

across gestational ages (18 weeks to 30 weeks) collected at our institution. **DISCUSSION/SIGNIFICANCE OF IMPACT:** Quantitative estimates of brain volume, and deviations from normative data, would be a major advancement in objective clinical assessments of fetal MRI. Such data can currently only be obtained through laborious manual segmentations; automated deep learning methods have the potential to reduce the time and cost of this process.

4420

Characterizing medical comorbidity prior to autism diagnosis in children before age two.

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OBJECTIVES/GOALS: Autism spectrum disorder (ASD) is a developmental disorder with a high financial and personal burden. Individuals with ASD experience significant comorbid medical conditions. We identified conditions that appear prior to ASD diagnosis in order to potentially improve early screening practices. **METHODS/STUDY POPULATION:** We used electronic health record data from an anonymized database at Vanderbilt University Medical Center for individuals with ASD and matched controls to analyze comorbid conditions prior to an ASD diagnosis. Data were censored to include only individuals who first appeared in the database prior to two years of age ($n_{\text{total}} = 1551$, $n_{\text{controls}} = 976$, $n_{\text{ASD}} = 575$). Comorbidities (~1800 conditions) were compared between the ASD and matched control group using a novel tool (pyPheWAS) to examine presence, count, and duration of comorbidities that occurred between 0-2 years old and before ASD diagnosis. **RESULTS/ANTICIPATED RESULTS:** Convulsions ($p = 0.000404$, $\beta = 0.807$), constipation ($p = 0.000789$, $\beta = 0.894$), and strabismus ($p = 0.00243$, $\beta = 1.155$) were the most significant comorbid conditions prior to age 2 in individuals who would later be diagnosed with ASD. The group with ASD also had more visits associated with convulsions ($p = 0.00511$, $\beta = 0.195$), diseases of the esophagus ($p = 0.0117$, $\beta = 1.675$), and allergic reactions to food ($p = 0.0119$, $\beta = 0.540$) prior to their diagnosis. The ASD group was also seen for a longer duration regarding convulsions ($p = 0.000273$, $\beta = 0.695$), constipation ($p = 0.00157$, $\beta = 0.712$), and malaise and fatigue ($p = 0.00188$, $\beta = 0.903$) before ASD diagnosis. **DISCUSSION/SIGNIFICANCE OF IMPACT:** Precise comorbid condition profiles in early childhood may help uncover biomarkers leading to better prediction of a future ASD diagnosis. Medical conditions that precede the onset of measurable behavioral symptoms may enhance early screening, treatment, and intervention in ASD.

4227

Closing the cross-institutional referral loop: Applying human factors to improve consultations

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OBJECTIVES/GOALS: Although referrals for specialty consultations are a core clinical process, they are prone to coordination and communication breakdowns that have led to adverse clinical outcomes. This project's objective is to improve timely documentation, transmission, access, and quality of consultation notes across

healthcare systems. **METHODS/STUDY POPULATION:** There are two specific aims for this project. In Aim 1, we will characterize clinical workflows and information flow during cross-institutional referrals. In Aim 2, we will develop and test a prototype leveraging electronic health information exchange (HIE) to increase closing the loop for cross-institutional referrals and improve the quality of consultation notes. To accomplish these aims, we will use human factors methods, including data analytics, medical-record reviews, semi-structured interviews of consultants, rapid prototyping, and usability evaluations. **RESULTS/ANTICIPATED RESULTS:** Results will inform the design and integration of clinician-facing technologies into clinical workflows to close the referral loop and improve diagnostic processes. Aim 1 will provide quantitative evidence about the quality of cross-institutional referrals, inform the eventual implementation of our prototype, and identify user interface features required for successful electronic health information exchange. Based on the results from Aim 1, reports and visual representations will be generated to illustrate information flows and clinical workflows. This will prioritize design efforts for the intervention's prototype. Aim 2 will translate clinicians' requirements into prototype features and assess clinicians' experience with the prototype. **DISCUSSION/SIGNIFICANCE OF IMPACT:** The use and usefulness of HIE has been limited due to usability and implementation issues. Cross-institutional referrals are complex and dependent on HIE due to EHRs' lack of interoperability. This project will provide evidence-based recommendations for the use of Fast Healthcare Interoperability Resources (FHIR) to improve HIE during referrals.

