,” he says. “Hopefully, that will facilitate people stepping up in the future.”

“They seemed skeptical at first.”

Jacob Tjaden, D.O., a fellow in child and adolescent psychiatry at the University of Minnesota, encountered his first in-flight emergency last January. About halfway through the five-hour flight to Peru, he heard the call for a nurse or doctor. Tjaden had settled in for the flight, and had even had a beer at that point. After hearing the call a second time, he responded.

When he approached the front of the plane, Tjaden came upon a fit-looking but distraught 19-year-old woman from Argentina. She spoke only Spanish, and the flight attendants' English skills were not adequate for translating during a medical emergency. Tjaden knew a little Spanish. “I had to go back and forth with the flight attendant to try to convey what I was asking and understand her answers,” he says.

Tjaden learned that the woman was experiencing numbness on the side of her face and body. He provided his medical license number, so they could open the medical kit, but he only used the blood pressure cuff and stethoscope, which he describes as “crappy.” Tjaden found the woman's pulse to be regular but tachycardic and noticed that she had low blood pressure. He learned that she had no personal or family history of cardiovascular disease but that she did have a history of migraines.

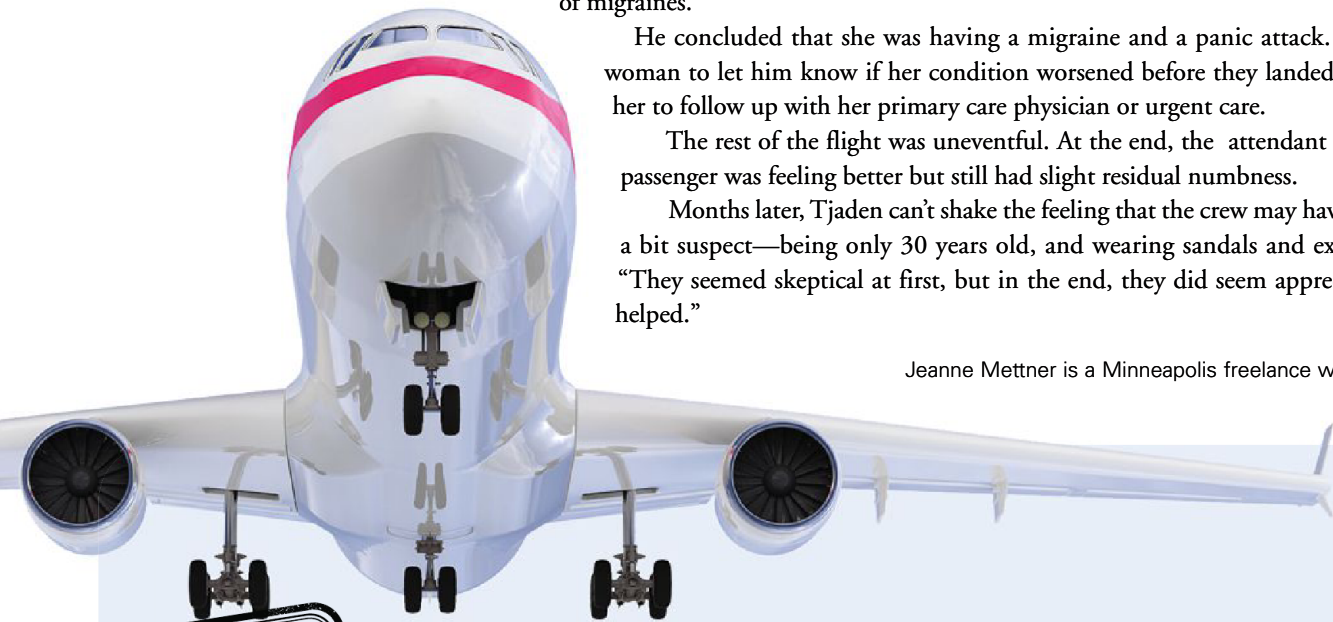
He concluded that she was having a migraine and a panic attack. He told the woman to let him know if her condition worsened before they landed and advised her to follow up with her primary care physician or urgent care.

The rest of the flight was uneventful. At the end, the attendant told him the passenger was feeling better but still had slight residual numbness.

Months later, Tjaden can't shake the feeling that the crew may have found him a bit suspect—being only 30 years old, and wearing sandals and exercise pants. “They seemed skeptical at first, but in the end, they did seem appreciative that I helped.”

MM

Jeanne Mettner is a Minneapolis freelance writer.



The International Civil Aviation Organization, a United Nations body that regulates flight safety, requires all cabin crew members to receive first aid training. The organization states that at a minimum,

training should include cardiopulmonary resuscitation, management of injuries and illnesses, and how to use first-aid equipment and supplies, and, if applicable, medical equipment. But what that means exactly isn't spelled out, and the guidelines regarding what procedures to follow during in-flight medical emergencies are cryptic.

It's ultimately the responsibility of a country's

national governing agency (in the United States, it's the Federal Aviation Administration) to decide what airlines headquartered within its borders must teach its flight attendants and cabin crew regarding how to deal with an onboard medical emergency. At U.S. Airways, for example, flight attendants receive 9.5 hours of training in first aid, CPR, and use of medical equipment, according to Stephen

Howell, director of in-flight training for the airline. After that, attendants receive an annual refresher course.

Consequently, pilots turn to the flight's physician passengers, along with the airline's operation control center and any available on-ground medical support, to make the call about what to do in the event of a serious medical emergency.

Children and Airplanes

Are We Having Fun Yet?

By Philip R. Fischer, M.D., and M. Rizwan Sohail, M.D.

■ Health care providers are often asked by parents whether it is safe for their child to fly and what they can do to make air travel more pleasant for the child and for their fellow passengers. This article provides answers to seven frequently asked questions about children and air travel.

Two million children leave the United States each year on international flights.¹ Millions more fly domestically. Whether in the clinic, at a party, or on the sidelines at a soccer game, physicians are often asked by parents how they can best manage common concerns related to traveling on airplanes with children.

Parents can do a number of things to make air travel more pleasant for their children and for everyone else on board the plane. Health care providers can help them by explaining how flying affects young bodies and teaching them to prepare for problems that might occur during flight. The following are seven questions parents frequently ask about taking children on airplanes.

Is my newborn old enough to fly?

It was once thought that infant alveoli required six weeks of post-gestational development before it could handle the low air pressure in an aircraft cabin. No evidence supports this hypothesis, however, and age is not in any way a predictor of one's ability to tolerate low-pressure environments.

There has also been concern that the relative hypoxia experienced in an aircraft (the equivalent of breathing air with only 15% oxygen at sea-level instead of the

normal 21%) might be risky for babies. Indeed, sleep studies conducted in a laboratory with conditions simulating those in an airplane cabin have shown that healthy 3-month-olds had lower oxygen saturation levels in the lab (SpO₂ 93%) than in a normal environment (SpO₂ of 98%). The infants in the lab also had more respiratory pattern variations. However, they did not have any significantly prolonged episodes of hypoxia or apnea.² Similarly, there is little evidence that high altitude is associated with increased risk of sudden infant death syndrome.³

Babies who were born prematurely and have a history of neonatal lung disease are at increased risk for complications during air travel. In one investigation, 47 former prematurely born infants and toddlers with resolved lung disease, who no longer required oxygen supplementation, were subjected to 14% to 15% oxygen for 20 minutes. Eighty-one percent of those infants developed hypoxia (SpO₂ less than 85%). All of the infants who developed hypoxia were younger than 12 months of age.⁴ Based on these data, it is reasonable to recommend that parents of babies who were born prematurely and have a history of neonatal lung disease postpone air travel until after their child's first birthday.

Another consideration is the mother's

readiness for travel after giving birth. It is not easy physically or emotionally for a new mother to travel with a newborn. Having adequate time to rest and recover from delivery and to spend time with her child is very important for the health of both mother and child and for mother-child bonding. Elective travel would not be wise if it would compromise a mother's mental or physical health.

What about earaches on planes?

Commercial aircraft are pressurized in a way that makes cabin air similar to ambient air at about 7,500 feet above sea level. During take-off and ascent, cabin pressure drops quickly. However, pressure in the middle ear, which is regulated and dependent on the opening of the Eustachian tubes, drops more slowly. This results in the volume of air in the middle of the ear expanding rapidly and causing pain. A similar but inverse process happens when the air pressure in the external ear canal increases during descent and landing, which also causes discomfort. Because infants and children have smaller Eustachian tubes that are readily obstructed by virus- or allergy-induced pharyngeal swelling, they frequently experience discomfort for a longer period than adults do. Up to 5% of young children have bothersome ear pain with ascent, and 13% have similar pain with descent.⁵

Parents of young children frequently ask if there is a medicine that they can give their child to prevent earaches during air travel. There is no known medication that

can help. In one study, adults with recurrent air-travel-associated earaches found they had less pain when they took pseudoephedrine (2 mg/kg orally) 30 minutes prior to take-off.⁶ Children, on the other hand, had equal rates of ear pain whether they received preventive pseudoephedrine or placebo.⁵

Parents can, however, make food and drinks available during take-off and landing, so children (especially young infants) can suck and swallow in ways that manipulate the Eustachian tubes and facilitate pressure equalization.

