From Tribal College to Cutting-Edge Data Science: A Journey of Discovery

Trey Saddler
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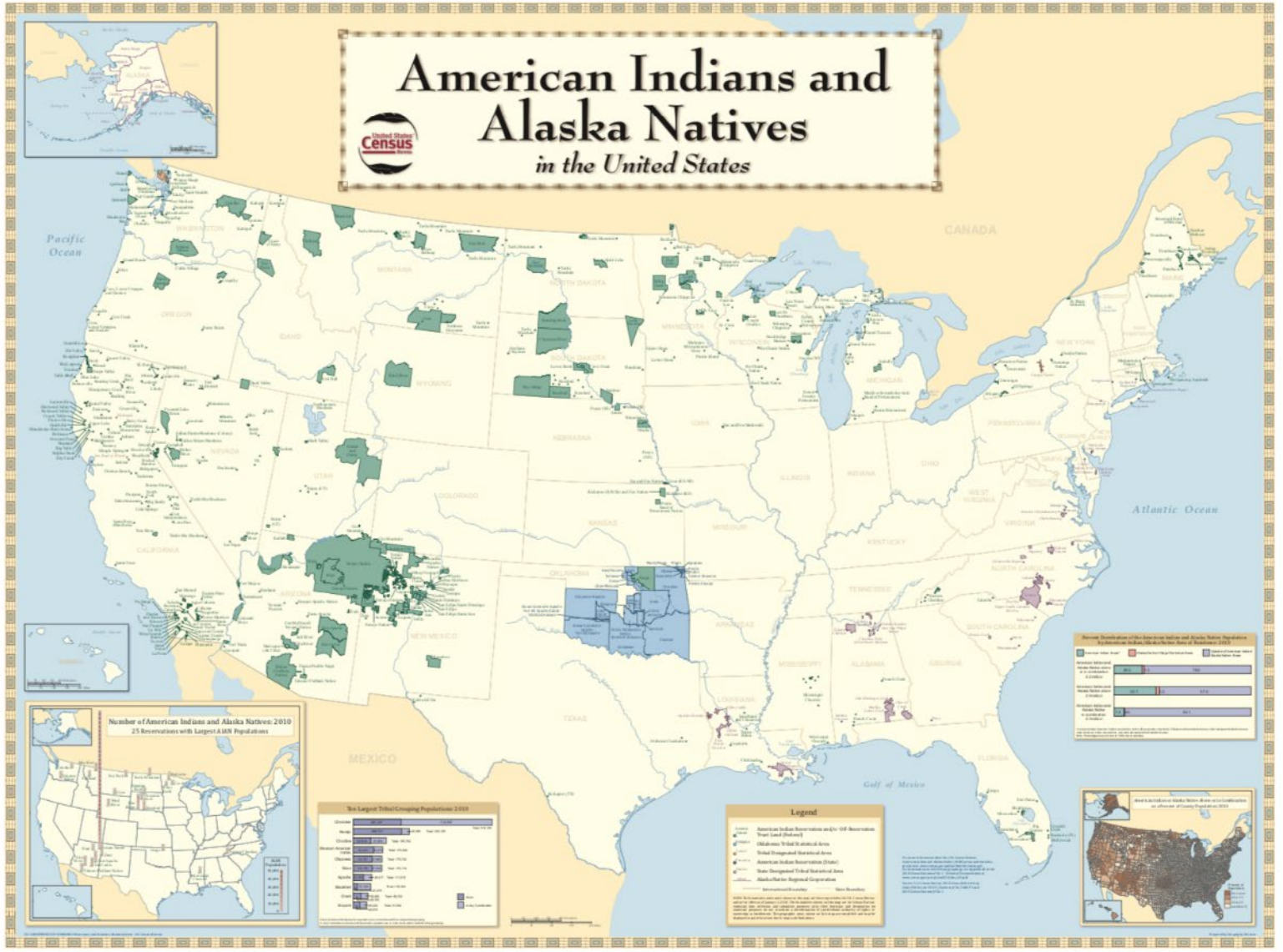
Division of Translational Toxicology
National Institute of Environmental Health Sciences



