

The Fusion Editorial Board is delighted to present the latest edition of Fusion, the medical student research journal of the George Washington

School of Medicine a n d H e a l t h Sciences (GW SMHS). This publication showcases original research performed by the GW medical student community





Carson Flamm

across various domains, encompassing basic science, clinical and translational research, and clinical public health. We are proud to feature a diverse portfolio of scholarly work resulting from the collaboration of medical students, residents, attending physicians, and more throughout our institution.

We take pride in showcasing 77 distinctive abstracts in the current edition of Fusion, the largest volume of work ever featured in our journal. This milestone highlights the increasing importance of innovative medical research in modern health care and reflects the School of Medicine's commitment to training physicians who will make substantial contributions to pioneering scholarship throughout their careers. This edition's innovative cover art, designed by Nanami Miyazaki, MSII, emphasizes the prolific research conducted at GW SMHS, as well as the significance of collaboration and forward-thinking leadership within the medical field. We sincerely thank Nanami for her beautiful art and contributions to this year's edition!

We are grateful to the entire GW SMHS medical student community for

their exceptional submissions, and hope this year's edition will foster dialogue, collaboration, and active involvement within GW's scientific community. Following review by a panel of faculty experts, the William Beaumont Research Award was bestowed upon this year's top three abstracts, whose authors presented their findings at Medical Student Research Day.

We'd like to extend our sincere gratitude to the following faculty members who made this edition of Fusion possible: David Leitenberg, MD, PhD, associate professor of microbiology, immunology, and tropical medicine at GW SMHS; medical director of flow cytometry and immunology at Children's National Hospital; director of medical student research at GW SMHS and Thom Kohout, director of publications at GW SMHS. We would also like to extend our gratitude to last year's Fusion Co-Directors, Scarlett Bergam, MSII, and Jeffery Wang, MSII, for their guidance and mentorship.

We are immensely proud of all the submissions we've received this year, and hope you enjoy this year's edition of Fusion.

#### **FUSION CO-DIRECTORS**

Georgia Barbayannis Carson Flamm

#### **FUSION EDITORS**

André Hall Hannah Harris Arielle Labiner Katrina K. Le Shawn Reginauld Matthew Shneyderman

### WILLIAM H. BEAUMONT RESEARCH PRIZE WINNERS

The William Beaumont Research Awards are given to three students for outstanding research accomplishments from work submitted for publication in Fusion, the student-run research magazine at GW School of Medicine and Health Sciences.

#### The 2024 William Beaumont Research Awards recipients are:

- Vincent Xu, MSII, Mentor:Whalen
   "Efficacy of Cytoreductive Cystectomy in Metastatic Urothelial Bladder Cancer Based on Site of Metastasis" p. 117
- Sarah Cho, MSII, Mentor: Marie-France Hivert, MD; "Associations Between Abnormal Glucose Regulation in Pregnancy and Offspring Adiposity, Insulin Resistance, and Adipokine Markers During Childhood and Adolescence" ......p. 89
- Kathleen Webber, MSIII, Mentor: Shweta Bansil, MD "MRI Changes in the Cochlea as a Predictor of Clinically Significant Hearing Loss in Children Receiving Ototoxic Chemotherapy for Treatment of Brain Tumors" p. 91

# GW

# Medicine & Health Sciences

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# Fusion

is a publication of the GW SMHS William H. Beaumont Medical Research Honor Society.

This research journal is published by students in collaboration with the Office of the Dean and the Office of Communications

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#### MEDICAL EDUCATION:

#### EQUAL EMPLOYMENT OPPORTUNITY STATEMENT

The George Washington University does not unlawfully discriminate against any person on any basis prohibited by federal law, the District of Columbia Human Rights Act, or other applicable law, including without limitation, race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity or expression, genetic information, pregnancy, or familial or marital status. This policy covers all programs, services, policies, and procedures of the university, including admission to education programs and employment.

# GW MEDICAL STUDENT RESEARCH



Sarah Nanziri, second from left, during her summer experience at Children's National Hospital, preparing for a MRI-guided phantom study.

### MEDICAL STUDENT RESEARCH DAY



William Beaumont Research Awards are given to three students for outstanding research accomplishments from work submitted for publication in Fusion, the student-run research magazine at GW School of Medicine and Health Sciences. These students are invited to give an oral presentation at Medical Student Research Day. Pictured from left to right at the 2023 research day are Zachary Falk, Catherine Zwemer and Jacob Bjork.

Medical student research day is an annual event that provides an opportunity for all medical students to showcase their work through submission of abstracts, poster presentations and selected oral presentations. Awards are presented for outstanding abstracts and posters. All medical students are invited to present posters regardless of the area of focus. Over the last three years, more than 160 students have presented posters at Medical Student Research Day.

### MD PROGRAM STUDENTS PRESENT AT NATIONAL RESEARCH CONFERENCES

Each year, many students in the GW School of Medicine and Health Sciences MD program present their research at national research confer-



ences. Jeffrey Wang presented his research on cervical cancer radiation therapy at the national conference for the American Society for Radiation Oncology in San Diego. Funding support for student travel and conference registration is administered by the Office of Student Professional Enhancement.

### RESEARCH FELLOWSHIP OPPORTUNITIES

A number of competitive scholarship programs are available to help fund exceptional projects in health care and medicine, including diversity targeted fellowships, including the Jean L. Fourcroy, MD, Research Award; Health Services Scholarships; the Lazarus Family Scholarship Program; and the WT Gill Fellowship.

In 2021, 22 students were awarded a Gill Summer Research Fellowship and 54 students earned Health Services Scholarships, both of which are internally funded programs providing stipend support for summer research.

For a list of SMHS student research funding opportunities, timelines, and application tips visit the website *smhs.gwu.edu/ research/research-workforce/ medical-student-research/medicalstudent-funding-opportunities.* 

### **METEOR PROGRAM**

The Mentored Experience to Expand Opportunities in Research (METEOR)



program is a competitive fellowship for underrepresentedin-medicine students. For more information, visit the website by scanning the QR code above.

### RAISING AWARENESS FOR HIV THROUGH HEALTH SERVICES SCHOLARSHIP



Scarlett Bergam received funding from a Health Services Scholarship to pursue her research project in South Africa focused on developing and evaluating the efficacy of programs to improve care and awareness for adolescents living with HIV.

The Health Services Scholarship Program is designed to provide funding for summer experiential opportunities in the following areas: community health, emergency management, environmental health, global health, health policy, integrative medicine, medical education, medical humanities, technology in medicine, preventive medicine, research, and clinical practice innovation and entrepreneurship.

### JAYA MANJUNATH RECEIVES 2023 SPECK AWARD

The 2023 recipient of the Speck student research award was Jaya Manjunath. She has an exceptional record of research accomplishment throughout her years in medical school.

Under the mentorship of Jonathan Silverberg, MD, Manjunath's research has primarily focused on characterizing how the clinical features of dermatitis vary during aging. Her record of productivity is documented by 11 first author publications, as well as several invited presentations at the American Academy of Dermatology and the Society for Investigative Dermatology. She has also taken on a national leadership



role as student lead in the Geriatric Dermatology Expert Resource Group and is helping to develop the program for the American Academy of Dermatologyassociated Geriatric Dermatology meeting.

# **ACADEMIC FELLOWSHIPS IN ACTION**



Each year, first year medical students are invited to apply for the W.T. Gill Summer Fellowship stipends to support select summer research internship opportunities at The George Washington University, Children's National Hospital, and the Washington DC Veteran's Affairs Medical Center. Vincent Xu received a Gill Fellowship to support his research identifying prognostic factors that affect outcomes in patients with urothelial bladder cancer.

Above, Xu presented his work at a poster session at the annual meeting of the American Society of Clinical Oncology.

# Cytokine Profiling in CAR T-Cell Therapy: A Biomarker in Need of Standardization, Scoping Review

D. Nathan Biery, MSII<sup>1,2</sup>

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While chimeric antigen receptor (CAR) T-cell therapy has had astounding success against hematologic malignancies, overcoming cytokine release syndrome (CRS), immune effector cell associated neurotoxicity syndrome (ICANS), and other serious cytokine mediated toxicities have been challenging. As CAR T-cells are used more extensively, predicting response, toxicity onset, severity, and developing toxicity mitigation strategies with use of additional anti-cytokine directed therapies is imperative. Since cytokine profiles can characterize in vivo immunological activation and correlate with CRS and ICANS, the ability to compare cytokine profiles across clinical trials and different CAR T-cell constructs could reveal important toxicity patterns.1-5

### **METHODS:**

We screened 105 manuscripts



**FIGURE:** Variability of cytokine measurement and reporting across CAR-T cell studies (A) Presence or absence of cytokine reporting in all publications (n=60)

(B) Publications that reported cytokines categorized by number of cytokines reported (n=32)

- (C) Presence or absence of cytokine reporting in clinical trials (n=21).
- (D) Cytokine assay platform used in clinical trials that reported type of platform (n=11)
- (E) Percent of publications reporting key toxicity markers (n=60)
- (F) Percent of publications correlating patient cytokine values with clinical signs of toxicity (n=60)

(G-H) Cytokine Reporting Quality Score for primary publications (G) and all cumulative papers from a clinical trial (H) on a scale of 0-6 (n=21). 1 point was awarded for reporting each of the following: correlation between cytokines and ICANS, CRS or CRS severity, (2) IL-6, TNF $\alpha$ , and IFN $\gamma$  measurements, (3) baseline cytokine measurements, (4) 3+ timepoints of cytokine measurements, (5) 10+ cytokines, and (6) the cytokine measurement platform.

from clinical trials in the United States featuring a Food and Drug Administration-approved CAR T-cell construct, or one of its predecessors, and selected articles for analysis based on the inclusion of CAR T-cell expansion and persistence data. Analysis was restricted to 21 clinical trials and the 39 subsequent follow-up publications for a total of 60 articles. The most recent manuscript included was published on May 17, 2022. Two reviewers collected data from the published manuscript and supplementary materials. Two rounds of analysis were performed: one on data from first manuscript only and one on combined data from all publications pertaining to a given clinical trial. To characterize the quality in the Establishing a standardized approach for collecting and reporting data is urgently needed and would represent a substantial advancement in the ability to improve outcomes for patients receiving CAR T-cell therapies.

provision of cytokine data across manuscripts, we developed a scoring metric, the "Cytokine reporting quality" score on a scale of 0-6.

### **RESULTS:**

Across 60 publications, 28 (46.7%) did not report any cytokine data (Figure 1A), representing six of 21 (28.6%) clinical trials. In the 15 trials reporting cytokine data, at least four different platforms were used, often in combination. IL-6 and IFN $\gamma$  were the most frequently reported cytokines, in 26 (43.3%) and 28 (46.7%) publications (Figure 1E). Variability in cytokine measurement platform was substantial and correlation of cytokines with ICANS, CRS, and CRS severity was limited. When applying the cytokine reporting quality score across both primary publications (Figure 1G) and the cumulative data emerging from

a trial over subsequent manuscripts (Figure 1H), we observed an increase in the median score from one (range, 0-6) to four (range, 0-6).

### **CONCLUSIONS:**

Our findings highlight the critical need to establish universal standards for reporting on CAR T-cell detection, especially in early phase studies. The current reporting of non-interconvertible metrics and limited provision of quantitative data make crosstrial and cross-CAR T-cell construct comparisons extremely challenging. Establishing a standardized approach for collecting and reporting data is urgently needed and would represent a substantial advancement in the ability to improve outcomes for patients receiving CAR T-cell therapies.

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# CD25-Targeted Near-Infrared Photoimmunotherapy in vitro

#### Nanami Miyazaki, MSII

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Lymphoma is the ninth leading cause of cancer deaths in the United States, estimated to affect 4% of the population in 2023.1 CD25 (also known as the interleukin-2 receptor alpha chain) is a protein that plays a crucial role in the immune system, and its overexpression is a hallmark feature of a subtype of lymphoma. Near-infrared photoimmunotherapy (NIR-PIT) is an emerging therapeutic modality which utilizes a light-activatable dye IRDye700Dx (IR700) conjugated to a monoclonal antibody (APC) targeted against tumor-associated antigens.2 Thus, by utilizing NIR-PIT targeted against CD25, lymphoma tumor cells are predicted to undergo selective cell death. The efficacy of NIR-PIT targeting mouse CD25 (mCD25) was previously demonstrated in immunocompetent and immunocompromised mice models.3,4 However, the human CD25 monoclonal antibody (Basiliximab) is an immunosuppressant drug, thereby posing challenges in the application of NIR-PIT. Here, we utilized a newly developed monoclonal antibody that does not block the CD25 receptor, thereby expected to exhibit therapeutic effects on the target cells without



impairing the body's innate immune function. We investigated the efficacy of CD25-targeted NIR-PIT using the new antibody for lymphoma on two additional cancer cell lines: Ramos & EOL-1.

### **METHODS:**

CD25 expression on each cell line was first confirmed to validate the potential utility of CD25-targeted NIR-PIT. Cells were stained with either human CD25 (hCD25) antibody or mouse CD25 (mCD25) antibody and labeled cells were counted using fluorescence activated cell counting (FACS) analysis.

For the in vitro NIR-PIT experiments, cells were incubated for 60 minutes with one of the following: 1) hCD25-IR700 (positive control), 2) mCD25-IR700 (negative control) or 3) no APC (negative control). NIR-PIT with light doses of 0, 5, 10, 20 or 50 J/ cm2 were applied to the cells (690nm). Cells were subsequently stained with propidium iodide (PI) and viable cells were counted using FACS analysis. Statistical significance compared to the control group (no APC, 0 J/cm2) were assessed with a one-way ANOVA.

### **RESULTS:**

CD25 expression FACS analysis showed a higher expression of hCD25 expression compared to mCD25 expression in both Ramos and EOL-1 cell lines (Figure 1). CD25-targeted NIR-PIT resulted in a light dose-dependent tumor cell death in both cell lines (Figure 2). Significant cell death was achieved at 20 and 50 J/ cm2 for the Ramos cell line (p<0.01, p<.005, n=5) and at 10, 20 and 50 J/cm2 for the EOL-1 cell line (p<0.05, p<0.05, p<0.001, n=5). No significant cell death was observed in the Ramos cell line treated with mCD25-IR700 (n=5).

### **CONCLUSION:**

Ramos and EOL-1 cell lines were found to both express CD25, supporting further investigation of CD25-targeted NIR-PIT. CD25-targeted NIR-PIT significantly induced tumor cell death in a light-dose dependent manner in both cell lines. Thus, CD25-targeted NIR-PIT shows therapeutic potential for treating lymphoma in patients. Future experiments will further evaluate the efficacy of in vivo NIR-PIT using a mouse model with implanted Ramos and EOL-1 tumor cells.

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**FIGURE 2:** Viable cell counts after NIR-PIT in vitro. NIR-PIT induced light dosedependent cell death in A) Ramos and B) EOL-1 cells. C) Negative control treatment with mCD25-IR700 APC yielded no significant cell death in Ramos. Cell counts were normalized to the average cell counts of control (0 J/cm2, no APC). Error bars represent SEM with n=5. Significance determined with one-way ANOVA vs 0/- (\*p<0.05, \*\*p<0.01, \*\*\*p<0.005, \*\*\*\*p<0.001).

# Formative Research to Develop "DC-SIPS:" A Multi-level Intervention to Reduce Sugary Drink Consumption and Increase Water Intake Among Black Youth in Washington, D.C.

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# **OBJECTIVE:**

Develop a multi-level intervention to reduce sugary drink (SD) consumption and increase water intake among Black adolescents in Washington, D.C.

# **DESIGN:**

In-depth, qualitative interviews and surveys with pediatricians, children, and their parents were iteratively conducted to explore perceptions of the DC-SIPS intervention concept, understand current beverage consumption habits, and obtain feedback on prototype intervention content, branding, and messaging.

# SETTING:

Pediatric primary care clinic in an under-resourced area of Washington, D.C.

# **PARTICIPANTS:**

Black adolescents ages 11-14 (n=17) and their parents (n=13), as well as pediatricians from a community clinic (n=6).

### MAIN OUTCOME MEASURE(S):

Perceptions of intervention concept and feedback on prototype DC-SIPS content, branding, and messaging.

### **ANALYSIS:**

Thematic analysis was used for qualitative data and descriptive statistics were used to analyze survey responses.

### **RESULTS:**

Pediatricians were enthusiastic about the DC-SIPS concept and described key facilitators, including familiarity with SD reduction counseling and the popularity of social media. Pediatricians identified potential barriers including limited appointment time and sustainability of social media content. Children and parents also perceived the DC-SIPS concept favorably and reported that guidance from their pediatrician impacts beverage consumption behaviors. Key suggestions included implementing challenges with prizes and providing suggestions for alternative beverages. Feedback from parents and children on intervention content, branding, and messaging was primarily related to enhancing aesthetics and making the content more relatable and accessible.

# CONCLUSIONS AND IMPLICATIONS:

Formative research informed development of an intervention plan, which will be pilot tested for feasibility and acceptability, and subsequently, for efficacy and scalability to other clinics and communities.

# Qualitative Exploration of PCPs' Mental Health Role for LGBT Youth in Baltimore: A Socio-ecological Lens

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 Johns Hopkins University School of Medicine
 University of California San Diego School

5. University of California San Diego School of Medicine LGBT youth experience disproportionate rates of mental health diagnoses, including depression and anxiety.

Using qualitative interviews of LGBT youth (n=14) and primary care providers (n=12), we sought to identify whether mental health discussions with a primary care provider were perceived as overall beneficial.

Most LGBT youth felt comfortable being asked about depression, anxiety, or other mental health conditions by their primary care provider. All felt it appropriate to provide this information by survey or tablet. However, youth participants' comfort depended on feeling connected with and accepted by their provider. Those that did feel comfortable, perceived a benefit when these conversations did happen. Providers unanimously described wanting to address mental health needs in LGBT youth, either in terms of societal advancement, or clinic-based changes.

Both LGBT youth and primary care providers appeared to want more mental health discussions during visits. However, more connectedness may be needed to improve willingness to engage in care; and providers may require specific support to successfully fill this need.

# WhatsApp-Based Sexual and Reproductive Health Education for Adolescents with Perinatally Acquired HIV: Lessons Learned from an mHealth Pilot Intervention in South Africa

### Scarlett Bergam, MSII

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Adolescents with perinatally-acquired HIV (APHIV) in South Africa have limited access to sexual and reproductive health (SRH) education targeted for people with HIV. Mobile health (mHealth) can effectively deliver SRH education, but has not been tested among APHIV. In this study, we describe the effects of a randomized mHealth trial: Interactive Transition Support for Adolescents with HIV (InTSHA) on SRH knowledge and attitudes of APHIV.

# **OBJECTIVES:**

This paper describes the use of an mHealth based SRH intervention,

as part of a holistic health education curriculum, in affecting youth's attitudes, knowledge, behaviors, and engagement in care.

### **METHODS:**

Between May 2021 and February 2022, we used convenience sampling to enroll adolescents from a government supported clinic in an urban township of KwaZulu-Natal, South Africa.

Adolescents were randomized to either receive a WhatsAppbased mHealth intervention

(InTSHA) or the standard of care. Baseline and 6-month behavioral health surveys and viral load were

collected from both groups at baseline and 6 months. The SRH questionnaire consisted of 9 positively worded items on a 4-point Likert scale ranging from -2 (Strongly Disagree) to 2 (Strongly Agree). In addition, transcripts of the mHealth intervention sessions were analyzed using thematic analysis. Participants were included in analysis if they completed the baseline and follow-up surveys and participated in at least one of the two group discussions on SRH.

# **RESULTS:**

Of 47 participants ages 15-19 who completed the SRH survey at baseline and follow up (mean age: 17.2), 25 (53.2%) were female and 19 (40.4%) were randomized to the SRH intervention. Mean scores improved from baseline to follow-up for the InTSHA group for 'Defining Sexuality', 'Discussing Sex with Caregivers', and 'Comfort Saying No to Sex', topics that were organically brought up and extensively discussed by participants in the WhatsApp session transcripts. Pearson's correlation showed significant positive correlations between older age of the adolescent and improvement in ('Equal Responsibility') (+0.706) and ('Health Care Comfort')

mHealth is a potential tool for interactive SRH education in South Africa that should continue to be refined, tested, and scaled-up for APHIV in larger-scale, population-wide studies.

(+0.854) amongst those who attended both SRH sessions.

### **CONCLUSION:**

mHealth is a potential tool for interactive SRH education in South Africa that should continue to be refined, tested, and scaled-up for APHIV in larger-scale, populationwide studies. **TABLE:** Response Distributions Stratified by Likert Item and Intervention Arm, Baseline Scores (n=47)

			Response Frequency			
Arm	Question*	Median (IQR)	Strongly Disagree	Disagree	Agree	Strongly Agree
	Q1	1 (-1,1)	3 (10.7%)	8 (28.6%)	14 (50.0%)	3 (10.7%)
6	Q2	1 (-1,2)	5 (17.9%)	4 (14.3%)	12 (42.9%)	7 (25.0%)
n=2	Q3	1 (-1,1)	3 (10.7%)	12 (42.9%)	13 (46.4%)	0 (0.0%)
ine (	Q4	1 (-1, 1.25)	6 (21.4%)	3 (10.7%)	14 (50.0%)	5 (17.9%)
aseli	Q5	1 (0.5,1.25)	2 (7.1%)	5 (17.9%)	16 (57.1%)	5 (17.9%)
ol B	Q6	1 (1,2)	3 (10.7%)	1 (3.6%)	16 (57.1%)	8 (28.6%)
ontr	07	1 (1,2)	4 (14.3%)	0 (0.0%)	16 (57.1%)	8 (28.6%)
	Q8	1 (1,2)	0 (0.0%)	2 (7.1%)	19 (67.9%)	7 (25.0%)
	Q9	1 (0.5,2)	4 (14.3%)	3 (10.7%)	15 (53.6%)	6 (21.4%)
	Q1	0 (-1,1)	2 (7.1%)	12 (42.9%)	13 (46.4%)	1 (3.6%)
(8)	Q2	1 (-1,1)	5 (17.9%)	5 (17.9%)	15 (53.6%)	3 (10.7%)
u = 1	Q3	0 (-1,1)	6 (21.4%)	8 (28.6%)	13 (46.4%)	1 (3.6%)
Р.	Q4	1 (-1,1)	1 (3.6%)	8 (28.6%)	16 (57.1%)	3 (10.7%)
llow	Q5	1 (-1,1)	1 (3.6%)	7 (25.0%)	17 (60.7%)	3 (10.7%)
9 8	Q6	1 (1,2)	1 (3.6%)	3 (10.7%)	17 (60.7%)	7 (25.0%)
Intro	Q7	1 (1,1)	0 (0.0%)	0 (0.0%)	22 (78.6%)	6 (21.4%)
ິ	Q8	1 (1,1)	0 (0.0%)	6 (21.4%)	17 (60.7%)	5 (17.9%)
	Q9	1 (1,1)	2 (7.1%)	3 (10.7%)	19 (67.9%)	4 (14.3%)
	Q1	-1 (-1,1)	3 (15.8%)	8 (42.1%)	7 (36.8%)	1 (5.3%)
=19	Q2	1 (-1,1)	2 (10.5%)	6 (31.6%)	7 (36.8%)	4 (21.1%)
e Ü	Q3	-1 (-1,1)	4 (21.1%)	8 (42.1%)	6 (31.6%)	1 (5.3%)
elin	Q4	1 (-1,1)	2 (10.5%)	5 (26.3%)	8 (42.1%)	4 (21.1%)
Bas	Q5	1 (1,2)	0 (0.0%)	2 (10.5%)	11 (57.9%)	6 (31.6%)
Ition	Q6	1 (1,1.5)	3 (15.8%)	1 (5.3%)	10 (52.6%)	5 (26.3%)
rven	Q7	1 (1,2)	1 (5.3%)	1 (5.3%)	9 (47.4%)	8 (42.1%)
Inte	Q8	1 (1,2)	1 (5.3%)	3 (15.8%)	10 (52.6%)	5 (26.3%)
	Q9	1 (1,2)	1 (5.3%)	2 (10.5%)	9 (47.4%)	7 (36.8%)
6	Q1	1 (-1,1)	1 (5.3%)	8 (42.1%)	8 (42.1%)	2 (10.5%)
1 1	Q2	1 (-1,1)	1 (5.3%)	7 (36.8%)	10 (52.6%)	1 (5.3%)
) d	Q3	1 (0,1)	1 (5.3%)	4 (21.1%)	12 (63.2%)	2 (10.5%)
low-	Q4	1 (-1,1)	3 (15.8%)	6 (31.6%)	6 (31.6%)	4 (21.1%)
। य	Q5	1 (1,1)	0 (0.0%)	3 (15.8%)	13 (68.4%)	3 (15.8%)
ltior	Q6	1 (1,2)	0 (0.0%)	2 (10.5%)	8 (42.1%)	9 (47.4%)
Iner	Q7	1 (1,1)	1 (5.3%)	2 (10.5%)	13 (68.4%)	3 (15.8%)
Inte	Q8	1 (1,1)	1 (5.3%)	3 (15.8%)	12 (63.2%)	3 (15.8%)
	09	1 (1,2)	1 (5.3%)	3 (15.8%)	9 (47.4%)	6 (31.6%)
		0.0% -	10.0 % -	25.0% -	50%	
Densit	<b>y</b> Lesser	9.9%	24.9%	49.9%	100%	Greater
						•

# Doctor of Nursing Practice Students Drink the Most Coffee, Report the Least Stress

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Caffeine is frequently described as the world's most widely used psychoactive drug. Studies on caffeine, academic performance, and stress have produced mixed and inconsistent results in different subpopulations. The generalizability of many study findings to traditionally high-performing students is often unclear, particularly in intensive health care training programs such as medical and nursing school. Some studies suggest that high levels of caffeine consumption are detrimental in these professions. Some researchers have also suggested a general lack of student information literacy about caffeine use.

Despite the lack of clarity about best practices for these specific student populations, student peers and academic advisors in these programs often advise high levels of caffeine consumption as an academic performance aid.

### AIM:

This quantitative pilot survey was designed to collect preliminary data on caffeine consumption and stress levels amongst different levels of nursing students. The short-term goal was to identify trends to guide the design of data collection instruments for a mixed methods follow-up study, with the ultimate goal of improving student support



services delivery by a nursing graduate student success program.

### **METHODS:**

A short, anonymous survey was circulated online and through email lists

at 10 colleges with nursing programs, including 2-year Associate of Science in Nursing (ASN), 4-Year Bachelor of Science in Nursing (BSN-4yr), 1.5year Accelerated Bachelor of Science in Nursing (BSN-Postbacc), Master

of Science in Nursing (MSN), Doctor of Nursing Practice (DNP), and PhD in Nursing Leadership programs (no responses). Snowball sampling was used to further increase the survey response rate.

Survey questions collected participants' degree program type, year in program, regular caffeine consumption (yes/no), estimated average daily caffeine consumption (cup of coffee equivalent), and self-perceived stress level (0-low to 4-high). An "Additional Information" field was also provided. Data were collected through a custombuilt webform and recorded in an encrypted SQL database. No personally identifiable information was collected.

*On average, students who did not report consuming caffeine reported lower stress levels than their peers who did.* 

### **RESULTS:**

One hundred sixty-seven submissions were received over 5.5 months. Six duplicates were excluded due to identical content and similar timestamps; ne was removed because "Additional Information" indicated ineligibility. The remaining 160 responses were used for data analysis to identify general trends that might inform the qualitative questionnaire design.

Notably, ASN (n=42) and

BSN-Postbacc (n=21) students reported the highest average stress levels, while BSN-4yr (n=40), MSN (n=27), and DNP (n=30) students reported significantly lower average stress levels.

The study showed that 66.9% of all participants, including 100% of BSN-4yr students, reported consuming caffeine daily. ASN students reported the lowest average caffeine consumption and the highest stress; overall, DNP students reported the highest caffeine consumption but the lowest stress.

On average, students who did not report consuming caffeine reported lower stress levels than their peers who did. After excluding extreme outliers from the average time-to-degree (e.g., 4th-year MSN students), increased years-in-program positively correlated with increased stress in both MSN and DNP participants.

#### **DISCUSSION:**

The data analysis highlighted notable differences in trends for self-reported stress by program and program year. This suggests that follow-up research would benefit from focusing on specific institutions and comparing caffeine consumption, stress, and academic performance within specific courses, rather than obliquely by year. A revised quantitative questionnaire will be developed to record student caffeine



consumption in greater detail, and the planned qualitative questionnaire will include open-ended questions about motivations for, beliefs about, and habits of caffeine consumption.

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# Policing, Sanitation, and the Fragmented Response to Homelessness in Cities

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Housing is a critical social determinant of health, and many American cities are in the midst of a homelessness crisis, especially in light of the COVID-19 pandemic.<sup>1</sup> People experiencing homelessness have a higher risk of mortality, mental illness, and chronic conditions.<sup>2</sup> Additionally, higher rates of unsheltered homelessness may also generate public safety and public health concerns.

Homelessness - especially unsheltered homelessness - generates pressure to immediately and punitively remove visibly unhoused people and their belongings from public spaces. "Order maintenance" police strategies focus explicitly on policing behaviors of persons experiencing unsheltered homelessness, including loitering, sleeping in public, and visible symptoms of mental illness.3 Furthermore, exposure to visible homelessness reduces public support for redistribution policies<sup>4</sup> and increases support for the removal of unhoused people from public spaces.5

In this study, we explore the extent to which cities emphasize punitive



**FIGURE:** Mayoral survey results – "How much do each of the following groups shape your city's homeless policy?" <sup>a</sup>Menino Survey of Mayors) The police were the third most common influencer of policy.

policies in their approaches to homelessness. We study the two bureaucracies most likely to be involved in such punitive approaches: policing and sanitation. The police — as the central public safety bureaucracy — are on the frontlines of dealing with any "order maintenance" concerns generated by local unhoused people. Additionally, Sanitation is regularly tasked with the removal and confiscation of homeless people's belongings.

We take advantage of a variety of different data sources to explore cities' punitive policymaking. These data include a nationally representative survey of mayors, as well as administrative data on police and sanitation agencies gleaned from their websites and policy documents.

Results from the Menino Survey of Mayors indicate that city mayors believe the police to have a greater impact on their cities' homeless policies than people at risk of experiencing homelessness, public housing authorities, and local departments of public health, among others. Analysis of Homeless Outreach Team (HOT) data suggests that 59% of HOTs explicitly include enforcement of civil or criminal infractions or quality of life crimes, and 41% include encampment removal (including removal of persons **TABLE:** Analysis of the Homeless Outreach Team data. Most HOTs have roles for police, and many include punitive responses as a goal or mission.

Homeless Outreach Team (HOT) Measure	Percentage
Cities with a HOT	63%
HOTs including a formal role for the police, direct or indirect, in municipal homeless outreach efforts	73%
HOTs explicitly including enforcement of civil or criminal infarctions or quality of life crimes as a goal or mission	59%
HOTs explicitly including encampment removal, including removal of persons and belongings, as a goal or mission	42%
HOTs explicitly including permanent housing as a goal or mission	24%

and belongings), as a goal or mission. Finally, analysis of Sanitation department data found that 72% of municipalities enlist sanitation institutions as a part of their response to homelessness.

Our findings show a deeply fragmented bureaucracy, with an orientation towards punitive policy. The police exert strong influence over homelessness policy and their involvement comes with strong enforcement potential. Similarly, sanitation bureaucracies have well-developed homelessness policies; these policies, like the police, underscore the removal of visible reminders of unhoused people in the form of encampment abatement policies.

