

WoundSentry: Smart VOC-Sensing Dressing for Early Wound Infection Detection in Front-Line Care

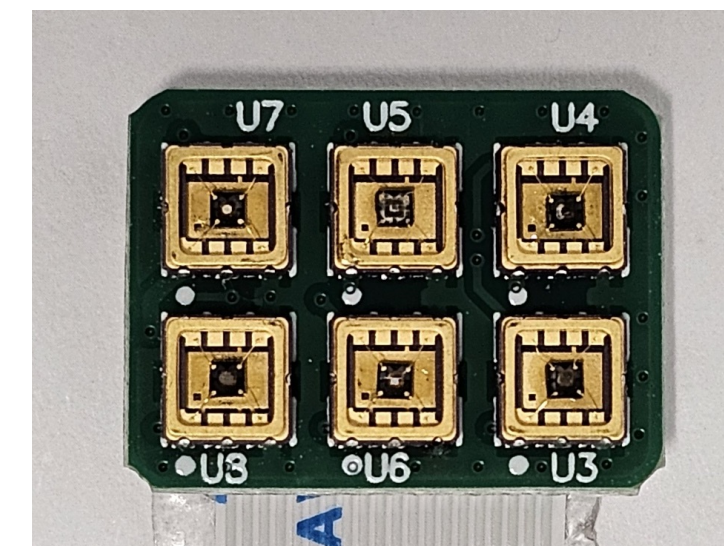
Taejun Ko, PhD; Deyu Liu, PhD; Derese Getnet, PhD; Buyu Yeh, MS; Jennifer Dootz, MS; V. S. Sajja, PhD; Bjorn K. Song, PhD; Allan Freedline, DPM; Robert Hopkins, MD; Xiaonao Liu, PhD
Tao Treasures LLC (d/b/a NanoBioFAB), Frederick, Maryland | Song Biotechnologies, Baltimore, Maryland

Introduction

During prolonged casualty care, infection may evolve between intermittent visual assessments. **Microbial volatile organic compounds (mVOCs)** provide a noninvasive chemical signal that can be sampled without contacting the wound bed. WoundSentry is being developed as a dressing-integrated platform that combines a disposable wound interface with a reusable multisensor module for noninvasive VOC assessment.

STUDY QUESTION

Does a Smart Dressing capability with mVOC capability sense and detect wound infection as an adjunct care tool for medics in the frontlines?



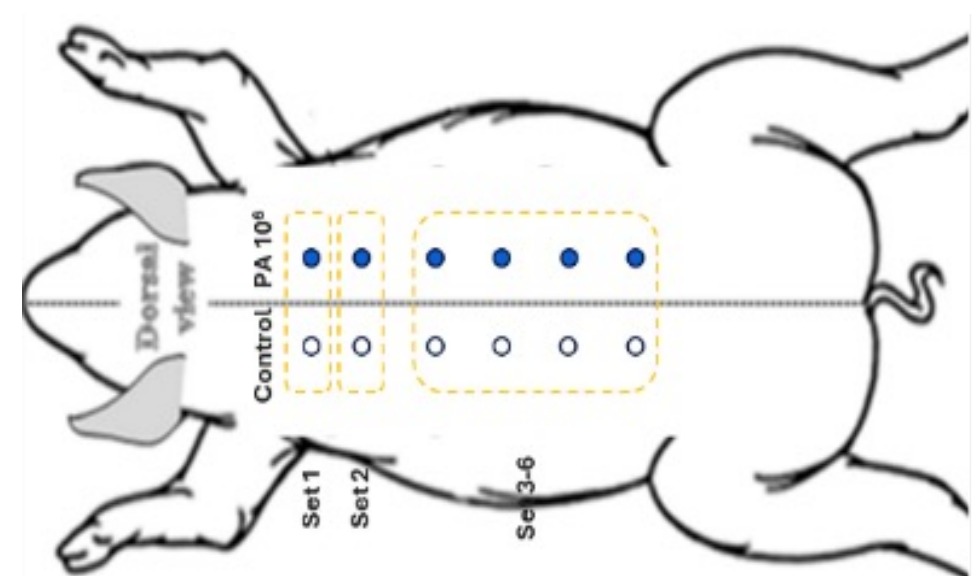
Technology: Integrated six-sensor array for VOC fingerprinting

