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Serving *all* Communities

Laura Fejerman, co-director of the UC Davis Comprehensive Cancer Center's new Women's Cancer Care and Research Program (left) meets with health educator Maria Gonzalez in south Sacramento.

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Welcome from the Chairs

Dear Friends,

We're thrilled to share the fourth issue of our joint UC Radiology newsletter with you, on the theme of *Serving all Communities.*

Because imaging guides so many healthcare decisions, our ethical responsibility as radiologists requires us to understand our patients' needs beyond the information revealed in imaging studies, including the social, cultural, and economic influences that affect their ability to access and maintain care. At the same time, our ability to innovate technology gives us a unique perspective on developing novel interventions that remove or reduce barriers to care. Such innovations offer remote diagnosis and treatment options for patients in geographic locations distant from our academic centers and advance environmental sustainability.

Across our five campuses, faculty and trainees are tireless advocates for health equity, and they address these issues as clinicians, teachers, researchers, and leaders in our profession. Here, we showcase how we're bringing imaging insights to underserved populations and thereby reducing avoidable negative health outcomes for the communities we serve. From self-scheduling of screening mammograms to lung cancer screening to mentoring underrepresented scientists, radiologists have leading roles in the pursuit of health equity.

Illuminating Public Health Perspectives

The UC Davis Comprehensive Cancer Center wants to improve breast cancer detection and survival odds among Latinas and Hispanic women by connecting with them in community settings to share resources for prevention, assessment for hereditary risk, screening, and treatment. Using *promotores*, health educators with ties to the community, the Women's Cancer Care and Research program (WeCARE) is able to grow a network of trust related to seeking and receiving breast care.

Located 20 miles from the US / Mexico border, UC San Diego is a safety net hospital and level one trauma center that has seen a five-fold increase in the number of serious injuries and deaths attributed to the now 30-foot high wall along 400+ miles of the border. A retrospective study using data from imaging studies mirrors this increase in injury, based on the use of search terms "border fall" or "border wall."

At UC Irvine, a collaborative project with Emory University is testing an intervention for metastatic breast cancer patients that aims to lower symptom burden and improve quality of life. This multilevel mobile health (mHealth)

From left: Vahid Yaghmai, MD; Dieter Enzmann, MD; Alexander Norbash, MD; Christopher Hess, MD, PhD; Elizabeth Anne Morris, M

> **We are incredibly proud of the work highlighted here and extend our gratitude to the faculty and trainees who are leading these important efforts.**

intervention integrates a smart pillbox and an early warning system of nonadherence using bidirectional automated texting with provider alerts and referral to financial navigation services if non-adherence is cost-related.

Leading Through Technological Innovation

UCLA is laying the groundwork to extend remotely controlled robotic stroke interventions to patients outside of urban centers. The timeliness of stroke treatment plays a major role in determining outcomes for stroke patients, which makes lengthy travel time to an adequately equipped and staffed medical center highly problematic. Reducing delays in stroke treatments with technological innovation has the potential to help reduce the heavy toll of negative health outcomes for patients.

At UCSF, researchers at the Center for Intelligent Imaging (ci^2) set out to answer if AI tools could be used to help health systems and payors target care management and preventive health and develop cost and reimbursement plans. Investigators hypothesized that chest radiographs (CXRs) capture many general health indicators, and when used along with information on age, sex and ZIP code, this information could predict future medical costs. Using these tools, the study identified hidden information underlying patient imaging such as patient health and socioeconomic risk factors that would otherwise not be evaluated in normal clinical radiology workflow.

We are incredibly proud of the work highlighted here and extend our gratitude to the faculty and trainees who are leading these important efforts. We invite you to explore this issue to learn more about some of the many ways that University of California radiologists and imaging scientists are making imaging more equitable for our communities.

Sincerely,

Dieter Enzmann
Christopher Hess
Elizabeth Morris
Alexander Norbash
Vahid Yaghmai

Promotores: Cancer Crusaders in the Community
Tu Historia Cuenta: Your Story Matters

The story of breast cancer in Hispanic women and Latinas is one that has not been fully told or investigated. Overall, breast cancer rates in this population are 28% lower than in non-Hispanic white women — but that doesn't give the complete picture.

Because of health disparities that prevent access to adequate and affordable health care, breast cancer in Latinas and Hispanic women may remain undiagnosed until later stages when it is more difficult and expensive to treat. That's one reason Hispanic women and Latinas are about 30% more likely to die from their breast cancer than non-Hispanic white women. They are also at higher risk for triple-negative and human epidermal growth factor receptor-positive breast cancers, which are more aggressive than other types of breast cancer.

UC Davis Comprehensive Cancer Center wants to improve the detection and survival odds of Hispanic women and Latinas by seeking them out in the community and connecting them to resources for prevention, screening and treatment of breast cancer.

Tu Historia Cuenta, which in Spanish means "your story matters," is the name of a new program led by Laura Fejerman, co-director of the cancer center's new Women's Cancer Care and Research Program (WeCARE). The project examines hereditary breast cancer risks and screening in Hispanic women and Latinas in Northern and Southern California, and provides family risk assessment and navigation to services.

Fejerman, who is also co-director of the cancer center's Latinos United for Cancer Health Advancement or LUCHA, said that Latinas are less likely to seek genetic counseling or testing for breast cancer compared to non-Hispanic white women. They also have lower rates of mammography screening.

"Low-income Latinas are getting left behind because they are not aware of the role genes play in breast cancer and, if they become aware, often they don't have access to genetic counseling and testing," said Fejerman.

Inspired by and in partnership with Ysabel Duron, a Latina advocate and founder of The Latino Cancer Institute in San Jose, Fejerman designed a specific program that focused on hereditary breast cancer

as a community partnership. Health educators known as "promotores" are trained to educate Latinas about how to access resources for breast cancer screenings and treatment.

Fejerman said UC Davis Comprehensive Cancer Center wants to better serve Hispanic and Latino cancer patients and their families, and that starts by developing community relationships that can overcome language and cultural barriers. Promotores conduct outreach in Spanish and spend about an hour talking with individual Latinas.

During the COVID-19 pandemic, the program began conducting hereditary breast cancer education sessions in Spanish via Zoom so that progress could continue despite social distancing safeguards.

The California Initiative to Advance Precision Medicine, part of the Governor's Office of Planning and Research, is funding Tu Historia Cuenta, which UC Davis, UC San Francisco and City of Hope are operating collaboratively.

Fejerman said Tu Historia Cuenta is the first step in reducing health disparities and addressing the breast cancer burden that exists currently in the Hispanic and Latino community.

> ❝ **Low-income Latinas are getting left behind because they are not aware of the role genes play in breast cancer and, if they become aware, often they don't have access to genetic counseling and testing.** ❞ —Maria Gonzalez (pictured above)

Meet a Promotora

Maria Gonzalez is a promotora — a community health educator. The Centers for Disease Control and Prevention recognizes promotores de salud, also known as promotoras, as important lay health workers who are trusted and empowered to educate and connect their peers to information and resources that can save lives.

"Maria represents the people she is trying to help," said Fejerman, who depends on Gonzalez and three other promotores in the Sacramento and San Francisco areas to conduct outreach among Hispanic women and Latinas as part of her Tu Historia Cuenta breast cancer project.

Gonzalez, 49 and a mother of five, knows the importance of connecting her family, friends and neighbors to resources that keep them healthy. She first helped other parents with special-needs children navigate access to resources, including those provided by the UC Davis MIND Institute after receiving care for her child at the research and treatment center for neurodevelopmental conditions.

Now, after battling breast cancer eight years ago, Gonzalez works for an agency called Visión y Compromiso that was contracted by the Tu Historia Cuenta program. She was trained to educate members of her community about hereditary breast cancer and navigate them to screening services.

"I like the idea of helping women like me, educating them and building relationships while connecting them with resources that give them access to care," said Gonzalez.

One of those programs is the state-funded Every Woman Counts screening service, providing mammograms free of charge to underserved women. Typically, Gonzalez connects with 15 to 20 women a month, speaking in Spanish to them via Zoom meetings set up in advance.

Gonzalez makes presentations at churches, schools and community group meetings, where she registers women for classes. Through Fejerman, who translates her Spanish into English, Gonzalez said she doesn't usually have to initiate contact with community members. Women typically find her because she is well known in the community and considered a key intermediary to health care resources.

"Mainly, people know me through word-of-mouth," said Gonzalez. "People are coming to me already to get health information." Identities of the women whom Gonzalez interviews are kept private.