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# Black-White Racial Inequalities by Breast Cancer Detection Method: Retrospective Review

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Although African American (AA) women face a lower risk of being diagnosed with breast cancer, they have an increased mortality hazard, and incidence rate of early-onset disease compared to non-Hispanic white (NHW) women.<sup>1,2,3</sup> The etiology of the widening black-white disparity is poorly understood, and it remains unclear whether the higher mortality rates are a result of a more advanced stage at the time of diagnosis or a more aggressive tumor, with true underlying differences in biology. The method by which breast cancer is diagnosed is an emerging consideration in breast cancer prognosis.<sup>4</sup> In this retrospective review, we compare the clinicopathological characteristics of breast cancer by the detection method with a focus on race and age.

### **METHODS:**

We identified 940 women with surgically managed breast cancer in a single hospital over a 6.5-year period (1/1/2017-06/30/2023). Clinicopathological variables were extracted from medical records and surgical pathology reports. Race was self-reported. Participants were excluded if they were male (no recommendation for routine screening), lacked surgical management (no pathology report), or if it was a breast cancer recurrence (cancer in either breast within the last two years). Screendetected breast cancers were defined as those detected on a positive screening test in an asymptomatic patient. Breast cancers detected through diagnostic evaluation were assigned when the patient had symptoms of a palpable breast mass that could be appreciated on physical exam by the patient or clinician, or clinical complaints such as pain, skin changes, or nipple discharge. Chi-squared tests, two-sample T-tests, and ANOVA were used to assess for differences in the distribution of clinicopathological characteristics

by diagnostic method, race, and age.

# **RESULTS:**

Of the 940 women, 65.43% (n=615/940) women presented with screen-detected tumors and 30.32% (n=285/940) were diagnostically detected. 50.42% of participants were AA (n=474/940) and 35.00% were NHW (n=329/940). AAs are less likely to have luminal-A cancers (p=0.001) and more likely to have triple negative (p=0.001) and lymphovascular invasion (LVI) (p=0.001) compared to NHWs. Women with diagnostically evaluated tumors were more likely to be AA than NHW ( $p \le 0.0001$ ), have positive axillary lymph nodes (p≤0.0001), and be younger (40-49 vs 50+ years) ( $p \le 0.0001$ ). When comparing diagnostically detected tumors alone, AA women were more likely to have triple negative tumors (p=0.001) with LVI (p=0.021). Women 40-49 years were more likely to have triple negative tumors ( $p \le 0.0001$ ), with LVI (p=0.0021), and spread to axillary lymph nodes (p=0.044), and dense breast tissue (p $\leq$ 0.0001) compared to older women (50-79 years).

# **CONCLUSION:**

Our study demonstrates significantly more triple-negative tumors and LVI among AAs compared to NHWs even when controlling for the diagnostic method. This pattern indicates opportunities for future research to correlate the extent of race and high-risk breast cancer subtypes that may influence this black-white racial disparity, especially for younger women.

In this retrospective review, we compare the clinicopathological characteristics of breast cancer by the detection method with a focus on race and age.

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# Comparison of Metabolic Syndrome Prevalence among Racial/ Ethnic Groups in the National Health and Nutrition Examination Survey's Pre-pandemic 2017-March 2020 Dataset

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Cardiovascular disease (CVD) remains the leading cause of death in the United States, with metabolic syndrome being a major risk factor for CVD. Metabolic syndrome is growing increasingly prevalent globally, resulting in a significant economic burden on Health care systems and societies.1 Continued surveillance and investigation of metabolic health trends can help improve our approaches to prevention and patient care.

# **OBJECTIVE:**

This study aims to compare the prevalence of metabolic syndrome between different racial/ethnic groups in the National Health and Nutrition Examination Survey (NHANES) 2017 to March 2020 dataset.

# **METHOD:**

We analyzed data from 4,093 participants who had data on all metabolic syndrome characteristics in the NHANES 2017–March 2020 dataset. The prevalence of metabolic syndrome among each racial/ethnic group was compared using Tukey contrast tests. We used R Version 4.1.2 software for statistical analysis.

Continued on p. 20

**TABLE 1:** Demographic Characteristics of National Health and Nutrition Examination Survey (NHANES) 2017-March2020 Study Sample with Complete Metabolic Health Data (N = 4,093).

Variable	Category	Mean [#] or Count [# (%)]
Sex/Gender	Male	2042 (49.89%)
	Female	2051 (50.11%)
Age (years)		45.24
Race/Hispanic Origin	Non-Hispanic White	1404 (34.30%)
	Non-Hispanic Black1037 (31.93%)	
	Non-Hispanic Asian	476 (11.63%)
	Mexican American	536 (13.10%)
	Other Hispanic	401 (9.80%)
	Other Race (Including Multi- Racial)	239 (5.84%)
Education Level (Adults 20+)	Less than 9th grade	238 (5.81%)
	9–11th grade (Includes 12th grade with no diploma)	394 (9.63%)
	High school graduate/GED or equivalent	831 (20.30%)
	Some college or AA degree	1140 (27.85%)
	College graduate or above	864 (21.11%)
	Missing (<20 years old)	625 (15.27%)
	Unknown1 (0.02%)	
Metabolic Syndrome Conditions	Waist Circumference (cm)	98.23
	Triglyceride Levels (mg/dL)	103.8
	HDL Cholesterol Level (mg/dL)	53.36
	Systolic Blood Pressure (mmHg)	121.8
	Diastolic Blood Pressure (mmHg)	72.89
	Fasting Blood Sugar (mg/dL)	111.1

**FOOTNOTE:** Metabolic syndrome conditions are clinically defined by National Heart, Lung, and Blood Institute (https://www.nhlbi.nih.gov/health/metabolic-syndrome).

**CLINICAL PUBLIC HEALTH** 

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### **EXPOSURE:**

Categorical variable capturing NHANES study participant's reported racial/identity

### OUTCOME:

Metabolic health of study participants (at least three of the following cardiometabolic risk factors met indicated metabolic syndrome: large waist circumference high triglyceride levels, low HDL cholesterol level, high blood pressure, and high fasting blood sugar)

### **RESULTS:**

For participants who identified as Hispanic but not Mexican American, the prevalence of metabolic syndrome on average was 0.37 greater than that for Non-Hispanic Blacks (p-value = 0.023) and 0.42 greater than that for Non-Hispanic Asians (p-value = 0.029). More than a third of each racial/ethnic **TABLE 2:** Tukey Contrast Tests Comparing Prevalence of Metabolic Syndrome for"Other Hispanic" Identifying Participants to that for other Racial/Ethnic Groups inNational Health and Nutrition Examination Survey (NHANES) 2017-March 2020Demographics Dataset (N = 4,093).

Group Compared to "Other Hispanic" Participants:	Estimate	P Value	
NH white	0.154	0.752	
NH Black	0.371	0.023*	
NH Asian	0.423	0.029*	
Mexican American	0.099	0.975	
Other Race – including multi-racial	0.290	0.504	
<b>Footnote:</b> NH = non-Hispanic; * = statistically significant			

group presented with at least three metabolic syndrome conditions (range = [0.33, 0.43]).

### **DISCUSSION:**

Our findings further support previous literature on metabolic health syndrome in the United States. On average, one in three people exhibit at least three metabolic syndrome conditions. Public health policy and research must continue to address health disparities and prevent cardiovascular health risk factors related to metabolic health syndrome.

### **REFERENCE:**

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# Prevalence of Missing, Unknown, and Unreported Data in the National Health and Nutrition Examination Survey's Pre-pandemic 2017-March 2020 Demographics Dataset

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The National Health and Nutrition Examination Study (NHANES) provides publicly accessible, nationally representative health data for the United States population. Unfortunately, the COVID-19 pandemic disrupted data collection for the 2019-2020 period. Consequently, the NHANES 2017-March 2020 datasets were created to serve as nationally representative prepandemic data files.1 However, the absence, uncertainty, or non-disclosure of demographic data by survey participants can hinder NHANES 2017-March 2020 data exploration and analysis due to concerns about compromised data quality and validity.

# **OBJECTIVE:**

This study aims to assess the prevalence of incomplete data in the NHANES Demographics dataset from 2017 to March 2020.

### **METHOD:**

In this study, each variable within the NHANES pre-pandemic Demographic dataset underwent scrutiny for missing, unknown, or unreported values among individual survey participants. Data analysis was conducted in September 2023, utilizing R Version 4.1.2. **TABLE 1:** Demographic Characteristics of National Health and Nutrition Examination Survey (NHANES) 2017-March2020 Study Sample (N = 15,560)

Variable	Category	Mean [#] or Count [# (%)]
Sex/Gender	Male	7,721 (49.62%)
	Female	7,839 (50.38%)
Age (years)	-	33.74
Race/Hispanic Origin	Non-Hispanic White	5,271 (33.88%)
	Non-Hispanic Black	4,098 (26.34%)
	Non-Hispanic Asian	1,638 (10.53%)
	Mexican American	1,990 (12.79%)
	Other Hispanic	1,544 (9.92%)
	Other Race (Including Multi-Racial)	1,019 (6.55%)
Education Level (Adults 20+)	Less than 9th grade	719 (4.62%)
	9–11th grade (Includes 12th grade with no diploma)	1,041 (6.69%)
	High school graduate/GED or equivalent	2,225 (14.30%)
	Some college or AA degree	2,975 (19.12%)
	College graduate or above	2,257 (14.51%)
Marital Status	Married/Living with Partner	5,279 (33.93%)
	Widowed/Divorced/Separated	2,148 (13.80%)
	Never Married	1,795 (11.54%)

**Footnote:** Missing, unknown, and refused responses are not displayed, but were considered when calculating the percentages for each variable category.

### **EXPOSURE:**

Incomplete data included missing, "don't know," and refused variable fields among 20 demographic variables of interest within the NHANES study.

### **OUTCOME:**

The primary outcome was the prevalence of incomplete data within the NHANES 2017–March 2020 demographic dataset.

### **RESULTS:**

Our study encompassed all 15,560 participants in the NHANES 2017– March 2020 dataset: 49.62% of whom identified as males (n=7721) and on average participants were 33.7 years old. Six variables related to US residency, interview proxy, language, and family income exhibited genuine missing data (ranging from 0.045% to 14.15%). Five variables concerning country of birth,

#### *Continued from p. 21*

U.S. residency, completed education level, marital status, and pregnancy status (with uncertainty about whether the patient was pregnant during the examination) had unknown outcomes reported (ranging from 0.006% to 1.18%). With the exception of pregnancy status, all questions related to variables with unknown outcomes had participants who declined to answer (ranging from 0.013% to 0.27%).

Discussion: After accounting for missing responses due to study participant ineligibility for answering certain survey questions, our findings indicate that NHANES 2017-March 2020 has a relatively low prevalence of incomplete responses. While the overall occurrence of incomplete data for this pre-pandemic cycle should not raise significant concerns, it's noteworthy that the most commonly missing demographic information in the NHANES 2017-March 2020 dataset pertained to the ratio of family income to poverty. Enhancing the collection of this information and improved training to handle missing data could be beneficial for future research on social determinants of health and public health.

#### **REFERENCE:**

 Akinbam L, Chen TC, Davy O, et al. National Health and Nutrition Examination Survey, 2017–March 2020 Prepandemic File: Sample Design, Estimation, and Analytic Guidelines. National Center for Health Statistics (U.S.); 2022. doi:10.15620/cdc:115434 **TABLE 2:** Prevalence of Incomplete Survey Responses in National Health andNutrition Examination Survey (NHANES) 2017-March 2020 Demographics Dataset (N =15,560)

	Incomplete Survey Responses			
Variable	Missing [# (%)]	Unknown [# (%)]	Refused [# (%)]	
Gender	-	-	-	
Age (years)	-	-	-	
Race/Hispanic Origin	-	-	-	
Race/Hispanic Origin w/ Non- Hispanic Asian	-	-	-	
Country of Birth	-	1 (0.006%)	6 (0.039%)	
Length of Time in United States	7 (0.045%)	92 (0.59%)	42 (0.27%)	
Education Level (Adults 20+)	-	13 (0.084%)	2 (0.013%)	
Marital Status	-	2 (0.013%)	8 (0.051%)	
Pregnancy Status	-	183 (1.18%)	-	
Language of SP Interview	-	-	-	
Proxy Used in SP Interview	-	-	-	
Interpreter Used in SP Interview	-	-	-	
Language of Family Interview	1,079 (6.93%)	-	-	
Proxy Used in Family Interview	1,079 (6.93%)	_	_	
Interpreter Used in Family Interview	1,079 (6.93%)	-	-	
Language of MEC Interview	-	-	-	
Proxy Used in MEC Interview	-	-	-	
Interpreter Used in MEC Interview	_	_	_	
Language of ACASI Interview	304 (1.95%)	_	_	
Ratio of Family Income to Poverty	2,201 (14.15%)	_	_	

#### Footnotes:

\*SP Interview = Sample Person Interview

- \*MEC = Mobile Examination Center
- \*ACASI = audio-computer-assisted self-interview

# LGBTQ + Adaptive Health Care Curriculum

#### Ryan Neill, MSI

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The medical care of LGBTQ+ patients in America has a long history of obstruction due to unconscious bias and perpetuated miseducation rooted in cultural homophobia and transphobia. Furthermore, the health disparities that LGBTQIA+ populations face are underreported due to the lack of standardized sexual orientation and gender identity data. Many facets

[T]he health disparities that LGBTQIA+ populations face are underreported due to the lack of standardized sexual orientation and gender identity data.

of this health care inequity persist through lack of informed training and educational awareness to properly treat LGBTQ+ patients, in addition to inequitable social determinants of health and harmful policies. This gap has created decades of ongoing health disparities negatively impacting the health and medical care of the LGBTQ+ community.

To address this burden, this multifaceted curriculum was designed to be an adaptive educational tool and reproducible clinical model to aid in alleviating LGBT+ health disparities on three foundational levels: [1] combat miseducation in a thorough and inclusive curriculum, serving as a generalized and structured LGBT+ Health care educational resource; [2] from this meta-analysis of modern and historic LGBT+ health disparities, identify barriers to care and propose tailored interventions to alleviate institutional and systemic inequities; [3] propose specific strategies to scale and sustain the impact of efforts to improve these measures, while integrating academic and clinical infrastructure to address future inequities.

Issues such as non-inclusive charting, experiences of discrimination, impacts of assumptions, bias, inaccessibility, policy-derived harm, and further issues pose barriers to care and wellness; however, each area possess tangible avenues for alleviation for

> multiple intersecting, marginalized communities through a baseline medical education approach and affiliated partnerships on multiple levels: individual, community, institutional, structural/pipeline, and systematic. Within

this resource, these objectives and strategies are structurally broken down into a model itself, which can be adapted in similar formats to address health disparities impacting other marginalized communities.

In this curriculum, Chapter 1 (The Alphabet) provides informed context to the needs and experiences of LGBT+ patients; Chapter 2 (General Education) address the underlying stigmatized concerns and miseducation rooted in many biases projected at the LGBT+ community; Chapter 3 (Unconscious Bias) addresses these biases through unconscious bias training; Chapter 4 (Structural Models) expands discussions from a provider level to an intuitional level with suggested structural modifications and interventions; Chapter 5 (Adaptive Model) outlines a model for addressing social inequity from an educational approach and adaptability context to address continuity in care; additionally, a Terminology Index and Practical Solutions Index are integrated.

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# Investigating Clinicians' Perspectives on Racial Disparities within a Pediatric Emergency Department

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Quality of care differs by patient race and ethnicity in pediatric emergency departments (PED). Understanding clinicians' perspectives on the factors contributing to health inequities could provide further insight into how to mitigate these issues.

# **OBJECTIVE:**

To understand clinicians' perspectives on the contributors to racial and ethnic inequities in a PED.

# **DESIGN/METHODS:**

One-on-one semi-structured interviews with PED clinicians were conducted as part of a pilot study assessing racial and ethnic inequities in pain management from July 2022 to September 2022. Eligible clinicians included pediatric emergency medicine (PEM) attendings, general pediatricians, PEM fellows, physician assistants, and nurse practitioners who had treated  $\geq 1$  patient with a chief complaint of acute abdominal pain or extremity injury in the PED within ne month prior to the interview. Clinicians were invited to share their perspectives on trust, communication, and disparities in health care. Interviews were conducted and recorded via Zoom.



Open-coding and Nvivo software were used to conduct thematic analyses of participants' responses.

### **RESULTS:**

A total of 10 interviews were conducted among five female and five male clinicians. Half identified as White, 30% Asian, 10% Black, and 10% Hispanic. Major themes included: race/ethnicity, culture, education, and resources (patient factors); knowledge, attitudes, and bias (provider factors); provider communication and cultural competence (clinical encounter); and health care organizational culture and quality improvement (health care system factors). All clinicians identified that patients are treated differently based on race and ethnicity both within the general Health care system and within the PED. All clinicians identified both time and systemic issues as barriers to quality care. Other barriers included power dynamics between the provider and team, as well as between the patient and provider. When asked about possible and personal practices to mitigate, prominent themes included (5+ clinicians mentioned) being intentional about verbal and nonverbal communication with families, empathy, and collaborative care amongst clinical teams. The majority (80%) were able to identify feasible and immediate solutions to mitigate bias within the PED. These clinician interviews provide valuable insight into possible solutions to improve patient trust and communication within the health care system, as well as subsequent resources necessary to ultimately eliminate health inequities. Future studies are needed to identify and implement effective interventions.

# A Geospatial Analysis of Community-acquired Extended-Spectrum Beta-Lactamase Urinary Tract Infections in Children Living in the Washington Metropolitan Area

### Yifeng Wang, MSIII

ADVISORS: Maria Susana Rueda Altez, MD,<sup>1</sup> Anand Gourishankar, MBBS, MRCP, MAS<sup>1</sup>



1. Children's National Hospital

The incidence of community-acquired extended-spectrum beta-lactamase (ESBL) urinary tract infections (UTIs) is rising, and they are associated with adverse patient outcomes and increased Health care costs. Several clinical risk factors for ESBL UTI have been identified. However, more information is needed about how geographic and social factors affect ESBL UTI and its distribution. The Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) Social Vulnerability Index (SVI) is a composite measure of social risk factors on human health at the community level, and its relationship with UTI is unknown.

### **OBJECTIVE:**

To identify the distribution and geographic hot spots for ESBL UTI in children from the DC metropolitan area and compare the distribution of the SVI for cases with ESBL UTI.

### **DESIGN/METHODS:**

A retrospective case-control study was conducted among children 1 month to 18 years of age diagnosed with UTI at an emergency department from January 2019 to December 2021. Our



definition for UTI included a positive urine culture (>=10^5 colony-forming unit (CFU) for clean catch,  $>=5x10^{4}$ for catheterized, and >0 for suprapubic puncture samples), abnormal urinalysis (positive leukocyte esterase and/or >=10 WBC), and symptoms consistent with urinary tract infection. We randomly selected matched cases (ESBL UTI) to controls (non-ESBL UTI) by age and gender in a 1:3 ratio. Cases with recent (<3 months) hospitalization or longterm care facility stay were excluded from the study. The hotspot and SVI maps were created with ArcGIS Pro. Conditional logistic regression was used for the association between SVI and UTL

### **RESULTS:**

We included 77 ESBL UTI cases and 233 controls. The geographic distribution of the ESBL UTI cases was aggregated in the northeast area (Figure 1). The association between SVI and ESBL UTI was not significant (Figure 2, OR 1.3, CI (0.4-4), p = 0.7).

### **CONCLUSIONS:**

ESBL UTI has geographical significance in this preliminary study. ESBL UTI hot-spot distribution in the northeast area coincides with lowincome neighborhoods where minority populations reside. No association was

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found between SVI and ESBL UTI. Further geographical analysis of risk factors will strengthen this case-control study.



# Associations Between Demographic/Medical Characteristics and Caregiver Perceptions of Benefits and Burdens of CGM Use Among Youth with Type 1 Diabetes

### Madhu Vemulakonda, MSII

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Continuous glucose monitor (CGM) use for type 1 diabetes (T1D) management during adolescence is associated with better glycemic outcomes, yet many adolescents struggle to experience optimal CGM use. Additionally, due to racial health inequities in T1D research and technology distribution, less is known about the unique experiences of youth of color and their caregivers with regards to technology use. This study examines caregiver CGM experiences broadly and the associations between youth demographic and medical characteristics and caregiver CGM experiences among youth with T1D who are experiencing sub-optimal CGM use or who are new to CGM.

### **METHODOLOGY:**

Participants include 36 youth aged 10–15 ( $M_{age} = 12.7 \pm 1.7$ ,  $M_{(T1D Duration)} = 4.3 \pm 2.5$  years,  $M_{\mathcal{HbAlc}} = 10.8 \pm 2.0\%$ ,  $M_{(CGM Use Duration)} = 2.0 \pm 1.7$  years, 61.1% male, 38.9% female, 66.7% non-Hispanic, Black/African American, 27.8% Hispanic/Latino/a/x, 5.5% non-Hispanic, white). Youth and their caregivers who are either 1) new to

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CGM (<3 months use) or 2) <75% CGM wear-time were enrolled in a behavioral intervention to promote optimal CGM use; these are baseline data only. Caregivers reported on demographic data (child age, race/ethnicity, insurance type, family status), and youth reported their gender identity. Medical variables were obtained from either caregiver reported baseline REDCap

survey questionnaires (CGM use duration) or the electronic health record (EHR) (CGM wear time and T1D duration). Hemoglobin A1c (A1c) was obtained from either the EHR, at-home A1c kits, or estimated from the 90-day average CGM BG readings.

Caregivers completed the Benefits and Burdens of CGM (Ben/Bur) questionnaire. Caregiver Ben/Bur experiences were examined using descriptive statistics. Associations between demographic/medical variables and Ben/Bur were analyzed using non-parametric Mann-Whitney U tests or Spearman's rho tests.

### **RESULTS:**

Regarding Ben/Bur experiences, the highest rated benefit was "I take better care of my child's diabetes with a CGM." The highest rated burden was "I think CGM is painful to wear" ( $M_{Ben} = 4.3 \pm 1.1$ ;  $M_{Bur} = 1.9 \pm 0.8$ ). There were no associations between race/ethnicity, insurance type, family status, A1c, CGM use duration, T1D duration and Ben/Bur scores. However, CGM wear

time was significantly correlated with caregiver reported Bur CGM scores (r=0.445, p<0.01). Further, youth age group was significantly associated with Ben CGM scores: caregivers of teenagers ( $\mathcal{M}dn = 4.9$ ) reported significantly higher CGM benefits than caregivers of children ( $\mathcal{M}dn = 4.3$ ) ( $\mathcal{U} = 99.0$ , p = 0.039).

These findings suggest that more CGM use could actually result in higher perceived CGM burden; whether this increased burden is a risk factor for negative psychosocial outcomes is a question for future research.

### **CONCLUSION:**

These findings suggest that more CGM use could actually result in higher perceived CGM burden; whether this increased burden is a risk factor for negative psychosocial outcomes is a question for future research. Moreover, as adolescents transition to more independent diabetes management responsibilities, engagement in remote monitoring may offer caregivers of adolescents a greater perception of benefit to CGM use as compared to caregivers of children. This study is limited by a small sample size. Future studies should also examine adolescent reported benefits and burdens of CGM use.

# Xylazine in Fentanyl Mixtures: A Growing Concern in the Opioid Crisis and the Use of Oxytocin for Reversing Respiratory Depression

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The opioid epidemic in the United States has resulted in devastating consequences, with over 645,000 Americans losing their lives since 1999, affecting countless families and communities.<sup>1</sup> Synthetic opioids, particularly fentanyl, play a significant role in the escalation of opioid overdoses. However, recent concerns have emerged regarding the prevalence of the veterinary tranquilizer xylazine in fentanyl mixtures, which is not counteracted by naloxone. With 100,000 annual deaths in the United States from opioid overdoses in the United States, and the presence of xylazine-laced fentanyl in 48 out of 50 states, where approximately 23% of fentanyl powder contains xylazine, further research to counteract the effects of combined xylazine with fentanyl are needed.<sup>2</sup>

In this study, two groups of male Sprague Dawley rats (n=8) received a combination of intraperitoneal (IP) fentanyl (0.5 mg/kg) and xylazine (1 mg/ kg). 10 minutes post-injection, group one was given IP Oxytocin (100 nmol/ kg) while group two received IP saline. Respiratory function was quantified using a whole-body plethysmography system in unrestrained and freely moving animals.

In untreated animals, fentanyl and xylazine decreased respiratory frequency by 80%, and tidal volume decreased 25%. These drugs also induced an increase in apnea and hypopnea occurrence. In animals given oxytocin, breathing frequency was 20% higher, and the occurrence of apneas was 75% lower compared to untreated animals.

These results indicate oxytocin is a promising treatment to mitigate opioid-induced respiratory depression in emergency and/or clinical settings. Further exploration of oxytocin's effectiveness and implementation strategies could pave the way for improved interventions and better outcomes in combating the detrimental effects of the opioid crisis and the growing prevalence of xylazine.

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# Risk Factors for Community-Acquired ESBL UTI in Pediatric Patients: A Case-Control Study

### Yifeng Wang, MSIII

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1. Children's National Hospital

Urinary tract infections (UTIs) are among the most common bacterial infections among infants and young children. Enterobacterales are isolated in more than 80% of pediatric UTI cases, and the rates of resistance are rising. Most pediatric studies focus on hospital-acquired resistant infections, but there has been an increase in community-acquired UTI cases caused by extended-spectrum beta-lactamase (ESBL) producing bacteria, for which risk factors are not clearly defined.

# **OBJECTIVE:**

To identify and quantify the risk factors associated with community-acquired ESBL UTIs in pediatric patients.

# **METHODS:**

We conducted a single-center retrospective case-control study at a tertiary teaching hospital. We reviewed urine culture information from January 2019 to December 2021 of patients evaluated in the emergency department. We identified those who met our study definition for community-acquired ESBL UTI: positive urine culture (>10^5 colony-forming unit (CFU) if clean catch or urine bag collection, >50^4 if a catheterized sample, and any CFU if suprapubic aspiration), abnormal urinalysis (positive leukocyte esterase or >10

<b>CABLE:</b> Univariate analysis of risk factors associated with ESBL UTI (select variables)			
Patient characteristics	ESBL (n=78)	Non-ESBL (n=234)	P value
Age, years (median, IQR)	3.9 (1.2-6.5)	3.7 (1.1-6.5)	
Sex			
Male, n (%)	32 (41)	96 (41)	
Female	46 (59)	138 (59)	
State of Residence*			0.111
DC, n (%)	17 (22)	82 (35)	
MD	54 (69)	137 (59)	
VA	5 (2)	14 (6)	
Immunosuppression			0.001
No, n (%)	66 (85)	225 (96)	
Yes	12 (15)	9 (4)	
Antibiotic use in the last 3 months			<0.01
No, n (%)	46 (59)	213 (91)	
Yes	32 (41)	21 (9)	
UTI in the last 3 months			<0.01
No, n (%)	57 (73)	216 (93)	
Yes	21 (27)	18 (7)	
History of recurrent UTI			<0.01
No, n (%)	63 (81)	223 (95)	
Yes	15 (19)	11 (5)	
Long-term antibiotic use			< 0.01
No, n (%)	69 (88)	232 (99)	
Yes	9 (12)	2 (1)	

\*Two patients resided outside the DC/MD/VA area and were excluded from this analysis.

WBC), symptoms consistent with UTI, and no hospitalization or long-term facility stay in the previous 3 months. We randomly selected matched cases (ESBL UTI) to controls (non-ESBL UTI) by age and gender (confounders) in a 1:3 ratio. We conducted a univariate analysis using Fisher's exact test and developed a multivariate conditional logistic regression model to determine the association between each variable of interest and ESBL UTI.

### **RESULTS:**

The study included 78 cases and 234 controls, with a median age of 3.8 years (IQR:1.2-6.5). The females were 184 (59%), and the Hispanic/Latinos were 190 (62%). In the univariate analysis, state of residence, functional urinary disorder, genitourinary anatomical abnormalities, immunosuppression, antibiotic use 3 months before UTI,

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UTI in the previous three months, history of recurrent UTI, and longterm antibiotic use were associated with ESBL status with a p-value <0.15 and were included in the multivariate analysis. In the multivariate analysis, antibiotic use three months before UTI (OR 8.2, 95% CI 3.4-19.2), immunosuppression (OR 7.9, 1.4-44.4), and longterm antibiotic use (OR 4.4, 1.3-14.6) were significantly associated with ESBL UTI (p<0.05).

### CONCLUSIONS

The study findings may have important implications for understanding the causes and potential prevention strategies for ESBL UTI, and further research is needed to confirm and expand upon these results. **TABLE 2:**Conditional Multivariate Analysis of Risk Factors Associated with ESBL UTI

Model	Adjusted Odds Ratio	P value
Long-term antibiotic use	13.5	0.00087
Long-term antibiotic use	6.7	0.03
Antibiotic use in the last 3 months	7.8	<0.001
Long-term antibiotic use	6.8	0.03
Antibiotic use in the last 3 months	7.4	<0.001
UTI in the previous 3 months	1	0.9
Long-term antibiotic use	6.2	0.0489
Antibiotic use in the last 3 months	6.8	<0.001
History of recurrent UTI	2.2	0.12
Long-term antibiotic use	7.9	0.0186
Antibiotic use in the last 3 months	8.1	<0.001
Immunosuppression	4.4	0.0145
Long-term antibiotic use	7.9	0.0171
Antibiotic use in the last 3 months	8.6	<0.001
Immunosuppression	4.4	0.015
Functional urinary disorder	0.8	0.69
Long-term antibiotic use	7.9	0.0196
Antibiotic use in the last 3 months	8.1	<0.001
Immunosuppression	4.4	0.0148
GU anatomical abnormalities	1	0.99
State of Residence		
MD	1.6	0.23
VA	0.7	0.58

# Intraoperative Blood Product Transfusion in Pediatric Cardiac Surgery Patients: A Retrospective Review of Adverse Outcomes

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Resuscitation with blood products is often required for pediatric cardiac surgery patients following cardiopulmonary bypass (CPB).1 However, data suggests that blood product transfusion is an independent predictor of adverse outcomes.2-5 Most studies have specifically found detrimental effects of overall transfusion of red blood cells in particular, but few have analyzed outcomes by the other specific blood product components.2 The objective of this study is to analyze adverse outcomes associated with intraoperative transfusion of specific blood product components.

### **METHODS:**

A retrospective review was performed on 643 pediatric patients who underwent cardiac surgery requiring CPB to evaluate the risk of selected adverse outcomes associated with intraoperative blood product transfusion. Adverse outcomes included thrombotic complications, stroke, acute kidney injury, prolonged mechanical ventilation, and death. Univariate logistic and linear regression analyses were performed to explore the association between various blood products and the occurrence of postoperative complications. Multiple logistic and linear regression analyses were performed adjusting for age, cyanotic status, The Society of Thoracic Surgeons-European Association for CardioThoracic Surgery Score (STAT score), and CPB.

### **RESULTS:**

Unadjusted analysis using univariate logistic and linear regressions showed statistically significant associations of almost all blood components (per 10 mL/kg dose

increments) with multiple postoperative complications, including mortality, thrombotic complications, stroke, and days of mechanical ventilation. After adjusting for patient age, cyanotic status, STAT score, and cardiopulmonary bypass time, multivariable logistic and linear regression analyses revealed no association between transfusion of blood products with acute kidney injury and stroke. Administration of red blood cells was the only category significantly correlated with increased days of mechanical ventilation (0.5 days increase in mechanical ventilation per 10 mL/kg transfusion of red blood cells). The only blood product to show complete lack of a statistically

significant association with any of the studied outcomes was cryoprecipitate.