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Mercury Exposure Among Flathead Indian Reservation WIC Participants

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♦ Abstract

The main route of exposure to mercury is as methylmercury through consumption of fish. Methylmercury has been linked to neurodevelopmental defecits in young children and children exposed in-utero, as well as cardiovascular disease in adults. Pregnant women, women who may become pregnant, women who are nursing and young children represent the most sensitive population to the negative neurodevelopmental effects of mercury. Thousands of lake trout are donated to Flathead Reservation food banks through a local fishing tournament designed to reduce lake trout populations through a large scale catch and consumption strategy (called "Mack Days"). Previous studies of lake trout from Flathead Lake, Montana, have shown elevated levels of methylmercury, resulting in updated fish consumption guidelines. Participants in the Women, Infant and Children program (WIC) are eligible to receive free fish from local food banks, which may include these lake trout. A previous survey of local women in the WIC program showed that approximately 50% eat fish, however, the majority were not aware of potential adverse effects of mercury or of any fish consumption advisories. Since dietary surveys are frequently inaccurate, follow-up hair mercury analysis was necessary to determine if any of these participants were at risk from elevated methylmercury exposure. The survey was also used to better develop mercury risk communication strategies in this population. In this study, hair samples were collected from 183 women of child-bearing age (18-40) from around the Flathead Indian Reservation, most of whom were WIC participants. Mercury levels were determined in samples of hair 3 cm in length (20-25 mg) from the scalp, representing a 3-month integrated exposure, using EPA method 7473. Results demonstrate that the hair levels in ~90% of the participants sampled were below the national average of 200-300 ppb mercury, some even below 50 ppb, indicating one or fewer fish portions per month. None were above the 1000 ppb threshold of concern. Longitudinal analysis of a subset of samples shows this consumption pattern to be fairly consistent over the course of the past year. This shows that, although some women on the reservation are offered free fish, many do not take advantage of this resource. The data suggests that lack of dietary omega-3 oils from not eating enough fish may pose a greater risk than the deleterious effects of mercury from eating too much fish.

♦ Introduction

Mercury exposure from fish is a widespread health concern (NRC 2000). Thousands of Mackinaw (Lake Trout, *Salvelinus namaycush*) are caught during the bi-annual "Mack Days" event from Flathead Lake and are donated to area food banks. A previous study has shown that mercury could be a concern in Mack trout from Flathead Lake (Stevens et al. 2009). This study has demonstrated that these fish biomagnify mercury to possibly dangerous levels (Fig. a). An earlier survey among WIC participants indicated consumption rates of fish that may be of concern (Kuntz et al., 2009). A hair study is being performed to corroborate the results of the survey.

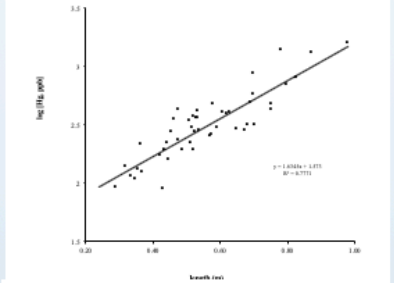


Fig. a: Log_{10} of the total mercury concentration in muscle tissue vs length of Mackinaw from Flathead Lake, MT *(taken from Stevens et al., 2009)*.

♦ Objectives

This project is a follow-up study to the earlier pilot survey to clarify consumption patterns among this Native population. It was hoped to improve the precision of the survey by including a larger sample size [from n=65 to n=200]. Surveys pertaining to diet are notoriously inaccurate, so direct surveillance of the target population was important to determine the actual risk [i.e. hair mercury over 1 ppm].

♦ Methods & Materials

Hair was collected by other team members at WIC clinics from across the Flathead Reservation and brought to the SKC Environmental Laboratory for mercury analysis. Hair was taken from the back of the head closest to the scalp (demonstrated by Fig. b) and mercury concentration in the first 3 cm (Fig. c) was determined (representing an integrated 3-month exposure). Mercury concentration was determined by direct combustion using EPA Method 7473.