"Gonzalez is a crucial link in growing the trust network in our community," Fejerman said. "I feel we will finally make progress in addressing the cancer burden in Hispanic and Latino communities by leveraging promotores such as Gonzalez who have a strong passion and a commitment to healthier communities." ∎

Reference: *Originally published in Synthesis* Summer 2022 Issue: *bit.ly/synth22*

A Patient Online Portal to Allow Self-scheduling of Mammograms

Figure 1. MyChart self-scheduling home page
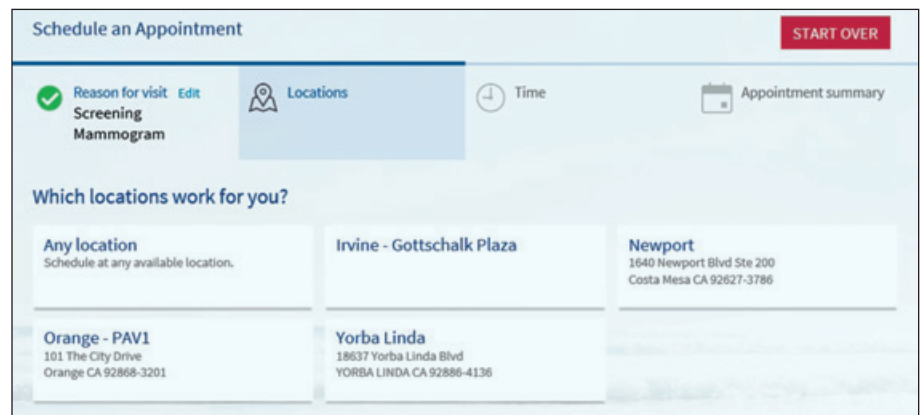
Figure 2. MyChart screening mammogram self-scheduling location offerings

AUTHOR:

Irene Tsai, MD
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In February 2021, UCI began implementing its EPIC online patient portal, MyChart, to allow patients to self-schedule their screening mammogram appointments, with the hopes that this would increase patient access and satisfaction, as well as improve efficiency. By utilizing MyChart, patients are able to avoid phone calls to busy call centers and directly schedule at their own convenience.

Working with IT analysts, appointment templates were created in EPIC and made available to patients through MyChart. Appointments could be made through a "ticket scheduling" process, where patients receive electronic notifications through MyChart, that an order for screening mammogram has been placed for them by their referring providers. They are then directed to schedule their screening mammogram appointments directly through the online MyChart portal (Figure 1). Patients are also able to "direct schedule" their annual screening mammograms without the need for a physician order.

Patients are then presented with all available appointment times, for any applicable locations, to schedule at their own convenience (Figures
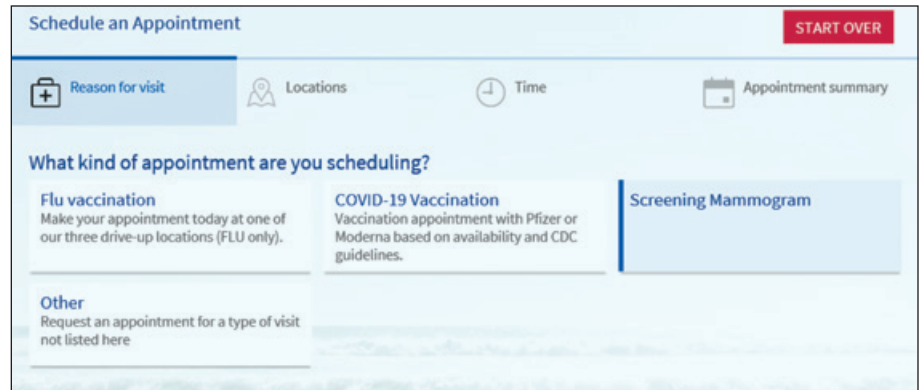
Appointments could be made through a "ticket scheduling" process, where patients receive electronic notifications through MyChart, that an order for screening mammogram has been placed for them by their referring providers.

2 and 3). Logic has been built into the algorithm, to validate insurance authorization status, and to ensure that appointments are appropriate for the locations provided.

Once scheduled, the patients are then provided directions and visit instructions through MyChart and are also sent periodic visit reminders through MyChart and via text message (Figure 4).

A carefully constructed patient self-scheduling system can increase patient access and satisfaction, while also helping to ensure full schedules, with corresponding volume increases. The goal for UCI's self-scheduling screening mammogram program was for 5% of total scheduled appointments in the

first six months post-implementation. UCI surpassed this goal within three months, with a 7% self-scheduled rate in two months and over 9% rate in the third month. Data from July 2022 demonstrates that 17.2% of all total screening mammogram appointments are now made through this MyChart patient self-scheduling system. There has also been very positive feedback, with patients commenting on the efficiency and ease with scheduling through this portal.

In the future, UCI will be investigating how this system can help to increase patient adherence to screening mammogram and help it establish future outreach programs to reach a broader patient population. ∎

Figure 3. MyChart self-scheduling available appointment times

Figure 4. Directions and visit instructions in MyChart after mammogram appointments are made

UCI

Use of mHealth Intervention for Patients with Metastatic Breast Cancer

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Gelareh Sadigh, MD
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Medical financial hardship is a well-documented issue in the United States with 56% of adult Americans reporting financial hardship between 2015–2017.

Financial hardship can directly impact patients' adherence to recommended care and is associated with decreased quality of life and survival. Patients with metastatic cancer are specifically at high risk due to high out-of-pocket costs associated with many of the modern chemotherapy or targeted therapy agents as well as imaging exams.
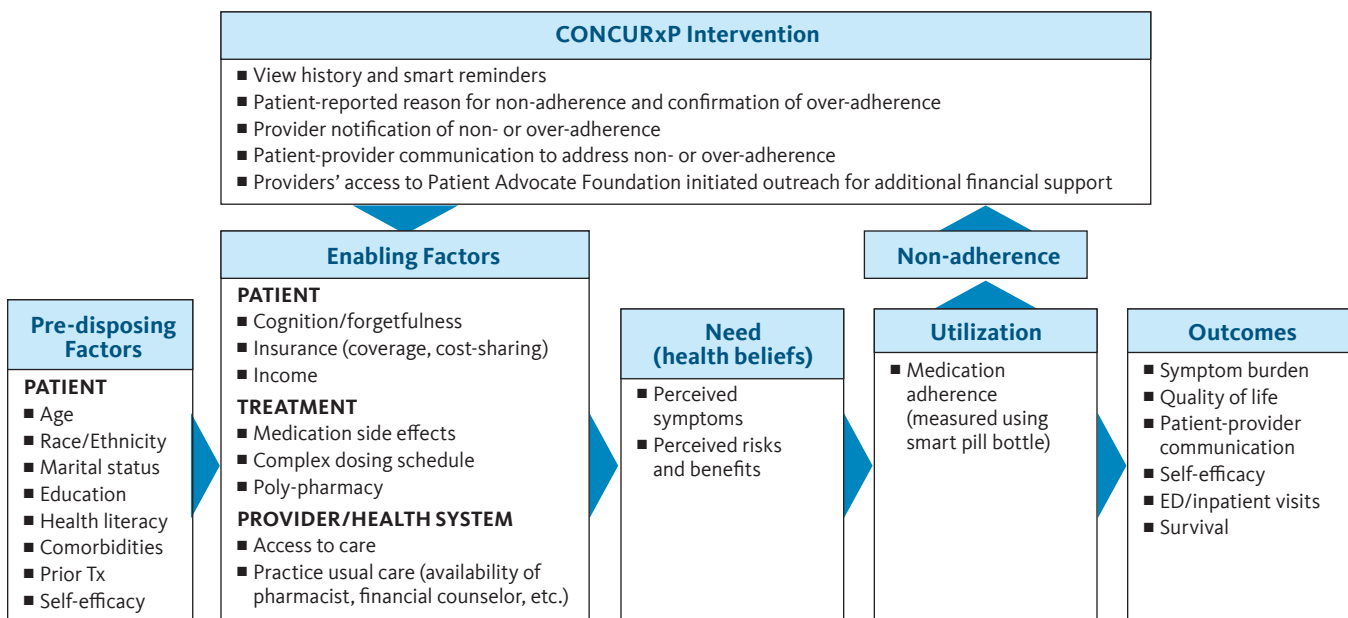
For women with hormone receptor-positive (HR+) and human epidermal growth factor receptor 2–negative (HER2-) metastatic breast cancer, cyclin-dependent kinase 4/6 inhibitors (CDK4/6i) lead to a doubling of progression-free survival from 14.5 to 24.8 months, increase in 5-year overall survival from 16.8% to 23.2%, and a reduction in symptom burden when added to endocrine therapy. However, in these patients' care, nonadherence is an issue due to complex medication schedule, side effects, and financial hardship. The average wholesale cost of medication per cycle is $15k, and imaging remains one of the most frequently ordered diagnostic tests contributing to financial hardship. The increasing penetration of mobile phones across every segment of the population can be leveraged by the healthcare community to engage patients between visits and improve adherence.

