Findings were confirmed by mixed-effects models. Together, these parameters quantify disease-specific microstructure and demonstrate technical and biological feasibility for clinical translation. DISCUSSION/SIGNIFICANCE OF IMPACT: QUS provides interpretable biophysical markers that differentiate fungal, inflammatory, and fibrotic nail diseases. By bridging imaging physics with clinical diagnosis, QUS offers a scalable, noninvasive approach for point-of-care dermatologic imaging and advances the translation of QUS into practice.

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Integrating patient voices to enhance patient-reported outcomes: A human-guided machine learning approach to analyzing health narratives

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OBJECTIVES/GOALS: To evaluate the extent to which characterization of unstructured patient-generated health data (UPGD) (e.g., health journals) with human-guided machine learning (HGML) improves model explainability and integrates patient voices among renal cancer patients in a randomized control trial (RCT). METHODS/STUDY POPULATION: Data were collected in an RCT (NCT00505310) assessing the benefits of an emotional expression intervention on renal cancer patients' quality-of-life outcomes. Over a 10-day period, patients completed four journal-type written responses to structured prompts about their health lifestyle behaviors or deepest thoughts and feelings linked to cancer. I will 1) evaluate the extent to which a standard ML model versus an HGML model aligns with principles of trustworthy health AI when characterizing UPGD, 2) evaluate the extent to which UPGD captures condition-specific data complementary to PROMs, and 3) extract journey maps from narratives about patient experiences navigating cancer care. RESULTS/ANTICIPATED RESULTS: Results will illustrate a patient-centered value research approach that centers patient perspectives, contextualizes heterogeneous factors influencing patient outcomes, and mitigates biases in the health research machine learning pipeline. DISCUSSION/SIGNIFICANCE OF IMPACT: This research contributes to the development of evidence-based and empirically validated strategies for health researchers to incorporate explainable HGML tools that facilitate the inclusion of patients' experiences, perspectives, needs, and priorities throughout the research process.

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Inflammatory biomarkers in heart failure family caregivers: Associations of TNF-α and adiponectin with cardiovascular risk

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OBJECTIVES/GOALS: Caring for a loved one with heart failure (HF) is a chronic stressor that may elevate cardiovascular disease (CVD) risk. This study examined relationships between TNF-α, adiponectin, and clinical and demographic factors among HF family caregivers (FCGs). METHODS/STUDY POPULATION: This study is a secondary data analysis of baseline data from FCGs of individuals with HF enrolled in an intervention study (N=122, mean age 55 ± 11.7 years, range 25–80). The sample included 92% women and was racially diverse, with 59% identifying as African American, 39.3% as Caucasian, and 1.64% as other ethnicities. TNF-α and adiponectin levels were analyzed, and Spearman's correlation was used to explore their associations with cardiovascular and metabolic indicators, including lipids and anthropometric measures. RESULTS/ANTICIPATED RESULTS: TNF-α was inversely associated with total cholesterol ($\rho = -0.241$, $p = 0.037$) and adiponectin ($\rho = -0.275$, $p = 0.017$). Adiponectin was negatively associated with triglycerides ($\rho = -0.208$, $p = 0.023$), C-reactive protein (CRP; $\rho = -0.283$, $p = 0.002$), and metabolic syndrome ($\rho = -0.181$, $p = 0.049$). These findings suggest that TNF-α contributes to inflammation, while adiponectin may play a protective role in metabolic health. DISCUSSION/SIGNIFICANCE OF IMPACT: Findings suggest that elevated TNF-α and reduced adiponectin may mark higher CVD risk in HF caregivers. Targeting inflammation and boosting adiponectin could reduce this risk. Longitudinal studies are needed to confirm these relationships and guide caregiver-focused interventions.

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Hospital capacity strain and delays in antimicrobial redosing in sepsis*

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OBJECTIVES/GOALS: The relationship between factors that strain a healthcare system and delays in antimicrobial dosing for patients with sepsis is unclear – including redosing after first administration. The objective of this study is to define elements of capacity strain that impact timely second antimicrobial administration using electronic health record data. METHODS/STUDY POPULATION: In our planned retrospective cohort study, patients are eligible for inclusion if they present to one of 19 Atrium Health hospitals' emergency department (ED) between 2022 and 2024, meet 2 or more Systemic Inflammatory Response Syndrome criteria within 6 hours, and are subsequently admitted to an intensive care unit (ICU). Capacity strain is defined using multiple measures including ED and ICU census, ED acuity, patient turnover, and ED wait times. The primary outcome is time between first and second doses of antimicrobials. Secondary outcomes are hospital length of stay (LOS), ICU LOS, days free of mechanical ventilation, and 90-day hospital re-admission. Association between variables will be assessed using univariate and multivariable regression models. Fit statistics will compare model performance. RESULTS/ANTICIPATED RESULTS: Based on prior literature, we anticipate finding high rates of antimicrobial dosing delays (>10% incidence). We hypothesize that higher census, higher ED acuity, higher turnover, and wait times will each be associated with increased risk for delay in antimicrobial administration. This association will hold true when exposures are

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assessed in the ED, as well as in the ICU. We also expect that a model containing a combination of our proposed exposures will outperform each individual measure. DISCUSSION/SIGNIFICANCE OF IMPACT: Gaps remain in understanding how system pressures interact with sepsis care delivery and outcomes. Health system strain may contribute to poor adherence to evidence-based practices. Identifying key strain measures can help direct the design and implementation of targeted interventions to improve care delivery and resource allocation.

