

# EMED

STANFORD DEPARTMENT OF EMERGENCY MEDICINE



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# Learn More About Our Diversity, Equity, and Inclusion Work



Diversity, equity, and inclusion make our team, our practice, and our world immeasurably stronger. Our faculty, trainees, and staff prioritize translating these values into action to ensure our patient care, research, and healthcare professionals reflect and respect all members of our community. DEI efforts are woven throughout our research projects, particularly in those projects featured in this publication designated with a **DEI**.

In addition, the Department of Emergency Medicine DEI Committee actively works to evaluate and expand diversity, equity, and inclusion in our faculty, programs, and culture, and recently oversaw a year-long assessment of department DEI opportunities for growth.

We participate in Stanford's Leadership Education in Advancing Diversity (LEAD) program and the Stanford Clinical Opportunity for Residency Experience Program (SCORE) diversity program to ensure all students have a clear path to leadership in emergency medicine.

The department DEI Residency Recruitment Advisory Group employs a holistic review in screening, interviews, ranking, and selection.

Emergency medicine residents receive training on social justice and health equity via health equity rounds and upstander training throughout the year.

The Women in EM group holds regular meetings for female attendings, fellows, and residents on career development and advancement.

Nearly 60% of leadership positions are held by women, including the department chair, and 44% of faculty are female. 10% of emergency medicine faculty are from underrepresented in medicine (URiM) groups.

All faculty are trained in unconscious bias/microaggressions and on the treatment of LGBTQ+ patients. All staff are trained in recognizing bias and upstander training.

Read more at [emed.stanford.edu](https://emed.stanford.edu)



Photo by Steve Fisch

LETTER FROM THE CHAIR

# Defining the Future of Academic Emergency Medicine

Academic emergency medicine emerged roughly 50 years ago with formal training programs and aspirations for an ambitious research agenda. In our early years, emergency departments commanded such desirable locations as underground floors or “found” spaces that no one else claimed. We grew, and we adapted in many significant ways. In the following decades, we fought to gain representation within schools of medicine as departments, not just divisions. We staked a claim with board certifications, expertise in the emergent airway, sub-specialty pediatric EM training, point-of-care ultrasound, critical care, social emergency medicine, emergency medical services, global emergency medicine, and more. On the horizon, we see our pioneering specialty exploring informatics, pain medicine, climate change in health, and palliative care.

Now, in this period of our semi-centennial, we can recognize and be proud of how far we have come. At the same time, our specialty remains in a bit of a crisis clinically and academically. One road points toward a struggling reactive approach - a mad scramble in survival mode to continue advocating for our patients trapped in emergency department hallways and for those without access while we also slowly try to climb the academic ladder with decreasing federal funding. At the same time, we see the student pipeline to our incredible discipline degrading. We are sometimes a “backup” match choice, or one chosen because shorter training means students can begin paying off student loans sooner. **Can we forge a better road?**

Over the last few years, emergency rooms (ERs) have given way to emergency departments (EDs). In the last decade, even our most stalwart academic institutions finally recognized our specialty as unique and necessary. At Stanford, what was once a 25-bed conglomeration of random spaces is now our 43,000-square-foot adult ED with a wholly separate and specialized pediatric ED. Our faculty of 18 has grown to 86 (and counting), some of whom serve in critical leadership roles in the healthcare system. Like many departments of emergency medicine, we play an essential role and serve as the gateway for care through our trauma centers, stroke centers, geriatric ED, pediatric ED, and many other designations that symbolize the complexity of healthcare and our specialty.

**While our physical spaces, organization charts, and professional designations show progress, we face new challenges.**

The corporatization of medicine threatens our autonomy and our broader vision. Many of us have the same conversations year after year regarding crowding, boarding, length of stay, and patients leaving without being seen. Yet board meetings rarely have space to explore ways to create new knowledge, save lives, and educate capable, innovative emergency physicians.

As physician-scientists become even more endangered in our specialty, medical students sometimes shy away from emergency medicine pathways because of academic reputational challenges. For those of us already in the field, academic medicine has come under immense stress with insecure federal funding. We know, however, from the last 50 years, that nothing worthwhile comes easily.

**Imagine emergency medicine commanding a proactive and vital leadership role in redefining the continuum of unscheduled or episodic patient care, from birth to death, from all walks of life, in locations regional and remote, across media and technology platforms.** Imagine using our extraordinary aptitudes of innovation and dedication to transform healthcare and create new knowledge. If any specialty can do this, I would pick the one with the tenacity and talent to see any patient, anywhere, for anything, all the time, and across all organ systems.

After years of witnessing patients in crisis on their worst days, emergency medicine physicians are

developing tools to prevent a healthcare crisis. Who better to design medical systems than those of us who have a front-row seat to every possible combination of disease, lifestyle, and social driver of health?

We save lives, often daily. This fact alone should elevate our specialty and inspire medical students to join our ranks. We are creating the technology, processes, and channels to diagnose and treat at an individualized level of specificity and speed never seen before. Let us create a reality where emergency medicine is among the most competitive academic specialties for the finest students seeking to change the future. We are moving acute care beyond hospital walls, beyond community clinics, and emergency medical services. We are moving it into kitchens and living rooms through remote care, taking the “anywhere” in our mantra to an entirely new level.

I am optimistic that emergency medicine can continue to emerge as a leader within the broader house of clinical and academic medicine. No other medical discipline is as adept at mastering the dialectical exchange of patients within the complex healthcare system and also seeing science across many fields. Not surprisingly, many emergency medicine colleagues have ascended to leadership positions throughout healthcare, government, and industry. What a great foundation!

### **What is next?**

During my five years as Chair at Stanford, I have been fortunate to work in a school of medicine and university heavily invested in research and the academic mission. Nevertheless, growing a young emergency medicine department toward academic productivity and innovation has been challenging. The culture shift, the necessary infrastructure and support staff, and the need to create a deep bench of academic physicians who can inspire one another are not overnight projects. However, we are deeply committed to achieving the academic excellence that our field deserves.

The next step lies with creating and supporting pathways and pipelines in undergraduate and medical school education to ensure the sustainability of academicians in our profession. We also need to expand our training to instill a dedication to advancing the science and practice of emergency care. Emergency medicine should never be viewed as just a job or a way to train for a minimum number of years and then enjoy a part-time physician lifestyle. Emergency medicine is a calling.

Together, we can navigate the challenges ahead, champion the values and integrity of our discipline, and ensure a vibrant and diverse future for academic emergency medicine.

Onward and upward,



**Andra L. Blomkalns, MD, MBA**  
*Redlich Family Professor and Chair  
Department of Emergency Medicine  
Stanford University School of Medicine*



# STRATEGICALLY PLANNING FOR THE FUTURE

In 2024, Stanford Department of Emergency Medicine inaugurated an integrated strategic plan that unites the expertise of the School of Medicine's Department of Emergency Medicine (the university side) and the Emergency Medicine Service Line from Stanford Health Care (the clinical side) in a collaborative and concerted effort to transform healthcare for all.

Built on a five-year roadmap implemented in 2024, our strategic plan addresses the overwhelming demand for Stanford Medicine's services; expands our scientific understanding of health; and ensures workforce training to strengthen emergency medicine innovation and discovery.

The information harnessed through our emphasis on digital health, AI, and data science will be pivotal for practicing precision emergency medicine and furthering the health of the populations we serve. Our integrated roadmap furthers our commitment to digital health and non-traditional care delivery models, to enhance our efficiency and improve patient access to care while embodying our values of leadership, innovation, diversity, excellence, and service. We continue to pioneer advancements in AI within emergency medicine, while actively working to define ethical practices

for data collection and utilization that center the patient as the decision maker.

**Building upon our success in establishing a strong research infrastructure within the department, Stanford emergency medicine's strategic plan integrates clinical trials and implementation science research into our daily clinical activities.** Partnering with colleagues from across Stanford University, we will advance the science behind emergency and post-acute care leveraging expertise in informatics, AI, health services, and community-engaged research within and outside the department.

**A critical component of the integrated strategic plan is the development of the future workforce. Central to this effort is our competency-based training for healthcare providers.** Our objective is to ensure our practitioners possess vital skills and health data literacy, allowing them to seamlessly transition between the emerging health technologies of tomorrow and their patient interactions. We are steadfast in nurturing an environment that promotes learning, encourages diversity and a sense of belonging, and guarantees that our providers are well-equipped to adapt to the rapidly evolving demands of the healthcare landscape.

**Our plan also reinforces our ongoing commitment to enhance access to care for vulnerable and underserved populations.** Using data-driven, value-focused approaches that partner with community organizations we will streamline care coordination, optimize delivery models that strengthen continuity of care, and establish quality of care practices that will serve as best practices nationally.

As we embark on this ambitious plan with our partners at Stanford Health Care, we will share progress, lessons learned, challenges, and accomplishments with our colleagues around the country. Our strategic plan for our department is one we hope will *also* serve as a primary driver in transforming our specialty and care for patients everywhere.