How Technology Works

- 6-sensor array is refined to detect VOC sampling mVOCs from microbial pathogens
- AI-based analytics provides actionable information
- Already shown: VOC fingerprint generation and infection classification with high degree of sensitivity/specificity

Pig Excision Wound (EW) Infection Model

Two Yorkshire pigs (40–45 kg), with 12 wounds per animal



After 15–20 minutes of absorption, wounds were covered with sterile Tegaderm to maintain a semi-occlusive environment. At 24, 48, and 72 hours, scheduled wound sets underwent a 5-minute VOC spot check, photography, and swab sampling before redressing.

Day 0

Wound creation
PA inoculation
Dressing placement

Day 1

VOC monitoring,
Imaging &
Swab sampling
for 4 wounds

Day 2

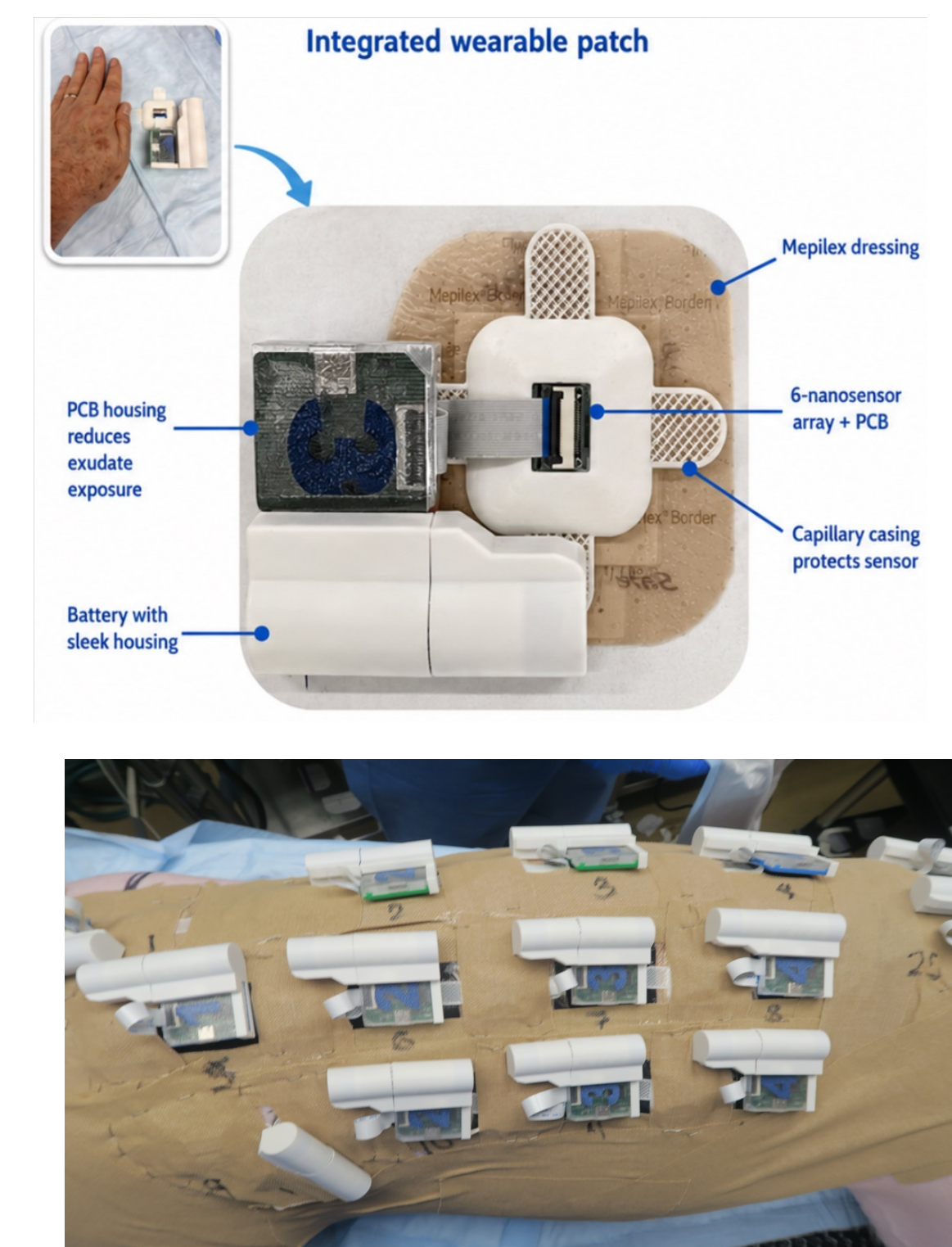
VOC monitoring,
Imaging &
Swab sampling
for 4 wounds