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Is it all right for a child with middle-ear effusion or otitis media to travel?

It turns out that when there is fluid in the middle ear, changes in air pressure do not cause significant expansion or shrinkage of the middle ear space; thus, children with middle-ear effusion or otitis media do not often experience pain as a result of changes in altitude. Similarly, children with patent tympanostomy tubes should have no trouble with ear pain on flights.

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Is it OK to sedate a child who will otherwise get fussy on a plane?

Most frequent flyers have stories about crying babies on planes, and some choose seats far from the bulkhead areas, where infants are preferentially seated. Because everything from earaches to interrupted schedules can make infants fussy during a flight, parents sometimes choose to sedate their children to decrease the chance that they'll bother other travelers.

Most pediatric travel medicine specialists do not recommend sedatives for traveling children. However, there are no medical data that provide guidance on this issue. Over-the-counter diphenhydramine (1 mg/kg orally) is commonly used. It is usually safe, but parents should be warned that some infants have a paradoxical reaction and may become hyperactive or agitated after receiving a dose. If parents choose to sedate their child during air travel, they should try a test dose at home to make sure their child is not prone to these paradoxical reactions.

The real issue in deciding whether to

sedate a child is the parents' philosophy. Some parents want their children to learn to cope with the uncomfortable, dull, and unpleasant aspects of travel (and life in general). So they often use toys, books, video screens, and aisle walks to try to occupy their children during the "boring" hours of air travel. Other parents may want to make the trip seem less inconvenient and use a mild sedative. (On a related note, if parents use sleep aids when traveling across multiple time zones, at least one adult care provider should remain unsedated in order to be available to the children traveling with them.)

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Does my baby need to use a car seat on the plane?

Although they are tragic and newsworthy, airplane crashes are rare. Mile per mile, air travel is much safer than road travel. Injuries associated with unexpected turbulence aboard planes are also uncommon. An approved child restraint system is the safest place for a young child during times of extreme turbulence or in an emergency. The physical forces that cause "rough air" and that are in play during crash landings, however, are very different from the physical forces that are generated during car crashes. Thus, families opting to place a child in a car seat on an airplane should make sure that the seat is also designed and certified for aircraft use.

Pediatricians are not yet convinced that the use of safety seats should be mandated for infants on commercial flights for several reasons.⁷ First, serious air-travel-associated injury is extremely uncommon, so uncommon that accurate risk-benefit calculations are impossible to make. Second, requiring families to purchase an extra ticket would prompt many to opt for road travel instead, which has a higher risk of serious injury and death than air travel. The Federal Aviation Administration and Travel Security Administration also offer advice for traveling safely with children.^{8,9}

Parents should know that there is more to airplane safety than using restraints, though. Passengers seated in aisle seats are more likely to have luggage from overhead bins and hot drinks spilled on

Tips for Safe and Comfortable Air Travel for Children

1. Parents of babies who were born prematurely and had neonatal lung disease should consider avoiding air travel in the first year of the child's life. Otherwise, young age is not a risk for adverse consequences of air travel.
2. Have something for infants to suck on or swallow during ascent and descent in order to avoid earaches. Ear infections are not a contraindication to air travel.
3. Young children may use safety restraint seats during the flight if the seats are certified for aircraft use. It is unclear if it is necessary to prohibit lap travel for infants in planes.
4. Parents of children with peanut allergies should always have epinephrine available, whether or not they are traveling by air.
5. Health care providers should use travel-planning visits as an opportunity to remind parents that children should be up to date on routine vaccines, especially for illnesses such as measles and influenza that are transmitted via the respiratory route.

them than are passengers in other seats; therefore, young children should not be placed in aisle seats.

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Could my child with peanut allergies have a reaction to a nearby passenger's food ?

Approximately 15% of the U.S. population has allergies of some sort. About 1% are allergic to peanuts. Fatal reactions are rare but possible, and very small quantities of peanut allergen can provoke a reaction. To avoid putting passengers at risk, some airlines have limited the availability of peanuts in their snack menu.

Data regarding peanut reactions in children during flights are very limited. In adults, however, approximately 9% of individuals with severe nut/seed allergies report food reactions on airplanes. Most

peanut reactions occur because of aerosolized exposure, not ingestion. In one study, half of the affected people required epinephrine treatment during the flight. Most of them did not inform flight attendants, as they administered the product themselves.¹⁰ Whether in the air, at a restaurant, or at home, inadvertent allergen exposures are possible. Reviews of fatal food reactions indicate that most victims knew of their allergy, and that very few received epinephrine within 30 minutes of the onset of symptoms.^{11,12} Consequently, the lesson is clear: Parents of children with peanut allergies should carry epinephrine with them, and affected children should receive an epinephrine injection soon after the onset of symptoms of a severe reaction.

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Can my child get measles or influenza by flying?

The air on commercial planes is incredibly clean. It is recycled 20 to 30 times each hour, and the recirculated air is passed through particulate filters that remove microbes 0.3 to 1 micrometers in size, including mycobacteria, fungi, and some viruses.¹³⁻¹⁵ In fact, a study in the 1990s found that the concentration of microorganisms in airline cabin air is much lower than that found in the air we breathe on a daily basis.¹⁶

Nonetheless, the close proximity of passengers on a plane does provide a significant risk for disease transmission. A simulation study revealed that when passengers coughed once and talked for 15 seconds, they dispersed droplets containing germs to passengers in the rows immediately surrounding them within 30 seconds and to passengers within seven rows of them within four minutes.¹⁷

Three recent cases of measles in Australia illustrate the potential for droplet spread of contagious germs.¹⁸ Two siblings were seated eight rows behind a coughing passenger (who developed a rash and was diagnosed with measles a few days later) during a 4½-hour flight. Each of the siblings had received two measles vaccines (at 1 year and at 4 to 5 years of age), and each went on to develop measles. Another traveler who was not completely immunized

spent time in a departure lounge with the index patient and went on to develop measles. The case of the two siblings demonstrates that even vaccinated children seated fairly far from a coughing passenger can get measles from an aircraft-associated exposure.

Similarly, influenza can be spread in airplanes. The risk is greater in economy class cabins that are full than in those that are less full or in first-class cabins.¹⁹ Therefore, vaccination against influenza prior to travel is strongly advised.

There has also been concern about the spread of tuberculosis in airplanes, partly because of media coverage of contagious passengers. However, the risk of tuberculosis transmission on airplanes has proved to be quite low.²⁰ In one study of 131 aircraft passengers who potentially had contact with a patient with pulmonary tuberculosis, no cases of active disease were reported.²¹ Risk of acquiring the disease is somewhat higher for patients with cavitary lung disease who have positive sputum smears for mycobacteria at the time of travel. It should be noted that risk of tuberculosis exposure is generally limited to passengers seated two to three rows in front of and behind the index case, and most do not develop active tuberculosis even after exposure.

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Conclusion

Air travel provides children with a wonderful opportunity to see new places and learn new things. There are potential hazards, however. Health care providers should educate parents about the risks of air travel to children and ways to minimize them. In most cases, they can reassure parents and offer tips to make travel safer and more comfortable for their children. **MM**

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When Is it Safe to Fly?

Addressing Medical Conditions in Pilots

By Lawrence Steinkraus, M.D.

■ Since World War I, the role of physicians who care for pilots has been to minimize the risks posed by the unique environment in airplanes and the demands of flying. Originally, that meant screening out those with any physical limitations that might affect their ability to fly such as vision or cardiac problems. Today, however, with the ability to better manage patients with multiple conditions, the physician's task is more nuanced and requires an estimation of risk based on the how well a pilot's condition can be managed and the type of flying he or she does. This article looks at how pilots are medically evaluated and how the standards for medical certification are evolving, allowing some pilots who have certain conditions to continue flying.

Mr. B is a 60-year-old airline pilot who needs to renew his first-class Federal Aviation Administration (FAA) medical certificate in order to continue flying. He has a history of prostate cancer, hypertension, type 2 diabetes mellitus, hyperlipidemia, coronary disease (he's had coronary artery bypass grafting) as well as adjustment disorder with depressed mood that remains clinically quiescent. Mr. B is taking a number of medications including a beta-blocker, aspirin, lisinopril, metformin, and simvastatin. He has been doing well and is followed annually as required by the FAA's Special Issuance program, which mandates specific testing for each of his diagnoses. As part of the renewal process, he has been scheduled to see a urologist, an endocrinologist, and a cardiologist. A prostate-specific antigen test, lipid profile, hemoglobin A1C, electrocardiogram, and graded exercise test have been ordered.

Once the evaluation is completed, an Aviation Medical Examiner (AME), a physician certified by the FAA to award medical certificates, will perform the appropriate forensic examination, complete the necessary documentation, and submit the findings as well as lab reports, consultant notes, and other data to the FAA. If all tests indicate his conditions are stable, Mr. B will receive his medical certificate.