National Cancer Institute (NCI) / National Institutes of Health (NIH) R01-funded research in the Department of Radiological Sciences at University of California, Irvine, with Dr. Gelareh Sadigh as Principal Investigator, and at Emory University, with Dr. Ilana Graetz as MPI, is testing the effectiveness of a multilevel mobile health (mHeal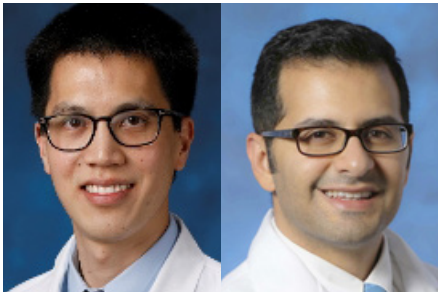th) intervention that integrates a smart pillbox and an early warning system of nonadherence that uses a bidirectional automated texting feature with provider alerts, and referral to financial navigation services if non-adherence is cost-related. With closer monitoring of adherence and symptoms, our intervention can result in lower symptom burden and improved quality of life. This intervention is being tested among metastatic breast cancer patients who receive care at NCI Community Oncology Research Program (NCORP) practices across the United States and in collaboration with the cancer care delivery research program of ECOG-ACRIN Cancer Cooperative group. NCORP is an NCI-supported network of over 900 clinical practices with independent care delivery resources throughout the country. The intervention is expected to improve patients' care adherence, symptom burden, quality of life, and survival and decrease unexpected healthcare utilization.

Significantly, a successful mHealth intervention could be disseminated across systems, conditions, and populations. Use of text-enabled mobile phones, rather than smartphones, decreases potential technology inequity and supports the participation of underserved populations. The study will provide actionable results to improve health outcomes in the diverse population of the NCORP. ∎

Improving Medication Adherence Using a CONnected CUstomized Treatment Platform (CONCURxp)

CONCURxP Intervention

- View history and smart reminders
- Patient-reported reason for non-adherence and confirmation of over-adherence
- Provider notification of non- or over-adherence
- Patient-provider communication to address non- or over-adherence
- Providers' access to Patient Advocate Foundation initiated outreach for additional financial support

Pre-disposing Factors

PATIENT
- Age
- Race/Ethnicity
- Marital status
- Education
- Health literacy
- Comorbidities
- Prior Tx
- Self-efficacy

Enabling Factors

PATIENT
- Cognition/forgetfulness
- Insurance (coverage, cost-sharing)
- Income

TREATMENT
- Medication side effects
- Complex dosing schedule
- Poly-pharmacy

PROVIDER/HEALTH SYSTEM
- Access to care
- Practice usual care (availability of pharmacist, financial counselor, etc.)

Need (health beliefs)

- Perceived symptoms
- Perceived risks and benefits

Non-adherence

Utilization

- Medication adherence (measured using smart pill bottle)

Outcomes

- Symptom burden
- Quality of life
- Patient-provider communication
- Self-efficacy
- ED/inpatient visits
- Survival

Sustainability in Medical Imaging at UC Irvine

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UCI has recently undertaken three sustainability initiatives involving both CT and MRI modalities utilizing a new scanner technology and multidose contrast injector for the former and offering point-of-care (POC) portable imaging system for the latter.

Ecological Advantages of New CT Scanner Design

Energy consumption of medical devices has significant environmental impact. A new CT scanner installed in the hospital offers average savings of 58% for standard examinations. Detector design offers 48% less power consumption compared to older models. Reduction of lead is achieved by avoiding lead counterweights in the scanner and reduction of lead for shielding. The scanner itself is mainly made of metals, making it easy to recycle. In fact, 99% of the materials used in this CT system are recyclables.

Sustainability Impact of Multidose Contrast Injectors

UCI radiology recently purchased and installed a syringeless multidose contrast injector unit in its emergency department CT suite. This was a timely installation as it was implemented at the time of the recent global intravenous contrast media shortage. This device consists of a sophisticated power injector where exact contrast dosage is given to the patient, decreasing wasted contrast in the single-use vial systems.

This multi-dose power injection device takes two 500 mL contrast vials and a 1000 mL saline bag, which can be used for 8 hours continuously, once spiked. The tubing involved includes single bottle use (8-hour) spike tubes, which end in spikes connecting to the contrast vials and saline; a pump tube (24-hour rated), which connects to the spike tubes; and patient tubing, which is a single use tube that connects the pump tube to patient IV cannula.

When comparing to standard power injectors, this device offers significant decrease in syringe, contrast and saline containers, and contrast media waste. This device utilizes spikes instead of syringes. A standard power injector requires approximately 6-8 times more syringes than spikes for daily usage. Additionally, approximately 4-5 times more contrast containers and about 20 times more saline containers daily are used with standard injectors. While contrast waste is difficult to accurately quantify, UCI estimates a 5-to-10-fold decrease in daily contrast waste using the multidose injector.

Sustainability Impact of Portable MRI Exams

The US Food & Drug Administration (FDA) has recently provided 510(k) premarket notification for a bedside, POC 0.064T MRI device, which can perform non-contrast brain MRI with basic MRI pulse sequences including T1 fast spin echo (FSE), T2-FSE, T2/fluid-attenuated inversion recovery (FLAIR), and diffusion-weighted imaging (DWI)/ apparent diffusion coefficient (ADC) sequences.

This low-field imaging device, which plugs into standard electric outlets throughout the hospital, does not require nearly the same amount of energy or liquid helium to maintain the superconductivity needed for traditional high-field MR scanners. Additionally, as a portable device, brain MR exams can be done at bedside, significantly reducing the resources and time needed to transport critically-ill ICU patients to a designated MRI floor (1). Rapid follow up imaging can be performed when patients have clinical deterioration with less energy consumption than standard CT and high-field MR exams.

These three initiatives at UCI improve sustainability by decreasing waste and energy requirements. ∎

Reference: *Kuoy E et al. Point-of-Care Brain MRI: Preliminary Results from a Single-Center Retrospective Study.* Radiology. *2022 Aug 2:211721. PMID: 35916678.*

Border Trauma: A Public Health Crisis with Humanitarian Consequences on Both Sides of the US-Mexico Border
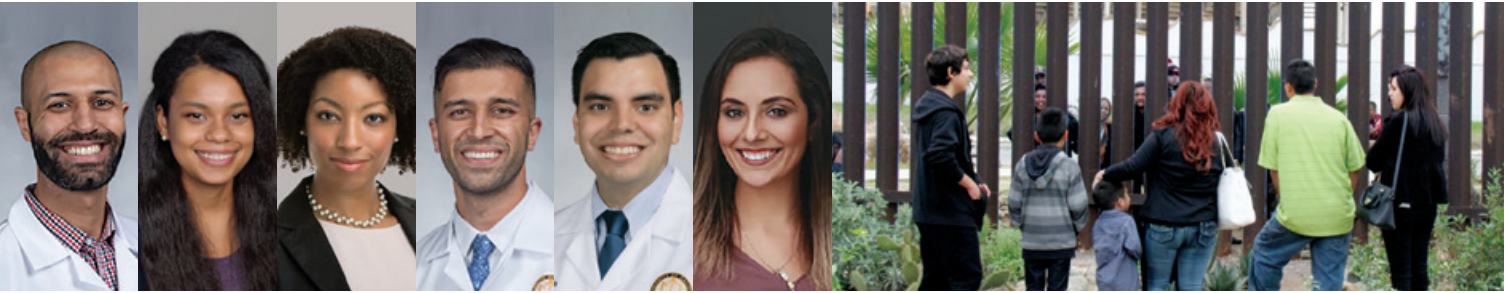
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The University of California San Diego (UCSD) is uniquely positioned within 20 miles of the US-Mexico border and serves as San Diego's safety net hospital and as a level one trauma center. UCSD serves a diverse patient population, which includes the documented and undocumented immigrant patient populations. It is not uncommon for UCSD to provide high-level trauma care to patients transferred from Mexico as well as care for those who experience trauma at the US-Mexico Border.