Day 3

VOC monitoring,
Imaging &
Swab sampling
for 16 wounds

- All protocols are approved by IACUC prior to experiments
- Twelve 12-mm full-thickness excisional wounds per animal
- Group of 6 EWs received 1 mL sterile PBS or 1 mL *P. aeruginosa* at 10^6 CFU/mL (10^6 CFU/wound).

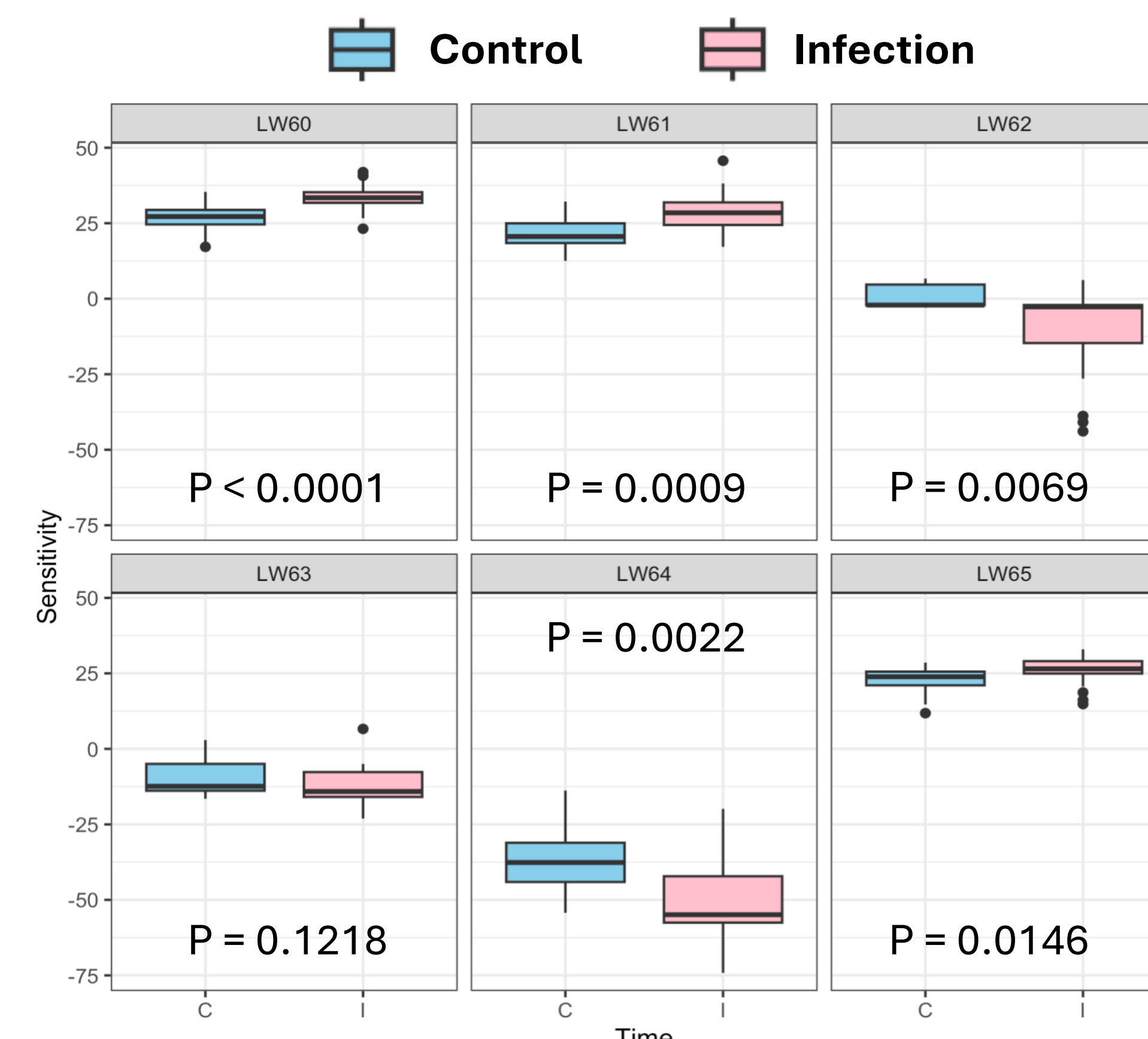
WoundSentry™: Advanced Prototype



Data collection in the In Vivo conditions for perspective

- Dimensions
 - 3" dressing x 3.2" of length x 4" of width
- Battery lasts up to 7 days
 - Further refine to reduce size
- Onboard tech will be adopted to red or green indicator
 - Red – Microbial presence
