

Post-mission Metagenomic Surveillance of Blood Microbiota in Military Working Dogs



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DISCLAIMER

The opinions and assertions expressed herein are those of the authors and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences, the Department of War or the Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc. All authors report no conflict of interests.

INTRODUCTION

- **Military working dogs (MWDs)** play an important role in Combat and Special Operations.
- During deployment, MWDs live closely with their handlers.
- We hypothesized that Antimicrobial Resistant bacteria may be shared in MWD and humans during deployment.



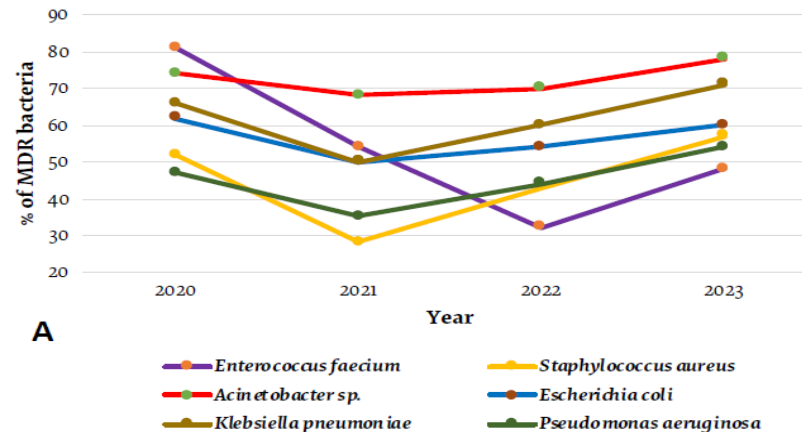
Photo source: <https://www.boredpanda.com/service-dogs-loyalty-military-police/>

BACKGROUND

- Human studies have shown micro-organism genetic material in the blood of healthy persons ([Pietrzak, Int J Mol Sci. 2023 Feb 3;24\(3\):3051](#))
- One study of blood microbiome in canines compared genes in healthy versus sick dogs ([Scarcella, Vet Sci 2023.10.277](#))
 - Differences were found in phyla *Bacteriodota*, *Firmicutes*, and *Proteobacter*
- Mechanism thought to be translocation from “leaky gut” or oral mucosa
- Microbial population presence in human and MWDs blood is hypothesized to be the “dormant phase” of bacteria, L-forms that in certain conditions can become active, transport to peripheral tissues

BACKGROUND

- Iraq: increasing antimicrobial resistance (AMR). The predominant species with AMR include *Escherichia coli*, *Acinetobacter baumannii*, *Staphylococcus* and *Enterococcus faecalis*. ([Alhifi, EMHJ 2026. 32\(5\)](#))



Trend of MDR bacteria in Iraq
2020-2023

- Iraq: high rates of resistance of *A. baumannii* to multiple antimicrobial agents, “Iraqi-Bacter” ([Aronson N. Clin Inf Dis 2006. 43\(8\):1045-51](#))
- U.S. soldiers frequently contracted multidrug-resistant (MDR) infections after trauma ([Murray C. J Trauma Acute Care Surg 2008; 64\(3\):S232-8](#))

OBJECTIVE

- To investigate the microbiota in MWD blood using metagenomic analysis to provide insights about potential pathogens and antimicrobial resistance and inform about threats to the operational readiness of dog and human warfighters

Population Demographics

Target Population: Military Working Dogs (MWDs) deployed to Iraq

Cohort Size: N = 50 dogs.

Sampling Window: Whole blood collected approximately 6 months post-return from deployment to Iraq.