Since 2019, UCSD has seen an increase in the number and severity of injuries occurring at the US-Mexico border wall. These findings, published by Dr. Amy Liepert et al, show that since 2019, UCSD has seen a five-time increase in the number of high-severity injuries occurring at the US-Mexico border. Authors attributed this to the increase in the height of the border wall:

"On January 24, 2017, the executive order Border Security and Immigration Enforcements was signed by President Trump. This resulted in replacement of 406 miles of existing 6- to 17-ft barriers with a 30-ft-tall (9.1 m) steel barrier. An additional 49 miles of new barrier were also added. The new 30-ft border wall was reported in lay media to be unclimbable." Although considered *unclimbable* UCSD saw an increase in the number of falls from the border year after year since the construction.

The UCSD border trauma study was conducted retrospectively, and calculated border wall fall admissions from January 2016 to December 2021. Data on hospital mortality, overall injury severity, hospital length of stay, and inflation-adjusted hospital costs were also collected. To normalize for changing migration rates, admissions were calculated per 100,000 US customs and Border protection (CBP) apprehensions. The period 2016-2018 was defined as "before construction" and 2019-2021 was defined as "after construction" of the 30-ft wall. On-scene mortality of border wall falls was obtained from the San Diego County Medical Examiner.

The findings showed 67 fall admissions from the border wall before the new wall construction to 375 after the construction. This over 5-fold increase remains significant even when adjusting for CBP apprehensions. There was an increase in hospital length of stay and ICU length of stay (LOS), as well as mortality. The LOS went from 4 to 6 days and associated median cost went from $30,714 to $44,000 per patient. Hospital costs alone for border wall-injured undocumented immigrants were estimated to be approximately $13 million between 2019 and 2021. There were zero reported on-scene deaths prior to the wall construction and a total of 14 on-scene deaths after the increased wall height.

Radiology imaging trends mirror these findings. A query for "border wall" or "border fall" in PACS via M-modal from 7/2017 to 7/2022 identified 528 unique patients and a total of 3,023 imaging studies. Although only a little over halfway through the year, the number of imaging studies has already hit 1086 studies for 2022, while all of 2021 totaled 1453. UCSD is on the trajectory to surpass the number of studies performed in 2021 related to border trauma.

Trauma occurring along the US-Mexico border is a public health crisis that has increased trauma center bed utilization. Thus, exacerbating the severe strain on limited acute care bed capacity caused by the COVID-19 pandemic. The increased ICU demand exacerbated staffing shortages and increased professional moral injury. "Many individuals who fell from the border wall suffered significant brain and facial injuries and complex fractures of their extremities or spine, requiring a high level of care from providers. Many patients also required multiple surgical procedures." After being stabilized, issues in disposition occurred due to lack of health insurance and residency status, and many patients were not eligible for rehabilitation facilities or post-discharge physical therapy, which further prolonged their length of stay.

Future policy decisions along the US-Mexico border should include assessments of the humanitarian consequences and potential effects on local health care system resources. The Trump administration approved replacing and increasing the height of the border wall at Friendship Park – San Diego's South coastal border – to 30 feet. However, construction has not started and remains at a halt. Friendship Park serves a place where families from both sides of the border can meet and see each other through slits in the steal barrier and the park has become an area where community events and prayer services are held. Access to the park will remain closed during construction and when the new barrier is constructed, it will eliminate the ability to see loved ones on the other side of the barrier.

On August 5, 2022, it was announced by CBP that the wall's construction will be put on halt for 120 days. A construction date is not set, and key stake holders continue dialogue about the impact on the humanitarian level. ∎

For those wishing to join the conversation, "Friends of Friendship Park" is an advocacy group with updates on the status of the coastal border wall's construction at www.friendshippark.org.

Border fence between San Diego's border patrol offices in California, US (left) and Tijuana, Mexico (right)
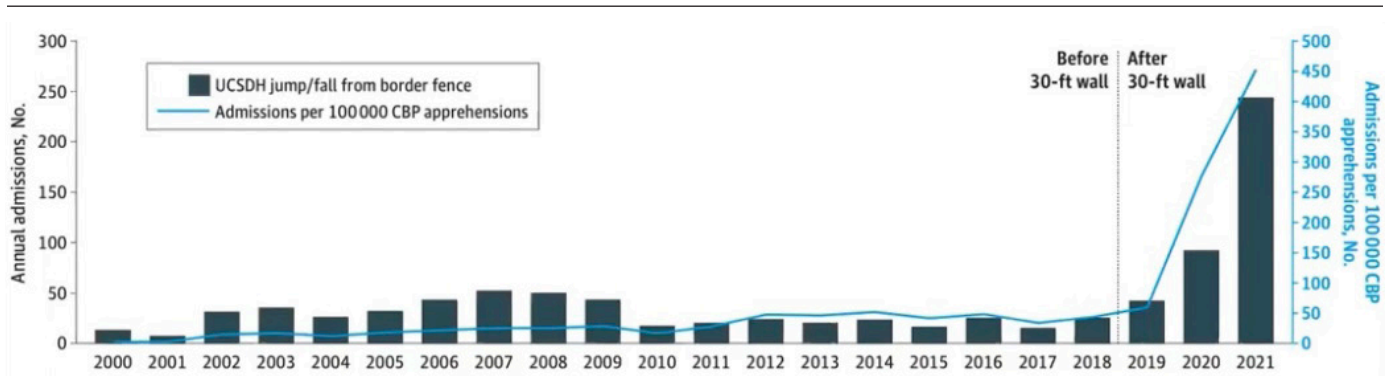

Figure 1. University of California, San Diego jump/fall major trauma admits from border fence (by year)
CPB = Custom and Border Protection
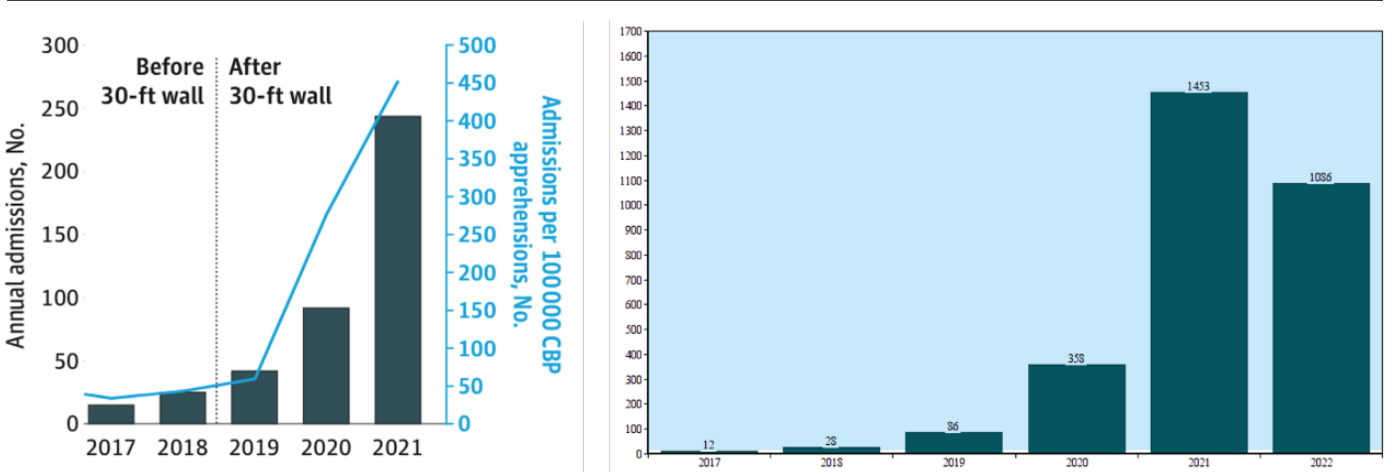
Figure 2. Imaging utilization for border trauma. When searching the UCSD PACS from July 2017 to July 2022 for keywords such as "border fall" or "border wall" there is an increase in studies with indications related to border trauma year after year. This closely mirrors the trauma study's findings with increased admissions related to border trauma each year. UCSD is on the trajectory to surpass the number of studies performed in 2021 related to border trauma.

Investigating Robotic Neurointerventions with an Eye Toward Remote Stroke Treatment

AUTHOR:

Gary R. Duckwiler, MD, Professor and Director Interventional Neuroradiology, Director, INR Fellowship Program, Co-Director UCLA HHT Center of Excellence, Department of Radiological Sciences, David Geffen School of Medicine at UCLA

The timeliness of treatment plays such a large role in determining outcomes for stroke patients that travel time to an adequately equipped and staffed medical center can become highly problematic, particularly outside of urban centers. Remotely controlled robotic interventions could help reduce the heavy toll exacted each year by delayed stroke treatment, but there is much work to be done in laying the groundwork for this technological solution.

