A Comprehensive Approach to Pressure Injury Management via Multimodal Wound Imaging and What Is Next in Pressure Injury Prevention

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Introduction

- Pressure injuries (PIs) are caused by pressure, shear, or moisture. Bacterial infection can worsen injuries, leading to poor healing, increased size, osteomyelitis, hospitalization, sepsis, and death.
- Proactive detection of pressure points, areas of enhanced trauma and early identification and localization of bacterial burden is crucial to improve outcomes.
- Fluorescence (FL) imaging and other skin diagnostic technologies such as thermal imaging have a pivotal role in pressure injury management and even prevention as shown in the medical literature[2-4].

Objective:

To explore the diagnostic benefits and clinical practice impact of FL Imaging (MolecuLight®) in PI infection management.

Additionally, we report pilot findings on incipient injury detection through thermal imaging (MolecuLight®).

Study Methods

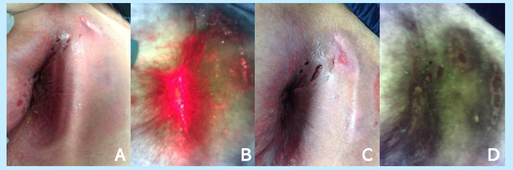
A compendium of real-world data as follows:

- ***Clinical trial:*** Post-hoc analysis of 22 PIs from the FLAAG clinical trial[1] examined whether adding FL Imaging improves the diagnostic accuracy of clinical assessments for bacterial presence in this wound type.
- ***Case series:*** Prospective longitudinal study of 30 PI wounds in 26 outpatients imaged at each visit to assess how FL Imaging informs wound management.
- ***Preliminary findings from pilot study:*** Examining the role of thermal imaging in the detection of incipient PIs.

Results

Clinical Trial.

- Biopsies revealed that 100% of PIs had bacterial loads of concern (range: 10^4 –10^8 CFU/g, median 10^6 CFU/g).
- Only 2/22 (9%) were identified as positive for bacteria based on SOC, while FL Imaging correctly identified 68% (15/22) of PIs as positive for bacteria.
- The addition of FL Imaging increased the diagnostic sensitivity of harmful bacteria by 7.5-fold over the SOC (clinical) diagnosis.



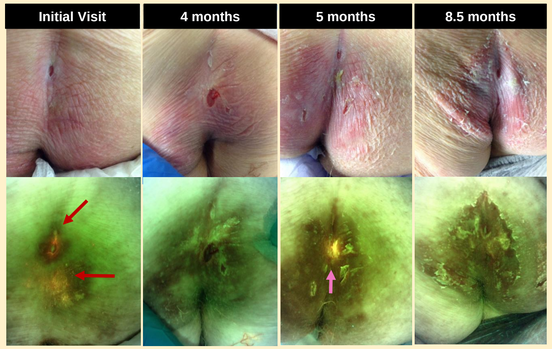
A) Standard image of a sacral pressure ulcer, B) FL Imaging showing red fluorescence from multiple bacterial species. Five weeks later, C) the standard image shows improvement, and D) FL Imaging reveals absence of fluorescence.

Real World Data.

- Highly complex and comorbid with PIs at all stages; Mean age 66 yr (range 9-97).
- Bacterial burden per FL Imaging fluctuated over the course of treatment:

Overall	*Initial Visit*	*Follow-ups (1-98 months)*
70% of patients were FL-positive at some point during treatment	19 (63%) FL-positive	13 (68%) became FL-negative at some point → 7 fluctuated between FL-positive/negative 6 (32%) remained FL-positive
	11 (37%) FL-negative	9 (82%) remained FL-negative and healed 2 (18%) fluctuated between FL-positive/negative

- 19 (63%) of PIs were followed to complete healing (3 LFU, 8 patient deceased).
- 100% of patients benefited from FL Imaging.
- 100% of FL-positive PIs underwent antimicrobial cleansing; 47% of these were prescribed antibiotics when debridement could not eliminate FL signals.
- No antibiotics were prescribed for FL-negative PIs.

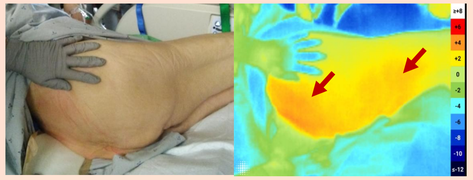


Fluctuations in bioburden. 93 y/o male with a small sacral PI, history of aortic aneurysm, hypertension, degenerative disc disease, severe bilateral lower extremity edema, and morbid obesity. FL Imaging detected bacterial burden, guided debridement, and altered wound dressing choice.

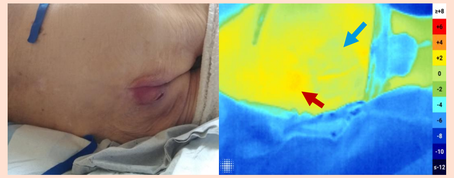
Pilot study. (preliminary observations)

According to the literature, thermal imaging can identify trauma and pressure areas early, prompting timely offloading and preventing skin rupture.[3-4]

Data is presently being collected to identify trends of thermal imaging findings related to PIs. Overall, we have observed that:



Higher Temperatures (red arrows): May indicate early-stage pressure trauma and suggest the need to offload the area to prevent further damage.



Cooler Temperatures (blue arrows): Seem to be associated with existing tissue damage, often found in patients with skin breakdowns and open wounds.

Discussion

- Current standard of care (SOC) methods are inadequate because they assess the host's response to bacterial presence rather than detecting the bacteria directly, which can be unreliable in patients with minimal clinical responses.
- Clinical trial data underscore the potential for FL Imaging to improve the sensitivity of bacterial detection over SOC.
- Real world data shows that most PIs displayed positive FL signals during treatment. These bacteria tended to disappear and reappear (fluctuate) over the course of treatment in this wound type.
- Bedside bacterial localization guided therapeutic decisions and procedures such as debridement, improved patient education, and had a positive impact on antimicrobial stewardship.
- Combined with FL Imaging, thermal imaging offers a comprehensive assessment of a pressure injury's tissue viability and bacterial infection status.

Conclusion

Real-time FL Imaging of pathological bacterial levels (MolecuLight®) should be adopted as the new standard of care for chronic wounds, including pressure injuries.

Further research is needed to assess their impact on outcomes.

1. Le et al. Adv Wound Care, 2020. 2. Kelso M. Adv Skin & Wound, 2024. 3. Koerner S, Adv Skin & Wound, 2019. 4. Itakura DA, et al. J Therm Biol. 2022