 - Green – No substantial growth
- An adjunct decision support aid for far forward environments enabling a medic to assess and intervene early in infection
- Tested in laboratory animal models

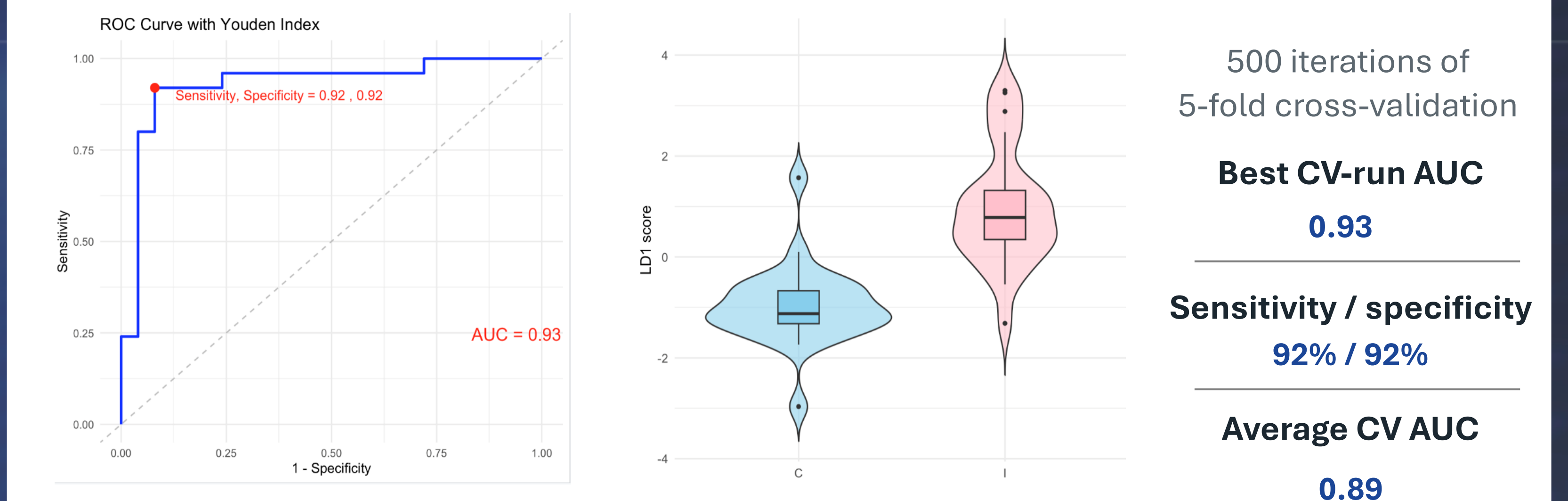
Results: 3 Day Pig Excision Study



- Day-3 sensor responses obtained during 5-minute spot checks were compared between PBS-control and PA-inoculated wounds.
- Five of six sensor channels showed significant group differences, including four with $p < 0.01$.
- Complementary response directions across the sensor array supported multivariate pattern-based classification.