Robotic control for neurointerventional procedures can offer advantages over manual control even when there is no need for the procedure to be performed remotely. When operating the controls of a robot, the neurointerventionalist can work from a safe location, away from possible radiation exposure and freed from the need to wear lead protection. Robotic control may even prove to have value for interventional radiologists who are learning procedures that are new to them by providing an enhanced margin of safety in how they manipulate their tools and devices. Researchers are also looking into ways to add a layer of artificial intelligence to help operators navigate complex three-dimensional anatomy and to further enhance the safety and efficiency of using a robot for these procedures.

"The robot may have benefits because of greater fine control over the movement of the devices. Using joystick controls and having geared mechanisms, you can do various incremental movements potentially more accurately than with manual control," says Gary Duckwiler, MD, professor of radiology and neurosurgery, and chief and fellowship director of the Division of Interventional Neuroradiology. "But the huge potential for this is in determining if we can do remote work with the robot."

The robot that is currently available and FDA-approved for neurointerventional procedures is being used for diagnostic cerebral angiography and carotid stenting, which can be done utilizing a single catheter. "Driving one catheter up requires a certain number of gears and channels; driving two catheters up requires additional gears and channels," explains Dr. Duckwiler. "Ultimately, to do a full stroke case will require multiple channels, and that capability is not currently available, though it is under development."

UCLA currently has the single-catheter robot installed in its clinical angiography suite and has begun using it in patient care. A second, dual-catheter robot will soon be installed in UCLA's research facility. While this device is not yet FDA-approved, it is being used by centers in Canada and France to treat brain aneurysms and will be an important part of investigations being carried out at UCLA to pave the way for robots to be used in remote neurointerventional procedures.

Working with other sites in the UC system — UC San Francisco also has a robot in its clinical practice — Dr. Duckwiler and other UCLA neurointerventionalists are delineating the workflow, processes, and requirements to enable remote work. "We're working with our fellow institutions on range-finding for the things that are going to be necessary to do remote procedures," says Dr. Duckwiler. "Things like: do I wear a headset; how many cameras do I need in the room to see the patient, the groin, and the associated staff; how do I control the angio suite and X-ray in that room; how many channels of communication do I need when I operate; what is the time lag; what speed do I need from my internet connection to drive different parts of the procedure. Before we actually put a catheter in a remote patient, all that infrastructure is critical."

Following this work on the necessary external conditions for remote work, Dr. Duckwiler and his UCLA colleagues will begin pre-clinical work within the institution using the robots in the clinical angiography suite and the research facility. They will then expand their work to include pre-clinical remote work with other institutions. "That will form the baseline for requirements moving forward — hopefully in two years or so — to doing remote diagnostic studies using the current, FDA-approved robots in the clinical setting," explains Dr. Duckwiler. "I will have an expert physician at UCSF at the bedside ready to take over at any

time, but I would do the angiogram on the UCSF patient from Los Angeles. They would reverse the process and perform a diagnostic angiography procedure on a UCLA patient." Meanwhile, the more advanced, dual-catheter robot being installed at UCLA's research facility will be used for pre-clinical investigation of aneurysm interventions, beginning with local robotic control and advancing to remote pre-clinical work.

Another focus of the pre-clinical investigations will be evaluating the group of devices supported by the robot and how that group may need to be expanded to meet the requirements of performing more advanced procedures. "The current generation of robot doesn't allow for the full range of wires and catheters we would use under manual conditions," Dr. Duckwiler points out. "If we're going to be doing more advanced interventions — aneurysms, stroke, embolizations — we need to understand the full range of devices we would need and how the robot would need to be able to incorporate those devices."

For Dr. Duckwiler, the ultimate goal is to bring critical procedures that re-establish blood flow to stroke victims who don't have ready access to expert treatment. Many areas, even moderate population centers, aren't able to support the teams of experts necessary to offer round-the-clock access to stroke interventions. "There are large swaths of the country and large swaths of the world that don't have that," says Dr. Duckwiler. "Our motivation is to be able to bring these life-saving treatments to these individuals who would not otherwise have access to timely care." ■

References:

Top photos: Reproduced from the American Journal of Neuroradiology (AJNR), *A Review of Robotic Interventional Neuroradiology.* Beaman et al, doi.org/10.3174/ajnr.A6976. *Permission conveyed through Copyright Clearance Center, Inc. ©2021*

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Left: Sterile Corpath GRX patient-side robotic system during setup. Right: Lead-shielded remote Corpath GRX control station during cerebral angiography procedure.

> **A societal observation is that crises can accelerate trends already underway. Teleradiology and artificial intelligence (AI) trends show this. COVID shined Klieg lights on urgent health disparities which will be more diligently measured and more directly corrected. Disparities in radiology appear in even common exams such as a differential use of prostate MR imaging in minority patients.** —Gary R. Duckwiler, MD
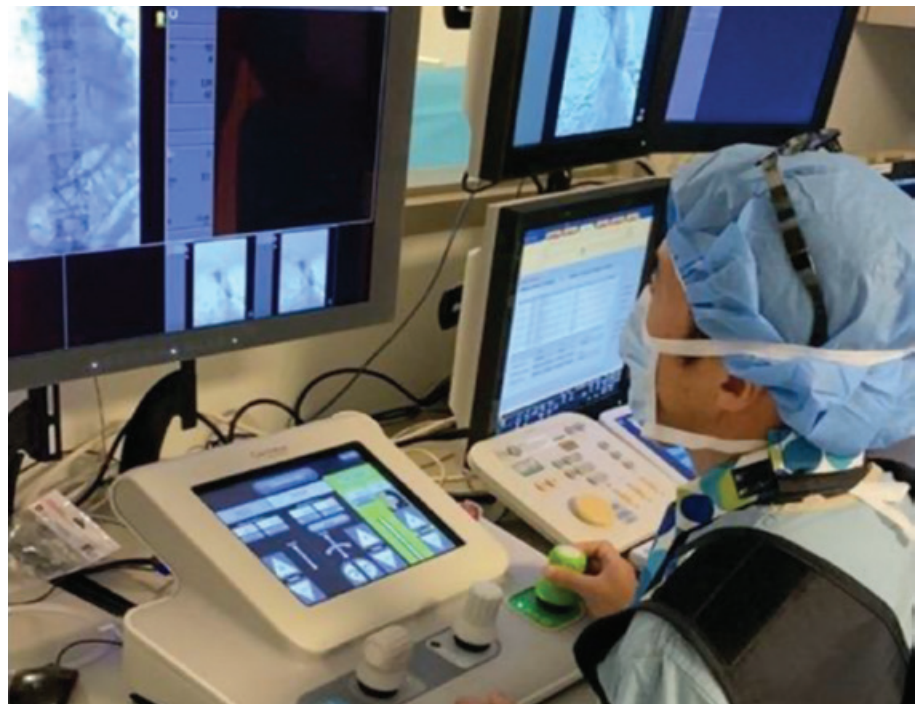
Catheter manipulation using a push-pull and rotation joystick control solely based on the visual information.

REACH Study Aims to Increase Lung Cancer Screening
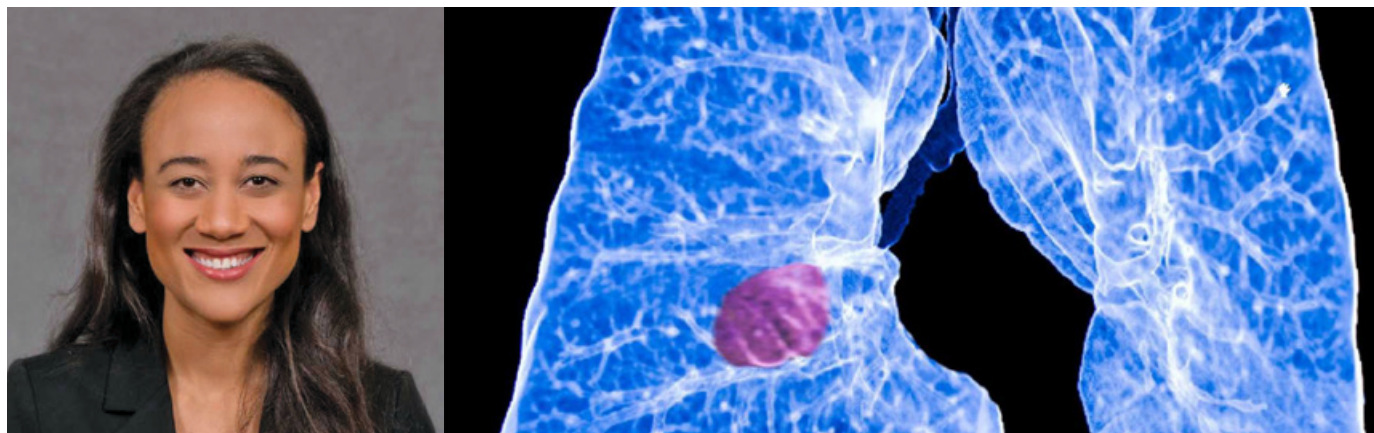
From left: Ashley Prosper, MD; a low-dose CT scan can detect asymptomatic cases using one-tenth of the radiation used in a diagnostic chest CT. It produces much-higher-resolution images than a chest X-ray.