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Synthesis and preliminary characterization of a Fruquintinib–Ruthenium (III) complex for treatment of NSCLC.

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OBJECTIVES/GOALS: This research develops a Ruthenium (III)–Fruquintinib complex for lung cancer treatment. Goals include structural characterization using MALDI-TOF and UV–Vis spectroscopy, synthesis optimization, and antitumor activity assessment comparing efficacy against Fruquintinib alone through cell studies. METHODS/STUDY POPULATION: The Ruthenium(III)–Fruquintinib complex is synthesized through an optimized coordination chemistry protocol ensuring reproducibility. Small-scale reactions defined baseline conditions, monitored by UV–Vis spectroscopy for ligand–metal charge transfer. After successful crystallization, the method was scaled up consistently. Structural characterization using MALDI-TOF mass spectrometry will be performed in collaboration with the MSRC, University of Puerto Rico, with infrared spectroscopy as a complementary validation. Biological evaluation will use NSCLC cell lines to compare cytotoxic efficacy against Fruquintinib alone, employing MTT assays to determine IC50 and potential synergistic effects. RESULTS/ANTICIPATED RESULTS: Lung cancer remains the leading cause of cancer-related mortality, with 125,070 projected deaths in 2024. Current treatments for metastatic disease include surgery, chemotherapy, radiation, and targeted therapy. Fruquintinib (FQ), a VEGFR inhibitor, showed promise in early NSCLC trials but limited efficacy in advanced stages. Ruthenium (III) complexes, based on the hard–soft acid–base principle, offer potential anticancer properties. Combining FQ with Ruthenium (III) may enhance therapeutic outcomes. Preliminary synthesis yielded reproducible crystals confirmed by UV–Vis signals. Future MALDI-TOF characterization and biological assays will assess structural validity and antitumor potential. DISCUSSION/SIGNIFICANCE OF IMPACT: The Ruthenium (III)–Fruquintinib complex could enhance Fruquintinib efficacy in advanced NSCLC. This approach demonstrates the potential of metal-based drug design to improve cancer therapies, offering insights into combinatorial strategies and advancing coordination chemistry in medicinal research.

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Real-world sleep tracking reveals effects of neighborhood disadvantage, stress, and health on sleep duration*

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OBJECTIVES/GOALS: Sleep is a useful intervention target to improve mental and physical health. Yet, the contextual factors that impact sleep in real-life settings are poorly understood. We assessed how psychological and socioenvironmental factors influence self-reported sleep in a large, US sample (Study 1) and sleep physiology in a prospective cohort (Study 2). METHODS/STUDY POPULATION: Study 1: 13,483 participants (63% males, mean age 46, 24% non-White) completed on-demand blood pressure (BP), self-reported stress, physical health, and sleep duration assessments for 3 weeks. Study 2: 42 Black adults (23% males, mean age 42) completed up to six ambulatory sleep recordings at home for 2 weeks. Stage durations for rapid eye movement (REM) and non-REM Stages 1, 2, and 3 were determined. Daily self-reports of stress and physical health were also gathered. For both studies, residence zip codes were linked to a national database to quantify neighborhood factors (i.e., built environment, poverty, social cohesion, etc.). Multiple linear regressions and mixed-effect models assessed whether neighborhood factors, demographics, health indices, and stress could predict sleep durations. RESULTS/ANTICIPATED RESULTS: In Study 1, neighborhood disadvantage, perceived stress, and systolic BP were associated with shorter sleep durations. Better self-reported health predicted longer sleep durations. Black, Native, Latino/as, and Pacific Islander participants had shorter sleep durations, whereas White participants had longer sleep durations. An interaction between perceived stress intensity and health indicated that better health (+1SD) protected sleep from increasing stress. Preliminary analyses in 26 participants from Study 2 revealed that neighborhood disadvantage and self-reported poor health are associated with shorter Stage 2 sleep durations. However, daily stress did not predict stage durations, and no interactions emerged. DISCUSSION/SIGNIFICANCE OF IMPACT: Neighborhood disadvantage led to short sleep in two studies, with novel findings indicating that Stage 2 durations may be most sensitive to structural disadvantage. Interventions that invest in material resources to reduce neighborhood inequities may be an innovative approach to protect sleep and mitigate related illness.

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