Research advisor Jennifer Freeman writes: "Ryker's research is investigating whether a developmental exposure to herbicides used in the midwestern United States may alter behavioral patterns. His research is important because his findings provide new toxicity information for the new herbicide mixture products containing glyphosate and dicamba."

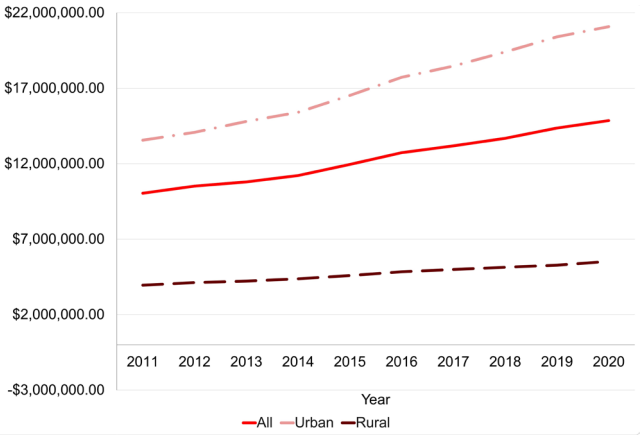
Analyzing Health Care Delivery Costs from 2011 to 2020 in the Emergency Departments and Overall Hospital Costs

Student researcher: *Jacob A. Corey, Senior*

The goal of this research was to analyze how COVID-19 affected the cost of health care within hospitals, specifically within the emergency department (ED) and overall hospital expenditures. It was hypothesized that both urban and rural hospitals would see a sharp increase in the costs for 2020, especially in emergency departments, due to the pandemic.

Hospital cost data for the years 2011–2020 from form CMS-2252-10 shared by the Centers for Medicare and Medicaid Services was utilized for this project. Inclusion criteria were based on whether hospitals had submitted cost results for EDs and total hospital cost results in at least 8 years of the 10-year time span. The total number of hospitals included in this study was n = 3,141, with 958 of these hospitals being rural and 2,183 being urban.

The average overall hospital cost increase from 2011 to 2019 was 4.48% per year, but it was 6.18% from 2019 to 2020. The average urban total hospital cost increase from 2011 to 2019 was 4.76% per year, but it was 6.70% from 2019 to 2020. The average rural total hospital cost increase from 2011 to 2019 was 3.84% per year, but it was 6.12% from 2019 to 2020.



Average emergency department costs from 2011 to 2020 for all, rural, and urban hospitals.

The average overall ED cost increase from 2011 to 2019 was 4.46% per year, but it was 3.43% from 2019 to 2020. The average urban ED cost increase from 2011 to 2019 was 5.03% per year, but it was 3.32% from 2019 to 2020. The average rural ED cost increase from 2011 to 2019 was 3.81% per year, but it was 4.72% from 2019 to 2020.

A major limitation of this study involves the inclusion criteria requiring 8 years of reports out of the 10 years of data. This caused around half of the hospitals in the CMS-2252-10 form to be excluded from this analysis.

Research advisor Cody Mullen writes: "When the COVID-19 pandemic started in 2020 our health care system quickly and effectively responded to the needs of the communities they serve. It is important to understand how hospital operations changed. This study starts to document the changes in hospital operations during the pandemic for both urban and rural facilities."

Formulation of Preservation Solutions for Model Generation with In Vivo Tissue Morphology

Student researcher: *Holly Pickett, Junior*

Historically, standard tissue fixation methods present an unrealistic representation of in vivo tissue morphology. These resultant alterations, such as tissue hardening, not only hamper development of key connections between form and function in the anatomy classroom, but also the critical diagnostic skills necessary to attain clinical gains. The aim of this project is to develop a new tissue preservation method to bridge such gaps. This involves assessing the effects of a modified-release fixation component in solution containing physiological electrolytes. Porcine lungs were dissected into lobes and placed in two solutions with different concentrations of the fixation component. The lungs were observed using tactile manipulation for in vivo tissue resilience over the course of four months, also being attentive to bacterial growth that could lead to decay. Investigative results

