PRACTICE CHANGERS

Puking from Pot

SEE PAGE 5

TRAVEL

Adventure to Emergency

SEE PAGE 9

AIRWAY

Facing Our Greatest Challenge

SEE PAGE 20

WILEY

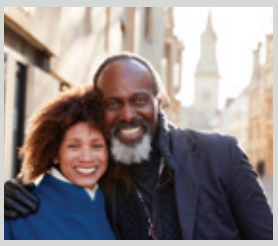
American College of Emergency Physicians®
ADVANCING EMERGENCY CARE

ACEP Now

The Official Voice of Emergency Medicine

FEBRUARY 2021 Volume 40 Number 2 FACEBOOK/ACEPFAN TWITTER/ACEPNOW ACEPNOW.COM

PLUS



THE END OF THE RAINBOW

Hanging Up Your White Coat

SEE PAGE 15

POLICY Rx

Tuning in to Our Communities' Needs

SEE PAGE 16

FIND IT ONLINE

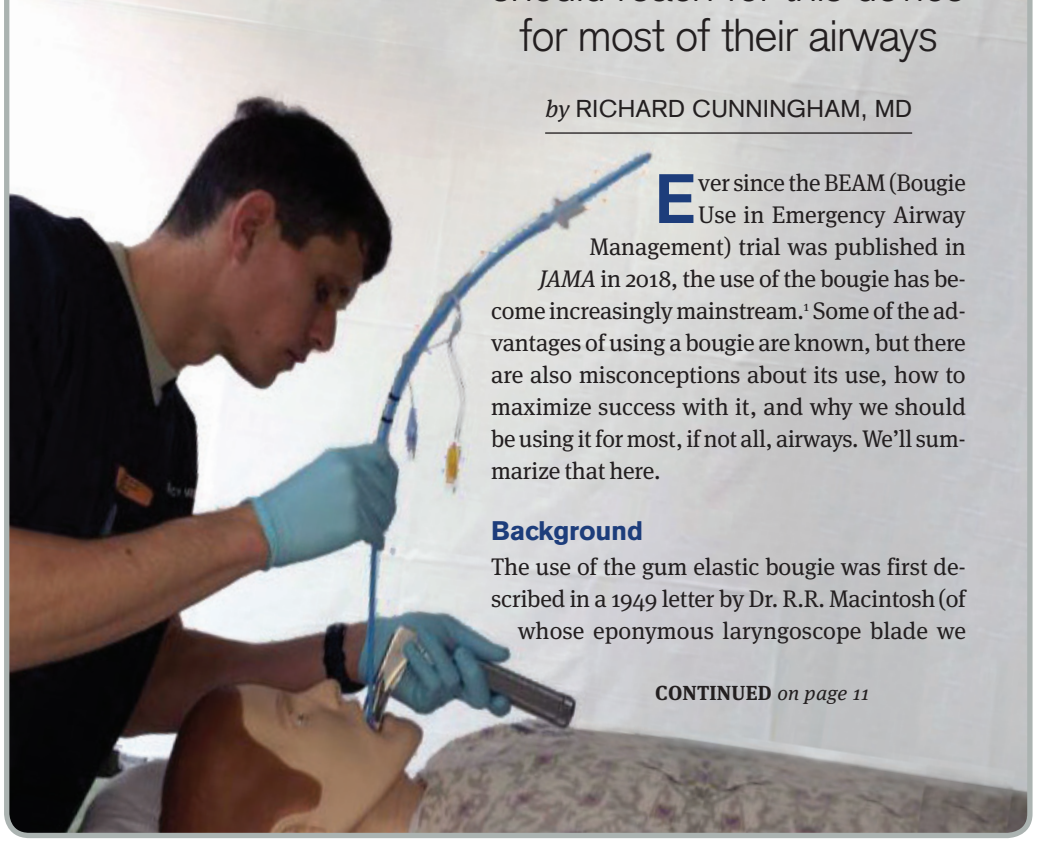
For more clinical stories and practice trends, plus commentary and opinion pieces, go to:

www.acepnow.com

THE BOUGIE AS AN AIRWAY SAVIOR

Emergency physicians should reach for this device for most of their airways

by RICHARD CUNNINGHAM, MD



Ever since the BEAM (Bougie Use in Emergency Airway Management) trial was published in *JAMA* in 2018, the use of the bougie has become increasingly mainstream.[1] Some of the advantages of using a bougie are known, but there are also misconceptions about its use, how to maximize success with it, and why we should be using it for most, if not all, airways. We'll summarize that here.

Background

The use of the gum elastic bougie was first described in a 1949 letter by Dr. R.R. Macintosh (of whose eponymous laryngoscope blade we

CONTINUED *on page 11*

Post-COVID Myocarditis

by LANDON JONES, MD; AND RICHARD M. CANTOR, MD, FAAP, FACEP

KIDS KORNER

Question 1: Is there an increased incidence of COVID-related myocarditis in children?

Viruses are the most common cause of pediatric myocarditis. In general, the most common viruses causing pediatric myocarditis are Coxsackievirus B, other enteroviruses, influenza, rubella, and adenovirus.[1] During and after important viral outbreaks, including the original 2002 severe acute respiratory syndrome (SARS), 2012 Middle Eastern respiratory syndrome (MERS), and 2009 H1N1 influenza A, increases in cardiac abnormalities in adults (suggesting cardiac association with these viruses) have been reported.[2,3]

We are unable to find any articles addressing association between either the original 2002 SARS or MERS with myocarditis in children. Regarding the 2009/2010 H1N1 influenza outbreak, however, reports from pediatric ICUs in the United States and Japan suggested myocarditis incidence of around 1 to 2 percent in these patients (n=8 cases total).[4,5]

Clinically, the incidence of myocarditis is

CONTINUED *on page 19*

ACEP Now
The Official Voice of Emergency Medicine

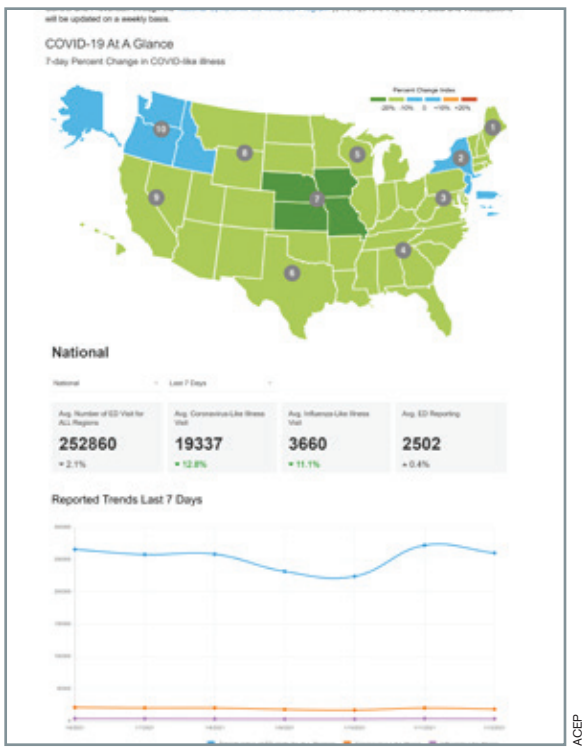
INFORMATION FOR SUBSCRIBERS

Subscriptions are free for members of ACEP and SEMPA. Free access is also available online at www.acepnow.com. Paid subscriptions are available to all others for $310/year individual. To initiate a paid subscription, email cs-journals@wiley.com or call (800) 835-6770. ACEP Now (ISSN: 2333-259X print; 2333-2603 digital) is published monthly on behalf of the American College of Emergency Physicians by Wiley Periodicals LLC, 111 River Street, Hoboken, NJ 07030-5774. Periodical postage paid at Hoboken, NJ, and additional offices. Postmaster: Send address changes to ACEP Now, American College of Emergency Physicians, P.O. Box 619911, Dallas, Texas 75261-9911. Readers can email address changes and correspondence to acepnow@acep.org. Printed in the United States by Hess Print Solutions (HPS), Brimfield, OH.

NEWS FROM THE COLLEGE

UPDATES AND ALERTS FROM ACEP

COVID-19 Data Visualizations



ACEP

ACEP continues to expand its COVID-19 resource library. A recent addition is the "COVID-19 in U.S. Emergency Departments - Data Visualizations," with data across three categories—total visits, COVID-like illness visits, and influenza-like illness visits—that can be sorted by region and time frame. The data are available at both national and Health and Human Services regional resolutions and across several timescales (eg, 7-day, 30-day, 90-day). Data are obtained from the U.S. Centers for Disease Control and Prevention through the National Syndromic Surveillance Program and will be updated on a weekly basis. View the resource at www.acep.org/coviddata.

Nominations Open for ACEP Board, Council

The ACEP Nominating Committee is accepting individual and component body recommendations for Board of Directors, Council Speaker, and Council Vice Speaker candidates. Nominations are due March 22, 2021, and qualifications and application details are available at www.acep.org/board-nominations. Elections for the Board of Directors and Council officers will be held Oct. 24 during the ACEP Council meeting.

Awards Deadline Coming Up

Now is the time to nominate your peers for ACEP's 2021 awards! The annual awards program provides an opportunity to recognize all members for significant professional contributions as well as service to the College. All members of ACEP are eligible to participate in one or more of the College's award programs. Nominations are due March 1, and winners will be honored at the 2021 ACEP Scientific Assembly in October. Learn more at www.acep.org/awards.

Virtual Grand Rounds Continue

ACEP's monthly Virtual Grand Rounds, one of our most popular new education resources during the pandemic, has more topics coming up:

- March 24, 2021: Injury Prevention
- April 28, 2021: Communication: Difficult Conversations
- May 19, 2021: ENT Emergencies

Past sessions are available for viewing, including COVID-19, Wellness, Airway, Ultrasound, Pediatrics, Neurology, Cardiology, and Social Determinants of Health. Learn more or sign up at www.acep.org/virtualgrandrounds.

Conversations with Industry

ACEP's "Conversations with Industry" initiative is a new way for ACEP members to learn about industry products, services, and treatments in this socially distant era. While you may not be able to see products or treatments in person, you can still connect with companies to learn about solutions that may assist your daily practice. View three new packages of micro-education content at www.acep.org/CWI.

- "Guidelines and Use of Nasal High Flow for COVID-19" by Fisher & Paykel Healthcare
- "Brain Injury Assessment" with BrainScope
- "Mitigating Hematoma Expansion: HCP Insights" by Alexion Pharmaceuticals

CORRECTION

Our December 2020 issue omitted the following caption for this photo: **Kara Toles, MD**. *ACEP Now* apologizes for this error.

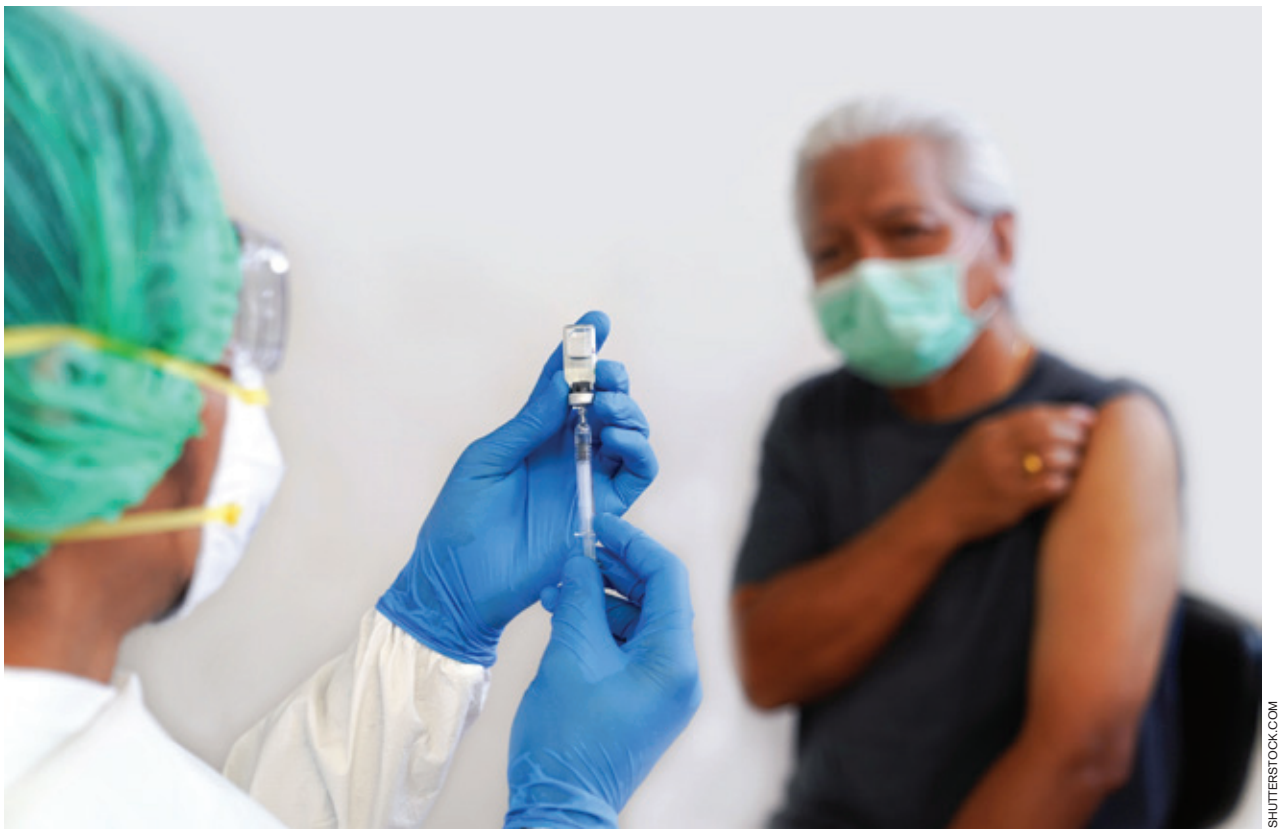
OPINIONS FROM EMERGENCY MEDICINE

A NEW SPIN

Let's Give Vaccination Programs a Shot

Emergency departments can bolster influenza and COVID-19 vaccination programs

by ELISSA M. SCHECHTER-PERKINS, MD, MPH; RICHARD ROTHMAN, MD, PHD; KIRAN FARYAR, MD; MICHAEL WAXMAN, MD; BHAKTI HANSOTI, MD; MICHAEL LYONS, MD; YU-HSIANG HSIEH, PHD; EILI KLEIN, PHD; LARISSA MAY, MD; JASON WILSON, MD; AND DANIEL R. MARTIN, MD, MBA, *on behalf of the Society for Academic Emergency Medicine interest group Emergency Medicine Transmissible Infectious Diseases and Epidemics (EMTIDE)*



SHUTTERSTOCK.COM

The COVID-19 pandemic has proven, yet again, that U.S. emergency departments are a critical part of the nation's health care safety net. As medical centers throughout the country canceled visits in the spring and shifted ambulatory visits to telemedicine, emergency departments remained open and continued to provide 24-7 care. As the coronavirus surges across the nation, emergency departments will continue to care for patients who might otherwise not have in-person contact with the health care system. Emergency departments represent a critical component of the health care infrastructure. There is a unique opportunity for them to serve individual patients, meet public health needs, and contribute to the integrity of the health care system itself by helping to maintain hospital capacity: by providing coronavirus vaccinations during acute ED patient encounters in appropriately selected patients.

Approach to ED-Based Coronavirus Vaccination

Pilot programs across the country have demonstrated over several years the viability of using the emergency department to bolster influenza vaccinations programs.[1-4] However, there has not been broad uptake of these programs, despite policy statements supporting such programs from national organizations including the Centers for Disease Control and Prevention, Advisory Committee on Immunization Practices, and ACEP itself. With the need to vaccinate millions of people across the country against SARS-CoV-2, now is the right time for U.S. emergency departments to consider implementing vaccination programs.

In 2016, there were 144.8 million ED visits in the United States.[5] Compared to the rest of the health care system, individuals who visit emergency departments are disproportionately minorities, less likely to have other contacts with the health care system, and less likely to have health insurance. Thus, we can surmise lower vaccination rates among ED patients compared to the overall U.S. population. These same communities have been disproportionally affected by the COVID-19 pandemic and would most benefit from widespread vaccination efforts.

Why EDs?

Every year, hospitalizations, ambulance diversion, and overall demand on ED resources increase in the winter months, partially driven by the influenza season.[6] Hospital systems nationwide are more concerned than ever about inpatient capacity in light of the COVID-19 pandemic. Vaccinating their communities against influenza and SARS-CoV-2 may ease strains on hospital capacity by preventing cases of influenza and COVID-19 that would otherwise present to the emergency departments and potentially require admission.

Detractors may suggest that emergency departments should not engage in public health initiatives, as they can be costly, interfere with ED throughput, and interfere with our primary mission to provide emergent care. However, prior work by the Emergency Medicine Transmissible Infectious Diseases and Epidemics interest group of the Society for Academic Emergency Medicine on HIV testing in emergency departments has demonstrated emergency departments can facilitate public health initiatives while continuing to provide high-quality care without negatively affecting patient throughput or health system costs.[7,8] Success of this endeavor will require partnership and sharing/diversion of personnel, resources, and infrastructure from local, state, regional, and federal partners.

Emergency departments can be part of the solution to a vast health care problem that includes reaching out to the underserved, uninsured, and minority patients who we need to help get vaccinated against SARS-CoV-2. We believe that because we *can*, we have an obligation to do so. As a specialty, we pride ourselves on our ability to be versatile and adapt to whatever catastrophes the world throws our way. Embracing imperatives such as this proves our adaptability in the face of a pandemic and may even lead to the enhancement of the prestige of our specialty.

Disclosures: Dr. Lyons receives investigator-initiated project support from Gilead Sciences, Inc. paid to the institution. Dr. Wilson receives grant support from Gilead Pharmaceuticals, Alexion, Janssen, and Pfizer.