Breed: German Shepherds, Labrador Retrievers

Average age of MWDs - 4 years old

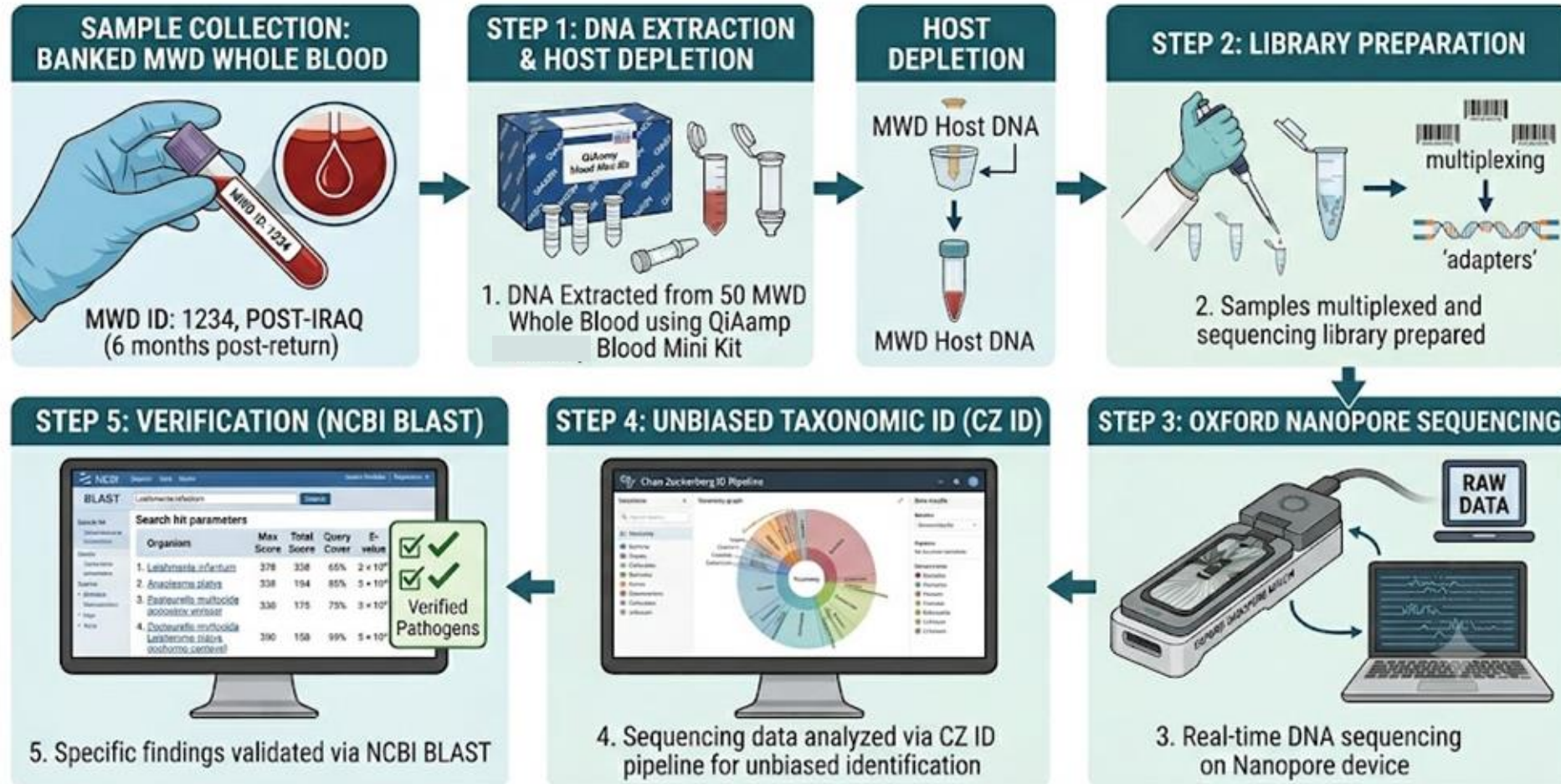
Sex: 79.2 % male MWDs
20.8 % female MWDs

Medical History during deployment

Clinical marker	Healthy (No clinical signs) MWDs (n=23)	Sick (Clinical signs) MWDs (n=27)
Physical State	Alert, shiny coat, pink gums	Lethargic, dull coat, pale gums
Behavioral Indicators	High motivation, sociable	Hiding, isolating, restless
GI system	Firm stool, stable appetite	Diarrhea, vomiting, anorexia