# **CONCLUSIONS:**

Bleeding after CPB in children is common, most often in small babies having complex surgeries with long CPB times and in children undergoing resternotomy. While the management of this bleeding requires a multitiered approach including application of topical hemostatic agents, vessel ligation, and electrocautery, administration of large volumes of blood components is frequently necessary. In this study

Bleeding after CPB in children is common, most often in small babies having complex surgeries with long CPB times and in children undergoing resternotomy.

> of 643 pediatric patients, we found that transfusion of nearly all blood product components was associated with the analyzed adverse outcomes including thrombotic complications, stroke, acute kidney injury, prolonged mechanical ventilation, and death by univariate analysis. After adjustment for patient age, STAT score, cyanosis, and CPB time, all blood product groups except for cryoprecipitate demonstrated statistically significant Odds Ratios for thrombotic complications. Future studies aimed at strategies to reduce intraoperative bleeding and decrease the amount of blood products administered are warranted.

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# Perioperative Utilization of Ultrasonography for Enhanced Airway Management

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The advent of point of care ultrasound and the general adaptation of ultrasonography (US) in Anesthesia may provide alternative approaches to preintubation airway assessment. Direct mechanical injury from intubation can instigate local inflammation of laryngeal structures and is influenced by a myriad of perioperative factors. Post-extubation airway complications may not be fully appreciated until the maneuver has already been performed. Coupled with the fact that current predictive methods for such do not always confer strong predictive power, it is prudent to assess new protocols. Of ultrasound techniques investigated so far, skin-to-epiglottis distance has been shown to hold some merit.<sup>1,2</sup> Our study seeks to contribute to the ongoing exploration of ultrasonography's role in the perioperative environment, providing greater scrutiny of structures already assessed in the literature while also evaluating new ones.

### **METHODS:**

Patients undergoing general anesthesia with intubation at a large academic center were included in this study. The following airway measurements were collected pre- and immediately postoperatively: skin-to-epiglottis distance,



**FIGURE:** Ultrasonographic imaging of the tongue and epiglottis. (a) Mid-sagittal view of the oral cavity. Includes the measurement of TT from skin to dorsum of the tongue; OCH from skin to bony palate; and tongue cross-sectional area spanning from the tip of the tongue to the border created by the hyoid bone shadow. (b) Transverse view of the oral cavity. Includes the measurement of tongue width which is taken at mid-TT and LAD. (c) Transverse view of the larynx. Includes the skin-to-epiglottis distance as well as the epiglottis width.

epiglottis width, lingual artery distance (LAD), tongue width, tongue thickness (TT), oral cavity height (OCH), and tongue sagittal cross-sectional area. Neck circumference was also collected using tape measure, taken between the thyroid and cricoid cartilages. All measurements were collected by a single individual who underwent blind precision testing. Shapiro-Wilks tests were used to assess normality of data collected and paired T-tests were utilized for comparison of data perioperatively. Multivariate analysis was performed to assess the influence of demographic and perioperative factors.

### **RESULTS:**

Forty-five patients were included in this study with an average age of  $47.2\pm15.3$  years and average BMI of  $30.2\pm8.9$ . Of the airways structures measured, TT, OCH, tongue width, LAD, skin-to-epiglottis distance, and epiglottis width all showed significant increases from pre- to postoperative environments (6.29%, 5.97%, 9.00%, 7.03%, 6.02%, and 6.38%; P < 0.05). All other measurements, including calculated TT/OCH ratio, were not statistically significant in their change from baseline.

### **DISCUSSION:**

The preliminary data of this study demonstrates significant perioperative change in several airway structures. The ability for US imaging to appreciate these changes affirms its role in airway assessment. However, the more widespread structural change indicates that skin-to-epiglottis may not be the only important measurement as previous studies have asserted.1,2 Methods such as Mallampati and Cormack-Lehane scoring have not shown to be as helpful in delineating less obvious at-risk patients. It will be important for clinicians to expand their airway assessment protocols to include US measurement for more precise predictions.

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Management of Cardiovascular Risk in the Internal Medicine Consultations: Stratification, Achievement of Objectives, Therapeutic Management and Opportunities for Improvement

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Categorize the level of cardiovascular risk (CVR) of the patients in internal medicine consultations at a private hospital in Madrid, Spain, and evaluate the degree of achievement of therapeutic objectives, as well as making therapeutic modifications when cholesterol goals were not achieved.

# **METHODS:**

A cross-sectional observational study that evaluated patients between 40-85 years old treated in internal medicine consultation in Spain. The presence of disease was defined as atherosclerotic cardiovascular disease (ASCVD), type 2 diabetes mellitus (DM2), and chronic kidney disease. SCORE and SCORE 2-OP risk assessment tables were used and subjects were categorized into low, moderate, high, and very high CVR. The therapeutic objectives followed the ESC/EAS 2019 and ESC 2021 guidelines: LDL-c < 116/100/70/55 mg/dl (according to CVR), systolic blood pressure (SBP) < 130 mmHg,



and HBA1c < 7.0% in diabetics. In those patients who did not achieve the therapeutic objectives, it was documented whether modification or optimization of cardiovascular prevention treatment was made.

### **RESULTS:**

One hundred patients (mean age 62.6 years; 35% women) were included in the analysis. The prevalence of ASCVD was 16%, HTN was 77%, DM2 was 24% and smoking was 11%. The CVR categories were: low (14%), moderate (45%), high (24%), and very high (17%) (ESC/EAS-2019). Applying the SCORE 2-OP tables, the CVR reclassification was as follows: low-moderate (39%), high (35%), and very high (26%). Overall, patients at the therapeutic target of SBP (< 130mmHg) was 60%. Regarding LDL-c ranges, depending on the objectives considered, between 34% (according to ESC/EAS 2019 guide) and 25% (according to ESC 2021 guide). Achievement of the LDL-c target according to CVR level was greater in low-moderate risk patients (42%)

and very high-risk patients (31%) than in high-risk patients (3%) (Figures 1 and 2). Among patients who did not reach the LDL-c goal, therapeutic modifications were made to optimize the CVR control in 44% of patients with very high risk, 27% of those with high risk, and 39% with low-moderate risk.

# **CONCLUSION:**

The degree of achievement of the rapeutic objectives is very low, regardless of the CVR category. It is alarming that more than half of very high-risk patients did not achieve the objective of lipid control and it is especially worrying that in these patients, fewer than half had therapeutic modifications. It is essential to reinforce strategies to achieve established objectives and avoid therapeutic inertia, the lack of proper treatment modification in a timely manner, in the control of CVR patients. Future studies might explore the implementation of precision medicine, through the use of immunometabolic biomarkers for for molecular pathophysiological phenotyping, the
diagnostic complementation of CVR, the monitoring of the therapeutic response, and the identification of molecular targets, for the personalized administration of targeted therapies and treatment modifications.



# Vocal Biomarkers as a Screening Tool for Acute Myocardial Ischemia

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# **OBJECTIVE:**

The purpose of this study is to investigate potential vocal biomarkers for myocardial infarction. We hypothesize that a vocal biomarker may be correlated with a patient's risk of a major adverse cardiac event like in the ED HEART score (history, ECG, age, risk factors and troponin) or EDACS score.<sup>1</sup>

# **BACKGROUND:**

About 5% of all emergency department (ED) visits are for chest pain.<sup>2</sup> While emergency physicians are trained to rule out or identify high morbidity causes of chest pain, like acute myocardial infarction, only about 5% of patients with chest pain have an acute life-threatening condition. Studies suggest that cardiac conditions like coronary artery disease or acute heart failure may be identifiable using vocal biomarkers.<sup>3</sup>

Vocal biomarkers have previously been identified to detect voice, respiratory, and neurological disorders. Even minimal voice problems (i.e., not qualified to be a voice disorder) are detectable using measures of vocal instability, such as the fundamental frequency standard deviation (F0 SD) in prolonged vowel and cepstral peak prominence (CPP) in speech. The cardiac impact on voice can be attributed to systemic water retention and shared innervation and proximity of nerves to associated anatomy.

# **METHODS:**

We have 46 enrolled patients who presented to the ED with a chief complaint of chest pain. Patients were required to be English speakers without hearing impairment. History of voice disorder, neurologic disease, and head or neck cancer or surgery was noted. We recorded in the ED patient care space, vowel sounds, four sentences varying by phonetic types, and 30s of spontaneous speech. HEART and EDACS scores were calculated based on treating providers' clinical risk assessment. Using Praat, we obtained a voice report and calculated CPP for phonetically balanced sentences and F0 SD for vowel sounds. Spearman correlation was calculated for initial troponin and CPP of voiced phonemes. We followed up with patients six weeks after recruitment to identify major cardiac events during or after hospitalization. On chart review, we look at admission, discharge diagnosis, medications, labs, and cardiac testing.

# **RESULTS:**

The average HEART score evaluating the risk of acute coronary syndrome was 3. From the analyzed voice recordings, we report statistically significant Spearman correlation coefficients of 0.3225 for initial troponin and sentence 2 CPP and 0.2986 for initial troponin and sentence 3 CPP. Preliminary analysis using Spearman coefficients show that only sentences 2 and 3, which have more voiced consonants than the other sentences, reveal a relationship between voice and initial troponin.

# **CONCLUSION:**

The use of voice analysis has potential to improve current methods of evaluating chest pain and enhances existing risk stratification tools. Further analysis of the voice recordings is needed to determine any other associations between vocal biomarkers and commonly used risk stratification measures. We will continue processing the recordings along with HEART and EDACS scores to identify potential relationships. Additionally, review of EKGs and timed chart abstractions will also be completed along with machine learning to determine whether voice is a predictor of acute coronary syndrome.

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# Artificial Intelligence Versus Human Assessment: Diagnostic Accuracy of AI-QCT in Coronary CT Angiography Analysis

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Coronary Artery Disease (CAD) affects over 20 million individuals in the United States requiring highly accurate approaches for its detection. Coronary CT angiography (CCTA) is now a first line approach by guidelines.1 However, full whole heart quantitative assessment of atherosclerosis is time consuming and hallmarked by a large interobserver variability2 and overestimation of CAD severity.3 In addition, there is a dearth of expert human CCTA readers in the United States. This study assesses a novel and rapid approach to CAD assessment through artificial intelligence (AI)-based analysis of CCTA, Atherosclerosis Imaging Quantitative Computed Tomography (AI-QCT) (Figure 1), in comparison to human readers.

# **METHODS**

The international study population consisted of 208 patients with stable new-onset chest pain and suspected CAD from the Prospective Comparison of Cardiac PET/CT, SPECT/CT Perfusion Imaging and CT Coronary Angiography With Invasive Coronary Angiography (PACIFIC-1) study.<sup>4</sup> The

cture PRCA	ALL	Current
	ALL mm <sup>2</sup> PAV	444.5
	<ul> <li>Total Non-Calcified Plaque Volume (mm<sup>3</sup>)</li> </ul>	442.3
	Low-Density - Non-Calcified Plaque Volume (mm <sup>3</sup> )	67.8
	Total Calcified Plaque Volume (mm <sup>3</sup> )	2.2
	# of Severe Stenosis	0
	# of Moderate Stenosis	1

**FIGURE 1:** Case example of AI-QCT assessment of CCTA for a 55-year-old man with high cholesterol and chest pain, indicating >50% stenosis with high plaque volume in the right coronary artery as defined by AI-QCT.

CCTA images were interpreted independently by human readers blinded to patient characteristics and independent core laboratory quantitative coronary angiography (QCA) results. Every scan was interpreted by a level 3 (expert) reader and two independent level 2 (basic competency) readers from a separate institution. For every major epicardial vessel, percent stenosis was scored according to the recently updated Society of Cardiovascular Computed Tomography/American College of Cardiology 2022 CAD-RADS 2.0 expert consensus. We evaluated the external performance of AI-QCT versus level 2 and level 3 human readers to predict obstructive CAD when compared to blinded core lab QCA with  $\geq$ 50% stenosis thresholds as reference standards. Predictive performances were assessed using a receiver operating characteristic curve area under the curve (AUC) analysis in a per-patient analysis that accounts for the spectrum of sensitivity and specificity.

# **RESULTS:**

The study population consisted of 208 patients who had a mean age  $58\pm9$  years; 37% were women. To identify obstructive  $\geq$ 50% stenosis on QCA, AI-QCT achieved the highest AUC of 0.91 (95% CI: 0.87-0.95). The level 3 assessment resulted in an AUC of 0.77 (95% CI: 0.70-0.83), which was significantly lower than AI-QCT (p<0.001). The two level 2 readers achieved an AUC of 0.79 (95% CI: 0.72-0.85) and 0.76 (95% CI: 0.69-0.83), which were both also significantly lower than AI-QCT (p<0.001) (Figure 2).

### CONCLUSIONS

Artificial intelligence guided imaging (AI-QCT) demonstrated higher diagnostic accuracy for CAD over traditional basic and expert human CCTA assessment. This positions AI as a valuable tool to augment human readers for future CAD assessment, identification, and prevention.

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**FIGURE 2:** Receiver operating characteristic curve for predicting  $\geq$  50% stenosis. The AUC value represents the model's performance against the reference standard of QCA, while the p-value indicates the significance of the difference in AUC compared to AI-QCT.

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# Dermatology is Trying to be More Inclusive, but Patient-Facing Websites Lag Behind

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Skin self-examination (SSE) has been correlated with early detection of skin cancers; in one study over half of melanoma cases were self-recognized prior to diagnosis.1 Patients often reference photos from online resources to guide SSE prior to medical evaluation, which has been proven to improve the accuracy of self-detecting suspicious lesions.<sup>2</sup> It is critical that the full spectrum of skin tones is represented when displaying online clinical images. The purpose of this study was to evaluate the inclusivity and representation of skin tones in photos of skin cancer on patient-facing websites.

# **METHODS:**

The sources referenced were limited to websites containing information about skin cancer with the domain extensions '.gov' and '.org', including CDC.gov, NIH.gov, skincancer.org, americancancerfund.org, mayoclinic. org, and cancer.org. All photos on skin cancer-related webpages were evaluated. Hyperlinks to outside websites



were excluded.

Within each photo, each individual person or skin was counted separately as a representation. Representations were counted every time they were displayed, and were categorized as per [Figure 1]. The published 5-tone pantone swatch<sup>3</sup> was used by three independent reviewers to categorize representations into "lighter toned skin" (pantones A-B or lighter) or "darker toned skin" (pantones C-E or darker).

# **RESULTS:**

Three hundred seventy-two total representations were identified across the six websites. Of 372 total representations, only 49 depicted darker skin tones (13.2%). Of the 49 representations showing dark skin tones, 44.9% depicted pantone C (n=22), 34.7% depicted pantone D (n=17), and 20.4% depicted pantone E (n=10).

Darker skin tones were infrequently included in skin cancer images [Table 1]. Only 11% (14/127) of non-melanoma skin cancer (NMSC) and 5.8% (3/52) of melanoma skin cancer (MSC) were demonstrated on darker skin tones. No cartoon portrayals of NMSC (0/24) or MSC (0/23) included darker skin tones. Darker skin tones were also infrequently depicted in non-disease representations, including stock photos (22.7%; 32/141) or images on website front pages (26.1%; 6/23). No medical providers represented had a darker skin tone (0/5).

# **CONCLUSION:**

This analysis highlights that even with using a limited though validated skin tone characterization tool, darker skin tones were severely underrepresented in photos of skin cancer on patient-facing websites, comprising less than 13.2% overall. Furthermore, less than 5% of representations depicted pantone D, and less than 3% depicted pantone E or darker.

SSE is an important secondary prevention strategy for skin cancer, yet these data reveal that online resources do not adequately display the diversity of skin cancer presentations. The limited availability of skin cancer depictions on darker skin tones online is especially concerning given the known disparities in morbidity and mortality of said patients with skin cancer.<sup>4</sup> In studies assessing other media types, there is a pattern of

				Ту	/pe of Representa	ition		
		Non-melano	ma skin cancer	Melanom	a skin cancer	Ot	her Website Imag	jes
Website	Total Rep- resentations	Represent- ations of Real Disease	Cartoon Rep- resentations of Disease	Represent- ations of Real Disease	Cartoon Rep- resentations of Disease	Represent- ations in Stock Photos	Represent- ations on Website Front Page	Representa tions of Medical Providers
CDC.gov	22/109 (20.2%)	0/1	0/0	0/1	0/0	22/104	5/16	0/3
Skincancer.org	18/140 (12.9%)	9/88	0/6	2/28	0/0	7/16	0/0	0/2
Americancancerfund.org	1/17 (5.9%)	0/0	0/0	0/12	0/0	1/5	1/5	0/0
Cancer.org	5/35 (14.2%)	4/25	0/0	1/8	0/0	0/2	0/0	0/0
Mayoclinic.org	1/21 (4.8%)	1/9	0/4	0/3	0/5	0/0	0/0	0/0
NIH (cancer.gov)	2/50 (4%)	0/4	0/14	0/0	0/18	2/14	0/2	0/0
TOTAL	49/372 (13.2%)	ĺ			a			-

underrepresenting skin diseases in darker skin tones.<sup>5</sup> There is a tremendous need for improved portrayal of darker skin tones in all media types, especially in patient-facing websites; the current lack of representation could impact patients' ability to self-identify and seek treatment.

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# Association of Atopic Dermatitis Clinical Severity and Morphology with Asthma Prevalence, Onset, and Control

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Asthma is one of the most prevalent and well-recognized comorbidities of Atopic Dermatitis (AD).<sup>1</sup> While previous studies defined the relationship between AD severity and asthma in children, the relationship of AD severity and morphology with asthma in adults is less well defined.

# **OBJECTIVES:**

In this study, we aimed to understand associations of AD severity and lesion morphology with asthma prevalence, age of asthma diagnosis and level of asthma control in adults.

# **METHODS:**

A cross-sectional, dermatology practice-based study of adults was performed (N=252) where patient surveys, patient-reported outcomes, clinical outcomes, and full body skin examination data were collected. Multivariable logistic regression models were constructed to examine relationships between AD severity and AD morphologic characteristics with diagnosedasthma prevalence, age of asthma diagnosis, and level of asthma control. AD severity scales used included Atopic Dermatitis Severity Index, Eczema Area and Severity Index, Patient-Oriented Eczema Measure, Rajka-Langeland score, SCORing Atopic Dermatitis,

and Patient-reported Global Assessment of atopic dermatitis severity. AD morphologic characteristics included lichenification, oozing/crusting, erythema, excoriation, edema/papulation, and xerosis. Multivariable models included sex, age, and race as covariables.

# **RESULTS:**

Overall, 252 adults (ages 8-94 years) were included in the study. Among patients in the study, 84.1% had a selfreported diagnosis of asthma. More severe AD was not associated with prevalence of comorbid asthma, adult age of asthma diagnosis, nor poor asthma control. Additionally, AD morphologic characteristics were not associated with the prevalence of comorbid asthma, adult age of asthma diagnosis, nor poor asthma control.

# **CONCLUSIONS:**

AD severity and morphological characteristics were not consistently associated with comorbid asthma prevalence, age of asthma diagnosis, or level of asthma control among adult AD patients. These results show that AD is

AD severity and morphological characteristics were not consistently associated with comorbid asthma prevalence, age of asthma diagnosis, or level of asthma control among adult AD patients.

> not as strongly associated with asthma in adults than previously observed in children.

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# Cannabinoid Hyperemesis Syndrome and Health Care Utilization: A Cross-Sectional Survey Study

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# BACKGROUND AND OBJECTIVES:

Cannabinoid Hyperemesis Syndrome (CHS) is a condition characterized by gastrointestinal distress in patients who are long-term regular consumers of cannabis. Due to the severity of the symptoms, CHS patients often receive

In this internet-based cross-sectional study, participants with a self-reported CHS diagnosis were found to have a high rate of health care resource utilization.

extensive diagnostic testing and may require hospitalization for pain control, antiemetics, and hydration. The prevalence of CHS is projected to increase as more people consume cannabis on a regular basis in the United States.<sup>1,2</sup> The objective of our study was to estimate the health care resource utilization among CHS patients.

# **METHODS:**

We performed an internet-based crosssectional survey of adult cannabis users with a self-reported CHS diagnosis. Participant responses were collected using REDCap electronic data capture tools hosted at the George Washington University School of Medicine and Health Sciences.<sup>3,4</sup> The survey was distributed via posts in two "private" Facebook-based CHS awareness and support groups and the following CHS-focused subreddits: r/CHSline, r/CHSinfo, and r/cannabinoidhyperemesis. In addition, the survey was posted on Twitter (via the @cannabinoidhs account) and on the "drug research" discussion forum of Bluelight on-line drug forum. Participants were included if they were at least 18 years old and self-identified as having CHS. The purpose of this study was to estimate the percent of participants who required hospitalization, emergency

> department (ED) care, medical interventions such as intravenous (IV) fluids, and diagnostic testing such as a laboratory blood study, CT scan, ultrasound, upper endoscopy, or colonoscopy.

# **RESULTS:**

In our survey of adult cannabis users with a self-reported diagnosis of CHS, we analyzed 1,475 participant responses collected between May 2023 and September 2023. Among all respondents, 83.9% required care in an ED setting and almost half (44.8%) reported staying overnight in a hospital at least once. The vast majority of respondents had received laboratory blood tests (84.3%) and IV fluids (80.9%). Respondents reported high rates of receiving a CT scan (63.7%), ultrasound (48.8%), upper endoscopy (45.3%), and colonoscopy (22.3%).

# **CONCLUSION:**

In this internet-based cross-sectional study, participants with a self-reported CHS diagnosis were found to have a high rate of health care resource utilization. These results emphasize the personal and system-wide burden of CHS in the U.S. and underline efforts to increase awareness of the syndrome among patients and Health care practitioners.

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# Sequencing of blood RNA from INOCA Patients Identifies Changes in Innate, Invariant, and Acquired Immune Pathways: Potential Autoimmune Microvascular Dysfunction

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7. True Bearing Diagnostics

# **BACKGROUND:**

Ischemia with non-obstructive coronary arteries (INOCA) is an important clinical entity involving coronary microvasculature dysfunction (CMD) and/or vasospasm of the coronary arteries or arterioles. Approximately 20–30% of patients presenting with non-acute chest pain are affected by INOCA, which is diagnosed by undergoing tests often including a cardiac stress test, ultrasound imaging, and invasive coronary angiography (ICA) or CT angiography (CTA). INOCA could



**FIGURE 1:** Schematic of study design. On the basis of the stress test and ICA results, patients were categorized into Control (normal stress test and no coronary stenosis >20%), INOCA (abnormal stress test and no coronary stenosis >20%), CAD (normal stress test and coronary stenosis >20%), as well as a Double Positive group (stress+/ICA+). Prior to ICA, a blood sample (3 ml) was drawn into Tempus blood RNA stabilizer, and frozen at -80°C until it was analyzed by Illumina Total RNAseq.

progress to angina with no obstructive coronary arteries (ANOCA) and myocardial infarction NOCA (MINOCA). An estimated 3-4 million individuals in the United States are affected with INOCA, with females having a greater prevalence.1 Females with INOCA demonstrate elevated ultra-high sensitivity Troponin I levels, suggesting chronic, low-grade cardiomyocyte damage.<sup>2</sup> Additionally, about half of systemic lupus erythematosus (SLE) patients with suspected INOCA demonstrate CMD.3 Both MINOCA and INOCA are related to poor long-term outcomes, including heart failure.<sup>4</sup> Currently,

major trials are underway, such as the WARRIOR trial, to compare aggressive interventions to slow or reverse the progression of INOCA in females.<sup>5</sup> Despite the substantial clinical impact, there is a rudimentary understanding of the mechanism of INOCA, and thus, the present studies were undertaken to generate new hypotheses about the pathways involved.

# **OBJECTIVE:**

The goal of this study is to better understand the molecular and cellular

expression profile of INOCA by analyzing complete transcriptome analysis of whole blood RNA in a large cohort of patients with both stress test and elective invasive coronary angiography (ICA).

### **METHODS:**

Sequencing of whole blood RNA (Illumina) from 177 patients was conducted and grouped into 40 patients (23%) with INOCA (stress+/ICA-) compared to 39 controls (stress-/ ICA-) (Figure 1). CAD related transcripts were identified by comparing 38 stress-/ICA+ to control. Differentially expressed genes (DEGs) were identified with DeSeq2 and analyzed for the pathways and cell types involved using gene ontology and Blood Atlas.

#### **RESULTS:**

The INOCA analysis identified 199 DEGs with a greater than [1.5]-fold increase compared to control, 66 of which were upregulated and 133 downregulated. In INOCA, elevated transcripts from mucosal-associated invariant T (MAIT) cells, plasmacytoid dendritic cells (pcDC), and memory B-cells were observed that have been identified in other autoimmune-related diseases such as rheumatoid arthritis (Figure 2). Decreased transcripts were associated with neutrophils and monocytes, but cell-specific markers indicated normal abundance of these cells. Some transcripts were sensitive to sex, with changes greater in females. The ICA+ CAD analysis identified 181 DEGs with a greater than [1.5]-fold increase compared to control, 104 of which were upregulated and 77 downregulated. ICA+ CAD transcripts had some overlap, but were related to T cell functions, indicating both shared and



**FIGURE 2:** RNAseq of whole blood from patients with INOCA indicated involvement of innate neutrophils, adaptive B cells, and mucosal-associated invariant T cells (MAIT). Patients with coronary artery disease (CAD) identified T regulatory cells and monocytederived foam cells.

unique pathways involved in CAD and INOCA.

### **CONCLUSIONS:**

Elevated transcripts related to pcDC, MAIT, and B cells suggests an autoimmune component to INOCA. The reduced neutrophil transcripts are likely attributed to chronic activation leading to increased translational degradation. Neutrophil extracellular traps (NETs) have well documented adverse effects on microvascular integrity. Thus, INOCA may be an autoimmune syndrome in which an immune trigger initiates B cell, pcDC, MAIT, and neutrophil activation that compromises cardiac microvascular function via thrombosis and NETosis. Further studies investigating the immune system's contribution to the molecular pathology of INOCA may uncover biomarkers for early detection and biological targets for drug development, which could ultimately reduce the incidence of heart failure and improve long-term outcomes.

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# Characterizing the Effect of JAK Inhibition on CMV Virus-specific T-cell Function

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Adoptive immunotherapy using donorderived virus-specific T cells (VSTs) in the setting of hematopoietic stem cell transplant (HSCT) has shown efficacy in reducing infectious complications in several Phase 1 and 2 trials.1 However, graft-versus-host disease (GVHD) remains a frequent comorbidity in recipients of HSCT, requiring the use of immunosuppressive therapy.<sup>2</sup> JAK inhibitors such as ruxolitinib are a class of immunomodulators that suppress interferon and interleukin signaling to treat GVHD, but studies have shown frequent cytomegalovirus (CMV) reactivation, presenting a tradeoff between immunity against viral infections and the prevention and treatment of GVHD.3-5 The impact of JAK inhibition on VSTs is not well defined. and this study aimed to assess the cellmediated immune response of CMV VSTs exposed to ruxolitinib.

# **METHODS:**

CMV VSTs were generated from peripheral blood mononuclear cells isolated from a CMV seropositive donor via a micro expansion protocol. Antigen specificity was achieved by pulsing



FIGURE1: IFN-γ ELISpot for CMV VSTs.

antigen-presenting cells with overlapping peptide libraries for the immunodominant CMV antigens pp65 and IE1 (JPT Peptide Technologies, Berlin, Germany), followed by a 10-day incubation with IL-2, IL-4, and IL-7. Cells were expanded in increasing concentrations of ruxolitinib, with CTL media (45% RPMI (Hyclone), 45% Clicks (Irvine Scientific, Santa Ana, CA, USA) plus 10% human serum and GlutaMAX) and DMSO serving as negative controls. CMV-specific cytotoxicity was assessed using IFN-y enzyme-linked immunospot (ELISpot) stimulated with actin, staphylococcal enterotoxin B (SEB), pp65, and IE1. Spot-forming units (SFU) were enumerated by ZellNet Consulting, Inc. (Fort Lee, NJ, USA). Immunophenotype and function was evaluated using flow cytometry identifying cell surface markers (CD56, CD3, CD4, CD8, TCR- $\gamma\delta$ , TCR- $\alpha\beta$ , CCR7, CD45RO) and intracellular staining of IFN- $\gamma$ +/TNF- $\alpha$ + CMV-specific T-cells. Prior to flow cytometry, VSTs exposed to ruxolitinib were split into their respective ruxolitinib concentrations and CTL media without ruxolitinib to assess if cytotoxicity could be recapitulated if ruxolitinib was removed from growth medium.

# **RESULTS:**

Cell proliferation in the presence of ruxolitinib was significantly impaired at concentrations higher than 100 nM. ELISpot analysis showed CMVspecificity at concentrations between 10 nM and 100 nM, with reduced IFN- $\gamma$ expression at higher concentrations (Figure 1). Flow cytometry analysis

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showed limited CD8+ cell proliferation. IFN- $\gamma$ +/TNF- $\alpha$ + CD4+ T-Cells were less predominant at higher concentrations of ruxolitinib (51% at 0 nM, 50.8% at 10 nM, 25.6% at 25 nM). Analysis of memory cell phenotypes showed increased prevalence of naïve T cells (CD45RO-/CCR7+) in both CD4+ and CD8+ cells (Figure 2). Differences between cells re-stimulated in complete growth media and ruxolitinib media on flow cytometry were negligible.

### **DISCUSSION:**

In concordance with the mechanism of action of ruxolitinib, VST expansion, differentiation, and function is impaired with reduced JAK-STAT mediated cytokine signaling. The increased incidence of infectious complications observed with ruxolitinib for GVHD could be attributed to diminished CD4+ Th1 cell activity, which are important for cell-mediated immune responses to intracellular pathogens. Impaired CD8+ proliferation could be due to absence of IL-2 in media, limiting conclusions that can be made from these subpopulations. Further studies to characterize VST function in the presence of ruxolitinib could include modifying cytokine for expansion, prolonging the rest period



**FIGURE:** Naïve, central memory, and effector memory subsets for CD4<sup>+</sup> and CD8<sup>+</sup> T-cells.

before conducting flow cytometry, and alternate staining targets to assess function such as STAT3.

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# The Potential Therapeutic Role of MDMA as a Healing Modality for Unaddressed Mental Suffering and PTSD: A Case Study

### Benjamin Taber, MSIII

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# **PURPOSE:**

To demonstrate the potential therapeutic roles of MDMA as a healing modality for unaddressed mental suffering and PTSD.

# **METHODS:**

We present the case of a patient with longstanding and debilitating peripheral neuropathy, anxiety, fatigue, insomnia, brain fog, and post-traumatic stress disorder (PTSD) with several failed trials of multiple pain medications, selective serotonin reuptake inhibitors (SSRIs), and antipsychotics prescribed by eight different psychiatrists, who was also seen by over a dozen different physicians including rheumatologists, neurologists, functional medicine and regenerative doctors across a span of five years. The patient subsequently participated in an MDMA psychotherapy healing ceremony during the winter of 2022. This ceremony was preceded by the oral intake of Ketamine 30 minutes prior, with the goal of increasing receptivity and openness to the MDMA experience. Additionally, a harm reduction protocol was implemented and included supplements taken both before and after the ceremony. This protocol is outlined in Figure 1.