Matthew Strehlow, MD  
Executive Vice Chair

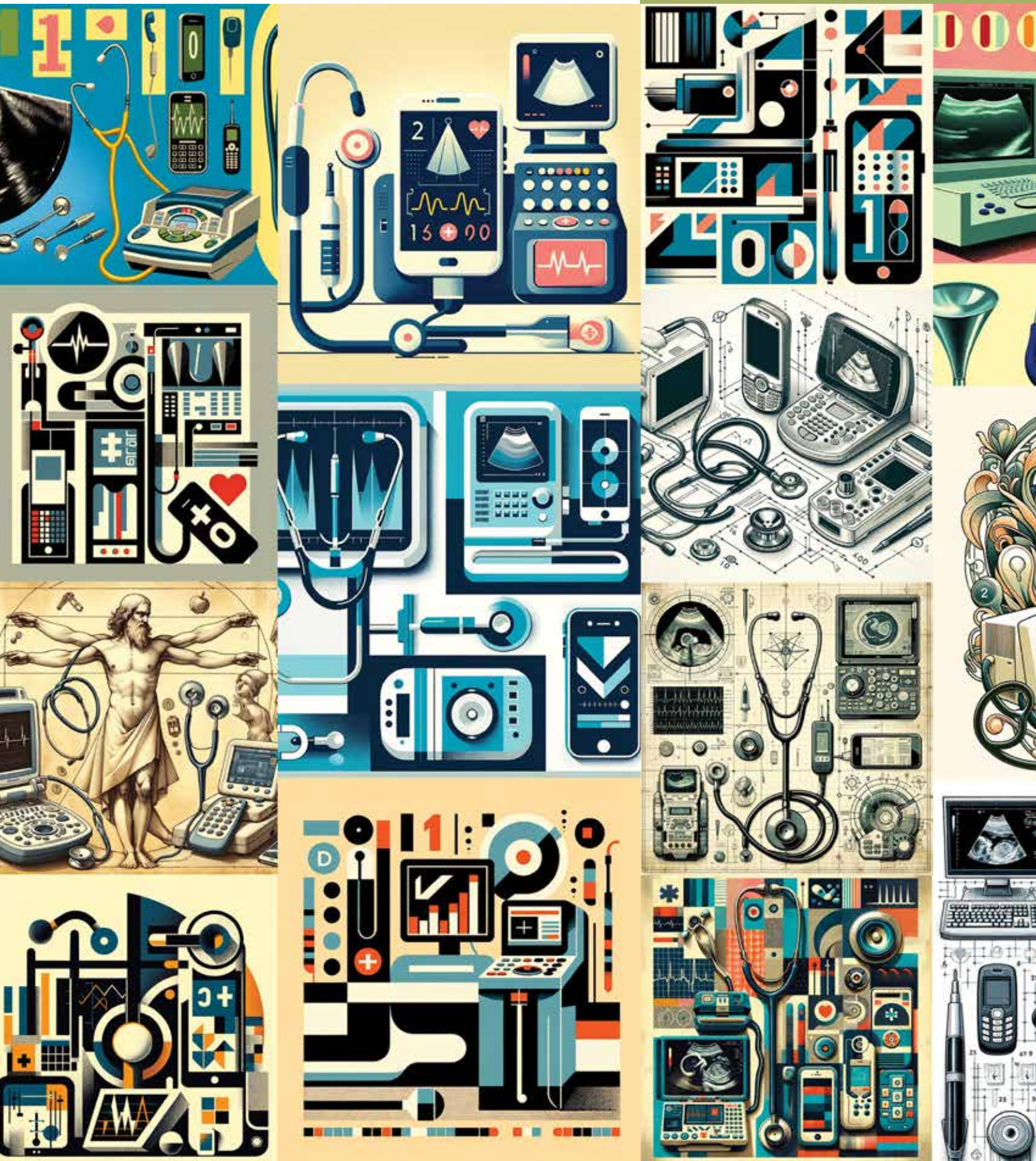




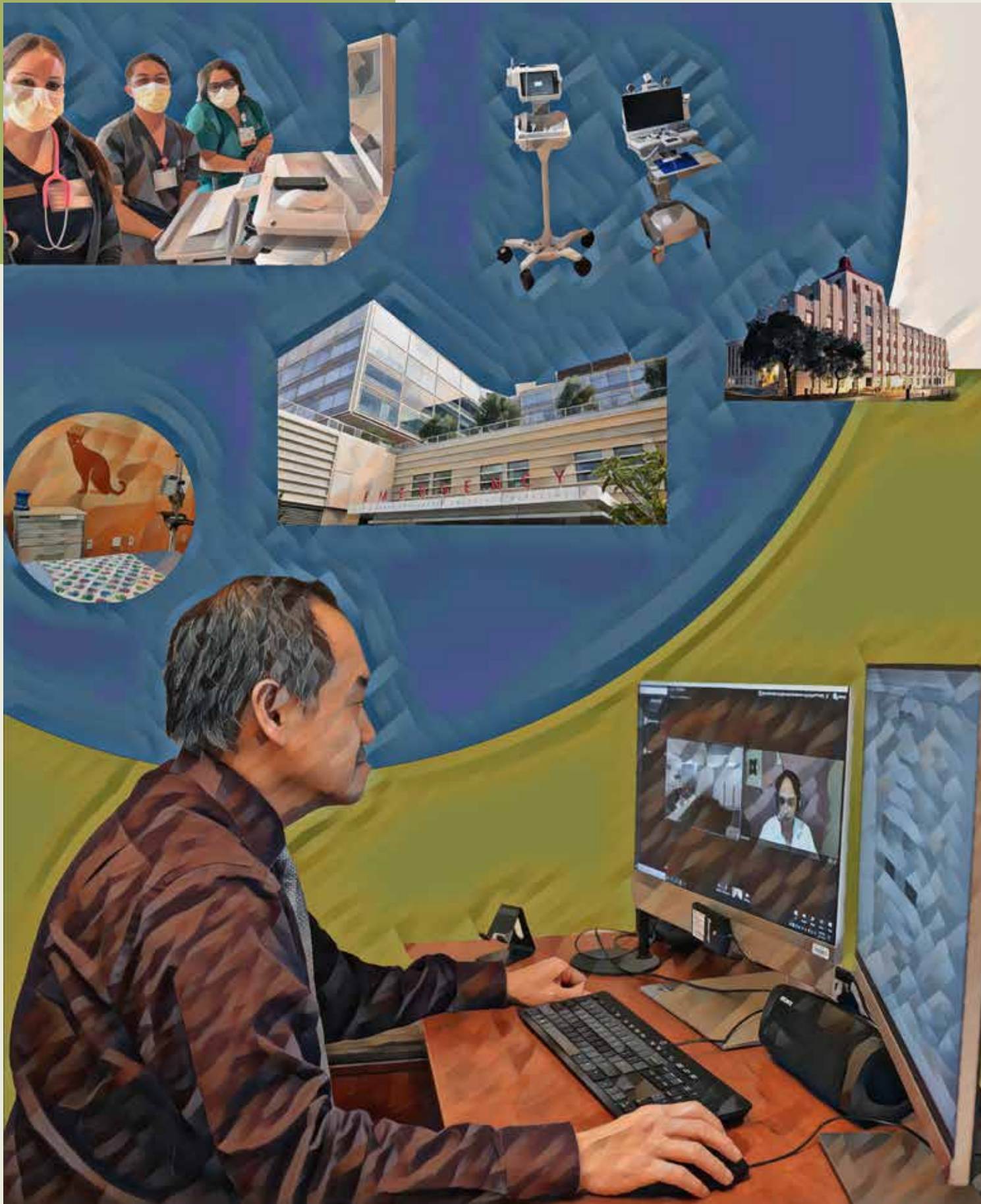


Illustration by DALL-E

# Technology & Data

The promise of AI and new technologies is not only limitless but customizable, as this illustration suggests. The same request to an image generator to “create an illustration in the style of XYZ that includes an ultrasound machine, patient monitor, stethoscope, and binary code” yields varying results depending on what is plugged in for XYZ — art deco, a builder’s blueprint, da Vinci, etc.

Similarly, all components of patient care when employed by different hands will result in myriad solutions to elevate and individualize care. The following pages tell the stories of just a few of the creations from Stanford emergency medicine physicians that utilize data and technology in new ways.



# Breaking the Virtual Care Barrier

Stanford's Virtual Visit Track (VVT) in the emergency department revolutionizes patient care, enabling remote consultation by board-certified emergency medicine physicians, resulting in shorter stays, satisfied patients, and fewer return visits. On a typical 8-hour shift, 15 patients are seen via Stanford VVT, and more than 4,000 patients have utilized the service.

On a recent 9 p.m. visit to the Stanford Hospital Marc and Laura Andreessen Adult Emergency Department (ED), 44-year-old Jane Dougherty presented with a cough, congestion, and high fevers. Despite the late hour, the lobby was full of waiting patients. As a lower-acuity patient, Jane faced a potentially long wait time to be placed in a traditional ED room to be seen by a physician.

However, because she met specific lower-acuity criteria, Jane was triaged to the Virtual Visit Track (VVT) and treated by a remote, board-certified telehealth emergency medicine physician.

Jane was taken to a custom-designed telehealth area of the ED and connected by video to discuss her concerns and symptoms with **Sam Shen, MD**, professor of emergency medicine and one of the leads of the VVT project, who was based at a remote site. Shen guided an on-site ED technician, and nurse in facilitating a physical examination while he observed on a monitor. Based on his evaluation and diagnostic test results, Shen diagnosed a viral syndrome and determined the best next steps for care.

Jane was able to leave in less than an hour.

## How it Works

In the VVT model, a remote board-certified emergency medicine physician serves as the telemedicine doctor and provides care to lower-acuity patients who present at either the pediatric ED or the adult ED. These EDs experience surges at different times, and the VVT enables a single physician at a satellite location to “float” between the two.

The telemedicine physician is located at a remote site and utilizes virtual visit-enabling hardware and software to deliver ED care with support from the VVT-trained ED staff in the patient's room. Telehealth physicians, nurses, and technicians are trained through a video series developed by Stanford emergency medicine physicians, with content geared to their unique roles.

Stanford ED converted its existing Fast Track care unit into a VVT in 2020 in the middle of the COVID-19 pandemic surge and has since expanded the program. The VVT innovation helped garner Stanford Hospital a 2023 Davies Award of Excellence from the Healthcare Information and Management Systems Society.

## SHORTER STAYS AND SATISFIED PATIENTS

For Virtual Visit Track patients, Stanford researchers found the median ED length of stay was 1.9 hours compared with 4.2 hours for patients who received care through standard ED workflows after adjusting for acuity levels.

**OVER 80%** of patients selected five out of five on their willingness to recommend the service.

**100% OF VVT PHYSICIANS** rated their ability to deliver care on par with an in-person consultation as “excellent” or “very good.”

**6.7% OF VVT PATIENTS** returned to the ED within 72 hours following their initial visit versus 7.2% for patients experiencing standard care workflows.

Ryan Ribeira, MD, project co-lead notes while virtual care has advanced rapidly for other specialties, emergency medicine requires a more complex care approach and a steeper learning curve.

## Future Innovations

First implemented in partnership with Meagan Moyer, MPH, RDN program manager for the Stanford Health Care Digital Healthcare Integration team, the program has been expanded to include Stanford's off-site clinic staffed by emergency medicine attendings and ED staff. The program also offers scheduled video visits within 72 hours for patients discharged from the ED, when applicable. In the future, Stanford will explore providing low-acuity in-home telehealth care, and provide guidance via telehealth physicians to local EMS vehicles.

**“We are seeing an evolution in providing telehealth. Outpatient MDs have years of training and experience in telehealth, but this is new for EM doctors. Some telehealth tactics transfer but some don't, and we've had to develop new ways to evaluate patients remotely. As our doctors treat more cases, they become more comfortable with their skills and available resources.”**

# Sepsis Test Results *in Hours,* Not Days

**Samuel Yang, MD**, associate professor of emergency medicine, is accelerating the diagnosis of bloodstream infections, including a novel approach to quickly determine the susceptibility of bacterial pathogens to antibiotics.

Current sepsis testing is growth-dependent, requiring the causative pathogens to grow many generations to a detectable level before the diagnosis can be made and the best antibiotic choice determined.

### **This can take days.**

Yang's test analyzes bacteria at the single-cell level and is intended to deliver results **within two to three hours**. His approach captures live bacteria directly from whole blood and probes the genetic sequences within the bacterium for species identification, before tracking phenotypic features such as size, shape, and metabolism to assess the bacteria's response to different antibiotics, even before the doubling time of the bacteria.

To work at such a minute scale, the test must be sensitive enough to first detect a low abundance of pathogens in the bloodstream and then capture a pathogen in its viable state. The test must also take into account intrinsic variability in pathogens as well as the host environment. Yang employs advances in microfluidics, microscopy, and machine learning to focus specifically on how pathogens would respond to different antibiotics in the host physiologic environment, accelerating the process to guide faster treatment decisions.

Yang and his team are also exploring how this technology could guide antibiotic treatment duration. Physicians can opt to treat infection with a narrow or broad spectrum of antibiotics, but current microbiological testing cannot guide how long to treat each infection. If duration is too short a patient may be undertreated. Too long, and you risk the emergence of drug-resistant bacteria. A test that reliably predicts how pathogens respond to antibiotics could also enable physicians to customize treatment duration for maximum impact and minimal risk.

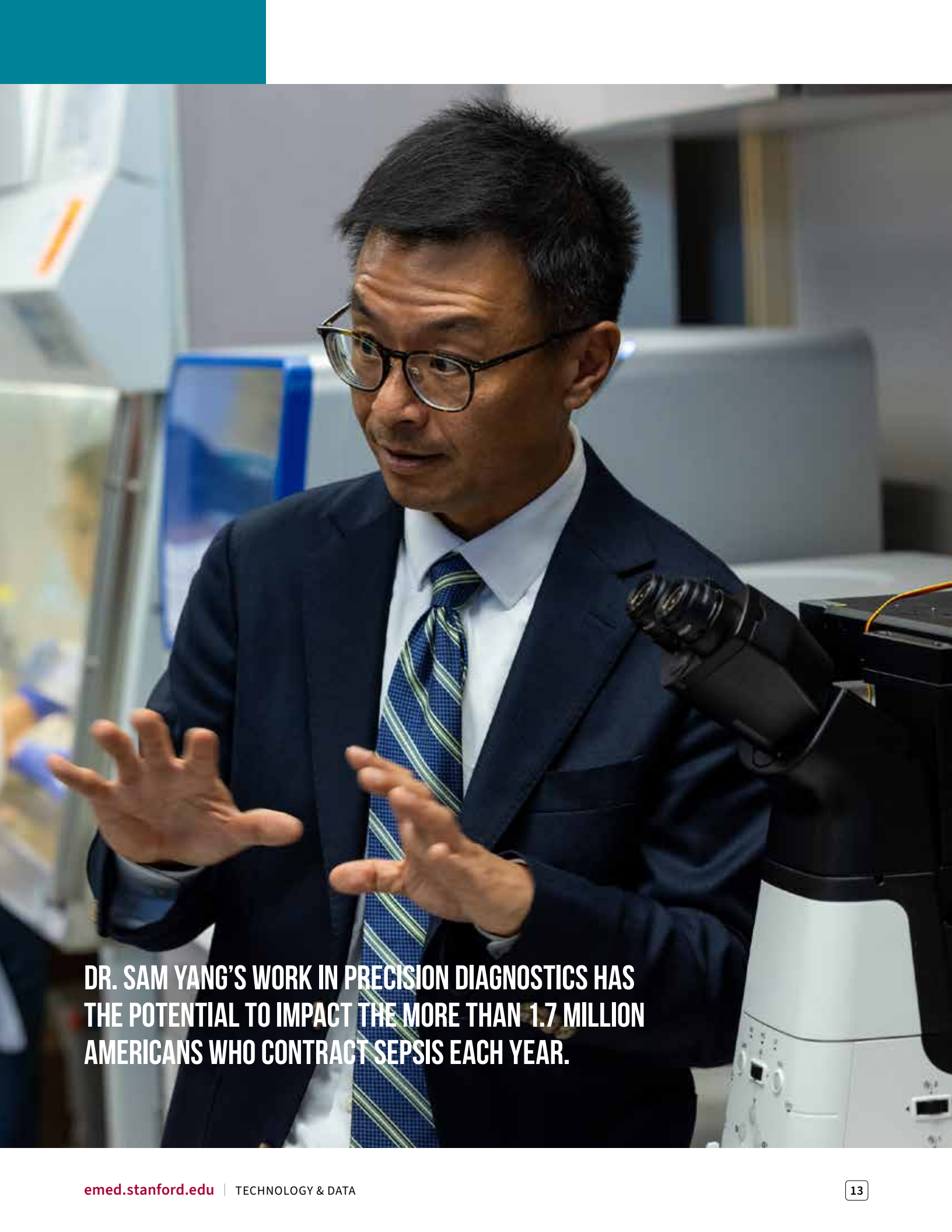
Yang and the team have also made new progress in deconstructing how the body's immune response plays a role in fighting bloodstream infection.

First responder cells or neutrophils provide the earliest warning of infection, and fight infection by committing NETosis or "cellular suicide." Neutrophils expel their own DNA content to the extracellular space as a weblike structure called neutrophil extracellular traps (NETs) that captures and neutralizes a pathogen. Doing so most often causes the neutrophils to die. Yang's group discovered that NETs are actually deoxyribozymes (DNAzymes) that can catalyze the formation of free radicals, which are shown to be the main drivers in pathogen killing but may also contribute to detrimental inflammations in response to bloodstream infection. His team is investigating how this fits into the sepsis diagnostic puzzle.

Yang received research funding for the project from the National Institutes of Health totaling \$7.4 million, and is five years into the ten-year project. His work in precision diagnostics has the potential to impact the more than 1.7 million Americans who contract sepsis each year.



Photo by Steve Fisch



**DR. SAM YANG'S WORK IN PRECISION DIAGNOSTICS HAS THE POTENTIAL TO IMPACT THE MORE THAN 1.7 MILLION AMERICANS WHO CONTRACT SEPSIS EACH YEAR.**



# Quality, Equity, and AI in Emergency Cardiac Care

**Maame Yaa (Maya) Yiadom, MD** and a team of emergency medicine physician-researchers tested an AI model against human practice in identifying patients with acute coronary syndrome (ACS). Their findings emphasize the disparities in age-based ACS screening and highlight the delicate interplay between human expertise and AI algorithms in the pursuit of precision emergency care.

Time is of the essence in identifying patients who present to the emergency department (ED), with acute coronary syndrome (ACS), commonly known as a heart attack. Within the first 10 minutes of arrival, an early electrocardiogram (ECG) is critical to uncovering ST-elevation myocardial infarction or STEMI.

Traditionally non-clinical registration staff use internationally accepted criteria like age and chief complaint, as well as human judgment to screen for ACS patients in need of an early ECG. However, statistics reveal Black, Native American, Pacific Islander, and Alaskan individuals experience heart attacks at much younger ages than their White or Asian counterparts. Any screening based on age can introduce bias and inequity at this critical decision point and become a barrier to accessing care.

Maame Yaa (Maya) Yiadom, MD, emergency medicine associate professor, explored the efficacy of different screening methods in a five-year retrospective study encompassing nearly 280,000 ED visits, funded by the Stanford Institute for Human-Centered Artificial Intelligence.

Yiadom and team compared:

- Traditional staff-administered clinical screening protocol.
- A predictive diagnostic AI screening model.
- Human observation augmented by the predictive AI model.

Yiadom found that screening by protocol systematically underdiagnosed young, Black, Native American, Alaskan, Hawaiian/Pacific Islander, and Hispanic patients. The predictive AI model occasionally missed ACS and STEMI cases but did identify an additional 11.1% of patients versus the conventional practice.

**The best-performing option was screening by human observation, bolstered by the AI model, which displayed the highest sensitivity in detecting ACS and exhibited consistency and equity.**

AI plus humans edged out the AI model. Yiadom attributes this to the algorithm-based model exhibiting unpredicted biases. Admissions staff were picking up on nuances and correcting for the model's overly simple paradigm. "When it comes to AI-based models, simplicity can be detrimental in trying to achieve precision medicine," said Yiadom.