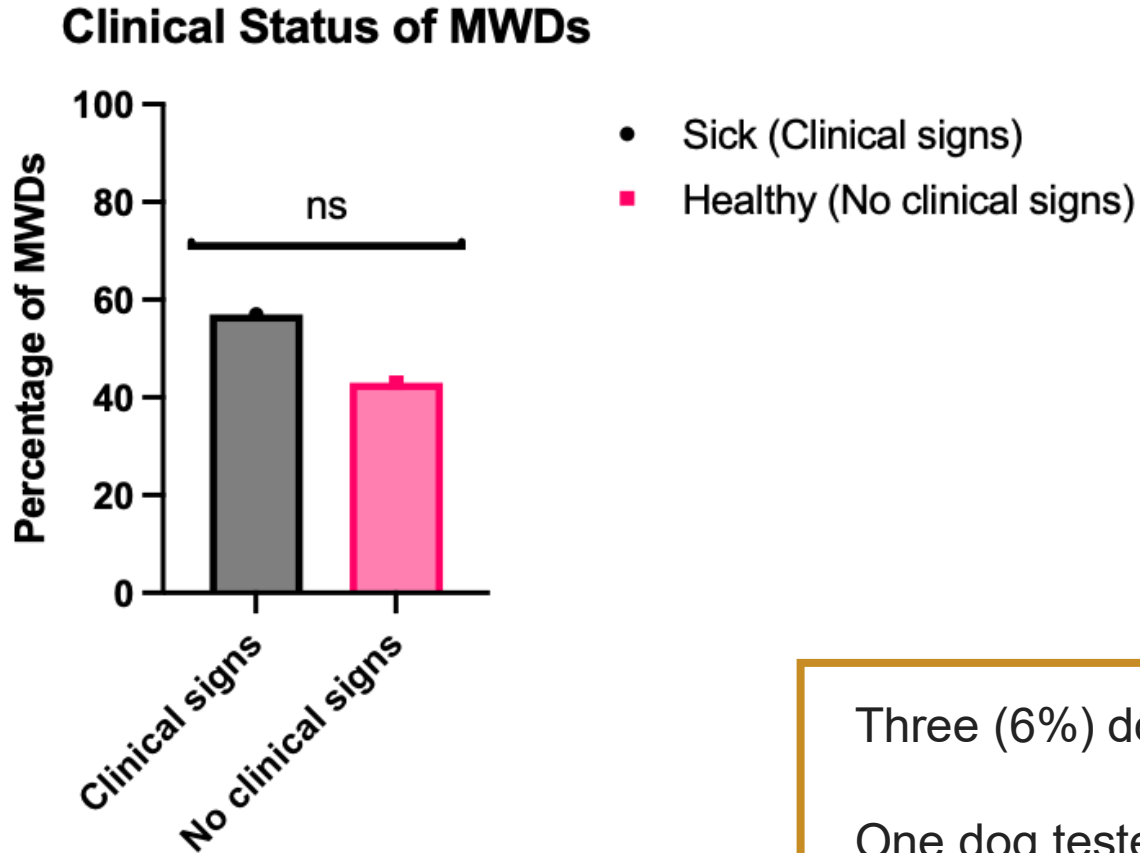
MATERIALS AND METHODS

WORKFLOW FOR UNBIASED PATHOGEN DETECTION IN IRAQ MWDs



- We used frozen whole blood from Food Analysis and Diagnostics laboratory repository
- Metadata including medical history and diagnoses were abstracted from medical records and correlated with pathogen detection and abundance.

RESULTS: Both healthy and sick MWD had bacterial DNA in blood



Detected DNA of potentially antimicrobial-resistant (AMR) pathogens in both groups:

Acinetobacter baumannii (the "Iraqibacter")