Originally published in SAEM Pulse *Jan.–Feb. 2021.*

References

1. Rodriguez RM, Baraff LJ. Emergency department immunization of the elderly with pneumococcal and influenza vaccines. *Ann Emerg Med.* 1993;22(11):1729-1732.
2. Slobodkin D, Kitlas J, Zielske P. Opportunities not missed—systematic influenza and pneumococcal immunization in a public inner-city emergency department. *Vaccine.* 1998;16(19):1795-1802.
3. Rimple D, Weiss SJ, Brett M, et al. An emergency department–based vaccination program: overcoming the barriers for adults at high risk for vaccine-preventable diseases. *Acad Emerg Med.* 2006;13(9):922-930.
4. Casalino E, Ghazali A, Bouzid D, et al. Emergency department influenza vaccination campaign allows increasing influenza vaccination coverage without disrupting time interval quality indicators. *Intern Emerg Med.* 2018;13(5):673-678.
5. Lane BH, Mallow PJ, Hooker MB, et al. Trends in United States emergency department visits and associated charges from 2010 to 2016. *Am J Emerg Med.* 2020;38(8):1576-1581.
6. Schull MJ, Mamdani MM, Fang J. Community influenza outbreaks and emergency department ambulance diversion. *Ann Emerg Med.* 2004;44(1):61-67.
7. Kecojevic A, Lindsell CJ, Lyons MS, et al. Public health and clinical impact of increasing emergency department–based HIV testing: perspectives from the 2007 conference of the National Emergency Department HIV Testing Consortium. *Ann Emerg Med.* 2011;58(1 Suppl 1):S151-S159.e1.
8. Galbraith JW, Anderson ES, Hsieh Y-H, et al. High prevalence of hepatitis C infection among adult patients at four urban emergency departments—Birmingham, Oakland, Baltimore, and Boston, 2015–2017. *MMWR Morb Mortal Wkly Rep.* 2020;69(19):569-574.

DR. SCHECHTER-PERKINS is with Boston University School of Medicine/Boston Medical Center. **DR. ROTHMAN, DR. HANSOTI, DR. HSIEH,** and **DR. KLEIN** are with John Hopkins University School of Medicine in Baltimore. **DR. FARYAR** and **DR. LYONS** are with University of Cincinnati College of Medicine. **DR. WAXMAN** is with Albany Medical College in Albany, New York. **DR. MAY** is with UC Davis Health in Sacramento, California. **DR. WILSON** is with Morsani College of Medicine, University of South Florida, Tampa General Hospital. **DR. MARTIN** is with Ohio State University Wexner Medical Center in Columbus. All are members of the EMTIDE interest group.

"A New Spin" is the personal perspective of the authors and does not represent an official position of *ACEP Now* or ACEP.

ACEP4U: Improving Care for Older Adults

GET GUIDELINES AND RESOURCES THROUGH THE GERIATRIC ED ACCREDITATION PROGRAM AND GERIATRIC EM SECTION

by NICOLE TIDWELL AND JORDAN GRANTHAM

As our overall population ages and people live longer than ever, the need for specialized care for older adults in the emergency department is increasing. By 2034, the U.S. Census Bureau projects that older adults will exceed the number of children for the first time in U.S. history.[1] Nearly every ED shift includes caring for older patients who present with multiple medical problems, sometimes coupled with social and physical needs. Within the last decade, hospitals started to realize that "one-size ED" does not fit all. This growing population of older adults has unique needs that require special consideration.

Raising the Standard of Care

ACEP developed its Geriatric ED Accreditation (GEDA) program in 2018, but the work started years prior. In 2013, ACEP, the Society for Academic Emergency Medicine (SAEM), the American Geriatrics Society (AGS), and the Emergency Nurses Association (ENA) released the Geriatric Emergency Department Guidelines, the product of two years of consensus-based collaboration. The guidelines specify broad domains and recommend measures ranging from geriatric-friendly equipment to geriatric-focused staff to more routine screening for delirium, dementia, falls, and more.

These guidelines were used to develop the GEDA framework, featuring three levels of accreditation focused on four key best practices:

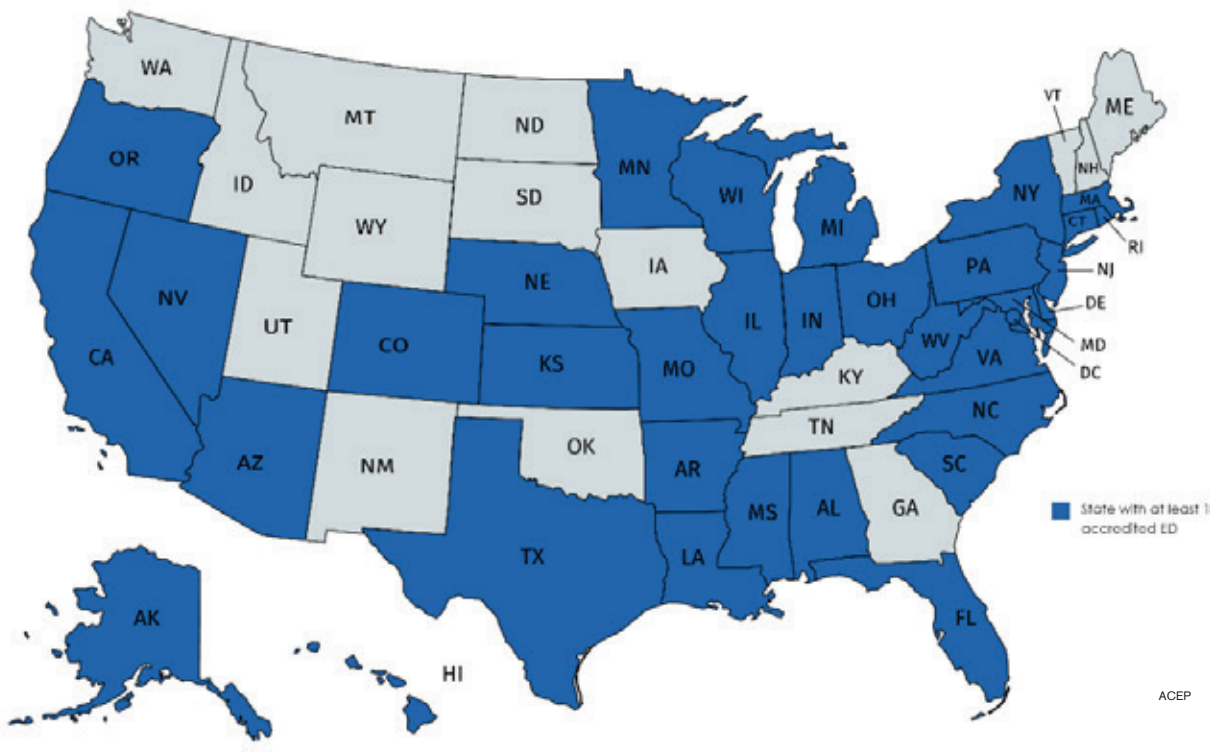
- Ensuring geriatric-focused education and interdisciplinary staffing
- Providing standardized approaches to care that address common geriatric issues
- Ensuring optimal transitions of care from the emergency department to other settings (inpatient, home, community-based care, rehabilitation, long-term care)
- Promoting geriatric-focused quality improvement and enhancements of the physical environment and supplies

"Hospitals were trying to address this growing need in patient care on their own. The GEDA program made it easier to identify gaps and areas for improvement; GEDA provides the framework to help facilities get the resources needed to make more formal changes to improve care for older adults," said Kevin Biese, MD, MAT, FACEP, chair of the ACEP program and co-director of geriatric emergency medicine at the University of North Carolina School of Medicine in Chapel Hill.

The accreditation requirements address staffing, education, policies and procedures, quality, outcomes, equipment, and the right environment—all of which can enhance care for older adults. Take the environmental category requirements for Level 1 accreditation, for example: Simple measures such as dimmed lights, thicker mattresses, and nonslip floors can go a long way to improving patient care.

In most cases, having a geriatric ED does not mean creating a separate space for older adults but rather optimizing processes (screening for geriatric syndromes), physician and nurse education, structural enhancements (appropriate beds, floors, lighting), and community connections to better care for older adults.

Figure 1: States with GEDA-Accredited EDs



By the Numbers

In January, there were 212 GEDA-accredited sites:

LEVEL 1: 13	LEVEL 2: 21	LEVEL 3: 185

In the two and a half years since its inception, the number of hospitals accredited by GEDA has grown rapidly. As of January 2021, GEDA had accredited 219 sites across 35 states and four countries (see Figure 1).

GEDA is actively working with 350 additional sites seeking accreditation, including working with many health systems and a nationwide project with Veterans Affairs (VA) to accredit more than 60 VA facilities. This growth was made possible through support from the Gary and Mary West Health Institute and The John A. Hartford Foundation to enhance geriatric emergency care across the country.

Beyond Accreditation

Clinical Tools

ADEPT (for Assess, Diagnose, Evaluate, Prevent, and Treat) is a point-of-care tool for managing confusion and agitation in elderly patients. It's free for all ACEP members and can be accessed through www.acep.org/adept or by downloading the emPOC app, which includes ADEPT as one of its many point-of-care tools. The app is especially convenient for those who have trouble accessing Wi-Fi in their emergency departments and want reliable access to these care pathways.

Visit www.acep.org/geriatric-care for a collection of resources including the geriatric ED guidelines, a series of videos about the unique circumstances of geriatric care in the emergency department, and a related eCME bundle.

Networking

Emergency physicians interested in bettering care for older patients can get involved by joining ACEP's Geriatric EM Section. Joining the section provides opportunities to become a leader in the area of geriatrics. Visit www.acep.org/geriatricsection to get involved and view helpful resources developed by the section.

Reference

1. Vespa J, Armstrong DM, Medina L. Demographic turning points for the United States: population projections for 2020 to 2060. United States Census Bureau website. Available at: https://www.census.gov/library/publications/2020/demo/p25-1144.html. Accessed Jan. 21, 2021.

MS. TIDWELL is GEDA program manager at ACEP.
MS. GRANTHAM is ACEP's communications manager.

PUTTING RESEARCH TO WORK FOR YOU

PRACTICE CHANGERS

DR. WESTAFER (@LWestafer) is assistant professor of emergency medicine and emergency medicine research fellowship director at the University of Massachusetts Medical School–Baystate, and co-host of FOAMcast.

Puking from Pot

How can you provide immediate relief for patients with cannabinoid hyperemesis syndrome?

by LAUREN WESTAFER, DO

Editors' Note: *Looking to learn something new to improve patient care? This new quarterly column breaks down recent research into practical tips you can use in everyday practice.*

The department is filled with the sound of retching as you approach the room of the next patient, a 29-year-old male with nausea, vomiting, and abdominal pain. Although the patient received ondansetron in the ambulance, he is still uncomfortable. He reveals that he has had similar episodes of generalized abdominal pain, nausea, and vomiting in the past. Taking a hot shower sometimes helps. He has not had fevers or diarrhea, and his abdominal exam is benign. Before exiting the room, you have one remaining question to ask: Does he use marijuana, and if yes, how often?

Cannabinoid Hyperemesis Syndrome

This is a classic case of cannabinoid hyperemesis syndrome (CHS). The treatment, cessation of marijuana use, will not provide immediate relief in the emergency department. So what do you do in the meantime?

CHS, first characterized in 2004, presents similarly to other cyclic vomiting syndromes.[1] CHS is characterized by nausea, vomiting (classically described as cyclic), and abdominal pain in patients with chronic use of marijuana. Patients frequently report that hot showers relieve symptoms, and some have described compulsive bathing.[2] For some, CHS seems at odds with the long-touted antiemetic properties of tetrahydrocannabinol (THC). How could an antiemetic cause a cyclic vomiting syndrome?

The mechanism underlying CHS is not entirely clear, but it is believed that the gastrointestinal effects are a result of activation of cannabinoid 1 (CB1) receptors, which inhibit gastric emptying and motility. With chronic use, THC can at times emerge from adipose tissue and enter the bloodstream, potentially contributing to a bout.

In many instances, ondansetron does not suffice in treating CHS.[3] Fortunately, the butyrophenones—haloperidol and droperidol—have emerged as promising treatments. Reports of the success of haloperidol and droperidol have largely been documented in case series and retrospective studies.[4] These medications have a track record of efficacy in postoperative nausea and migraine headaches, so it is credible that they might be effective in CHS. Until recently, the best available evidence was a retrospective study of patients who received droperidol, most of whom received 0.625 mg or 1.25 mg. Patients who received droperidol had a shorter length of stay (6.7 hours versus 13.9 hours).[4] However, we now have a small prospective randomized trial comparing haloperidol to ondansetron in CHS, which was published in the *Annals of Emergency Medicine*.

New Evidence

In this trial, Ruberto et al randomized 13 patients to intravenous haloperidol (either 0.05 or 0.1 mg/kg) and 17 patients to 8 mg of intravenous ondansetron.[5] Haloperidol outperformed ondansetron at two hours after treatment, reducing pain and nausea 2.3 points more than ondansetron on a 0–10 scale (difference 2.3 cm; 95% CI, 0.6–4.0). The authors sliced and diced the data, looking at multiple outcomes (various pain and nausea measurements, administration of rescue medications, and length of stay). Essentially, all of the secondary outcomes favored haloperidol, although these results are not conclusive given the small size and design of the trial.

While the study was too small to demonstrate the superiority of one dose of haloperidol over the other in a statistical manner, when the researchers looked at trends in pain scores, the high-dose haloperidol group did not seem to trend to faster or better reduction of pain and nausea. Importantly, there were three occurrences of akathisia or dystonia in patients in the haloperidol group—all of whom received the high-dose haloperidol regimen. Although the study is small, these results are conclusive enough to state the following: Forget the idiom that says, "go big or go home." In fact, the low-dose haloperidol group was something of a misnomer; subjects in the "low-dose" group received what many of us would consider to be a normal, if not hefty, dose of haloperidol. Most subjects in the "low-dose" arm of the study received more than the 2.5 mg IV dose that many practitioners use for nausea and vomiting today. The "high-dose" group meanwhile, might have better been called the "*very* high-dose" group—a 70-kg patient would have received 7 mg of haloperidol.

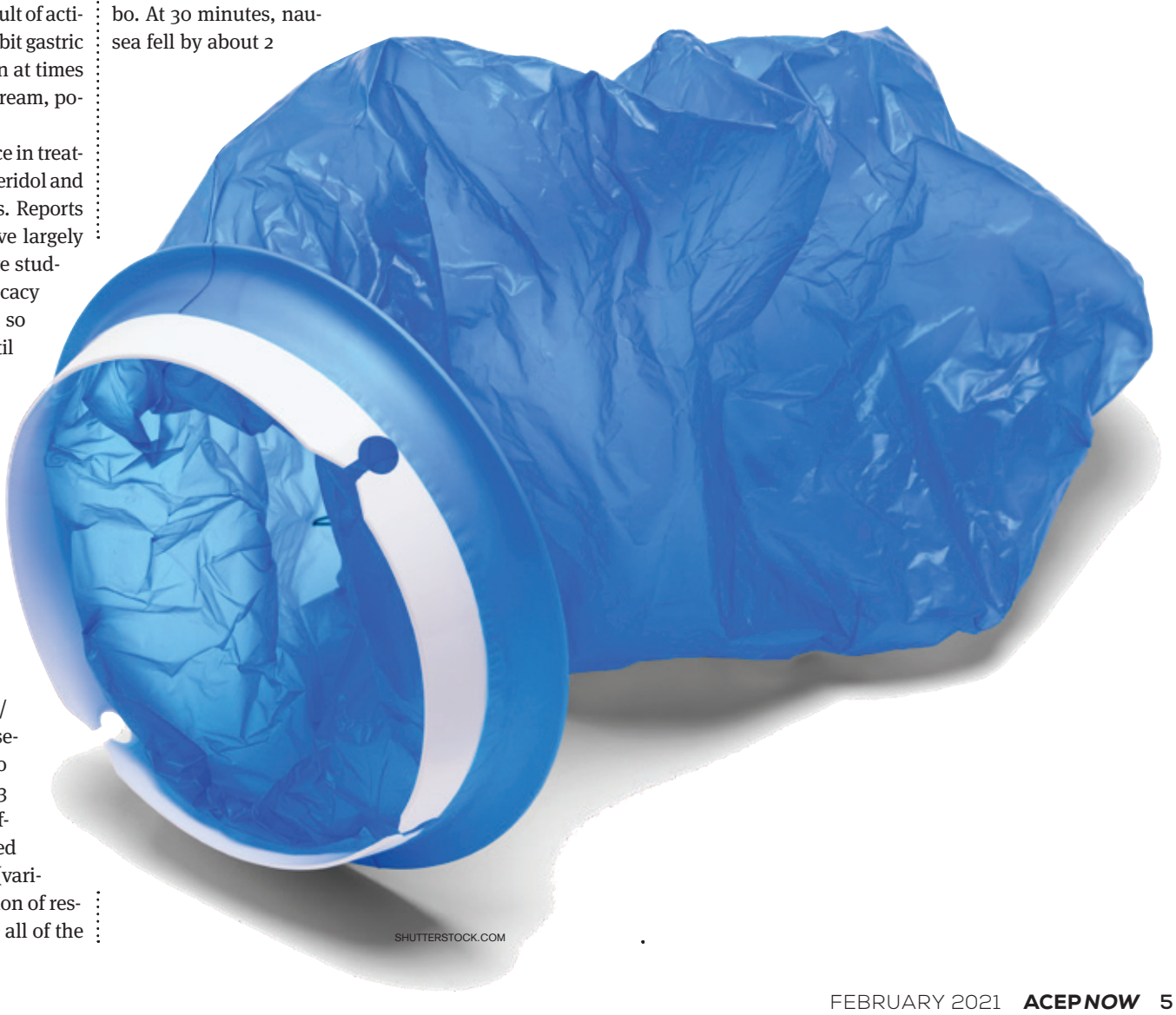
Turning Up the Heat

In addition to haloperidol and droperidol, capsaicin has been touted as a treatment for CHS in numerous case reports.[6–9] Similar to hot showers, this topical treatment activates receptors responsible for the sensation of heat and has been used as an analgesic. In *Academic Emergency Medicine*, Dean et al report results from a pilot randomized trial of 30 patients with CHS.[10] In this blinded trial, 17 patients were randomized to 0.1% topical capsaicin and 13 to a moisturizing lotion placebo. At 30 minutes, nausea fell by about 2 points on a 10-point scale in both groups. But at 60 minutes, nausea was reduced by another full point in the capsaicin group, while those in the placebo group reported no change. Fewer patients in the capsaicin group received antiemetics both before randomization and as a rescue medication.

Although these randomized studies are small, they confirm the treatment of CHS that many have adopted on the grounds of anecdotes, retrospective data, and clinical practice. It appears that the butyrophenones (haloperidol and droperidol) are effective antiemetics and capsacin may also have a role.