Caring for patients with multiple medical conditions is challenging. Caring for pilots with multiple conditions is even more so, as the physician has the added responsibility of understanding which conditions may affect flight safety, with the primary concern being sudden incapacitation during flight. It is a challenge that is becoming more common, as the number of older pilots increases. According to the FAA, the average age of civilian pilots has been rising slowly over the last decade.¹ In addition, because we can now successfully treat diseases that would have been life-shortening in the past, standards with respect to aviation and medical status have changed.

As a result, the number of pilots requiring Special Issuances (called waivers in the U.S. military) for medical problems has also been increasing.² Thus, patients like Mr. B who have multiple health concerns and wish to maintain their pilot's license are not uncommon today.

This article looks at how pilots are medically evaluated and how the standards for medical certification are evolving, allowing pilots who have conditions that would have once grounded them to continue flying.

Evolving Standards and Changing Protocols

Physicians first began to develop protocols for evaluating pilots during World War I, when it became apparent that pilots were crashing their aircraft because of medical and physiologic issues (eg, hypoxia). At first, the approach of these physicians—known as “flight surgeons”—was to develop standards to screen out those who might not be fit to fly; that is, they tried to select individuals who were most likely to perform well when exposed to altitude, acceleration forces, and temperature extremes, and who had acute vision as well as good coordination and quick reflexes. Initially, pilots were expected to have 20/20 vision, normal cardiovascular function, clear minds, and quick reflexes. Consequently, the majority of people were denied medical certification.

Later on, civilian and military agencies developed more sophisticated examination protocols that clarified who was or was not fit to fly. Persons with seizure disorders, severe cardiac problems, or diabetes requiring insulin, for example, were usually not certified because of the potential risk that they might become incapacitated during flight or that their ability to function might degrade. Also excluded were those with conditions such as lung disease, which might decrease tolerance for hypoxia with increasing altitude, or who were using medica-

tions that could cloud thinking or slow reflexes such as sedating antihistamines or narcotics. Even age was considered a concern, as it came with adverse changes in cognition, muscle strength, coordination, and tolerance for flight stressors such as hypoxia or acceleration. As treatments improved and thinking about age changed, and after years of study and advocacy by various organizations, those standards and requirements have evolved. For example, under mandate by the Fair Treatment for Experienced Pilots Act, the age limit for civilian commercial pilots was revised in 2007. Whereas pilots were once required to retire at age 60, they can now fly until age 65.

The FAA is guided by federal law—in this case, the Code of Federal Regulations or 14 CFR part 67. If an aviator does not meet specified standards in the law, he or she is technically disqualified, and his or her medical certificate may be denied, suspended, or revoked. However, the FAA allows for Special Issuances, which are valid for a specified period, during which time the pilot must show that he or she can perform the duties authorized by the class of medical certificate applied for without endangering public safety. Standards and exception policies are more strict for those seeking first-class certification than for those seeking second- or third-class certification; in other words, commercial airline pilots (those needing first-class certification) must pass more stringent exams than private pilots. A number of conditions ranging from cardiac problems to psychiatric disorders can disqualify a pilot. Others can disqualify a pilot under specific circumstances. For example, angina pectoris and bipolar disorder would disqualify a pilot, while controlled hypertension or a single episode of renal colic without retained stone would not.

Conditions that Disqualify a Pilot from Flying

- Angina pectoris
- Bipolar disorder
- Cardiac valve replacement
- Coronary heart disease that has required treatment or, if untreated, that has been symptomatic or clinically significant
- Diabetes mellitus requiring insulin or other hypoglycemic medication
- Disturbance of consciousness without satisfactory medical explanation of the cause
- Epilepsy
- Heart replacement
- Myocardial infarction
- Permanent cardiac pacemaker
- Personality disorder that is severe enough to have repeatedly manifested itself by overt acts
- Psychosis
- Substance abuse and dependence
- Transient loss of control of nervous system function(s) without satisfactory medical explanation of cause.

Source: FAA Guide for Aviation Medical Examiners (www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/app_process/general/decision/)

Fit to Fly?

The term “flight surgeon” refers to a physician designated to determine fitness for flying duties (civilian or military) as well as boarded aeromedical specialists. The question of whether a civilian pilot is medically fit to fly is the domain of the AME (see “The Medical Certification Process”). In addition to conducting an examination, these physicians go through a risk-assessment process that considers both the pilot’s physical condition and the type of flying they do. In the early years of aviation, a pilot was a pilot. Today, most countries recognize classes of aviators, ranging from the recreational flyer to the commercial pilot who carries hundreds of passengers.

With this classification system in mind, flight surgeons calculate the risk of a medical condition leading to potential accidents. For instance, a recreational flyer in an ultralight aircraft who suffers a mid-flight syncopal spell is unlikely to cause as much damage as a commercial pilot flying in a Boeing 747 filled with passengers who has such a spell. Arguably, the copilot in the 747 could take the controls, but during critical phases of flight such as landing, especially in bad weather or during an aircraft emergency, suddenly losing half the crew significantly increases the chance for an accident.

When evaluating a pilot’s fitness for flying, flight surgeons often use what is referred to as the “1% rule.” Simplified, this means they will only certify a pilot to fly if there is less than a 1% chance that the individual will have a disabling event caused by their condition during a critical phase of flight such as landing or take off over the course of a year. Obviously, knowing that a pilot has a particular medical problem such as coronary disease or stroke is critical to assessing the risk for an in-flight problem. If one adds in other factors such as age, other medical problems, medications the person is taking and their potential side effects, the effect of fatigue, and whether the pilot flies with another crew member, it can be very difficult or impossible to precisely estimate the risk. This uncertainty has led to conservatism within the industry, meaning that some pilots have not been allowed to fly with illnesses or conditions that might never cause a problem. But that is starting to change.

In addition to calculating the risk that a particular pilot with a particular condition might face, the flight surgeon needs to know the potential steps to take that might reduce or eliminate risks. In the military, this may mean ensuring pilots are fit to successfully operate a jet while tolerating acceleration forces up to nine times the force of gravity. On the civilian side, it could mean understanding that a pilot with a diagnosis of ADHD may have cognitive deficits that could impact judgment and decision-making, although he or she may look healthy and feel well on methylphenidate.

Acknowledging the difficulty of predicting risk, flight surgeons and aeromedical organizations have worked hard to collect data on how pilots with diseases or health concerns have performed during flight. They have used that information to justify relaxing the limitations for some conditions. One example is mi-

The Medical Certification Process

In the United States, the FAA oversees medical certification for civilian pilots. There are three primary certification classifications. Pilots holding first-class medical certificates are allowed to command passenger aircraft carrying more than 50 people. Those with second-class certificates can fly commercial aircraft as co-pilots or flight engineers. Pilots holding third-class medical certificates make up the bulk of the flying population and typically operate smaller privately owned aircraft.

FAA-designated Aviation Medical Examiners (AMEs) perform required examinations to grant pilots medical certificates. The FAA manages the AME system for the Department of Transportation and conducts training for physicians. Senior AMEs, recognized by the FAA as having the required training and experience, perform examinations on pilots requesting first-class medical certificates.

In the United States, the American Board of Preventive Medicine recognizes physicians with additional training and experience in aeromedical issues with board certification as aerospace medicine specialists (ASMs). These specialists may or may not also be AMEs. ASMs may provide direct clinical care for flyers, conduct aeromedical research, hold aeromedical policy and management positions, and perform aeromedical evacuation of ill and injured patients. Some act as human factors experts in space- and aircraft design. There are two military ASM residencies (U.S. Air Force and U.S. Navy), two civilian residencies (Wright State University and University of Texas), and one ASM fellowship (Mayo) in the United States.

tral valve prolapse (MVP). The U.S. Air Force followed individuals with MVP for a number of years and found that most could fly without adverse outcomes.³ In a similar vein, the FAA has recently opened the door to some flyers who are on certain antidepressants (SSRIs), allowing them to resume flying under very tight observation rules. Despite many years of study and data collection, however, we still have gaps in our knowledge base. For that reason, flight surgeons are often forced to use data about the nonflying population to make their decisions about whether a pilot is medically fit to fly.

The Flight Exam

When examining a pilot, a physician must assess whether the individual meets specified standards identified by the FAA or military as necessary for performing flight duties. Pilots who fly commercial aircraft carrying more than 50 passengers must meet stricter standards on urine, vision, blood pressure, hearing, and cardiac tests than those who fly recreationally. In addition to adhering to these standards, they need to pay close attention to issues that are of interest aeromedically. For instance, because of

the pressure changes that occur with ascent and descent, Eustachian tube function must be assessed dynamically. The pilot must be able to perform a Valsalva maneuver while the physician observes the tympanic membrane move. The neurologic exam must ensure there are no equilibrium defects. The flight surgeon must understand how to look for potential ophthalmologic conditions beyond visual acuity that might affect the pilot's ability to read instruments or operate the aircraft. When examining the musculoskeletal system, the physician must ensure the pilot will be able to operate controls and get in and out of the aircraft without difficulty. In some aircraft, the pilot must be able to exit through a cockpit window and slide 15 to 20 feet down a rope during an emergency evacuation.