Stenotrophomonas maltophilia

Pseudomonas aeruginosa

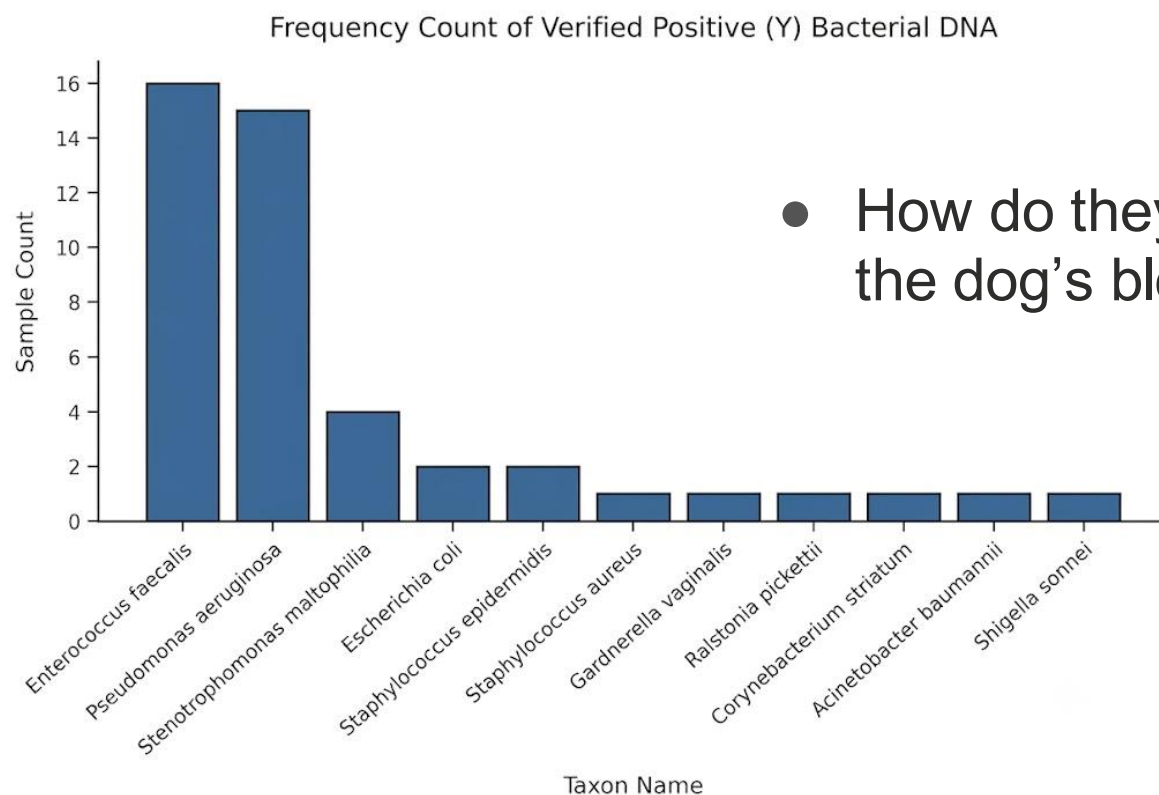
Three (6%) dogs had **diarrhea** noted during or after deployment

One dog tested positively for **2 *Shigella species*** (2%)

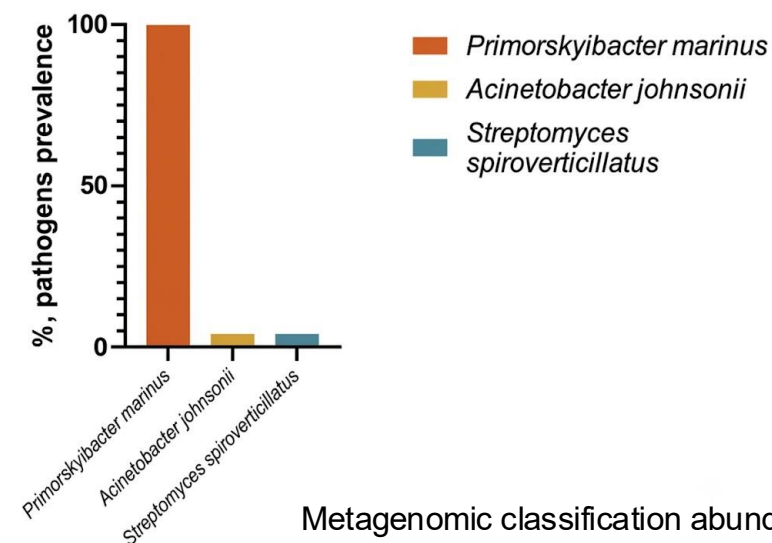
Post Iraq MWD blood microbiome

Metagenomics revealed presence of environmental bacterial DNA in the dog blood.

Environmental bacteria capable of surviving free-living lifestyles in soil, water, dust, sediments, vegetation or human skin



- How do they get into the dog's blood?