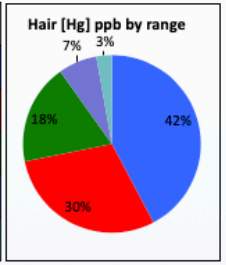
Fig. b: Demonstration of hair collection site and general method. The hair is usually wrapped in a sticky note, paperclipped, then stored in a plastic bag (Fig. c).
Fig. d: Preparing samples to be run through the analyzer.
Fig. e: Diagram of the Nippon MA-2 direct mercury analyzer.

♦ Results

Preliminary Results

Fig. f: Integrated 3-month (3 cm) hair mercury concentration in WIC survey participants

[Hg] (ppb)	n
0 - 50	30
51 - 100	21
101 - 200	13
201 - 400	5
401 - 1000	2



The table is split into categories based on distribution. The pie chart demonstrates that roughly 90% of the sample population falls below the national average for mercury hair concentration of 200 ppb (McDowell et al., 2004) (red, green, blue slices < 201 ppb [Hg]).

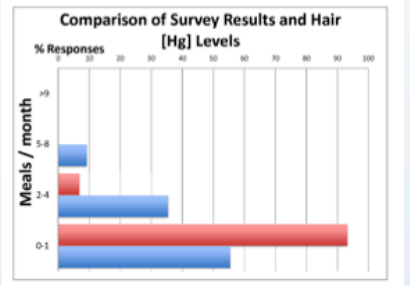


Fig. g

Meals / month	*0-1*	*2-4*	*5-8*	*>9*
% Hair Study (n=73)	93.2	6.8	0	0
% 2006 Survey (n=65)	55.4	35.4	9.2	0

The blue bars are data taken from *Kuntz et al., 2009*. The red bars are a consumption estimates from this study based on a 6 oz serving of a 300 ppb [Hg] fish representing one meal.

♦ Summary

Since the experiment is still in the preliminary stages and the results from the most recent survey have not been compiled yet, the researchers were forced to compare the hair mercury levels to the 2006 survey results. The mercury concentration in the hair did not reflect the anticipated levels based on the original survey. At this point in the study, mercury toxicity does not appear to be a major concern for the women of the WIC program. One unexpected outcome of this study was the discovery of such low fish consumption among participants. Some studies shows that lack of omega-3s in diet can be of greater concern to fetuses and developing children than [Hg] exposure *(e.g. Hibbeln et al., 2007)*.

♦ Discussion

The preliminary results of the experiment demonstrate that mercury toxicity does not seem to be an issue for the Flathead Reservation WIC population at this time. After gathering the results of the remaining samples (projected n=200 total), the researchers will reevaluate their projections. The data collected so far suggests that more research needs to be conducted on clarifying consumption patterns and determining the reasons for fish avoidance.

♦ References

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♦ Acknowledgements

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Special thanks to: Salish Kootenai College; Women, Infant, Children (WIC) Special Supplemental Nutrition Program