References

1. Allen JH, de Moore GM, Heddle R, et al. Cannabinoid hyperemesis: cyclical hyperemesis in association with chronic cannabis abuse. *Gut.* 2004;53(11):1566-1570.
2. Simonetto DA, Oxentenko AS, Herman ML, et al. Cannabinoid hyperemesis: a case series of 98 patients. *Mayo Clin Proc.* 2012;87(2):114-119.
3. Chang YH, Windish DM. Cannabinoid hyperemesis relieved by compulsive bathing. *Mayo Clin Proc.* 2009;84(1):76-78.
4. Lee C, Greene SL, Wong A. The utility of droperidol in the treatment of cannabinoid hyperemesis syndrome. *Clin Toxicol (Phila).* 2019;57(9):773-777.
5. Ruberto AJ, Sivilotti MLA, Forrester S, et al. Intravenous haloperidol versus ondansetron for cannabis hyperemesis syndrome (HaVOC): a randomized, controlled trial. *Ann Emerg Med.* 2020;S0196-0644(20)30666-1.
6. Dezieck L, Hafez Z, Conicella A, et al. Resolution of cannabis hyperemesis syndrome with topical capsaicin in the emergency department: a case series. *Clin Toxicol (Phila).* 2017;55(8):908-913.
7. Graham J, Barberio M, Wang GS. Capsaicin cream for treatment of cannabinoid hyperemesis syndrome in adolescents: a case series. *Pediatrics.* 2017;140:e20163795.
8. Moon AM, Buckley SA, Mark NM. Successful treatment of cannabinoid hyperemesis syndrome with topical capsaicin. *ACG Case Rep J.* 2018;5:e3.
9. Wagner S, Hoppe J, Zuckerman M, et al. Efficacy and safety of topical capsaicin for cannabinoid hyperemesis syndrome in the emergency department. *Clin Toxicol (Phila).* 2020;58(6):471-475.
10. Dean DJ, Sabagha N, Rose K, et al. A pilot trial of topical capsaicin cream for treatment of cannabinoid hyperemesis syndrome. *Acad Emerg Med.* 2020;27(11):1166-1172.



SHUTTERSTOCK.COM

RESIDENCY SPOTLIGHT

WESTERN MICHIGAN UNIVERSITY HOMER STRYKER M.D. SCHOOL OF MEDICINE EMERGENCY MEDICINE RESIDENCY

Location:
Kalamazoo, Michigan

Year founded:
1993

Number of residents:
48 per class, three-year program

WESTERN MICHIGAN UNIVERSITY HOMER STRYKER M.D. SCHOOL OF MEDICINE EM RESIDENCY

Resident EMS Day, where residents rotate through EMS stations including vehicle extrication and rappelling from a building.

Secret weapons (medical)

- We feature two large tertiary trauma centers encompassing more than 150,000 ED visits a year and nearly 100 emergency medicine faculty members.
- Residents get incredible critical care training, with up to *eight months* of ICU rotations. We have an unusual staffing model where almost all residents on the ICU service in a given month are emergency medicine residents at all levels.
- Our academic department now oversees the EMS system at Yellowstone National Park and provides real-time medical control of EMS incidents. We have an elective in which residents provide on-site training to Yellowstone personnel and do wilderness medicine.
- Another unusual feature is our "medical support unit," a specially equipped medical response vehicle staffed 24-7 by senior emergency medicine residents to respond to high-yield EMS calls such as cardiac arrests, major traumatic incidents, and disaster scenes. We also work closely with our colleagues at West Michigan Air Care to provide extensive air medical experience.
- Our medical school has a 25,000-square-foot state-of-the-art simulation center, which includes a 13-bed virtual hospital to learn and practice emergency medicine skills.

Secret weapons (nonmedical)

- Large class sizes (16 residents per class) allow for flexibility and work-life balance. When you need to switch out of a shift to go on a trip, there is likely someone able to make a trade. When you have a day off, so do some of your co-residents.
- The 2019 Cost of Living Index, which is based on a study examining 255 urban areas, ranked Kalamazoo the third least expensive place to live.
- Western Michigan has a plethora of nature to offer, including the Al Sabo Preserve (741 acres of marsh, forest, streams, and rolling hills) and the Kal-Haven Trail (a 34-mile trail linking Kalamazoo to Lake Michigan).
- Residents take advantage of the proximity to Lake Michigan, fitting in days at one of the many beaches or fishing trips out on the lake.
- NerdWallet named Kalamazoo a Top 10 Best City for Work-Life Balance.

Recent publications of note:

- Van Dyne EA, Neaterour P, Rivera A, et al. Incidence and outcome of severe and nonsevere thrombocytopenia associated with Zika virus infection-Puerto Rico, 2016. *Open Forum Infect Dis*. 2018;6(1):ofy325.
- Hoyle JD Jr, Ekblad G, Hover T, et al. Dosing errors made by paramedics during pediatric patient simulations after implementation of a state-wide pediatric drug dosing reference. *Prehosp Emerg Care*. 2020;24(2):204-213.

—Philip Pazderka, MD, program director

Trivia

There is a reason Michigan is called the "Water Wonderland"—we have more than 3,000 miles of Great Lakes shoreline, more than 11,000 inland lakes, and more than 36,000 miles of streams. Kalamazoo County itself has 16 lakes.

SPACE AGE TECHNOLOGY IN YOUR HOSPITAL

We can thank the space race for patient monitoring technologies

by JOHN HAUBER, MD

CANADIAN SPACE AGENCY/NASA

Canadian Space Agency astronaut David Saint-Jacques tries the Bio-Monitor, a smart shirt system is designed to measure and record astronauts' vital signs.

Imagine yourself in a large academic hospital in 1950s New York. You meander through the busy "accident room" and find your next patient. They're not looking so hot. A set of vitals would help. You take out your stethoscope and your blood pressure cuff and start counting heartbeats using your wristwatch.

Now return to the present day. Sitting at your workstation, you eyeball the ICU-bound patient in the bed across the room and see a reassuring set of vitals on the monitor. In the next room over, you see the same. You turn to the telemetry monitor and scroll through to ensure that you didn't miss any arrhythmias. You quickly return to your other work with peace of mind.

Much has changed in medicine over the last 70 years. How did we come this far?

To answer this, we must return to the 1950s and what we knew—or rather didn't know—leading into the "space race." In preparing for travel into the inhospitable environment of space, everything that we took for granted on Earth had to be scrutinized. Would our vision, taste, smell, touch, hearing, or vestibular systems function normally? Could blood still circulate effectively in microgravity? Quaint though it may seem today, there were legitimate concerns by leading doctors at the time that humans entering microgravity would quickly develop pulmonary edema, pneumonia, or even vestibular incapacitation.[1] Though it may seem trivial now, these questions were cutting-edge science at the time.

Engineers, biomedical scientists, and the astronauts themselves knew there was no guarantee of safety. Without any prior experience with humans in space, the early goals of the Mercury missions included gathering biomedical data for future missions. Telemetry instrumentation was rudimentary and confined to analog technology—there were no hard drives for storing data. So how would the ground-based teams gather data and effectively monitor astronauts' health?

A string of remote monitoring stations established around the world whittled down the "blackout time"—no radio communication to the orbiting capsule—to no more than 10-minute spans. From these stations, the integrity of the spacecraft, its trajectory, and the health of the crew could be assessed and relayed to the next station. While orbiting Earth, Mercury astronauts' rectal temperatures, heart rates, and respiratory rates were transmitted by radio to each passing monitoring site. They were also interviewed via radio by medical monitors to assess their cognition and any self-reported symptoms.[2] Reassuring data were collected in this manner, but the technical difficulties underscored the need for more reliable monitoring.

With planning under way for the Gemini and Apollo programs, a new company, Spacelabs Medical, Inc., was subcontracted to help develop better telemetry monitoring systems. The technology produced by this partnership paved the way for the modern telemetry systems we now use in hospitals around the world. Respiratory rate—previously measured by a thermistor situated near the mouth in crew helmets—could now be reliably calculated using electrical impedance of the thorax via ECG electrodes (ie, leads). An automated blood pressure cuff outfitted with microphones could independently detect the systolic and diastolic Korotkoff sounds. Development of signal conditioners to mitigate signal noise also improved the fidelity of ECG, blood pressure, and respiratory rate readings, leading to more accurate and extensive data collection.[3,4]

These improvements laid the foundation for the biomedical research of subsequent programs like Skylab and Spacelab. By the late 1960s, having proven their mettle in space, these technologies started being implemented here on Earth in hospitals across the country. The benefit of continuous, remote patient monitoring spread rapidly. The standard use of telemetry systems soon became a given in hospitals worldwide. Decades of further innovation and refinement have resulted in the systems we know well today. (For example, we no longer have microphones in our automatic cuffs!)

But what comes next? Wireless telemetry? We've all experienced the frustration of preparing a patient for transport and all of the wires and IV lines that must be repeatedly disentangled. Carré Technologies of Montreal, working in conjunction with the Canadian Space Agency, may have the answer to our ongoing tangle torture thanks to its recently developed Bio-Monitor telemetry shirt.

Astronauts aboard the International Space Station are already using the Bio-Monitor, known as Astroskin. Astroskin is a shirt that is capable of wirelessly transmitting vital signs, including heart rate, ECG readings, blood pressure measurements, oxygen saturation, temperature, and respiratory rate.[5] While the technology is not yet ready for hospital use, it is already being used in a variety of ground-based applications, including monitoring high-performance athletes in training. Other companies are developing similar wireless products. It's only a matter of time until we have these technologies in our hospitals. With the aerospace industry continually pushing the technological envelope for space- and ground-based applications, we will continue to reap the benefits of what is learned, applying these innovations to caring for our patients with less hassle and increased safety.

For more information, check out the Aerospace Medicine Section of ACEP at www.acep.org/how-we-serve/sections/aerospace-section/.

References

1. Pitts J. *SP-4213 The Human Factor: Biomedicine in the Manned Space Program to 1980*. Washington, DC: NASA; 1985.
2. SP-45 Mercury Project summary, chapter 8. National Aeronautics and Space Administration website. Available at: https://history.nasa.gov/SP-45/ch8.htm#8.1. Accessed Dec. 11, 2020.
3. Miller J. Inventing the Apollo spaceflight biomedical sensors. Smithsonian National Air and Space Museum website. Available at: https://airandspace.si.edu/stories/editorial/inventing-apollo-spaceflight-biomedical-sensors. Accessed Nov. 19, 2020.
4. SP-368 Biomedical Results of Apollo. National Aeronautics and Space Administration website. Available at: https://history.nasa.gov/SP-368/contents.htm. Accessed Dec. 11, 2020.
5. Bio-Monitor: keeping an eye on astronauts' vital signs. Canadian Space Agency website. Available at: https://www.asc-csa.gc.ca/eng/sciences/bio-monitor.asp. Accessed Nov. 24, 2020.

DR. HAUBER is an emergency medicine resident at Mount Sinai Morningside-West in New York City.

SHUTTERSTOCK.COM

What About the Flu?

COVID-19 safety measures seem to have greatly reduced influenza cases this season

by JEREMY SAMUEL FAUST, MD, MS, MA, FACEP

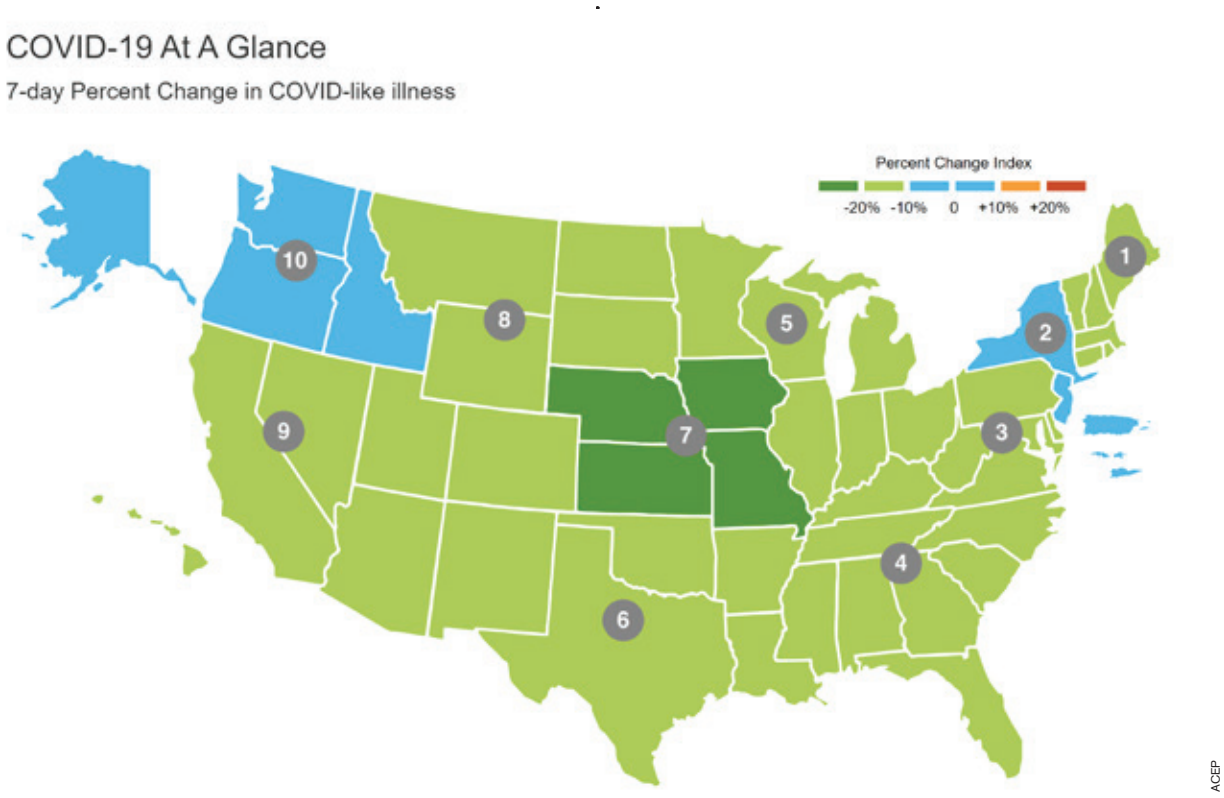
Editors' Note: *This article was accepted on Jan. 21, 2020, and was accurate at that time. Because information about SARS-CoV-2 and COVID-19 is evolving rapidly, please verify these recommendations and information.*

With thousands of articles published weekly on COVID-19, navigating the literature on this emerging infectious disease can be daunting. To help health care professionals and the general public keep up and to fight medical misinformation, a group of emergency physicians started the website Brief19.com, which publishes analysis of COVID-19 research and policy five days a week, all for free. Here are highlights from recent Briefs.

When word surfaced that a novel coronavirus was responsible for the outbreak of a deadly new severe acute respiratory syndrome in December 2019 in China, few people, if anyone, knew what to make of it. A year later, we know that COVID-19 will go down as the first truly historic pandemic of the 21st century. But before that was obvious, physicians and public health experts looked for ways to contextualize what was happening. Everyone, here and around the world, wanted to know how worried to be. The natural inclination in trying to understand a devil we did not know, SARS-CoV-2, was to try to compare it to one that we did, seasonal influenza.

As I wrote with Carlos del Rio, MD, professor of medicine at Emory University School of Medicine in Atlanta and infectious diseases specialist, last year in *JAMA Internal Medicine*, that was a major cognitive blunder.[1] The main problem, we wrote, was the statistic that we all repeat by rote—that around 40,000 to 60,000 people die of influenza in the United States annually—was and has always been a clunky estimate. That figure includes a series of corrections that just don't hold up.

For example, the model used by the U.S. Centers for Disease Control and Prevention (CDC) assumes that scores of hospitalized patients die of influenza but never get tested for flu. That assumption struck us as odd since I can't admit a patient with appendicitis in January without sending a flu swab, let alone anyone with respiratory symptoms. Indeed, it's likely that low-acuity cases of influenza are substantially underreported in the community. But the notion that the health care system is somehow missing a majority of influenza deaths just does not have face validity. If anything, it's likely that the infection fatality rate for seasonal influenza is far lower than the 0.1 percent rate the CDC and the World Health Organization routinely cite; we probably know about the vast majority of flu-related deaths, but we probably detect relatively few of the milder cases. In our analysis, we estimated that COVID-19 in the spring was already killing between 9 and 44 times more people than flu does *at its peak*. It's possible that it's even worse than that, but in reality, it depends how you measure.



ACEP

This fall, many people started to worry about the possibility of "twinfluenza," or the idea that come winter, we'd be fighting COVID-19 and seasonal flu all at once.[2] The good news is that seasonal influenza appears to have been substantially reduced—in some areas, there has scarcely been any flu at all. This may be due to two major changes. First, our friends in the southern hemisphere, specifically in Australia and New Zealand, all but eliminated flu during their flu season (June–Aug.). That means fewer mutations and less circulating virus (and less travel means less overseas transmission). Second, the interventions that flatten the COVID-19 curve, like physical distancing and mask wearing, might be decimating flu.

The CDC has been tracking reports of influenza-like illnesses (ILIs) for years. Now, it also tracks coronavirus-like illnesses (CLIs). A new tool on ACEP's website (pictured above) allows users to track and compare them, including by region and date.[3] What's clear is that, at the moment, ILIs don't hold a candle compared to CLIs. ILIs are way down from previous years. Will this change last? Will we in the United States start wearing masks during ILI and CLI season, as many people in some nations in Asia do? If so, we may have learned something beneficial from this horrible crisis that will save lives (and misery) for decades to come.

References

1. Faust JS, del Rio C. Assessment of deaths from COVID-19 and from seasonal influenza. *JAMA Intern Med.* 2020;180(8):1045-1046.
2. Lesko J. Avoiding "twinfluenza." Brief19 website. Available at: https://brief19.com/2020/09/09/brief#avoiding-twinfluenza. Accessed Jan. 21, 2021.
3. COVID-19 in U.S. emergency departments. ACEP website. Available at: https://www.acep.org/corona/covid-19-data-visualization. Accessed Jan. 21, 2021.

DR. FAUST is Medical Editor in Chief of *ACEP Now,* an instructor at Harvard Medical School, and an attending physician in department of emergency medicine at Brigham and Women's Hospital in Boston. Follow him on Twitter @JeremyFaust and follow Brief19 @Brief_19.

From Adventure to Emergency

Make sure you prepare for possible medical emergencies when working or traveling abroad

by WADE WERNECKE, MD, FACEP, FAAFP

WADE WERNECKE

LEFT: Dr. Wernecke about a month into his recovery, learning to walk and balance after an extremity fracture and overall debility.

ABOVE: Dr. Wernecke upon his arrival back home following his accident, pictured with his daughter Taylor and her dog.