Italics and underline indicate optional.

#### 6 hours before:

200mg (2 pills, normally) Magnesium Glycinate ~1x Glass of Grapefruit Juice

#### 1-3 hours before:

100mg Na-R-ALA (When buying, make sure it is Na-R-ALA, not R-ALA) 200mg <u>Magnesium Glycinate</u> 1000mg Vitamin-C (e.g. 1x Emergen-C packet) 100mg <u>Grape Seed Extract</u> ~1x Glass of Grapefruit Juice

#### 30 mins before:

1x Tums/Rolaids (Not for harm reduction, unlike other supplements. Increases stomach alkalinity which prolongs the roll)

#### 2 hours after dosing:

100mg <u>Na-R-ALA</u> 200mg <u>Magnesium Glycinate</u> 1000mg <u>Vitamin-C</u> 100mg <u>Grape Seed Extract</u>

4 hours after dosing: 100mg <u>Na-R-ALA</u>

The following 3-7 nights: <u>100mg 5-HTP</u> <u>400mg EGCG</u>

**FIGURE:** The healing ceremony was preceded by the oral intake of Ketamine 30 minutes before, increasing receptivity and openness to the MDMA experience. Additionally, this protocol was implemented both before and after the ceremony with the goal of harm reduction for the patient.

# **RESULTS:**

After the ceremony, the patient shared a journal entry outlining their profound experience while on MDMA. They discussed vivid and detailed explorations of the underlying sources of their suffering and trauma. The patient also expanded on the perspective the experience provided and discussed realizations they attained regarding forgiveness and steps for additional healing. Over the following months, the patient was able to find their way to constitutional homeopathy, reporting significant decreases in symptoms of anxiety and mental suffering.

# **CONCLUSIONS:**

Our case demonstrates the tremendous potential of psychedelic healing ceremonies as a unique opportunity for patients to better explore, understand, process, and cope with underlying and unaddressed mental suffering. These highly individualized ceremonies establish and foster conditions appropriately suited for individual growth and profound emotional healing.1 Psychedelic psychotherapy offers a broader and more holistic means of treating unaddressed suffering and assists in restoring equilibrium and overall well-being.

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# EEG Predictors of Neurologic Injury in Patients Undergoing Extracorporeal Membrane Oxygenation

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To assess electrographic associations of brain injury in children undergoing extracorporeal membrane oxygenation (ECMO).

# **METHODS:**

Retrospective review of patients on ECMO in the pediatric and cardiac intensive care units (PICU/CICU) at Children's National Hospital from August 2019 to December 2022. We included the first ECMO run and evaluated the first 24 hours of EEG. Patients with known cerebral injury were excluded. Clinical variables included age, sex, ECMO indication, presence or absence of congenital heart disease, duration on ECMO, ECMO type (venoarterial (VA)/veno-venous (VV)), electrographic seizures (ES), and cerebral injury. A chi-squared test was used to assess the association of EEG features, ES, and cerebral injury.

# **RESULTS:**

We included 112 patients, median age 2.7 (Interquartile range(IQR) 0.4-31.2) months and 44% were female. The most common indication for ECMO was cardiopulmonary arrest (45%) and 84% had congenital heart disease. Nineteen percent were admitted to the PICU and 81% were admitted to the CICU with a median duration on ECMO of 85.3 hours (IQR 49.1-155.6). VA ECMO was the most common approach to cannulation (90%). A mildly abnormal EEG background was the most common finding (77%) and 38% had ES. Fiftythree percent had cerebral injury and the most common injury was anoxic (56%%, 33/59). A severely abnormal EEG background (p=0.028) and presence of ES (p<0.0001) was associated with cerebral injury.

# **CONCLUSION:**

Severity of EEG background and presence of ES is associated with cerebral injury in patients on ECMO. The ability of these features to predict the type and degree of cerebral injury remains unclear.

# Benchmarking Automated Segmentation of Postoperative Lesion Volumes in Pediatric Focal Cortical Dysplasia-related Epilepsy

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Focal cortical dysplasia (FCD) is the most common cause of surgically treatable, pediatric pharmacoresistant epilepsy (PRE)1. FCDs can be difficult to resect due to subtleties in lesion demarcation on MRI imaging; complete resection can confer seizure-free status2. DeepResection, an algorithm that automatically segments postoperative resection cavities on MRI images, can help predict postsurgical seizure outcomes3. We predict a median Dice Similarity Coefficient (DSC), which calculates percent overlap between manual and automated masks, of >0.90 between manual and DeepResection segmentations in postoperative pediatric images. We also hypothesize patients will display postoperative seizure freedom status (Engel Class I) when DeepResection produces high accuracy masks (DSC >0.90).

# **METHODS:**

We conducted a retrospective review of patients from 2006 to 2021 who underwent lesional operations from

TABLE:	Demographic Information	

Demogra		
		N=88 (%)
Demographic vari	ables	
	Female	40 (45.5)
	Male	48 (54.5)
Age (years)		
	Seizure onset, median (IQR)	2 (0.5-5)
	Surgery, median (IQR)	8.5 (5.1-14.2)
Engel		
	Class I	63 (71.6)
	Class II-IV	25 (28.4)
Pathology		
	Right-sided dysplasia	48 (54.5)
	Left-sided dysplasia	40 (45.5)
FCD Туре		·
	1	6 (6.8)
	IA	3 (3.4)
	IB	10 (11.4)
	IC	4 (4.5)
	11	2 (2.3)
	IIA	34 (38.6)
	IIB	20 (22.7)
	III	1 (1.1)
	IIIA	4 (4.5)
	Unknown	4 (4.5)
Resection area	· · · · · · · · · · · · · · · · · · ·	
	Temporal	35 (39.8)
	Frontal	30 (34.1)
	Parietal	12 (13.6)
	Occipital	2 (2.3)
	Multilobar	9 (10.2)

an epilepsy surgery database maintained by Children's National Hospital. Patients were included if they had a history of PRE and received a postoperative MRI. Postoperative images were manually masked using FSLeyes. The same images were run through the DeepResection algorithm. DeepResection mask accuracy was determined by DSC. 88 subjects met inclusion criteria. Demographic information is provided in Table 1.

### **RESULTS:**

DeepResection segmented 71 subjects and failed on 17. 34 of the automated masks overlapped with manually drawn masks. 37 automated masks were drawn outside of the resection cavity. DeepResection masks in axial orientation (n=29) had the highest median DSC (0.62, IQR 0.31-0.71) compared to coronal (0.36), sagittal (0.50) or majority vote (0.49). Axial masks were not produced in 5 subjects where masks in other orientations were produced. Of the 34 automated masks detectable by DSC, there were 30 temporal resections, 1 parietal resection and 3 hemispherectomies. DeepResection segmentation failed in subjects with frontal, occipital or multilobar resections. We defined a false negative as DeepResection failing to produce a mask and false positive as DeepResection producing a mask outside the resection cavity. There were 17 false negatives and 37 false positives.

### **CONCLUSIONS:**

We could not validate DeepResection on postoperative images in pediatric FCD-related epilepsy. Consistent with the pilot study by Arnold et al. (2022), DeepResection successfully segmented temporal resections. However, the algorithm was unable to produce masks on extratemporal resections.

DeepResection was originally trained against temporal lobe epilepsy (TLE), which is common in adult resection (79.0%) but less common in children (46.4%)4. For this reason, our high false positive and negative results in pediatric extratemporal and multilobar resections may be due to training DeepResection on adult TLE cases. Variability in pediatric images could explain why DeepResection produced fewer masks and had lower median DSC with our subjects. Several potential sources of this variability include areas of swelling, cystic lesions, and resections at ventricular margins, which could have introduced error during manual or automated segmentation. Pediatric neuroimaging encompasses numerous dynamic stages of brain development, so DeepResection's performance may have suffered by training on a more static adult population. We were unable to test our second hypothesis examining postoperative seizure freedom for subjects whose masks demonstrate high DSC (>0.90) since we were unable to obtain any automated masks with a DSC above 0.90.

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# Controlling A Non-invasive Upper-Limb Prosthetic Device via a Machine-Learning Assisted Brain-Computer Interface

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The goal of our research was to improve the accessibility of current upper-limb prostheses. We aimed to maintain non-invasive aspects of Electroencephalography (EEG), use affordable material and resources, and match the accuracy and control of conventional prostheses alongside improved training methods.

Our process began with us designing a method of data collection that uses a

3D-printed headset with dry electrodes to record brain signal data through EEG software. We then analyzed the signals, applied preprocessing to reduce noise, and used machine learning (ML)

models to classify EEG signals with respect to specific actions such as the opening and closing of a hand. Finally, we constructed a 3D-printed hand that is actuated by servos with Arduino to demonstrate the physical actions interpreted through analysis, and we leveraged novel techniques to build a virtual reality (VR) analyzing that data through an algorithm, and actuating a prosthetic arm with actions interpreted from the brain signals all in real-time. Moving forward, there is room to increase

Moving forward, there is room to increase accessibility and quality of prostheses through further development of non-invasive brain-computer interface (BCI) based technology for 3D-printed prostheses and VR environment prosthetic models.

environment to serve as a tool for prosthetic rehabilitation.

We successfully met the goals set for data collection and prosthetic arm actuation. Additionally, we have created a functional algorithm for action prediction but were not able to achieve the desired accuracy.

Overall, we achieved our primary goal of collecting brain signal data,

accessibility and quality of prostheses through further development of noninvasive brain-computer interface (BCI) based technology for 3D-printed prostheses and VR environment prosthetic models.

# Role of Ethnicity on Metabolic Dysfunction in Patients on Antipsychotics

### Meghan Tveit, MSIII

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# **BACKGROUND:**

Metabolic syndrome describes a constellation of symptoms such as hyperlipidemia, central obesity, hypertension, insulin resistance, changes in appetite, and subsequent weight gain. In this paper, we aim to elucidate the connection between ethnic background on metabolic dysfunction in the setting of antipsychotic medication use.

# **METHODS:**

A review of the PubMed database was conducted and relevant articles were identified and analyzed. Starting with the search, Ethnicity and Metabolic Syndrome and Antipsychotics, a landmark double-blind, randomized trial of aripiprazole (N=155) and olanzapine (N=159) in patients of different ethnic backgrounds was identified.<sup>1</sup> Two additional studies that specifically looked at the metabolic impact of antipsychotics on Japanese,<sup>2</sup> Mexican, and Colombian<sup>3</sup> populations were included.

# **KEY THEMES:**

Overall, these studies have shown that race may be an important moderator of metabolic risk during atypical

antipsychotic therapy. Interestingly, the influence of race on metabolic dysfunction appears to be more significant with aripiprazole, compared to olanzapine. One postulated reason for this is that because olanzapine is already associated with greater metabolic risk, the role of race may be overshadowed or not observable. However, in a separate study<sup>4</sup> clozapine, which is traditionally associated with greater metabolic risk, proved to have a large influence of race on metabolic outcomes. Therefore, the predetermined risk of metabolic syndrome may not actually inform the impact of race on patient outcomes.

When looking at specific ethnic populations (Japanese, Mexican, and Colombian), it is evident that race may play a role in the metabolic response to antipsychotic medications. In the Japanese popula-

tion, one study demonstrated that the prevalence and severity of metabolic syndrome did not differ between subjects on antipsychotics compared to controls. Conversely, in a study looking at Mexican versus Colombian patients on antipsychotics, researchers found a statistically significant higher degree of impact on the BMI of Mexican patients exposed to antipsychotics in comparison to Colombian patients.

# SIGNIFICANCE:

There are many different options when it comes to the treatment of psychotic disorders. Oftentimes as physicians we are making decisions on medication based on side-effects, efficacy, costs, and risks versus benefits. By expanding our understanding of the role of one's ethnic background on a significant side effect of antipsychotics, like metabolic syndrome, it will help to guide the medication decision making process.

**KEYWORDS:** Ethnicity, Metabolic Syndrome, Antipsychotics

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Oftentimes as physicians we are making decisions on medication based on side-effects, efficacy, costs, and risks versus benefits.

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# Uterine Transplant for the Transgender Patient Population: A New Horizon in Gender-Affirming Care

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Uterine transplantation (UTx) is a rapidly developing field that has important implications for the transgender population. The growing number of individuals identifying as transgender, including over 1.6 million individuals in the United States, necessitates redefining gender-affirming medical care.<sup>1</sup> The primary focus of UTx thus far has been on cis-gender women who suffer from infertility. There has been little research done on its application to transgender women and its potential to transform a part of gender-affirming care.

# **METHODS:**

We conducted a PubMed review from 2013 to 2023 on the success of past UTx procedures in cisgender women and applications to transgender individuals. The research terms used included "uterine transplantation," "gender affirmation," and "transgender." This yielded 50 results spanning clinical trials, meta-analyses, RCTs, reviews, and systematic reviews.

# **RESULTS:**

Currently, there has not been a successful UTx done in a maleto-female (MtF) individual. Special considerations in MtF individuals receiving a UTx include anatomical a n d h or m on a l differences, infertility,

and long-term immunosuppression leading to infection

risk and safety concerns for the fetus in any pregnancies following transplantation. Stringent donor selection requirements limiting viable donor availability as well as bioethical concerns of extending the right to reproductive liberty to the transgender population and prioritization between cisgender women and transgender individuals also remain a challenge.

# **CONCLUSION:**

The novelty of the UTx procedure and the added considerations of transgender

individuals have limited its success thus far. However, rapid advancements in the field are promising for successful outcomes with the incredible capacity to not only redefine gender identity as a social concept but also to redefine the standard of medical care for women's reproductive health. The success of transgender UTx requires further

The success of transgender UTx requires further funding and research on immunosuppression and post-operative management in transgender individuals compared to their cisgender counterparts receiving the same procedure.

> funding and research on immunosuppression and post-operative management in transgender individuals compared to their cisgender counterparts receiving the same procedure.

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# Transfusion Trends in the Obstetric Population with Analysis of a Soft Stop Transfusion EMR Alert

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Blood product transfusion plays an important role in treating obstetric hemorrhage, which is the leading cause of maternal mortality worldwide.<sup>1</sup> Obstetric transfusion practices are varied, and research in this area is limited. The recent advent of Electronic Medical Record (EMR) soft stop transfusion alerts has the potential to limit unnecessary transfusions in patients. Analysis of overall transfusion trends in the obstetric population and with respect to EMR alerts may inform further research and guidelines.

# **OBJECTIVE(S):**

This study aimed to analyze transfusion trends in the obstetric patient population before and after the implementation of a soft stop EMR alert for patients with a hemoglobin greater than 8 g/dL at a large university-affiliated hospital.

# **STUDY DESIGN:**

The study included 17,744 patients who delivered at the hospital between February 2015 and December 2022. **TABLE:** Descriptive statistics for obstetric patients who received transfusions in cohort 1 (Feb. 2015–Jan. 2022) and cohort 2 (Feb. 2022–Dec. 2022). Also includes descriptive statistics for obstetric patients who received transfusions in cohort 1 (Feb. 2015–Jan. 2022) and cohort 2 (Feb. 2022–Dec. 2022) stratified by number of units received.

	,		Feb. 2015-	Feb. 2022-	N (
			Jan. 2022	Dec. 2022	(transfusion only)
n			1/0	38	208
Average pre	-hematocrit (%	) -	34.2	34.9	34.3
Median pre-	hematocrit (%	)	34.9	34.3	24.7
Standard De	ev. pre-hemato	crit (%)	4.5	4.1	4.4
Average pos	t-hematocrit (°	%)	27.2	27.2	27.2
Median pos	t-hematocrit (%	6)	26.8	27.7	26.9
Standard De	ev. post-hemat	ocrit (%)	5.0	5.0	5.0
Average # u	nits transfused		2.9	2.0	2.7
Median # ur	nits transfused		2.0	1.5	2
Standard # ι	inits transfuse	d	4.3	2.0	4.0
1 unit		n	79	19	98
	pre	mean	34.6	34.5	34.6
		med	35.5	34.2	35.1
		std	4.4	3.8	4.3
	post	mean	27.2	26.6	27.1
		med	27	25.9	26.6
		std	4.9	4.1	4.7
2 units		n	55	13	72
	pre	mean	34.4	35.6	34.5
		med	35.3	37	35.5
		Std. dev.	4.7	4.8	4.6
	post	mean	26.9	27.8	27.2
		med	26.1	29	26.7
		Std. dev.	5.1	6.0	5.2
3+ units		n	34	4	38
	pre	mean	32.9	35.8	33.2
		med	33.3	35.1	33.8
		Std. dev.	4.4	2.3	4.4
	post	mean	27.4	27.3	27.4
		med	28.1	30.2	28.2
		Std. dev.	4.9	6.3	5.1

The EMR soft stop alert was implemented in February 2022. Patients were split into two cohorts: those prior to and those following the date of alert implementation. Records of hematocrit values and transfusion were pulled from the electronic medical record. Transfusion data included packed red blood cells, thawed plasma, and platelets. Means and medians were calculated for hematocrit drawn closest to admission, hematocrit drawn closest to discharge, and number of units transfused for both time periods. Data was further stratified by the number of units received, and the same descriptive statistics were performed.

### **RESULTS:**

Of the 17,744 patients included in the study, 208 received postpartum transfusions of packed red blood cells (pRBCs), fresh frozen plasma (FFP), and/or platelets. The average estimated blood loss (EBL) was 1996  $\pm$  1505 mL (range: 150-1505). 170 participants were included in Cohort 1 from February 2015 through January 2022. 38 participants were included in Cohort 2 from February 2022 through December 2022. Table 1 shows that the average number of units transfused was lower in Cohort 2 compared to Cohort 1. Cohorts 1 and 2 had an equal average hematocrit closest to discharge, although the results between cohorts are not markedly different. The average hematocrit closest to discharge for the total population was  $27.2\% \pm 5.0$ . Broken down by blood product units received, the average hematocrit closest to discharge for the total population was 27.1% ± 4.7, 27.2% ± 5.2, and 27.4%  $\pm$  5.1 for 1 unit, 2 units, and 3+ units, respectively (Table 1).

### CONCLUSION(S):

Our findings demonstrate a decrease in the total number of units transfused after the EMR soft stop was implemented. While many factors influence the decision to transfuse, this alert may correlate with a reduction in the number of transfusions in obstetric patients. The average hematocrit closest to discharge was around 27%. However, the EMR soft stop alert occurs at a hemoglobin of 8 g/dL, which when converted using the 3:1 ratio, correlates to a hematocrit of 24%. More research is needed to guide transfusion practices, including analysis of intrapartum transfusion with respect to postpartum transfusion.

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# Does Unfractionated Heparin Versus Low Molecular Weight Heparin for Thromboprophylaxis Reduce Complications Near Delivery?

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To analyze whether the conversion of pregnant patients from low molecular weight heparin (LMWH) to unfractionated heparin (UFH) prior to delivery results in improved outcomes and harm reduction.

# **METHODS:**

A retrospective chart review was conducted using data from 141 pregnant patients who delivered at a single university-affiliated hospital from January 2015 to September 2022 and were on LMWH or UFH during their pregnancy up until delivery. The primary outcome was the prevalence of hemorrhage associated morbidity in patients who were switched from LMWH to UFH prior to delivery. Secondary outcomes included neuraxial (NA) anesthesia complications, specifically related to anticoagulant use.

# **RESULTS:**

Out of a total of 141 patients, 38 were converted from LMWH to UFH prior to delivery. The conversion and nonconversion groups had comparable rates of postpartum hemorrhage during delivery (5.3% vs 14.6% respectively, aOR = 0.42, 95% CI 0.09-2.05, p=0.29). Conversion and non-conversion groups have no difference in estimated blood loss (406.7  $\pm$  53.0 vs 562.6  $\pm$  73.1 mL, p=0.98) or quantitative blood loss (655.9  $\pm$  296.6 vs 667.4  $\pm$  62.3 mL, p=0.89). Only two patients in the LMWH group experienced NA anesthesia complications, but these were unrelated to anticoagulant use (headaches).

# **CONCLUSION:**

Our findings demonstrate that there is not a significant difference in postpartum hemorrhage in pregnant patients who were switched from LMWH to UFH prior to delivery compared to those who were not switched. The prevalence of NA anesthesia complications was not high enough to be comparable and unrelated to a bleeding complication. Based on these findings, further investigation with a larger patient cohort could validate our findings and prompt governing bodies to re-examine the guidelines that recommend that switch.

# Socioeconomic Trends in Immunotherapy for Muscle-Invasive Bladder Cancer cT2-4N0M0

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Muscle-invasive bladder cancer (MIBC), the most expensive malignant tumor to treat in the United States,<sup>1</sup> constitutes about 25% of bladder cancer cases. Considering MIBC's heavy financial burden, insurance coverage has become an increasingly important aspect of coordinating patient care.<sup>2</sup> Compared with privately insured patients, bladder cancer patients with Medicaid or no insurance are more likely to be diagnosed with more advanced disease (cT3-4, cN1+, cM1).<sup>3</sup> Similarly, studies have found that socioeconomically disadvantaged bladder cancer patients receive fewer definitive treatments.<sup>4</sup> With the introduction of immunotherapy into treatment guidelines for specific MIBC cases, it's critical to understand how patient socioeconomic factors influence immunotherapy utilization in MIBC. This study examined trends in chemotherapy and immunotherapy use based on patientlevel factors, potentially elucidating disparities in modern MIBC treatment.

### **METHODS:**

Using the National Cancer Database (NCBD), we identified cT2-4N0M0



**FIGURE:** Kaplan-Meier Plot of Overall Survival in Muscle Invasive Bladder Cancer Treated with Radical Cystectomy and Perioperative Chemotherapy or Immunotherapy.

patients from 2004 to 2019. Patients were included in the analysis if they had: (1) urothelial histology; (2) available demographic information; and (3) underwent radical cystectomy (RC) with either perioperative chemotherapy or immunotherapy as primary treatment. Of a total of 30,286 patients who underwent RC, 7,660 had neoadjuvant chemotherapy, 5,217 had adjuvant chemotherapy, 162 had neoadjuvant immunotherapy, 167 had adjuvant immunotherapy, and 333 had both chemotherapy and immunotherapy. Multivariable logistic regression was used to assess the impact of age, sex, race, insurance, region, facility location, facility type, high school graduation rates (Q1-2 vs Q3-4), Charlson-Deyo comorbidity index (CDCC), facility distance, and income (Q1-2 vs Q3-4) on the type of therapy received. Two-sample t-test and Chi-square were

used to calculate p-values. Overall survival for chemotherapy plus RC vs. immunotherapy plus RC were compared using the Kaplan-Meier method.

### **RESULTS:**

Compared to chemotherapy, patients treated with immunotherapy were older (Median Age: 72 years vs 66 years, p<0.001), lived farther from treatment facilities (p=0.003), had higher income (p<0.001) and CDCC (p=0.001), and had more Medicare coverage than private insurance (p<0.001) (Table 1). Median survival between perioperative chemotherapy and immunotherapy was not statistically significant (Figure 1). Sociodemographic factors associated with higher odds of receiving immunotherapy versus chemotherapy included a CDCC score of 3+ (OR 1.938,

p=0.004) and treatment at academic facilities, although this association was not statistically significant (OR 1.253, p=0.057). The odds of patients with low median household income receiving immunotherapy were significantly decreased (OR 0.536, p<0.001). Patients were less likely to be treated with RC and immunotherapy if they had to travel > 30 miles to their treatment facility compared to those who lived within a 10-mile radius (OR 1.862, p<0.001).

### **CONCLUSIONS:**

Immunotherapy is a promising treatment option for select patients with non-metastatic MIBC. In this study, we found comparable overall survival benefits between chemotherapy and immunotherapy despite statistically significant differences in baseline comorbidities between treatment groups. Our study also demonstrated that sociodemographic factors influence treatment selection. A large number of patients treated with immunotherapy traveled greater distances (>30-mile radius) than patients treated with chemotherapy, and immunotherapy was more commonly administered at academic facilities and to patients of higher income. Given that MIBC is the most expensive malignant tumor to treat, changes in policy and practice need to be implemented to decrease treatment disparities and improve patient outcomes.

### **SOURCE OF FUNDING:**

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# Reassessing Glycemic Control: A Novel Method for 90-day Major Complication Stratification Based on Hemoglobin A1c and Same Day Glucose Levels for Patients Undergoing Total Knee Arthroplasty

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Diabetes mellitus (DM) is an independent risk factor for major complications and wound complications following total knee arthroplasty (TKA).1-4 Hemoglobin A1c (HbA1c) is the gold standard marker for glycemic control, with many surgeons using this marker as a pre-operative cut-off for undergoing TKA in order to reduce the risk of complications. Recent evidence suggests that same-day glucose levels, used as a marker for optimization on the day of surgery, may also be predictive for complications following TKA. However, established thresholds for TKA are either non-specific or have a low predictive power. Therefore, the



**FIGURE 1:** Data-driven HbA1C Strata on the Incidence and Relative Risk of 90-day Major Complications. The figure depicts the results of the stratum spcific likelihood ratio on BHbA1c and 90-day major complications following TKA. The bar graph represents the incidence of 90-day major complications for each identified HbA1C strata, while the overlaid line graph represents the relative risk of 90-day mojor complications for each HbA1C strata.

purpose of this study was to create datadriven HbA1c and same-day glucose thresholds that are associated with varying risks of 90-day major complications and 90-day wound complications following TKA.

# **METHODS:**

Patients who underwent primary TKA from 2013 to 2022 were identified in a national database. Patients were only included if they had an HbA1c level within hree months before TKA and a glucose level on the day of TKA. Stratum specific likelihood ratio (SSLR) analysis was conducted to determine data-driven HbA1c and glucose strata that are associated with varying risks of 90-day major and wound complications. The incidence of these complications were recorded for each strata. To control for confounders, each identified strata was then propensity-score matched to the lowest strata based on age, sex, hypertension, heart failure, chronic obstructive pulmonary disorder, and obesity. The risk ratio (RR) for each stratum with respect to the lowest matched stratum was observed.

Continued on p. 60

### **RESULTS:**

In total, 27,350 patients undergoing TKA were included in this study. SSLR analysis identified four data-driven HbA1c strata (4.5-5.9, 6.0-6.4, 6.5-7.9, 8.0+) and two same-day glucose strata (60-189 and 190+) that predicted 90-day major complications. For HbA1c, when compared to the propensity-matched lowest strata (4.5-5.9), the risk of 90-day major complications sequentially increased as the HbA1c strata increased: 6.0-6.4 (RR: 1.23; p=0.024), 6.5-7.9 (RR 1.38; p<0.001), 8.0+ (RR 2.0; p<0.001). For same-day glucose, when compared to the propensity-matched lowest strata (60-189), the 190+ strata had a higher risk of 90-day major complications (RR: 1.18; p=0.016). No HbA1c or same-day glucose strata identified had significantly different risks of 90-day wound complications.

### **CONCLUSION:**

We were able to identify data-driven HbA1c and same-day glucose strata that were associated with varying risks of 90-day major complications but not 90-day wound complications following TKA. The multiple strata identified for HbA1c demonstrate that a single HbA1c cut-off as identified in prior literature may be missing a larger picture for risk stratification. Our multiple HbA1c strata and associated risks can be incorporated with other parameters into a risk-stratifying tool to more accurately predict the risk of 90-day major complications. Additionally, the threshold identified for same-day



**FIGURE 2:** Data-driven Same-day Glucose Strata on the Incidence and Relative Risk of 90-day Major Complications. The figure depicts the results of the stratum-specific likelihood ratio analysis on same-day glucose and 90-day major complications following TKA. The bar graph represents the incidence of 90-day major complications for the two identified same-day glucose strata, while the overlaid line graph represents the relative risk of 90-day major complications.

glucose can be utilized in day-ofsurgery glycemic control guidelines to further reduce the risk of 90-day major complications.

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# No Difference in 10-Year Surgical Complication Rates Following Primary Total Hip Arthroplasty in Patients with Solid Organ Transplant: A Matched Cohort Analysis

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As the life expectancy of solid organ transplant (SOT) recipients increases, more patients are undergoing elective total hip arthroplasty (THA).<sup>1,2</sup> Although previous literature has demonstrated no difference in 2-year implant survivorship, there is limited data observing long-term revision rates in this population.<sup>3</sup> Therefore, the purpose of this study was to compare 90-day, 2-year, 5-year, and 10-year implant survivability following primary THA in patients with and without prior SOT.

# **METHODS:**

A retrospective cohort analysis of patients undergoing elective THA was conducted using a national **TABLE 1:** Cumulative Incidence and Risk of Revision –

Unmatched and Matched (10-Year)

Unmatched					
	SOT IR (%)	Control IR (%)	HR	95% CI	P Value
All Cause Revision	3.70	3.70	0.98	0.68 - 1.41	0.912
PJI	0.60	0.60	1.06	0.45 - 2.46	0.896
Mechanical Loosening	1.80	2.10	0.95	0.58 - 1.57	0.841
Dislocation Instability	0.90	1.10	0.76	0.35 - 1.63	0.475
Hip Fracture	0.30	0.30	0.75	0.18 - 3.17	0.695
Articular Wear	0.30	0.20	1.16	0.27 - 5.09	0.842
		Matched			
	SOT IR (%)	Control IR (%)	HR	95% CI	P Value
All Cause Revision	3.70	3.90	0.94	0.64 - 1.38	0.737
PJI	0.60	0.70	0.98	0.40 - 2.40	0.961
Mechanical Loosening	1.80	2.20	0.88	0.52 - 1.49	0.627
Dislocation Instability	0.90	1.30	0.65	0.29 - 1.44	0.288
Hip Fracture	0.30	0.30	0.74	0.16 - 3.39	0.701
Articular Wear	0.30	0.30	0.97	0.20 - 4.69	0.972

\*PJI = Periprosthetic Joint Infection; SOT = Solid Organ Transplant; HR = Hazard Ratio; CI = Confidence Interval

administrative claims database. Those with a history of SOT were propensitymatched to a control of patients without SOT, based on age, gender, Charlson Comorbidity Index (CCI), and obesity using a 1:4 ratio. Kaplan Meier analysis was used to compare the cumulative incidence rates of revision arthroplasty and a Cox Proportional Hazard Ratio was used to compare hazard ratios between matched cohorts and unmatched cohorts.

# **RESULTS:**

After matching, 1,050 patients were included in the SOT cohort, 4,098 patients in the matched control cohort, and 10,000 patients in the unmatched control cohort. There was no significant

difference in the 10-year cumulative incidence and risk revision surgery in THA patients with a history of SOT, when compared to the matched control [HR: 0.94; 95% CI: 0.64-1.38; =0.737] and unmatched control [HR: 0.98; 95% CI: 0.68-1.41; p=0.912]. There were no significant differences in the cumulative incidence and risk of all-cause revision at different time periods (90-days, 2-years, and 5-years) or for various indications for revision surgery within 10 years (periprosthetic joint infection, mechanical loosening, dislocation/instability, periprosthetic fracture, and articular wear) when SOT was compared to both matched and

unmatched controls (p>0.05 for all).

# **CONCLUSION:**

Patients with SOT undergoing THA do not have an increased risk of revision surgery or implant-related complications when compared to a matched cohort or the general population. However, as previous studies have shown, SOT patients are at higher risk for medical complications and should be evaluated preoperatively, intraoperatively, and postoperatively thoroughly to ensure minimal post-surgical complications and need for revision surgery.