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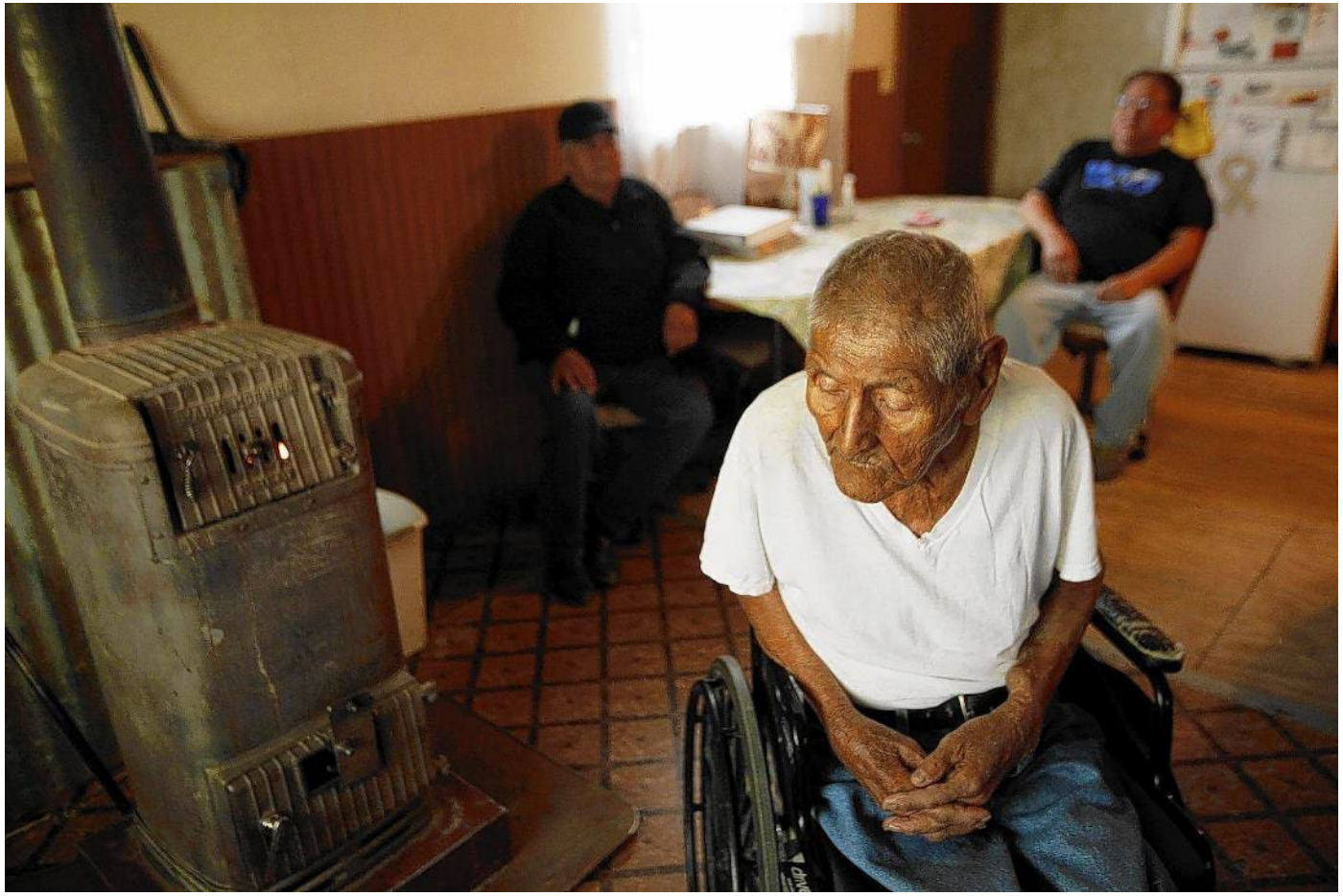

World War II veteran and Code Talker Tom Jones Jr., 89, sits near a wood stove, which is the only source of heat in his house.

Credit Genaro Molina/Los Angeles Times https://www.knau.org/post/plan-introduced-fix-troubled-navajo-veterans-housing-program