I have been an emergency physician for over three decades. I am partially blind but have remained active doing medical mission work overseas. In December 2018, I went on a medical mission trip with another emergency physician to Thailand. Afterward, I extended my travel to explore more of Asia and make my way to Cambodia. I had heard of a charitable hospital called Sonja Kill Memorial Hospital in Kampot, Cambodia, so I wanted to visit them to see if I could be of service. However, my plans were suddenly interrupted when passing through Laos on my way there.

My Accident

I was walking along a highway in Laos. It was dark. A semi-trailer swerved off the road and struck me. I suffered a brief loss of consciousness. I woke up in a rice paddy on my back, quadriplegic, and starving for air. Immediately, I concluded that I had severed my spinal cord at a high level. I was ready to die as I stared at the beautiful moon and stars. What actually had happened was that I fractured my C_4 and C_5 and my spinal cord was in "shock." I passed out from asphyxia.

When I regained consciousness, I knew I was in critical condition. I was in severe pain and desperately struggling to breathe. I took a few moments to do a secondary survey on myself. I had an open fracture of my left lower extremity, broken neck (which turned out to be teardrop fractures at C_4 and C_5), several rib fractures, a hemopneumothorax, an exploded right shoulder, and paralyzed right upper extremity. I could taste blood, but other than facial abrasions and swelling, my cranium seemed intact. I had abdomen pain, but on exam, I was soft and not peritoneal. I was still cognitively intact. I realized if I were to have a chance of survival, I would need help. But nobody was there.

It took what seemed like forever to crawl back to the highway. The passersby would not stop. After about 20 minutes lying next to the highway, in plain sight, I had no option but to use myself to try to stop traffic. I crawled into oncoming traffic, hoping the drivers would see me and stop. It worked. I was scooped up and thrown in a pickup bed. I bounced my way to the nearest hospital.

The facility was not well-equipped but managed to give me the large needle I requested. I knew I at least had a pneumothorax, as subcutaneous air was accumulating around my chest and neck. I wanted to be prepared to perform an auto-thoracostomy if tension built up.

The hospital workers put me in the back of an old van, and I bounced around for four hours to the next hospital. Four hours of hell. I thought of late Sen. John McCain's experience in a rice paddy.

After arriving, the hospital called my family, who called my insurance company, who misread my coverage and told them I was not covered in the country of Laos. Without insurance and with little cash on hand, I did not get treatment. They advised me that I needed to go to another hospital. I refused.

I was starting to become delirious, so they put me in a hospital ward. After 16 hours, the doctor returned to check on me. My oxygen saturations were in the 70s. I was in no condition to refuse any course of action. I was sent to Thailand, where on arrival to the next hospital, a chest tube was placed. They attended to my open fracture but not until my friend from Chang Mai flew to my rescue with cash in hand. Later, I was sent to the fourth and final hospital for definitive care.

Because of the extensive buildup of subcutaneous air, further surgery was delayed four more days. In the meantime, I was put in the ICU. I will never know if that delay contributed to my permanent paralysis.

The surgeon fixed my shoulder "the best they could." By then, the insurance company confirmed that, in fact, I was covered for care, even in Laos. It was only after I recovered from anesthesia that I noticed my neck pain. Prior to my shoulder repair, the neck pain had been masked by my shoulder pain—the ultimate distracting injury. The team found the teardrop fractures. I told them I would deal with that once back home. I refused transfer to yet another hospital, this time in Bangkok. I figured that if my previous transports and intubations had not killed me, my neck was stable enough.

I spent a month in the hospital and flew home recumbent. I still suffer neck pain and shoulder paralysis, but I am thankful to be alive. The final bill, all told, came out to around $40,000, a fraction of what it would cost in the United States.

The Lesson

This is not just about me telling my unusual story. I want you to learn and educate others about the dangers that exist when emergent treatment is needed and you are far from home. As more and more people adventure to remote destinations, we need to be aware of the risks for ourselves and our friends and family. But it is also a call to action. We must assist in ongoing international efforts to help countries establish EMS programs and to obtain better emergency equipment and training.

Of course, I emphasize to all travelers to do what you can to avoid risky behaviors. In the event of an emergency, we or our representatives must make it clear to insurance providers that their immediate action is necessary. Without proper confirmation of coverage, lifesaving treatment may be withheld. You don't want to die because someone said the wrong thing on the phone. I suspect that travelers and insurers do not realize that what happened to me could happen to others. In many wealthier countries, patients get lifesaving measures first and insurance is discussed later.

Since my accident, I've seen that I'm not the only person at risk. I made it to back to Sonja Kill Memorial Hospital in Cambodia to teach this year. While there, I witnessed a young tourist get hit by a van as he pulled onto the highway on his motorbike. Initially unconscious like I had been, he woke up with altered mental status and had severe facial fractures. We were able to get him to our emergency department. We did not have a CT scanner, and he needed be transferred to Phnom Penh. Getting his insurance confirmation took several hours. All the while, he lay in our emergency department. What if he had an emergent need for neurosurgery?

Before you travel abroad, make sure you know where your coverage covers you. If you need to add coverage, *do it*. If you truly are covered in remote locations, carry documentation to that effect. Additionally, it never hurts to carry some extra cash, avoid traveling alone, and keep an app on your phone for translations. Make sure copies of your insurance papers and emergency contact numbers are in your wallet, luggage, or backpack. Make these things easy to find. You may not be conscious and able to assist when that information is needed.

All that said, please do not let these stories deter you from traveling to wonderful places or providing medical care in places that need someone with your skills. Just be aware of this danger and prepare for any eventuality that may occur. I have been a family physician and emergency physician for more than three decades. But, by far, the greatest reward I have found is from volunteering my services to those much less fortunate than myself. I wouldn't give that up for anything.

DR. WERNECKE is an emergency physician in Hot Springs, Arkansas. He also serves the medical missions CMO-COB Christian Mission to the Orient in Chiang Mai, Thailand, and Sonja Kill Memorial Hospital in Kampot, Cambodia administered by HOPE Worldwide.

KEEPING YOU SAFE

The ACEP publishing team at Wiley has been deeply touched by the dedication of the health care professionals who stand on the COVID-19 front lines—those who are fighting the disease, and those we have lost.

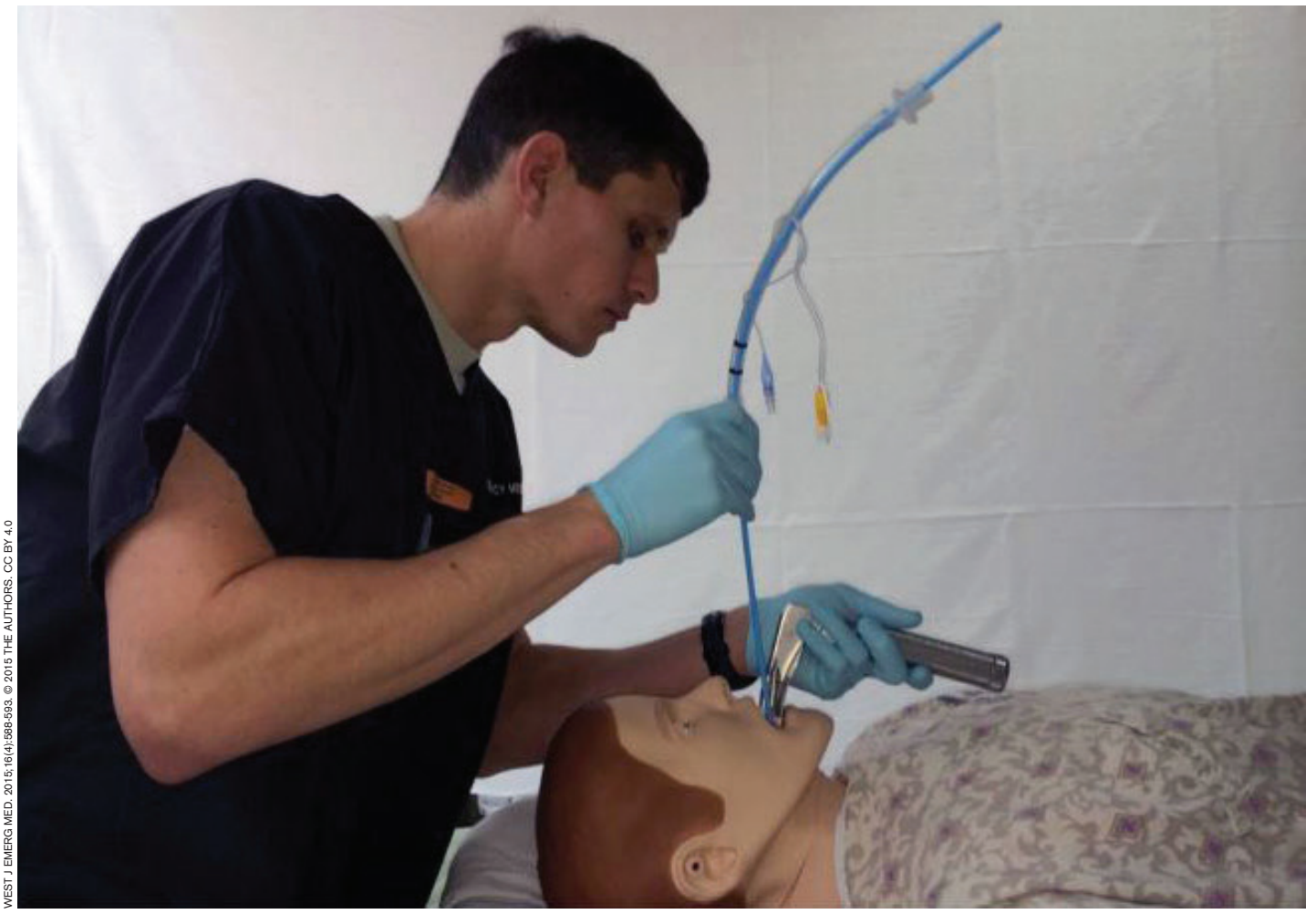
We believe sharing evidence-based research is vital. But we also believe that honoring each and every health care team member we're privileged to work with means doing more.

Wiley has partnered with #GetUsPPE, a grassroots coalition of volunteers working to build a national, centralized platform to enable communities to get personal protective equipment to health care workers who need it most.

If you or your colleagues have a critical need for PPE, please visit **getusppe.org** to learn more.

Stay Safe. Stay Informed.

WILEY



Emergency intubator demonstrating preloaded bougie technique on a mannequin.

BOUGIE | CONTINUED FROM PAGE 1

are all familiar).[2] In that letter, Dr. Macintosh wrote about using what was essentially a urinary catheter. The term "gum elastic bougie" is actually somewhat of a misnomer; the most common form of the bougie as we know it was introduced in 1973 as the Eschmann tracheal tube introducer, and it is not made of gum, not elastic, and not a bougie (at least with respect to the original medical definition, that being a cylindrical instrument meant for introduction into the urethra or other tubular structures in order to dilate constrictures).[3] Nevertheless, the name has stuck.

Why Use a Bougie?

First and foremost, the bougie leads to increased first-pass success in obtaining a definitive endotracheal airway. In the BEAM trial, the bougie had a 98 percent first-pass success rate versus 87 percent in the stylet group. What's more, in patients with at least one difficult airway characteristic, the bougie group had a successful first attempt in 96 percent of patients compared to 82 percent in the stylet group.

This increased success rate is likely attributable to two factors. The first is the enhanced ability to obtain visual confirmation of tracheal placement compared to direct endotracheal tube (ETT) placement without the bougie. Given its 15 French (5 mm) diameter, it is much easier to visualize passage of the bougie through the vocal folds compared to an ETT and stylet setup. In fact, Dr. Macintosh himself noted this as its principal advantage in his original correspondence.

The second factor has to do with tactile confirmation. This is confirmed in one of two ways by the operator. One can use the angled coudé tip of the bougie to rock it along the tracheal rings, eliciting a "clicking" sensation. One can also (gently) advance the bougie until resistance is felt either at the carina or in either of the mainstem bronchi; this is known as the "hold-up" sign. In one study, tracheal clicks were felt in 89.7 percent of intubations and had a 100 percent specificity of successful ETT placement.[4] In the same study, the hold-up sign was 100 percent sensitive and specific for successful placement. What's more, an observer (such as a supervising physician attending on a resident procedure) can place their hand externally on the trachea and independently confirm placement when tracheal clicks are felt.

Trauma airway management offers another situation in which the bougie can come in handy. Manual in-line stabilization (MILS) is known to decrease the grade of view of the glottis. One study showed a prevalence of 22 percent of grade III views in patients with MILS.[5] That study showed increased intubation success when the bougie was used, and all patients who were unable to be intubated under direct visualization were rescued with the addition of a bougie.

However, there is one method that can help maximize success in the most difficult of airway scenarios (ie, Cormack-Lehane [CL] views III and IV). Interestingly, this technique appeared in the original paper describing the CL grading system way back in 1984.[6] It involves first obtaining an adequate view of the cords, then retracting the laryngoscope slightly to allow the epiglottis to drop down, thereby converting the view from a CL grade I to a grade III. You can then use the coudé tip of the bougie to trace the posterior of the surface of the epiglottis through and past the vocal cords. While probably not the best strategy for emergent airway management, this technique can be practiced in any cadaver or in the simulation lab. Arguably, the biggest advantage of a bougie is the ability to pass it blindly into the trachea when adequate visualization is not possible, so mastering this technique can strengthen your repertoire for salvaging the most challenging of airways.

Moreover, a bougie can also assist with blind digital intubation when necessary.[7] Also, in the case of moderate and massive hemoptysis, rotating the coudé tip 90 degrees to the right or left after insertion past the cords facilitates selective lung intubation. One cadaver study showed this technique to be successful 100 percent of the time.[8]

In addition to increased first-pass success, the bougie has other useful applications. The "scalpel-bougie-tube" technique has become the preferred method for many operators during the emergency establishment of a surgical airway, and among other places, it is taught in the United Kingdom's Difficult Airway Society training.[9]

Busting Bougie Myths

One common misconception about bougie use is that it should only be used when the vocal cords are not visualized (ie, Cormack-Lehane views IIB, III, and IV). However, it can be argued that without *routine* use of a bougie, the likelihood of success (ie, proper placement of bougie, confirmation with tracheal clicks or hold-up sign, railroading of tube over the bougie without dislodgment from the trachea, etc.) with a true grade III or IV view may be much less likely. There is literature that points to this. In a study looking at the National Emergency Airway Registry III (NEAR III), a bougie was used in only 3.5 percent of intubations and had a somewhat dismal success rate of 69 percent.[10] Unfortunately, there are no data on how often tracheal clicks or the hold-up sign were used during these attempts. Some detractors of bougies report having never felt clicks while using the device. Both of these observations (the low success rate found in NEAR III and anecdotal reports of failing to detect tracheal

CONTINUED *on page 12*

By the Numbers

U.S. Motor Vehicle Crashes During COVID-19

DURING JAN.–SEPT. 2020

VEHICLE MILES TRAVELED (VMT)

▼ **14.5%**

FATALITY RATE PER 100 MILLION VMT

▲ **TO 1.35**
FROM 1.10

ESTIMATED TRAFFIC FATALITIES

28,190

▲ **4.6%** from 2019

DURING APRIL–MAY 2020
(maximal stay-at-home period)

VS. JUNE–JULY 2020
(re-opening period)

ESTIMATED TRAFFIC FATALITIES DURING APRIL–MAY

4,845

▼ **10.2%** from 2019

ESTIMATED TRAFFIC FATALITIES DURING JUNE–JULY

7,405

▲ **14.2%** from 2019

DRIVER SEATBELT USE DECREASED
from 78.1% prior to the pandemic period (before March 17, 2020) to

71.6%
during the pandemic (March 17–July 18, 2020).

Compiled by Michael J. Mello, MD, professor of emergency medicine, Warren Alpert Medical School of Brown University in Providence, Rhode Island. Visit **ACEPNow.com** for the sources of these statistics.

FACEPs IN THE CROWD

More than 12,000 ACEP members have achieved Fellow status with the College and use the FACEP designation with pride! Here, we highlight ACEP Fellows who have fascinating hobbies and passions outside the emergency department.

J. Mark Rendon, MD, FACEP

J. Mark Rendon, MD, FACEP, attending physician, assistant clerkship director, and assistant professor of emergency medicine at UT Southwestern Medical Center in Dallas, is a bona fide brewmaster. His Cream Ale was named Best of Show out of a whopping 1,300 entries in the 2020 Bluebonnet Brew-Off, the largest single-site homebrewing competition in the country. "Brewing is both a science and an art," Dr. Rendon said. "As a science, there is a growing, encyclopedic amount of information—ranging from enzymatic reactions, water chemistry, and microbiology—that a brewer could spend a lifetime learning. As an art, the scientifically informed homebrewer can practice creativity and originality to produce their desired outcome: a delicious beer." He approaches his brewing education like his emergency medicine training, learning how to brew a variety of beers instead of specializing in one type. He said brewing in the garage while listening to his favorite music does wonders for his wellness.

Diane Birnbaumer, MD, FACEP

Diane Birnbaumer, MD, FACEP, senior educator at Harbor-UCLA Medical Center department of emergency medicine and professor emeritus of medicine at the David Geffen School of Medicine at UCLA in Los Angeles, is an avid solar eclipse chaser. She's seen seven total solar eclipses on five continents. She got hooked on astronomy and cosmology in college and says experiencing a solar eclipse surrounded by people is an awesome experience. "The last five minutes before totality turn the world on its head. … Right before totality, you take off your protective glasses and look up to see the brilliant diamond ring," Dr. Birnbaumer said. "The sun becomes a hole in the sky surrounded by the brilliant corona, only visible during a total solar eclipse. If you know where to look, you'll see planets and bright stars. If you look at the horizon, you'll see you are surrounded by 360 degrees of sunset. … I have to tell you, the experience rocks your world." Her hobby helps keep things in perspective, she said. "What an eclipse does is show you what is always there, even if you can't see it because the sun is so bright … ," she explained. "It affects how I think and perhaps helps me be more inquisitive and thoughtful."

Morgan Wilbanks, MD, FACEP

Morgan Wilbanks, MD, FACEP, assistant professor of emergency medicine and interim director of undergraduate medical education at the Medical College of Wisconsin in Milwaukee, is a *Jeopardy!* champion. His three-day run resulted in $46,000 in prize winnings and memories to last a lifetime. "Being up at the podium, next to Alex Trebek, and holding the buzzer gave me the biggest thrill of my life," Dr. Wilbanks said. He's loved trivia for a long time, having grown up watching *Jeopardy!* and competing on his quiz bowl team in high school. He says that as an emergency physician, trivia comes naturally because you have to know a wide variety of topics, similar to emergency medicine. He spent much of his time off-shift catching up on *Jeopardy!* episodes and working through his flash deck with 250,000 trivia questions. He was invited to a regional audition in 2008, and after he didn't advance, he continued to work toward that goal. This past year, he finally got his chance to be on the show and really made it count!

