Multi-Drug-Resistant Bacteria Carriers of Heavy Metals in Texas Gulf Waters

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Galveston Bay Estuary Program, Texas Commission on Environmental Quality
Monitoring & Research Subcommittee Meeting
June 11th, 2025

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Public Health Concern

Vibrio (V.) vulnificus & V. alginolyticus

- Bio-Safety Level-2
- Texas Coastal Bend marine and estuarine waters
- Obligate halophile
- Multi-Drug Resistant (MDR):

  ampicillin, vancomycin, and penicillin
- Open wound contact with seawater or consumption of raw seafood

V. vulnificus infection with necrotizing fasciitis.[1]

V. alginolyticus stained with trypan blue (40X).

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Research Goal & Hypothesis

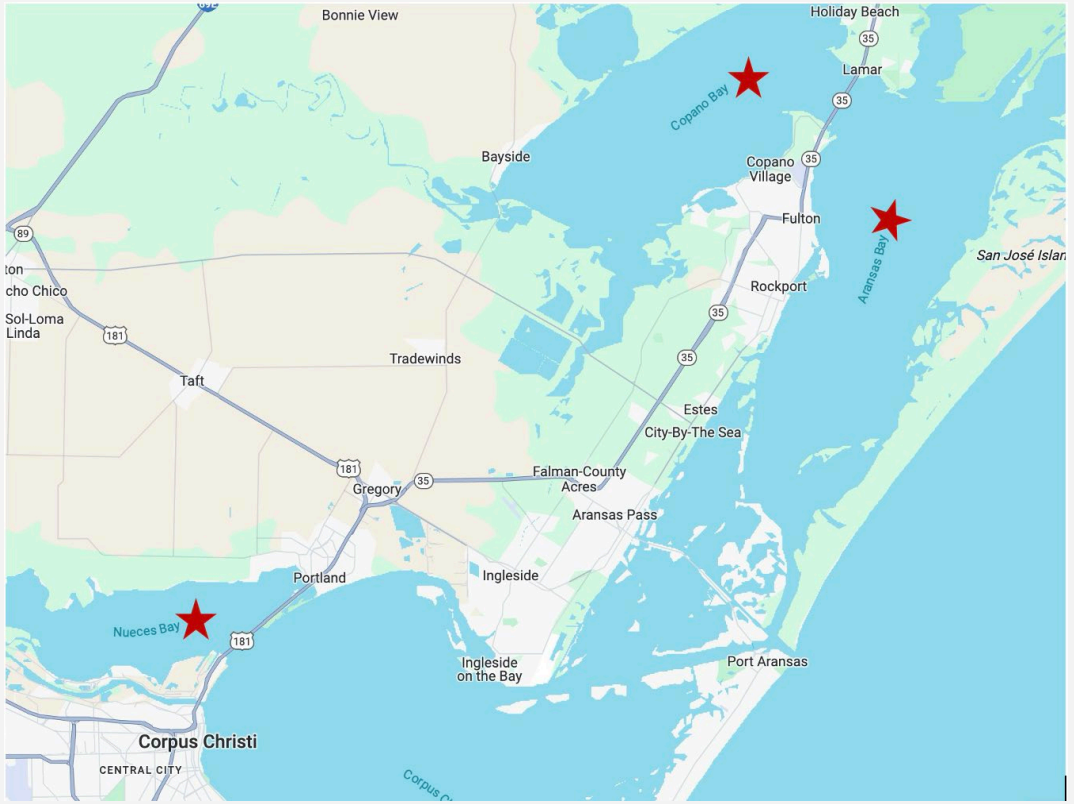
Research Goal

- To determine the bioaccumulation of heavy metal contaminants in *V. vulnificus* and *V. alginolyticus* isolates from Texas Coastal Bend estuarine and marine waters using Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES).

Hypothesis

- The bioaccumulation of hazardous heavy metals into the local bacterial cells correlates with increased antimicrobial resistance.