Working with pilots poses special challenges to physicians. Pilots tend to view the flight exam warily. They want to keep flying and frequently understate medical issues in order to avoid being grounded. The flight surgeon often must work hard to discover underlying issues. For that reason, physicians may need to be alert to subtle signs. Something seemingly minor, such as use of an agent for erectile dysfunction, should lead the examiner to ask whether this indicates a more serious vascular problem such as coronary or cerebrovascular disease, which raises the risk for sudden incapacitation. Also, it's important that the physician can "speak airplane" and seek to understand the pilot's point of view. (Some of the best "flight docs" are often pilots themselves.) Encounters tend to be far more productive when there is a good relationship between the pilot and physician. If the physician can convince the pilot that it's better to address health problems up front, he or she can guide the aviator through some of the toughest waiver procedures in the shortest time possible.

Common Concerns

Several common medical conditions require special evaluations and submissions of waivers or Special Issuance applications. The waiver or Special Issuance process is really just good medicine. The system ensures that the pilot is monitored appropriately, that there have been no significant adverse changes in their health (such as worsening of coronary disease or glaucoma), and that any preventive measures (lowering lipid levels or controlling blood pressure) have been implemented. Although this monitoring may seem onerous at times to pilots, it enables the FAA and military aeromedical agencies to maximize public safety and pilot health simultaneously. An added bonus is the epidemiologic data collected on flyers with various medical conditions, which will be important in determining risk for other pilots in the future.

Obstructive sleep apnea (OSA) is an increasingly common condition that requires a waiver or Special Issuance as part of the medical certification process, as it may cause pilots to become easily fatigued or fall asleep during flight operations. Identifying pilots who are at risk for OSA but who may not admit they have it requires the examiner to look for risk factors such as obesity, larger neck size, history of morning headaches, and daytime drowsiness. A sleep study also may be required if they are found

to have increased risk factors. Given a diagnosis of OSA, the FAA will want to see that the condition has been successfully treated (eg, with CPAP). The AME will also encourage the patient to reduce his risk by losing weight.

Pilots with atherosclerotic coronary disease must undergo appropriate testing and interventions to prove that their disease is under control and that there is minimal risk for in-flight incapacitation or return of symptoms (ie, angina, dysrhythmia) that might interfere with their ability to perform flight duties. Return to flying after a coronary bypass requires an appropriate waiting period (usually six months), demonstration of normal cardiac function with exercise (a treadmill test), and evidence that the pilot is addressing any modifiable risk factors (obesity, hypercholesterolemia, or hypertension) aggressively and successfully.

If a pilot has suffered a stroke, the concern is for control of risk factors, stroke recurrence, and possible post-stroke sequelae. Typically, a two-year observation period, during which the pilot does not fly, is required even if he or she has fully recovered and has a normal examination. This is because the FAA relies on population data, which indicate that the highest risk of recurrence is during the two years post-event, although this varies with individual risk factors and stroke etiology. Some patients, such as those with lacunar strokes, may be returned earlier if the antecedent risk factors (eg, hypertension) have been controlled.

Pilots with diabetes who are taking hypoglycemic medications such as sulfonylureas are of concern because of potential for hypoglycemic events with few or no symptoms. This can be a significant problem if the pilot is operating an aircraft alone. Use of phosphodiesterase inhibitors can be problematic because of potential for cardiac electrical conduction effects. With sildafenil, color vision changes are an issue.

Diabetes that requires insulin is a particular concern. It is potentially incapacitating if hypoglycemia becomes severe enough, and its complications such as retinal disease can subtly affect pilot performance. For those with type 1 diabetes, returning to flying is a highly controlled process. It is currently an option only for recreational pilots. In such cases, pilots must show adequate control and lack of significant secondary complications such as retinopathy or proteinuria. They also must pass appropriate screening for potential coronary disease including treadmill testing if they are older than 40 years of age.

Although those conditions clearly put pilots at risk, flight surgeons need to be aware that common and/or minor problems also could affect a pilot's ability to fly safely. For example, even something as seemingly benign as GERD or irritable bowel syndrome may become severely distracting at altitude, given expansion of gas within the GI tract.

Conclusion

The FAA and other aeromedical authorities are concerned about the safety of both pilots and the public. Pilots and physicians, even those who are not flight surgeons, share the responsibility for addressing medical issues in the best way possible in order to limit

Aerospace Medicine at Mayo Clinic

On average, physicians in the Section of Aerospace Medicine on Mayo Clinic's Rochester campus evaluate more than 400 pilots per year. Approximately 38% of these are seeking first-class, 17% second-class, and 45% third-class medical certificates. The number of examinations requested has been growing by roughly 10% per year over the past decade. About half of these aviators require either an initial FAA Special Issuance or renewal of a Special Issuance for conditions ranging from simple hypertension to type 2 diabetes combined with coronary disease.

The diagnoses most commonly requiring waiver management in pilots evaluated at Mayo Clinic are hypertension, malignancy, heart disease, sleep apnea, and neurologic disorders. In 2009, over a 10-month period, 159 special issuance submissions resulted in 147 pilots receiving certificates.

risk. Conversely, because experienced pilots are safer pilots, it is important not to unnecessarily ground those with conditions that are adequately managed and do not have significant potential to affect their performance. Physicians who are not flight surgeons who see pilots as patients should consider consulting with a flight surgeon prior to embarking on diagnostic and therapeutic interventions, as some diagnoses, procedures, and medications may be less likely to affect the pilot's flying career than others.

All providers and pilots need to do their best to understand the aerospace environment and the challenges it presents to humans. Because pilots want to keep flying, flight docs need to establish good a relationship with each pilot patient. By encouraging pilots to raise health concerns, they can address them early and keep their pilot patients flying as long as possible and as safely as possible.

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Radiation Exposure and Air Travel

Should We Worry?

By Ronnell Hansen, M.D., and Elisa Hansen, D.O.

■ With the federal government introducing new advanced imaging scanners at airports, the traveling public has become concerned about the radiation exposure they may receive when passing through scanners as well as during flight. This article offers a primer on radiation and the extent to which exposure from various sources can affect health. It also provides advice for physicians whose patients may have concerns about radiation exposure during air travel.

The catastrophic events at Japan's tsunami-damaged Fukushima nuclear power plant and media reports about inappropriately high radiation doses delivered during medical imaging have heightened public concern about the potential long-term consequences of radiation exposure. Although we presume a positive risk-benefit ratio from diagnostic scans and medical treatments that involve radiation, there is growing concern about the health effects of the cumulative amount of radiation individuals are exposed to over the course of their lifetime. With the recent addition of more security scanners at airports around the country, the public has expressed concern about the amount of radiation they may be exposed to when passing through security and flying.

This article provides background on radiation and discusses what is known about its potential effect on biologic systems as well as the statistical risk of radiation exposure in airports and on airplanes.

Understanding Radiation

Visible light, X-rays, gamma rays (nuclear medicine), microwaves, and radio waves (MRI) are all forms of radiation; radiation can be defined simply as moving energy and occurs in ionizing and nonionizing forms. Ionizing radiation consists of particles (photons) that have enough energy to remove electrons from atoms or molecules. Alpha, beta, neutron, gamma, and X-ray waves are forms of ionizing radiation. Ionization (electron removal) results in free radicals, atoms or molecules containing unpaired electrons that tend to be chemically reactive and potentially can damage DNA. Nonionizing radiation consists of lower-energy particles/photons, which typically only change the rotational, vibrational, or electron valence of molecules and atoms, affecting their ability to bond with other atoms. Nonionizing radiation can produce nonmutagenic effects such as inciting thermal energy in biological tissue that can lead to burns. Radio waves and the magnetic waves used in diagnostic MRI are examples of nonionizing radiation.¹

The two main sources of ionizing radiation are natural ra-

diation (cosmic radiation and radiation from radon gas and radioactive materials in the body) and radiation from medical tests and procedures (imaging and cancer therapy). Quantifying their potential for biologic damage is not easy. The measure "total ionizing dose," which is the amount of energy deposited per unit mass of medium, is not necessarily a good indicator of likely biological effect because equal doses of different types of radiation cause different amounts of damage to living tissue. A better estimate of effect is "equivalent dose," which takes into account factors reflecting different relative biological consequences. Equivalent dose is calculated by multiplying the absorbed dose by a weighting factor that is different for each type of radiation. It is frequently reported in milliSieverts (mSv).