4521

Collecting, Interpreting and Utilizing Retrospective Clinical Data from Data Warehouses

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OBJECTIVES/GOALS: Utilizing clinical electronic health record (eHR) data pulled *en masse* from data warehouses provides unique challenges when applying it to retrospective studies. Use of this data in conjunction with metabolomic and genomic results to predict response to lisinopril or ondansetron has been completed. **METHODS/STUDY POPULATION:** Study population consists of >2000 subjects recruited from the Emergency Medicine Specimen Bank at University of Colorado Denver (UCD). All patients presenting to the emergency department are approached to participate which significantly increases demographic diversity of our study populations. Clinical data is pulled from Health Data Compass (data warehouse at UCD that collects all electronic health record (EHR) data to be able to deliver de-identified). Effectiveness of lisinopril and ondansetron were investigated using metabolomic data collected via ultra-high performance liquid chromatography mass spectrometry and genomic data from Illumina chip technology to find relevant correlations. **RESULTS/ANTICIPATED RESULTS:** Obtaining retrospective clinical data from data warehouses comes with significant challenges to be addressed. Verifying all clinical variables from patient EHRs is a crucial step that requires extensive quality control steps. As well, ensuring data validity, appropriateness of data points pulled as relate to the study criteria and identifying alternate EHR data points is needed. Chart review is a critical step necessary to surmount these challenges. Additionally, use of retrospective EHR data often necessitates the development of novel definitions of clinical effectiveness that can be abstracted from the EHR—such as how to determine decrease in nausea without a visual analogue scale. **DISCUSSION/SIGNIFICANCE OF IMPACT:** Utilizing

data warehouses to deliver EHR data provides a valuable tool for completing retrospective precision medicine projects. The validation of definitions for clinical outcomes identifiable retrospectively are necessary and provide novel guidance for future studies.

4192

Decreasing Inappropriate STAT Image Ordering

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OBJECTIVES/GOALS: Currently physicians are able to order CT Chest/Abd/Pelvis images as STAT or Routine. STAT images denote an emergency and are done immediately. We aim to determine the percentage of CT images that are inappropriately ordered as STAT, determine physician image ordering habits, and develop targeted interventions to encourage appropriate STAT image ordering. **METHODS/STUDY POPULATION:** A fishbone diagram helped reveal possible causes of inappropriate STAT image ordering. Based on the fishbone diagram, a survey was created to assess CT image ordering habits amongst radiology and internal medicine residents and attending physicians. All CT Chest/Abd/Pelvis images ordered over a 3 month period of time (July-Oct 2017) was obtained. The dataset included whether the image was ordered Stat vs Routine, time of image order, physician name and location, and reason for the imaging study. The STAT images were evaluated based on the explanation provided in the CT image order. Currently 2 radiology residents, 2 internal medicine residents, and 2 internal medicine hospitalists are evaluating all STAT CT images to determine appropriateness and how long they are willing to wait for the image to result in a read. **RESULTS/ANTICIPATED RESULTS:** Analysis of all CT Chest/Abd/Pelvis imaging orders revealed that 51% (1710/3345) of them were ordered as STAT. The preliminary analysis of 227 STAT images showed that 6% were inappropriate. We anticipate results of our survey to show differences in how long a STAT vs Routine image orders should take amongst Radiology and Internal Medicine clinicians. We also anticipate our survey to show differences in factors that warrant STAT imaging amongst the different medical fields. We anticipate that the clinician manual evaluation of all STAT CT image will reveal a large percentage of imaging orders to be inappropriate. All STAT imaging that were flagged as inappropriate will be characterized by the department who ordered the image and the reason provided for the imaging to assess for common themes. **DISCUSSION/SIGNIFICANCE OF IMPACT:** STAT images are the new routine with more images ordered STAT than Routine. Inappropriate STAT imaging results in truly urgent patients not getting the medical care they need. Many images ordered stat could potentially be switched to routine. By evaluating why clinicians are ordering STAT CT image inappropriately, we will be able to develop targeted interventions to decrease inappropriate STAT CT imaging.