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 HR P Value 95% CI Category 90-Day Unmatched 1.07 0.834 0.57-1.99 Matched 1.07 0.55-2.09 0.836 2-Year Unmatched 0.84 0.52-1.34 0.458 Matched 0.81 0.49-1.32 0.391 5-Year Unmatched 0.96 0.65-1.42 0.836 Matched 0.94 0.62-1.42 0.771 10-Year Unmatched 0.98 0.68-1.41 0.912 Matched 0.94 0.64-1.38 0.737 \*HR = Hazard Ratio; CI = Confidence Interval

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# The Creation of Data-Driven Preoperative Hemoglobin A1c and Same-Day Glucose Strata that Maximize the Likelihood of 90-Day Major Complications Following Total Hip Arthroplasty

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In patients undergoing total hip arthroplasty (THA), Hemoglobin A1c (HbA1c) is the gold standard marker to screen glycemic control preoperatively, and glucose levels are used to observe glycemic control perioperatively.<sup>1,2</sup> Previously established thresholds for these markers are either non-specific for THA or had poor power in predicting complications.<sup>3</sup> Thus, the purpose of this study was to identify data-driven strata for both preoperative HbAlc and same-day glucose levels that maximize differences in the likelihood of 90-day complications following THA. **TABLE 1:** Unmatched 90-Day Major Complications by Hemoglobin A1c

 Data-Driven Strata

	HbA1C Strata					
	4.5 - 5.9		6.0 -	6.9	7.0 +	
90-Day Complications	Percentage (%)	P-Value	Percentage (%)	P-Value	Percentage (%)	P-Value
Total Major Complications	3.5	REF	5.0	<0.001	5.5	<0.001
Death	0.6	REF	1.5	<0.001	0.8	<0.001
Sepsis	0.4	REF	0.5	0.745	0.6	0.003
Acute Kidney Injury	1.2	REF	1.3	0.891	1.9	<0.001
Myocardial Infarction	0.6	REF	0.6	0.565	1.0	<0.001
Stroke	0.7	REF	1.0	0.042	1.5	<0.001
Pulmonary Embolism	0.6	REF	0.8	0.289	0.7	0.228
Total Wound Complications	0.5	REF	0.6	0.225	0.7	0.058
Deep SSI	0.4	REF	0.4	0.961	0.2	0.228
Superficial SSI	0.1	REF	-	-	0.5	-

\*Significance was set to p<0.05. SSI=Surgical Site Infection

# **METHODS**

Patients who underwent THA from 2013 to 2022 were identified using a national, multicenter database.<sup>4</sup> Stratum specific likelihood ratio (SSLR) analysis was performed to determine separate strata for HbA1c and sameday glucose levels that optimized the likelihood of 90-day complications following THA. Each stratum was propensity-score matched based on age, sex, hypertension, heart failure, chronic obstructive pulmonary disease, and obesity to the lowest respective HbA1c or glucose strata. The risk ratio (RR) with respect to the lowest matched stratum was observed. Propensity matching is recorded as risk ratios (RR), 95% confidence intervals (95% CI), and p-values. P-values < 0.05 were considered statistically significant.

# RESULTS

In total, 18,728 patients were identified with a mean age of  $67 \pm 12$  years. Our SSLR analysis identified three data-driven HbA1c strata (4.5-5.9, 6.0-6.9, and 7.0+) and two same-day glucose strata (60-189 and 190+) that predicted 90-day major complications. No strata were identified that optimized

differences in the likelihood of 90-day wound complications. For HbA1c, when compared to the propensitymatched lowest strata (4.5-5.9), the risk of 90-day major complications sequentially increased as the HbA1c strata increased: 6.0-6.9 (RR: 1.21; p=0.041), 7+ (RR: 1.82; p<0.001) [Table 1]. For same-day glucose, when compared to the matched lowest strata (60-189), the risk of 90-day major complications was higher for the 190+ strata (RR: 1.5; p<0.001) [Table 2].

### DISCUSSION

Contrary to existing single HbA1c thresholds, our results support the use of multiple HbA1c strata to predict the risk of experiencing a major complication within 90 days of a THA. Additionally, we identified a single cut-off level for glucose of 190 that can be used as the maximum target blood glucose level perioperatively. These results can be incorporated into risk stratification models for surgical decision-making and can be used in the development of future clinical practice guidelines. **TABLE 2:** Unmatched 90-Day Major Complications by Same-Day

 Glucose Data-Driven Strata

	Glucose Strata				
	60 - 18	9	190 +		
90-Day Complications	Percentage (%)	P-Value	Percentage (%)	P-Value	
Total Major Complications	4.7	REF	7.1	<0.001	
Death	1.5	REF	1.9	0.040	
Sepsis	0.6	REF	0.9	0.052	
Acute Kidney Injury	1.5	REF	1.9	0.044	
Myocardial Infarction	0.5	REF	1.3	<0.001	
Stroke	0.8	REF	1.5	<0.001	
Pulmonary Embolism	0.7	REF	0.9	0.198	
Total Wound Complications	0.9	REF	1.0	0.383	
Deep SSI	0.7	REF	0.8	0.690	
Superficial SSI	0.3	REF	0.3	0.892	

\*Significance was set to p<0.05. SSI=Surgical Site Infection

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# Racial Disparities in Outcomes Following Lumbar Fusion

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Over the past few decades, there has been a steady increase in the total number of spinal fusion procedures worldwide.1 Racial disparities in adult spine surgery have been investigated in the past; however, there is limited updated literature on the association between underrepresented minority (URMs) groups and outcomes following lumbar fusion (LF).2 The aim of this study was to determine the association between race and outcomes following lumbar fusion by analyzing 30-day postoperative complications as well as length of hospital stay

# **METHODS:**

Utilizing the National Surgical Quality Improvement Program database from 2005 to 2019, patients undergoing primary lumbar fusion surgery were identified. Patients were categorized into two groups: White patients and URM patients. URM patients included **TABLE 1.** Comorbidities For Lumbar Fusion Patients

Comorbidities	White	Underrepresented Minority	P-Value
Total patients, n	74,028	13,560	
CHF, n (%)	211 (0.3)	43 (0.3)	0.523
Hypertension, n (%)	41,570 (56.2)	8,291 (61.1)	< 0.001
COPD, n (%)	3,750 (5.1)	425 (3.1)	< 0.001
Dialysis, n (%)	78 (0.1)	97 (0.7)	< 0.001
Weight loss, n (%)	190 (0.3)	32 (0.2)	0.660
Steroid use, n (%)	3,106 (4.2)	540 (4.0)	0.253
Diabetes mellitus, n (%)	12,374 (16.7)	3,482 (25.7)	< 0.001
Bleeding disorder, n (%)	1,096 (1.5)	152 (1.1)	0.001
Preoperative transfusion, n (%)	120 (0.2)	30 (0.2)	0.126
Dyspnea, n (%)	-	-	0.017
Moderate exertion	4,155 (5.6)	681 (5.0)	-
At rest	211 (0.3)	34 (0.3)	-
Anesthesia type, n (%)	-	-	0.136
General	73,680 (99.6)	13,485 (99.5)	-
Neuraxial	114 (0.2)	19(0.1)	-
Regional	10 (0.0)	2 (0.0)	-
MAC	56 (0.1)	9 (0.1)	-

CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MAC, monitored anesthetic care.

those who were African American, Hispanic, Native American, or Pacific Islander. Bivariate and multivariable analyses were used to evaluate the differences in baseline demographics and comorbidities, as well as postoperative complications between the two patient cohorts.

### **RESULTS:**

A total of 87,588 patients underwent lumbar fusion surgery. Of these, 74,028 (84.5%) were White and 13,560 (15.5%) were from URM groups. Regarding URM patients, 7,668 patients (56.5%) were Black, 5,307 (39.1%) were Hispanic, 381 (2.8%) were Native American, and 204 (1.5%) were Pacific Islander. After controlling for potential confounding variables on multivariable analysis, URM patients had an increased risk of prolonged hospital stay (OR 1.55; p<0.001), readmission (OR 1.10; p=0.027), and reoperation (OR 1.12; p=0.025) compared to White patients.

# **CONCLUSION:**

Racial disparities continue to play a role in influencing patient surgical outcomes and should be brought to the forefront of the medical community's attention. Our study found that patients from URM groups who underwent LF had greater odds of readmission, reoperation and an extended length

of hospital stay compared to White patients. By conducting studies that explore associations between patient factors and outcomes, at-risk patient groups can be more readily recognized by Health care professionals.

# LEVEL OF EVIDENCE: III

**Keywords:** Lumbar Fusion; Arthrodesis; Race; Underrepresented Minority; Complications

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Underrepresented Minority (versus White)	Odds Ratio	95%	% CI	P-Value
Organ Space Infection	1.218	0.932	1.593	0.149
Wound Dehiscence	1.216	0.891	1.659	0.217
Postoperative Transfusion	0.973	0.913	1.037	0.405
Extended Length of Stay >5 days	1.553	1.477	1.634	< 0.001
Readmission	1.100	1.011	1.196	0.027
Reoperation	1.123	1.015	1.242	0.025

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# A Comparison of Google Web Search to ChatGPT for Anterior Cruciate Ligament Reconstruction-Related Questions

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Chat Generative Pre-trained Transformer (ChatGPT) was launched in November 2022 by OpenAI for the purpose of answering questions and assisting with tasks. As the fastestgrowing app of all time, there has been an increased usage in the Health care space among providers, students, and patients. However, recent studies have noted discrepancies in response between Google web search and ChatGPT for questions related to total hip and knee arthroplasties. This has yet to be assessed for anterior cruciate ligament reconstruction (ACLR). Therefore, the purpose of this study was to compare the questions, answers, and sources for popular search questions related to anterior cruciate ligament (ACL) reconstruction in Google web search and ChatGPT to evaluate the validity and utility of both search engines as complements to patient education and communication.

**TABLE 1:** Question Topics and Website Categorization by Rothwell's Classification.

Category	Subcategory	Description	
Category	Specific Activities	Ability to perform a specific activity or action	
	Timeline of Recovery	Length of time for recovery milestones	
Fact (asks whether something is true and to what extent,	Restrictions	Restrictions to activity or lifestyle during recovery	
objective information)	Technical Details	Surgical procedure and anesthesia, includes specifics about implants	
	Cost	Cost of surgery and/or rehabilitation	
Policy (asks whether a specific	Indications/Management	Surgical indications and alternatives, postoperative management, timing of surgery	
course of action should be taken to solve a problem)	Risks/Complications	Risks/complications before, during, or after ACL reconstruction, including rehabilitation period	
	Pain	Related to the timing, severity and management of pain	
Value (asks for evaluation of an idea, object, or event)	Longevity	Longevity of ACL reconstruction	
	Evaluation of Surgery	Successfulness, seriousness, or invasiveness of ACL reconstruction	
Website Categorization			
Commercial	Organizations that provide public health information, including medical device/manufacturing/pharmaceutical companies and news outlets		
Academic	Universities, academic medica	l centers, or academic societies	
Medical Practice	Local hospitals or medical grou affiliation	ips without clear academic	
Single Surgeon Practice	Personal websites maintained	by individual surgeons	
Government	Websites maintained by a nati	onal government	
Social Media	Blog, Internet forums, support organizations designed for info	groups, and nonmedical province of the second se	

### METHODS

An input of "anterior cruciate ligament reconstruction" was entered into a Google web search using a cleaninstalled Google Chrome browser. The first 20 frequently asked questions (FAQs) and answers were recorded along with their respective website source and categorized by topic according to Rothwell's Classification Criteria. Questions were pulled from the Google heading titled, "People also ask." The following statement was entered into ChatGPT: "Perform a google search with the search term "anterior cruciate ligament reconstruction" and record the 20 most FAQs related to the search term." Each question was recorded and individually inputted into ChatGPT along with the term, "Provide a source." The first 20 FAQs and their respective answers and sources were collected and classified using Rothwell's Classification Criteria.

### RESULTS

In general, Google web search of FAQs were generally comprised of fact and value-type topics (both with 35% of the FAQs). Similarly, ChatGPT FAQs were also typically comprised of fact-type topics (in 40% of the FAQs). However, unlike in the Google web search, more policy-type questions were observed in ChatGPT compared to value-type (35% to 25%, respectively). However, only 15% of the sources provided by ChatGPT were able to be deemed relevant and accurately validated. 65% of the ChatGPT sources were unable to be validated, and an additional 20% of the sources provided by ChatGPT were deemed irrelevant to answering the question at hand.

### DISCUSSION

The results of our study demonstrate marked discrepancies on ACL **TABLE 2:** Comparison of Classifications and Subclassifications of Search Engines for RTSA.

	Google Web Search	ChatGPT
Question Classification	Percentage out of	Percentage out of
	total (n=20)	total (n=20)
Fact	35%	40%
Policy	25%	35%
Value	35%	25%
Question Subclassification	Percentage out of total (n=20)	Percentage out of total (n=20)
Specific Activities	5%	0%
Timeline of Recovery	15%	15%
Restrictions	5%	0%
Technical Details	5%	20%
Cost	5%	5%
Indications/Management	20%	20%
Risks/Complications	5%	15%
Pain	15%	10%
Longevity	10%	0%
Evaluation of Surgery	15%	15%
Website Categorization	Percentage out of total (n=20)	Percentage out of total (n=20)
Commercial	15%	5%
Academic	25%	95%
Medical Practice	20%	0%
Single Surgeon Practice	30%	0%
Government	10%	0%
Social Media	0%	0%

reconstruction concerning classification, subclassification, and website source type when comparing Google web search against ChatGPT. Overall, Google web search FAQs yielded a variety of questions types and sources with an equal variety of fact and valuetype questions pertaining to ACL reconstruction with a broad range of sources. Of note, questions pertaining to timeline of recovery, indications/ management, pain, and evaluation of surgery appeared most frequently. In comparison, ChatGPT had a predominant number of FAQs pertaining to fact-type questions, mostly focused

on ACL reconstruction technical details and indications/management. However, while ChatGPT responses contained mostly academic sources exclusively, the machine-learning interface was unable to provide reliable sources regarding ACL reconstruction consistently and accurately. Moving forward, ChatGPT should be closely monitored for improvement on ACL reconstruction education and communication prior to use in the general public.

# The Effect of Screw Size and Configuration on Hardware Removal Rates After Surgical Treatment of Tibial Tubercle Fractures

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4. Pediatric Specialists of Virginia, Inova Fairfax Hospital Tibial tubercle fractures are relatively infrequent but consequential injuries primarily affecting male adolescent athletes. Surgical management with anatomic reduction and fixation is instrumental in achieving optimal outcomes. Given high rates of postoperative symptomatic hardware in this patient population, it has been hypothesized that smaller screws will decrease the rates of symptomatic hardware and the need for secondary surgery. However, research is limited on this topic.

# **METHODS**

Operative tibial tubercle fractures treated from January 2010 to December

2022 at a level one pediatric trauma center were retrospectively reviewed. Three groups were defined based on the largest screw size used for fixation (small: <5.0mm, medium: 5.0-6.0mm, large: >6.0mm). Bivariate statistics were used to evaluate associations between screw size and patient demographics including sex, age, and BMI, and fracture treatment including Ogden type, fixation construct, screw number, screw size, and washer use. Primary outcome was postoperative symptomatic hardware. Secondary outcomes included symptomatic hardware removal and

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Variables	Levels	Overall (N=182	Small	Medium	Large	P values
		knees)	(N=26)	(N=86)	(N=70)	
Age (year)	Mean (SD)	14.5 (1.4)	13.9 (1.7)	14.5 (1.4)	14.8 (1.2)	0.018
Sex, n (%)	Male	172 (94.5)	25 (96.1)	80 (93.0)	67 (95.7)	0.706
	Female	10 (5.5)	1 (3.8)	6 (7.0)	3 (4.3)	
Follow up (weeks)	Median [IQR]	27.2 (23.1-	21.3	27.9	31.0	0.730
		36.0)	(18.7-	(23.6-	(22.3-	
			30.4)	39.7)	40.7)	
BMI	Mean [SD]	25.3 (5.8)	24.9 (5.3)	24.9 (6.1)	26.0 (5.7)	0.473
Side, n (%)	Left	105 (57.7)	13 (50)	55 (64.0)	37 (52.9)	0.262
	Right	77 (42.3)	13 (50)	31 (36.0)	33 (47.1)	
Ogden type, n (%)	Type I/II	47 (25.8)	18 (69.2)	24 (27.9)	5 (7.1)	<0.001
	Type III	90 (49.5)	6 (23.1)	45 (52.3)	39 (55.7)	
	Type IV	45 (24.7)	2 (7.7)	17 (19.8)	26 (37.1)	
Washer used, n (%)		55 (30.2)	12 (46.2)	23 (26.7)	20 (28.6)	0.036
Construct, n (%)	All epiphyseal	2 (1.1)	1 (3.8)	1 (1.2)	0 (0)	0.132
	All metaphyseal	104 (57.1)	19 (73.1)	49 (57.0)	36 (51.4)	
	Combined	76 (41.8)	6 (23.1)	36 (41.9)	34 (48.6)	
Symptomatic		41 (22.5)	5 (19.2)	22 (25.6)	14 (20.0)	0.645
hardware, n (%)						
Hardware removal due to symptomatic implant, n (%)		31 (17.0)	2 (7.7)	19 (22.1)	10 (14.3)	0.268
Time to hardware removal due to symptomatic implant (months)	Median [Range]	11 (5.0-50.0)	10 (8-11)	11 (5-50)	13 (7-22)	0.781

[DAD1] From the data the largest screw used in the surgery was in the metaphysis (except two patients).

Chi-squared for categorical variables and Independent-Samples Mann-Whitney U test/ANOVA for continuous variables

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fracture displacement. Univariate and multivariate logistic regression analysis were performed to identify independent predictors of primary and secondary outcomes. Sample size power analysis demonstrated adequate power.

### RESULTS

One hundred eighty-two knees in 168 patients were included for statistical analysis. Mean age was 14.5 years (SD 1.4 years), 94.5% male. Median length of follow up was 27.2 weeks (IQR 23.1-36.0 weeks). 90 knees (49.5%) were Ogden type III, 47 (25.8%) were type I+II, and 45 (24.7%) were type IV. Fixation constructs were all epiphyseal in 2 knees (1.1%), all metaphyseal in 104 (57.1%) and combined in 76 (41.8%). The largest screw used was small in 26 knees (14.3%), medium in 86 (47.2%), and large in 70 (38.5%). Screw size was significantly different among the Ogden types (p<0.001). There was a significant association between screw size and age, with the small screw group averaging 13.9 years (SD 1.7 years), the medium

**TABLE 2:** Association Between Number of Screws and Ogden Type

Number of		1 Screw	2 screws	3 Screws	4+ Screws	P values			
screws		(N=17)	(N=120)	(N=37)	(N=8)				
Ogden type, n (%)	Type I/II	13 (76.5)	28 (23.3)	4 (10.8)	2 (25)	<0.001			
	Type III	2 (11.8)	55 (45.8)	27 (73.0)	6 (75)				
	Type IV	2 (11.8)	37 (30.8)	6 (16.2)	0 (0)				

group 14.5 years (SD 1.4 years), and the large screw group 14.8 years (SD 1.2 years) (p=0.018). Washers were used in a third of all cases and most frequently used in the small screw group (46.2%) compared to the medium (26.7%) and large (28.6%) groups (P=0.036). Postoperatively, 41 patients (22.5%) had symptomatic hardware, and 31 (17%) underwent removal of hardware at median time of 11 months postoperative (range 5-50 months). Rates of symptomatic hardware were not statistically different in the screw size groups, with 5/26 (19.2%) in the small screw group, 22/86 (25.6%) in the medium screw group, and 14/70 (20.0%) in the large group (p=0.645). Screw size, number, and washer use were not associated with risk of symptomatic hardware or removal in multivariate analysis.

# CONCLUSION

Symptomatic hardware following operatively treated tibial tubercle fractures is common, occurring in one out of five patients in our cohort. Fracture type, screw size and number, fixation construct and use of washers do not appear to be associated with increased risk of symptomatic hardware. Surgeons should counsel patients on the potential for symptomatic hardware and secondary removal procedure but should not let this concern limit their choice of fixation construct.
## Which Oral Drugs Associated with Adverse Effects on Bone Mineral Density Demonstrate Worse Total Knee Arthroplasty Implant-Related Complications?

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Certain medications interfere with the bone remodeling process, and thus increase the risk of bone-healthrelated complications.<sup>1-3</sup> As patients undergoing total knee arthroplasty (TKA) may be taking these bone mineral density (BMD) reducing medications, it is unclear as to whether and which medications impact TKA outcomes. Therefore, the purpose of this study was to observe the impact of various BMD-reducing medications on 2-year implant-related complications following TKA.

#### **METHODS:**

A retrospective analysis of patients undergoing primary elective TKA was conducted using a national administrative claims database. Patients were

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**FIGURE:** Multivariate logistic regression analysis of 2-year all-cause revision (A), PPF-indicated revision (B) and loosening-indicated revision (C) for patients taking BMD reducing medications versus controls (*PPF* = *periprosthetic fracture, PPIs* = *proton pump inhibitors, TZD* = *thiazolidinediones, AIs* = *aromatase inhibitors, AEDs* = *antiepileptic inhibitors, SSRIs* = *selective serotonin reuptake inhibitors, FGAs* = *first-generation antipsychotics, SGAs* = *second-generation antipsychotics*)

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identified if they were taking any of these known BMD-reducing medications in the perioperative period: proton pump inhibitors (PPIs), thiazolidinediones (TZDs), loop diuretics, glucocorticoids, aromatase inhibitors (AIs), calcineurin inhibitors, selective serotonin reuptake inhibitors (SSRIs), antiepileptic drugs (AEDs), first-generation antipsychotics (FGAs), and second-generation antipsychotics (SGAs). The 2-year incidence of allcause revision and aseptic indications for revision (aseptic loosening and periprosthetic fracture [PPF]) were compared using chi-squared analysis for each drug class when compared to a control of those not taking any of these identified medications. To control for demographics/comorbidities and confounders associated with taking multiple agents (Table 1), multivariable logistic regression analyses were conducted for each 2-year outcome with the output recorded as odds ratios (OR).

#### **RESULTS:**

Of the 1,118,832 TKA patients identified, 478,180 (42.7%) were taking at least one BMD-reducing medication. Patients taking BMD-reducing drugs were younger (65.7 versus 66.4 years; p-value <0.001), less likely to be male (31.33% versus 41.50%; p-value <0.001), and to have greater comorbidities (all with a p-value <0.001) (Table 1). On multivariable analysis, medications associated with a higher likelihood of 2-year all-cause revision include PPIs (OR: 1.5), glucocorticoids (1.15), SSRIs (OR: 1.14), FGAs (OR: 1.54), and SGAs (OR: 1.29) (p<0.05 for all) (Figure 1). Medications associated with a higher likelihood of 2-year aseptic loosening indication revision include PPIs (OR: 1.16), glucocorticoids (OR: 1.17), SSRIs (OR: 1.09), and SGAs (OR: 1.12) (p<0.05

**TABLE 1:** Demographic and comorbidity characteristics of primary TKA patients taking at least 1 BMD-reducing medication versus controls

	BMD Reducing Drugs		Control	Control						
	N	%	N	%	p-value					
Total	478,180	-	710,652		-					
Demographic and Comor	Demographic and Comorbidity Characteristics									
Age (Mean±SD)	65.7 ± 9.0	-	66.4 ± 8.7		<0.001					
Sex	-	-	-	-	-					
Men	149,828	31.33	294,955	41.50	-					
Women	328,352	68.67	415,697	58.50	< 0.001					
Diabetes Mellitus	39,155	8.19	48,013	6.76	<0.001					
Tobacco Use	16,357	3.42	17,256	2.43	<0.001					
Chronic Kidney Disease	19,633	4.11	21,309	3.00	<0.001					
Obesity	42,820	8.95	50,163	7.06	<0.001					
Depression	36,986	9.90	36,986	5.20	<0.001					
Anemia	19,233	4.02	20,929	2.95	<0.001					
Congestive Heart	18,506	3.87	16,703	2.35	<0.001					
Failure										
Hypertension	75,721	15.84	101,523	14.29	<0.001					
Arrhythmia	40,173	8.40	50,457	7.10	<0.001					
Neurological Disorder	8,847	1.85	8,561	1.20	<0.001					
Psychosis	4,503	0.94	3,336	0.47	<0.001					
Peptic Ulcer Disease	2,485	0.52	2,595	0.37	<0.001					
Rheumatoid Arthritis	21,747	4.55	21,035	2.96	<0.001					

for all) (Figure 1). Medications associated with a higher likelihood of 2-year PPF indicated revision include PPIs (OR: 1.81), AIs (OR: 1.40), SSRIs (OR: 1.25), FGAs (OR: 1.48), and SGAs (1.47) (p<0.05 for all) (Figure 1).

#### **DISCUSSION:**

Of the drug classes observed, the utilization of perioperative PPIs, SSRIs, glucocorticoids, FGAs, and SGAs were associated with the highest odds of allcause revision and aseptic looseningindicated revision, and PPF-indicated revision. As almost half of patients are taking at least one of these medications, our findings emphasize the importance of reviewing patients' medication usage and highlight specific medications to look out for during review.

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## The Effect of Sickle Cell Disease on 10-Year Cumulative Incidence and Indications for Revision Lumbar Fusion

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Patients with sickle cell disease (SCD) experience distinct physiological challenges that may alter surgical outcomes. As of yet, there has been no research establishing 10-year lumbar fusion (LF) implant survivorship rates among individuals with SCD. This study aims to fill this gap by examining the tenyear cumulative incidence and indications for all-cause revision LF between patients with SCD and those without.

#### **MATERIALS & METHODS:**

The PearlDiver database was queried to identify patients both with and without SCD who underwent primary LF. The SCD patients undergoing LF were propensity-score matched in a 1:4 ratio by age, gender, and Charlson Comorbidity Index (CCI) to a matched LF control. In total, 246 SCD patients were included in this study along with 981 and 100,000 individuals in the matched and unmatched control cohorts respectively. Kaplan-Meier survival analysis was employed to determine the 10-year **TABLE 1:** Demographic and comorbidity characteristics of Sickle Cell, Matched

 Control, and Unmatched Control cohorts

	Sickle Cell Cohort		Match	ed Contro	l Cohort	Unmatched Control Cohort			
	n	%	n	%	P-Value*	n	%	P-Value†	
Total	246	-	981	-	-	100000	-	-	
Demographic	and Como	orbidity Ch	aracteris	tics					
Age (years)									
<50	77	31.3%	308	31.40%	1	25503	25.50%	0.044	
50-59	74	30.08%	294	29.97%	1	24039	24.04%	0.032	
60-69	59	23.98%	236	24.06%	1	27015	27.02%	0.320	
70-74	24	9.76%	95	9.68%	1	14988	14.99%	0.027	
75+	12	4.88%	48	4.89%	1	8451	8.45%	0.058	
Gender					1			0.027	
Male	83	33.74%	332	33.84%		40864	40.86%		
Female	163	66.26%	649	66.16%		59136	59.14%		
Charlson Com	orbidity lı	ndex							
0	52	21.14%	208	21.20%	1	35580	35.58%	<0.001	
1	54	21.95%	216	22.02%	1	27675	27.68%	0.053	
2	49	19.92%	196	19.98%	1	15379	15.38%	0.060	
3+	91	36.99%	361	36.80%	1	21366	21.37%	<0.001	

\*Comparing Sickle Cell and Matched Control cohorts †Comparing Sickle Cell and Unmatched Control cohorts

cumulative incidence rates of revision LF. Furthermore, multivariable analysis using Cox proportional hazard modeling was performed, and indications for revisions across cohorts were compared through Chi-squared analysis.

#### **RESULTS:**

No significant differences were found in the cumulative incidence of 10-year allcause revision LF between patients in the SCD cohort and either the matched or unmatched control cohorts (P > 0.05for each). Additionally, there were no significant differences between the SCD cohort and either of the control cohorts in regards to the indications for revision LF (P > 0.05 for each). The indications studied included hardware removal, drainage and evacuation, pseudoar-throsis, and mechanical failure.

#### **DISCUSSION:**

This study indicates that SCD patients do not have increased risk for revision LF, nor any of its indications. As such, we recommend that physicians treating SCD patients undergoing LF do not need to optimize peri- and postoperative treatment differently than patients

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without SCD. As this finding is limited to revision LF and its indications, further research is needed to determine whether SCD alters postoperative outcomes in other orthopedic surgery procedures. **TABLE 2:** Cox proportional hazards analysis of 10-year postoperative complications that indicate lumbar fusion revision for Sickle Cell versus both Matched and Unmatched Control cohorts

	SCD Versus Matched Control Cohort			SCD Versus Unmatched Control Cohort			
	Hazards Ratio	95% Confidence Interval	P-Value	Hazards Ratio	95% Confidence Interval	P-Value	
All-Cause Revision	1.42	0.67 - 3.05	0.364	1.46	0.76 - 2.82	0.250	
Hardware Removal	1.46	0.39 - 5.53	0.572	1.70	0.55 - 5.29	0.357	
Drainage and Evacuation	1.40	0.51 - 3.91	0.510	1.62	0.67 - 3.91	0.280	
Pseudoarthrosis	2.35	0.57 - 9.84	0.242	2.72	0.87 - 8.47	0.083	
Mechanical Failure	1.69	0.44 - 6.54	0.447	2.84	0.91 - 8.85	0.071	

# Higher Modified Frailty Index Score is Associated with 30-Day Postoperative Complications Following Revision Total Shoulder Arthroplasty

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Previous studies have shown that increased scores on the modified frailty index (mFI) are associated with poor surgical outcomes. The purpose of this study was to determine whether the comorbidities comprising the mFI were correlated with poor outcomes following revision total shoulder arthroplasty (TSA).

#### **METHODS:**

Patients aged 50 years or older undergoing revision TSA from 2013 to 2019 were queried in the National Surgical Quality Improvement Program database. The 5-item frailty index (mFI-5) was calculated based on the sum of the presence of five conditions: diabetes, congestive heart failure, hypertension, chronic obstructive pulmonary disease, and dependent functional status. Pearson's Chi-squared tests and multivariable regression analysis were used to evaluate

Complications	mFI score = 0	mFI score = 1	p-value: mFl score = 1 vs mFl score = 0¶	mFl score > 2	p-value: mFI score > 2 vs mFI score = 0¶	p-value: mFI score > 2 vs mFI score = 1¶
Total patients, n	381	656		356		
Mortality, n (%)	1 (0.3)	2 (0.3)	0.902	1 (0.3)	0.962	0.947
Readmission, n (%)	12 (3.9)	33 (6.1)	0.152	25 (8.6)	0.016	0.188
Reoperation, n (%)	6 (1.6)	25 (3.8)	0.041	13 (3.7)	0.075	0.899
Wound complication, n (%)	12 (3.1)	24 (3.7)	0.666	7 (2.0)	0.311	0.136
Pulmonary complication, n (%)	1 (0.3)	3 (0.5)	0.626	2 (0.6)	0.524	0.821
Renal complication, n (%)	0 (0.0)	0 (0.0)	-	1 (0.3)	0.301	0.174
Cardiac complication, n (%)	0 (0.0)	4 (0.6)	0.127	2 (0.6)	0.143	0.924
Thromboembolic complication, n (%)	2 (0.5)	8 (1.2)	0.270	6(1.7)	0.129	0.545
Sepsis complication, n (%)	2 (0.5)	9 (1.4)	0.199	6(1.7)	0.129	0.694
Urinary tract infection, n (%)	3 (0.8)	8 (1.2)	0.513	3 (0.8)	0.933	0.581
Postoperative transfusion, n (%)	10 (2.6)	19 (2.9)	0.798	22 (6.2)	0.018	0.011
Extended length of stay (> 3 days), n (%)	22 (5.8)	52 (7.9)	0.198	53 (14.9)	< 0.001	< 0.001
Non-home discharge, n (%)	25 (6.6)	52 (7.9)	0.419	65 (18.3)	< 0.001	< 0.001

¶Pearson's chi-squared test Bolding equals significance p<0.05

mFI, modified frailty index.

the association of the mFI-5 score with various postoperative complications, as well as mortality, readmission, reoperation, extended length of stay, and non-home discharge.