The initial research study was performed in vitro — within a computer but with a keen focus on clinical needs and limitations. "Too often AI models are built without real-world testing in a clinical setting by technical teams who don't understand how it will impact patient care," notes Yiadom. "My team's advantage is our intimate knowledge of the clinical care environment."

## Next Steps

Yiadom recently received a \$3.8 million R01 grant from the National Institutes of Health's National Heart, Lung, and Blood Institute for the next phase of the project.

Real-world testing of the current model will be done in partnership with Vanderbilt University Medical Center where the model will also be exposed to live patient data, running silently in the background as patients are admitted, and storing the results for further analysis. In addition, a higher-performing and more equitable model will be developed at Stanford using data from three diverse patient populations including Vanderbilt (Tennessee), Beaumont (Michigan), and Cooper Hospital (New Jersey).

In the subsequent phase of the project, the refined model will be activated to work in real-time during ED arrival intake. Yiadom shares, "At this stage our primary interest is ensuring the effectiveness, safety, and reliability of the AI model much like we do for drug and medical device development with rigorous scientific testing; but also equity. This is a new frontier in medicine."



TECHNOLOGY & DATA

# Transforming Patient Monitoring with **MACHINE LEARNING**

**David Kim, MD, PhD** and his team are developing software that synthesizes data from electronic health records and physiologic monitors in real-time to provide more specific and accurate information about a patient's physiology during an emergency department (ED) visit.

Trained on tens of thousands of ED visits, PhysioHub learns the relationships between many aspects of a patient's trajectory and produces a detailed representation of individual physiology and risks. Simultaneously modeling the relationships between ECG signals, lab results, vital sign trends, and subsequent diagnoses may enable emergency physicians to make more informed and accurate predictions about a patient's likely response to an intervention.

Modern AI language models like GPT-4 calibrate themselves against countless next-word predictions. However, the complexity of emergency medicine,

with simultaneous processes occurring over different timescales, presents challenges for the development of effective AI models. Kim emphasizes the need to develop tools that address the high intensity, variety, and unpredictability of emergency medicine.

Kim envisions using the software to automate repetitive processes and to extract more meaningful information about patient physiology, enabling physicians to spend less time on data collation and more time answering difficult diagnostic and therapeutic questions. The goal is not just to enhance the efficiency of data interpretation, but to achieve more accurate and

specific diagnoses, and better patient outcomes.

In Kim's view, practical experience and domain knowledge are vital for creating tools that physicians find useful in the emergency setting. Kim credits his students and collaborators, specifically Stanford Computer Science graduate students Tom Jin and Julia Reisler, with leveraging modern machine learning capabilities towards clinically ambitious goals. He advises innovators to focus on achieving better outcomes in real world settings, rather than focusing solely on test characteristics like accuracy alone.

## **BEYOND THE EMERGENCY DEPARTMENT**

Looking ahead, Kim is launching a new project to monitor certain high-risk ED patients after hospital discharge. Study participants will wear a wireless armband device to continuously monitor their physiology after leaving the hospital. Kim and the team will combine in-hospital and remote monitoring data to better understand how patient physiology evolves after discharge, and to identify remote monitoring signals that may represent important changes in health status.



# Reading People's Faces

Stanford is exploring if a video algorithm can predict hospital admission likelihood by assessing patients' visual cues, in a project co-led by **Ryan Ribeira, MD**, site principal investigator.

The goal of the project is to create a tool that can assist telemedicine physicians and emergency department (ED) staff in making informed decisions about patient admissions based on visual cues. The algorithm, currently in the experimental phase, could potentially predict a patient's likelihood of admission to the hospital.

The research team embarked on a comprehensive data gathering journey by recording telemedicine encounters with patient consent. As the focus expanded to include ED presentations, the team utilized a cell phone to capture preset activities mirroring real-life triage scenarios. Patients, following prescribed activities like reading fixed

statements and performing specific hand and head movements, contributed to a diverse dataset.

The team then built a robust database comprising over 500 filtered data points from both telemedicine and ED cases of all kinds. An extensive video cleanup process was necessary to address biases based on variables such as how many wires were connected to the patient or whether they were in street clothes versus hospital gowns.

After mapping areas for algorithm consideration, the team built a deep learning algorithm to "read" the videos, allowing the algorithm to identify patterns and draw its own associations and conclusions without predefined criteria.

The preliminary results from the data fed into the algorithm are promising. In a head-to-head comparison, members of the study team analyzed the same video data that the algorithm utilized for its decisions, to determine if a patient should be admitted to the hospital. The algorithm performed on par with, if not better than, human counterparts. This early success suggests the potential effectiveness of the algorithm in predicting patient outcomes based on visual cues.



# Predicting Falls After Discharge

TECHNOLOGY & DATA

For America's aging population, preventing falls is crucial for maintaining independence in their golden years. **Brian Suffoletto, MD**, and his team are using AI and digital technology to predict and prevent falls in older patients after leaving the emergency department (ED).



Suffoletto's team used ED accelerometer data and a neural network model to predict post-discharge fall risk in a recent study. The neural network model can detect subtle nuances in movement that humans might miss, improving prediction accuracy. It doesn't merely add elements; it may introduce complex, hidden features. Early results confirmed the effectiveness of this approach in assessing and predicting post-ED fall risk.

Going beyond predictive diagnostics, Suffoletto and his team are also designing digital interventions to reduce fall risk in the crucial months following discharge.

In a recent study involving 150 older adults, Suffoletto gathered data on their step

**By 2030, 20% of the US population will be 65 or older. Around 20 million patients over 65 visit EDs each year, and 20% of Stanford Hospital's ED patients fall into this vulnerable group. Suffoletto, associate professor of emergency medicine, uses ED visits to assess the future fall risk of older patients. He uses body-worn sensors and AI to identify those at risk of falls and provide digital interventions for them to maintain independence at home.**

counts after leaving the ED. During their rehabilitation period, these patients tended to lead sedentary lives, translating into a higher risk of falls due to factors like sarcopenia muscle loss, decreased range of motion, and more.

Suffoletto is enrolling elderly patients assessed as fall risks. These patients will receive accelerometer-based pedometers and participate in a text message program designed to encourage daily step count reporting.

Suffoletto has spent more than 10 years developing digital behavioral interventions for various medical risks from young adult binge drinking to distracted driving. Recent studies include machine modeling to predict intoxication based on measurable changes in voice, and the use of smartphone accelerometer sensors to detect alcohol intoxication by analyzing an individual's gait.

# Precision Cardiac Care

**Kenton Anderson, MD**, and a national collaborative of transesophageal echocardiography (TEE) experts pioneer the use of TEE during cardiac arrest, providing real-time images of the heart's aortic valve.

During cardiac arrest, one predictor for positive patient outcomes is the opening and closing of the aortic valve, signifying forward blood flow. However, chest compressions performed in the traditional center of the chest location frequently keep the aortic valve closed, which could do more harm than good.

Enter **transesophageal echocardiography (TEE)**. In TEE, physicians insert an ultrasound probe into a patient's esophagus to obtain images of the heart while the patient is in cardiac arrest, enabling them to see if the aortic valve is opening. TEE images are much simpler to obtain during ongoing chest compressions than traditional transthoracic echo images, are usually much higher quality, and are not impeded by defibrillation pads and other ongoing procedures.

Anderson, associate professor of emergency medicine, served as principal investigator for a national collaborative of 12 emergency medicine and critical care

TEE experts who developed and released a mastery learning checklist for TEE training in cardiac arrest. Anderson also helped implement the use of TEE in cases of cardiac arrest at Stanford University's Marc and Laura Andreessen Emergency Department and developed training modules and tools for attendings and residents.

Anderson credits Stanford's Center for Immersive Simulation-based Learning (CIGH) facility for offering state-of-the-art simulations that enable faculty and residents to achieve certification. Unlike most ultrasound training where healthy volunteers can be used to teach scanning, TEE training requires that the patient — or a simulator — be in active cardiac arrest.

Incorporating TEE required collaborative efforts across different departments to address issues such as equipment cleaning, secure storage of hospital scans, training for attending physicians, residents, and nurses, and establishing coding procedures for billing.



# What Digital Health Tells Us About Disease

**Christine Ngaruiya, MD**, uses Natural Language Processing to uncover gender disparities in noncommunicable diseases, while also leading initiatives at the intersection of health and climate change, fostering targeted interventions and policy changes worldwide.

For more than a decade, Ngaruiya has worked toward increasing research and resources for noncommunicable diseases (NCDs), with a focus on racial equity and addressing disparities in health outcomes. Her work comprises epidemiologic assessments and the use of implementation science to develop targeted, context-sensitive interventions in Africa. Among this work is the application of digital health tools for public health interventions as well as exploring the intersection between climate change and the increasing global NCD burden.

Ngaruiya notes there is a substantial disparity in funding between communicable and NCDs, as well as gender inequality and a need for gender-specific targets. Her work helps to improve specificity in creating successful interventions.

Ngaruiya led a study that employed Natural Language Processing (NLP) on 5,358 discharge summaries of patients with acute myocardial infarction (AMI) in Pakistan, partnering with leadership at the Aga Khan University Hospital-Pakistan to investigate gender differences in symptoms and management of ischemic heart disease. The NLP model demonstrated high specificity and sensitivity, and highlighted potential gender disparities in how NCDs are identified and measured. Women with AMI are more likely to present with shortness of breath or gastrointestinal complaints while men are more likely to present with conventional symptoms such as chest pain.

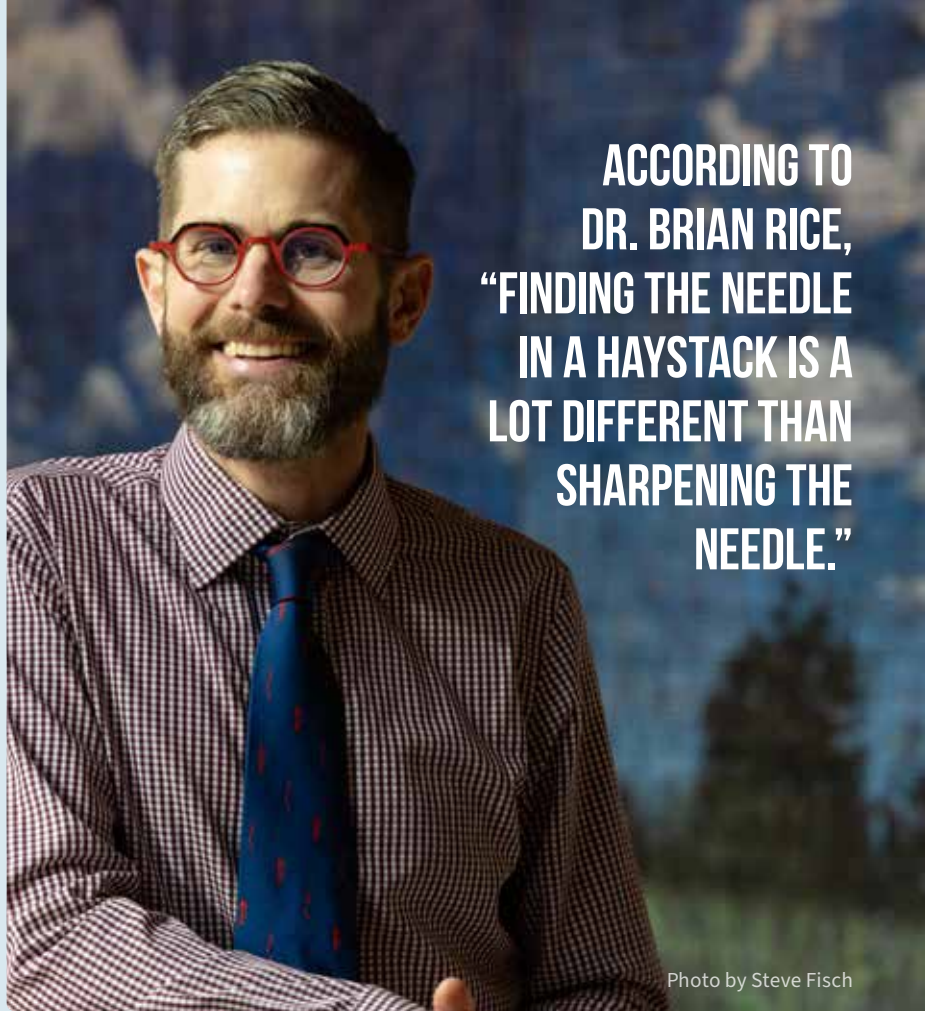
According to Ngaruiya, NLP is underutilized in public health interventions, where accuracy, speed, cost-effectiveness, and scope could identify gender disparities as well as influence policy changes and improve healthcare outcomes in diverse global settings. NLP allows for the extraction of valuable information from large datasets, comprising tens or hundreds of thousands of data points. The manual extraction of specific information from vast datasets is tedious and prone to imperfections. NLP automates this process and teaches itself to be more effective than humans in identifying and extracting relevant data even in the presence of variations, spelling errors, or missing information.

Ngaruiya is also tackling climate change initiatives, collaborating with partners like the National Cancer Institute to explore intersections between health and environmental factors. A recent project involves assessing the impact of climate change on various health aspects and formulating policies in collaboration with the Kenyan government and regional authorities.

Ngaruiya came to Stanford in 2023 to serve as the population and global health research director for the Department of Emergency Medicine, drawn by the university's diverse resources, multiple centers, and the broader digital community in the Bay Area.



# USING AI TO SAVE LIVES IN RURAL ALASKA



ACCORDING TO DR. BRIAN RICE, “FINDING THE NEEDLE IN A HAYSTACK IS A LOT DIFFERENT THAN SHARPENING THE NEEDLE.”

Photo by Steve Fisch

**Brian Rice, MD**, uses machine learning to analyze medevac utilization in remote areas of Alaska where air transport is the lifeline for emergencies.

A mother in a small, rural Alaska village takes her child to the local community health aide. The child is having trouble breathing. The aide, who has limited medical training, must refer to a manual throughout the exam. The community is connected to the outside world only by airplane so the health aid must decide if the child’s condition warrants an airlift medevac to a larger facility hundreds of miles away.

Healthcare providers in Alaska do not have a shared, common classification to determine when to call for a medevac, despite the reliance on air transport in crises. Rice, associate professor of emergency medicine, hopes to offer providers a decision support tool to save lives.

Thanks to a five-year grant from the National Institutes of Health, Rice is leading a mixed methods study consisting of interviews and data analysis of health care records. Machine learning models will analyze appropriate medevac utilization in some of the most remote areas of the United States.

Rural Alaska is made up primarily of Alaska Native communities connected by air. 100% of the areas Rice is analyzing are not connected to the road system. When emergencies occur, the only way for patients to see a doctor is to fly hundreds of miles. A health aide, with limited information, must communicate with doctors at a distant

hospital to determine if the patient needs a medevac.