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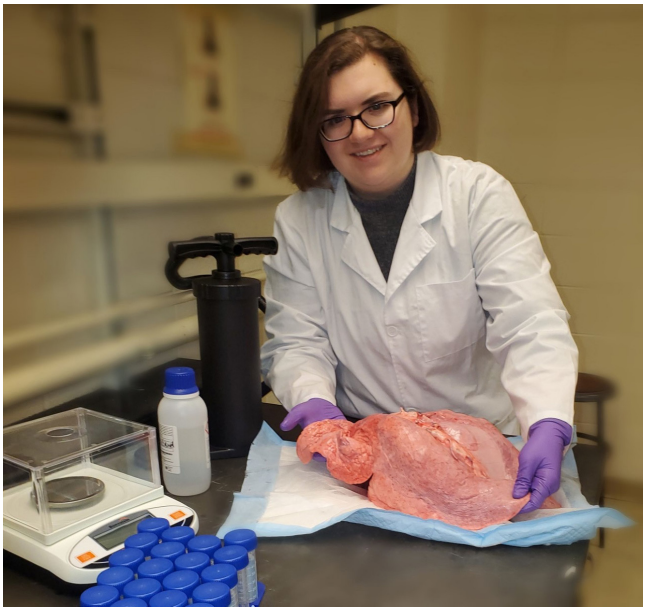

Researcher Holly Pickett makes initial visual examination of fresh pig lung tissue before placing it in preservation solution.

revealed the ability of the modified-release fixation component to prevent tissue degradation for an extended period of time, as demonstrated by the lack of microbial growth and retention of structural integrity. Furthermore, as expected, the concentration of the fixation component in solution displayed direct correlation with negative morphological effects. Further experimentation will focus on analyzing the effects of albumin, an osmotically active plasma protein, on the preservation of lung tissue samples, as well as using mechanical ventilation to measure the preservation solution's ability to retain lung tissue's elastic properties. Once developed, this preservation method can then be applied in the construction of functional anatomical models to be utilized in active learning environments to facilitate the intimate clinical connections between structure and function.

Research mentor Lisa Hilliard writes: "Holly's passion and commitment continues to drive this project's evolution and progress. Despite advancements, standard fixation yields poor portrayals of living morphology, inhibiting students' development of critical physiological understanding and diagnostic skills. Since tangible interactions with tissue models foster deep understanding and intellectual development, bridging this fixation-preservation gap is key."

Comparing Effects of Atrazine Exposure on Neuroendocrine Molecular Targets at Two Developmental Exposure Periods in the Zebrafish

Student researcher: *Jenna Swihart, Senior*

Atrazine is an herbicide commonly applied to control broadleaf and grassy weeds in agricultural regions of the United States. Although its use was banned by the European Union in 2003 because of surface and groundwater contamination risk, the U.S. EPA allows for a 3 ppb maximum contaminant level for drinking water. Atrazine is a known endocrine-disrupting chemical with the potential to cause adverse effects at the hormonal and molecular level in neuroendocrine system pathways; however, the mechanism causing dysregulation following atrazine exposure has yet to be determined. In this study, hypothalamic and pituitary molecular targets were investigated to explain a mechanism for the negative endocrine axes impacts. Selection of gene targets was based upon common neuroendocrine hormones that have been reported in literature to be dysregulated following atrazine exposure in various models. Embryos were collected from adult wild type zebrafish and randomly assigned to 0, 0.3, 3, or 30 ppb (μg/L) atrazine treatment. For one timepoint, exposure began at 1 hour post fertilization (1 hpf) and continued until the end of embryogenesis (72 hpf). Another timepoint focusing on the larval stage began atrazine exposure at 72 hpf and ended at 120 hpf. After exposure was ceased, RNA was isolated, cDNA was synthesized, and qPCR assessed one hypothalamic target (*gnrh*) and three pituitary targets (*gh1, fshb, lhb*). Using an analysis of variance (ANOVA, $\alpha = 0.05$), four to six biological replicates were statistically compared. At both timepoints *gh1* displayed alterations in relative gene expression, while *fshb* was only changed at 72 hpf. There were no changes in relative gene expression at 1–72 hpf or 72–120 hpf for *gnrh* and *lhb*.

Research advisor Jennifer Freeman writes: "Jenna's research project is evaluating if there is specificity for when certain neuroendocrine genes have altered expression during development. Her findings report gene-specific and developmental time period–specific changes, providing information on key developmental timing of molecular alterations from the atrazine exposure."