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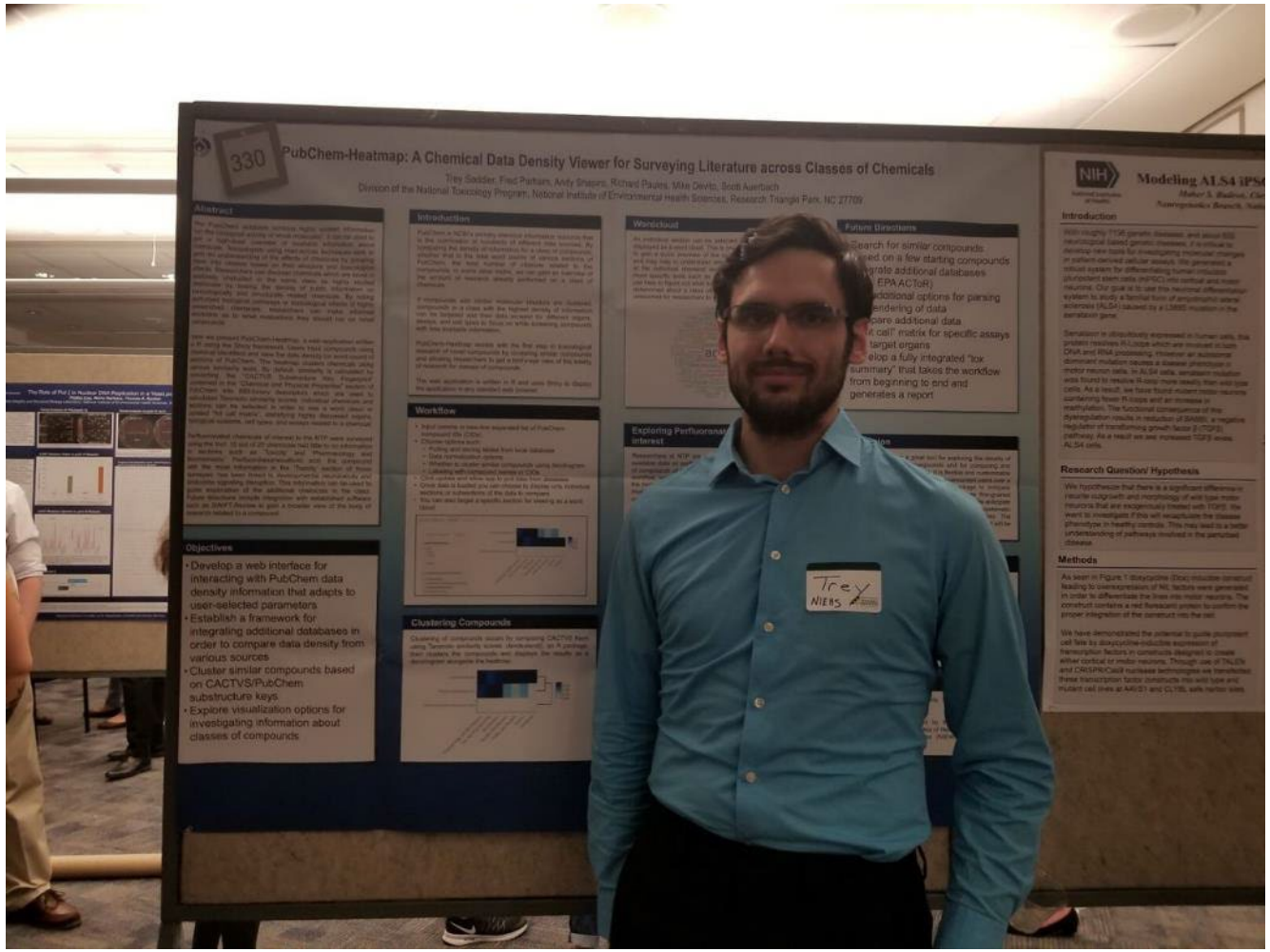
Identification of Candidate Genes
After Exposure
Nelson, Spencer[1,2]; Ciencewicki, Jonathan[1]; Gladwell, Wesley[1]; Mutlu,
[1]NIEHS Laboratory of Respiratory Biology, [2]University of North Carolina-Cha
Molecula
Abstract
Objective
Background
Methods
Experimental Design
LCLs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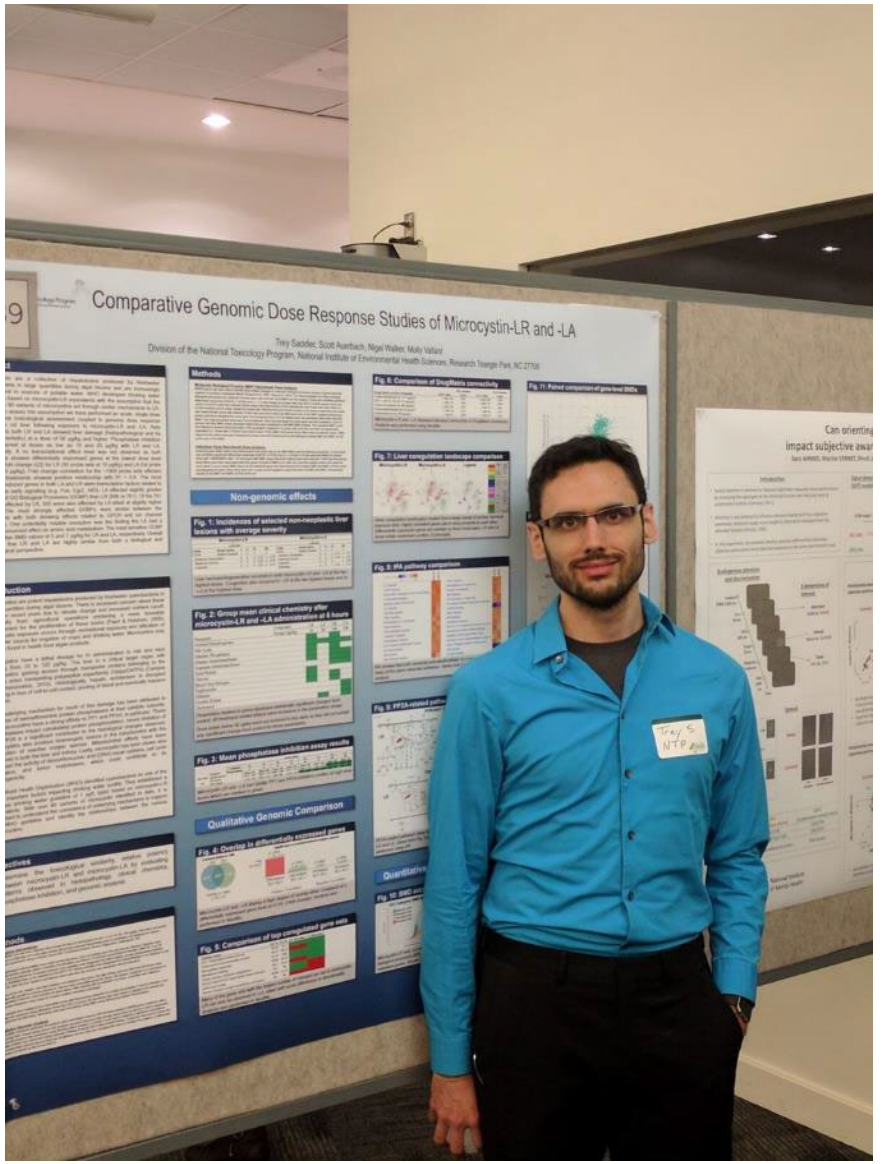
PubChem-Heatmap: A Chemical Data Density Viewer for Surveying Literature across Classes of Chemicals
Trey Saddler, Fred Parham, Andy Shapiro, Richard Paules, Mike Devito, Scott Auerbach
Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709
Abstract
Introduction
Wordcloud
Future Directions
Workflow
Objectives
• Develop a web interface for interacting with PubChem data density information that adapts to user-selected parameters
• Establish a framework for integrating additional databases in order to compare data density from various sources
• Cluster similar compounds based on CACTVS/PubChem substructure keys
• Explore visualization options for investigating information about classes of compounds
Clustering Compounds
Modeling ALS4 iPS
Introduction
Research Question/ Hypothesis
Methods
Trey
NIEHS