KNOW AN EMERGENCY PHYSICIAN WHO SHOULD BE FEATURED IN "**FACEPs in the Crowd**"? SEND YOUR SUGGESTIONS TO **ACEPNOW@ACEP.ORG.** LEARN HOW TO BECOME A FACEP AT **WWW.ACEP.ORG/FACEPSINTHECROWD**.

BOUGIE | CONTINUED FROM PAGE 11

clicks) are likely related to inadequate training and practice with the devices. In other words, using the bougie all of the time will make its benefit more likely to be noticed in the smaller number of cases where it stands to impart its greatest effect. In a sense, the BEAM trial provides some evidence for this. In that study, tracheal clicks were reported in a full 91 percent of the attempts. In fairness, that observation also obliquely highlights one of the main limitations of that trial, which is that was a single-center study conducted in a facility where bougies were already in routine use during first-pass attempts. This likely bolstered its findings but also provides support for the idea that practice with the bougie can lead to such positive outcomes. So one might view this less as a limitation and more as an indication of the utility of teaching and promoting the use of a bougie.

Another concern some have is that the bougie contributes to an increased risk of airway trauma and pneumothorax. There is no high-quality evidence that supports this claim. In fact, the BEAM trial showed no significant difference in rates of pneumothorax, lip laceration, bleeding from the oropharynx or perilaryngeal structures, dental trauma, or direct airway injury between the bougie and stylet groups. A letter in *Anesthesia* in 2003 found just a single case report of trauma unambiguously caused by a bougie.[11] The case involved a patient who required reintubation due to an expanding hematoma soon after undergoing glossectomy and radical neck dissection, and the patient suffered a pharyngeal wall perforation.[12] Meanwhile, stylet use itself (which many anesthesiologists shun) and multiple attempts to intubate have both been associated with airway trauma.[13,14] If bougies lead to increased first-pass success, it follows that a corresponding fewer number of intubation attempts would lower the risk of airway trauma.

Bougie Pitfalls

One of the most common mistakes when using a bougie is removing the laryngoscope before railroading the endotracheal tube over the bougie. This will cause the tongue and oropharyngeal structures to collapse posteriorly and potentially inhibit passage of the tube. It is therefore imperative to maintain the laryngoscope in place until the tube has passed through the cords successfully. If resistance is met with the laryngoscope blade still in place, it is likely that the bevel of the ETT has been lodged against the posterior cartilages, thereby prohibiting its progress. This is easily remedied by retracting the tube 1–2 cm, rotating it 90 degrees counterclockwise, and subsequently advancing the tube again.[15]

Conclusion

The best way to master the bougie is practice. While the bougie has been around for almost three quarters of a century, it is still widely seen as a backup "adjunct." However, recent evidence and forward-thinking emergency physicians are starting to change that paradigm. The widespread use of "bougie first" has the potential to revolutionize emergency airway management, leading to better outcomes for patients.

References

1. Driver BE, Prekker ME, Klein LR, et al. Effect of use of a bougie vs endotracheal tube and stylet on first-attempt intubation success among patients with difficult airways undergoing emergency intubation: a randomized clinical trial. *JAMA*. 2018;319(21):2179-2189.
2. Macintosh RR. An aid to oral intubation (letter). *BMJ*. 1949;1:28.
3. El-Orbany MI, Salem MR, Joseph NJ. The Eschmann tracheal tube introducer is not gum, elastic, or a bougie. *Anesthesiology*. 2004;101(5):1240
4. Kidd JF, Dyson A, Latto IP. Successful difficult intubation. Use of the gum elastic bougie. *Anaesthesia*. 1988;43(6):437-438. Erratum in: *Anaesthesia*. 1988;43(9):822.
5. Nolan JP, Wilson ME. Orotracheal intubation in patients with potential cervical spine injuries. An indication for the gum elastic bougie. *Anaesthesia*. 1993;48(7):630-633.
6. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia*. 1984;39(11):1105-1111.
7. Rich JM. Successful blind digital intubation with a bougie introducer in a patient with an unexpected difficult airway. *Proc (Bayl Univ Med Cent)*. 2008;21(4):397-399.
8. Gottlieb M, Sharma V, Field J, et al. Utilization of a gum elastic bougie to facilitate single lung intubation. *Am J Emerg Med*. 2016;34(12):2408-2410.
9. Price TM, McCoy EP. Emergency front of neck access in airway management. *BJA Educ*. 2019;19(8):246-253.
10. Brown CA 3rd, Bair AE, Pallin DJ, et al; NEAR III Investigators. Techniques, success, and adverse events of emergency department adult intubations. *Ann Emerg Med*. 2015;65(4):363-370.e1.
11. Hodzovic I, Latto IP, Henderson JJ. Bougie trauma—what trauma? *Anaesthesia*. 2003;58(2):192-193.
12. Kadry M, Popat M. Pharyngeal wall perforation—an unusual complication of blind intubation with a gum elastic bougie. *Anaesthesia*. 1999;54(4):404-405.
13. Marty-Ané CH, Picard E, Jonquet O, et al. Membranous tracheal rupture after endotracheal intubation. *Ann Thorac Surg*. 1995;60(5):1367-1371.
14. Miñambres E, Burón J, Ballesteros MA, et al. Tracheal rupture after endotracheal intubation: a literature systematic review. *Eur J Cardiothorac Surg*. 2009;35(6):1056-1062.
15. Dogra S, Falconer R, Latto IP. Successful difficult intubation. Tracheal tube placement over a gum-elastic bougie. *Anaesthesia*. 1990;45(9):774-776.

DR. CUNNINGHAM is a PGY2 emergency medicine resident at Maricopa Medical Center in Phoenix, Arizona, with interests in airway management and critical care. In his free time, he is a mediocre mountain biker and wannabe polyglot.

COVID-19 mRNA Vaccine

HOW THEY WORK AND SOME CURRENT CONCERNS

by HARRY W. SEVERANCE, MD

Two COVID-19 vaccine candidates, one from Pfizer-BioNTech and the other from Moderna, have received emergency use authorization (EUA) from the Food and Drug Administration. For the first time outside of clinical trial environment, vaccinations began in the United States in mid-December.

Ingredients in the Pfizer and Moderna vaccines are listed in Tables 1 and 2. Both vaccines use gene-based technology, relying on synthetic messenger RNA (mRNA).[1] In each, a synthetic strand of mRNA created for these vaccines was designed to emulate the SARS-CoV-2 mRNA strand that specifically codes for the production of the coronavirus-specific spike protein. Once inside of the cell, our own ribosomes translate the synthetic mRNA into the spike protein. That protein is then recognized as foreign, and our immune systems create antibodies.

This spike protein was chosen because it binds and fuses with human cells, allowing entry.[1] It resides on the viral capsid (envelope) of the coronavirus, a lipid bilayer that encloses the viral nuclear material.[2] Thus, this viral surface spike protein is visible to the human immune system and is highly antigenic during virus invasion.

Unlike conventional vaccines, the chosen mRNA segment does not come from "live" viruses grown in eggs or cell culture. Rather, it is a hybrid mRNA synthesized in the lab.[1-3] Therefore, such vaccines can be developed rapidly in large quantities, with the potential for rapid production and delivery to large-scale recipient populations. This technology is highly attractive for the ability to produce and provide vaccine doses rapidly, both to address current needs and to address subsequent pandemics that may appear and spread rapidly in the future.

Vaccines based on mRNA represent a new approach, one that had not previously been used clinically for infectious diseases. There have been some small, early-phase trials researching mRNA vaccines for diseases such as rabies, influenza, and Zika. However, the majority of mRNA research until recently had been directed at cancer immunotherapy. This is the first time mRNA vaccines have been proposed for wide-scale clinical release and utilization. Of note, two other vaccine candidates are currently either in trials or widespread use: the University of Oxford/AstraZeneca vaccine (now in use in the United Kingdom) and the Johnson & Johnson/Janssen Pharmaceuticals vaccine (trials are under way). These use more traditional vaccine technologies based on adenoviruses.

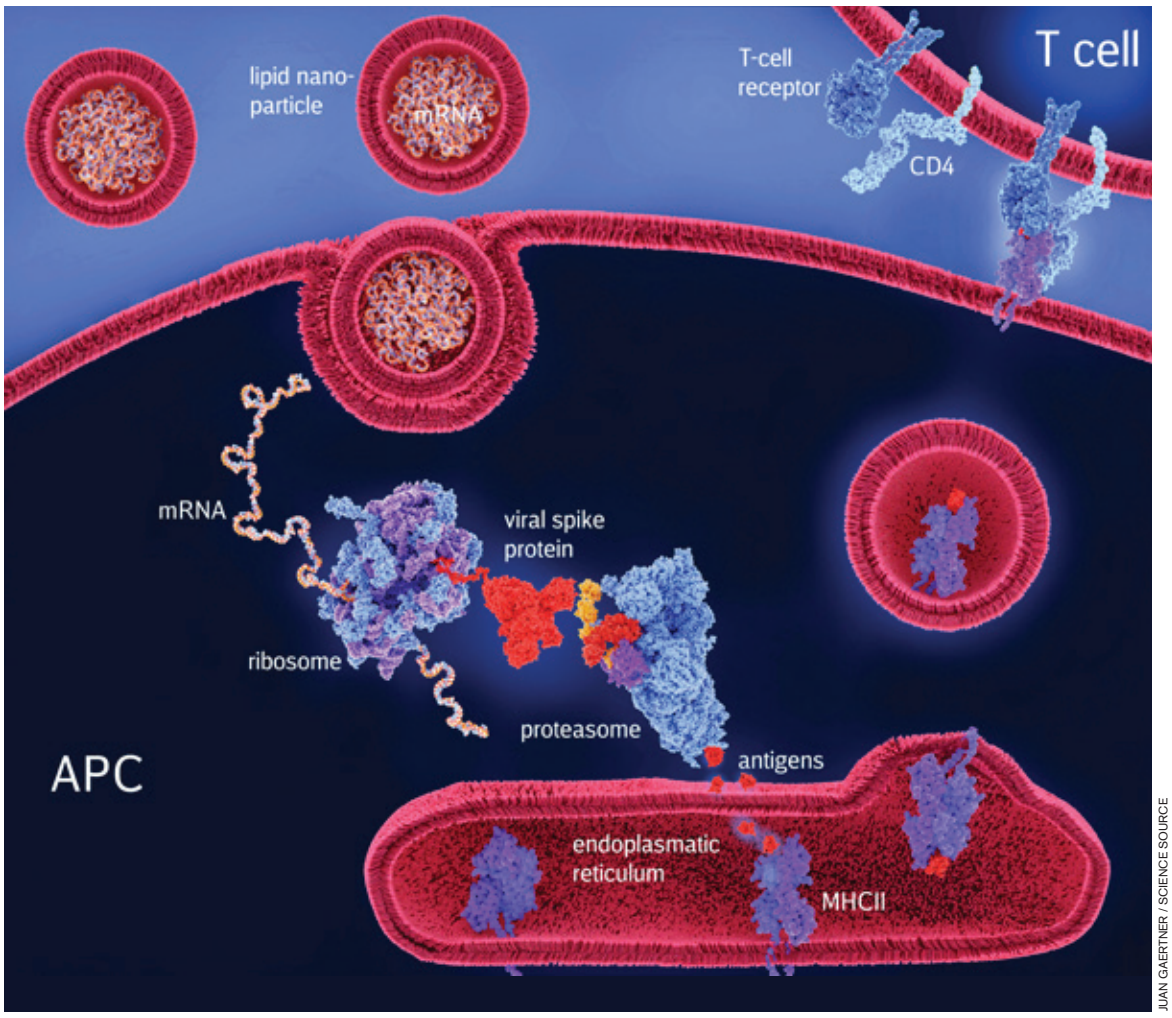
More Detail on How mRNA Vaccines Work

These mRNA vaccine candidates are exciting in that they can be rapidly and safely produced but also have thus far demonstrated greater than 94 to 95 percent immunization success. This is a success rate far in excess of other historical vaccines. But let's look a bit more closely at how they achieve this.

During vaccination, the lab-generated mRNA template that codes for the spike protein is delivered, in these cases, via injection into a host's muscle. (It has been proposed that such vaccines could potentially be delivered by other routes such as nasal spray.)[4] As this mRNA segment is not part of an intact virion, the mRNA template has been encased, in the lab, within a lipid carrier molecule to further assist the mRNA in successfully reaching and crossing the host cell membrane to carry out its function of entering cells of the just-vaccinated host.

Upon entering the cell's cytoplasm, the mRNA redirects some of the cell's protein production machinery (of which ribosomes are the workhorse) to begin producing viral spike proteins. The produced spike proteins are then incorporated into and "displayed" on the host cell's outer membrane surface.[5] This mRNA-directed production is, in some ways, similar to ac-

CONTINUED *on page 14*



JUAN GAERTNER / SCIENCE SOURCE

COVID-19 mRNA vaccine induces an immune response through the activation of T cells with antigenes obtained out of the viral spike protein (red)., which is encoded by the mRNA contained in the vaccine. APC=antigen-presenting cell

Table 1: Ingredients of Pfizer-BioNTech mRNA Vaccine

Active ingredient	30 mcg of a nucleoside-modified messenger RNA (modRNA) encoding the viral spike (S) glycoprotein of SARS-CoV-2
Fats	
Lipids	0.43 mg (4-hydroxybutyl)azanediyl) bis(hexane-6,1-diyl)bis(2-hexyldecanoate), 0.05 mg 2[(polyethylene glycol)-2000]-N,N-ditetradecylacetamide, 0.09 mg 1,2-distearoyl-sn-glycero-3- phosphocholine, and 0.2 mg cholesterol
Salts	0.01 mg potassium chloride 0.01 mg monobasic potassium phosphate 0.36 mg sodium chloride 0.07 mg dibasic sodium phosphate dihydrate
Sugar	6 mg sucrose

Source: www.usatoday.com/story/news/health/2020/12/12/pfizer-covid-vaccine-ingredient-list-nothing-too-surprising-there/6520511002/

Table 2: Ingredients of Moderna Vaccine

Active ingredient	mRNA
Lipids	SM-102, 1,2-dimyristoyl-rac-glycero3-methoxypolyethylene glycol-2000 (PEG2000-DMG), cholesterol, and 1,2-distearoyl-snglycero-3-phosphocholine (DSPC)
Tromethamine	
Tromethamine hydrochloride	
Acetic acid	
Sodium acetate	
Sucrose	

Source: https://www.desmoinesregister.com/story/news/health/2020/12/18/covid-19-vaccine-pfizer-moderna-comparison-side-effects-ingredients/3961742001/

tual virus infection where the infecting virus hijacks the cell's machinery. When a replication-competent virus infects a cell, the viral mRNA introduced contains templates for all of the proteins the virus needs to replicate. Those sequences redirect our cellular production line into making all the different virus particle proteins. A completed virion is then assembled. A viral particle either exits a cell via an established cellular pathway or is released when a dying cell ruptures. However, in this case only one virus component is produced: the spike protein. None of the other 28 proteins in a typical SARS-CoV-2 genome are manufactured, so the virus itself has not been replicated. Therefore, the host cell's functions are not otherwise disrupted, and the cell does not die during this production process.

With the newly manufactured spike protein now situated on the outer membrane of the host cell, it is visible to antibody and T-cell systems. This triggers the body to develop an immunological response, just as it would if the real virus were present. Thus, the body's immune system has now been "immunized" to attack the SARS-CoV-2 virus if it subsequently invades. In addition, the cell breaks down the existing mRNA after it translates its message into the spike protein, meaning that it can continue to function normally and with no long-term changes.[4,5] It is also important to note that while the synthetic mRNA remains in the cell cytoplasm until broken down, it never enters the nucleus of the cell where the cell's DNA resides.[5] Therefore, mRNA vaccines cannot introduce any changes into our own genomes.

Are There Concerns?

With any new technology come concerns, especially with ones like mRNA vaccines, which were developed rapidly and previously had never been delivered to millions of humans. Already, there are multiple myths circulating online and elsewhere, at least two of which relate to the function of mRNA vaccines.[6,7] One myth is that mRNA vaccines use a "live" version of the coronavirus. This is false. As described above, the mRNA for these vaccines was synthetically generated in laboratories; mRNA vaccines are not grown in eggs or cell cultures, though some other established vaccines in use for other diseases are. A second myth is that mRNA vaccines can alter the human cell's DNA. As also noted previously, the synthetic mRNA remains in the cell's cytoplasm until broken down and never enters the nucleus of the cell.

Several other hypothetical problems have been suggested. One of the chief hypothetical concerns is the possibility of the vaccine inducing an autoimmune state and/or heightened inflammatory state in the vaccinated host.[7] Some have suggested that, by the human cell installing the virus spike protein on its cell membrane, certain immune systems could become hyperreactive and identify the whole cell as "foreign" and develop autoantibodies to all cells in its "lineage" all over the human body. This would in effect create a temporary or permanent autoimmune disease state. Others have proposed autoimmune reactions could occur if there are spike protein homologues elsewhere in the body.[8] Autoimmune induction like this has previously occurred in medical therapies, most recently in some cases of cancer immunotherapy. However, many Pfizer clinical trial vaccine recipients are now over nine months out from their initial injections. So far, no reports have been released on any type of autoimmune or other ongoing or evolving debilitating symptoms related to vaccination.

As with any new medical technology, all of the answers we need will not be available until a very large number of people have received it. However, with the information available to us currently, a risk-benefit assessment strongly favors mRNA vaccination. This is especially true for those at increased risk of COVID-19 exposure or those at increased risk of developing more severe disease.