Health Effects of Radiation Exposure

The public's No. 1 concern regarding radiation is that it may cause cancer. The probability of exposure to ionizing radiation causing cancer depends on both the dose rate and the sensitivity of the organism. Ionizing radiation causes harm in two ways: It forms free radicals that may indirectly damage DNA, and it may directly break down DNA molecules.²⁻⁵

The average amount of radiation a person in the United States receives from all sources is estimated to be 6.20 mSv per year.¹ That may vary depending on the environment in which one lives, the work a person does, and the medical procedures he or she undergoes. Currently, international standards allow exposures up to 50 mSv per year for those working with and around radioactive material. Federal law mandates lower doses for women who are pregnant—5 mSv during the entire gestational period and 0.5 mSv during any month of pregnancy.^{6,7}

Determining biological significance and potential damage to tissues and systems remains a challenge, however, as not all tissues (and perhaps not all individuals) react the same way to the same level of exposure. In many cases, it may be difficult if not impossible to determine the precise dose to any given tissue, and often doses are adjusted to standardized "whole-body exposures," even

though only a small portion of the body may be exposed. Adding to the confusion is the fact that medical equipment manufacturers use variable methods to quantify the dose delivered by their products. Calculating dose is further complicated by a person's size and percentage of body fat. Patients who have very little body fat to attenuate radiation can receive higher effective doses. As a result of these factors, some CT-dose algorithms for pediatric patients may have underestimated the delivered effective dose in neonates by as much as 300%. Recently, much-improved volumetric dose methods using phantoms (simulated targets) have been developed, substantially improving such estimates, which are now thought to be within 20% of the actual delivered dose.⁸ As medical tests and treatments deliver so much radiation, recording patient exposures and the cumulative amount delivered in the electronic health record will likely be required in the future.

Unlike ionizing radiation, nonionizing radiation is currently considered noncarcinogenic. The effect of nonionizing forms of radiation on living tissue has only recently been studied, and different biological effects of exposure to different types of nonionizing radiation have been observed.^{9,10} For example, a majority of animal studies show no adverse effect of chronic exposure to microwaves, although some do suggest they might contribute to the potential for increased rates of tumor growth (which also occurs in chronically stressed animals not exposed to radiation).¹¹ Boian S. Alexandrov and colleagues from the Center for Nonlinear Studies at Los Alamos National Laboratory constructed mathematical models to assess the effect of terahertz waves that were a frequency 10 to 100 times higher than microwaves on double-stranded DNA. Their analysis suggested that terahertz waves might "unzip" DNA, creating bubbles within the double strand that could significantly interfere with processes such as gene expression and DNA replication.¹² Experimental verification of this model has not yet been performed. Recent analysis suggests this would not actually occur under reasonable physical conditions.¹³

Radiation Related to Air Travel

Air travelers are exposed to two main sources of radiation: cosmic radiation during flight and radiation from scanners while undergoing security clearance.

Two types of modern advanced imaging technology are used for security scanning: backscatter X-ray (BSX) scanners and millimeter wave scanners (MWS). BSX scanners, like medical imaging machines, use X-ray photons but at considerably lower doses. Unlike traditional X-ray or CT imaging, which directs higher-energy radiation through a target, BSX scanners use lower-energy radiation that reflects from a target. This technology is able to assess only one side of a target such as the front or back side of a human being, rendering a 2-D image that resembles a chalk etching. The Health Physics Society estimates that the dose of radiation from a BSX scan is approximately 0.05 μ Sv;^{14,15} American Science and Engineering Inc., a manufacturer of backscatter scanners, estimates the dose at 0.09 μ Sv.

The Food and Drug Administration proposes an allowable

scan dose of 0.1 μ Sv, assuming that the dose increases the individual lifetime risk of death from cancer 5×10^{-10} .¹⁶⁻¹⁹ Thus, we could anticipate one additional cancer death per 200 million scans.

Active MWS systems transmit a millimeter wave through dual antennas as they rotate around a target, constructing a 3-D image using reflected energy similar to BSX. Passive MWS systems detect energy naturally emitted from the body or from objects concealed on the body and produce an image that resembles a fuzzy photo negative. Passive MWS systems direct no additional energy at the subject and are considered as safe as a digital camera for both the screener and the person being scanned.

High-altitude cosmic radiation likely poses more risk to travelers than radiation from either type of security scanner. The dose received during air travel is estimated at approximately 0.005 mSv/hr; thus, the dose received during a six-hour flight would be approximately 20 μ Sv, which is 200 to 400 times greater than a dose received during a BSX scan. For every 1 million people who travel by air, an estimated 600 additional cancers would occur as a result of exposure to the higher levels of radiation during flight.²⁰

Relative Risk

The statistical associations between exposure to radiation and cancer typically have been based on populations exposed to high levels of ionizing radiation such as the survivors of the atomic blasts at Hiroshima and Nagasaki and recipients of selected diagnostic or therapeutic medical procedures. Accurately determining potential causal relationships between exposure to smaller radiation doses and cancer is complicated by the relatively high incidence of lifetime risk of cancer for the general population independent of additional extrinsic radiation exposure. The lifetime risk of developing cancer is 44% for men and 38% for women; the lifetime risk of dying from cancer is 23% for men and 20% for women.²¹ Thus, extrapolations of cancer risk from minuscule exposures to radiation across large populations cannot easily be statistically supported. In an analysis of the issue, the National Council on Radiation Protection stated the following: "Summation of trivial average risks over very large populations or time periods into a single value produces a distorted image of risk, completely out of perspective with risks accepted every day, both voluntarily and involuntarily, and statistical extrapolation predicting one death in 200 million scanned is an unrealistic over-estimation."²²

To gain some perspective on the amount of risk we are confronting when we fly, we need to think in terms of relative risk. Andrew J. Einstein, director of cardiac CT research at Columbia University Medical Center in New York has estimated that a passenger would need to be scanned with BSX from front and back about 200,000 times to receive the amount of radiation equal to one typical CT scan.²³ Comparably, having a BSX scan every day of your life would deliver one-tenth of the dose delivered during a typical CT scan. Most recent analyses by University of California San Francisco/University of California Berkeley,²⁰ the Center for Radiological Research at Columbia University Medical Center New York,²⁴ and the National Council on Radiation

Protection and Measurements²⁵ have largely alleviated concerns about radiation exposure from BSX scanners, assuming they are used correctly. Individual risk is considered sufficiently low for the security function performed, and exposure to radiation from BSX scanners is estimated to be safe for most persons flying only a few times a year. The risk is higher for frequent flyers, and the long-term consequences of such exposures are unknown.²⁶

It is important for people to understand that they are exposed to background radiation from multiple sources in daily life. A number of additional factors contribute to the amount of radiation to which they are exposed. Comparative examples include residing in a state bordering the Gulf or the Atlantic coast, which adds a dose of 0.16 mSv; living on the Colorado Plateau (0.63 mSv); residing in stone/adobe/brick/concrete building (0.07 mSv); living within 50 miles of a nuclear power plant (0.0001 mSv); living within 50 miles of a coal-fired power plant (0.0003 mSv); consuming food (0.4 mSv); and breathing the radon gas found in air (2.28 mSv). More localized forms of radiation exposure may come from uranium in porcelain dental crowns or false teeth (0.0007 mSv per day) or smoking half a pack of cigarettes daily (0.18 mSv per day).²⁷

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Conclusion

Statistically, the risk posed by exposure to radiation from passing through BSX and MWS scanners in airports and during commercial flight is exceedingly low. Relatively speaking, the radiation people receive from medical imaging and procedures poses a much greater risk. For that reason, when physicians are counseling patients who are concerned about the amount of radiation they will receive going through airport security or during flight they might do better to focus the discussion on issues that are more likely to ensure safety such as appropriate use of medical radiation and developing habits including use of seat belts.

The American College of Radiology has developed educational materials for patients, providers, and radiologists through their Image Wisely and Image Gently campaigns in an effort to reduce the amount of medical radiation patients receive for routine procedures. In addition, manufacturers of imaging equipment are developing new technologies that will significantly reduce the amount of radiation delivered during imaging—in some cases by more than tenfold. Although the amount of radiation delivered during a CT scan may never be as low as that delivered by an airport security scan, we are likely to see substantial reductions in medical imaging radiation during the next three to five years.

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Air Travel and Venous Thromboembolism

Minimizing the Risk

By John R. Bartholomew, M.D., Jonathan L. Schaffer, M.D., M.B.A.,
and Georges F. McCormick, M.D.

■ For those traveling on long flights, the risk of deep vein thrombosis or pulmonary embolism, generally referred to as venous thromboembolism (VTE), is real and dangerous if left unrecognized or untreated. The goal of this article is to provide an overview of how best to prevent VTE during travel, and how to diagnose and treat it.

Venous thromboembolism (VTE) associated with travel has emerged as an important public health concern over the past decade. Numerous epidemiologic and case control studies have reported air travel as a risk factor for the development of VTE and have attempted to determine who is at risk and which precautions need to be taken to prevent this potentially fatal event.¹⁻⁷ Often referred to as “traveler’s thrombosis” or “flight-related deep vein thrombosis,” VTE can also develop after long trips by automobile, bus, or train.^{8,9} Although the absolute risk is very low, this threat appears to be about three times higher in travelers and increases with longer trips.³

This article focuses on defining VTE and recognizing its clinical features, as well as providing recommendations and guidelines to prevent, diagnose, and treat this complication in people who travel.

What Is Venous Thromboembolism?