The information about when and why a patient gets a medevac is scattered, according to Rice, and written in unstructured ways into clinical notes. Natural language processing is required to analyze what went into the decision. These data include clinical and non-clinical features such as time of day, experience levels of providers, and, most importantly, severe weather conditions that can make the difference between life and death in rural Alaska.

Rice is creating the model himself. He learned programming in his youth to construct computer versions of the *Choose Your Own Adventure* novels. More recently, Rice wrote programming to analyze free-text chief complaints presented at hospitals in Uganda. For his Alaska project, Rice is being mentored by Tina Hernandez-Boussard, PhD, Stanford professor of medicine (Biomedical Informatics).

Rice hopes the study will provide an understanding of what questions providers should ask undifferentiated patients. Therein lies a distinction between precision medicine and precision emergency medicine — while much of precision medicine focuses on therapeutics, precision emergency medicine places a greater emphasis on diagnostics.

# Operation AI

**Dev Dash, MD,** aims to reshape emergency medicine operations through the use of large language models for admissions assessment, critical care cohorting, and more.

AI, thoughtfully applied, has the potential to save millions of physician hours while reducing healthcare costs. The use of AI in care delivery is frequently explored, but Dash, assistant professor of emergency medicine, is testing the use of complex AI models for operational use on multiple fronts:

**Admissions Assessment** — Dash is exploring the use of a large language model (LLM) to “ingest” complex admissions pathways to assist with patient disposition. Saving just five minutes of physician time per patient could free 1,000+ minutes a day for physicians to treat other patients.

**Critical Care Cohorting** — Critical care is documented using specific phrases and templates. If an emergency medicine provider uses slightly different language or is missing certain elements, critical care billing codes may not be applied. Dash is training a LLM that would identify patient records as critical care that would have otherwise been overlooked and help identify patients who are sicker than they appear on initial triage.

**Evaluating LLMs** — Dash states that new LLMs drop every few days. However, most administrators are left scratching their heads when it comes to assessing what LLM will work best for their hospital. Dash is working on a method to score LLMs on multiple dimensions depending on specific clinical use cases and hospital needs.

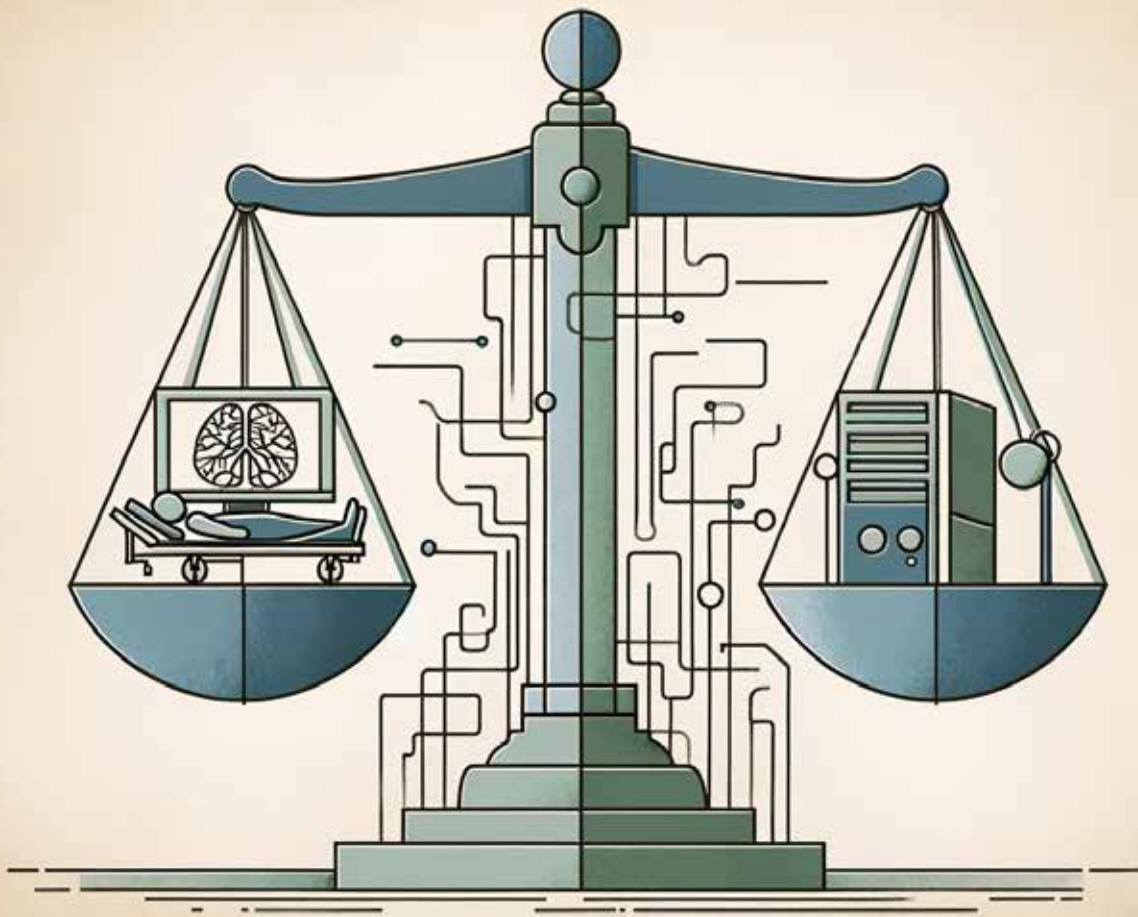
According to Dash, healthcare leaders should always start with the pain point and how to assist a clinical workflow versus focusing on easily available data sources or trying to use the latest machine learning model.

A pain-point-centric approach should be led by physicians with deep clinical expertise and an understanding of clinical workflows, according to Dash. However he adds, “Physicians who have expertise on both sides — being clinical savvy and able to interface seamlessly with data scientists — are very rare. However, it is easier to train emergency medicine physicians on machine learning methods than it is to train computer scientists on the clinical workflows.”

Dash is also mindful of the ethical pitfalls in current AI and LLM development. “Most technology comes from the English-speaking, western world, where the majority of patient data we can access is from urban, healthy, wealthy patients because they have greater access to healthcare,” he notes. “But models built purely on this type of data will almost certainly fail when applied to other populations. You can destroy a model’s accuracy simply by applying it to patients in a different zip code.”



Photo by Steve Fisch



## TECHNOLOGY & DATA

# How to Evaluate the Ethics of AI

Precision medicine can be viewed as a double-edged sword. While new data analytics and methodologies promise to revolutionize personalized therapies, there is a risk that these innovations could unintentionally perpetuate health disparities or restrict access to care.

Historically, the conversation on precision medicine has neglected the unique challenges of emergency care. However, a study led by **Christian Rose, MD**, and **Jennifer Newberry, MD, JD**, of Stanford Department of Emergency Medicine, in collaboration with colleagues from Brown University, Loyola University Chicago, and UCSF, aims to reset the narrative.

This study explores the techno-ethical complexities of applying precision medicine in the volatile emergency care environment. The authors also introduced a groundbreaking framework designed to steer healthcare providers and

policymakers toward the ethical and equitable deployment of precision medicine in emergency settings.

The Stanford-led team employed a qualitative, nominal group technique to identify 91 ethical quandaries that impede the smooth implementation of precision medicine in emergency settings. The study outlines three core ethical themes:

**Values** — The alignment of patient values with systemic priorities raises concerns, particularly regarding cost-effectiveness and research directions.

**Privacy** — Data-centric healthcare calls for stringent protocols to protect patient autonomy and data while leveraging the power of precision medicine.

**Justice** — Justice in the context of precision medicine addresses disparities in healthcare and ensures equitable

access to advanced medical treatments and interventions tailored to individual genetic, environmental, and lifestyle factors.

These themes translate into challenges across three pivotal phases:

- Data acquisition
- Clinical application
- Long-term impact

A three-by-three matrix was constructed to map themes to phases, serving as an actionable guide for future innovation in precision emergency medicine.

The study further underscores the necessity for a multidisciplinary approach, advocating for the synergetic involvement of both data science and social emergency medicine teams to bridge gaps in research and practical application.



# Education & Training

Photo by Steve Fisch



# THE FUTURE OF EMERGENCY MEDICINE EDUCATION

A conversation with **Mike Gisondi, MD**, vice chair of education, and **Sara Krzyzaniak, MD**, associate vice chair and director of the emergency medicine residency program in the Stanford University Department of Emergency Medicine.

## As the pace of change in medicine accelerates, how do we ensure emergency medicine trainees have the skills to adapt?

**Gisondi:** An emergency physician is going to manage new or unusual cases throughout their career, much more frequently than other specialties, so we must teach our trainees to be adaptive learners and problem solvers, and prepare them for the outlier cases. Adaptive learners are efficient and effective at solving problems they've rarely or never seen before. They are not necessarily the smartest in the class, but they're very good at learning and solving problems.

To train for the unexpected, trainees need to see as many variations of common cases as possible, in advance, to build the broadest possible knowledge base. Then they can call upon that foundational knowledge and use it differently to solve new problems. But to do so, they also have to be flexible and change how they approach things, either diagnostically or therapeutically, based on the context.

We use simulation to train residents on cases not often seen in clinical practice. We also use hypothetical questions on shift, such as: 'Jane is presenting with chest discomfort — what if Jane was 80 years old, or a man, or had diabetes.' We change important details when discussing patients with a resident and run through a number of case variations quickly to build their heuristics.

**Krzyzaniak:** I agree — the most important thing we can teach our residents is how to be adaptive and how to plan their learning when they encounter something new.

Our faculty members provide feedback to residents based on observable behaviors and areas for improvement after every single shift, both verbally and using an app. The feedback mechanism tells residents, 'Here is your knowledge gap, and here's where I want you to be tomorrow, next week, next year.' We train our residents to look for those gaps as well. Then in a guided self-assessment with their coach, they create a learning plan specific to their needs.

## What does precision career development mean at Stanford?

**Krzyzaniak:** We give our residents early opportunities for niche development. We added career development time to the intern year curriculum after we realized that the second year was too late to fully explore electives and make meaningful connections with our faculty in their niche development.

Now, interns are given two weeks to select and explore two of thirteen introductory areas — to connect with our faculty and fellows, learn about their projects, attend meetings, and see what it would be like to have a career in global health or in social emergency medicine, for example. In the background, we also have our research curriculum running, so residents simultaneously learn about the principles of scientific inquiry.

With that foundation, in their second year, residents select from over 100 electives they can pursue in depth. And every year residents develop something new — most recently, we added electives in palliative care, medical humanities, and climate change.

Our faculty provide mentoring for residents in their areas of expertise and faculty who completed specialized training are assigned a cadre of residents to coach throughout the year.

## How do you foster physician-researchers when residency is crowded with clinical practice and didactics?

**Krzyzaniak:** We recently introduced longitudinal elective time for research. This option allows residents to spread their elective time over a year, effectively resulting in clinical shift reduction to complete their research. This model is also beneficial for residents working on community-based projects

where trust and partnerships take time to build.

We also created the Alumni Scholarship Fund with generous donations from our residency program alumni. Residents can apply for funding for courses or activities. Our first awardee, Nabiha Nuruzzaman, MD, used the Alumni Scholarship to support her tuition as a Health Equity Scholar with the Cambridge Health Alliance. As part of this program, she partnered with local community organizations in Navajo Nation to develop an elective for providers to learn about and address issues of environmental justice and health.

## How can residents learn to incorporate social drivers of health and address inequities in care?

**Krzyzaniak:** This is crucial. We know every patient is different, and every disease process looks different based on the person, for many reasons.

Our didactic curriculum includes time for health equity rounds and social emergency medicine. Our case-based discussions explore how social drivers impact patients. We have an ED complex care team that works with patients to address social drivers that lead to repeat visits. Our ED also has 24/7 social work and case management, two substance use navigators, and interpreters to help provide bedside patient-centered care.

**Gisondi:** Just as a phenotype is expressed differently in different environments, patients manifest conditions differently. Our specialty is supposed to take care of anyone, anytime, from any background, regardless of the ability to pay. That's something we're all very proud of, but putting that ethos into practice every day can be challenging.

## Are you training residents to use AI in the ED?

**Krzyzaniak:** We educate residents on the pros and cons of AI in medicine as part of our didactic curriculum. And our faculty are doing research using AI and writing about AI, so our residents have opportunities to learn more. But I don't feel AI is yet a part of everyday emergency medicine. A lot of our conversations are looking to the future when AI is more embedded in clinical practice.

**Gisondi:** If you ask this question again 12 months from now, we will have much more robust examples. Things are moving so quickly in that space — this time last year, the phrase “generative AI” was not a commonly used term.

In education, there was an initial fear students would use AI to fabricate essays or for malicious purposes. But we have to get past those fears of new technologies — in this case, there are so many substantive ways that we can use AI to support learning. I am planning a new faculty development workshop series on AI applications for clinical practice, teaching, research, etc.

There's the issue of utilizing AI effectively, but also the question of what value the physician will have in the future. Trying to predict all of that now is challenging. You're training people for a job that doesn't really exist yet. But it gets back to adaptive learning. If we give residents the skills to learn about something that they haven't yet seen, we prepare them to evolve as medicine evolves.

## Does the patient population at Stanford impact the training residents receive?

**Krzyzaniak:** Our residents see a tremendously diverse patient population in part because they work at three distinct sites — county, community, and tertiary academic hospitals.

Even within Stanford Hospital ED, we have incredible diversity. On any given shift, I can walk from room to room and see the complex medical patient that Stanford is known for; the otherwise healthy patient presenting with an acute complaint; and the undomiciled patient with substance use disorder who's been there for the third time that day without acute medical needs but instead many social needs.

We are located in the heart of Silicon Valley, which affords us many resources and innovation; but we also have a diverse and large patient population that is financially insecure because of the high cost of living. Before coming here, I never discharged someone to their RV parked three blocks away. Now I'm trying to figure out what I can do for this person who has cellulitis but doesn't actually have running water in their RV and needs antibiotics but doesn't have a place to elevate their leg.

**Gisondi:** There's a long-standing misconception that Stanford is an ivory tower ED with wealthy patients and low volumes. But our census actually places us as one of the busiest EDs in the country, certainly among academic programs. And twenty percent of patients we admit from the ED come from more than 50 miles away.

We have such a wide diversity of socioeconomic and cultural backgrounds here in the Bay Area. Someone from East Palo Alto, which is under-resourced, will manage their diabetes differently than someone who lives in more affluent Marin County. We train our residents to understand that as clinicians, we have to be aware of these drivers and flex the management of a case based on the patient's social realities and the roadblocks they might be facing.