References

1. Abbasi J. COVID-19 and mRNA vaccines—first large test for a new approach. *JAMA*. 2020;324(12):1125-1127.
2. Coronavirus. Wikipedia website. Available at: https://en.wikipedia.org/wiki/Coronavirus. Accessed Jan. 10, 2020.
3. Garde D, Saltzman J. The story of mRNA: how a once-dismissed idea became a leading technology in the COVID vaccine race. Stat website. Available at: https://www.statnews.com/2020/11/10/the-story-of-mrna-how-a-once-dismissed-idea-became-a-leading-technology-in-the-covid-vaccine-race/. Accessed Jan. 10, 2020.
4. RNA vaccines: an introduction. PHG Foundation website. Available at: https://www.phgfoundation.org/briefing/rna-vaccines. Accessed Jan. 10, 2020.
5. Understanding mRNA COVID-19 vaccines. Centers for Disease Control and Prevention website. Available at: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/mrna.html. Accessed Jan. 10, 2020.
6. Nania R. 7 myths about coronavirus vaccines. AARP website. Available at: https://www.aarp.org/health/drugs-supplements/info-2020/covid-vaccine-myths.html. Accessed Jan. 10, 2020.
7. Adams M. mRNA vaccines, a primer: How they work, why they're "cleaner" than traditional vaccines, and why they might prove catastrophic in a rushed coronavirus response. Natural News website. Available at: https://www.naturalnews.com/2020-05-25-mrna-vaccines-how-they-work-coronavirus.html. Accessed Jan. 10, 2020.
8. No proof of Pfizer's COVID-19 vaccine causing female sterilisation. Boom website. Available at: https://www.boomlive.in/world/no-proof-of-pfizers-covid-19-vaccine-causing-female-sterilisation-11132. Accessed Jan. 10, 2020.

DR. SEVERANCE is adjunct assistant professor in the department of medicine at Duke University School of Medicine in Durham, North Carolina, and attending physician in the division of hyperbaric medicine, department of emergency medicine at Erlanger Baroness Medical Center/Erlanger Health System and UT College of Medicine/UT Health Science Center in Chattanooga, Tennessee. Contact him via Linked in at linkedin.com/in/harry-w-severance-md-84b6901b7.

PROTECT YOUR POT OF GOLD FROM BAD ADVICE

THE END OF THE RAINBOW

DR. DAHLE blogs at www.whitecoatinvestor.com and is a best-selling author and podcaster. He is not a licensed financial adviser, accountant, or attorney and recommends you consult with your own advisers prior to acting on any information you read here.

SHUTTERSTOCK.COM

Hanging Up Your White Coat

How to access your retirement money when retiring early

by JAMES M. DAHLE, MD, FACEP

Q. I am tired of practicing. I want to retire early. I have done a good job saving and investing and am stepping that up so I can have enough by age 55 to support my needed retirement income. How can I get to my money without paying the 10 percent penalty for withdrawing before age 59½?

A. Many doctors dream of retiring from the workforce before the traditional retirement age of 60 to 70. Most of them cannot do it because they spend too much, did not save enough, and did not invest wisely. They simply do not have the resources to retire at their desired standard of living without additional savings, a few more years of compound interest on their investments, and perhaps even the additional income from Social Security.

The select few who do have the resources to retire earlier than that worry about the age 59½ rule. This is a rule that applies to retirement accounts like traditional individual retirement arrangements (IRAs) and Roth IRAs. At its most basic level, the rule says that if you withdraw money from an IRA prior to age 59½, you will not only owe any taxes due but also face a 10 percent penalty. However, this rule should never prevent someone who is otherwise able to retire prior to age 59½ from actually doing so for a number of reasons.

First, anyone who saved enough money to be able to retire before age 59½ probably was not able to fit all of their savings into their available retirement accounts. They likely also have a sizable taxable account from which money can be withdrawn without any penalty simply by paying any long-term capital gains taxes that are due. Those taxes, of course, only apply to the gains; the principal comes out tax-free. Generally, the earlier you retire, the larger the ratio of your taxable accounts to your retirement accounts will be. So you can simply live off the taxable assets until you turn 59½ and *then* tap into the retirement accounts. Spending taxable assets first is generally the best move anyway as it allows your retirement accounts to continue to benefit from the tax and asset protection offered by retirement accounts for a longer period of time. Taxable assets also create their own income, whether that be qualified dividends from mutual funds, interest from certificates of deposit or bank accounts, or rents from income property. These sources of income can be used to cover your retirement expenses instead of being reinvested.

Second, many types of retirement accounts are not subject to the age 59½ rule. For example, many doctors are eligible for a 457(b) account, a type of deferred compensation. While the distribution rules in every 457(b) are different, you can often access this money penalty-free as soon as you stop working. 401(k)s and 403(b)s have an age 55 rule where you can withdraw from them penalty-free once you are 55 and have stopped working. If you plan to do this, be sure *not* to roll your 401(k) into an IRA as soon as you separate from the employer!

Withdrawals from health savings accounts (HSAs) to pay for health care are also not subject to the age 59½ rule. Those withdrawals come out tax- and penalty-free at any age. While an HSA generally cannot be used to pay for health insurance premiums, it can be used to pay premiums for COBRA (the federal program that allows workers to continue benefits provided by their group health plan for a limited time following job loss or certain other life events). After age 65, all withdrawals from an HSA are penalty-free, although only tax-free when used for health care.

Third, Roth IRA contributions can always be withdrawn tax- and penalty-free. Only the earnings are subject to the 10 percent penalty. Note that if you have funded your Roth IRA via Roth conversions (such as through the backdoor Roth IRA process), that principal is subject to a five-year waiting period before it can be withdrawn tax- and penalty-free. (See www.acepnow.com/article/backdoor-roth-iras-funding-one/ for more on backdoor Roth IRAs.) If Roth IRA principal withdrawals are your plan to cover living expenses between ages 55 and 60, then you need to make sure you've started doing any necessary Roth conversions by age 50.

Fourth, consider the substantially equal periodic payment (SEPP) rule. This allows you to start withdrawing from retirement accounts at any age penalty-free. Once you start SEPP withdrawals, you must continue them for at least five years or until age 59½, whichever time is shorter. The amount you can withdraw is limited but is approximately equal to the amount you should be withdrawing anyway if you want your money to last for a long period of retirement. There are three different methods you can use to calculate these withdrawals, but all of them would allow a 50-year-old to withdraw 3 to 4 percent of the portfolio per year penalty-free and a 55-year-old to withdraw 3 to 4.5 percent.

Fifth, there are many exceptions to the age 59½ IRA withdrawal rule. These include paying for medical insurance, disability, qualified higher education expenses for you or your children, a first home for you or your children ($10,000 limit), a new child or adoption ($5,000 limit), an IRS levy, and a military reservist distribution if on active duty.

Finally, IRA money is never locked up. It is your money, and you can access and spend it any time you like. The age 59½ rule only applies a 10 percent penalty to otherwise unqualified withdrawals. Few early retirees ever have to pay that penalty, but it is always an option to just pay it.

Congratulations on saving up enough money to retire early. Knowledge of IRS rules and careful management of withdrawals should allow you to cover your expenses without ever paying the 10 percent early withdrawal penalty on IRAs.

DR. DARK is assistant professor of emergency medicine at Baylor College of Medicine in Houston and executive editor of PolicyRx.org.

SHUTTERSTOCK.COM

Tuning in to Our Communities' Needs

Frequent ED users often need extra help accessing health resources

by CEDRIC DARK, MD, MPH, FACEP

Recently, one of our frequent emergency department users, an older woman with alabaster skin who I had last seen sitting in her motorized scooter outside our hospital one crisp fall morning, died. For emergency physicians, our weekly and sometimes daily interactions with patients who seem to return time and time again to the department can cause us to forge a close relationship with them, an experience that we often do not have with the vast majority of people who cross our paths.

Our relationship with frequent ED users can be complicated. Many of these interactions can feel like aggravations because of the subacute nature of their medical needs. But over time, if we allow ourselves to be open to it, we bond with such patients and they become like family. These individuals often come from lower socioeconomic backgrounds and have complicating problems such as substance abuse and mental health issues. All of this can make it more difficult for them to engage in meaningful, long-lasting relationships with primary care physicians. In reality, due to our 24-7 availability, we in the emergency department become their primary care doctors, struggling mightily to reconcile their medications, address acute problems, and link them to the right care. One of our roles then must be to work diligently to assure that frequent ED users can access appropriate community resources.

While we all hope that the COVID-19 pandemic comes to a conclusion in 2021, emergency physicians must assure that our family of frequent ED users has the resources to weather this continuing storm. The resources that better-connected patients, those without mental health and substance abuse issues, have available to them—portable oxygen, the ability to safely quarantine, and effective pharmaceutical countermeasures against the virus—need to be available to our frequent ED user family as well.

As vaccinations become available to the public, we must be sure that those who are most vulnerable also receive protection. In our community in Texas, we have partnered with hotels to provide safe spaces for quarantine to prevent spread of COVID-19 in homeless shelters and group homes. Drugs shown effective in treating COVID-19, remdesivir and dexamethasone, are available to patients requiring hospital admission. However, providing portable oxygen to patients who lack financial means or who might not be able to reliably keep up with expensive durable medical goods but who otherwise would not need hospital-based services remains challenging and often requires an out-of-pocket payment of at least $120 per month for those without health insurance coverage.

I had a vision of my recently passed patient—pleasant, smiling, and happy—and in this dream, I imagined her real family at her side, caring for her as our emergency department family had done countless times and as we will do for the next person who takes her place as one of our most frequent visitors. I worry, however, that the unique strain that COVID-19 imparts on frequent ED users could prove fatal if we are not tuned into the needs of the most vulnerable members of our communities.

EMRA+POLICYRx HEALTH POLICY JOURNAL CLUB

Resources for Frequent ED Users

by SHRUTI GUJARAN

Working in any emergency department, over time clinicians will notice some familiar faces. Patients characterized as frequent emergency department users (FEDUs) have more than five visits per year. The implications of their frequent visits can be significant. While FEDUs are a small portion of all ED users (4 to 16 percent), they account for up to half of total ED visits, contributing to crowding and health care costs.[1] Previous work has characterized FEDUs as patients with lower socioeconomic status and educational levels who are often sicker at baseline due to a complex constellation of medical comorbidities. But for FEDUs using multiple sites, are there other factors driving their visits?

A recent study addressed this question by determining how many FEDUs sought care at multiple sites (more than three sites per year), identifying the social, clinical, and contextual factors associated with these patterns.[2] The study used Health Cost and Utilization Project data from 2011 to 2014 for all outpatient ED visits in New York, Massachusetts, and Florida.

The study found that across all three states, 1,033,626 FEDUs accounted for more than 7 million visits. Nearly one-quarter of all FEDUs were also multisite users, accounting for 30 percent of the overall ED visits. Moreover, multisite frequent users were more likely to have diagnoses related to mental health and substance abuse than single-site frequent users. This correlation highlights that, in order to mitigate multisite ED use, there is a need for the implementation of integrated mental health and substance abuse treatment programs *across* health systems targeting high utilizers, expanding beyond the scope of a single emergency department.[3] Policies must address the lack of cohesive infrastructure leading to high utilization by multisite FEDUs since a fragmented health care system creates challenges in addressing the medical, social, and psychological needs of frequent utilizers.

As we witness our health system's shortcomings through the lens of the COVID-19 pandemic, let us acknowledge the need for supportive community infrastructure for FEDUs. Advocacy by emergency physicians for community-wide approaches to coordinated mental health and substance abuse counseling and support as well as chronic disease prevention and treatment is paramount to improve the systems of care that affect our most frequent visitors.

References

1. Trueger S. On "unnecessary" ED visits: background reading. MDaware website. Available at: http://mdaware.blogspot.com/2017/11/unnecessary-ed-visits-background-reading.html. Accessed Jan. 9, 2020.
2. Giannouchos TV, Washburn DJ, Kum HC, et al. Predictors of multiple emergency department utilization among frequent emergency department users in 3 states. *Med Care*. 2020;58(2):137-145.

MS. GUJARAN is a medical student at the University of Maryland School of Medicine in Baltimore.

BRINGING DATA TO THE BEDSIDE

BENCHMARKING ALLIANCE

DR. AUGUSTINE is chair of the National Clinical Governance Board of US Acute Care Solutions in Canton, Ohio; clinical professor of emergency medicine at Wright State University in Dayton, Ohio; vice president of the Emergency Department Benchmarking Alliance; and a member of the ACEP Board of Directors.

Ever-Changing Use of ED Diagnostics

Year-on-year trends and comparative metrics to analyze your ED

by JAMES AUGUSTINE, MD, FACEP

Emergency departments have become overall diagnostic and treatment centers of excellence and availability in the American health care system. This role has been accentuated in the high-acuity era of COVID-19.

With the surge of telemedicine and other virtual connections with the health system, the ongoing need for centers that provide immediate and unscheduled diagnostic testing to appropriately diagnose and manage new illnesses and injuries has only grown.

The Emergency Department Benchmarking Alliance (EDBA) measures ED utilization of diagnostic testing as the number of procedures performed per 100 patients seen. The latest survey for the year 2019 uses data from approximately 1,000 emergency departments that together saw 50 million patients and reports the results in cohorts based on facility type and on volume of patients seen in those departments (see Table 1).[1] These data that capture ongoing changes in utilization and ED flow provide important insights for ED

CONTINUED *on page 18*

Table 1: 2019 ECG and Imaging Procedure Utilization

ED TYPE	ECGS PER 100 PATIENTS	MRI PROCEDURES PER 100 PATIENTS	ULTRASOUND PROCEDURES PER 100 PATIENTS	CT PROCEDURES PER 100 PATIENTS	SIMPLE RADIOGRAPH PROCEDURES PER 100 PATIENTS
All EDs (n=1,400)	28	1.8	7	27	48
Under 20k Volume	22	0.6	4	18	37
20–40k	25	1.5	6	20	41
40–60k	28	1.5	9	25	45
60–80k	30	2.5	10	29	48
80–100k	37	2.5	9	30	53
Over 100k Volume	35	3.3	8	20	40
Pediatric EDs	3	1.0	5	5	26
Adult EDs	35	2.5	6	36	50
Freestanding EDs	16		4	12	36

Figure 1: ECG and CT Utilization per 100 Patients

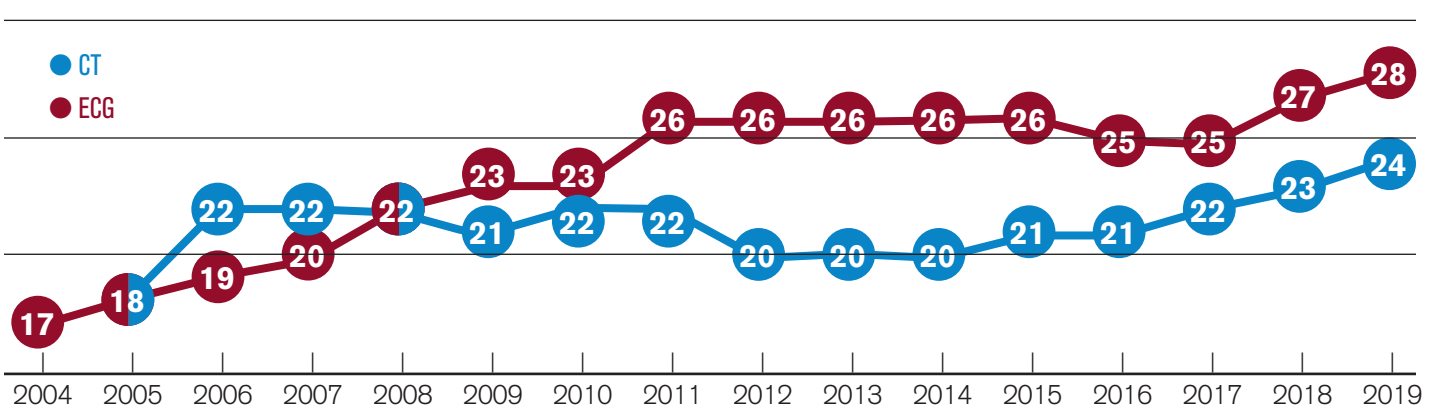
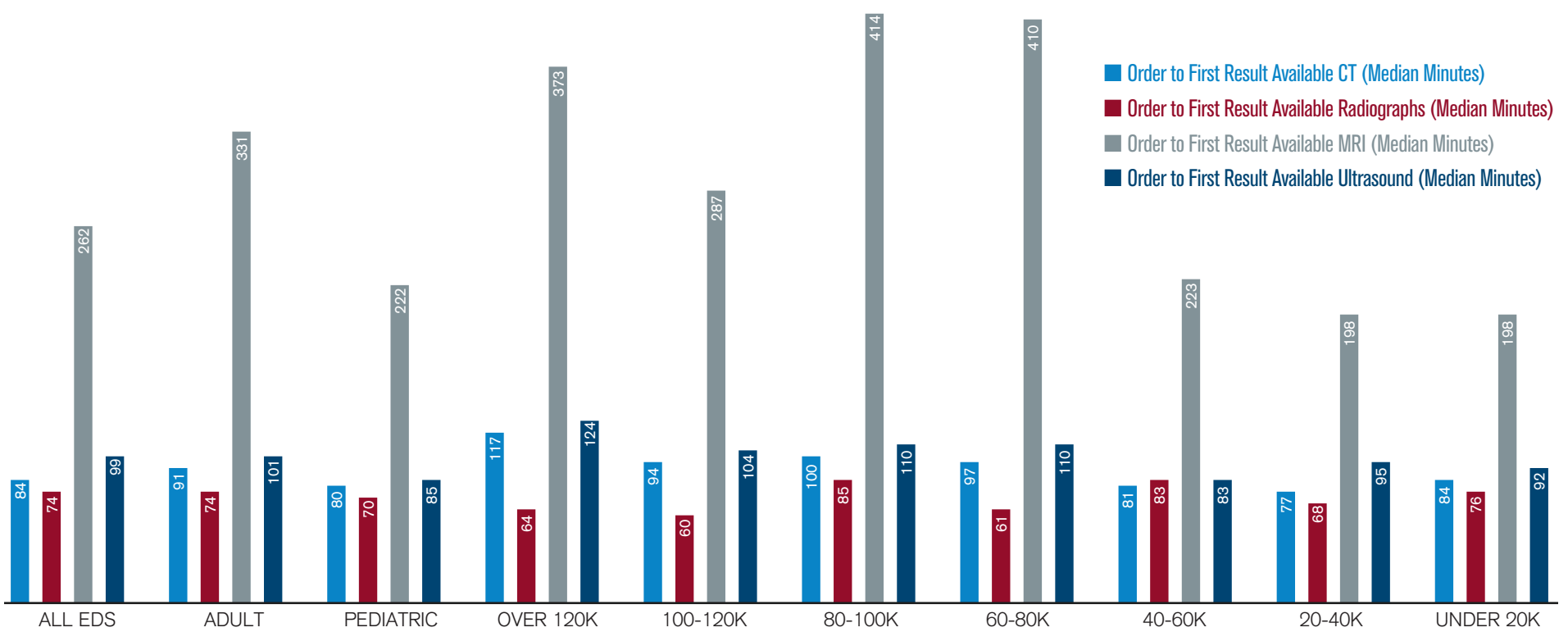


Figure 2: Median Diagnostic Imaging Turnaround Times (Minutes)



leaders. It is important to note that a variety of quality measures are in place to quantify the use of diagnostic procedures by emergency departments and individual practitioners. While utilization data are a key component of quality measurement, it is essential to consider the differences in the patient population being served by various facilities when any comparisons are made.