Comparative Genomic Dose Response Studies of Microcystin-LR and -LA
Trey Saddler, Scott Auerbach, Nigel Walker, Molly Vallant
Division of the National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709
Methods
Non-genomic effects
Qualitative Genomic Comparison
Trey S.
NTP

EYE ON CDI: FROM TOXICOLOGY TO DATA SCIENCE

SA

By Scott Auerbach posted 10-26-2023 11:56 AM

0 Recommend

This blog joins others in "Eye on CDI" series that features the career paths of individuals who started in toxicology as students in the SOT Undergraduate Diversity Program and are now in the scientific workforce. This blog features input by Trey Saddler, and I am pleased to share this story on his behalf.

Trey Saddler is one of the rare scientists who didn't enjoy science growing up. He avoided science until Dr. Doug Stevens brought Trey into his Environmental Chemistry Lab at Salish Kootenai College (SKC). After researching and presenting on methylmercury levels in the hair of Native American women of child-bearing age and mercury/selenium levels in lake trout, Trey would find his passion for science.

Dr. Stevens also encouraged Trey to apply for the 2013 SOT Undergraduate Diversity Program, where Trey presented a poster on mercury level in Maine seals. For a summer internship in 2013, Dr. Stevens introduced Trey to Dr. Darlene Dixon. Trey performed research on the effects of tetrabromobisphenol A in human endometrial cells in Dr. Dixon's Mechanistic Toxicology lab. Trey continued working in Dr. Steven's lab during the school year but also finished summer internships at US Environmental Protection Agency in Region 9, working on establishing a Tribal Indoor Air Quality and Health Network, and in Region 10 on Federal and Tribal Fishery and Hatchery. Trey also enjoyed the SOT Undergraduate Diversity Program so much that he returned as a peer mentor in March 2015.

After graduating from SKC in 2015, Trey returned to Dr. Dixon's lab as a postbac. After working with her for a year, Dr. Dixon recognized that Trey's real passion was working with computers. She had Trey talk with Dr. Mike DeVito, who recommended that Trey work with Dr. Scott Auerbach. While working with Dr. Auerbach, Trey learned and applied various data analysis tools, including R, Shiny, ggplot, and SQL. Trey wrote various tools and pipelines used internally in the National Institute of Environmental Health Sciences (NIEHS) Division of Translational Toxicology (DTT).

Trey (middle) with Dr. Linda Birnbaum (left) and Dr. Darlene Dixon (right)

At the conclusion of his postbac, Dr. Auerbach introduced Trey to Dr. Charles Schmitt in the Office of Data Science (ODS) at NIEHS. Trey worked in ODS for three years as a data scientist contractor and continued to develop his analytics skills, as well as learning linux administration, containerization, devops, how to work with the National Institutes of Health (NIH) BioWulf supercomputer, and other associated skills.

Under a reorganization of DTT, Trey was moved back to working with Dr. Auerbach and Dr. David Reif in the Predictive Toxicology Branch. Since the beginning of 2023, Trey, Dr. Auerbach and Dr. Reif have been developing a project called ToxPipe, which uses AI and retrieval augmented generation to help toxicologists parse and explore multi-omic data more easily. Trey applied for and received $150,000 from a funding proposal request to explore the use of cloud computing for NIH Intramural Research. Trey also started his MS in data analytics from Western Governors University in October 2023 and hopes to finish in time to attend grad school in the second-half of 2024 for data science, where he would continue his work on using AI to advance toxicological and life science research.

Diversity Speaker Series addresses Native American health challenges

Previous Article First Article

The National Toxicology Program's Trey Saddler described how problems such as poor air and water quality affect tribal communities.

BY JOHN YEWELL

Trey Saddler, a data scientist in the National Toxicology Program (NTP), spoke at NIEHS Dec. 12 about the environmental health problems faced by American Indians.

His talk was sponsored by the NIEHS Office of Science Education and Diversity as part of the Diversity Speaker Series.

A member of the Chippewa Cree Tribe, Saddler also is a descendant of the Confederated Salish and Kootenai Tribes. He earned a bachelor's degree in life sciences with a focus on environmental health at Salish Kootenai College, a tribal college in Pablo, Montana.

"There are a lot of issues [affecting tribes]," said Saddler, who works in the NTP Office of Data Science.

Before joining the Office of Data Science, Saddler studied tribal fisheries, hatcheries, and indoor air quality through Environmental Protection Agency internships. (Photo courtesy of Steve McCaw)

Path to data science

Saddler came to NTP as a summer intern in 2013 at the invitation of Darlene Dixon, D.V.M., Ph.D., head of the Molecular Pathogenesis Group.

He returned to NTP in 2015 as an Intramural Research Training Award postbaccalaureate fellow, working first with Dixon and then Scott Auerbach, Ph.D., head of the Toxicoinformatics Group.

In 2018, he joined the recently created Office of Data Science, headed by Charles Schmitt, Ph.D.