## Based on the number of unfilled entry-level positions in 2023 Match, what needs to change in emergency medicine residency training?

**Krzyzaniak:** I think there were multiple contributing factors in the 2023 Match when half of the programs in the country didn't fill in the first round.

Our specialty was hurt by a workforce study that projected a surplus of emergency physicians. We now know that those projections used questionable assumptions, but deans of medical schools and career advisors may not know that. COVID-19 had an impact as well. It was a scary time to be in emergency medicine and the pandemic contributed to burnout and impacted the decisions of students considering the specialty.

Regardless of the reasons though, the 2023 recruitment results should be a warning call for all of us. We need to paint a complete picture of emergency medicine for medical students. It's a wonderful specialty! We need stronger representation at the medical school level. And we need to bring more medical students into the ED. When we do, they

say, 'This isn't at all what I expected. This is fulfilling and exciting.' But they're not getting enough exposure to see that.

## What does the future of emergency medicine training look like?

**Gisondi:** The emergency medicine care delivery model is evolving before our eyes. The ways that patients access the healthcare system for acute care is changing — many will present to the ED, but others will use video visits, home-based care options, or innovative channels that our faculty are just now building. We are moving to a care delivery model that's more progressive and meets patients where they're at. We will better facilitate healthcare access in ways that aren't burdensome to patients.

Our residents need to learn how to train in those environments. For example, we will soon offer residents clinical experiences using emergency medicine telehealth.

**Krzyzaniak:** Emergency medicine is very different from what it was in the 1970s when the first EM training programs started. The medicine is more complex. The technology is more complex. And we're asked to serve many roles for our patients: primary care physicians, specialists, case managers, psychiatrists, et cetera.

We also must understand how social drivers of health impact patient outcomes; master the art of communication to successfully interface with other medical teams; and learn to be efficient in the face of steadily climbing ED volumes at Stanford. And we need to be prepared to take emergency medicine outside of the ED walls to meet the needs of all of our patients.

# What to Know About Competency-Based Training

A new data-based model ensures emergency medicine residents have mastered the everyday physician activities that are the foundation of clinical practice.

Holly Caretta-Weyer, MD, MHPE, and a collaborative consortium of leaders within emergency medicine have utilized a five-year \$1.25 million grant from the American Medical Association (AMA) to develop an ecosystem of assessment and predictive learning analytics that move the specialty toward competency-based medical education.

An entrustable professional activity (EPA) is an “everyday physician activity,” ranging from developing a differential diagnosis to resuscitating a victim of multisystem trauma. Caretta-Weyer and the team have identified 22 EPAs that serve as the basis to provide residents with specific, real-time feedback on their performance.

Data from the feedback is also used to detect trends by comparing a resident’s results to those at similar points in their training.

As a result, knowledge gaps are identified in less than half the time and residents can course correct much more quickly, with coaches guiding them in the learning process.

## Here’s how it works:

At the end of a shift, faculty attendings open a dedicated app developed by partners at the University of Michigan. After selecting the observed resident and EPA, faculty enter feedback on what the resident did well and at least one area for improvement. The feedback is typically short — just a sentence or two — but it is direct, specific, and timely, and faculty are coached on how to provide constructive suggestions.

According to Caretta-Weyer, a clinical associate professor of emergency medicine, the amount of feedback for emergency medicine residents at Stanford has increased tenfold from 300 data points per year to more than 3,000.

While residents can view feedback almost immediately after their shift, they can also access a personalized dashboard showing their performance trends over time. At Stanford, a competency committee evaluates the data for each resident and an assigned faculty coach meets quarterly with residents to review the dashboard and map out a learning plan to address knowledge gaps and

professional development opportunities.

The project has been implemented at six test sites around the country, including Stanford. Caretta-Weyer and the team are now translating this work into national standards for emergency medicine residency on several fronts:

- A task force led by the Council of Residency Directors in Emergency Medicine (CORD) is examining the results of the test sites with an eye toward operationalizing the results in an adaptable way across all emergency medicine programs.
- The American Board of Emergency Medicine (ABEM) recently convened representatives from SAEM, CORD, and the AMA to explore adopting the EPAs as standards of measure across the specialty and integrating them into Board eligibility.

- In 2025, the SAEM Consensus Conference will focus on competency-based education, including the use of EPAs.

While Board certification has long been the litmus test for emergency medicine training, the pass/fail feedback comes post-residency and the multiple-choice questions may not always align with optimal learning and skills acquisition. In contrast, EPA-based competency training allows for constantly adjusted learning while still in residency, ensuring mastery over required skills far in advance of the Board exams.

The app and feedback dashboard could be used by programs of all sizes and budgets. Caretta-Weyer and the team are developing guidance on how to scale other model components such as competency committee processes and coaching paradigms based on available program resources.

# Digital Solutions to Create Equity in Mentoring

**Sally Mahmoud-Werthmann, MD**, is addressing underrepresentation in emergency medicine by developing a mobile app to connect mentees with mentors who share similar lived experiences.

Disparate access to mentorship opportunities is a recognized contributor to the chronic underrepresentation of women, Black, Hispanic, and Native American groups in emergency medicine.

Mahmoud-Werthmann, assistant professor of emergency medicine, is leveraging digital technology to help mentees find mentors with shared lived experiences. Increasing gender, racial, and ethnic physician diversity in emergency medicine will, she hopes, ensure more equitable and culturally competent patient care.

Although the benefits of mentorship are well-described, some physicians are less likely to have mentors, which harms their career and training experience. Telementorship has the potential to close this mentorship gap.

Mahmoud-Werthmann, who completed a social emergency medicine fellowship at Stanford, is developing a virtual mentorship platform called DoctorWell that is accessible, equitable, and intersectionality-informed, meaning that the multi-dimensional factors and social dynamics of both mentor and mentee experiences are taken into account.

Mahmoud-Werthmann was inspired in part by her own experiences as a woman of color. In addition to experiencing the typical and substantial educational and clinical demands of residency, Mahmoud-Werthmann also experienced biases, microaggressions, minority tax, and other workplace stressors unique to her identity as a Black female physician. Having two children during residency introduced additional challenges and exacerbated existing ones.

“Fortunately, I had two wonderful faculty mentors, Drs. Jocelyn Freeman Garrick and Erik Anderson who were instrumental to my growth and career development,” she notes. “And as a young attending, Drs. Ayesha Khan and Ashley Rider have provided me with more than just mentorship and sponsorship — they’ve been beacons of light during times of ambiguity.”



Photo by Steve Fisch

## How it Works

- Participating resident mentees download a mobile app and complete an initial application, answering questions about demographics, personal interests, and professional interests.
- Mentees rank the importance of faculty mentor demographic concordance in race, ethnicity, gender identity, and sexual orientation.
- The algorithm provides a curated list of potential faculty matches. Residents can browse faculty profiles before selecting a mentor.
- The platform has an in-app chat function as well as Zoom integration to host mentorship meetings. Data will be collected on resident burnout, imposter syndrome, and overall mentorship satisfaction using validated scales.
- Results from the pilot project will inform how the algorithm impacts burnout and imposter syndrome amongst residents as well as mentee satisfaction with the pairing.



## EDUCATION & TRAINING

# Growing the Emergency Medicine Pipeline in Rwanda

**Joe Becker, MD**, spearheads the development of a groundbreaking clerkship program for medical students, addressing the country's evolving healthcare needs and fostering interest in emergency medicine careers.

In Rwanda, where the government is working to expand medical training, Becker plays an integral part in shaping the nascent emergency medicine residency and medical student clerkship training for the country.

In 2023, Becker launched the first clerkship in emergency medicine for 30 Rwandan medical students at the University of Global Health Equity (UGHE). The six-week program starts in Butaro, Northern Rwanda with a week-long intensive overview of the specialty and emergency department (ED) protocols, as well as a review of the most common illnesses and procedures in Rwandan EDs, such as intubation, burn treatments, and malaria

remedies.

Students then rotate through three hospitals in Kigali for the next five weeks. Faculty from multiple US universities join Stanford faculty in conducting bedside teaching, demonstrating procedures, and delivering didactics every Wednesday. Because Rwandan patients often stay in the ED longer, the teaching faculty are able to conduct rounds with their clerkship students.

Becker, an associate professor of emergency medicine, developed the curriculum based on his previous work on residency training. In 2013, Becker was part of a team that developed the first emergency medicine residency curriculum in Rwanda for the University

of Rwanda as part of the Human Resources for Health initiative. The four-year residency program enrolls five to eight general practitioners most years.

According to Becker, emergency medicine has become increasingly vital to Rwanda due to an epidemiologic transformation currently underway. As the country develops more paved roads, accident trauma is on the rise, while some diseases are declining, shifting Rwanda to a Western model of mortality, with increases in traumatic injury, diabetes, and heart disease.

Recruiting US faculty willing to make the journey to Rwanda is not difficult but the adjustment to different care provisions and ED experiences

can be challenging. Pathologies are different and patients have fewer resources, requiring physicians to be more judicious in ordering tests. Physicians in Rwanda also encounter a higher incidence of patient death, particularly among younger patients.

Becker's goal is to increase the number of clerkship students and residents each year. So far, the curriculum has been well received. In Rwanda, medical students typically opt for more lucrative specialties but thirty percent of the clerkship students said they would consider a career in emergency medicine. There is also talk of the second emergency medicine residency program.

# TEACHING ULTRASOUND IN LOWER-RESOURCE AREAS

Stanford recently launched an ultrasound ‘boot camp’ to train emergency medicine residents in Rwanda, enhancing patient care and diagnostic capabilities in resource-limited settings.

Stanford’s Department of Emergency Medicine launched an ultrasound training program for emergency medicine residents at the University Teaching Hospital of Kigali in Rwanda.

Patients in Rwanda emergency departments (EDs) tend to be high acuity; ultrasounds can change the course of a patient’s treatment even more so than in the United States. And bedside ultrasound can substitute for expensive imaging diagnostics in lower-resourced areas.

The Rwanda emergency medicine training program does not consistently offer an ultrasound curriculum. Physicians learn through bedside

teaching, which can be sporadic, inconsistent, and incomplete. A hospital might have just one ultrasound machine, which may be hard to repair.

Thanks to a seed grant from Stanford’s Center for Innovation in Global Health, Stanford emergency medicine fellows and physicians developed an ultrasound “boot camp” for second and third-year residents consisting of lectures and hands-on training. The project was created by **Patrick Lanter, MD**, global emergency medicine/ultrasound fellow, and **Enoch Obeng, MD**, former global emergency medicine fellow and current faculty member, in collaboration with **Michelle**

**Feltes, MD**, assistant professor of emergency medicine.

While much of the curriculum is similar to that used in the United States, several differences reflect the targeted Rwandan needs. Focused assessment with sonography for HIV-associated tuberculosis (FASH) is taught because tuberculosis rates in Rwanda are high. There is a bigger emphasis on treating trauma from vehicular accidents in Rwanda where patients are often in more advanced distress because of delays in getting to the hospital.

After the boot camp concludes, images captured in Rwanda are sent to Stanford, where Lanter and **Timothy Batchelor, MD**, global emergency medicine/ultrasound fellow, review both quality and diagnosis and send constructive feedback to Rwandan residents to increase in-country knowledge.

Sustainability and long-term impact are key considerations. Three Rwandan boot camp participants volunteered to join Stanford’s image review process to become what are called “super users.” The goal is to have super users assist in teaching subsequent training sessions as well as implement their own image review process, growing the number of local emergency medicine ultrasound experts in Rwanda.

Additionally, the team hopes to use the data collected on ultrasound use and impact to illustrate the need for more equipment and training for the Rwanda Ministry of Health and other funders.









# Pediatric Emergency Medicine

In 2022, the unveiling of the Marc and Laura Andreessen Pediatric Emergency Department marked a new chapter in Stanford Hospital's enduring legacy of innovation in pediatric emergency care. The following year, the esteemed Deborah Hsu, MD, MEd, assumed her pioneering position as the inaugural chief of pediatric emergency medicine. These milestones underscore Stanford's unwavering dedication to advancing the field of pediatric emergency medicine over several decades. Discover how our state-of-the-art facility is not only equipped to provide exceptional medical care tailored to our young patients but also designed to ensure comfort and offer comprehensive resources to their caregivers. And get acquainted with some of the visionary physicians who are at the forefront of transforming pediatric care for our society's most vulnerable members.

# A Space for Our Youngest Patients

In 2022, Stanford opened the state-of-the-art Marc and Laura Andreesen Pediatric Emergency Department (ED) specifically designed for patients under the age of 21 and their caregivers. The new facility serves as the pediatric ED for both Stanford Hospital and Lucile Packard Children’s Hospital and took more than four years to design, following site visits to other pediatric acute care facilities and consultation with child care specialists. Since opening, the pediatric ED has seen nearly 30,000 pediatric patients each year comprising all levels of complexity and socio-economic status.

## Space for Families

The pediatric ED is both patient- and family-centric. Rooms have added space to accommodate parents, guardians, caregivers, and other family members including children. Family-friendly entertainment options are available to distract young patients and address patient and family anxieties.

## Patient Flow

To minimize children’s exposure to other emergencies, young patients are rapidly roomed or provided a private area. Triage is separate from the main waiting room; all resuscitation rooms are private; and staff are mindful of sightlines when young patients are moved.

## Pediatric Expertise

The new facility is staffed by specialized pediatric emergency medicine physicians who have completed five or more years of specialized training on how to care for children when they need emergent care the most.

## Child Life Specialists

Child life specialists with extensive training in child development work alongside physicians to provide education and support to patients and families, and even guide therapeutic play.

## Keeping Physicians Close

Rooms are arranged around pods to keep physicians close to patients. Enlarged trauma rooms accommodate the multiple doctors who typically attend to pediatric patients. The ED also has quick access to the specialists and resources of Lucile Packard Children’s Hospital.

## Child-Friendly Decor

From colorful, nature themes reflecting the California ecosystem to playful animal images at child-eye-level, to child-level counters, the decor is intentionally designed to create a safe, welcoming environment for young patients and their siblings.





### Level 1 Trauma & Quaternary Care

The pediatric ED offers advanced trauma care for pediatric patients in three trauma bays, plus immediate access to pediatric surgery, imaging, rehabilitation, and other services. Stanford also has a robust pediatric stroke protocol.

### Diagnostic Imaging

Stanford pediatric emergency and radiology departments partner to minimize radiation exposure from diagnostic imaging studies. Magnetic resonance imaging is used whenever possible. If CT scans or x-rays are needed, pediatric-specific low-radiation protocols are utilized.