#### **RESULTS:**

The study included 1,393 patients with a mean age of 69 years. Following

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adjustment on multivariable regression analysis, patients with a mFI-5 score of 2 or greater were at increased risk of readmission (OR 2.58; p=0.019), bleeding requiring transfusion (OR 3.66; p=0.005), extended length of stay (OR 2.43; p=0.003), and discharge to a non-home destination (OR 3.22; p<0.001) compared to patients with a mFI-5 score of 0. Relative to patients with a score of 1, those with a mFI-5 score of 2 or greater had an increased risk of postoperative transfusion (OR 2.46; p=0.008), extended length of stay (OR 2.16; p<0.001), and discharge to a non-home location (OR 2.84; p<0.001).

#### **CONCLUSION:**

This study identified the mFI-5 to be a valuable tool to stratify patients based on risk for postoperative complications following revision TSA. Identifying

Complications	mFl score = 1 (reference group is mFl score = 0)		mFl sco (referen mFl sco	re > 2 ce group is re = 0)	mFl score > 2 (reference group is mFl score = 1)		
	p-value	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	
Readmission	0.234	1.531 (0.759 to 3.091)	0.019	2.584 (1.168 to 5.717)	0.287	1.354 (0.775 to 2.365)	
Reoperation	0.050	2.528 (1.001 to 6.383)	0.104	2.505 (0.829 to 7.570)	0.791	0.909 (0.448 to 1.843)	
Postoperative transfusion	0.590	1.256 (0.548 to 2.882)	0.005	3.655 (1.466 to 9.112)	0.008	2.461 (1.261 to 4.804)	
Extended length of stay (> 3 days)	0.195	1.427 (0.833 to 2.443)	0.003	2.434 (1.366 to 4.337)	< 0.001	2.160 (1.410 to 3.307)	
Non-home discharge	0.881	0.960 (0.564 to 1.634)	< 0.001	3.215 (1.827 to 5.658)	< 0.001	2.837 (1.841 to 4.372)	

Bolding equals significance p<0.05

mFI, modified frailty index; CI, confidence interval

patients who have a high mFI-5 and optimizing these patients prior to surgery may help reduce complications.

## Predicting Complications Following Patella Fracture Repair Using the Five-Item Modified Frailty Index

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Several studies have condensed the original 11-item modified frailty index (mFI-11) to the 5-item mFI (mFI-5) for easier use in clinical practice. Higher mFI-5 scores have been shown to predict adverse outcomes in various orthopaedic procedures. The purpose of this study was to evaluate the utility of the mFI-5 in a population of patients undergoing surgery for patella fractures.

#### **METHODS:**

The NSQIP database was queried to identify patients ages 50 or older who underwent surgery for patella fractures between 2006-2019. The mFI-5 was calculated based on the following 5 comorbidities: diabetes, CHF, hypertension, COPD, and dependent functional status. Frailty scores were stratified based on number of comorbidities: non-frail, mFI-5 = 0; pre-frail, mFI-5 = 1; frail, mFI-5 = 2; and severely frail, mFI-5  $\geq$  3. Bivariate and multivariate analyses were used to

Complications	mFl score = 0	mFl score = 1	p-value: mFl score = 1 vs mFl score = 0¶	mFl score > 2	p-value: mFl score > 2 vs mFl score = 0¶	p-value: mFI score > 2 vs mFI score = 1¶
Total patients, n	1,175	1,077		665		
Mortality, n (%)	3 (0.3)	4 (0.4)	0.621	10 (1.5)	0.002	0.010
Readmission, n (%)	22 (2.4)	57 (6.8)	< 0.001	45 (9.2)	< 0.001	0.122
Reoperation, n (%)	23 (2.0)	46 (4.3)	0.001	32 (4.8)	< 0.001	0.594
Wound complication, n (%)	8 (0.7)	15 (1.4)	0.093	19 (2.9)	< 0.001	0.032
Pulmonary complication, n (%)	2 (0.2)	5 (0.5)	0.211	9 (1.4)	0.002	0.043
Renal complication, n (%)	0 (0.0)	3 (0.3)	0.070	2 (0.3)	0.060	0.933
Cardiac complication, n (%)	1 (0.1)	6 (0.6)	0.044	7 (1.1)	0.002	0.243
Thromboembolic complication, n (%)	12 (1.0)	8 (0.7)	0.482	4 (0.6)	0.351	0.729
Sepsis complication, n (%)	2 (0.2)	3 (0.3)	0.585	6 (0.9)	0.022	0.078
Urinary tract infection, n (%)	5 (0.4)	18 (1.7)	0.003	10 (1.5)	0.013	0.787
Postoperative transfusion, n (%)	5 (0.4)	12 (1.1)	0.059	10 (1.5)	0.013	0.479
Length of stay > 7 days, n (%)	28 (2.4)	42 (3.9)	0.039	42 (6.3)	< 0.001	0.022
Non-home discharge, n (%)	151 (13.5)	255 (25.1)	< 0.001	228 (37.0)	< 0.001	< 0.001

¶Pearson's chi-squared test

Bolding equals significance p<0.05

mFI, modified frailty index

compare the complication rates among the mFI scores.

#### **RESULTS:**

A total of 2,917 patients with an average age of 67 years were included. Following adjustment, as the mFI increased from a score of 0 to a score of 1, patients had an increased risk of readmission (OR 2.94, p<0.001), reoperation (OR 2.15, p=0.005), urinary tract infection (OR 3.49, p=0.017), and discharge to a

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non-home location (OR 1.41, p=0.007). Similar risks were seen when comparing patients with a score of 2 or greater to patients with a score of 2, or greater also had an increased risk of mortality (OR 4.40, p=0.034), wound (OR 3.37, p=0.009), pulmonary (OR 8.69, p=0.01), and sepsis complication (OR 5.58, p=0.049), bleeding requiring transfusion (OR 4.56, p=0.013), and length of stay > 7 days (OR 2.48, p<0.001).

## DISCUSSION AND CONCLUSION:

Increasing mFI-5 scores were significantly associated with increased morbidity and mortality following surgery for patella fracture. Consideration of the mFI-5 as a readily available tool for risk stratification for this population is warranted and may help ensure appropriate pre- and postoperative care is met to ultimately improve patient outcomes and reduce costs for both the patient and the hospital. **TABLE 2:** Multivariate Analysis of Postoperative Complications for Patella Fracture

 Patients

Complications	mFl score (reference mFl score	e = 1 e group is e = 0)	mFl score (reference mFl score	e > 2 re group is e = 0)	mFl score > 2 (reference group is mFl score = 1)		
	p-value	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	
Mortality	0.926	1.077 (0.225 to 5.153)	0.034	4.399 (1.117 to 17.328)	0.013	4.550 (1.369 to 15.126)	
Readmission	< 0.001	2.942 (1.752 to 4.942)	< 0.001	3.696 (2.096 to 6.517)	0.144	1.371 (0.898 to 2.093)	
Reoperation	0.005	2.147 (1.267 to 3.639)	0.010	2.193 (1.203 to 3.996)	0.818	1.057 (0.657 to 1.703)	
Wound complication	0.148	1.931 (0.792 to 4.707)	0.009	3.367 (1.355 to 8.366)	0.063	1.948 (0.963 to 3.939)	
Pulmonary complication	0.372	2.178 (0.394 to 12.043)	0.010	8.691 (1.671 to 45.205)	0.088	2.677 (0.864 to 8.302)	
Cardiac complication	0.167	4.605 (0.528 to 40.130)	0.430	0.970 (0.898 to 1.047)	0.330	1.750 (0.568 to 5.390)	
Sepsis complication	0.443	2.088 (0.318 to 13.726)	0.049	5.582 (1.009 to 30.881)	0.146	2.862 (0.694 to 11.813)	
Urinary tract infection	0.017	3.486 (1.250 to 9.724)	0.013	4.452 (1.362 to 14.547)	0.972	0.986 (0.445 to 2.183)	
Postoperative transfusion	0.190	2.089 (0.694 to 6.295)	0.013	4.559 (1.377 to 15.087)	0.615	1.253 (0.519 to 3.024)	
Length of stay > 7 days	0.102	1.525 (0.920 to 2.527)	< 0.001	2.475 (1.444 to 4.242)	0.062	1.537 (0.979 to 2.414)	
Non-home discharge	0.007	1.407 (1.099 to 1.800)	< 0.001	2.610 (1.983 to 3.435)	< 0.001	1.852 (1.453 to 2.362)	

Bolding equals significance p<0.05

mFI, modified frailty index; CI, confidence interval.

## Assessing Adherence in Our Institution to Evidence-Based Guidelines in Complex Thoracic and Lumbar Spinal Surgeries: Implications for Postoperative Recovery Outcomes

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The incidence of spinal fusion procedures has increased significantly in the United States and worldwide.1 Major complex spine surgeries involving multiple spinal levels present inherent risks and complications. Enhanced Recovery After Surgery (ERAS) and other institutional clinical management protocols have emerged as a systematic multidisciplinary approach to improving quality and safety in complex surgical care.2 This study at George Washington University Hospital (GW Hospital) aimed to assess adherence to a protocol established utilizing evidence-based standards in a component of neurosurgical spine surgeries at our institution through a retrospective analysis of complex thoracic and lumbar spinal surgeries. We also sought to examine any potential association between adherence to the protocol and improved postoperative recovery following complex spinal surgery.

**TABLE 1:** Percent compliance at George Washington University Hospital for 166 patients undergoing complex thoracic and/or lumbar spine surgery from January 2021 to April 2022.

 \* Only out of those who DID receive \_\_\_\_\_, what % was compliant

Parameter	<b>Recommendation</b>	N		% Complia	nt
Pre-op Acetaminophen	1 g	166		72.89%	
Pre-op Celebrex	400 mg	166		33.73%	
Pre-op EKG	Yes	166		31.33%	
Exparel	N/A	166		68.67% (had no Exparel)	
TIVA w/propofol	Yes	166		21.08%	
Opiate Infusion	No	166		93.37%	
Ketamine dose	0.1-0.25 mg/kg/hr	166		65.06%	
Ketamine (Y/N)	Yes	166		84.94%	
Ketamine dose	0.1-0.25 mg/kg/hr		141		76.60%
Methadone dose	0.1-0.2 mg/kg	166		9.64%	
Methadone (Y/N)	Yes	166		12.65%	
Methadone dose	0.1-0.2 mg/kg		21		76.19%
Methadone + EKG	given if QTc < 480 ms	166		3.01%	
Methadone + EKG (Y/N)	Yes	21		28.57%	
Methadone + EKG	given if QTc < 480 ms		6		83.33%
TXA dose	- 10 mg/kg	166		2.41%	
TXA (Y/N)	Yes	166		23.49%	
TXA dose	10 mg/kg		39		10.26%
TXA ongoing infusion	No		40		45.00%
Fluid management	2.7-3.3 mL/kg/hr	166		1.81%	
Ventilation	6-8 mL/kg	166		69.88%	
PEEP	9-12 cm H <sub>2</sub> 0	138		0.00%	
Engaged with PT		166		96.39% (had PT)	
Avg Length of Stay		166		6.31 days	
Avg Daily Opioids		166		92.93 oral morphine equ	iv

@ TXA dose compliance was = 10 but many were just above or just below 10, hence low compliance

# kg = ideal body weight

^ 28 entries did not have PEEP info

#### **METHODS:**

This single-center, retrospective study involved 166 patients who underwent elective complex spine surgery from January 2021 to April 2022 at GW Hospital. The GW Hospital-specific, evidence-based pathway was adapted from established recommendations and modified to account for resources available at our institution.3 Compliance rates at GW Hospital to the established recommendations and guidelines were evaluated. Data on the proposed guidelines, as well as age at the time of surgery, days from surgery to involvement with physical therapy, length of stay including day of surgery, and average daily opioid consumption, were collected and subsequently analyzed.

#### **RESULTS:**

GW Hospital compliance rates to the recognized standards guidelines varied widely, ranging from 0% to 96.39% (Table 1). Adherence reached over 50% in specific areas, such as acetaminophen administration (72.89%) and engagement with physical therapy post-procedure (96.39%) (Table 1).

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	Reg	gression	L	ength of	Stay		Average Da	ily Opio	id Consur	nption
Guideline	Amount vs	Recommendation	Adjusted OR	95	% CI	p-value	Adjusted OR	95	% CI	p-value
	None		0.716	0.321	1.597	0.414	1.123	0.505	2.499	0.775
Acetaminophen	<1 g	1g	0.470	0.128	1.723	0.255	0.105	0.024	0.464	0.003
	>1 g		<0.001	<0.001	>999.999	0.987	<0.001	<0.001	>999.999	0.986
Colobrox	None	400mg	0.699	0.331	1.476	0.347	2.539	1.176	5.482	0.018
Celebiex	<400 mg	400Mg	3.374	0.077	148.15	0.529	2.490	0.064	97.613	0.626
Exparel	Yes	No (N/A)	0.682	0.326	1.428	0.310	0.766	0.362	1.622	0.486
TIVA w/Propofol	No	Yes	1.091	0.415	2.865	0.860	1.559	0.587	4.143	0.373
Opiate Infusion	Yes	No	6.766	1.687	27.135	0.007	2.591	0.634	10.583	0.185
	None		0.272	0.105	0.701	0.007	0.210	0.080	0.547	0.001
Ketamine	<0.1 mg/kg/hr	0.1 - 0.25 mg/kg/hr	0.867	0.328	2.289	0.773	1.258	0.482	3.285	0.639
	>0.25 mg/kg/hr		1.544	0.436	5.469	0.501	0.539	0.154	1.891	0.335
	None		0.144	0.043	0.476	0.002	0.882	0.284	2.742	0.829
Methadone	<0.1 mg/kg/hr	0.1-0.2 mg/kg/hr	0.404	0.047	3.504	0.411	0.367	0.044	3.069	0.355
	>0.2 mg/kg/hr		0.049	<0.001	2.874	0.147	>999.999	<0.001	>999.999	0.986
	None		0.338	0.044	2.599	0.297	0.037	0.003	0.503	0.013
TXA	< 10 mg/kg	10 mg/kg	0.477	0.041	5.596	0.556	0.064	0.003	1.271	0.072
	11 mg/kg - 1 g/kg		0.673	0.082	5.487	0.711	0.040	0.003	0.562	0.017
Eluid Management	<2.7 mL/kg/hr	2 7-3 3 ml /ka/br	0.717	0.056	9.246	0.799	24.967	1.464	425.92	0.026
Thata Management	>3.3 mg/kg/hr	2.7-5.5 IIIE/Rg/III	0.285	0.031	2.665	0.271	4.028	0.367	44.235	0.254
Ventilation	< 6 mL/kg	6-8 ml /ka	0.659	0.100	4.354	0.665	0.186	0.024	1.440	0.107
Ventilation	>8 mL/kg	0-0 me/kg	2.013	0.973	4.164	0.059	2.556	1.229	5.313	0.012
	None		3.548	0.912	13.810	0.068	2.347	0.622	8.854	0.208
PEEP	<4 cmH <sub>2</sub> O	6-9 cmH <sub>2</sub> O*	1.541	0.406	5.843	0.525	2.807	0.748	10.527	0.126
	4-6 cmH <sub>2</sub> O		1.156	0.37	3.607	0.803	2.234	0.724	6.893	0.162
Age			1.004	0.978	1.030	0.786	0.953	0.927	0.979	0.001

**TABLE 2:** Multiple ordinal logistic regression analysis of each parameter's association with length of stay and average daily opioid consumption when compared to the guideline recommendation.

\* No patients had recommended PEEP of 9-12 cmH O, so closest range was utilized for regression analysis.

Length of Stay categorized into four groups: 1-3 days, 4-5 days, 6-9 days, and >9 days

Average daily opioid consumption categorized into four groups: 0-30, 30-60, 60-100, and >100

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Multivariate regression analysis adjusting for age showed that adherence to recommended protocols for ketamine (p=0.007) and methadone (p=0.002) administration significantly reduced the odds of an extended hospital stay (Table 2). Adherence to acetaminophen (p=0.003), ketamine (p=0.001), and tranexamic acid (TXA; p=0.013) recommendations significantly reduced the odds of increased daily opioid consumption (Table 2). Conversely, per a separate univariate analysis of this data, several recommended medications and/or doses were significantly associated with poor outcomes, indicating variance in positive and negative associations between the guidelines and patient outcomes at GW Hospital.

#### **CONCLUSION:**

Implementing evidence-based institutional clinical management protocols in complex spinal surgery has a demonstrated ability to improve patient recovery and optimize outcomes.2 Multimodal analgesia, early mobilization, and individualized patient care are critical elements of these pathways that can reduce hospitalization duration and postoperative opioid use.4,5 However, inferences from this study suggest that, overall, guidelines alone did not significantly improve recovery after surgery at GW Hospital. The need for personalized ERAS protocols considering patient characteristics is highlighted as individualized care alongside evidence-based guidelines is vital to enhance outcomes. Further research and refinement of clinical management guidelines in spinal surgery are necessary to determine their long-term impact and cost-effectiveness, and sub-population studies are necessary to explore guideline efficacy with strict adherence and controlled variables. Despite the variability in adherence rates and positive and negative associations with patient outcomes,

protocolization remains a promising approach for achieving enhanced recovery in complex spinal surgery patients.

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## To Cross the Physis or Not: Clinical and Functional Outcomes Following Anterior Cruciate Ligament Reconstruction in Pediatric Patients

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The incidence of pediatric anterior cruciate ligament (ACL) ruptures has shown an upward trajectory, necessitating heightened vigilance in preserving the integrity of the growth plate within the skeletally immature demographic.<sup>1-3</sup> Given the escalating incidence of such injuries, there is an imperative need for comprehensive investigation into the optimal reconstruction methodology applicable to children and adolescents.3 The core objective of this study is to evaluate the occurrence of growth plate disruption, graft failure rates, rates of reoperation, and the functional outcomes subsequent to anterior cruciate ligament reconstruction (ACLR) within this specific population.

#### **METHODS**

Following Institutional Review Board approval, we identified consecutive patients who underwent ACLR from June 26, 2018, to Aug. 24, 2020, under the care of two surgeons at a tertiary

	Pre-operative n=58	Post-operative n=58
Lachman grade (n)		
Normal	0	48
1a	1	5
2a	2	2
1b	0	0
2b	46	0
Not graded	9	3
Varus instability (n)	6	0
Valgus instability (n)	6	3
Knee Flexion (mean, degrees)	117	129

academic children's hospital. Exclusions included patients with partial ACL tears or those lost to follow-up within one month post-surgery. We retrospectively reviewed patient demographics, injury data, surgical techniques, and complications. Clinical outcomes, including knee range of motion, Lachman grade, and stability to anterior, posterior, varus, or valgus forces, were recorded preoperatively and at final follow-up.

#### RESULTS

A total of 64 patients were identified, with 56 meeting inclusion criteria, representing 58 ACL tears (mean  $\pm$ SD age, 15.02  $\pm$  2.07 years; 18 male). Predominantly, injuries were sportsrelated (81%), with basketball as the most common cause. Most patients (68%) had reached skeletal maturity and underwent transphyseal autograft reconstruction. Eighteen patients were skeletally immature at surgery (mean  $\pm$  SD bone age, 13.76  $\pm$  1.42 years). Ten had all-epiphyseal reconstruction, and eight had transphyseal reconstruction. Two skeletally immature patients showed growth issues or leg length discrepancies post-ACLR (both all-epiphyseal). Follow-up averaged 9.02 months; return to sports took 12.94 months. There was a 9% reinjury rate (5 reinjuries - 3 retears, 2 partial tears), with two in skeletally immature individuals. Functional outcomes are detailed in Table.

#### CONCLUSION

In this pediatric cohort, both transphyseal and all-epiphyseal reconstruction techniques have exhibited favorable functional outcomes and low graft failure rates. Notably, among skeletally immature patients, only the all-epiphyseal technique resulted in growth disturbance. Consequently, future studies should prioritize the inclusion of a more extensive skeletally immature cohort to advance our comprehension of optimal treatment strategies. Transphyseal and all-epiphyseal reconstruction methods constitute acceptable techniques for ACLR within a highly active pediatric cohort.

#### LEVEL OF EVIDENCE: CASE SERIES, IV

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Cruciate Ligament Reconstruction: A Systematic Review of Transphyseal Versus Physeal-Sparing Techniques. Am J Sports Med. 2017;45(2):488-494. doi:10.1177/0363546516638079

## The Use of Black Tea and Honey for the Treatment of Pharyngocutaneous Fistula

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Pharyngocutaneous fistula (PCF) is a common complication of oropharyngeal procedures that can lead to wound infection, flap failure, and inflammation or rupture of the carotid sheath. Antibiotics are typically the first-line treatment, but culture-directed therapy can be difficult; broad-spectrum antibiotics can lead to yeast overgrowth and multidrug-resistant bacterial infections. The use of complementary and alternative treatment modalities can help to alleviate this by providing topical antisepsis, reducing secretions, and promoting wound healing from within. Honey has a long-standing history as a wound-healing agent and has been shown to have antiseptic and therapeutic effects making it an effective treatment modality in terms of bacterial infection, specifically infections of open wounds such as PCFs.1,2 Black tea is another promising alternative treatment method that has displayed anti-microbial, anti-inflammatory, and antioxidant capabilities.3,4 We describe a unique approach to treating PCF infections using honey and black tea in conjunction with antibiotics.



**FIGURE 1 A-B:**PET/CT shoed persistent activity within the right base of toungue, which increased standardized uptake value (SUV) from 8.1 to 12.9 on the interval imaging after two months.

#### **METHODS**

Case report

#### **CASE PRESENTATION**

A 72-year-old male with persistent p16+ squamous cell carcinoma (SCC) of the

right base of tongue who received definitive chemoradiation 6 months prior, presented to an otolaryngology clinic at a tertiary medical center with a fixed right level 2 neck mass and ulcerated base of tongue mass that was firm to palpation. PET/CT

showed persistent activity within the right base of tongue which increased standardized uptake value (SUV) from 8.1 to 12.9 on interval imaging after 2 months (Figure 1A-B). The patient underwent salvage surgery to include near total glossectomy and bilateral neck dissection including right radical neck dissection.

Submucosal SCC measuring 3.5 cm with extensive perineural invasion (PNI) was invading the root of the tongue (staged ypT4N1) requiring mandibulotomy with anterolateral thigh (ALT) free flap reconstruction. On the third day of post-operation recovery, thick tracheal secretions were noted and cultured, showing Acinetobacter baumannii. Ceftriaxone was added to the antibiotic regimen of clindamycin.

The antiseptic and healing properties of honey and black tea, as well as their therapeutic effects, make them promising natural remedies for multidrug-resistant infections.

> Oral care was initiated on day 9 postoperation with a mixture of black tea and food-grade honey to begin rehabilitating the patient's swallowing abilities and to thin the oral secretions, along with switch to cefepime and vancomycin. The patient's drains had significantly improved within two weeks of initiating oral treatment. CT scans from days 9 (Figure 2A-B), 24 (Figure 2C), and 38 (Figure 2D) illustrate the interval resolution of the pharyngocutaneous fistula and its secretions.



**FIGURE 2 A-D:** CT scans taken nine days (Figure 2 A-B), 24 days (Figure 2 C), and 38 days (Figure D) post-operation.

#### DISCUSSION/ CONCLUSIONS

It is crucial to find alternative treatment remedies to address the issue of antibiotic resistance due to overuse. The antiseptic and healing properties of honey and black tea, as well as their therapeutic effects, make them promising natural remedies for multidrugresistant infections.

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## Pediatric Vertigo Surveillance and Management: A Preliminary Analysis and Single Institution Assessment

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Vestibular disorders, particularly among individuals with inner ear conditions, oncology patients, and those recovering from concussions, can significantly impact quality of life and overall development. While vertigo is an infrequent complaint among children and adolescents, its prevalence is often linked to central or peripheral vestibulopathy. The origins of pediatric vertigo frequently remain enigmatic, but the presence of such symptoms may unveil significant underlying pathologies warranting thorough otoneurological assessments and tests. Conditions such as labyrinthitis, benign paroxysmal positional vertigo, developmental delays, and otitis media are potential etiologies.

We hypothesize that the etiologies of childhood vertigo diverge substantially from those observed in adults. These origins tend to be central in nature rather than stemming from vestibulopathy, and we propose that they may be effectively managed through vestibular therapy.

#### **METHODS:**

The Balance and Vestibular Program at Children's National Hospital is dedicated to addressing vestibular system dysfunction in children, encompassing issues like dizziness, vertigo, imbalance, and delayed motor function development. This interdisciplinary initiative involves a team of otolaryngologists, neurologists, audiologists, and physical therapists, collectively addressing these concerns. The present study aimed to utilize routine data gathered from an existing research database within this program, focusing on a subset of patients with vestibular disorders. The investigation spanned the timeframe from 2014 to 2022. Within this cohort, the study included a total of 58 patients, with an average age of 15 years (SD = 3.63, range = 2-23). Gender distribution revealed 31.1% of patients were male (N = 14), while 68.9% were female (N = 31).

This data, collected during patient appointments and encompassing medical history, clinical characteristics, blood tests, head and brain imaging, vision examinations, and balance assessments, served three main purposes: (1) forming retrospective and prospective protocols, (2) tracking real-time treatment outcomes, and (3) pinpointing potential gaps or vulnerabilities in patient care.

#### **RESULTS:**

Among the most frequent ENT diagnoses, unspecified disorders of bilateral vestibular function were the majority. The outcomes of vestibular evaluations were notably diverse. Normal results were observed in patients aged 15 or younger (N = 31, 53.4%), whereas 7 patients exhibited normal results despite being above 15 years old (12.1%).

A smaller subgroup demonstrated normal results alongside indications of left or right-sided weakness (N = 2, 3.4%). Peripheral function anomalies were detected in five patients aged 15 or below (8.6%), with no such observations among patients over 15 years old. Abnormal central function was identified in two patients aged 15 or below (3.4%) and three over 15 (5.2%). One case exhibited abnormalities in both central and peripheral functions. Additional abnormalities were noted in three cases (5.2%), while two cases had no specific mention of any anomalies.

Patients' primary complaints encompassed a range of symptoms. Vertigo (N = 45, 77.6%) and headache (N = 19, 32.8%) were the most prevalent, followed by tinnitus (N = 15, 25.9%), nystagmus (N = 6, 10.3%), ear fullness (N = 4, 6.9%), otalgia (N = 3, 5.2%), nausea (N = 2, 3.4%), and unspecified "other" (N = 3, 5.2%). This comprehensive analysis contributes to the understanding of pediatric vertigo surveillance and management within a single institution.

#### **DISCUSSION:**

Our study showcases the complexity of pediatric vertigo, highlighting its multifaceted etiologies, clinical presentations, and management strategies. This analysis enhances our comprehension of pediatric vertigo, contributing valuable insights to its surveillance and management.

## Disparities in the Prevalence and Management of Otitis Media: A Systematic Review

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At least 80% of children under five years of age will experience a case of acute otitis media (OM), or infection of the middle ear, in their lifetime; however, not all children with OM are managed equally.1,2 Efforts to identify persistent health disparities in pediatric otolaryngology the last decade have become increasingly popularized. Therefore, in a climate of increased efforts to build a culture of health equity, our systematic review aims to provide an update on the state of disparities in the prevalence and treatment of OM.

#### **OBJECTIVE:**

To provide an update on the state of racial/ethnic and socioeconomic disparities in the prevalence and treatment of OM.

#### **STUDY DESIGN:**

Systematic review.

#### **DATA SOURCES:**

PubMed, CINAHL, Scopus, Medline, and Web of Science

#### **METHODS:**

A systematic review was performed in accordance with PRISMA guidelines. Included studies were published between 2010 and 2023, written in English, and specifically addressed racial, ethnic, and/or SE disparities among pediatric OM patients in the United States. Two independent researchers screened the articles' titles and abstracts and performed full-text reviews.

#### **RESULTS:**

Of 862 studies identified, 21 studies met inclusion criteria. The majority (66%) evaluated both race/ethnicity and SE disparities, 19% focused on SE status, and 14% focused on race/ ethnicity. The most common measure of SE status was insurance status

(86%). The following descriptive trends were identified: 1) the prevalence of frequent ear infections was associated with non-Hispanic White race and low household income, 2) while some variability exists, delays to treatment and complications were associated with non-White race and public insurance.

#### **CONCLUSIONS:**

Prevalence and management disparities in OM have persisted over the last decade, providing opportunities at the level of the health care professional to mitigate such inequities although more work needs to be published to make studies amenable to meta-analysis evaluation. This review identifies potential opportunities for improvement at the interpersonal level. Physicians should utilize these opportunities to identify at-risk patients and provide anticipatory guidance; however further research is needed to further elucidate these trends and guide future interventions, including funding and supporting definitive micro- and macrolevel studies.

Prevalence and management disparities in OM have persisted over the last decade, providing opportunities at the level of the health care professional to mitigate such inequities although more work needs to be published to make studies amenable to meta-analysis evaluation.

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## Evaluation of Cochlear Implantation in Children with Cochlear Nerve Deficiency

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There is a lack of clarity regarding which children will have effective outcomes post cochlear implantation (CI) when there is imaging evidence of an absent or hypoplastic cochlear nerve. Our study evaluated the preoperative candidacy and postoperative performance of CI recipients with absent or hypoplastic cochlear nerves.

#### **METHODS:**

A retrospective case review was performed to identify children with cochlear nerve absence or deficiency who underwent CI evaluation. High-resolution three-dimensional T2-weighted magnetic resonance imaging in the oblique sagittal and axial planes were used to identify absent or hypoplastic cochlear nerves. CI candidacy was determined by test results from the auditory brainstem response and behavioral audiometry. Neural response telemetry (NRT) and behavioral audiometry were used to measure audiological performance after cochlear implantation.

#### **RESULTS:**

Seven children underwent cochlear implantation with imaging evidence of an absent or hypoplastic cochlear nerve. Based on aided behavioral test results indicating speech awareness thresholds of greater than 25 dB HL, all children were deemed candidates for CIs. Two patients experienced postimplantation facial nerve stimulation, prompting further re-programming of implant. Evaluation of auditory rehabilitation status indicated significant and appropriate benefit from CI in all seven patients who underwent our candidacy screening and testing. Due to developmental delays, one patient's performance was determined from post-CI NRT findings and demonstrated sound awareness through exhibited behavioral responses.

#### **CONCLUSIONS:**

Our experience with CIs for children with absent or hypoplastic cochlear nerves demonstrates that CI can be a viable option in select patients who satisfy pre-operative audiological criteria. Radiological identification of a hypoplastic of aplastic cochlear nerve does not preclude auditory innervation of the cochlea. CI recipients in this subgroup must be counseled on difficulty in predicting post-implantation language/speech outcomes, and cautioned about facial nerve stimulation.

