Medical Xpress

Mitigating the risk of infection in combat-related injuries

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The severely invasive nature of combat trauma creates massive regions of injury, colonization and infection, requiring specialized diagnostic and aggressive therapeutic approaches. Previous reports indicate an

estimated occurrence of wound infections in 18%–25% of combat-related injuries.

Hindering wound recovery are multidrug-resistant microorganisms, which have been consistently observed in injured service members with reports throughout the recent conflicts in Iraq and Afghanistan.

To support the early detection of potentially detrimental microbial factors, researchers at Lawrence Livermore National Laboratory (LLNL) have developed a targeted panel for the capture and sequencing of microbial genomic signatures relevant to wounds from combat injuries. The resulting paper, "Targeted metagenomic assessment reflects critical colonization in battlefield injuries," appears in *Microbiology Spectrum*.

"Generating these datasets and analytical approaches results in a clearer picture of microbes associated with military injury and their impact on health outcomes," said LLNL scientist and senior author Nicholas Be. "We're focused on developing and further applying these platforms to effectively predict risks and improve care for military service members."

Using microbial metagenomic sequencing, the panel selectively sequences thousands of microbial genomic regions relevant to bioburden (unsterilized bacteria) in traumatic wound injuries. This process facilitates high-confidence detection of critical microbial signatures that are otherwise difficult or impossible to assess using current standards of care. These microbial signatures include genus- and species-level identification of pathogens, antimicrobial resistance and virulence.

The panel was synthesized and validated using control reference samples from human background DNA. With help from the Uniformed Services University (USU) Surgical Critical Care Initiative, subsequent evaluations in wound samples derived from combat extremity injuries in

U.S. military service members were carried out to demonstrate the clinical utility of these targeted signatures.

Overall, the use of this panel could help guide the clinical management of wounds and offer opportunities for personalized treatments.

However, being able to quickly identify the types of bioburdens present in a wound is only part of the equation. Researchers also need to know the bioburden risks to the warfighter in operational environments, as opportunistic pathogens that can survive on gear represent risk factors for infection following an injury—especially following combat blasts, where fibers and other materials are embedded in wounded tissue.

In a second paper appearing in *Applied and Environmental Microbiology*, "The military gear microbiome: risk factors surrounding the warfighter," a team of researchers from Tripler Army Medical Center and LLNL obtained environmental swab specimens from the gear of soldiers from two independent military cohorts.

Just as textile advancements in the health care industry have been developed to minimize the acquisition and transmission of pathogens within hospitals and into the community, this research presents opportunities to leverage textile innovations in the military space—providing information that can help prioritize antimicrobial material designs to minimize the risks of contamination and infection.

Samples for this study were collected from participants in the Jungle Operations Training Course on Oahu, Hawaii, and active-duty service members deployed to Indonesia. The first set of samples was taken upon arrival and then again 14 days after the start of operations for sequencing and microbiome analyses. Gear types that were analyzed include boots, canteens, coats, and trousers.

The research team found that microbiome diversity, stability, and composition were dependent on gear type, training location, and sampling time point.

Microbiome changes observed on Day 14 had significantly higher species diversity in Hawai'i samples compared to Indonesian samples for boot, coat, and trouser swabs. Researchers also observed that potential microbial risk factors, such as the opportunistic pathogenic species acinetobacter, pseudomonas, and staphylococcus, were found to be present in all sample types and in both study sites.

"Both studies collectively demonstrate the likely and undesired impact of environmental microbial contamination on military wounds and the potential of using microbial features derived from sequencing as biomarkers for microbial surveillance and risk detection," said Car Reen Kok, LLNL postdoctoral scientist and lead author.

More information: Car Reen Kok et al, Targeted metagenomic assessment reflects critical colonization in battlefield injuries, *Microbiology Spectrum* (2023). DOI: 10.1128/spectrum.02520-23

Car Reen Kok et al, The military gear microbiome: risk factors surrounding the warfighter, *Applied and Environmental Microbiology* (2024). DOI: 10.1128/aem.01176-23

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