# The Evolution of Pediatric Emergency Medicine

A conversation with **Deborah Hsu, MD, MEd**, who came to Stanford as inaugural chief of the division of pediatric emergency medicine at Stanford University's Department of Emergency Medicine in 2023. Raised in a service-oriented home, Hsu considered a career in education but pursued pediatrics because of the opportunity to partner with families to determine children's needs for medical care. She was drawn to a fellowship in pediatric emergency medicine because of the team-based collaboration inherent in providing emergency care.

## How has pediatric emergency medicine evolved throughout your career?

**Hsu:** Early in my medical career, healthcare delivery tended toward being physician-centric. In the past ten years, it has shifted to a more collaborative approach involving the entire health care team including patients and their families. Emphasis on team-based and patient-centric care has allowed patients access to more diverse expertise.

Pediatric emergency medicine research has evolved from single-center to multi-center studies, and access to information in these diverse settings has resulted in the acceleration of care advancements. Also, the types of research being conducted have expanded to encompass more definitions of scholarship. We now routinely conduct research in education, quality, advocacy, and other fields that fall outside of traditional clinical and lab-based research.

I chose to focus my scholarly efforts on competency-based education, training, and assessment. I had concerns early on about finding ways to share my research, but over time, numerous avenues, including international forums, emerged, fostering widespread dissemination of this type of scholarly work.

## What are your guiding tenets in helping individuals and teams be more productive and collaborative?

**Hsu:** Transparency and inclusion. I practice transparency by providing regular updates on progress and fostering open communication, even on minor details. I tend to over-communicate, but in doing so, I have been successful in providing avenues for input, normalizing collaboration, and optimizing workflows.

In promoting inclusivity, I avoid assumptions about people's preferences. Earlier in my career, roles were frequently assigned based on perceived talents. Pediatric emergency medicine comprises people with diverse skills; it's challenging to identify interests solely based on what I may know about an individual. Instead, I make opportunities available to all and employ an inclusive process for selection. This ensures genuine interest, enhancing outcomes.

My approach to patient care is similar. I routinely ask patients and their families, 'What are your concerns? What specifically can we address during this visit?' Through these very simple questions, I ensure the ED team isn't making assumptions about patient needs. This process doesn't take any more time compared to other approaches and allows for the delivery of individualized care.

## Why Stanford?

**Hsu:** Andra Blomkalns, the chair of Stanford's Department of Emergency Medicine, played a pivotal role in my decision to come to Stanford. Her transparent leadership, coupled with inclusivity and support for academic pursuits, stood out.

In the interview process at Stanford, I also met amazing and welcoming people who were accomplished and collaborative. That's the way I'm wired. I knew if I came to Stanford, I would be working with like-minded people to advance pediatric emergency medicine in various ways.

## What is your vision for emergency medicine in pediatrics at Stanford?

**Hsu:** While many aspects excel here, there's always an opportunity for optimization. Strengthening partnerships with Lucile Packard Children's Hospital (LPCH) is a priority as the pediatric ED at Stanford Hospital serves as LPCH's ED. Leveraging technology for efficient but thorough care delivery and minimizing documentation time for ED team members is also key.

Our experiences as pediatric emergency physicians can inform the entire system about what resources are needed for the holistic care of patients. As generalists with undifferentiated patients, our approach is to think broadly, and then focus on immediate



care needs. We are trained to deal with uncertainty. It's ingrained in us to think quickly but thoroughly; to not miss critical issues, and to pivot with flexibility. In so doing, we identify needed resources, bridge gaps, and address social determinants of health as well as make diagnoses and treat acute illnesses and injuries.

### **How do you see emergency medicine residency training continuing to evolve?**

**Hsu:** To ensure physicians gain proficiency in practice, we must structure education so that competency is measured in specific and quantifiable terms, and constructive feedback is provided routinely to our trainees in a psychologically safe setting. We must shift from norm-based comparisons

to providing valid assessments of trainee competency and capabilities. De-emphasizing competition within peer groups facilitates the attainment of competency by all.

We've made some significant strides in competency-based education and assessment but there's so much more to do. I'm confident we can move the needle and I think there will be some significant changes over the next 10 years.

# UNVEILING CHILD TRAFFICKING PATTERNS

**Preeti Panda, MD**, a pediatric emergency medicine fellow at Stanford, conducts research to shed light on the socio-economic characteristics of trafficking victims, paving the way for informed policy initiatives in emergency departments.

Panda is leveraging large data systems to address child trafficking.

Panda first learned about the problem of child trafficking when serving as an AmeriCorps volunteer in a small town in upstate New York where several youth were at risk for exploitation. “I realized if it was happening there, it was happening everywhere,” she says.

Stanford Hospital is in close proximity to both San Francisco and Santa Clara counties, which are among the FBI’s list of top child sex trafficking areas in the nation, and individuals who are trafficked often experience abuse or health problems that cause them to present multiple times to local emergency departments (EDs).

Panda, a pediatric emergency medicine fellow, often screens pediatric ED patients for signs of trafficking risk factors such as if they’ve run away from home, live in a group home or foster care, have been incarcerated, or have a history of abuse. Other signs include physical marks like tattoos

intended as branding, injuries that don’t make sense, or an ambiguous caregiver or friend in the examination room.

Through multiple studies, Panda is developing a more detailed portrait of pediatric victims of trafficking to better enable ED physicians to identify those at risk.

## Impact of COVID-19 on Pediatric Trafficking

Panda used the World Health Organization’s International Classification of Diseases codes that distinguish victims of forced labor or sexual exploitation, paired with data from more than 49 hospitals around the country pulled from the Pediatric Health Information System to conduct an interrupted time series analysis. She identified approximately a twofold increase in trafficked youth presenting to pediatric EDs in the early months of the COVID-19 pandemic. Quantifying this phenomenon will help EDs better prepare when the next pandemic strikes.

## Socio-economic Characteristics of Trafficked Children

Panda utilized the Child Opportunity Index (COI) coupled with ED utilization to better characterize trafficked children. The COI takes into account 28 factors that can influence a child’s opportunities, including average income, nearest grocery store, access to health care, and other variables. A low score indicates low socio-economic status. Panda found that while most trafficked children had low COI scores, close to one-third were from high, or very high socio-economic backgrounds. Looking ahead, Panda will also use the data to identify disparities in care provided to trafficked and non-trafficked care children.

Panda’s research is funded in part by a grant from the Society for Academic Emergency Medicine. As part of her grant, Panda was able to create an advisory board of survivors of human trafficking to help guide her research and reporting. She is working with this advisory board to create policy briefs from this work to better inform future initiatives in the ED setting.



Photo by Steve Fisch

# Caring for Children Before They Arrive at the Hospital

During pediatric residency **Manish Shah, MD, MS**, found he was most excited about caring for children in the emergency department (ED). After completing a fellowship in pediatric emergency medicine, Shah treated a wide variety of clinical conditions that touched on every body system, and cared for patients representative of a diverse population from all socioeconomic groups with varied language preferences, race/ethnicity backgrounds, and access to insurance or higher level of care.

Shah witnessed how healthcare disparities often hindered the management of injuries and illnesses in pediatric patients. For example, asthma disproportionately affects children of lower socioeconomic status, who suffer from limited access to care and face unhealthy living conditions that may exacerbate their illness.

In addition, children do not receive the same quality of prehospital care as adults. During his pediatric emergency medicine fellowship, Shah had an opportunity to teach paramedics. He learned that 90% of the patients emergency medical services (EMS) professionals encountered were adults. Faced with a pediatric patient experiencing a critical illness, they were less confident in providing care due to infrequent exposure to this patient population.

This realization fueled Shah's commitment to address disparities in prehospital care from a policy perspective, through focused research, and by improving the evidence base for prehospital pediatric emergency care. Shah was drawn to Stanford's Department of Emergency Medicine in part because several of the department's faculty serve as medical directors for EMS agencies in many surrounding communities.

Shah is currently involved in two clinical trials for children in the prehospital setting. As principal investigator on the five-year study, Pediatric Dose Optimization for Seizures in Emergency Medical Services (PediDOSE), funded by the National Institute of Neurological Disorders and Stroke (NINDS), Shah and colleagues are focused on improving how paramedics dose midazolam for the treatment of status epilepticus during EMS care. The team is collaborating with EMS agencies in 20 different cities across the country to utilize a standardized protocol that employs age-based midazolam dosing, eliminating the need for paramedics to engage in error-prone calculations when determining the dose for each patient.

Shah is also a co-investigator and helped design the Pediatric Prehospital Airway Resuscitation Trial (PediPART). Funded by the National Heart, Lung, and Blood Institute (NHLBI) and

conducted in 10 metropolitan areas across the country, the study explores which airway management technique (e.g., mask ventilation; supraglottic devices, endotracheal intubation) contributes to the best outcomes for children experiencing respiratory failure from trauma, cardiac arrest, or undifferentiated illness.

The biggest challenge Shah sees in pediatric emergency medicine is readiness in the ability of EMS systems and EDs to care for children across the entire emergency care continuum.

Shah chaired the American Academy of Pediatrics Section on Emergency Medicine's subcommittee on EMS and now serves on the Steering Committee for the National Pediatric Prehospital Readiness Project (PPRP). He also co-lead the PPRP workgroup that developed the first national assessment of pediatric readiness of EMS systems, scheduled to go live in 2024.







# Population Health

Emergency medicine physicians have a unique vantage point from which to recognize the shared healthcare needs of different populations. One-on-one patient encounters inform how emergency medicine physicians approach improving resources and access to care for entire populations, inside the emergency department, out in the community, and even across the globe.

Illustration by Eric Nyquist

# Evaluating Latinx Mental Health in the Community

**Jennifer Newberry, MD, JD**, leads a bilingual team in a multi-year collaboration with community partners to assess and address mental health usage patterns in the East San José Latinx community.

Why is Latinx mental health a priority for emergency medicine? Newberry, associate professor of emergency medicine, cites three important reasons.

“First, we see the consequences of untreated mental health issues in the ED all the time,” says Newberry. “But we need to address mental health concerns *before* they reach a crisis that requires a trip to the ED.”

“Second,” she continues, “if Precision Emergency Medicine is the use of data to authentically care for patients, patients are the best ones to provide context for that data.”

“Third, our profession is built on the mantra of anyone, anywhere, anytime. Healthcare access is not just about getting patients to the ED. It is about bringing care to patients in the community.”

In 2022, Newberry was awarded a five-year grant from the National Institutes of Health to evaluate mental health usage in the Latinx community of East San José, located a short distance from Stanford University. She heads a team of bilingual research assistants who identify as Latinx. The team collaborates with Stanford’s Quantitative Sciences Unit; community-engaged researchers from the departments of epidemiology and psychology; Drexel University’s social network analysis experts; and community partners and *promotoras* from San José.

*Promotoras* are lay Hispanic/Latino community members with specialized training in health education. *Promotoras* have frequent contact and established trust with community members and

can amplify healthcare efforts at critical junctures.

In the first phase of the project, 19 *promotoras* and research assistants went door to door to collect data from over 1,000 households. 70% of those surveyed were foreign-born, a group with a traditionally low response rate to phone surveys. Most participants opted to take the survey in Spanish.

Questions helped researchers identify and map patterns of behavior in accessing community mental health services, as well as barriers to service. Barriers included transportation issues, costs, lack of providers from similar cultural backgrounds, the concern of being perceived as weak, and even the fear that children could be taken away if parents sought mental health services. In conversations with the community,

many voiced concerns about mental health services for their adolescent children and support for substance abuse issues.

In partnership with Drexel University, the team is conducting a mixed-methods social network analysis, including interviews with up to sixty respondents. The team is also asset-mapping 100+ mental health providers, overlaying details such as proximity to transportation, interpreter services, insurance status, etc.

The data, feedback, and asset mapping will be used to create models that illustrate barriers and opportunities. The data will then be used to inform a *promotora*-centered community intervention to increase Latinx usage of mental health services in East San José.



# Improving Care for Mothers Around the Globe

**Peter Acker, MD**, helps lead a groundbreaking maternal and child health initiative to create essential measures for emergency referrals, aiming to significantly reduce complications and deaths in developing countries.

In a global effort to increase access to quality emergency care for mothers and newborns, Acker, an associate professor of emergency medicine, is helping to improve emergency referrals.

Early in his career, Acker was working in a rural health facility in Cambodia when he learned that a woman had been sent to the facility with postpartum hemorrhage. She arrived after many delays and needed surgery and a blood transfusion, which that facility couldn't provide. She died soon after.

"I thought a lot about that woman and her newborn baby, her parents, and the long-lasting impact on her community," says Acker. "All of it could have been avoided if the system had the ability to rapidly refer her to a facility with the capacity to address her clinical needs. The necessary changes wouldn't require a large infusion of money. We just needed the existing system to work more efficiently."

Each year an estimated 15 percent of women develop complications during pregnancy or after giving birth, leading to the deaths of 287,000 women and 3 million newborns. The vast majority of the world's maternal deaths occur in developing countries where health systems are working to overcome many barriers to provide effective and timely emergency obstetric and newborn care.

The Emergency Obstetric and Newborn Care (EMONC) Needs Assessment Toolkit created in 1999 and updated in 2009 is employed across 80 countries to identify and address emergency care gaps. The Toolkit was developed by a group called Averting Maternal Death and Disability (AMDD) at



Photo by Steve Fisch

Columbia's Mailman School of Public Health.

However, a critical aspect of the care continuum was not included in the needs assessment: emergency transport.

To address this gap, AMDD reached out to an international community of practice to develop new criteria for assessing transport systems. Acker, the only emergency medicine physician in the group, shared his insight as a clinician and as a global emergency medicine expert with extensive experience in low-resource settings.

"Emergency care thinks about the whole system across patient categories," Acker notes. "Until recently, funding, and as a result, many projects addressed a specific condition or targeted a particular patient group. But you can have a tremendous impact by working to improve how systems address emergencies."

Acker and his colleagues in the community of practice conducted extensive research on emergency referral indicators, refining ideas and formulating a program for real-world testing.

At the 2023 International Maternal and Newborn Health Conference in South Africa, AAMD unveiled proposed updates to the EMONC tool that included measures for emergency referrals. The new measures, which enable health systems to evaluate their ability to refer mothers and newborns experiencing emergencies, are expected to profoundly impact global and maternal care, acting as a catalyst for governments and funders worldwide.