## Associations Between Abnormal Glucose Regulation in Pregnancy and Offspring Adiposity, Insulin Resistance, and Adipokine Markers During Childhood and Adolescence

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Gestational diabetes mellitus (GDM) is the most common metabolic complication in pregnancy.<sup>1</sup> There is growing evidence from observational studies that offspring exposed to gestational diabetes in utero are at an increased risk of obesity and disorders in glucose metabolism such as insulin resistance and type 2 diabetes (Figure 1). However, these findings are not consistent across age groups.<sup>2</sup> Moreover, while adiposity and insulin resistance have been mostly studied to reflect cardiometabolic health, there is a lack of knowledge on the impact of GDM exposure on other metabolic aspects such as adipokine profiles, lipid levels, or inflammatory markers, especially in longitudinal cohorts with follow-up from pregnancy to adolescence. We hypothesize that GDM is associated with higher offspring adiposity, insulin resistance markers, and adverse adipokine profiles in midadolescence compared to offspring of mothers with normal glucose tolerance during pregnancy.



**FIGURE 1:** Intergenerational impacts of gestational diabetes during pregnancy and its impacts on offspring cardiometabolic health outcomes.

#### **METHODS:**

We categorized mothers in the Project Viva cohort by their glucose tolerance status during the second trimester of pregnancy oral glucose tolerance test. We measured various offspring's adiposity markers, insulin resistance by the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), adipokines, lipids, and inflammatory markers at mid-childhood, early adolescence, and midadolescence (mean age ~ 18 years old). We used multivariable linear regression models and generalized estimating equations adjusted for child age, sex, ethnicity, maternal age, education, parity, smoking status during pregnancy, and pre-pregnancy body mass index (BMI).

#### **RESULTS:**

At mid-adolescence, offspring of mothers with GDM (n = 25) had a higher BMI z-score (0.45 [0.03, 0.87] kg/m2), waist circumference (5.10 [0.03, 10.18] cm), HOMA-IR (0.94 [0.23, 1.64] units), leptin (7.33 [0.82-13.84] ng/mL) and lower adiponectin (-1.49 [-2.88, 0.10] ug/mL) compared to offspring of mothers with NGT at midadolescence. However, adjusting for maternal sociodemographic factors and pre-pregnancy BMI attenuated all effect sizes. GDM was not associated with lipid levels or inflammatory markers. Associations between GDM and outcomes were generally stronger in midadolescence compared to early adolescence and mid-childhood (Figure 2).

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#### **CONCLUSION:**

GDM is associated with higher adiposity, insulin resistance, and adverse adipokines at mid-adolescence, although these associations are not fully independent of pre-pregnancy BMI. Therefore, both maternal weight and glycemic status may contribute to the programming of a child's metabolic health. Stronger associations observed in mid-adolescence compared to early adolescence and mid-childhood suggest that the peri-pubertal period may be a key time for the emergence of metabolic abnormalities, and interventions mitigating the impacts of GDM should be targeted prior to this period of development. Limitations of the study include the small sample size of mothers diagnosed with GDM, and



**FIGURE 2:** Associations between gestational diabetes mellitus (GDM) and adiposity, insulin resistance, and adipokines across mid-adolescence, early adolescence, and mid-childhood.

future studies should examine larger cohorts of children exposed to GDM.

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## MRI Changes in the Cochlea as a Predictor of Clinically Significant Hearing Loss in Children Receiving Ototoxic Chemotherapy for Treatment of Brain Tumors

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Central nervous system (CNS) tumors are the most common pediatric solid neoplasm, accounting for 20% of childhood cancers. Platinum based chemotherapy regimens using Cisplatin or Carboplatin are commonly utilized as first-line treatments but are associated with permanent, dose-dependent ototoxic effects. While audiometry remains the gold standard for monitoring for otologic sequelae of chemotherapy, the reliability of these tests may be limited in this population due to patient age or comorbidity. Recent studies have highlighted various inner ear signal changes on magnetic resonance imaging (MRI) during the evolution of chemotherapy-induced hearing changes, which may precede clinically detectable hearing loss. If MRI signal

Intercochlear MRI changess in a patient who developed bilateral sensorineural hearing loss



**FIGURE 1:** Axial T2WI (A) and T2 FLAIR image (B) through the posteerior fossa show a heterogenous midline mass consistent with medulloblastoma. Not normal intrachochlear signal: hyperintense on acute postoperative changes from interval gross total tumor resection; cochlear signal remains normal and unchanged (arrows). Three months later (and two months after chemotherapy initiation), an axial T2 FLAIR image (D) shows subtle increase in cochlear signal compared to the pre-treatment studies (arrows). Axial T2 FLAIR images at eight months (E) and 15 months (F) after diagnosis demonstrate progressively increasing cochlear signal hyperintensity in this patient that developed bilateral mild to moderal bilateralSNHL from 5000 to 8000 hz.

changes can be seen prior to clinically detectable hearing loss, this may influence alterations to the therapeutic regimen and/or audiologic protocol used for monitoring. This study presents the first longitudinal investigation of the association of MRI signal changes and hearing outcomes in pediatric patients undergoing chemotherapy for intracranial neoplasm.

#### **METHODS**

A retrospective cohort study of patients receiving treatment for intracranial neoplasms at Children's National Hospital between 2000-2019 was performed. We included patients with intracranial neoplasms who underwent serial MRI and audiologic examinations (n=29). Patients without baseline and post-treatment imaging or audiometry were excluded. Demographic, diagnostic, and treatment data was collected. The timeline of initial cochlear signal abnormality (T2 FLAIR hyperintensity) and audiometric four-tone pure tone average were assessed. The data was further analyzed to evaluate the temporal relationship between

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cochlear changes on MRI and onset of hearing loss. Kaplan-Meier analysis was performed.

#### RESULTS

Our analysis includes 29 children with intracranial neoplasms including medulloblastoma (25/29, 86.2%), ependymoma (3/29, 10.3%), and craniopharyngioma (1/29, 3.4%). The mean age at diagnosis was 8 years. No patients (0/29, 0%) demonstrated abnormal radiographic findings on initial MRI, while all (29/29,100%) developed abnormal signal changes on subsequent imaging. Of the 29 patients, 27 (93.1%) developed hearing loss. Most patients (18/29, 62.1%) demonstrated normal hearing at the time of first abnormal radiographic changes. The median number of weeks between MRI change and hearing loss for patients who experienced MRI change prior to hearing loss was 20.8 weeks (IQR: 9.43, 97.4) (Figure 2). Median time from start of radiotherapy to MRI change was significantly higher in the mild MRI change group compared to the moderate/severe MRI change group (P = < 0.001), while there was no significant difference in the start of chemotherapy to MRI change duration between the groups (P=0.108). Median time to hearing loss in patients who had MRI change before hearing loss was 4.7 months (95% CI: 3.8, 15.5) versus median time to hearing loss in patients who had hearing loss prior to



**FIGURE 2:** Kaplan-Meier analysis shows the hearing loss-free survival probability as a function of time since the baseline audiogram in two cohorts. Cohort 1 (yellow) represents the patients who developed hearing loss prior to radiographic changes. Cohort 2 (blue) developed hearing loss after radiographic changes. (Figure soomed in to 12 months for better vizualization.)

MRI change was 3.8 months (95% CI: 2.8, 5.8).

#### CONCLUSION

These findings suggest that radiographic changes in the cochlea may predate the onset of clinically significant hearing loss. Hearing loss occurred significantly later in patients who had MRI changes before hearing loss, suggesting a possibility for intervention between identification of MRI change and clinical hearing loss. No significant difference was identified between degree of MRI change and time to hearing loss. Additionally, there was no significant difference in time between the start of chemotherapy to MRI changes between the mild and moderate/severe groups.

### Virtual Nutrition Counseling in Pediatric Primary Care: An Integrated Approach to the Prevention and Management of Pediatric Obesity

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The prevention and treatment of childhood obesity remains a clinical challenge as the prevalence in the United States continues to increase. Data from 2020 indicates that the number of children aged 2-19 who were overweight or obese has increased to 22.4% from 19.3% in 2019 with widened racial and ethnic disparities.<sup>1,2</sup> The effects of obesity on pediatric health include comorbidities such as dyslipidemia, insulin resistance, hypertension, and metabolic disease which start to develop in childhood.<sup>3</sup> Early intervention in childhood, with an increased focus on dietary modifications, is a key component in the prevention and treatment of pediatric obesity. Pediatricians are uniquely positioned to address this health crisis early as they meet with the family and infant soon after birth; however, adequate nutrition counseling is a challenge given time constraints.4 Implementation of a Registered Dietitian is a potential solution as dieticians have the knowledge and skill set to effectively counsel families.

#### **METHODS:**

Our quality improvement study addressed the prevention and treatment of pediatric obesity within primary care by incorporating a registered dietitian



FIGURE 1: REDCap Survey Results: Nutrition Information Families Found Useful Discuss

into a pediatric primary care clinic in Washington, DC. The pediatric primary care clinic is in a primarily urban area serving mostly Medicaid patients (70%). A retrospective chart review was completed on 367 patient charts. Patients were between 9 months to 6 years of age and received virtual nutrition counseling at their well-child visits from July 20th, 2022 until July 11th, 2023. Dietary habits were documented and compared to age-matched controls.

#### **RESULTS:**

There was no statistical difference among fruit, vegetable, and sugary beverage intake between children who saw the dietitian and those who did not; however, dairy intake among those who previously had dietary counseling was greater compared to controls (1.9 servings/day versus 1.3 servings/ day, p=0.21). 137 patients who were overweight or obese and who saw the dietitian at least once were reviewed; of these, eight saw the dietitian twice, five saw the dietician three times, one saw the dietician five times, and two saw the dietician six times. Patients who saw the dietitian were advised by their provider to create a BMI follow-up appointment 78% of the time; however, only 32 patients, or 29.9%, did so. 131 families completed a Research Electronic Data Capture (REDCap) survey about the nutrition counseling experience. Types of food and beverages were the topics families found most useful to discuss (Figure 1), and over half of all families had a question relating to nutrition, with beverages, portion sizes, and meals being the most common (Figure 2). Overall, families reported they found the meetings with the dietician useful (4.44/5) and learned a lot from the visit (4.17/5). Five pediatric providers who worked with the model were also surveyed and strongly agreed

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that having a dietitian in primary care was helpful, saved them time, improved access, and served an important need.

#### **CONCLUSIONS:**

This quality improvement project was a novel first step to increase the access of patients to a registered dietitian and dietary counseling both in the prevention of obesogenic traits and in the treatment of overweight and obesity. This project confirmed the feasibility of this model within the medical home and showed that having a virtual dietitian integrated into pediatric primary care is sustainable and accessible.

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## The Use of Intrathecal Baclofen in the Management of Stiff Person Syndrome

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#### **CASE DIAGNOSIS:**

A 70-year-old female diagnosed in 1997 with Glutamic Acid Decarboxylase(GAD+) Stiff Person Syndrome(SPS).

#### **CASE DESCRIPTION:**

Her medications included Baclofen 20 mg QID and Diazepam 5 mg QID(later changed to Clonazepam 2 mg BID). Despite these interventions, she reported daily somnolence and made numerous trips to the ED for painful muscle spasms, uncontrolled jerking, stiffness, gait impairment, and diffuse body pain. Additionally, she received several doses of IVIg in the hospital for symptom management. In 2021, she was counseled on intrathecal baclofen(ITB) to improve her symptoms and reduce her doses of sedating medications. After detailed discussions on risks, benefits, and alternatives with her previous treating neurologist, her ITB pump was implanted with no surgical complications. She was initiated on a dose of 50 mcg which was slowly titrated to 147 mcg. She also decreased her Baclofen dosage to 5 mg QID and Clonazepam to 2 mg daily.

#### **DISCUSSION:**

Stiff Person Syndrome is an autoimmune disorder resulting in painful muscle spasms, truncal stiffness, and generalized rigidity. The mainstay of treatment includes oral antispasmodics and benzodiazepines such as baclofen and clonazepam. However, these medications can have intolerable, systemic side effects. ITB can be used as a next line in therapy and previous case reports have shown patients experiencing significant clinical and functional improvements. Once our patient's ITB dose was increased and oral medications decreased, she saw improvements in her spasms and a reduction in her sedation. She is on a multi-modal treatment plan including home physical and occupational therapy(PT/OT), which was initiated recently due to mobility impairments making regular outpatient PT/OT visits unfeasible. She reported feeling stronger allowing slightly more functional independence after only a few sessions.

#### **CONCLUSION:**

This case report is intended to add to the growing body of evidence outlining the successful utilization of ITB to minimize pill burden and reduce the deleterious effects of high doses of oral medications in patients with SPS.

### Language Barriers and Breast Reconstruction: A Systematic Review

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Breast reconstruction is a common procedure that often follows mastectomies performed to prevent and treat breast cancer.1 Breast reconstruction encompasses a number of different surgical techniques including a variety of autologous flaps and various implant options, conferring patients with greater responsibility and associated difficulty with decision-making.1 Despite the understood importance of patient-physician communication in the field of plastic surgery as emphasized by the American Society of Plastic Surgeons practice guidelines for postmastectomy breast reconstruction, variable and language discordance has not been well studied.2 Therefore, this paper aims to examine if language barriers have an influence on breast reconstruction surgical decision-making and surgical outcomes.

#### **METHODS:**

Following the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, this systematic review was performed in PubMed, Scopus, CINAHL, and Medline - Ovid within 10 years of the search date of June 2023. Inclusion criteria were English, original research articles with human subjects including data on patient-provider language differences and breast reconstruction decisions or outcomes. Exclusion criteria included non-original research and case reports. Studies validating translated materials or content readability such as for protocols were also excluded. Duplicates were removed. Search results were independently reviewed to determine included studies. One study was excluded due to inability to retrieve.

#### **RESULTS:**

Eight studies were included for risk of bias assessment, data extraction, and analysis. One study found no statistically significant difference in the likelihood of undergoing breast reconstruction based on variables of English versus non-English speaking groups, race,

ethnicity, or insurance. Other studies found lower patient-reported quality of life following mastectomies in patients with a language barrier despite controlling for these variables. Compared to English-speaking patients, non-English-speaking patients had lower rates of immediate breast reconstruction after controlling for race. However, hispanic ethnicity, independent from Spanishspeaking, was found to be a statistically significant variable against breast reconstruction following mastectomies and may suggest cultural influences as explanation for disparities in reconstructive decision-making. In addition, having a language barrier was associated with higher patient reporting of not receiving information on surgical options as compared to patients who did not experience a language barrier. Similarly, having a language barrier was also associated with patients being less likely to seek out information on reconstruction, alluding to a two-way barrier to patient education. In evaluation of interpreter use, studies varied with one citing statistically significant decrease in immediate breast reconstruction likelihood and another finding the dif-

Despite the frequency of breast reconstructive procedures and the prevalence of linguistic diversity in patient-provider encounters, the impact of language discordance on decisionmaking and medical outcomes is an area with limited research.

> ference disappeared following adjustment for patient factors.

#### **CONCLUSION:**

Despite the frequency of breast reconstructive procedures and the prevalence of linguistic diversity in patientprovider encounters, the impact of language discordance on decisionmaking and medical outcomes is an area with limited research. While some studies found disparities in breast reconstruction associated with language barriers, the influence of cultural and socioeconomic factors were found to be confounding variables in a portion of these studies. Thus, while language differences can negatively influence patient-provider interactions and subsequent outcomes, given the complexity of sociocultural influences, more research is required to understand if these variables contribute independently. Furthermore, the variation across studies may be attributed to site-specific features such as hospital policy on interpreter use. Nonetheless, this systematic review demonstrates the need for further study on the relationship between patient-provider language differences and reconstructive surgical decisions and outcomes in the field of plastic and reconstructive surgery.

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## Evaluating the Use of Hyperbaric Oxygen for Treatment and Prevention of Postoperative Ischemia in Breast Reconstruction: A Systematic Review

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Complications and poor outcomes following breast reconstruction are often related to tissue ischemia and subsequent necrosis of mastectomy skin. Hyperbaric oxygen therapy (HBOT) has shown promising results for reducing adverse effects. This systematic review summarizes and assesses evidence on the role of HBOT in breast reconstruction patients in treating ischemic complications following surgery and/or radiotherapy.

#### **METHODS:**

A comprehensive literature search was conducted in January 2023 using publications extracted from Pubmed, Scopus, Medline and CINAHL. Studies published after 2000 that investigated the impact of HBOT on post-operative outcomes of female patients undergoing implant or autologous breast reconstruction were included. Studies that had fewer than five patients, no fulltext access, and/or were not in English were excluded. Systematic reviews and viewpoint articles were also excluded.

#### **RESULTS:**

Our initial search yielded 263 studies. After three stages of screening, four retrospective case-control chart review studies were included ( $n \ge 7$  patients)<sup>.1,2,3,4</sup> Three of the four studies reported that HBOT had a significant advantage over alternative methods in reducing the risk of postoperative complications following post-mastectomy breast reconstruction, including successfully rescuing "at-risk" ischemic

breast skin flaps and preventing subsequent ischemic necrosis.<sup>1,2,3</sup> Contrarily, one study reported that HBOT did not significantly impact ischemic nipples following nipple-sparing mastectomy, though did not negate its potential benefit.<sup>4</sup> Generally, the studies found that initiating HBOT sooner rather

than later following reconstruction and increasing the number of HBOT sessions administered were associated with improved clinical outcomes.

#### **CONCLUSION:**

This systematic review showed that HBOT is advantageous at treating and preventing postoperative ischemic complications following breast surgery, though the current literature is sparse. Of the current literature, findings are limited by numerous factors including the small sample sizes, lack of standardized treatment algorithms, and clinical endpoints. Additionally, these studies speculated the cost-saving implications of HBOT but did not specify any actual or estimated cost savings. Therefore HBOT-related cost savings is something that must be further explored. We believe that HBOT is potentially beneficial in this context and further investigation is warranted for more robust evaluation of its application.

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### Geriatric Emergency Department and Delirium Screening Updated Systematic Scoping Review and Protocol

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Delirium poses a significant challenge in the emergency department (ED), increasing patient morbidity and mortality among other adverse outcomes.1 Given the variable clinical presentation of delirium, missed diagnoses are common. While a number of delirium screening tools exist and have been validated in settings such as the Intensive Care Unit (ICU), the efficacy and suitability of delirium screening tools in the geriatric ED setting specifically has yet to be assessed in depth, despite the high incidence of delirium in the ED and the recent movements toward more specialized emergency departments. We conducted a systematic review assessing the most commonly referenced delirium screening tools for their suitability for a geriatric emergency department. Based on our findings, we proposed a screening and interventional protocol for the prevention and treatment of hospital- acquired delirium.

#### **METHODS:**

We conducted a comprehensive systematic review of US English-language literature using databases including



PubMed, MEDLINE-Ovid, and Scopus from 2013 to 2023. We evaluated the total sample of articles (n = 109) for most frequently included delirium and cognitive impairment screening tools. We used various search strategies, combining MeSH terms and keywords, to identify articles on delirium screening in emergency care settings among older adults. Studies involving children, specific procedures, interventions, postoperative delirium, or non-ED settings were excluded. This review focuses on diagnostic and screening procedures during short-term emergency care for geriatric patients. Numerical frequency of included delirium and cognitive impairment screening tools in the total sample of articles was collected and assessed of which the 7 most studied tools were extracted for in depth analysis of sensitivity, specificity, delivery time, inter-rater reliability and general features.

#### **RESULTS:**

Of the 109 articles, Confusion Assessment Method (CAM) was used

69 times, CAM-ICU used 44, 4 A's Test (4AT) used 37 times, brief- CAM (bCAM) used 24, Delirium Triage Screen (DTS) used 20, Single Question in Delirium (SQiD) used 18, and modified CAM - ED (mCAM-ED) used 10. The results of the systematic review show 4AT as the most sensitive (Tieges, 2021: 95% CI 0.80–0.93, Jeony, 2020: 81.5%, Bellelli, 2014: 89.7%) and specific (Tieges, 2021: 95% CI 0.82–0.92, Jeony 2020: 87.5%, Bellelli, 2014: 84.1%) tool with a delivery duration of only 2 mins.

#### **CONCLUSION:**

In conclusion, our comprehensive analysis of delirium screening tools validated for the ED setting, considering factors such as sensitivity, specificity, and administration time, establishes 4AT as the optimal choice. Implementing a validated delirium screening protocol featuring the 4AT equips clinicians to swiftly detect delirium, facilitating timely intervention, mitigation of complications, and

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ultimately, improved patient outcomes.

#### **PROTOCOL:**

At the George Washington University Hospital, a Geriatric Emergency Department is being formally established with focuses on multifactorial protocols targeted toward the unique care requirements of older adults. Our systematic review serves as support for a delirium screening and intervention protocol that may subsequently function as a model for the growing movements of specialized ED care. We propose the following delirium screening protocol to be evaluated at the George Washington University Geriatric Emergency Department. When screened delirium positive, the interventional protocol, based on validated resources including the hospital elder life program (HELP) will be subsequently activated to focus on prevention and treatment of hospitalacquired delirium.2

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### **GW** Delirium Screening Protocol

All Patients Screened for Delirium via the 4-AT Clinical Assessment on Admission.





## Utility of the "All of Us" Database for Radiation Oncology Research

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#### **PURPOSE:**

We provide an overview of the "All of Us" Research Program, a National Institutes of Health-funded research database,<sup>1</sup> and report on the utility of this database for Radiation Oncology research.

#### **METHODS/MATERIALS:**

The "All of Us" Research Program aims to create a large and diverse health database with participants from across the United States. Patients consent to join the database and agree to share electronic health records, complete surveys, provide physical measurements, and donate at least one biospecimen. In this observational study, we used the public data browser feature of the "All of Us" Dataset to evaluate its utility for future radiation oncology research. Within the database, we report the number of cases of common cancers in the United States, using the International Classification of Disease, Tenth Revision (ICD-10) codes, and also the number of patients treated with common radiotherapy procedures, using Current Procedural

Terminology-4 (CPT-4) codes. We then qualitatively report on additional data of interest. Of note, public patient counts in "All of Us" are rounded to the nearest interval of 20. Additional tiers of data access exist, including individual-level data, which were not used in this survey of public data.

#### **RESULTS:**

The database includes 372,380 participants, of which 46,380 patients have a diagnosis of cancer. Within the identified top 10 cancers according to ACS2, there were a total of 26,540 primary malignant cancers. The most common

type of cancers were breast cancer (ICD-10 - c50 [n=6,960]), Prostate (ICD-10 - c61 [n=4,500]), Non-Hodgkin lymphoma (ICD-10 - c85[n=2,860]), Lung & bronchus (ICD-10 - c34 [n=2,000]), Colon (ICD-10 - c18[n=19,40]), Melanoma of the skin (ICD-10 c43 [n=1,740]), Thyroid

(ICD-10 - c73 [n=1,720]), Kidney (ICD10 - c64 [n=1,300]), and Urinary bladder (ICD10 - c67 [n=1,140]). The most common radiation therapy procedures were Computerized Tomography simulation (CPT - 77,290 [n=4,040]), Intensity Modulated Radiation Therapy (CPT - 77,386 [n=780]), 3D conformal radiation therapy (CPT - 77,412 [n=1,720]), Stereotactic Body Radiation Therapy (CPT - 77,373 [n=400]), Brachytherapy (CPT - 77,770-77,772 [n=240]), and Proton Therapy (CPT - 77,520-77,525 [n=140]). Qualitatively, other data within "All of Us" include lab values, drug exposures, comorbidities, other

procedures, physical measurements, and wearable biometrics (i.e., Fitbit) data. Genomic data typically includes germline testing using whole genome sequencing or genotyping array. Patient surveys include data on personal medical history, family health history, lifestyle, social determinants of health, COVID-19 experience, and overall health. Potential outcome variables of interest to oncology research in the database include survival, cause of death, additional procedures or diagnoses after cancer treatment, and quality of life metrics derived from the survey instruments.

The "All Of Us" Research Database includes a large number of cancer cases, of which a substantial number received radiotherapy. Future work will focus on focused hypothesisdriven research questions.

#### **CONCLUSION:**

The "All Of Us" Research Database includes a large number of cancer cases, of which a substantial number received radiotherapy. Future work will focus on focused hypothesis-driven research questions.

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## Dual-Energy Subtraction Radiography (DESR): A Way toEnhance Pulmonary Lesion Detection

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Dual-energy Subtraction Radiography (DESR) is a radiological technique pioneered in the 1980s that uses one of two methods (a single or double-exposure) to generate two chest radiographs: one that contains radio-opaque structures such as bone and one that has primarily radiolucent soft-tissue structures.<sup>1</sup>

The dual-energy nature of the technique is essential as it leverages the attenuation patterns of different tissues at different energies. Specifically, bone and other calcium-containing tissue are more attenuated when compared with soft-tissue structures at low energies. As energies increase, the difference in attenuation between soft tissue and bone diminishes. Thus, combining the two images allows one to create a soft tissue and a bone-containing pseudoradiograph (Figure 1, copyright of Martini et. al.).<sup>2</sup>

The advantages of DESR are numerous including a 7-fold reduction in radiation dose compared to low-dose CT imaging (LDCT).<sup>3</sup> And with novel imaging technologies, DESR can be



Fig 1. Conventional Radiography and DESR. Conventional radiograph (CR, a). Bone image (b), and soft tissue image (c) of the chest after subtraction of thoracic skeletal structures.

**FIGURE 1:** Example of a DESR Radiograph. A composit image, a bone-enhanced image, and a bone-subtracted image is shown.

delivered at radiation doses similar to conventional radiography (CR), despite capturing images at two different energies.<sup>4</sup> In addition to the lower radiation dose compared to CT, studies have shown superior detection of lung lesions compared to CR. DESR has also been investigated for use in detecting other thoracic pathology including coronary calcifications, hilar masses, and other chest wall abnormalities.<sup>5</sup> This meta-analysis and systematic review sought to further explore the detection ability of DESR versus CR in the detection of pulmonary lesions.

#### **METHODS:**

A literature search was conducted using Pubmed/MEDLINE by entering the terms "Dual-energy subtraction radiography," "DESR," and "Subtraction Radiography." Only studies comparing CR to DESR were included. Studies involving dual-energy CT and/or digital tomosynthesis were excluded. Studies involving pathological conditions other than pulmonary lesions were excluded. Studies utilizing AI algorithms for diagnosis were excluded. A total of 13 studies between 1994 and 2022 containing Receiver Operating Characteristic Area Under the Curve (ROC AUC) measures were identified. ROC AUC of DESR was compared with CR to generate a mean difference between DESR and CR.

#### **RESULTS:**

A total of 1076 patients from the 13 studies were included in the study, 375 of which had control radiographs without any nodules present. A total of at least 995 nodules were identified among the 701 patients that contained pulmonary nodules. For the size of the nodules, either mean, or median was given in twelve of the thirteen studies, with the mean/median ranging from 3 mm to 27 mm. The total range of nodule sizes in all the studies ranged from 3 mm to 140 mm. Six of the thirteen studies used a single exposure technique to create the DESR image using a range of energies between 100 - 125 Kvp. Six of the 13 studies utilized a single-exposure technique for creating the DESR image, with the most common two energies utilized being 60 and 120 Kvp with a 200 ms delay. One study used unknown energy parameters.

The mean difference for DESR AUC

compared to conventional radiography ROC AUC was 0.07 (95% CI: 0.04 - 0.9) (Figure 2). This means that, on average, there is a 7% increase in the physician's performance in detecting pulmonary lesions when DESR is used instead of conventional radiography.

#### **CONCLUSION:**

DESR showed superior ROC AUC compared to conventional radiography in detecting pulmonary lesions. This provides evidence that DESR could help improve clinical outcomes in the detection of pulmonary lesions.

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## Incomplete Ureteral Opacification in Computed Tomography (CT) Urography: Diagnostic Utility of Concurrent Repeat CT Imaging to Ensure Complete Ureteric Opacification

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CT Urogram (CTU) is the recommended imaging modality for various clinical indications, including hematuria and surveillance of urothelial malignancies. A common, recurring challenge in CTU is the incomplete opacification of the ureters, prompting repeat concurrent imaging to capture complete opacification. Thus, we aimed to determine the diagnostic utility of repeat CTU due to incomplete ureteral opacification.

#### **METHODS:**

Our institution uses a split-bolus protocol to administer contrast for the CT urogram. A retrospective analysis was conducted on 287 CT urograms performed at our institution between 2019 and 2023. Inclusion criteria were patients with repeated CT urograms due to incomplete ureter opacification and without post-surgical changes to the collecting system of the bladder. Of these, 37 (12.9%) cases had repeat CTU due to initial incomplete ureteral opacification without other concurrent procedures. Data extracted included which ureter was non-opacified, ureteric segment in question, number of repeat scans, subsequent pathologies

identified, and any change in the final diagnosis post repeat imaging.

#### **RESULTS:**

Of the 37 patients with repeated CTU, seven patients (18.9%) had only their right ureter incompletely

opacified; six patients (16.2%) had only their left ureter incompletely opacified, and 22 patients (59.5%) had both their ureters incompletely opacified. The most commonly unopacified ureteral segment was the distal segment (41.8%) followed by the middle segment (38.2%) and the proximal segment (20%). Despite the repeated concurrent CTU, only 32.4% achieved complete opacification, and none of the repeated CTUs led to a change in the final diagnosis. CTUs were primarily performed due to gross hematuria (35%), microscopic hematuria (13.5%), unspecified hematuria (10.8%), and bladder carcinoma (8.1%). CT imaging revealed 81.5% with no abnormality, 7.9% with ureteric stones, and 10.5% with hydronephrosis. No patients had a ureteric stricture or lesion.

#### **CONCLUSION:**

Our analysis suggests that despite the

Our analysis suggests that despite the perceived need for repeat concurrent CTU due to incomplete opacification, no significant change in the final diagnosis was observed.

> perceived need for repeat concurrent CTU due to incomplete opacification, no significant change in the final diagnosis was observed. The repeated scans, while aimed to enhance diagnostic confidence, may not necessarily augment clinical outcomes. These findings prompt a reconsideration of the routine practice of repeated imaging, especially when balancing diagnostic yield against potential radiation risks.

## Artificial Intelligence vs. Radiologists in Screening Mammography Interpretation

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According to the Centers for Disease Control and Prevention (CDC), breast cancer is the second leading cause of cancer death for women in the United States. As such, the U.S. Preventive Services Task Force recommends biennial breast cancer screening for women ages 50-74. As of Sept. 1, 2023, the FDA documented a total annual count of 39,844,021 mammography procedures.1 Due to the high stakes surrounding accurate screening as well as the sheer volume of screens, advancing technology to enhance precision as well as reduce the workload for radiologists in this area would be extremely advantageous. The advent of artificial intelligence (AI) systems within the field of radiology, specifically within screening mammography, has the potential to aid in expeditious cancer diagnoses, reduce false positive findings, and decrease screen-reading workload for radiologists, among other benefits. That being said, the clinical utility and safety of AI programs for screening mammography have yet to be fully characterized. The aim of this abstract is to compare the performance of AI systems to radiologist readers in interpreting digital screening mammography.

#### **METHODS:**

A literature review was conducted using the PubMed database to assess the sensitivity and specificity of mammography interpretations performed by artificial intelligence (AI) in comparison to readings by radiologists working independently. The review included data from three selected studies that met predetermined inclusion criteria. In total, the analysis included 1,463,810 cases and compared performance metrics with 95% CIs for AI and radiologist interpretations of imaging, respectively.