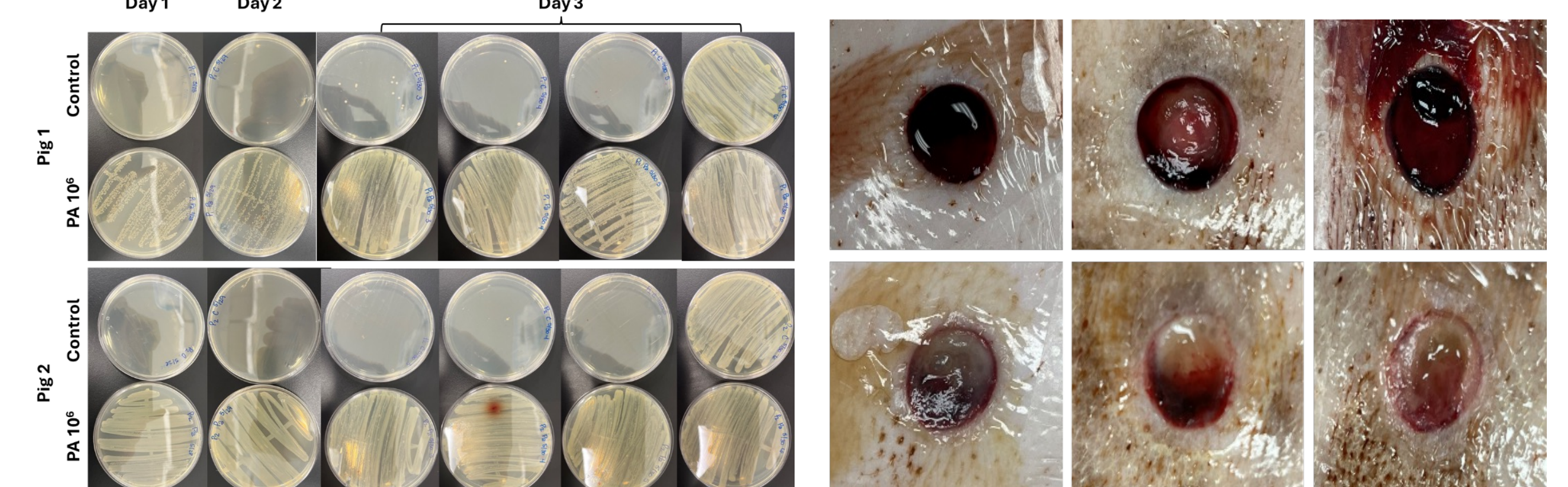
- 6-sensor array LW60-LW65 shows a unique response in the detection of pathogen when compared to control that has no PA**
- Successfully showed the microbial detection capabilities**

Results: 3 Day Pig Excision Study



High sensitivity and specificity shows that nanosensor array can detect microbial presence at a high discrimination compared to controls

Confirmation of Infection in the Wound



- Serial swab cultures shows PA-inoculated wounds from day 1-3 but no infection was seen in controls until day 3. At day 3, controls and PA has distinct color patterns in the culture plates, potentially from physiological bacteria in controls.
- Control wounds were relatively dry, uniformly red, and sharply defined with minimal discharge where as PA-inoculated wounds showed exudate with irregular margins and peripheral erythema

Conclusion | Impact to Warfighter | Status

Conclusion: We have successfully demonstrated the feasibility of WoundSentry system in a human-relevant animal model.

Impact to the Warfighter/Significance: WoundSentry is intended to enable earlier infection recognition, reduce dressing disruption, and extend medic monitoring capability while lowering provider cognitive burden in austere environments.

Developmental Status of the Technology: More than 100 functional prototypes have been built. Ongoing maturation includes refinement of the disposable dressing and reusable electronics, power optimization, and evaluation in burn and exudative wound models.

Acknowledgements: This study is partially supported by Defense Health Agency
SBIR phase II award #HT942525C0013

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Contact us:

Dr. Xiaonao Liu, CEO
email: xiaonaoliu@nanobiofab.com

Or scan to reach us



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