# Navigating EM *Post-Dobbs*

**Monica R. Saxena, MD, JD**, assistant professor of emergency medicine, developed a protocol to offer medication abortions to patients in the Stanford Hospital emergency department (ED), in collaboration with **Carl Preiksaitis, MD**, emergency medicine fellow, and **Andrea Henkel, MD, MS**, assistant professor and complex family planning subspecialist in the Department of Obstetrics & Gynecology. A patient wishing to terminate a pregnancy receives comprehensive options counseling and if they are less than ten weeks along, they are offered the option to initiate a medication abortion in the ED. The protocol was developed in the year leading up to the 2022 Supreme Court decision *Dobbs v. Jackson Women's Health Organization* ruling that overturned *Roe v. Wade*. Saxena discussed what she has been doing lately to safeguard emergency medicine's role in women's health and reproductive options.



We have seen a couple of other hospitals try to implement the program we're doing with varying success.

In restrictive states, there's some reluctance to implement a medication abortion program and there are places where it likely won't happen.

**What strategies can be employed to ensure a more comprehensive focus on women's health issues within emergency medicine?**

**Saxena:** I think we need to incorporate more about women's health into the training of our emergency medicine residents, not only about abortion but also women's cancers, maternal mortality, and maternity care deserts. There's a gap in emergency medicine when it comes to exploring and improving reproductive health or even women's health in general. Look at cardiovascular disease — the majority of research is on white men. One of the few areas where they've successfully secured resources and attention for a women's health issue is breast cancer. I believe research and training regarding the rest of women's health is lagging and it's frustrating.

**What is your current focus in the context of evolving legal landscapes post-Dobbs?**

**Saxena:** I'm evaluating the Post-Dobbs landscape for women's health and treating ectopic pregnancies in abortion restrictive states.

**How do abortion restrictions in certain states potentially impact emergency medicine physicians?**

**Saxena:** California is an abortion-permissive state. However, 14 states have banned all or most abortions and an additional seven states have varying restrictions. An emergency medicine physician could encounter restrictions in treating a pregnant woman facing a medical emergency. We've seen reports of physicians having to decide should they uphold our emergency medicine ethos to provide care to anyone, anywhere, anytime, or do they withhold treatment according to state law.

I think as a specialty, we have to look at how we keep our doors open for all patients, especially those patients in abortion-restrictive states who are facing medical emergencies within our scope of practice. The standard of care is constant but the care provided can be impacted by varying state laws. Compounding the issue, a lot of those states have care deserts, which means emergency physicians are dealing with patients who are potentially sicker and farther along in their medical emergency.

**In what ways can the approach to abortion services mirror the existing practices of emergency medicine?**

**Saxena:** In the ED, we treat life-threatening emergencies, but we also provide medical services to patients with all sorts of non-threatening medical complaints. We provide options counseling — informing patients about their choices when facing important healthcare decisions. In a similar vein, pregnant patients facing a decision to terminate pregnancy are provided options counseling.

**What role does administrative support play in the successful implementation of the medication abortion program?**

Stanford has been incredibly supportive, and I give a lot of that credit to our department chair and our faculty for implementing the protocol. The risk management concerns in California were a lot different from what they would be somewhere else.

## SHORING UP EMTALA

**Michael Bresler, MD**, Stanford emergency medicine professor emeritus, played a key role in amending the Emergency Medical Treatment and Labor Act (EMTALA) to protect physicians.

Scan the QR code to read his story.



# Emergency Care for Patients with Dementia

**Michelle Lin, MD, MPH, MS**, an advocate for comprehensive geriatric care, investigates the accessibility and impact of geriatric emergency departments, aiming to bridge the gap for marginalized populations.

Geriatric emergency departments (EDs) are facilities that support the older population through dedicated care practices like specially trained staff, comprehensive geriatric assessments, environmentally responsive design, care coordination with community resources, medication review, and enhanced communication and decision-making that involves caregivers.

However, there is a potential mismatch between communities in need of geriatric emergency care and those where healthcare innovations, like geriatric EDs, often emerge. While academic hospitals are more likely to provide accredited geriatric care, they may not be easily accessible or geographically proximal to marginalized populations. Dementia is more prevalent in historically marginalized racial and ethnic groups, with evidence suggesting under-treatment and under-diagnosis in these populations.

Lin is exploring the unique challenges and cognitive barriers faced by older adults with dementia in accessing emergency care.

In a national study, Lin is linking geriatric EDs to Medicare data, and then utilizing the demographic information to understand who is accessing the geriatric EDs and whether they are racially and ethnically aligned with the overall US population with dementia.

Lin, associate professor of emergency medicine, is using the American College of Emergency Physicians's (ACEP) Geriatric Emergency Department Accreditation list to delineate geriatric facilities. Stanford's Marc and Laura Andreessen Adult Emergency Department has received a Level 2 geriatric accreditation from ACEP.

Lin is also exploring if geriatric EDs are associated with reduced admission rates. Of older adults with dementia, more than half visit the ED every year, and of those, nearly half are hospitalized. Evidence suggests widespread implementation of geriatric EDs has the potential to reduce those hospitalizations by 10%. Lin is determining if ED hospitalization rates at GEDs across the country reflect this practice. It is a data point that is dear to her heart.

Shortly after starting at Stanford, Lin treated a patient with relatively mild

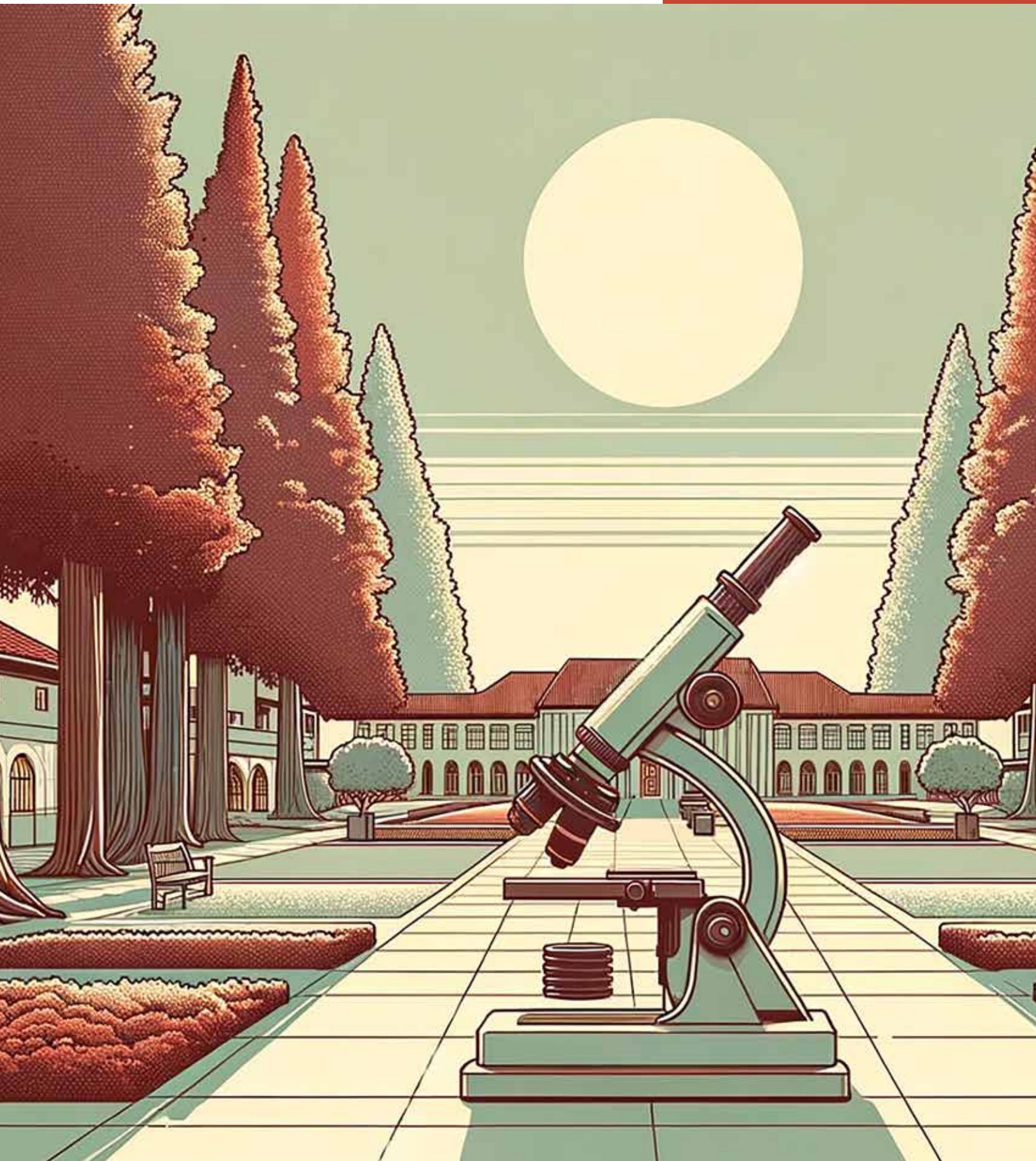


Photo by Steve Fisch

dementia who dipped in and out of a confused state but was overall lucid. Lin recalls the patient holding her hand and explained the last time she was in the hospital she had experienced complications. The patient told Lin, "Doctor, please do everything you can to prevent me from having to stay overnight in the hospital again. I don't have a lot of time left and I want to spend it with my family." This brief exchange inspired Lin to explore what other older adults faced in similar situations and how the decision-making process could be improved

through system changes like GEDS that promote comprehensive, patient-centered geriatric care.

The project is also examining the factors influencing safety net hospitals' decisions to adopt geriatric EDs. The study aims to understand the connection between the adoption of such programs and the financial resources of institutions. Lin also plans to explore which geriatric-focused interventions make the most difference in improving outcomes, and how even low-resource hospitals can provide impactful care for aging patients with dementia.





# Research Enterprise

How do you create a research infrastructure that encourages innovation and enables physicians to focus on science instead of administration? How do you encourage early career physicians to think differently and start down the research pathway? In a world of endless opportunities to create industry partnerships, how do you evaluate best fit, compatibility, and chances for success? Stanford Department of Emergency Medicine's research enterprise is relatively young but rapidly expanding and we share our approaches, systems, and lessons learned on the following pages.

# The Engine that **Drives** Innovation

At Stanford University's Department of Emergency Medicine, pursuing knowledge is a collaborative effort. An ecosystem of resources propels faculty, fellows, and residents to advance innovation, and attendings benefit from a reduced clinical shift load that enables them to engage in research.

## Specialized Support Staff

Faculty, fellows, and residents receive assistance in securing research funding from staff with expertise in federal grants, industry funding, seed grants, budgeting, post-award reporting, manuscript writing, and project management. Staff can quickly apply lessons learned from one grant to the next, helping faculty avoid potential roadblocks. The support team also liaises with Stanford's Research Management Group to create clear pathways for physician researchers. A unique grant submission intake process rapidly identifies areas of needed administrative support so researchers are left free to fully immerse themselves in scientific discovery.

Researchers work closely with Stanford's Quantitative Science Unit comprising 40+ experts, many of whom have PhDs in data science. Researchers can also partner with Stanford's Emergency Department Data Analytics Committee, which uses informatics and machine learning to conduct research, monitor care quality, and employ artificial intelligence and machine learning via electronic health records. Medical editor consultants are also on hand to assist with grant writing and reporting and in-department data experts assist with data cleaning and sorting.

Faculty attend scientific writing workshops and fellows are provided an annual two-day research workshop in addition to their Master's program. An emergency medicine intranet catalogs information on funding opportunities, data science, writing, editing, and publishing, medical editors, working with the institutional review board (IRB), and more.

## Clinical Research Unit

Stanford's Department of Emergency Medicine created the Clinical Research Unit (CRU) to convene a team focused on advancing the science of precision emergency medicine while ensuring patient safety and data integrity.

Clinical research comprises studies that enroll human participants in Stanford emergency settings, typically within the adult and pediatric emergency departments (EDs). Because clinical research demands unique planning, implementation, collaboration, and follow-up, the CRU provides specialized support to researchers and liaisons with hospital

departments and leadership.

A research manager and four coordinators provide support on human subject research throughout the lifecycle of a study, on the project management side (assisting with protocol development, budgeting, contracts, and IRB and regulatory submissions) as well as on the operational side (workflow development and implementation, screening and enrolling patients, training and informing nurses and staff). CRU staff work across multiple studies and can look for areas of collaboration, overlap, or challenges.

## Recent and upcoming clinical studies explore:

- Mild TBI assessment
- Sepsis diagnosis and treatment
- Vaccine effectiveness
- Cardiac high-sensitivity troponin
- Stroke and neurological emergencies
- Wearable vital signs monitoring
- AI-based biomarkers
- Antimicrobial stewardship



## Stanford Emergency Medicine Partnership Program

The Stanford Emergency Medicine Partnership Program (STEPP) is a structured system for sourcing, evaluating, and executing partnerships between the Stanford Department of Emergency Medicine and external innovators. A team of emergency medicine physicians oversees a multi-stage application process that ensures alignment and fit between the department and the applicant's mission, operations, needs, and viability.

Applicants are drawn mostly from industry-funded researchers focused on key areas of technological advancement, including:

- Medical devices
- Digital health
- Artificial Intelligence
- Health care at home
- Remote patient monitoring

Following an initial screening call, applicants face an in-depth interview from subject-matter emergency medicine physicians with experience in relevant areas such as AI or traumatic brain injury. Most of the physicians on the team also have a strong background in innovation and business development.

The screening process is similar to those used by venture capitalists, and assesses multiple variables including the quality of the research team; the product's scope, uniqueness, and application in the emergency medicine landscape; and evidence of a strong business model.

**Less than 6% of applicants progress to a partnership with the Department of Emergency Medicine. For the few who do, Stanford's world-class researchers provide ongoing guidance on study execution and evaluation.**

The wide range of applicants ensures that STEPP's core group of faculty is immersed in acute care technology. And while the team is focused on innovations to improve care, they are looking for a solution, not the only solution. STEPP also gravitates toward newer or smaller companies where a partnership with Stanford can have a large impact.

### Collaborators to date include:

- **BrainScope:** Decision support for traumatic brain injury
- **Shyld AI:** AI-enabled infection prevention
- **Prenosis:** AI-based biomarker discoveries
- **PyrAmes:** Continuous blood pressure monitoring



Our team of 20+ research technical and administrative staff includes **Lisa M. Jack, MA**, Research Technical Manager; **Loretta M. Matheson, MSCS**, Data Analyst; **Jamie S. Dent, MCL, MHA**, Grant Strategist/Planning; and **Leonard Basobas, MS**, EM-CRU Director of Growth and Development

# Research Seedlings

Since 2020 Stanford University's Department of Emergency Medicine has offered seed grants to encourage early-career physician-scientists to explore new territories in emergency medicine.