Diagnostic Test Utilization

Use of diagnostic testing was first reported by the EDBA in *ACEP Now* in 2017.[2] Table 1 shows EDBA data on the utilization of diagnostic testing based on volume of patients served and population served. There have been significant increases in use of diagnostic testing in adult-serving emergency departments compared to facilities serving pediatric populations. For example, pediatric emergency departments only use CT imaging procedures approximately four times per 100 patients seen, while adult-serving emergency departments have 32 uses per 100 patients. Emergency departments with annual volumes over 40,000 patients also turn to testing more frequently.

Utilization of ECGs also continues to increase, according to EDBA figures (see Figure 1), reflecting the increasing percentage of older patients being evaluated in emergency departments and our improved understanding of the variation in how acute coronary syndromes can present.

There is also a trend of increasing utilization of CT scans (see Figure 1), ultrasound, and MRI imaging. MRI utilization across all emergency departments has now grown to around two per 100 patients, and up to 2.5 in higher-volume emergency departments and trauma centers where acuity (and resource availability) may be higher.

To further characterize performance, hospitals were sorted based on trauma center designation. CT scans are used more frequently in Level I and II trauma centers, especially in facilities that also serve as high-level stroke centers and see a greater proportion of adults. There are 31 CT procedures per 100 patients in Level I and II trauma centers, and around 22 procedures in lower-level and nontrauma centers. ED leaders should be aware of the differences and, when called upon to study institutional utilization, should compare their experience to cohorts at a similar level of trauma designation and pediatric mix.

> The emergency department is the diagnostic center for the medical community. This role is particularly important for patients who have the greatest need for timely evaluation and treatment and might require hospitalization.

Diagnostic Imaging Turnaround Times

In 2019, EDBA assembled its first collection of data on turnaround times for select radiology and laboratory metrics. Turnaround time is defined as the median time interval from order placed in the electronic health record by the ED staff to first result available to the ED staff. For imaging procedures, this may be when the "preliminary" or "final" results are available, depending on the emergency department's policy of decision making for a given imaging modality. The intervals are presented in Figure 2 for routine radiographs, CT scans, MRI scans, and ultrasound procedures, with all displayed as median time elements in minutes. There are important time differences, and like many other elements of ED processing, they are shorter in the lower-volume emergency departments. Because this is the first year this data set has been reported, there are no trending graphs.

The emergency department is the diagnostic center for the medical community. This role is particularly important for patients who have the greatest need for timely evaluation and treatment and might require hospitalization. Because about 67 percent of inpatients are processed through the emergency department, emergency physicians are responsible for a disproportionate share of diagnostic testing and related patient flow issues.

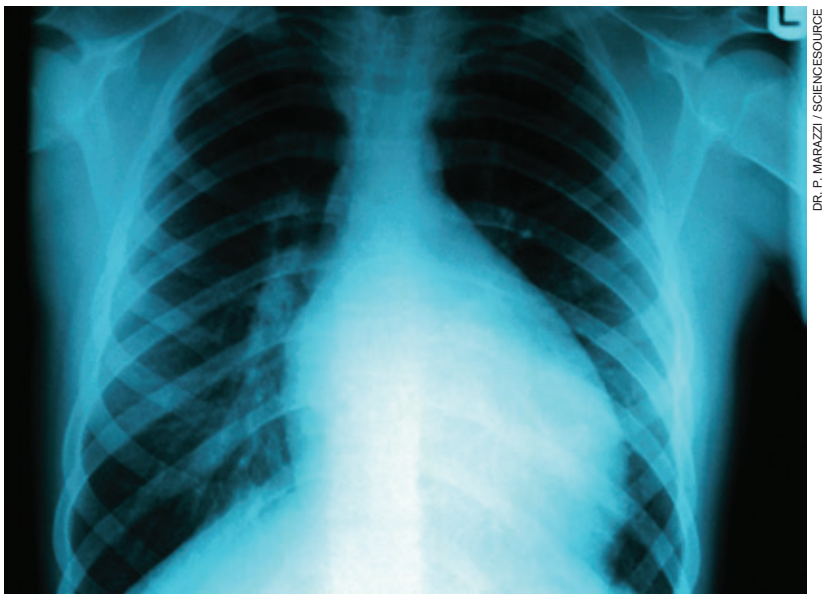
Emergency physicians should understand the typical utilization rates and turnaround times for diagnostic testing in their department. Now, thanks to new data, departments can see how their utilization practices compare to similar ones around the nation. It is hoped that this will allow better decision making about diagnostic imaging use as a marker of quality and lead to productive discussions with the hospital's imaging department about ensuring turnaround times are appropriate.

References

1. Yiadom MYAB, Napoli A, Granovsky M, et al. Managing and measuring emergency department care: results of the fourth Emergency Department Benchmarking Definitions Summit. *Acad Emerg Med*. 2020;27(7):600-611.
2. Augustine JJ. Diagnostic testing in the ED supports development of new metrics as quality indicators. *ACEP Now*. 2017;34(7):21-22.

important to know. Animal studies have demonstrated that exercising with myocarditis is associated with an increase in viral replication, which can result in permanent cardiac scarring. Whether this translates to humans including children is unknown. However, myocarditis has been shown to account for 20 percent of nontraumatic sudden cardiac deaths among a military recruit cohort, suggesting that any children who acquire myocarditis may carry downstream risks into early adulthood.[6]

More recently, a systematic review specifically evaluated pediatric COVID-19–associated myocarditis.[7] The authors found that, as of July 2020, there were 570 Centers for Disease Control and Prevention (CDC)–reported cases of pediatric multisystem inflammatory syndrome (PMIS). PMIS is more routinely referred to as MIS-C (multisystem inflammatory syndrome in children) in much of the emerging literature on this topic. The condition is a Kawasaki-like hyperinflammatory disease presentation involving multiple organ systems and often accompanying myocardial dysfunction. As of the end of July 2020, the authors calculated an incidence of CDC-reported MIS-C of approximately 0.2 to 0.6 percent of COVID-19 pediatric infections. In their systematic review, the authors identified 688 cases of MIS-C in the literature, with myocardial dysfunction documented in 340 of 688 of these cases (50.9 percent). Of note, isolated COVID-19–associated myocarditis cases have been reported in the literature, but most cases of myocarditis are related to MIS-C.



DR. P. MARAZZI / SCIENCESOURCE

Chest X-ray of a 16-year-old boy with myocarditis.

The overall incidence of COVID-19–associated myocarditis is difficult to estimate using these data, as these studies reported MIS-C patients in pediatric ICUs only. The incidence of less severe myocarditis is unknown in both patients with COVID-19 and influenza patients.

Is COVID-19 especially likely to cause myocarditis? That remains unknown. The incidence of COVID-19–associated myocarditis may turn out to be similar to other viral pathogens, but due to the vast number of COVID-19 infections, the prevalence of COVID-19–associated myocarditis definitely appears to be higher. For this reason alone, myocarditis needs to be higher on practitioners' differential diagnosis list when evaluating children in today's clinical environment.

While of uncertain clinical significance, there is a small amount of data on asymptomatic COVID-19–associated myocarditis in college student athletes (mean age of 20 years). A single study from Vanderbilt University evaluated 59 COVID-19–positive athletes, of whom 78 percent had mild symptoms and 22 percent were asymptomatic. These data were compared to results of 60 athlete controls and 27 healthy controls via cardiac magnetic resonance (CMR).[8] The median time from COVID-19 detection to CMR was 21.5 days (range 10–162 days), and two of 59 (3 percent) COVID-19–positive patients met clinical criteria for myocarditis. Again, the clinical significance of these findings remains uncertain, and this study was not in children. Still, it does warrant consideration that something similar may be happening in children, too.

Conclusion

We are unable to determine whether there is a higher incidence of COVID-19–associated myocarditis in children compared to other viral pathogens. However, the prevalence of myocarditis does appear to be higher, with the majority of cases appearing to be associated with MIS-C.

References

1. Barach P, Lipshultz SE. Rethinking COVID-19 in children: lessons learned from pediatric viral and inflammatory cardiovascular diseases. Prog Pediatr Cardiol. 2020; 101233.
2. Kochi AN, Tagliari AP, Forleo GB, et al. Cardiac and arrhythmic complications in patients with COVID-19. J Cardiovasc Electrophysiol. 2020;31(5):1003-1008.
3. Sellers SA, Hagan RS, Hayden FG, et al. The hidden burden of influenza: a review of the extra-pulmonary complications of influenza infection. Influenza Other Respir Viruses. 2017;11(5):372-393.
4. Tokuhira N, Shime N, Inoue M, et al. Mechanically ventilated children with 2009 pandemic influenza A/H1N1: results from the National Pediatric Intensive Care Registry in Japan. Pediatr Crit Care Med. 2012;13(5):e294-298.
5. Randolph AG, Vaughn F, Sullivan R, et al. Critically ill children during the 2009-2010 influenza pandemic in the United States. Pediatrics. 2011;128(6):e1450-1458.
6. Wilson MG, Hull JH, Rogers J, et al. Cardiorespiratory considerations for return-to-play in elite athletes after COVID-19 infection: a practical guide for sport and exercise medicine physicians. Br J Sports Med. 2020;54(19):1157-1161.
7. Rodriguez-Gonzalez M, Castellano-Martinez A, Cascales-Poyatos HM, et al. Cardiovascular impact of COVID-19 with a focus on children: a systematic review. World J Clin Cases. 2020;8(21):5250-5283.
8. Clark DE, Parikh A, Dendy JM, et al. COVID-19 Myocardial Pathology Evaluated through screEning Cardiac Magnetic Resonance (COMPETE CMR) [preprint]. medRxiv. 2020;2020.08.31.20185140.

Sinus Development

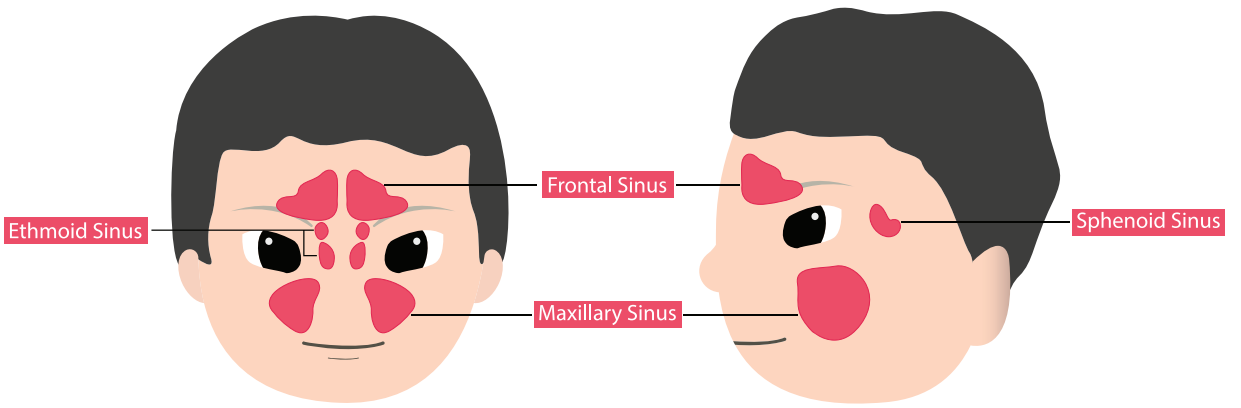
Question 2: In children, what is the typical paranasal sinus development progression?

According to a 2013 American Academy of Pediatrics clinical practice guideline for the diagnosis and management of acute bacterial sinusitis, diagnosis of acute bacterial sinusitis should occur after a child has one of the following: 1) upper respiratory infection symptoms for 10 days without improvement, 2) a worsening course (usually with nasal discharge) after a period of prior improvement, or 3) the severe onset of fever—defined as ≥39° C for three days—with purulent nasal discharge.[1] The diagnosis of sinusitis, though, requires the actual anatomical presence of a relevant sinus, too. What is the typical developmental progression of pediatric paranasal sinuses?

A 2003 retrospective study by Shah et al evaluated 91 pediatric CT scans from 66 children ages 0–12 years.[2] The authors used predefined measurement endpoints and radiological clinical experience to give these age groups developmental scores. The predetermined age groups were 0–3 months (n=9), 3–12 months (n=12), 1–3 years (n=12), 3–5 years (n=18), 5–8 years (n=26), and 8–12 years (n=14).

Consistent with other studies, all the paranasal sinuses were present at birth, but most were undeveloped. At birth, the sinuses—from largest to smallest—are ethmoid, maxillary, sphenoid, and frontal. Pneumatization (ie, development) of the maxillary sinuses begins to significantly occur in the 3–5-year range, which is also when the frontal sinus significantly begins to develop. In general, the order of significant development of the paranasal sinuses progresses from ethmoid to sphenoid and maxillary and then frontal. The sinuses we typically associate with acute sinusitis—the maxillary and frontal sinuses—are typically the last to begin significantly developing.

A separate retrospective magnetic resonance imaging–based study by Adibelli et al found similar results regarding the order of paranasal sinus development.[3] They evaluated 1,452 children ages 0–18 years and assessed age-specific dimensions of each of the sinuses. Unlike the CT study by Shah et al above, these authors did not appreciate any frontal sinus pneumatization prior to age 5 years. All children developed pneumatization of the frontal sinuses by age 10 years—so this study found frontal sinuses that developed even later. Maxillary sinuses seemed to develop relatively similarly to the study by Shah et al.



SHUTTERSTOCK.COM

Conclusion

The pediatric paranasal sinuses appear to develop in the following order: ethmoid, sphenoid/maxillary, then frontal. While they are all simultaneously enlarging, the maxillary sinuses significantly begin to develop around 3–5 years of age and the frontal sinuses are the last to significantly develop—closer to about 5 years of age. Diagnosing of acute bacterial sinusitis should take these anatomical age correlates into account.

References

1. Wald ER, Applegate KE, Bordley C, et al. Clinical practice guideline for the diagnosis and management of acute bacterial sinusitis in children aged 1 to 18 years. *Pediatrics*. 2013;132(1):e262-280.
2. Shah RK, Dhingra JK, Carter BL, et al. Paranasal sinus development: a radiographic study. *Laryngoscope*. 2003;113(2):205-209.
3. Adibelli ZH, Songu M, Adibelli H. Paranasal sinus development in children: a magnetic resonance imaging analysis. *Am J Rhinol Allergy*. 2011;25(1):30-35.

DR. JONES is assistant professor of pediatric emergency medicine at the University of Kentucky in Lexington.

DR. CANTOR is professor of emergency medicine and pediatrics, director of the pediatric emergency department, and medical director of the Central New York Regional Poison Control Center at Upstate Medical University in Syracuse, New York.

DR. LEVITAN is an adjunct professor of emergency medicine at Dartmouth's Geisel School of Medicine in Hanover, New Hampshire, and a visiting professor of emergency medicine at the University of Maryland in Baltimore.

DR. CHANG is associate professor of emergency medicine at Jefferson Health in Philadelphia.

Facing Our Greatest Challenge

Early identification of worsening COVID-19 lung disease may save lives

SHUTTERSTOCK.COM

by RICHARD M. LEVITAN, MD, FACEP; AND ANNA MARIE CHANG, MD

Editors' Note: *This article was accepted on Dec. 14, 2020, and was accurate at that time. Because information about SARS-CoV-2 and COVID-19 is evolving rapidly, please verify these recommendations and information.*

Until enough people are vaccinated so we achieve herd immunity, we will still be treating COVID-19. And while we know serious and severe COVID-19 when we see it, this disease can also be a silent killer. SARS-CoV-2 has spread insidiously through our communities; the true number of infections in the United States may be many times greater than the reported number of cases.[1] Further, approximately 50 percent of transmission is thought to be from asymptomatic persons.[2]

We tend to think about the most acute phase of COVID-19. But we are also learning about how this disease progresses insidiously in the lungs subacutely. Autopsy studies have often found diffuse alveolar damage and microthrombi in the lungs. Yet many patients with COVID-19 pneumonia do not appreciate they have lung involvement—at least not until it is too late.

In most patients who develop lung involvement, "silent hypoxia" and pneumonia visible on imaging occur about five to 10 days after initial infection. Early in the pandemic, Shah et al found that among 77 patients diagnosed from the emergency department with COVID-19, 22 went on to develop hypoxia within a few days.[3] The majority of them did not feel subjectively worse. They only returned to the hospital because of pulse oximetry monitoring and telehealth monitoring. Eight of these patients ended up in the ICU, six eventually were intubated, and two died.

There is no cure for COVID-19, but the disease course appears to be modifiable in some ways. One of the major changes is our approach to oxygen therapy. Oxygen administration lessens the work of breathing, decreases respiratory rate, and lessens inspiratory force. It is theorized this may modify what would otherwise be progressive patient self-inflicted lung injury. Awake proning with nasal oxygenation and steroids (dexamethasone in particular) have both become standard of care for patients with hypoxia.[4,5]

The risk of developing COVID-19 lung injury varies based on many factors, including age and comorbidities but also race and gender. We can estimate that between one in 25 and one in 50 who test positive for SARS-CoV-2 will end up developing COVID-19 pneumonia. Moreover, the readmission rate for those hospitalized for COVID-19 may be as high as 20 percent.[6] The ability to identify which of these patients will require admission (and even readmission) would be a great advantage. To some extent, we already can. The single best predictive biomarker of severe COVID-19 pneumonia is not a blood test. It's pulse oximetry.

Since the pandemic began, experts in Germany have closely monitored those diagnosed with COVID-19, doing daily health visits including measuring pulse oximetry. Their outcomes have been better than those in the United States. Fortunately, that approach has caught on in at least parts of the United States.

Last spring and summer, the Federal Communications Commission

CONTINUED *on page 21*

Pulse Oximetry, Race, and COVID-19

by ONYEKA OTUGO, MD, MPH

Racial bias is automated into various technologies such as facial recognition.[1] Racial bias is also ingrained in our health care system. However, the intersection of medical technology, health care, and racial bias is often overlooked. Lately, pulse oximetry has become an especially important example of that. This technology has played a big role during the COVID-19 pandemic—which is why we need to understand its strengths and weaknesses.