"When I first came on, I wanted to do toxicology," Saddler said. "I figured out quickly that I wanted to move away from cell culture work and do something with computers."

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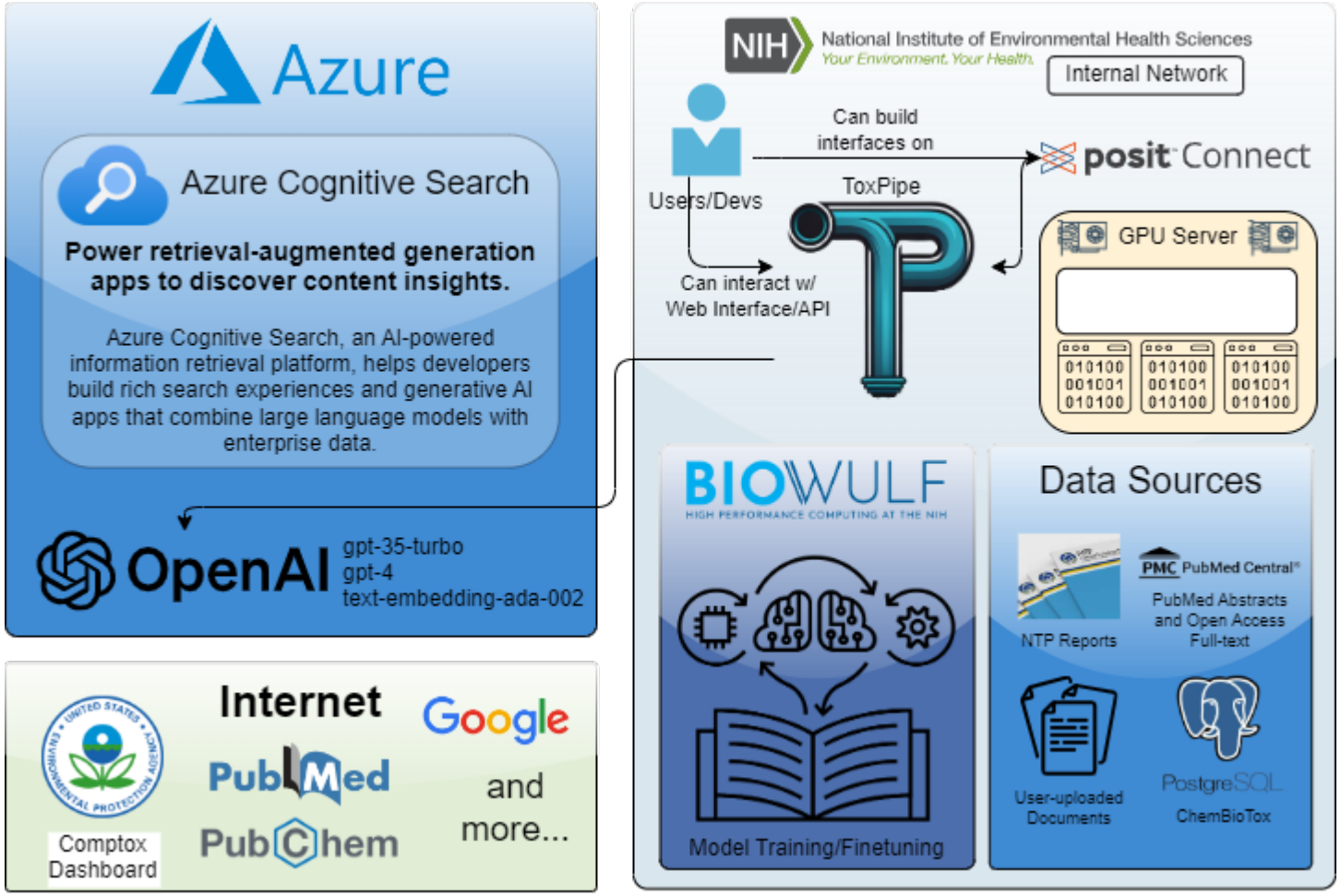
ToxPipe



Dr. Scott Auerbach

Dr. David Reif

Trey Saddler

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Thank you!