Deep vein thrombosis and pulmonary embolism represent different manifesta-

tions of the same clinical entity, ie, VTE. VTE is a common, lethal disease that affects hospitalized and nonhospitalized patients, frequently recurs, is often overlooked, may be asymptomatic, and may result in long-term complications that include pulmonary hypertension and the postthrombotic syndrome.

The leg veins are the most common site of deep vein thrombosis, accounting for nearly 90% of all cases; other locations include the arm and pelvic veins (Figure). Deep vein thrombosis in a proximal lower extremity (ie, involving the popliteal, femoral, common femoral, or external iliac vein) has an estimated 50% risk of migrating and leading to an acute pulmonary embolism if not treated, while approximately 25% of deep vein thromboses in the calf veins will, if not treated, propagate to involve the aforementioned veins.

Deep vein thrombosis of the upper extremities is generally related to an indwelling venous catheter or a central line being used for long-term administration of antibiotics, chemotherapy, or nutrition. A condition known as Paget-Schroetter syndrome or “effort throm-

Key Points

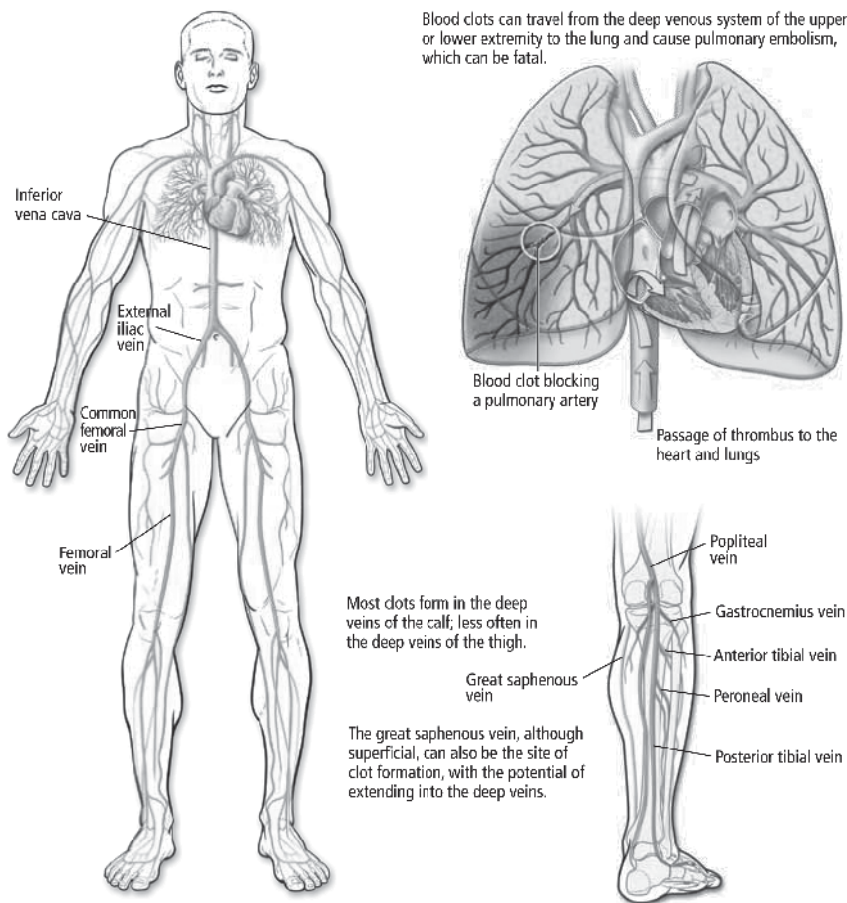
- The risk of VTE is about three times higher in passengers on long-distance flights than in the general population, although the absolute risk is still low.
- All long-distance air passengers should perform stretching exercises once an hour while in flight to prevent VTE. They should also stay hydrated.
- For patients at higher risk due to hypercoagulable conditions, physicians can consider prescribing compression stockings or an anticoagulant drug (a low-molecular-weight heparin or a factor Xa inhibitor) to be taken before the flight, or both.
- The evaluation of a patient with suspected VTE should include an estimation of the pretest probability of disease. If symptoms dictate, duplex ultrasonography of the upper or lower extremity to detect deep vein thrombosis or spiral computed tomography, ventilation-perfusion lung scan, or pulmonary angiography (where available) to diagnose an acute pulmonary embolism should be ordered.

Bartholomew JR, Schaffer JL, McCormick GF. Air travel and venous thromboembolism: minimizing the risk. Cleve Clin J Med. 2011;78:111-20. This article is reprinted with permission. Copyright © 2011 The Cleveland Clinic Foundation. All rights reserved.

Figure

Deep Venous Thrombosis and Pulmonary Embolism

Sitting for long periods during long flights can lead to venous stasis and deep venous thrombosis. Although the absolute risk is low, it is higher in those with preexisting risk factors for thrombosis, who may need preventive treatment (Table 4). All travelers should periodically stretch and move their legs.



Medical Illustrator: Bill Garriott © 2011 CCF

bosis” may be seen in younger or athletic people who have a history of strenuous or unusual arm exercise.

Risk Factors for VTE

Most patients who develop VTE have one or more risk factors for it (Table 1), the presence of which is often referred to as a hypercoagulable state or thrombophilia. These risk factors are generally classified as either genetic (inherited) or acquired (environmental). Most VTE events are in fact associated with a combination of genetic and acquired risk factors.

Common inherited risk factors include:

- Factor V Leiden mutation
- Prothrombin gene mutation

G20210A

- Hyperhomocysteinemia
- Deficiency of the natural anticoagulant proteins C, S, or antithrombin
- Elevated levels of factor VIII (may be inherited or acquired).

Acquired risk factors include:

- Older age
- Immobilization or stasis (such as sitting for long periods of time while traveling)
- Surgery (most notably orthopedic procedures including hip and knee replacement and repair of a hip fracture)
- Trauma
- Stroke
- Acute medical illness (including con-

gestive heart failure, chronic obstructive pulmonary disease, pneumonia)

- The antiphospholipid syndrome (consisting of a lupus anticoagulant, anticardiolipin antibodies, or both)
- Pregnancy and the postpartum state
- Use of oral contraceptives or hormone replacement therapy
- Cancer (including the myeloproliferative disorders) and certain chemotherapeutic agents
- Obesity (a body mass index >30 kg/m², see www.nhlbisupport.com/bmi/)
- Inflammatory bowel disease
- Previous VTE
- A central venous catheter or pacemaker
- Nephrotic syndrome.

In addition, emerging risk factors more recently recognized include male sex, persistence of elevated factor VIII levels, and the continued presence of an elevated D-dimer level or deep vein thrombosis on duplex ultrasonography once anticoagulation treatment is completed. There is also evidence of an association between VTE and risk factors for atherosclerotic arterial disease such as smoking, hypertension, hyperlipidemia, and diabetes.

Clinical Manifestations of VTE

Patients with deep vein thrombosis may complain of pain, swelling, or both in the leg or arm. Physical examination may reveal increased warmth, tenderness, erythema, edema, or dilated (collateral) veins, most notable on the upper thigh or calf (for deep vein thrombosis in the lower extremity) or the chest wall (for upper-extremity deep vein thrombosis). The examiner may also observe a tender, palpable cord, which represents a superficial vein thrombosis involving the great and small saphenous veins (Figure). In extreme situations, the limb may be cyanotic or gangrenous.

Patients with acute pulmonary embolism are likely to complain of the sudden onset of shortness of breath, pleuritic chest pain (especially with breathing), syncope, cough, or hemoptysis.

Table 1

Risk Factors for Venous Thromboembolism

Age

- Older age, with increasing risk after age 40

Weight

- Body mass index >30 kg/m² (can be calculated as [mass in pounds × 703]/[height in inches²]; see www.nhlbisupport.com/bmi/)

Medications

- Women taking oral contraceptives or hormone replacement

Medical or surgical issues

- Previous venous thromboembolism, either deep venous thrombosis or pulmonary embolism
- Varicose veins
- Medical illness (congestive heart failure, chronic obstructive pulmonary disease, stroke with paralysis or paresis, pneumonia)
- Pregnancy and up to six weeks postpartum
- Active cancer or cancer chemotherapy
- Central venous catheter placement
- Thrombophilia disorders, including factor V Leiden mutation, prothrombin G20210A gene mutation, protein C and S deficiencies, antithrombin deficiency, antiphospholipid syndrome, elevated levels of factor VIII
- Recently bedridden more than three days
- Recent cast immobilization or major surgery (within 12 weeks before flying that required general or regional anesthesia)
- Recent trauma within three months (or anything that compresses the veins such as a hematoma or fracture)

Additional Risk Factors Specific to Air Travelers

Height

- People who are under 165 cm (65 inches or 5 feet 5 inches) in height*
- People who are over 185 cm (73 inches or 6 feet 1 inch) in height*

Flight duration

- Single long-haul flights of more than eight to 10 hours Multiple long-haul flights of at least four hours (risk may persist up to eight weeks after the flight)*
- More frequent flights of any duration within a short time frame (ie, days or three weeks)

*Kuipers S, Cannegieter SC, Middeldorp S, et al. The absolute risk of venous thrombosis after air travel: a cohort study of 8,755 employees of international organizations. *PLoS Med.* 2007;4:1508-14.