4557

Defining the relationship between kidney structure and function in patients with and without diabetes and hypertension

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OBJECTIVES/GOALS: Histopathological descriptions of kidney tissue provide more information about kidney disease severity and

prognosis than serum measures, yet most patients with chronic kidney disease do not undergo kidney biopsy. We aim to develop a method to determine the degree of renal injury in patients with diabetes and hypertension without the need for biopsy. **METHODS/STUDY POPULATION:** Clinical data and renal tissue samples were collected from 864 patients undergoing tumor-associated nephrectomy in seven medical centers in the United States. Exclusion criteria included age < 18, presence of pyelonephritis or non-diabetic or hypertensive renal disease or incomplete clinical or histopathologic data. 19 histologic parameters were scored in a blinded manner by one renal pathologist. We examined the relationship between and functional variables (such as estimated glomerular filtration rate (eGFR)). Polynomial regression analysis was performed to model histopathologic variables and important clinical parameters such as eGFR. **RESULTS/ANTICIPATED RESULTS:** 607 samples met inclusion criteria and were stratified as: control (no history of diabetes or hypertension, n = 160), hypertension alone (n = 224) and both diabetes and hypertension (n = 223). Interstitial fibrosis (IF) and glomerulosclerosis (GS) had the strongest correlations with eGFR. Regression analysis was used to model histopathologic score for a given eGFR. We found that diabetes and hypertension modified the relationship between tubulointerstitial fibrosis and eGFR. For example, while hypertensive patients without diabetes had 33% IF at an eGFR of 30 ml/min/1.73m² (r² = 0.64, p<0.01), hypertensive patients with diabetes had 32% IF at an eGFR of 30 ml/min/1.73m² (r² = .43, p<0.01) and control patients had approximately 23% IF at an eGFR of 30 ml/min/1.73m² (r² = 0.22, p<0.01). **DISCUSSION/SIGNIFICANCE OF IMPACT:** Here, we describe the relationship between renal structural changes and renal function and show that hypertension significantly modifies the relationship at a given eGFR. These data can be used to reasonably predict renal structural changes given clinical information without the need for renal biopsy and may provide prognostic value.

4219

Discrepancies in flavor preferences among adult ever users of various tobacco products in the US – Findings from The Population Assessment of Tobacco and Health Study (2015-2016)

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OBJECTIVES/GOALS: Flavorings differ between brands and tobacco products, potentially altering the sensory perceptions. This study aimed to examine discrepancies in flavor preference across various non-cigarette tobacco products among a national representative sample of US adult regular tobacco users. **METHODS/STUDY POPULATION:** Data from the Population Assessment of Tobacco and Health (PATH) Study Wave 3 (W3) were used. Weighted prevalence of flavor preference for various tobacco products, including electronic nicotine delivery systems (ENDS), traditional cigars, cigarillos/filtered cigars, hookah and snus/smokeless, was presented for 9,037 adult current and new former users of multiple flavored tobacco products. Within-subject flavor discrepancies were assessed using generalized estimating equations (GEE) models considering the complex sampling design of the PATH study. **RESULTS/ANTICIPATED RESULTS:** Most regular users of a flavored tobacco products reported using one flavor category per product. Fruit flavors, followed by tobacco, were the most common flavor categories among ENDS