## **A Novel Application of Motion Analysis Software to Assess the Current State of Social Distancing Practices Among Visitors to Yosemite National Park**

At the start of the COVID-19 pandemic, James Marvel, MD set out to provide the National Park Service with precise, actionable data on visitor use patterns in the park to inform how best to operate during the pandemic. Marvel and team used artificial intelligence to track movement patterns in Yosemite National Park with a level of precision previously unobtainable.

*James Marvel, MD, assistant professor of emergency medicine*

## **Development of a Novel Deep Learning Algorithm for the Classification of Emergency Department Renal Point of Care Ultrasound**

The accuracy of point of care ultrasound performance can be practitioner dependent. Deep learning, enabling algorithms to learn to read images the way that human experts do, can help augment and standardize ultrasound interpretation. By teaching artificial intelligence to assess ultrasound images of kidneys to reliably classify and segment hydronephrosis, these

new algorithms can increase renal ultrasound accuracy and improve patient care.

*Ting Xu Tan, MD, emergency medicine ultrasound fellow*

*Youyou Duanmu, MD MPH, assistant professor of emergency medicine*

## **Real-Time Time-to-Event Analytics at the Emergency Department Bedside**

The difficulty for most machine learning projects is obtaining high-quality clinical labels. The team set out to better train a machine learning model and refine a hardware solution by obtaining an echocardiogram at the bedside to provide information at the moment of care. Their goal was to develop a device that could plug into the video port of any ultrasound machine, instantly providing information about the heart's ejection fraction as well as the video quality.

*Dev Dash, MD, assistant professor of emergency medicine*

## **Using Augmented Reality to Improve Learner Familiarity with Pediatric Resuscitation Carts**

Pediatric resuscitations are complex and require treatment based on a child's weight. Dedicated equipment carts provide the correct equipment but because they are sealed and sterile, they can be expensive to train on. Instead, the department created a phone app using augmented reality (AR) to help doctors learn to use the carts. The team's goal was to determine if the AR app helped doctors acquire knowledge easily and locate important equipment during a pediatric resuscitation more quickly.

*Sara Krzyzaniak, MD, director of Stanford's emergency medicine residency program*

## **Performance of Nasal Alar Pulse Oximetry Probe in Aeromedical Transport**

In medical air transport, vibrations from the aircraft and turbulence from air currents can lead to inaccurate readings from physiological sensors. Examining the accuracy of nasal pulse-oximetry versus the standard finger pulse-oximetry probe, analyzing their accuracy for patients with different skin tones, and comparing these numbers to results from patients with arterial lines can improve care.

*Alfredo Urdaneta, MD, associate professor of emergency medicine*



### **A Study to Evaluate the Impact of a Pilot Mentorship Mobile Application for UIM Emergency Medicine Residents**

A physician mentorship app provides an innovative, practical alternative to traditional in-person mentorship for eligible emergency medicine residents, and eliminates some barriers that have traditionally disadvantaged UIM trainees from finding optimal or effective mentorship.

*Sally Mahmoud-Werthmann, MD, assistant professor of emergency medicine*

### **Development of a Pregnancy Disclosure and Options Counseling Curriculum**

Improved physician training is essential to provide personalized care to pregnant patients while avoiding bias in emergency and acute care settings. The project team will assemble experts, develop a teaching program that will enable emergency doctors to have unbiased conversations with pregnant patients and customize care based on the patient's beliefs, preferences, and needs.

*Carl Preiksaitis, MD, Stanford emergency medicine medical education fellow*

### **The Impact of Restrictive State Abortion Law on Emergency Physician clinical practice: A National Survey of Emergency Medicine Physicians**

To understand the challenges emergency medicine doctors face following the Dobbs v. Jackson Women's Health Organization decision, the project team will collect, analyze, and share data that can be used to support changes in policies and practices to help doctors provide the right care to their patients.

*Monica Saxena, MD, assistant professor of emergency medicine*

### **Promoting Emergency Physician Retention: Strategies for Inclusion and Structural Transformation (PERSIST)**

A qualitative study is proposed to understand the increased attrition, especially among women, in the emergency medicine workforce since the COVID-19 pandemic, by examining the key factors influencing the decision to leave, and how these factors vary by gender and practice setting, to develop strategies to retain a diverse workforce.

*Serena Hua, MD, critical care fellow*

*Sally Mahmoud-Werthmann, MD, assistant professor of emergency medicine*

### **Development of a Pediatric Emergency Department-Based Program to Prevent Violence Against Youth**

The study aims to address the pressing issue of youth violence in the United States. by convening an interdisciplinary panel to create the first expert recommendations for a comprehensive, equity-focused violence prevention program in pediatric emergency departments, with a focus on addressing structural racism and inequities.

*Preeti Panda, MD, pediatric emergency medicine fellow*

### **CompassionNet: Universal Screening for Care Needs**

The study aims to improve the identification of palliative care needs in the emergency department using machine learning and natural language processing, to provide timely and targeted interventions for high-risk patients, thereby enhancing patient experience and clinical precision medicine outcomes.

*Nick Ashenburg, MD, assistant professor of emergency medicine*

*David Kim, MD, assistant professor of emergency medicine*

### **Female Altitude Physiology – Exploring Progesterone's Role in Acute Mountain Sickness**

The study aims to understand how female physiology, specifically fluctuating progesterone levels, may affect the risk of developing acute mountain sickness in high-altitude athletes, by recruiting a large cohort of pre-menopausal females and correlating their serum progesterone levels with symptoms of acute mountain sickness. The results could provide valuable data for female athletes planning high-altitude excursions.

*James Marvel, MD, assistant professor of emergency medicine*

*Patrick Burns, MD, associate professor of emergency medicine*

### **Diversity Characteristics Improve ACS Screening Predictions for Vulnerable Populations when Screening for STEMI**

The study aims to develop a diversity-enhanced logistic regression model to improve the prediction of acute coronary syndrome in emergency departments, with a focus on reducing inequities in screening and improving performance across demographic subgroups, by collaborating with Vanderbilt University and the Stanford University Quantitative Sciences Unit.

*Gabrielle Bunney, MD, innovation & design fellow*

### **Linkage to Care of At-Risk Emergency Department Patients**

The study aims to understand and improve the follow-up care for uninsured or Medi-Cal covered patients discharged from Stanford Health Care's emergency department, by collecting data on current follow-up rates, identifying barriers to follow-up care, and designing a linkage-to-care pathway in collaboration with local Federally Qualified Health Centers, to promote equity in care and improve the patient and provider experience.

*Christianna Sim, MD, social EM fellow*

*Ayesha Khan, MD, associate professor of emergency medicine*

# Turning Case Review Inside Out

Stanford Hospital's Marc and Laura Andreessen Emergency Department (ED) uses a unique case review process that has led to elevated patient care and improved physician satisfaction and trust.

Several years ago, Stanford moved away from the conventional case review method. Typically, case review is centered around peer review of a provider's performance, often fostering a culture of blame and defense. Stanford takes a holistic view, employing a human factor engineering approach incorporating the "five whys" investigative tool. This methodology involves a thorough investigation, engaging everyone involved in the case in a root cause analysis to identify human/team, system/process, or environmental factors that contributed to unexpected outcomes.

The case review culture evolved from punitive to collaborative, with physicians actively participating in the process. The shift in mindset has led to a significant reduction in cases flagged per month, from an average of 20 to just three or four. "Half of these cases now are self-referrals," notes **Laleh Gharahbaghian, MD**, emergency medicine professor and one of the leads of the project. "Because our physicians trust this process. They don't feel it is punitive. Instead, they want to improve the system and trust they will be given the benefit of the doubt and viewed as part of the solution."

The results have been transformative. Over 90% of root causes were identified as process or system issues, shifting the focus from blaming physicians to improving care by addressing underlying problems and then making meaningful changes to processes, systems and protocols, technology, and more. This ED's unique case review process is frequently cited as a Stanford Medicine best practice and has been adopted hospital-wide for all departments.

## A Coaching Resource You Can Use

*The Coaching Office: Advancing Coaching in Healthcare and Medical Education* (COACHME) was created at Stanford Medicine in 2021 to build capacity across Stanford to deliver quality coaching in medical education and to advance the field of coaching in medical education.

Coaching has been shown to enhance performance and motivation, as well as to mitigate burnout. **Sarah Williams, MD**, emergency medicine professor and COACHME program director, was inspired to create the program as her leadership project with the Stanford Medicine Leadership Academy. She completed a professional coach training program herself and extrapolated how physicians could benefit from similar training.

To date, five full courses and several customized offerings have been developed specifically for this purpose. More than 400 registrants from over 30 departments have participated. Trainees include department chairs, division chiefs, residency and fellowship directors, advisors, mentors, and others looking to incorporate coaching skills and approaches into their existing leadership, mentoring, and educational practices, as well as learn how to

develop coaching programs within their programs. The COACHME courses are now available to faculty both within and outside Stanford.

To learn more visit



# GREENING THE EMERGENCY DEPARTMENT

In emergency medicine, where every second counts, the push for sustainability might seem daunting. However, Stanford's Marc and Laura Andreessen Emergency Department (ED) is making strides in creating a more ecologically friendly environment.

The initiative, known as the Stanford ED Green Team, was sparked by inspiration from other specialties within the medical field, notably anesthesia and orthopedics. The team's primary goal is to reduce the carbon footprint of the ED's medical practices without compromising patient care quality.

One of the team's flagship projects involves the recycling of pulse oximeters, devices traditionally considered disposable. Driven by a collective effort from ED physicians, nurses, residents, and other staff members, the team has successfully implemented a program to recycle these devices, diverting them from the waste stream and working with medical device companies like Masimo for reprocessing.

Another focus is optimizing the ED's waste streams. The team has undertaken a comprehensive waste audit, weighing all trash leaving the department over 24 hours. This data-driven approach allows them to identify areas generating the most waste, leading to targeted interventions, such as educational campaigns and real-time tracking of waste disposal habits.

The effort began in 2018 when **Jean Reyes, MBA, MSN, RN**, first applied principles of corporate social responsibility, sustainability and cost-savings to her work on the Stanford Health Care (SHC) supply chain. Partnering with nursing and physician leadership as well as supply chain managers, Green Team co-lead Reyes expanded efforts throughout the pandemic, in part to conserve personal protective equipment (PPE). In 2022, Reyes officially launched the Greening the Stanford ED initiative.

Challenges unique to EDs, as highlighted by **James Marvel, MD**, assistant professor of emergency medicine and co-lead of the team, include the fast-paced nature of the environment and the unpredictability of patient needs. To address this, the team focuses on streamlining interventions into existing workflows to minimize the burden on staff while promoting sustainability.

Reyes and Marvel both emphasize the importance of starting small, tackling low-hanging fruit, and gradually expanding efforts. They credit the success of the ED Green Team in part to broader institutional support for sustainability within Stanford Medicine, which has made an unprecedented commitment to safeguarding the environment through innovative solutions to achieve ambitious sustainability goals.





# The Most Exciting Innovation in Emergency Medicine

In Fall 2024, the Stanford University Department of Emergency Medicine will host our fourth annual virtual symposium on emergency medicine innovation — StEMI X. Learn more about the event and our speakers from around the country at [stemix.live](https://stemix.live).

**Below, our StEMI X conference directors share what they are most excited about as they plan for the future of emergency medicine.**

## **Andrew Chu, MD**

*Assistant professor of emergency medicine*

There are so many things that get me excited about innovations in our field: large language models and their potential to augment clinical decision-making and support; new models of healthcare delivery that can provide acute care in the home (e.g., ED-in-Home); portable, diagnostic tools that can provide immediate, actionable results at the point-of-care, instead of CT scans and stress tests. It's a great time to be innovating in emergency medicine!

I'm most excited about working with my colleagues to develop a curriculum on innovation for our residents. We are re-imagining how we train our doctors to best prepare them for a rapidly evolving healthcare landscape characterized by unprecedented technological disruption. We want to teach our trainees problem-solving methodologies that will empower them to lead our field with creativity and precision in this new digital frontier.

## **Fran Riley, MD**

*Assistant professor of emergency medicine*

Extending emergency medicine outside of the brick-and-mortar hospital, to encompass telehealth and hospital at home — I think there's so much opportunity here, especially with the technology increasingly available to increase the fidelity of interactive experiences (e.g., haptics or augmented reality to improve physical exams), which can be paired with associated operations and policy changes needed to operationalize these solutions.

Advanced diagnostics — There are a host of companies working on non-invasive diagnostic tools to better detect intracranial hemorrhage, elevated intracranial pressure, coronary artery disease, and more, as well as tools to monitor and identify decompensating patients to help evaluate and disposition patients faster and with fewer side effects.

## **Dan Imler, MD**

*Associate professor of emergency medicine*

I'm most excited about the engagement of emergency medicine practitioners at the intersection of technology, healthcare, and entrepreneurship. I believe that EM practitioners have a unique insight into the healthcare system as a whole, which is why EM physicians are so commonly in positions of leadership within organizations.

We are currently seeing an inflection point where EM-trained physicians are no longer content simply putting our heads down and moving patients through the system. We are looking at new innovative ways to provide care, on a personal and system level. This "innovation" of perspective within the field is what I think can drive forward a future we all will be proud of within acute care and beyond.

# STANFORD DEPARTMENT OF EMERGENCY MEDICINE AT A GLANCE

## PATIENT CARE

106,000

In fiscal year 2023, Stanford's adult and pediatric emergency departments treated more than 106,000 patients (78,000 adults and 28,000 pediatric patients).

4,000

4,000 emergency department patients were treated through our virtual visits track (VVT).

63%

Our patients are 63% Hispanic, Asian, or Black. The majority of our patients receive federally subsidized care.

Level 1

We are the only Level 1 adult/ped trauma center between San Francisco and San Jose.

95

Our 95 attendings (and growing!) offer expertise in critical care, global emergency medicine, social emergency medicine and population health, medical education and simulation, ultrasound, innovation, wilderness medicine, and emergency medical services.

## RESEARCH

100+

Between 2018 and 2023, faculty, fellows, and residents received more than 100 grants. In 2023, attendings and residents produced more than 175 research publications.

Ranked 11th

The department ranks eleventh in the nation in funding from the National Institutes of Health among emergency medicine programs.

## EDUCATION

60

Sixty emergency medicine residents pursue a four-year residency training with opportunities for exploring career niches and advancing research portfolios.

16

Sixteen fellows pursue fellowships in twelve different subspecialties. Many conjointly pursue related advanced degrees with support from Stanford. Stanford was among the first emergency medicine programs in the nation to offer fellowships in wilderness medicine, innovation and design, and physician wellness.

## OUR VALUES

LEADERSHIP

INNOVATION

DIVERSITY

EXCELLENCE

DISCOVERY

SERVICE



**Stanford**  
MEDICINE

Emergency Medicine

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# INSIDE WHAT'S