Diagnosis of VTE

Clinical examination alone is generally insufficient to confirm a diagnosis of deep vein thrombosis or pulmonary embolism. Venous duplex ultrasonography is the most dependable investigation for deep vein thrombosis, but other tests include D-dimer and imaging studies such as computed tomographic venography or magnetic resonance venography of the lower extremities. A more invasive approach is venography; formerly considered the gold standard, it is now generally used only when the diagnosis is in doubt after noninvasive testing. The diagnosis of acute pulmonary embolism is best made

by spiral computed tomography.

Other studies that may prove helpful include a ventilation-perfusion lung scan for patients who cannot undergo computed tomography due to a contrast allergy or renal insufficiency. Pulmonary angiography, while the gold standard, is less commonly used today, given the specificity and sensitivity of computed tomography.

Echocardiography at the bedside may be useful for patients too sick to move, although the study may not be diagnostic unless thrombi are seen in the heart or pulmonary arteries.

Treatment of VTE

Treatments for VTE are summarized in Table 2. The length of treatment for acute VTE is generally three to six months. Patients with a known precipitating cause such as recent surgery or oral contraceptive use normally require three months of therapy, while those who had an unprovoked (idiopathic) event require longer therapy, sometimes continuing indefinitely.

■ For Acute Deep Venous Thrombosis

Acute deep vein thrombosis is now treated on an outpatient basis under most circumstances.

Unfractionated heparin is given intravenously for patients who need to be hospitalized, or subcutaneously in full dose for inpatient or outpatient treatment.

Low-molecular-weight heparins are available in subcutaneous preparations and can be given on an outpatient basis.

Fondaparinux (Arixtra), a factor Xa inhibitor, can also be given subcutaneously on an outpatient basis. Equivalent products are available outside the United States.

Warfarin (Coumadin), an oral vitamin K inhibitor, is the agent of choice for long-term management of deep vein thrombosis.

Other oral agents are available outside the United States.

■ For Pulmonary Embolism

Outpatient treatment of pulmonary embolism is not yet advised: an initial hospitalization is necessary. The same anticoagulants used for deep vein thrombosis are also used for acute pulmonary embolism.

■ Empiric Treatment in Underdeveloped Countries

VTE may be an even greater concern on an outbound trip to a remote area, where medical care capabilities may be less than ideal and diagnostic and treatment options may be limited.

If there is a high pretest probability of acute VTE and no diagnostic methods are available, empiric treatment with any of the parenteral anticoagulant agents listed in Table 2 is an option until the diagnosis

Table 2

Treatments for Venous Thromboembolism

Pharmacologic Methods

Heparin in full doses*

| | | | | |
|---|----|--|----|--|
| Intravenous: 80 units/kg bolus followed by 18 units/kg/hour | OR | Subcutaneous: 5,000 units intravenous bolus followed by 17,500 units subcutaneously every 12 hours | OR | 333 units/kg subcutaneous bolus followed by 250 units/kg subcutaneously every 12 hours |
|---|----|--|----|--|

Low-molecular-weight heparins†**

- Enoxaparin (Lovenox) 1 mg/kg subcutaneously every 12 hours, assuming renal function is normal
- Dalteparin (Fragmin) 200 units/kg subcutaneously every 24 hours
- Tinzaparin (Innohep) 175 units/kg subcutaneously every 24 hours
- All low-molecular-weight heparin preparations must be dose-adjusted if there is renal insufficiency (creatinine clearance <30 mL/min) and are contraindicated in patients on hemodialysis

Fondaparinux (Arixtra)†**

Weight-dependent dosing:

- 5 mg subcutaneously every 24 hours for patients weighing <50 kg
- 7.5 mg subcutaneously every 24 hours for patients weighing 50 to 100 kg
- 10 mg subcutaneously every 24 hours for patients weighing over 100 kg

All factor Xa inhibitors are contraindicated if there is renal insufficiency (creatinine clearance <30 mL/min) or patients on hemodialysis

Warfarin (Coumadin)†

Available in tablets of 1, 2, 2.5, 3, 4, 5, 6, 7.5, and 10 mg

Tissue plasminogen activator (Activase)*

100 mg intravenously over two hours for acute pulmonary embolism in life-threatening conditions (hemodynamic instability) or at the physician’s discretion if signs of right heart failure are present

Contraindicated if bleeding risk exists or recent stroke or surgery

Mechanical Methods

Inferior vena cava filters (temporary or permanent)

Mechanical thrombectomy for deep vein thrombosis, pulmonary embolectomy for pulmonary embolism

These procedures are generally performed only at tertiary medical centers

Graduated compression stockings

30 to 40 mm Hg to prevent the post-thrombotic condition. Should be given to all patients with lower-extremity deep vein thrombosis. If they are unable to comply with that much compression, a lower-compression stocking may be substituted (ie, 20 to 30 mm Hg).

* See package insert for additional instructions and specific contraindications

† Other agents of this class are available outside the United States

can be confirmed. Caveats:

- Care must be taken to be certain there is not a strong contraindication to the use of anticoagulation, such as bleeding or a drug allergy.
- Neither unfractionated heparin nor any of the low-molecular-weight heparins should be given to a patient who has a history of heparin-induced thrombocytopenia.
- In patients who have chronic kidney disease (creatinine clearance less than 30 mL/minute), the dosage of low-molecular-weight heparins must be adjusted and factor Xa inhibitors avoided. Both of these types of anticoagulants should be avoided in patients on hemodialysis.

More Aggressive Therapy

Under select circumstance, a more aggressive approach to the treatment of VTE may be necessary. These options are usually indicated for a patient with a massive deep vein thrombosis of a lower extremity and for certain patients with an upper-extremity deep vein thrombosis. Treatments include catheter-directed thrombolytic therapy and endovenous or surgical thrombectomy.

Thrombolytic therapy is recommended for a patient with an acute pulmonary embolism who is clinically unstable (systolic blood pressure lower than 90 mm Hg), if there is no contraindication to its use (bleeding risk or recent stroke or surgery). Thrombolytic therapy is also an option for those at low risk of bleeding with an acute pulmonary embolism who have signs and symptoms of right heart failure proven by echocardiography.

Surgical pulmonary embolectomy for acute massive pulmonary embolism and mechanical thrombectomy for extensive deep vein thrombosis are generally available only at highly sophisticated tertiary care centers.

An inferior vena cava filter is advised in patients with acute deep vein thrombosis or pulmonary embolism who cannot be fully anticoagulated to prevent the clot from migrating from the lower extremities to the lungs. These filters are available as

Table 3

Methods to Prevent Venous Thromboembolism during Air Travel

Pharmacologic Methods

Low-molecular-weight heparins

- Enoxaparin (Lovenox) 40 mg subcutaneously prior to departure (just once a day)
- Dalteparin (Fragmin) 5,000 IU subcutaneously prior to departure (just once a day)
- All low-molecular-weight heparin preparations must be dose-adjusted if there is renal insufficiency (creatinine clearance <30 mL/min) and are contraindicated in patients on hemodialysis. There are additional equivalent low-molecular-weight heparins available in other countries.

Factor Xa inhibitors

- Fondaparinux (Arixtra) 2.5 mg subcutaneously prior to departure (just once a day)
- Rivaroxaban (Xarelto) (approved in Europe and Canada; not approved in the United States for prophylaxis)
- All factor Xa inhibitors are contraindicated in patients with renal insufficiency (creatinine clearance <30 mL/min) or on hemodialysis

Direct thrombin inhibitor

- Dabigatran (Pradaxa in Europe and United States, Pradax in Canada); not approved in the United States for prophylaxis

Mechanical Methods

Exercises while traveling

Graduated compression stockings (15 to 30 mm Hg)

either permanent or temporary implants. Some temporary versions can remain in place for up to 150 days after insertion.

Prevention of VTE

Prevention is the standard of care for all patients admitted to the hospital and in select individuals as outpatients who are at

high risk of VTE.

A number of anticoagulant drugs are available in the United States for prophylaxis, including unfractionated heparin, low-molecular-weight heparin preparations, and fondaparinux (all of these given subcutaneously) and warfarin. In Europe and Canada, additional low-molecular-weight heparin preparations, factor Xa inhibitors, and direct thrombin inhibitors are available that have proven to be equally effective (Table 3).

Mechanical compression (graduated compression stockings, intermittent pneumatic compression devices) has proven effective in reducing the incidence of deep vein thrombosis and pulmonary embolism postoperatively in patients who cannot take anticoagulants. One study has demonstrated that compression stockings may also be effective in preventing VTE during travel.¹⁰

Absolute Risk Is Low

Over the past decade, special attention has been paid to travel as a risk factor for developing VTE.¹¹ Traveler's thrombosis has become an important public health concern. Numerous publications and epidemiologic studies have targeted air travel in an attempt to determine who is at risk and what precautions are necessary to prevent this complication.^{1-7,9}

The incidence of VTE following air travel is reported to be 3.2 per 1,000 person-years.⁴ While this incidence is relatively low, it is still 3.2 times higher than in the healthy population that is not flying.

