Accelerating Wound Sensor Development Using Ex Vivo Samples

Introduction

Smart wound dressings offer a promising step toward personalized care by enabling real-time monitoring and early infection detection [1]. However, introducing new technologies into clinical practice poses technical and regulatory challenges, including biocompatibility, sterility, and data transmission, which hinder clinical adoption. Clinical trials are also time-consuming and resource-intensive, especially in early development.

To overcome these barriers, this study evaluates used wound dressings as a non-invasive platform for sensor testing. By analyzing retained exudate, we assess the sensor's ability to detect clinically relevant markers without direct patient involvement, an approach that accelerates validation and design optimization before clinical use.

Here, we tested Odinwell's fluorescence-based sensor on both the wound-facing and external sides of dressings.

Methodology

Used wound dressings were obtained with the patient's informed consent via a biological sample broker (SmartSample, UK) after ethical approvals were received from both the collection country (ISTANBUL MEDIPOL UNIVERSITY: E-10741096-291.3.01-6781) and in the country where the tests were conducted (Swedish Ethical Review Authority Dnr 2025-01863-01). The used wound dressings were from patients with ulcers that had clear signs of infection. The samples were frozen to -80˚C within 20 minutes from harvesting and shipped to a laboratory for storage and testing (Industridoktorn®, Sweden). After identification of fluorescent areas, using a UV flashlight in combination with laser safety spectacles that block the UV light while transmitting red light, the Odinwell sensor system was used to spectrophotometrically analyze the emitted light using a 405 nm light source as excitation for the porphyrin and pyoverdine biomarkers. Data was acquired for different types of sensors to compare their performance, and repeated measures were taken for each sample and each sensor. The spectral data was then analyzed using Odinwell's developed algorithm to receive numerical data.

Results

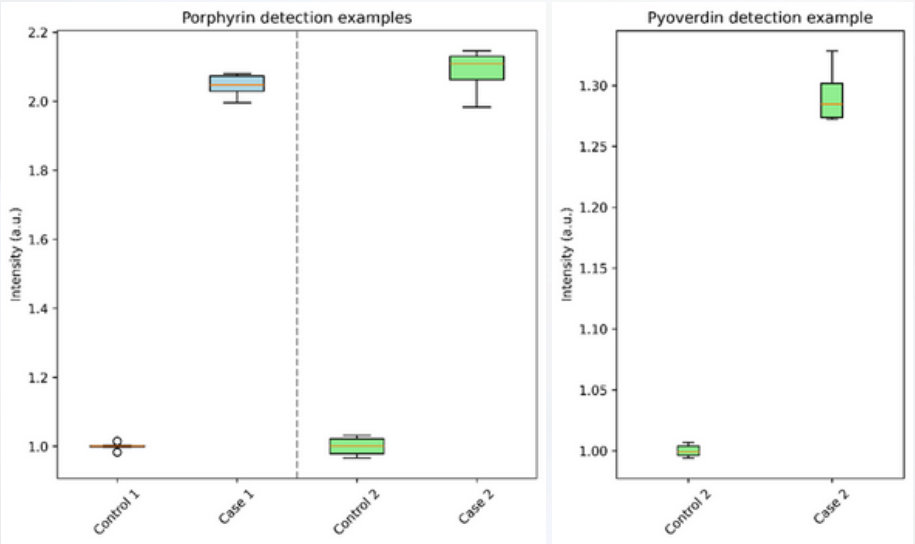

Figure 1 & 2 *present example data from two wound dressings that exhibited bacterial autofluorescence. The intensity corresponding to porphyrin and pyoverdine fluorescence was compared to the intensity of unused sterile dressings (Control) acquired during the same measurement session. Each box in the plot represents repeated measurements from one dressing using one sensor type, illustrating variability and signal strength across samples.*

Discussion and Future Outlook

In this work, we demonstrated that Odinwell's system is capable of detecting multiple biomarkers associated with bacterial presence directly from used wound dressings. Spectral data can provide a detailed insight into the type of bacteria, such as differentiating between types of porphyrin and pyoverdine, opening new possibilities for assisted wound assessment. For example, coproporphyrin III is associated with biofilm formation [2,3], and pyoverdine can help assess the virulence of *P. aeruginosa* in infected wounds, especially where biofilm formation is a concern [4].

The testing method is still being refined, and these results are preliminary. Not all samples showed fluorescence under the torch inspection; however, when fluorescence was visible during the inspection, it was also detectable by the sensor. A key area for improvement is the handling and processing of used dressings to preserve wound exudate integrity and ensure sensor readings reflect the in vivo environment.

References

[1] Wang, C., Shirzaei Sani, E., Shih, C. D., Lim, C. T., Wang, J., Armstrong, D. G., & Gao, W. (2024). Wound management materials and technologies from bench to bedside and beyond. Nature reviews. Materials, 9(8), 550–566.

[2] Wollenberg MS, Claesen J, Escapa IF, Aldridge KL, Fischbach MA, Lemon KP (2014). Propionibacterium-produced coproporphyrin III induces Staphylococcus aureus aggregation and biofilm formation. mBio. 5(4), e01286-14.

[3] Alves GB et al., (2025). Photodynamic inactivation mediated by endogenous porphyrins of Corynebacterium diphtheriae in planktonic and biofilm forms. ACS Omega, 10(9), 9177–9186.

[4] Kirienko, D. R., Revtovich, A. V., & Kirienko, N. V. (2016). A High-Content, Phenotypic Screen Identifies Fluorouridine as an Inhibitor of Pyoverdine Biosynthesis and Pseudomonas aeruginosa Virulence. mSphere, 1(4), e00217-16.