Few studies have evaluated the differences in the accuracy of pulse oximetry readings depending on race. Recently published research in the *New England Journal of Medicine* demonstrates how commonly the administration of supplemental oxygen depends on readings supplied by the pulse oximeter.[2] In the study, researchers evaluated adults who received supplemental oxygen. Pulse oximetry measurements were paired with arterial oxygen saturations collected within 10 minutes of each other. The study population included inpatients from the University of Michigan Hospital from January to July 2020 and patients in intensive care units in 178 hospitals from 2014 to 2015. The study evaluated occult hypoxemia in patients who self-identified their races as either white or Black. Adjustments were made based on age, sex, and cardiovascular health using the Sequential Organ Failure Assessment (SOFA). From the University of Michigan site, 10,789 paired measurements were obtained from 276 Black patients and 1,333 white patients, and from the multicenter sites, 37,308 paired measurements were obtained from 1,050 Black patients and 7,352 white patients. The findings were impressive. "Black patients had nearly three times the frequency of occult hypoxemia that was not detected by pulse oximetry as white patients," the authors write.

An older study published in 2007 in *Anesthesia and Analgesia* evaluated a smaller study population of 36 individuals and classified their skin tones as either light, intermediate, or dark.[3] That study noted that pulse oximeters were more likely to overestimate oxygen saturation in hypoxic patients

CONTINUED *on page 23*

began rolling out a COVID-19 telehealth program that provided funding to hospitals and health care centers to purchase devices for telehealth and remote monitoring of patients and families affected by COVID-19.[7] That support is necessary to provide equipment, personnel support, and patient education to enable home pulse oximetry monitoring, particularly in vulnerable populations. Progress has been made. In June 2020, the state of Vermont initiated a statewide government-sponsored universal postdiagnosis pulse oximetry monitoring program. Jennifer Read, MD, MS, MPH, an epidemiologist at the Vermont Department of Health, had examined all deaths in her state from COVID-19 and correctly concluded that hypoxemia was a major contributing factor. Similarly, the New York City Department of Health recently launched what is likely the largest government-sponsored pulse oximetry program in the country and is supplying New York City hospitals with several hundred thousand pulse oximeters.

If we are to reduce the number of patients requiring ICU care, decrease hospital length of stay, and decrease morbidity and mortality, we need to identify and treat COVID-19-related lung disease earlier. This will not save everyone; some patients develop progressive respiratory failure despite initiation of early treatment. Though our treatment regimens have improved, we need to identify and treat COVID-19 patients earlier—before they need ICU-level care and advanced airway management.

In most of emergency care, the simple admonition to "return if worse" is a reasonable discharge instruction. This is not sufficient for COVID-19, however. Patients should be closely monitored for 10–14 days after diagnosis with pulse oximetry checks three times a day. If pulse oximetry–measured oxygen saturation drops to 92 percent, patients should return to hospital for treatment. Walk testing (five minutes of ambulation) with a corresponding 5 percent or greater on pulse oximetry drop suggests an impending need for reevaluation and likely admission.

Emergency physicians can help their communities prevent many avoidable deaths and lessen ICU resource demands if we advocate for and provide universal pulse oximetry monitoring of all SARS-CoV-2-positive patients who are safe for initial home management.

References

1. Reese H, Iuliano AD, Patel NN, et al. Estimated incidence of COVID-19 illness and hospitalization — United States, February–September, 2020 [published online ahead of print Nov. 25, 2020]. *Clin Infect Dis*. doi: 10.1093/cid/ciaa1780.
2. Honein MA, Christie A, Rose DA, et al; CDC COVID-19 Response Team. Summary of guidance for public health strategies to address high levels of community transmission of SARS-CoV-2 and related deaths, December 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(49):1860-1867.
3. Shah S, Majmudar K, Stein A, et al. Novel use of home pulse oximetry monitoring in COVID-19 patients discharged from the emergency department identifies need for hospitalization. *Acad Emerg Med*. 2020;27(8):681-692.
4. RECOVERY Collaborative Group; Horby P, Lim WS, Emberson JR, et al. Dexamethasone in hospitalized patients with Covid-19 - preliminary report [published online ahead of print July 17, 2020]. *N Engl J Med*. doi: 10.1056/NEJMoa2021436.
5. Thompson AE, Ranard BL, Wei Y, et al. Prone positioning in awake, nonintubated patients with COVID-19 hypoxemic respiratory failure. *JAMA Intern Med*. 2020;180(11):1537–1539.
6. Donnelly JP, Wang XQ, Iwashyna TJ, et al. Readmission and death after initial hospital discharge among patients with COVID-19 in a large multihospital system. *JAMA*. 2021;325(3):304-306.

DR. WELCH is a practicing emergency physician with Utah Emergency Physicians and a research fellow at the Intermountain Institute for Health Care Delivery Research. She has written numerous articles and three books on ED quality, safety, and efficiency. She is a consultant with Quality Matters Consulting, and her expertise is in ED operations.

Fast Flow in the Desert

Shifting to physician in triage enabled fast assessment and treatment at Tennity ED

by SHARI WELCH, MD, FACEP

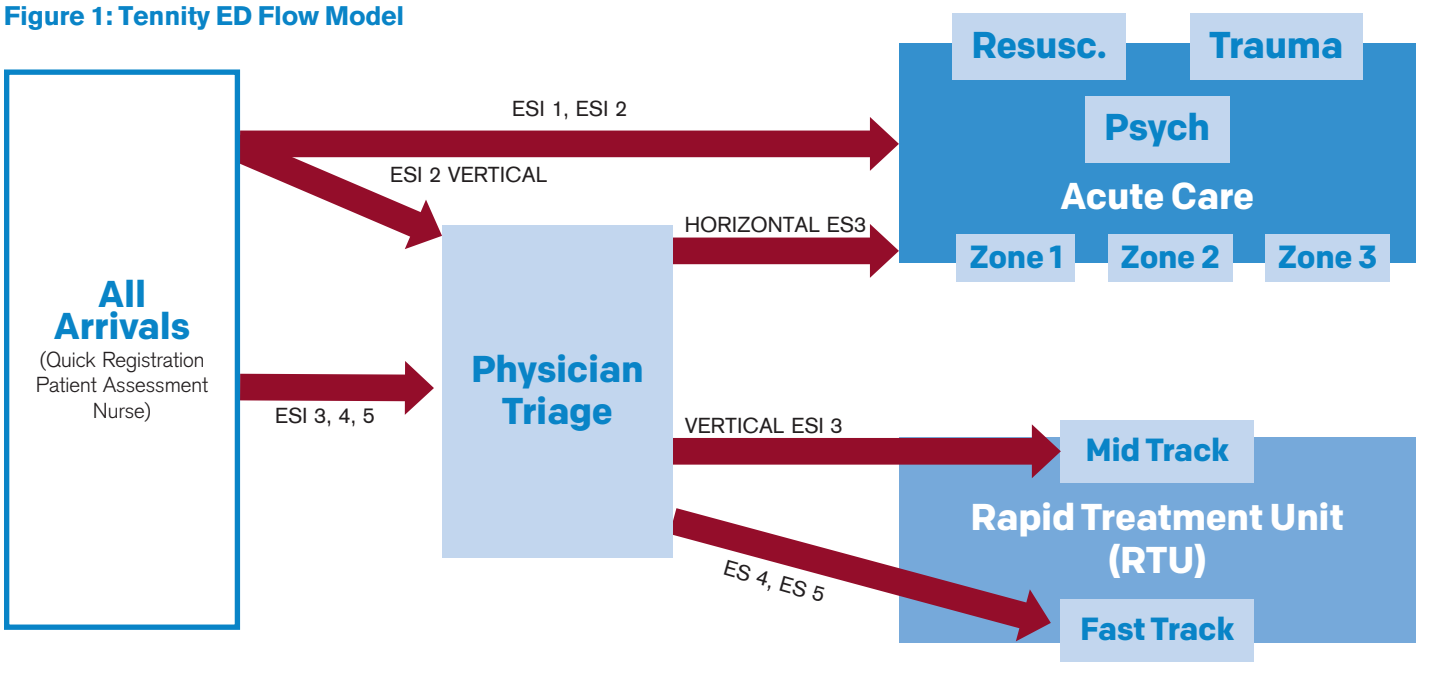
The leadership team in the Tennity Emergency Department at Eisenhower Health in Rancho Mirage, California, was struggling with their operations. The Tennity ED was seeing more than 83,000 patients annually in its 55-bed emergency department. The Coachella Valley is a popular retirement/resort destination, and the patient makeup at Tennity is heavily geriatric (56 percent). The admission rate varies by season between 25 and 30 percent, and boarding was problematic during peak times. Eisenhower Health is home to a new emergency medicine residency, so the teaching mission is important and another factor in ED operational efficiency.

Prior to the COVID-19 pandemic, the department was struggling to see patients in a timely manner, with door-to-clinician times at 70 minutes and total walkaway rates (left before treatment complete, or LBTC) topping out at 9.2 percent. The ED and hospital leaders wanted to reengineer their emergency department to better meet the demands of the community, and they began working on that before the pandemic. Rather than stopping the redesign when the pandemic hit, they soldiered throughout the following six months to accomplish the task. Marty Massiello, chief operating officer, and Ann Mostofi, chief nursing officer, provided the ED leadership team with process-improvement professionals and the right resources to support the project. Everyone stepped up.

The leadership team—medical director Euthym Kontaxis, MD; department chairman and operations director David Romness, MD; ED nursing director Tasha Anderson, RN; assistant nursing director Joshua Hickman, RN; nurse practitioner Ervin Xhufka, RN; process-improvement lead Joseph Torres; and Epic data analyst Andres Beltran—brought together representatives from all stakeholder groups to redesign the emergency department. The team ambitiously developed a sophisticated flow model with complex patient streaming built upon a physician in triage (PIT) platform (see Figure 1). Because low-acuity volumes were dropping, the team found that populating a traditional fast track was hit-or-miss. The department decided on a rapid treatment unit (RTU) model, which is a flexible unit that merges fast track and "mid track" functions and responds to the Emergency Severity Index (ESI) distribution that presents to the emergency department on any given day.

The Tennity ED waiting room at 7 p.m.

Figure 1: Tennity ED Flow Model



The New Flow

All patients are seen by a rapid assessment nurse and a registration clerk, where a quick (less than three minute) intake process begins. Registration creates a patient identity, and the assessment nurse does a "quick-look ESI" with a chief complaint, allergies, and pulse oximetry readings. This is enough information for the first round of patient sort-

Table 1: Tennity ED Metrics Before and After

	BEFORE COVID	AFTER COVID	AFTER IMPROVEMENT
Patients per day	229	153	179
Door to doctor (minutes)	70	86	14
Left before treatment complete	9.2%	7.5%	1.9%
Left without being seen	2.4%	6.4%	0.7%
Length of stay (minutes)	264	332	225

Tennity ED leadership team (from left): ED nursing director Tasha Anderson, RN; department chairman and operations director David Romness, MD; medical director Euthym Kontaxis, MD; and assistant nursing director Joshua Hickman, RN.

ing. Patients needing immediate bedding are sent to the acute care areas. Patients who can remain vertical and are deemed nonacute pass through the PIT. The PIT experience is rapid: The physician does a quick, focused history and physical; places orders; and writes a very abbreviated note. The ED tech draws labs and/or obtains an ECG, and the patient is escorted to the area selected by the physician as the most appropriate zone.

PIT patient streaming is based on acuity as designated by ESI *and* anticipated length of stay, which the physician is best at determining. The entire PIT process takes less than six minutes per patient. Scripting and information cards are used to explain the new process to the patient. The patient may go to one of the following areas: fast track; mid track (both located in the RTU); acute care zones 1, 2, or 3; or a psychiatric bed. The icing on the cake for the whole flow model is the institution of flow nurses called "patient flow coordinators" who constantly monitor flow and load level as well as identify bottlenecks in the department. The Tennity ED leadership team has also been creative in implementing a COVID-19 hot zone as case counts rise and fall. They created a separate negative pressure "COVID suspect" assessment area and a COVID-19 hot zone with appropriate isolation rooms and personal protective equipment for higher-acuity patients in the acute care part of the emergency department.

Education and training for implementing the new model included:

1. One-on-one meetings with each physician
2. "At-the-elbow" coaching of all key roles in the new model
3. Shift huddles
4. Online training modules
5. In-service presentations
6. Information binders with one-page visual displays outlining the flow model, inclusion and exclusion criteria for each area, swim lane diagrams for the choreography of work in each area, high-flow processes (described below), and standard work for each role in each zone

The development of these one-page documents helped the team to formally standardize the work in the department for the first time in 10 years.

The Tennity ED implemented several other strategies:

- **High-flow rescue:** "High flow" refers to the surge state in the emergency department. The Tennity ED leaders and staff have hard-wired triggers for when a geographic area in the department is overwhelmed (particularly PIT and RTU, where patient turnover needs to be fast). In this model, the middle- and low-acuity patients are siphoned off to the RTU so the acuity and admission rate are higher in the acute care areas. They developed a system that brings another worker to an area experiencing high flow so it doesn't get permanently overwhelmed and backlogged with patients. The front patient flow coordinators and back flow coordinator are trained to recognize and "turn on" the high-flow rescue.
- **PIT to NIT:** For emergency departments practicing PIT models, there is often a falloff in efficiency at night when the model closes down. The night shift, with its pared-back staffing, is vulnerable to surges, and the intake of middle- and lower-acuity patients can suffer. The Tennity ED frontline staff liked the abbreviated intake process so much, they did not want to shut it down completely at night. Instead of reverting to the old traditional nurse triage model, they run a nurse in triage (NIT) model. The nurse does the abbreviated intake and uses an established chief complaint–driven order set to quickly send labs in the PIT area before rapidly sending patients to the appropriate zone. As a result, the night shift not only comes into to an empty waiting room, all patients have been seen, have had labs drawn, and usually are roomed quickly.
- **Epic support for workflows:** Essential to these strategies was working with the Epic technology team at Eisenhower Health—Johnna Young and Susan Breshears—to modify the tracking board and create a PIT narrator to streamline the process. In this way, the IT system supported the new patient flow and workflow.

The results of the new process are in Table 1.

Nothing tells the story of the fantastic change implemented by the Tennity ED better the picture of an empty waiting room.

with darker skin. The findings also varied by pulse oximeter type, with adhesive sensors introducing greater bias when compared to clip-on sensors.

COVID-19 brings urgency to highlighting these differences. As we all know, a great deal of triaging occurs based on patients' initial vital signs as well as those recorded during evaluation and treatment in the emergency department. During the pandemic, peripheral oxygen saturation levels have arguably become the most important vital sign. In fact, whether patients should receive dexamethasone, which is the only therapy with a proven mortality benefit in treating COVID-19, hinges on oxygen levels; hypoxic patients *should* receive dexamethasone while normoxic patients *should not*. (There was a signal of harm in the RECOVERY trial among normoxic patients who received the steroid.)[4]

The reliance on pulse oximetry to triage Black patients in particular places these patients at an increased risk for delayed interventions and therefore an increased risk for hypoxemia and its downstream effects. Special attention should be paid to our discharge recommendations for patients with a known or suspected COVID-19 diagnosis. As reported by Dr. Levitan and Dr. Chang in the accompanying article, there are benefits to having patients monitor their oxygen saturation with at-home pulse oximeters.[5] However, efforts should be made to educate patients, especially those with darker skin tones, about the inaccuracy of these measurements and to place more emphasis on their symptoms rather than the measurements from these devices. Further study may help discover whether the threshold for what is considered a "hypoxic" reading should differ among people depending on their skin tone.

References

1. Harwell D. Federal study confirms racial bias of many facial-recognition systems, casts doubt on their expanding use. Washington Post website. Available at: https://www.washingtonpost.com/technology/2019/12/19/federal-study-confirms-racial-bias-many-facial-recognition-systems-casts-doubt-their-expanding-use. Accessed Jan. 28, 2021.
2. Sjoding MW, Dickson RP, Iwashyna TJ, et al. Racial bias in pulse oximetry measurement. *N Engl J Med*. 2020;383(25):2477-2478.
3. Feiner JR, Severinghaus JW, Bickler PE. Dark skin decreases the accuracy of pulse oximeters at low oxygen saturation: the effects of oximeter probe type and gender. *Anesth Analg*. 2007;105(6 Suppl):S18-23.
4. RECOVERY Collaborative Group; Horby P, Lim WS, Emberson JR, et al. Dexamethasone in hospitalized patients with Covid-19 - preliminary report [published online ahead of print July 17, 2020]. *N Engl J Med*. doi: 10.1056/NEJMoa2021436.
5. Torjesenl. Covid-19: patients to use pulse oximetry at home to spot deterioration. *BMJ*. 2020;371:m4151.

DR. OTUGO is a health policy research and translation fellow at Brigham and Women's Hospital in Boston.

Exciting opportunities at our growing organization

- Emergency Medicine Faculty Positions
- Pediatric Emergency Medicine Faculty Positions
- Vice Chair, Clinical Operations
- Vice Chair, Research

Penn State Health, Hershey PA, is expanding our health system. We offer multiple new positions for exceptional physicians eager to join our dynamic team of EM and PEM faculty treating patients at the only Level I Adult and Level I Pediatric Trauma Center in Central Pennsylvania.

What We're Offering:

- Salaries commensurate with qualifications
- Sign-on Bonus
- Relocation Assistance
- Retirement options, Penn State University Tuition Discount, and so much more!

What We're Seeking:

- Emergency Medicine trained physicians with additional training in any of the following: Toxicology, Ultrasound, Geriatric Medicine, Pediatric Emergency Medicine, Research
- Completion of an accredited Residency Program.
- BE/BC by ABEM or ABOEM

What the Area Offers:

We welcome you to a community that emulates the values Milton Hershey instilled in a town that holds his name. Located in a safe family-friendly setting, Hershey, PA, our local neighborhoods boast a reasonable cost of living whether you prefer a more suburban setting or thriving city rich in theater, arts, and culture. Known as the home of the Hershey chocolate bar, Hershey's community is rich in history and offers an abundant range of outdoor activities, arts, and diverse experiences. We're conveniently located within a short distance to major cities such as Philadelphia, Pittsburgh, NYC, Baltimore, and Washington DC.

PennState Health

FOR MORE INFORMATION PLEASE CONTACT:

Heather Peffley, PHR FASPR at: hpeffley@pennstatehealth.psu.edu