AUTHOR:

Ashley Prosper, MD
Section Chief, Cardiothoracic Imaging
Co-Director of UCLA Lung Screening
Program

Lung cancer is the leading cause of cancer-related death, resulting in more lives lost in the United States than colon, breast, and prostate cancer combined. Lung cancer screening with low-dose CT of the chest provides an opportunity to detect lung cancer at earlier stages when more treatment options are available. Clinical trials have demonstrated a substantial lung cancer mortality benefit for high-risk current and former smokers who receive lung cancer screening with low dose CT (LDCT), with a 20% reduction in lung cancer mortality reduction seen in the National Lung Screening Trial, an effort led by UCLA's Denise Aberle, MD. Unfortunately, lung cancer screening is underutilized, and far fewer Americans receive this screening exam than are eligible.

The magnitude of lung screening underutilization is perhaps best appreciated when lung screening with LDCT is compared to other image-based screening exams such as breast cancer screening. Even though both breast cancer screening with mammography and lung cancer screening with low-dose computed tomography (LDCT) scanning can lead to early cancer detection and significant reductions in disease-specific mortality, participation in lung cancer screening among eligible current and former smokers is woefully low, reaching <6% of eligible Americans, far less than the >75% utilization rate for women eligible for breast cancer screening with mammography. A recent analysis from the American Lung Association suggests that in California, utilization of lung cancer screening is even lower than the national average, with an estimated 1% utilization rate, based on an analysis of data from the American College of Radiology Lung Cancer Screening Registry.

Researchers at UCLA, including Ashley Prosper, MD; Hannah Milch, MD; William Hsu, PhD and Cheryce Fischer, MD, are leading a study that aims to improve our understanding of motivators and barriers to lung cancer screening, as well as identify strategies to increase lung screening utilization.

Viewing the gap in breast and lung screening utilization as an opportunity for growth, these researchers hope to leverage the high rates of breast cancer screening utilization to improve lung cancer screening uptake. The REACH (Refer Everyone, Advocate for Community Health) study empowers individuals undergoing breast cancer screening to learn about lung cancer screening, assess their own eligibility for lung cancer screening, and receive resources to share the information they have learned with others who may benefit from these screening exams. The REACH study is currently open to enrollment.

In addition to local efforts to understand the reasons for low utilization of lung cancer screening, such as those employed in the REACH study, Dr. Prosper points out that the University of California Health system is united in improving lung screening uptake. The University of California Lung Cancer Consortium (UCLCC) brings together the five University of California National Cancer Institute-designated health centers with the common goal of improving lung cancer care in California.

Recognizing that early detection of lung cancer improves outcomes, the UCLCC formed a Screening and Prevention Task Force, co-chaired
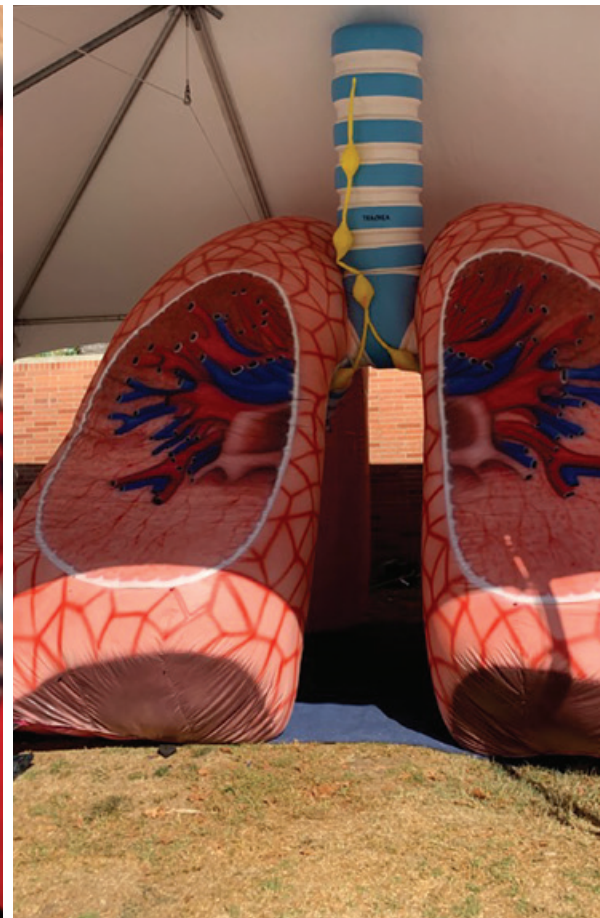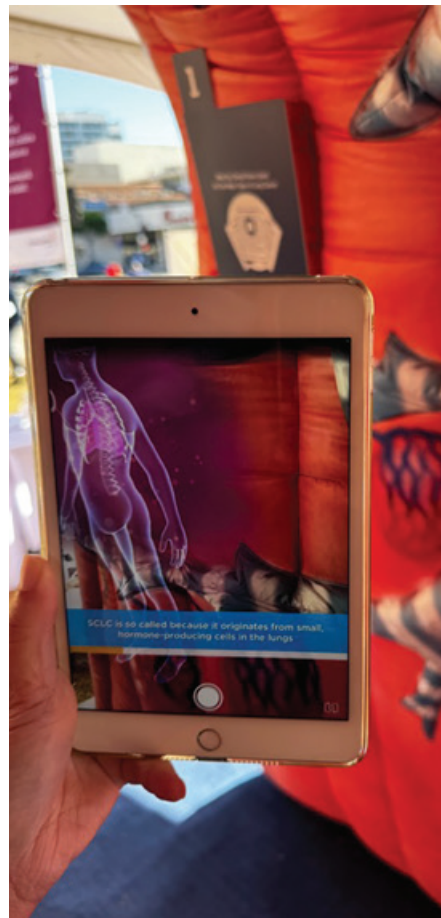
A community-facing lung cancer awareness event was held on the UCLA campus, with an inflatable lung exhibit displayed at a busy intersection. Community members were invited to learn about lung cancer screening and advancements in lung cancer therapy, using an iPad to scan QR codes posted on the exhibit with links to educational videos on lung cancer and lung cancer therapy.

by UCLA's Ashley Prosper, MD, and David Cooke, MD, FACS, of the UC Davis Thoracic Surgery program. The Screening and Prevention Task Force has united each of the five UC lung cancer screening programs to determine the University of California's systemwide rate of lung cancer screening uptake, the sharing of strategies and best practices for comprehensive screening programs, and community outreach efforts at each campus.

Coinciding with lung cancer awareness month in November, UCLA's lung screening program participated in Screen California 2023: Lung Cancer Screening in the Greater Los Angeles Area, a continuing medical education (CME) meeting that brought together lung cancer providers and screening program staff from across Los Angeles County, including a lecture by Denise Aberle, MD, on the evolution of lung cancer screening since the publication of the NLST in 2011, and a keynote speech on opportunities to improve health equity through lung cancer screening from Dr. Prosper.