The more serious complication of VTE, ie, acute pulmonary embolism, occurs less often. In three studies, the reported incidence ranged from 1.65 per million patients in flights longer than eight hours to a high of 4.8 per million patients in flights longer than 12 hours or distances exceeding 10,000 km (6,200 miles).^{5,12,13} For the 400 passengers on the average long-haul flight of 12 hours, there is at most a 0.2% chance that somebody on the plane will have a symptomatic VTE.

Risk Factors in Long-Distance Travelers

The risk of traveler's thrombosis has recently attracted the attention of passengers and the airline industry. Airlines are now openly discussing the risk and providing reminders such as exercises that should be undertaken in-flight. Some airlines are recommending that all patients consult their doctor to assess their personal risk of deep vein thrombosis before flying.

The most common risk factors for VTE in travelers are well established and are additive (Table 1). The extent of the additive risk, however, is not entirely clear.

What is clear is that when VTE occurs, it is a life-altering and life-threatening event. If it occurs on an outbound trip, the local resources and capabilities available at the destination may not be adequate for optimal treatment. If a traveler experiences a VTE event on an outbound trip, an emergency return trip to the continental United States or a regional center of expertise may be required. There is an additive risk with this subsequent travel event if the patient is not given immediate treatment first (Table 2). Hence, treatment prior to evacuation should be strongly considered.

The traveler must also be aware that VTE can be recognized up to two months after a long-haul flight, though it is especially a concern within the first two weeks after travel.^{2,4,14,15}

Recommendations for Long-Distance Air Travelers

Each person should be evaluated on a case-by-case basis for his or her need for VTE prophylaxis. Medical guidelines for airline passengers have been published by the Aerospace Medical Association and the American College of Chest Physicians (ACCP).^{16,17} In general, travelers should:

- Exercise the legs by flexing and extending the ankles at regular intervals while seated and frequently contracting the calf muscles.
- Walk about the cabin periodically, five minutes for every hour on longer-duration flights (over four hours) and when flight conditions permit. ➤

Table 4

Estimation of Venous Thromboembolism Risk for Travelers

The absolute risk of venous thromboembolism (VTE) is low. This tool has been devised in an effort to help guide the clinician in making a decision about when to use low-molecular-weight heparin or an anti-Xa inhibitor for VTE prophylaxis for individuals traveling on long-haul flights (more than eight to 10 hours). This has not been tested in any study, but rather it is based upon an estimation of the increased risk for VTE that the following conditions cause.

As for all travelers, standard thromboprophylaxis precautions (exercises and compression stockings) should be strongly recommended for travelers who have the following risk factors for VTE:

- Pregnancy or recent delivery within six weeks
- Use of contraceptives or hormone replacement therapy or tamoxifen
- Autoimmune disorders
- Congestive heart failure, pneumonia, chronic obstructive lung disease
- Leg varicosities
- Obesity (body mass index >30 kg/m²)
- Tall stature (>185 cm or 73 inches)
- Short stature (<165 cm or 65 inches)
- Age >70 years
- Family history of VTE or thrombophilia (hypercoagulable states)

When a patient who will have air travel lasting more than eight to 10 hours has several of the above risk factors, the clinician should consider adding low-molecular-weight heparin or a factor Xa inhibitor. Pharmacologic thromboprophylaxis should be strongly considered when the patient’s risk of thrombosis exceeds the potential for an adverse reaction from the use of these anticoagulants.

Any one of the following conditions should prompt the clinician to recommend low-molecular-weight heparin or a factor Xa inhibitor (unless currently on full-dose anticoagulation or bleeding risk is prohibitive), which should be given prior to departure:

- Prior provoked VTE with ongoing risks
- Recurrent VTE or unprovoked VTE at any time
- Known thrombophilia (hypercoagulable states including factor V Leiden mutation, prothrombin gene mutation G20210A, elevated factor VIII, deficiency of proteins S, C, or antithrombin), or the antiphospholipid syndrome
- Myeloproliferative disorders (especially essential thrombocytosis or polycythemia vera with a hematocrit >55%)
- Malignancy and ongoing chemotherapy treatment
- Flaccid leg paralysis, inability to ambulate, or a nonremovable long leg cast or brace
- Major surgery within the prior four to 12 weeks, most notably total hip and knee replacements, or hip fracture, or recently bedridden for more than three consecutive days
- Recent major trauma

- Drink adequate amounts of water and fruit juices to maintain good hydration.¹⁵
- Avoid alcohol and caffeinated beverages, which are dehydrating.
- Be careful about eating too much during the flight.
- Request an aisle seat if you are at risk.
- Do not place baggage underneath the seat in front of you because that reduces the ability to move the legs.
- Do not sleep in a cramped position,

and avoid the use of any type of sleep aid.

- Avoid wearing constrictive clothing around the lower extremities or waist.

If a patient has risk factors in addition to more than eight to 10 hours of flying (Tables 1 and 4), the physician should consider additional preventive measures including compression stockings or an anticoagulant drug as mentioned above, or both.

We recommend that all airplane pas-

sengers take the steps listed above to reduce venous stasis and avoid dehydration, even though these measures have not been proven effective in clinical trials.¹⁷

The ACCP further advises that decisions about pharmacologic prophylaxis of VTE for airplane passengers at high risk should be made on an individual basis, considering that there are potential adverse effects of prophylaxis and that these may outweigh the benefits. For long-distance travelers with additional risk factors for VTE, we suggest the following:

- Use of properly fitted, below-the-knee graduated compression stockings providing 15 to 30 mm Hg of pressure at the ankle (particularly when large varicosities or leg edema is present).
- For people at very high risk, a single prophylactic dose of a low-molecular-weight heparin or a factor Xa inhibitor injected just before departure (Table 3).
- Aspirin is not recommended as it is not effective for the prevention of VTE.¹⁸

Summary for the Air Traveler

All travelers on long flights should perform standard VTE prophylaxis exercises. Although VTE is uncommon, people with additional risk factors who travel frequently either on multiple flights in a short period of time or on very long flights should be evaluated on a case-by-case basis for a more aggressive approach to prevention (compression support hose or prophylactic administration of a low-molecular-weight heparin or a factor Xa inhibitor).

Should a VTE event occur during travel, the patient should seek medical care immediately. The standard evaluation of a patient with a suspected VTE should include an estimation of the pretest probability of disease, followed by duplex ultrasonography of the upper or lower extremity to detect a deep vein thrombosis. If symptoms dictate, then spiral computed tomography, ventilation-perfusion lung scan, or pulmonary angiography (where available) should be ordered to diagnose

acute pulmonary embolism. A positive D-dimer blood test alone is not diagnostic and may not be available in more remote locations. A negative D-dimer test result is most helpful to exclude VTE.

Standard therapy for VTE is immediate treatment with one of the anticoagulants listed in Table 2, unless the patient has a contraindication to treatment, such as bleeding or allergy. Immediate evacuation is recommended if the patient has a life-threatening pulmonary embolism, defined as hemodynamic instability (hypotension with a blood pressure under 90 mm Hg systolic or signs of right heart failure) that cannot be treated at a local facility. An air ambulance should be used to transport these patients. If the patient has an iliofemoral deep vein thrombosis, it is also advisable that he or she be considered for evacuation if severe symptoms are present, such as pain, swelling, or cyanosis. Unless contraindicated, all patients should be given either full-dose intravenous or full-dose subcutaneous heparin or subcutaneous injection of a readily available low-molecular-weight heparin preparations or factor Xa inhibitor at once.¹⁹ **MM**

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Mission Hospital

By Mark Imig, M.D.

Located on Nairobi-Nakuru highway
Matatus outside blaze a dusty trail

Kenyan highlands surround me
Sleeping Masai on the horizon

Lake Elementaita a majestic sight
Pelicans and flamingoes preparing for flight

Traumas, coughs, cancers, and strictures
Patients' stories live on in pictures

Lab test cost is "food off the table"
Patients hope their condition is treatable

Resources are fewer and patients are sicker
Some receive *dawas* and others need the theater

Simple meals of bread and work-breaks for chai
Families bring bananas and juice to the bedside

Many get better, walk out on their own
Others depart to an eternal home

Tropical medicine a learning experience
Caring and medicine mixed with Providence.

Mark Imig is in the department of psychiatry and psychology at Mayo Clinic in Rochester. He wrote this poem while serving on a Mayo International Health Program rotation in Kenya.

Top: The sign for St. Mary's Mission Hospital in Nairobi. **Middle:** The hospital's waiting room. **Bottom:** During his time in Kenya, Mark Imig worked with girls from St. Therese House of Hope, an orphanage for girls who are HIV positive. He's pictured with a group that accompanied him on a hike into the Kenyan highlands. He describes the girls as "remarkably resilient." Photos courtesy of Mark Imig