

# Real-time Bacterial Fluorescence Imaging Guides Antimicrobial Stewardship in Patients with Diverse Wounds



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## INTRODUCTION

- The growing epidemic of Antibiotic Resistance is directly related to the level of antibiotic use.
- Prior treatment of a patient with commonly used antibiotics greatly increases that person's risk of infection with an antibiotic-resistant organism.
- A key contributing factor to antimicrobial misuse in patients with wounds is diagnostic uncertainty<sup>1</sup> – Is there a bacterial infection in this wound?

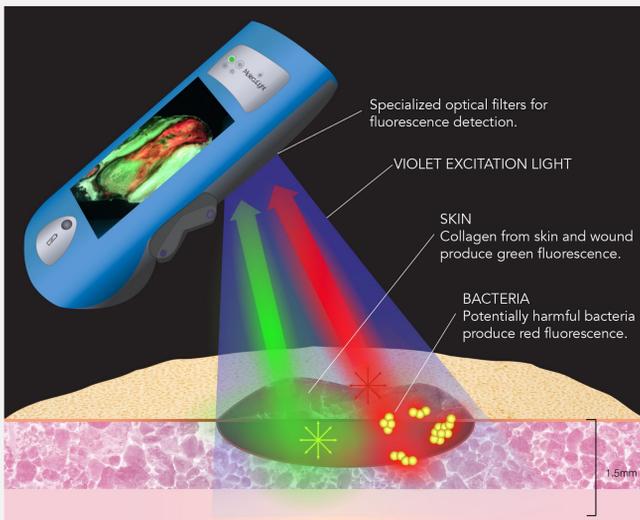
Possible Solutions to this worldwide problem:

- Rapid diagnostic tests for presence of bacterial infection, clinician and patient education
- Obtain optimal specimens for culture prior starting therapy (usually associated with 24-48 delay).

## METHODS

### Bacterial Fluorescence Imaging (MolecuLight i:X)

- When excited by 405 nm violet light, tissues fluoresce green while bacteria fluoresce red (porphyrin-producers, e.g. *Staphylococcus aureus*) or cyan (pyoverdine-producing *Pseudomonas aeruginosa*).
- This enables real-time, point-of-care detection and localization of bioburden within and around wounds<sup>2-4</sup>.



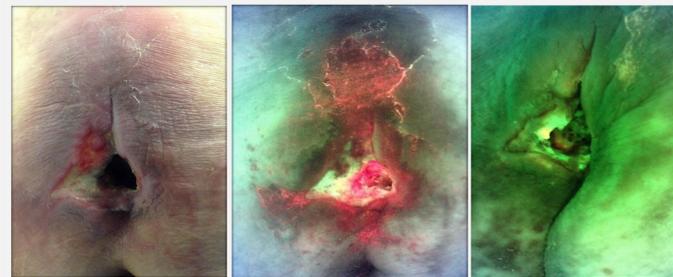
### Pilot Study

- Six wounds with diverse etiologies were imaged with the fluorescence imaging device at various stages of the wound healing process. Four were bacterial fluorescence positive, two were bacterial fluorescence negative). Each case is presented here and the effects on treatment decisions and patient care described.
- Wounds that were positive for red or cyan fluorescence signal were considered to have clinically significant bacterial loads. This real-time information guided immediate treatment decisions.
- All instances of bacterial fluorescence were confirmed via swab cultures. All cultured regions of bacterial fluorescence exhibited moderate to heavy pathogenic bacterial growth.

## RESULTS

### Bacterial Fluorescence Imaging Prevented Discharge of Two Pressure Injury Patients Requiring Systemic Antibiotics

#### Case 1: Pressure Injury - Coccyx



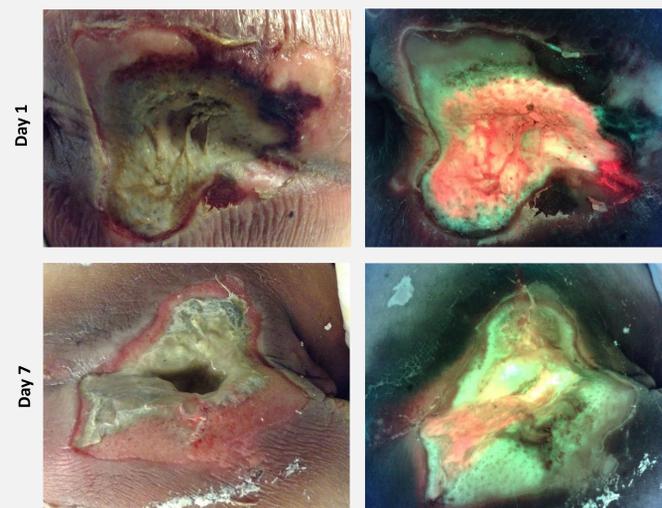
Standard Image Bacterial Fluorescence Image (Red/pink indicates bacteria) Bacterial Fluorescence Image (6 days later)

93-year-old female patient originally admitted for pneumonia developed a pressure injury during her hospital stay. Her respiratory status improved and respiratory doctors inquired about discharge/transfer off the acute ward. Bacterial fluorescence images revealing and documenting widespread bioburden in and around her wound resulted in systemic antibiotics and a suspension of all plans for immediate discharge.

Swabs confirmed heavy growth of mixed anaerobes.