Additional local efforts at UCLA include participation in National Lung Cancer Screening Day on November 11, 2023, which coincided with Screen California 2023. The event drew the attention of news media, including Estrella TV News, which included an interview with Dr. Prosper on their nightly news program, highlighting the importance of lung cancer screening and early lung cancer detection. While lung cancer screening is routinely offered at UCLA's imaging centers, Dr. Prosper pointed out that UCLA's lung screening program viewed National Lung Cancer Screening Day as an opportunity to engage with primary care physicians and other healthcare providers who refer patients for lung cancer screening, highlighting recent updates to lung cancer screening eligibility criteria from the United States Preventative Services Task Force and the Center for Medicaid and Medicare Services. ■

ACXR-Based Deep Learning Models Predict Future Healthcare Costs
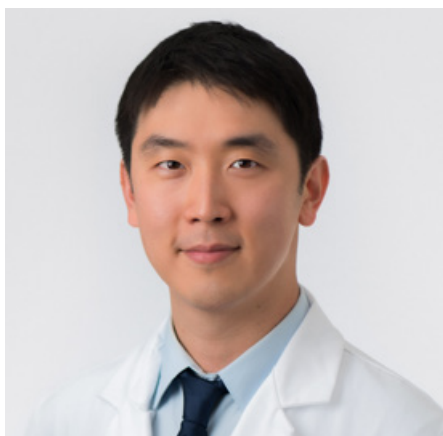
AUTHOR:

Jae Ho Sohn, MD, MS, Assistant Professor in Residence, Cardiac & Pulmonary Imaging, Center for Intelligent Imaging (ci^2)

Health care cost is a barrier to health care access. Expenses are higher in sicker patients and those who are underserved in society. What can be done at both the individual patient level and the hospital and national healthcare policy level to help with cost estimation, accurate budgeting and planning for risk in reimbursement models based on health outcomes?

Artificial intelligence (AI) in medicine researchers have noted that recent advances in computer vision models, especially rapid advancements in convolutional neural networks (CNN), contribute to a variety of applications. Deep learning has been especially powerful in identifying mild to moderate associations that humans might not routinely predict or detect in dense images.

Can AI tools be used to help health systems and payors target care management and preventive health and develop cost and reimbursement plans? Researchers at the UCSF Center for Intelligent Imaging (ci^2) set out to answer that question. In a recent pilot study, published in *Scientific Reports*, investigators hypothesized that chest radiographs (CXRs) capture many general health indicators so they may be used, potentially along with information on age, sex and ZIP code, to predict future medical costs.

A deep learning model was developed by retrospectively collecting 21,872 frontal CXRs from 19,524 patients with at least one-year spending data. Patients were non-obstetric adults who visited the emergency department and received a chest radiograph there or an outpatient facility on that same day. The best-performing deep learning models were able to relatively accurately identify which patients would have a top-50 percent personal healthcare cost after one, three, and five years with receiver operating characteristic curve (ROC-AUCs) of 0.806, 0.771 and 0.729.

This study also demonstrates the potential of machine learning and AI technology in identifying hidden information underlying patient imaging such as patient health and socioeconomic risk factors that would otherwise not be evaluated in normal clinical radiology workflow.

"Radiological imaging data is full of rich information that may not be routinely extracted by human radiologists, but big data and deep learning can help with this," says Youngho Seo, PhD, UCSF ci^2 member and senior author on this study. "Physicians are trained to identify only a handful of imaging biomarkers known to medical literature and/or of direct relevance to clinical care, but our deep learning algorithm can analyze thousands of imaging features to identify weak to moderate correlations, such as future healthcare spendings."

Thienkhai Vu, MD, a member of ci^2 and the UCSF cardiothoracic radiology faculty was also a part of this study along with Jaewon Yang, PhD, University of Texas Southwestern. Additional contributors include Karen Ordovas, MD, former UCSF faculty and current chief of Cardiothoracic Imaging at the University of Washington; Dima Lituiev, PhD, senior machine learning scientist at the UCSF Bakar Computational Health Sciences Institute; Benjamin Franc, PhD, Stanford University School of Medicine, and Dexter Hadley, MD, PHD, MSE, Chief of Artificial Intelligence at the University of Central Florida College of Medicine. ∎

Dr. Sohn leads the Big Data in Radiology team focusing on the application of data science techniques to improve lung cancer imaging, natural language processing, and radiologic workflow efficiency.

Learn more about the multidisciplinary research conducted at the Center for Intelligent Imaging (ci^2) at intelligentimaging.ucsf.edu.

Reference: *Sohn, J.H., Chen, Y., Lituiev, D. et al. Prediction of future healthcare expenses of patients from chest radio*graphs using deep learning: a pilot study. Sci Rep *12*, 8344 (2022). *bit.ly/ci2*
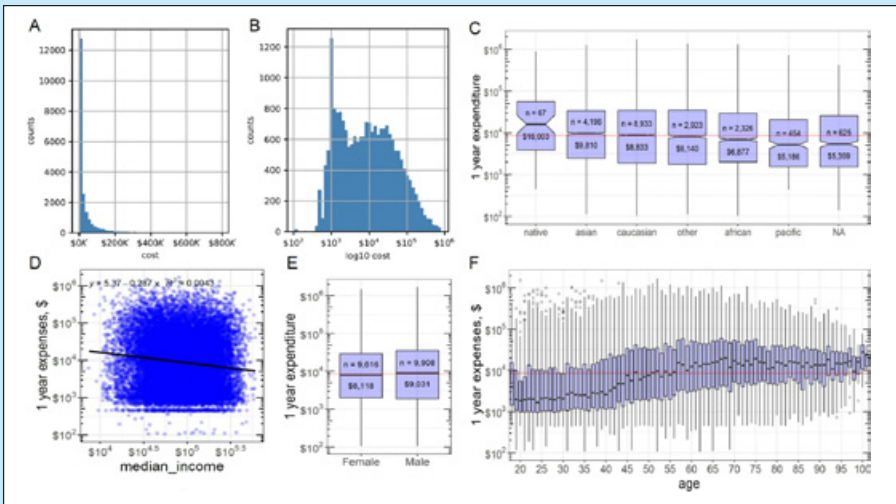
Figure 1. (A) Histogram showing the distribution of 1-year total healthcare expenditure. (B) Histogram showing log10-transformed 1 year of total healthcare expenditure. (C) Box plots of 1-year of expenditures for each race variable. The red line shows the population median. (D) Scatter plot of median income vs 1-year expenditure. (E) Box plots of 1-year expenditures for females and males. The red line shows the population median. (F) Box plots of 1-year expenditures for each age number. The red line shows the population median.

Actual cost: $1,327
Predicted cost: $1,204
Actual category: bottom 50%
Predicted category: bottom 50%
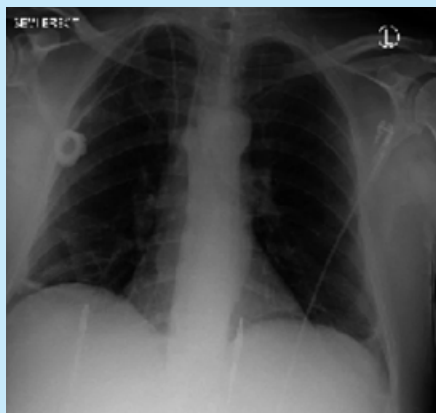
Actual cost: $70,096
Predicted cost: $68,794
Actual category: top 50%
Predicted category: top 50%

Figure 2. Representative examples with attention map visualization

> **Our study aimed to help hospitals identify high-risk patients who will need expensive treatment, allowing healthcare organizations to map out care management plans and health and wellness plans. Additionally, this could help health systems and payers develop accurate budgeting models for reimbursement.**
>
> —Jae Ho Sohn, MD, MS, co-first author on the study along with Yixin Chen, PhD student in the Department of Computer Science, University of Illinois Urbana-Champaign.

Preeminent Scientist, Collaborator, Mentor: Q&A with Nola Hylton, PhD

AUTHOR:

Vicky Agnew, UCSF Helen Diller Family Comprehensive Cancer Center

Dr. Nola Hylton's path to becoming a pre-eminent biomedical imaging scientist stretches back to childhood when she carried a deep curiosity about the world and "why things are as they are." After attending MIT and Stanford, Hylton joined UCSF and worked with colleagues to pioneer the use of MRI for detecting, diagnosing, and staging breast cancer. Dr. Hylton is professor in residence and director of the UCSF Breast Imaging Research Group. In this Q&A she talks about choosing a career that would have a positive effect on others, her enduring excitement for her work, and mentoring women of color in science.

Q. You are internationally recognized for pioneering the use of MRI for breast cancer, and in the past 20 years, you've received prestigious awards in academic medicine and radiology. These include the ISMRM Gold Medal for foundational work in breast MRI and induction into the National Academy of Engineering, to name just two. Please talk about the focus of your work and what for you have been the seminal moments.

A. The field of magnetic resonance imaging (MRI) was new and growing rapidly when I was a graduate student. I had the huge fortune of joining a laboratory that was developing both the software and hardware components of MRI. At that time, it could take several hours to complete an MRI exam. My thesis work involved using computer

Nola Hylton, PhD

techniques to simulate images from a reduced, basic set of acquired images, allowing shortened exams. Synthesized images could then be generated to adjust the contrast between multiple types of tissue, for example gray and white matter in the brain, to improve discernment and aid in detection and diagnosis.