Map of *Vibrio* isolates sampling points



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U.S. EPA Regulated Contaminants

Primary drinking water contaminants.[2] Primary saltwater contaminants.[3]

Contaminant	*MCLG (µg/L)*	*MCL (µg/L)*	*Health Effects in Humans*	*CMC (µg/L)*	*CCC (µg/L)*
Antimony	6	6	Increase blood cholesterol	-	-
Arsenic	0	10	Increase risk of cancer	69	36
Barium	2000	2000	Increase in blood pressure	-	-
Beryllium	4	4	Intestinal lesions	-	-
Cadmium	5	5	Kidney damage	33	7.9
Chromium	100	100	Allergic dermatitis	1100	50
Copper	1300	1300	Liver or kidney damage	4.8	3.1
Lead	0	10	Neurological issues	210	8.1
Mercury	2	2	Kidney damage	1.8	0.94
Selenium	50	50	Circulatory problems	290	71
Thallium	0.5	2	Kidney, intestine, or liver problems	-	-

US EPA. *National Primary Drinking Water Regulations*
National Primary Drinking Water Regulations

US EPA. *National Recommended Water Quality Criteria – Aquatic Life Criteria*
National Recommended Water Qualtiy Criteria

Abbreviations:
EPA - Environmental Protection Agency
MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal
CMC – Criterion Maximum Concentration
CCC – Criterion Continuous Concentration

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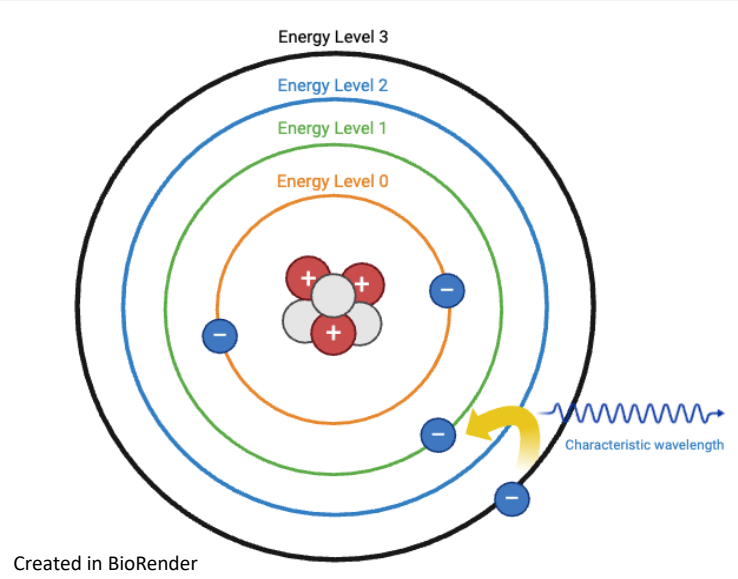
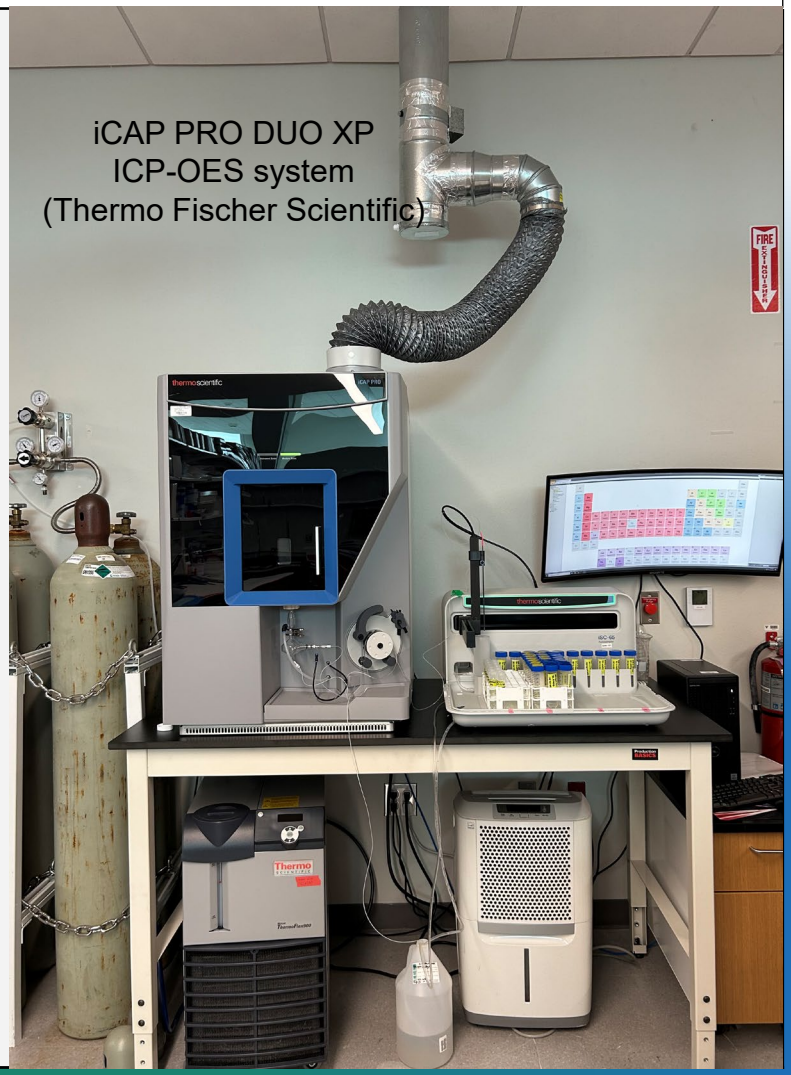
Chemical Analysis

Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES)

- ICP-OES used to quantify metal contaminants down to the low parts per billion (ppb or μg L^{-1}) or sub-ppb following EPA Method 200.7.[4]

Working Principle





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Chemical Analysis

ICP-OES Method Validation following EPA Method 200.7

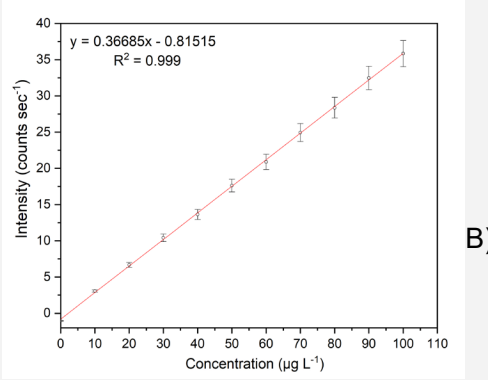
- *Four blanks*
- *Instrument Detection Limit*
- *Method Detection Limit*
- *Linear Dynamic Range*
- *External Calibration Method*
- *Standard Addition Method*
- *Quality Control Sample*
- *Instrument Performance Check*
- *Spectral Interference Check*

Sample Preparation

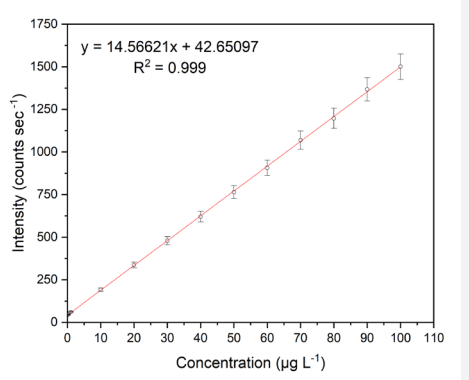
- *Chemical digestion using TraceMetal grade HNO_3*

External calibration curves for
(A) As, (B) Cr, (C) Hg, and (D) Pb

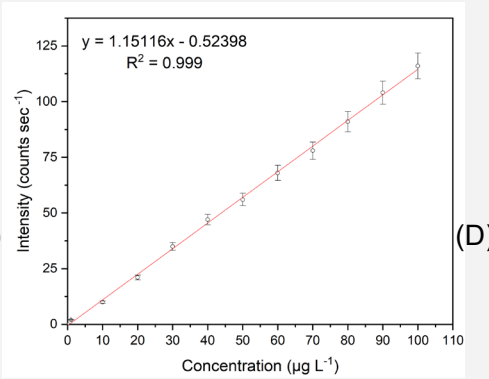
(A)



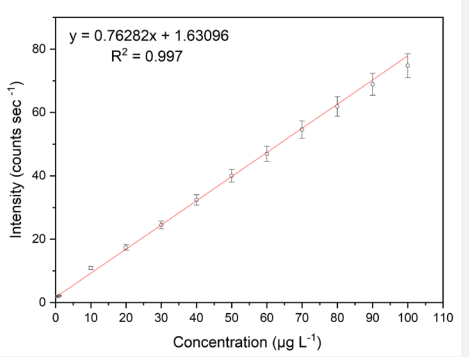
B)



(C)



(D)



Acknowledgements

Thank you!

- Texas A&M University Corpus Christi (TAMU-CC) funding, technical, and administrative personnel
- Welch Fellowship Award #BT0041
- NSF Award # 2307996

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TEAM PAVEL

Pavel Lab

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