### Bacterial Fluorescence Imaging Prevented Discharge of Two Pressure Injury Patients Requiring Systemic Antibiotics

#### Case 2: Pressure Injury - Coccyx



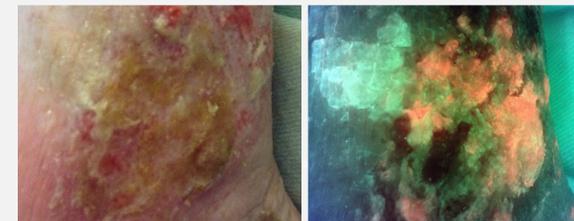
Day 1 Day 7 Standard Image Bacterial fluorescence Image (Red/pink indicates bacteria)

63-year-old female lymphoma patient presented in outpatient chemotherapy unit for follow up; sacral ulcer revealed. Unit intended to discharge patient home, until bacterial fluorescence images documented significant bioburden, leading to hospitalization and systemic antibiotics.

Swabs confirmed heavy growth of *Staphylococcus aureus* and *E. coli*.

### Bacterial Fluorescence Images Demonstrated Need for Systemic Antibiotics in an Asymptomatic Patient

#### Case 3: Venous Leg Ulcer

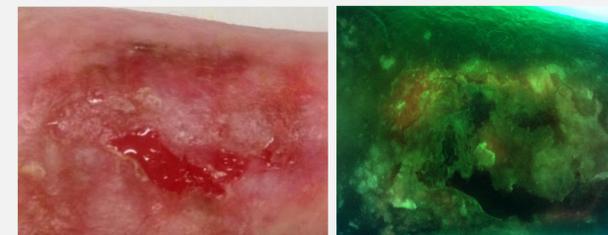


Standard Image Bacterial Fluorescence Image (Red/pink indicates bacteria)

82-year-old female admitted for painful venous leg ulcer several days prior received wound clinician referral as team was requesting discharge with community followup. Traditional signs and symptoms of extensive erythema were not present. Yet, bacterial fluorescence images revealed extensive bacterial burden, leading to systemic antibiotic and suspension of discharge. Swabs of red/pink region confirmed heavy growth of *Acinetobacter baumannii*.

### Real-time Bacterial Fluorescence Confirming Clinical Signs and Symptoms Provided Confidence in Prescribing Antibiotics

#### Case 4: Skin Graft (1 year prior)



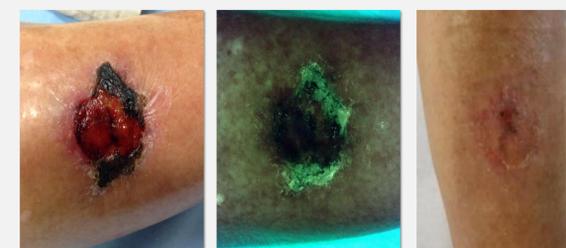
Standard Image Bacterial Fluorescence Image (Red/pink indicates bacteria)

88-year-old female had received a skin graft one year prior. She returned from a long flight from Europe with the grafted leg swollen and red. Bacterial fluorescence images revealed blush red (subsurface) bacteria, leading to a prescribed course of oral antibiotics and selection of antimicrobial dressings.

Swabs later confirmed heavy growth of *Staphylococcus aureus*.

### Real-time, Bioburden Based Decision Making Prevented Unwarranted Use of Antibiotics

#### Case 5: Skin tear Type III



Standard Image Bacterial fluorescence Standard Image (wound closed)

64-year-old female sustained lower leg injury. Presented in ER three weeks later when the wound had not healed. Increasing redness and pain were noted by the patient. Patient was concerned as she would be travelling to Indonesia in three weeks time. No bacterial burden was observed on fluorescence images. **When real-time images negative for bacteria were demonstrated to ER physician, antibiotic treatment was suspended.**

Traditional wound care provided wound closure prior to patient's departure.

### Real-time, Bioburden Based Decision Making Prevented Unwarranted Use of Antibiotics

#### Case 6: Abdominal Wound



Standard Image Fluorescence Image (No bacterial fluorescence)

57-year-old male with gastric cancer, prescribed systemic antibiotic after partial gastrectomy. Presented with midline dehiscence, antibiotics maintained. Returned when antibiotics were to conclude concerned that midline was opening. Fluorescence images showed no evidence of contamination. These images prevented prescription of further antibiotics.

At two week follow up patient's wound was almost closed.

## CONCLUSIONS

- Antibiotic resistance is a growing public health concern that can be prevented, at least in part, by antimicrobial stewardship. To this end, clinicians require more rapid diagnosis of bacterial presence to facilitate burden-based decision making at the point of care.
- Real-time, point-of-care bacterial fluorescence facilitated evidence-based deployment of systemic antibiotics and also prevented their unnecessary use.
  - Wounds without red fluorescence did not receive antibiotics and closed successfully.
  - Culture analysis of bacterial fluorescence targeted swabs later confirmed heavy bacteria growth in all cases.
- This case series highlights the potential of this handheld imaging device to provide invaluable, real-time information regarding the pathogenic state of a wound that can guide appropriate use of antibiotics and facilitate antimicrobial stewardship.

## REFERENCES

- European Wound Management Association, J Antimicrob Chemotherapy, 2016
- DaCosta RS et al. Point-of-Care Auto-fluorescence Imaging for Real-Time Sampling and Treatment Guidance of Bioburden in Chronic Wounds: First-in-Human Results, PLoS ONE 10(3), 2015.
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