A seminal moment for me was when the opportunity arose to apply my training in MRI to the challenge of breast cancer. Breast radiofrequency coils, a hardware component of MRI systems that allow more detailed pictures of the breast, had just become commercially available and we had received one at UCSF around the time I began my faculty position. I worked with a clinical colleague, Steve Frankel, to begin evaluating MRI for breast cancer detection. The next seminal moment was meeting and forming a collaboration with Dr. Laura Esserman, who was joining UCSF as a new faculty member and breast surgeon at the same time. We began to use breast MRI to monitor patients during their neoadjuvant (pre-operative) chemotherapy treatment. This early partnership began a long and productive collaboration that continues

today and involves scientists, clinical researchers, patient advocates, and industry partners from around the world.

Q. With your education in chemical engineering and applied physics, what prompted you to pursue imaging in breast cancer? Did you consider other professional avenues?

A. My decision to pursue chemical engineering during my undergraduate studies was largely based on practical considerations about employment opportunities after college. But I was more drawn toward physics and when I decided to apply to graduate school, the Applied Physics program at Stanford seemed ideal. It encompassed many specialized areas of interest that now exist as formal programs and departments at universities worldwide, for example biomedical engineering.

Timing and circumstances created the perfect opportunity to connect my training in science and technology with a career path that could have a direct impact on the lives of those around me. As mentioned earlier, the chance to use MRI to address the problem of breast cancer was the perfect match between my training and desire to work on a problem of immediate relevance. It also enabled me to work with more women and achieve greater gender balance in my work life since breast cancer overwhelmingly affects women. I am still excited about the work I do and have not really considered other professional avenues.

Q. In the US, STEM curricula for students in elementary, middle, and high school didn't take hold until the early 2000s, so you were a STEM student before STEM was cool. Who encouraged your interest in science?

A. I was always fascinated by math and science and encouraged in that direction by my parents, teachers and community. I had an innate curiosity about why things are as they are, and science made sense to me. The

strongest influence was from my father who was a member of the US Air Force and a Tuskegee Airman. He worked for many years as an electronics technician after he left the service. He often engaged me and my siblings with math challenges and puzzles to solve. He was the reason I applied to and attended MIT. My mother, teachers, and school administrators also encouraged my interests in science and math and navigated me to courses of study and programs that helped pave the way for my future educational opportunities.

Q. A 2015 article on MIC.com about the hardships experienced by Black women in science quotes you as saying that it was isolating to be the only Black student studying physics in your hometown of Mount Vernon, NY.

excel in our profession yet keep firmly tethered to our source of identity. These worlds can often be very far apart. This can discourage young Black women from choosing STEM career paths in the first place and is then a barrier to advancement and retention. I am hopeful this is changing in a real way. I see a next generation of Black women scientists who are both highly capable and confident. In their capacity as role models, they inspire a broad spectrum of both women and people of color.

Q. You've also been recognized for being a mentor. What is important to you about helping the next generation of scientists? How have things changed for women of color pursuing careers in science?

nity for younger scientists. In answering how things have changed for women of color pursuing careers in science, I would expand on my earlier comments to say that while numbers still appear dismal, I believe there is a more coherent picture being projected in our society about the significant role and contribution of women of color. I would also say that the expanding number of options allows for more possibility in envisioning a career path that will be both professionally and personally fulfilling. As a mentor, I would hope to help young scientists imagine that future.

Q. Where do you see your research going in the next five to ten years?

A. I hope to continue to move breast MRI technology forward so that it can have greater impact on reducing breast

> ❝ **Teaching and mentoring happen in both directions as all of us who love to teach recognize. There is true enjoyment and fulfillment in seeing concepts begin to click in the minds of students and to see them get excited and start to consider how that new knowledge can be applied.** ❞

—Nola Hylton, PhD

The article said that those feelings of isolation carried into your undergraduate and graduate years – compounded by your being among just a handful of women pursuing degrees in science. Would you talk about that? Was it a matter of race and gender equally contributing to feelings of isolation?

A. I would qualify those comments to emphasize it was a collective feeling of isolation among the Black student community and not personal isolation. My most lasting recollection is having been so much a part of a supportive and uplifting Black community, however small. We struggled then, as we do now with the collective isolation and frustration about the slowness of progress.

As Black women in science we face the dilemma of how to fully engage and

A. Teaching and mentoring happen in both directions as all of us who love to teach recognize. There is true enjoyment and fulfillment in seeing concepts begin to click in the minds of students and to see them get excited and start to consider how that new knowledge can be applied. I also receive inspiration from that interaction that helps me in my thinking and approach to problems. I want to help the next generation of scientists with their process of considering their big picture goals and interests and focusing them into short- and long-term goals. I also want to help them navigate their choices, as others did for me, when faced with many options.

I would note that the rapidly expanding set of options represents both a huge challenge and an opportu-

cancer. I think I can be most effective through the mentoring and support of junior research scientists and active encouragement of the partnerships necessary to move research innovations in breast imaging into wider clinical utilization.

Q. Final question – how do you like to spend time outside of work? Hobbies, favorite pastimes?

A. Dance has been my passion since my earliest recollections. Mostly Alvin Ailey style modern jazz blues. I was sure that would be my future career path …. Alas. But sharing time with family and friends tops the list and often includes travel and games of all kinds, especially Bid Whist. ∎

Reference: *Reprinted with permission. Original article: tinyurl.com/y9n24h2h*

UCSF

Using Sustainable Aviation Fuels for MRI Scanner Delivery

In another first for Green Radiology, UCSF and Siemens Healthineers have shown how using sustainable strategies for device delivery can substantially reduce greenhouse gas production in medical imaging. Supply chain carbon emissions, together with device manufacturing and operation, represent the largest contributors to medical imaging's carbon footprint.

Delivery of the Siemens MAGNETOM Sola 1.5T MRI to the China Basin Landing site in San Francisco. (Installation photos by Alastair Martin and Craig DeVincent.)

In July, UCSF received a Siemens MAGNETOM Sola 1.5T MRI system, delivered from Germany to San Francisco using a combination of sustainable aviation fuels (SAF) and short road transportation for an optimal mix of speed and sustainability.

Alastair Martin, PhD, who leads Capital Projects for UCSF Radiology, partnered with Vibhas Despande, PhD, from Siemens on using SAF for this scanner delivery. "As part of our commitment to Green Radiology we are focused on understanding and mitigating imaging's energy demands," Martin said. "At the same time, we are making strides to meet our goal of becoming the world's first carbon neutral imaging fleet by choosing the most energy efficient modes of transport when we invest in new scanners."

Bio SAF are typically derived from corn, plant waste, or other agricultural byproducts, while synthetic SAF may be produced using renewable energy, water and carbon dioxide (CO_2). Because various greenhouse gases have different warming potentials, CO_2 equivalent (CO_2e) standardizes the climate effects of a mixture of greenhouse gases. Siemens uses the industry-standard Global Logistics Emissions Council (GLEC) framework to calculate the average CO_2e emissions for both aviation and road transport. The GLEC framework estimated 52,500 kg CO_2e (well-to-wheel) for transportation in this specific case. This is compensated by approximately 22,000 liters of SAF.

Using SAF enables a 75-90% reduction in CO_2e emissions compared to conventional jet fuel kerosene. To bring delivery emissions for this particular scanner to almost zero, UCSF and Siemens Healthineers co-funded the cost of offsetting road transport emissions by procuring 110% to 125% of the SAF needed. Logistics consultants Kuehne+Nagel issued the third-party certificates for this low-carbon delivery using the "book and claim" accounting and reporting method, a versatile chain-of-custody model that tracks, documents, and verifies the attributes – including sustainability benefits – of products as they move through the supply chain.

Department chair, Christopher Hess, MD, PhD, noted that "As climate change continues along an increasingly precipitous course and to achieve the Paris Agreement's goal of limiting global temperatures to 1.5°C above pre-industrial levels, it is vital for the medical-industrial complex to develop strategies to reduce its carbon footprint. To reduce CO_2e emissions for future Siemens scanner deliveries, we will strive to use sea freight rather than air freight for the longest portion of transport from Germany to California. We are committed to reducing our carbon footprint through efficiency and innovation, and will continue to adapt our emissions-reduction efforts as market-based mechanisms evolve." ∎