#### **RESULTS:**

Of the 1,463,810 cases reviewed, AI applications demonstrated a weighted average sensitivity and specificity of 80.12% and 85.76%, respectively, in correctly identifying the presence or absence of cancerous findings on screening mammography. Comparatively, radiologists exhibit a weighted average sensitivity of 73.82% and specificity of 88.66% in identifying the presence or absence of cancerous breast lesions.

#### **CONCLUSION:**

In applying their wealth of expertise and experience to the nuances of imaging studies, radiologists remain indispensable in the field of medical diagnostics; however, the statistics presented here underscore the considerable potential of AI to augment higher sensitivity and specificity levels in specific radiologic diagnostic applications such as screening mammography. As technology continues to advance, the collaboration between radiologists and AI presents compelling evidence for reshaping the field of medical diagnostics, ultimately improving patient care with enhanced diagnostic accuracy and timeliness. The age of AI is upon us, and it behooves the next generation of radiologists in training to embrace and better understand the advantages and limitations of such a tool. In conclusion, this study demonstrates that AI performance in interpreting screening mammography is comparable in sensitivity and specificity to the performance of radiologist readers alone, lending support to the notion that AI is an excellent supplemental tool for radiologists in their surveillance of breast cancer.

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## A Review of Photon-Counting Detector CT Advancements, Clinical Applications, and Impact

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Photon-counting detector (PCD) CT technology has witnessed significant evolution in recent years, ushering in remarkable technical and clinical enhancements. In this review, we comprehensively synthesize findings from a collection of abstracts, each contributing unique insights into the realm of PCD-CT. Our objective is to provide a data-driven examination of PCD-CT's technological advancements, clinical applications, and resulting clinical impact.

#### **METHODOLOGY:**

To construct this review, we conducted an exhaustive examination of data extracted from a series of abstracts that explored various facets of PCD-CT. These abstracts encompassed topics spanning technological advancements, clinical applications, and clinical impact. By aggregating the specific numerical data and findings presented in these studies, we aim to offer a robust overview of the PCD-CT landscape.

## TECHNOLOGICAL ADVANCEMENTS:

Our synthesis underscores the impressive strides achieved by PCD CT systems: Photon-counting detectors have realized substantial reductions in electronic noise, thereby substantially enhancing image quality. The contrastto-noise ratio has witnessed significant improvement when iodinated contrast material is used. Notably, PCD CT systems have demonstrated enhanced radiation dose efficiency, translating into substantial dose reductions. The system's capacity to mitigate beamhardening and metal artifacts has contributed to more precise imaging. Exceptional spatial resolution, with capabilities reaching up to 33 line pairs

per centimeter, has enabled finer anatomical details. Simultaneous multi-energy data acquisition has opened new horizons in material-specific imaging, and the ability to differentiate

among various CT contrast agents has broadened clinical applications.

#### **CLINICAL APPLICATIONS:**

The diverse clinical applications of PCD technology have been empirically demonstrated: In coronary CT angiography (CCTA), PCD-CT has consistently delivered higher image quality and diagnostic confidence compared to conventional CT, often with significantly reduced radiation doses. For screening purposes in multiple myeloma, PCD-CT has provided equivalent or superior diagnostic quality while employing markedly lower radiation doses. In thoracic imaging, the technology has consistently delivered equivalent or superior diagnostic quality at significantly reduced radiation doses. High-resolution, low-dose PCD-CT has emerged as a valuable tool for improving diagnostic quality in thoracic imaging. In abdominal diagnostic imaging, PCD CT has optimized image quality while substantially lowering radiation doses.

#### **CLINICAL IMPACT:**

The scientific data compiled from these studies paints a clear picture of the clinical impact of PCD-CT: Across

This review, founded on a wealth of scientific data and empirical findings from multiple abstracts, underscores the substantial technological advancements, diverse clinical applications, and significant clinical impact of photon-counting detector CT.

> various applications, PCD CT has consistently yielded improved image quality, evident in median quality scores significantly higher than those of other modalities. Diagnostic confidence has been consistently enhanced, with consistently higher scores for PCD CT. Importantly, substantial reductions in radiation doses, reaching up to 76%, have been achieved without compromising diagnostic quality. The technology has enhanced lesion conspicuity and diagnostic accuracy, contributing to more precise patient evaluations. Additionally, participant PCD CT images have demonstrated up to 47% lower noise and improved spatial resolution.
#### **CONCLUSION:**

This review, founded on a wealth of scientific data and empirical findings from multiple abstracts, underscores the substantial technological advancements, diverse clinical applications, and significant clinical impact of photon-counting detector CT. The robust evidence highlights PCD-CT as a transformative imaging modality, poised to elevate patient care and diagnostic precision. The ongoing integration and exploration of PCD-CT hold promise for further advancements in medical imaging.

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# The Impact of Preoperative Depression on In-Hospital Outcomes in Coronary Artery Bypass Grafting: A Propensity-Matched Analysis of National Inpatient Sample 2015–20

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Depression has a high prevalence among patients undergoing coronary artery bypass grafting (CABG).<sup>1-4</sup> However, there is a scarcity of literature on the association between preoperative depression and CABG outcomes. This study aimed to explore the effects of preoperative major depression disorder (MDD) on in-hospital outcomes following CABG.

#### **METHODS:**

Patients who underwent CABG were identified in the National Inpatient Sample from the last quarter of 2015 to 2020. Patients were stratified based on the diagnosis of MDD, followed by a 1:3 propensity-score matching of demographics, socioeconomic status, comorbidities, relevant diagnosis, admission status, and hospital characteristics between MDD and non-MDD patients. In-hospital perioperative outcomes, length of stay (LOS), time from admission to operation, and total hospital charge were compared.

#### **RESULTS:**

There were 908 patients with MDD and 170,830 patients without MDD who underwent CABG. After propensity-score matching, 2,796 non-MDD were

**TABLE:** Comparison of in-hospital outcomes between patients with and without MDD who went under CABG after 1:3 propensity-score matching.

	MDD (n = 908)	Non-MDD (n = 2 796)	p-value
Mortality	18 (1.98%)	64 (2.29%)	0.70
MACE	23 (2.53%)	73 (2.61%)	1.00
MI	12 (1.32%)	43 (1.54%)	0.75
Stroke	4 (0.44%)	23 (0.82%)	0.37
TIA	5 (0.55%)	4 (0.14%)	0.05
Neurological complications	9 (0.99%)	29 (1.04%)	1.00
Pericardial complications	18 (1.98%)	44 (1.57%)	0.46
Pacemaker implantation	23 (2.53%)	40 (1.43%)	0.04
Cardiogenic shock	78 (8.59%)	228 (8.15%)	0.68
Respiratory complications	102 (11.23%)	337 (12.05%)	0.55
Mechanical ventilation	89 (9.8%)	269 (9.62%)	0.90
AKI	249 (27.42%)	707 (25.28%)	0.21
Post-procedural renal failure	8 (0.88%)	20 (0.72%)	0.66
VTE	11 (1.21%)	16 (0.57%)	0.07
PE	0 (0%)	1 (0.04%)	1.00
Hemorrhage/hematoma	599 (65.97%)	1683 (60.17%)	<0.01
Infection	42 (4.63%)	126 (4.5%)	0.85
Sepsis	1 (0.11%)	1 (0.04%)	0.43
Deep wound complication	4 (0.44%)	7 (0.25%)	0.48
Superficial wound complication	9 (0.99%)	20 (0.72%)	0.39
Vascular complication	7 (0.77%)	19 (0.68%)	0.82
Diaphragmatic paralysis	2 (0.22%)	7 (0.25%)	1.00
Reopen surgery	5 (0.55%)	26 (0.93%)	0.40
	Mean ± SE	Mean ± SE	p-value
Admission to operation (days)	3.21 ± 0.13	$2.63 \pm 0.06$	<0.01
LOS (days)	12.59 ± 0.46	10.45 ± 0.16	<0.01
Total hospital charge (US dollars)	272,255 ± 8930.1	230,133 ± 3861.1	<0.01

*Abbreviations*: AKI, acute kidney injury; aOR, adjusted odds ratio; CABG, coronary artery bypass grafting; CI, confidence interval; LOS, length of stay; MACE, major adverse cardiovascular event; MDD, major depression disorder; MI, myocardial infarction; PE, pulmonary embolism; SE, standard error; TIA, transient ischemic attack; VTE, venous thromboembolism.

matched with all 908 MDD patients. While MDD patients have no difference in in-hospital mortality or MACE, they had higher hemorrhage/ hematoma (65.97% vs 60.17%, p<0.01) and pacemaker implantation (2.53% vs 1.43%, p=0.04). MDD patients had longer time from admission to operation (3.21 $\pm$ 0.13 vs 2.63 $\pm$ 0.06 days, p<0.01), longer LOS (12.59 $\pm$ 0.46 vs 10.45  $\pm$  0.16 days, p<0.01), and higher total hospital charge (272,255 $\pm$ 8930.1 vs 230,133 $\pm$ 3861.1 U.S. dollars, p<0.01).

#### **CONCLUSION.**

Potential barriers could exist for MDD patients seeking access to CABG.

Preoperative MDD is a risk factor for complications following CABG including hemorrhage/hematoma and pacemaker implantation. Enhanced attention to blood management is advisable for MDD patients prior to CABG to maintain normal coagulation function.

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# Local Anesthesia is a Safer Alternative to General Anesthesia in Initial Inguinal Hernia Repair among Frail Patients

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Open inguinal hernia repair (OIHR) can be conducted under either general anesthesia (GA) or local anesthesia (LA).<sup>1,2</sup> Despite a lack of evidence supporting improved perioperative outcomes, GA is the predominant anesthesia type used in OIHR. Frailty is defined as a clinically recognizable state of age-related increased vulnerability. This study aimed to compare the 30-day perioperative outcomes of frail patients undergoing OIHR with either GA or LA.

#### **METHODS:**

Patients who underwent initial OIHR were identified in ACS-NSQIP database from 2005–21. Modified Frailty Index (mFI) was calculated based on the presence of congestive heart failure, chronic obstructive pulmonary disease, diabetes mellitus, dependent functional status, and hypertension. Only patients with mFI≥2 were included. Patients were divided based on GA or LA administered. Multivariable logistic regression was used to compare 30-day perioperative outcomes between frail patients who underwent GA and LA.

#### **RESULTS:**

There were 13,473 frail patients who underwent initial OIHR with GA, **TABLE:** Thirty-day perioperative outcomes of frail patients who underwent LA versus GA for initial OIHR.

30-day outcome (n, %)	LA (n = 3,686)	GA (n =13,473)	aOR for LA/GA (95% CI)	p-value
Mortality	16 (0.43%)	48 (0.36%)	1.062 (0.592-1.906)	0.84
MACE	20 (0.54%)	56 (0.42%)	1.191 (0.708-2.001)	0.51
Cardiac complications	17 (0.46%)	47 (0.35%)	1.235 (0.702-2.173)	0.46
Stroke	3 (0.08%)	12 (0.09%)	0.914 (0.258-3.240)	0.89
Pulmonary events	25 (0.68%)	98 (0.73%)	0.792 (0.502-1.249)	0.32
Renal dysfunction	9 (0.24%)	37 (0.27%)	0.887 (0.421-1.872)	0.75
Sepsis	12 (0.33%)	58 (0.43%)	0.735 (0.387-1.397)	0.35
Clot formation	4 (0.11%)	27 (0.2%)	0.586 (0.204-1.680)	0.32
Bleeding transfusion	3 (0.08%)	31 (0.23%)	0.282 (0.083-0.955)	0.04
Wound complications	14 (0.38%)	127 (0.94%)	0.471 (0.269-0.823)	0.01
Wound dehiscence	2 (0.05%)	12 (0.09%)	0.547 (0.119-2.510)	0.44
Superficial SSI	8 (0.22%)	82 (0.61%)	0.450 (0.216-0.939)	0.03
Deep incisional SSI	1 (0.03%)	20 (0.15%)	0.227 (0.030-1.710)	0.15
Organ space infection	3 (0.08%)	15 (0.11%)	0.642 (0.185-2.224)	0.48
Unplanned operation	34 (0.92%)	146 (1.08%)	0.823 (0.563-1.205)	0.32
Discharge not to home	342 (11.91%)	1519 (13.12%)	0.792 (0.691-0.908)	<0.01
Readmission	120 (3.26%)	437 (3.24%)	0.866 (0.700-1.071)	0.18
	Mean ± SD	Mean ± SD	F	p-value
Operation time (mins)	58.42 ± 25.26	67.60 ± 37.17	79.16	<0.01
Length of stay (days)	$0.45 \pm 2.30$	0.57 ± 2.96	6.95	<0.01

**Abbreviations:** aOR, adjusted odds ratio; OIHR, inguinal hernia repair; INR, international normalized ratio; LA, local anesthesia; MACE, major adverse cardiovascular events; LOS, length of stay; OIHR, open inguinal hernia repair; PT, prothrombin time; PTT, partial thromboplastin time; SD, standard deviation; SSI, surgical site infection.

while 3,686 underwent the procedure with LA. The 30-day mortality rates for LA and GA were low. However, frail patients who underwent LA had a lower risk of bleeding (aOR 0.282, p=0.04), superficial SSI (aOR 0.450, p=0.03), and discharge not to home (aOR 0.792, p<0.01). In addition, frail patients who underwent LA had shorter operation time (58.42  $\pm$  25.26 vs 67.60  $\pm$  37.17 mins, p<0.01) and shorter length of stay  $(0.45 \pm 2.30 \text{ vs } 0.57 \pm 2.96 \text{ days}, \text{ p}<0.01).$ 

#### **CONCLUSION:**

LA emerges as a safer alternative to GA for initial OIHR in frail patients, offering potential benefits such as reduced complications, increased daycase surgery volume, and decreased health care costs.

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# MRI-Compatible Robot for Intracerebral Hemorrhage Evacuation

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Intracerebral haemorrhage (ICH) is the second most common type of stroke and about one in 50 people are likely to suffer from ICH in their lifetime.<sup>1,2</sup> ICH refers to bleeding in the brain which can result in an increase in intracranial pressure. This blood can be toxic to the surrounding brain creating a harmful inflammatory environment for normal brain tissue.<sup>3</sup> Removal of the blood is essential for patient survival and better prognosis. Minimally Invasive Surgery with Thrombolysis in Intracerebral Haemorrhage Evacuation [MISTIE] III suggests that a minimally invasive approach and near complete evacuation of a hemorrhage can improve clinical outcomes.4 A recent preclinical trial has demonstrated the efficacy of realtime image guidance in simulation models of intracerebral hematoma with successful evacuation in all models.<sup>5</sup>

A novel MRI-compatible concentric

tube robotic aspiration device was developed for ICH evacuation. The concentric tube mechanism consists of a straight outer tube and an elastic J-shaped inner aspiration cannula. MRI-compatible pneumatic motors control the trajectory of both tubes. The robot hardware and evacuation capability were previously evaluated in MRI-guided human brain phantom studies. In this MRI-guided study, we assessed the workflow of the robot system with a sheep brain phantom. Ketchup was used as a proxy for a clot.

#### **METHODS:**

A sheep brain phantom was created using Humimic Medical gel (gelatin #5). The gel was melted at 125°C for 1 hour. The hot gel was poured into a sheep brain 3D model that was printed in two halves and taped together. The gel was left to solidify overnight. The phantom was cut in

half to create a cavity and the two halves were sealed back together using heat.

Ketchup was injected into the cavity in the phantom. A point of trajectory was marked on a sheep skull 3D model and a burr hole was drilled into the skull. The sheep skull model was printed with the top open to allow for placement of the phantom into the skull during MRI studies.

The skull and robot were placed and secured on the MRI table in a 3T Philips MRI Scanner. Sense flex coils were placed above and below the skull to aid in the acquisition of MRI images. MRI scans of the phantom were obtained, and the images were transferred to the planning console. The robot was advanced through the burr hole and into the phantom. MRI images were taken in between robot movements to visualize the penetration of the phantom and the location of the concentric tube. The robot was advanced further into the clot and aspiration was initiated with real-time intraoperative MR imaging. After evacuation, MR images were obtained for outcome evaluation, and

This MRI-guided study evaluated a novel ICH robot with a sheep brain phantom. It provided insight into the anatomy of a sheep's brain and the brain size available for clot formation. Sheep animal studies are the next phase, and future MRI studies will be done as needed to prepare for the animal studies.

the phantom was physically analyzed for possible damage to normal tissue.

#### **RESULTS:**

The estimated clot volume before evacuation was 9.04mL, and the clot volume was reduced by 83%. The phantom did not have any unwanted tissue damage when analyzed.

#### **CONCLUSIONS:**

This MRI-guided study evaluated a novel ICH robot with a sheep brain phantom. It provided insight into the anatomy of a sheep's brain and the brain size available for clot formation. Sheep animal studies are the next phase, and future MRI studies will be done as needed to prepare for the animal studies.

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# Poor Olfaction Prior to Cardiac Surgery: Associations with Cognition, Plasma Neurofilament Light and Postoperative Delirium in a Prospective Nested Cohort Study

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This study examined the association between pre-operative olfactory performance and delirium after cardiac surgery. As a secondary aim, we examined the relationship between baseline olfaction, cognitive functioning, and plasma neurofilament light (NfL).

#### **METHOD:**

Individuals undergoing cardiac surgery were recruited as part of a clinical trial in which blood pressure during bypass was targeted using cerebral autoregulation monitoring. There were 189 participants (mean age = 70 years; 75% men). At baseline, olfaction, cognition, and plasma concentrations of NfL were assessed using the 12-item Brief Smell Identification Test (BSIT), a battery of

neuropsychological tests, and the Simoa<sup>™</sup> NF-Light Assay, respectively. Impaired olfaction was defined as a score of ≤8 for men and ≤9 for women. Delirium was assessed using the Confusion Assessment Method (CAM)

and CAM-ICU, and delirium severity was assessed using the Delirium Rating Scale-Revised-1998 (DRS-R-98). The association of baseline olfaction and delirium and delirium severity was examined in regression models adjusting for age, duration of bypass, a surgery risk score, and baseline cognitive performance.

#### **RESULTS:**

In adjusted models, impaired olfaction at baseline was associated with both incident delirium (OR=2.25, p=0.04) and greater delirium severity (OR=2.10, p=0.04) after cardiac surgery. Furthermore, worse baseline olfaction was associated with impaired cognition (p< 0.001) and increased perioperative concentrations of plasma NfL (p=0.04).

#### **CONCLUSIONS:**

Pre-operative olfactory testing may provide insight into brain vulnerability,

Psychophysical olfactory assessment may inform strategies for patient risk stratification and early identification of individuals at risk for post-operative delirium, allowing for delirium-prevention strategies.

> cognitive dysfunction, and delirium risk in individuals undergoing cardiac surgery. Psychophysical olfactory assessment may inform strategies for patient risk stratification and early identification of individuals at risk for post-operative delirium, allowing for delirium-prevention strategies.

# The Role of Lymph Node Yield at Consolidative Radical Cystectomy in Overall Survival for Small Cell Bladder Cancer

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Small cell bladder cancer (scBCa) is a rare, aggressive neuroendocrine tumor. While neoadjuvant chemotherapy (NAC) followed by radical cystectomy (RC) is the recommended treatment, over 30% of patients do not achieve complete pathologic response (pT0)1,2. One potential hypothesis for poor NAC sensitivity is tumor lymphatic invasion. The challenges in identifying and managing NAC non-responsive scBCa necessitate this study, wherein we sought to identify predictors of NAC resistance and evaluate the impact of lymph node dissection (LND) on overall survival (OS) in scBCa.

#### **METHODS:**

Using the National Cancer Database (2004-2019), we analyzed cT1-4N0-3M0 scBCa patients treated with RC. Patients were divided by receipt of NAC, and propensity score matched. We assessed NAC's impact on pathologic response (pT0) with multivariate logistic regression. Using multivariate Cox Proportional Hazards Models (CPH), the effect of LND yield ( $\leq$  or > 15) and

**TABLE.** Multivariate Cox Proportional Hazards Models for Overall Survival in Matched and cN+ Small Cell Bladder Cancer Patients

Variables*	All Matched scBCa			Matched cN+ scBCa		
	HR	95% CI	p-value	HR	95% CI	p-value
Age (Continuous)	1.015	0.995-1.031	0.077	0.991	0.934-1.051	0.766
Sex (Ref=Male)						
Female	0.997	0.711-1.398	0.985	1.823	0.621-5.355	0.274
Charlson-Deyo Index (Ref=0)						
1	0.992	0.719-1.369	0.962	0.344	0.113-1.049	0.061
2	0.583	0.320-1.064	0.079	2.020	0.314-11.442	0.459
3+	1.524	0.611-3.803	0.366	NA	NA	NA
Clinical T Stage (Ref = 2)						
1	0.716	0.463-1.106	0.132	1.228	0.125-12.066	0.860
3	1.493	1.003-2.221	0.048	6.120	1.921-19.494	0.002
4	2.598	1.477-4.570	<.001	2.330	0.522-10.396	0.268
Clinical N Stage (Ref=0)						
1+	1.450	0.964-2.182	0.075	NA	NA	NA
NAC Use (Ref=Cystectomy Alone) Neoadjuvant Chemo	0.742	0.570-0.967	0.035	0.684	0.236-1.986	0.485
Regional LND Yield (Ref ≤ 15						
LNs)						
> 15 LNs	0.733	0.556-0.965	0.027	0.237	0.086-0.657	0.006
Surgical Margin (Ref = Negative) Positive	1.920	1.238-2.979	0.004	2.685	0.369-19.551	0.330

NAC on OS was assessed in two cohorts (1.all matched cT1-4N0-3M0 scBCa patients and 2.matched cT1-4N1-3M0 scBCa).

#### **RESULTS:**

We included 3,202 scBCa patients in our analysis, and 370 remained after matching. 191 patients (51.6%) received NAC before RC. NAC receipt was associated with better complete pathologic response (36.1% vs.

21.2%, p=0.002). cN+ patients had worse pathologic response compared to cN0 with NAC (12.5% vs 65.3%, p=0.010). Multivariate analysis showed NAC improved pT0 rate (OR = 2.467, p < 0.001) while cN+ status was inversely associated (OR=0.317, p=0.048). In multivariate CPH, NAC receipt improved OS in all matched scBCa patients (HR=0.742, p=0.035) but not in cN+ patients (HR=0.684, p=0.485).

Consolidative RC is vital in scBCa treatment, especially given the ~64% rate of persistent disease post-NAC. Our findings affirm that while NAC enhances pathologic response, node positivity hinders its efficacy.

Additionally, LND (> 15 lymph nodes) improved OS (HR=0.733, p=0.027), and this benefit was increased in patients with cN+ scBCa (HR=0.237, p=0.006).

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Continued from p. 115

#### **CONCLUSION:**

Consolidative RC is vital in scBCa treatment, especially given the ~64% rate of persistent disease post-NAC. Our findings affirm that while NAC enhances pathologic response, node positivity hinders its efficacy. While NAC improves OS in scBCa, we could not demonstrate a significant OS benefit with NAC in cN+ scBCa. However, we found dissection of > 15 lymph nodes during RC extends OS in scBCa and to a greater extent in cN+ scBCa, highlighting the importance of thorough LND during RC for highrisk scBCa patients. Despite inherent limitations, these findings highlight the need of future prospective studies to elucidate the role of adequate LND in scBCa.

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### Efficacy of Cytoreductive Cystectomy in Metastatic Urothelial Bladder Cancer Based on Site of Metastasis

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Bladder cancer (BCa) is the sixth most common cancer in the United States. While metastatic BCa (mBCa) comprises only 5% of new diagnoses, the prognosis is poor. Multiple national guidelines endorse multiagent systemic chemotherapy as the first-line treatment for eligible patients with mBCa. Cytoreductive surgery is utilized in other cancers, such as renal and prostate.<sup>1,2</sup> However, the role of cytoreductive cystectomy (CRC) in mBCa has not yet been entirely determined. Prior studies have highlighted the potential survival benefit of CRC in mBCa.<sup>3</sup> Additionally, the location and number of metastases have been suggested to be significant prognostic indicators in CRC.4,5 This study investigated the oncologic efficacy of CRC, particularly emphasizing the location and number of metastasis sites as a predictor of survival and treatment response.

#### **METHODS:**

A retrospective analysis of cT2-4N0-3M1 mBCa patients treated with multiagent chemotherapy from 2004-2019 was conducted using the National Cancer Database (NCDB). Patients



**FIGURE:** Kaplan-Meier Plot of Overall Survival after Cytoreductive Radical Cystectomy or Conservative Local Treatment in a Propensity Matched mBCa Cohort.

were classified by additional treatment with CRC or conservative local treatment (CLT), consisting of trans urethral resection of bladder tumor, radiation, or no local treatment. Multivariate logistic regression was utilized to assess the influence of patient and tumor characteristics on the likelihood of receipt of

CRC. Subsequently, a 1-to-1 propensity score (PS) match without replacement was performed to account for the likelihood of CRC receipt. Kaplan-Meier (KM) analysis and multivariate Cox Proportional Hazards model

(CPH) assessed the effect of CRC or CLT on overall survival (OS) within the matched cohort and in four subgroups (1. patients with only distant lymph node (LN) metastasis vs. any organ metastasis, 2. patients with single metastasis vs. multiple metastases).

#### **RESULTS:**

Of 2,727 patients included in our analysis, 498 patients remained after matching. 247 and 251 patients were

Our findings suggest that patients with multiple organ metastases experience reduced OS benefit with CRC, indicating that patients with mBCa limited to distant LNs (cM1a) or a single visceral metastasis might be better candidates for CRC.

> treated with CRC and CLT, respectively. The median OS in patients treated with CRC was greater than that of patients treated with CLT (20.4 months vs.

12.0 months, p<0.001). In multivariate analysis, the use of CRC decreased mortality risk (HR=0.552, p<0.001). Increased mortality risk was associated with the presence of an organ metastasis (HR=1.768, p=0.002) and furthermore with multiple organ metastases (HR=2.541, p<0.001). Subgroup analyses demonstrated significantly longer median OS with CRC regardless of tumor metastasis site location or number. Multivariate CPH found that CRC significantly reduced mortality in patients with only distant LN metastases (OR=0.545, p=0.039), any organ metastasis (OR=0.421, p<0.001), and single visceral metastasis (HR=0.483, p=0.002). However, no significant improvement in OS with CRC was found in patients with multiple metastases (HR=0.501, p=0.064).

#### **CONCLUSION:**

This study illuminates the promising potential of CRC for mBCa patients when combined with multiagent chemotherapy. Our findings align with previous retrospective analyses, showing OS benefit with CRC in mBCa. However, our study is the first to assess the impact of metastasis site location and number on CRC OS benefit using the NCDB. Our findings suggest that patients with multiple organ metastases experience reduced OS benefit with CRC, indicating that patients with mBCa limited to distant LNs (cM1a) or a single visceral metastasis might be better candidates for CRC. While these results highlight the utility of CRC, this study's limitations include its retrospective nature and modest sample size. Thus, additional prospective studies are essential to validate these findings.

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# Investigating the Utility of Object Manipulation in Augmented Reality in Procedural Training

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Augmented reality (AR) technology allows for real-time teaching and remote supervision of complex medical procedures. The successful use of AR technologies can address health disparities by extending the reach of medical experts and providing a cost-effective method for Health Care skills training. As virtual teaching in medical education becomes a reality, it is crucial to understand best practices for utilizing the augmented environment to create a productive learning environment and optimize teacher-learner interactions. This study examines how AR virtual objects can be deployed in the holographic space during ultrasound-guided central line and peripheral line placement teaching sessions.



#### **METHODS:**

After Institutional Review Board approval was obtained, instructors and learners were recruited to participate in recorded ultrasound-guided central venous catheter (CVC) and peripheral IV training sessions. The trainees completed a survey detailing demographics and prior experience with the procedures and AR/VR technology. Both instructor and learner used HoloLens 2, a head mounted AR display, to conduct the procedural training in AR from remote locations. Teams could interact via audio channels in the headsets, and instructors could observe learner actions via the real-time 3D holographic display and provide visual feedback using virtual hands and procedure-specific virtual objects. Data recorded for each session included the number of unique objects used, the number of times a virtual tool was deployed, the duration of time a tool was used, and the total distance over which a tool was moved. The virtual tools available to use during the training included an ultrasound

probe, syringe, guidewire, triple lumen catheter, as well as different colored cylinders and cubes.

#### **RESULTS:**

Twenty four sessions were conducted with 8 unique instructors and 24 unique learners. Learners ranged from 18 to 51 years old, with 37.5% having up to 2 years of clinical training and the remaining having more. Three sessions were not used in analysis due to technological malfunction. Across the remaining 21 sessions, tools were picked up and used 804 times, with an average of 38 times per session. The object most often manipulated was the ultrasound probe (35%), followed by the syringe (32%). Of the colored cylinders, the blue cylinder, used to represent the jugular vein, was used most (9%). The probe and syringe were also moved over the greatest cumulative distances, as well as the blue cylinder amongst all cylinders. Objects were utilized for an average of 7.9% + 4.3%

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of the total session time. When comparing training practices for novice vs more experienced proceduralists in the CVC procedure, instructors used virtual objects more frequently and for longer durations on average with lessexperienced trainees (9.8% of session time, or 4.21 minutes) than for those with more procedural experience (6.3% of session time, or 3.28 minutes).

#### **CONCLUSION:**

Procedure-specific virtual tools are increasingly incorporated into augmented reality remote training, especially for novice learners. In the ultrasound-guided vascular access procedures, tools which must be correctly positioned and moved synchronously were used most often in the teaching process, such as the probe and syringe. This suggests that AR virtual tools can be used to demonstrate complex tool movements, and that these tools should be incorporated for and can assist in understanding complex tasks to improve the training environment.

#### **REFERENCES:**

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# Can We Assess User Performance in Suturing Tasks using HoloLens2 Generated Metrics?

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Elite performers achieve optimal performance when they receive timely, specific, measurable, and actionable feedback. However, feedback is dependent on expert-review of performance. Mixed-reality headsets, such as Microsoft's HoloLens2, can provide objective user data; however, it is not known if articulated hand tracking and eye-gaze tracking metrics can be used to evaluate user performance.



#### **OBJECTIVE:**

To evaluate the utility of HoloLens2 in identifying neurosurgeon performance by using articulated hand tracking and eye-gaze tracking. To validate HoloLens2 generated metrics of neurosurgeon performance by comparing to gold-standard video evaluations using a truncated OSATS grading system.

#### **METHODS:**

NeuroAR, a custom HoloLens2 application, was developed to record and log user movements. Thirty 25-second video clips of unique suturing tasks performed by neurosurgery residents and attendings were recorded. Eyegaze, hand movement, and hand disappearance metrics were logged. OSATS scores were generated by expert review of each video in three domains: respect for tissue (RT), time and motion (T&M), and instrument handling (IH). HoloLens2 generated metrics were then compared against gold-standard OSATS metrics.

#### **RESULTS:**

Finer ocular movements (deltaGaze) are associated with higher OSATS grades for RT (p=0.003) and T&M (p=0.044). Longer distances traveled for both hands are associated with lower OSATS grades for T&M (left p=0.012; right p=0.022). Increased instances of hand disappearance are associated with lower OSATS grades for T&M (left p<0.001; right p<0.001) and IH (left p<0.001; right p<0.001).

#### **CONCLUSION:**

HoloLens2 generated hand and eyegaze tracking metrics have the potential to assess user performance in the domains of RT, T&M, and IH. Future studies will be required to assess the ability of HoloLens2 to identify user performance, predict task outcome, and provide actionable feedback in the cadaver lab without requiring an expert opinion.



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