Metagenomic classification abundance
CLCOutput_V2 Pipeline

Environmental factors

Dust and sandstorms in the Middle East come in two forms



Haboobs

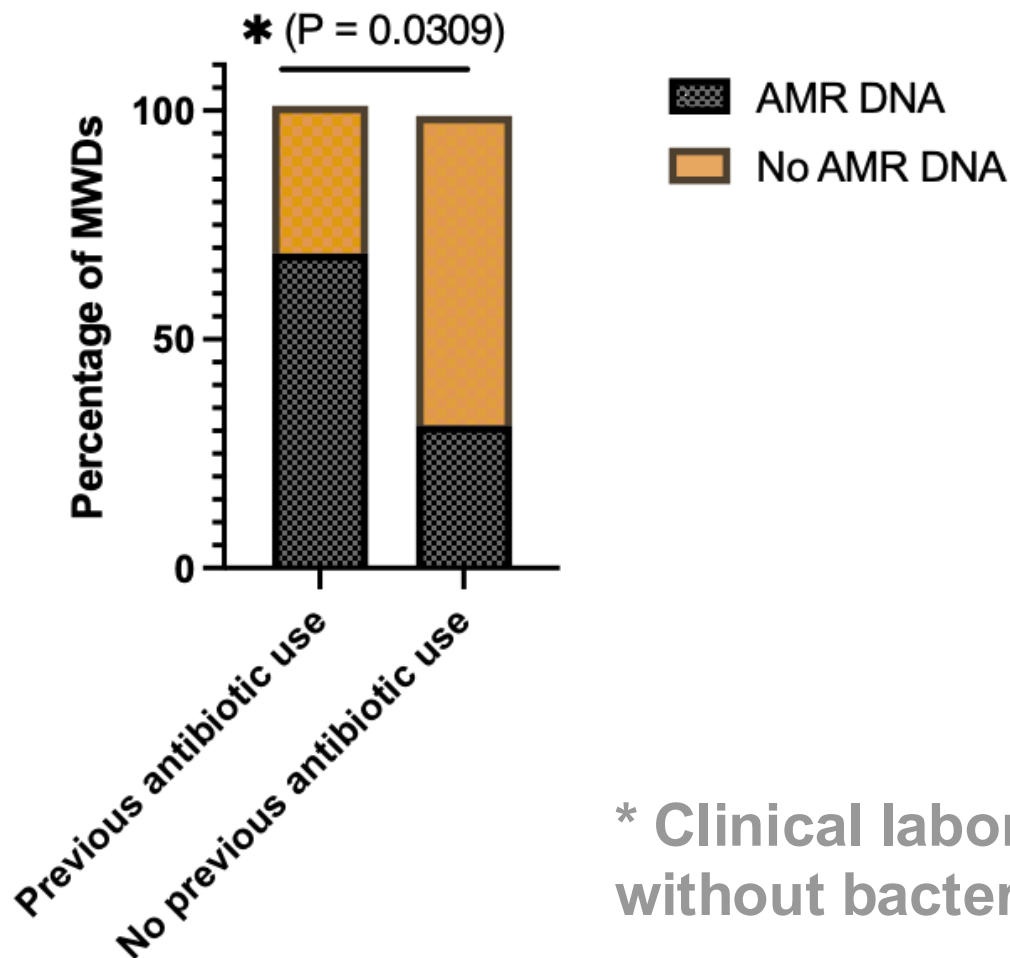
AL ASAD, IRAQ, 04.28.2005. Photo by [Sgt. Nicholas Smith](#). [War.gov](#)



Shamal

NASA image created by Jeff Schmaltz, rapidfire.sci.gsfc.nasa.gov/
MODIS Rapid Response team.

Higher rates of AMR bacteremia in MWD who received prior antibiotics



- Overall 22/50 (44%) MWD with AMR DNA in blood

Prior Antibiotic Exposure

11/16 (68%) MWD with AMR DNA in blood

11/34 (32%) MWD with no AMR blood

* Clinical laboratory values were similar in those with and without bacteremia

DISCUSSION

- Our study provided a single time-point snapshot of blood microbiome in MWDs post-deployment to Iraq.
- Bacterial species identified through metagenomic sequencing may be linked to their environmental exposures including dust storms.
- Diarrhea can compromise epithelial barrier function, leading to increased intestinal permeability—a "leaky gut" syndrome with the translocation of bacteria from the GI tract to the bloodstream that can result in transient bacteremia.

CONCLUSION

- Isolation of DNA of potential AMR pathogens from the tested dog's blood strongly implicates transient bacteremia in the MWDs deployed in Iraq.
- MWDs could serve as both sentinel and reservoir for human infections given the uniquely close relationship developed during combat.

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Photo courtesy: DVIDS (Defense Visual Information Distribution Service) of Department of War Information Activity (DWIA)





Thank you!

Q/A

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Photo by Tech. Sgt. Caycee Watson