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# RECOGNITION AND MANAGEMENT OF NECROTIZING SOFT TISSUE INFECTIONS

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WEST TEXAS HOSPITAL MEDICINE CONFERENCE

# WHY Would You Do This?!

## A Tale as Old as Time..

"Many were attacked by the erysipelas all over the body when the exciting cause was a trivial accident. The erysipelas would quickly spread in all directions. Flesh, sinews, and bones fell away in great quantities and there were many deaths." – Hippocrates 5BC

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## Modern Outcomes - Mortality

- 46% by Jones 1871 in Civil War
- 34% by McHenry 1995
- 12% in NIS in 2008, 5% in 2013
- 5 – 30% in contemporary series (median/mode around 15%)
- Texas Tech 6.5% last 3 years, 9% in 5years
- Global meta-analysis : 18%
- NO difference by region!
- ☹ Up to 75% still quoted in literature ☹

Endorf 2010 Psoinos 2013 Krieg 2014 Proud 2014 Chen 2017 Hansen 2017 Dissanaike 2016, 2021

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# Management of NSTI

- Early Diagnosis
- Aggressive Debridement
- Broad Spectrum Empiric Antibiotics
- ICU care
- Reconstruction
- Rehabilitation

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# Clinical Features

- Minimal skin changes: erythema
- Bullae
- Thrombosis of small vessels
- Skin necrosis

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## "Hard signs"

- Crepitus (99% specificity)
- Skin necrosis (99% specificity)
- Bullae (100% specificity)
- Hypotension
- Problem: sensitivity only 20 – 45%
- 35% of cases initially misdiagnosed

Haywood 1999, Chan T Am J Surg 2008

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## Plain Radiograph

Presence of gas is specific (95-100%) but not sensitive (<30%)

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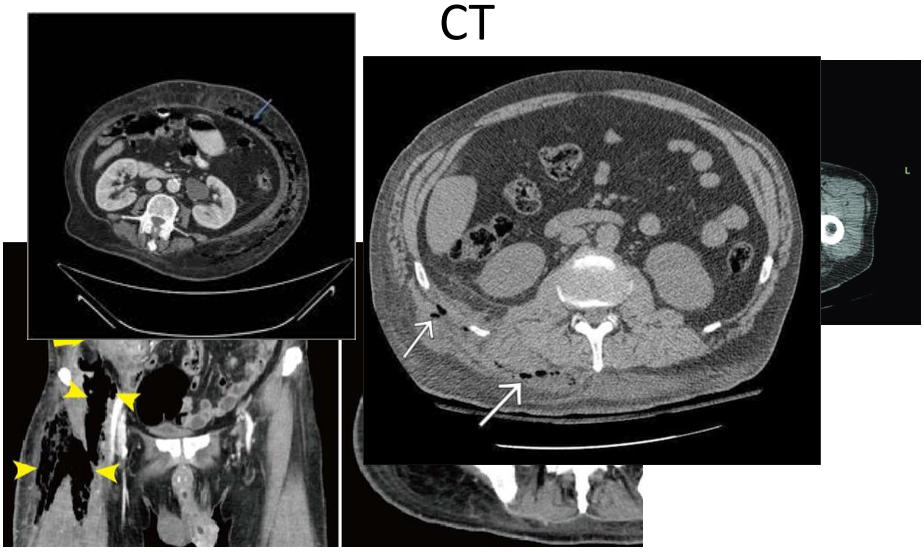
# CT



Evans & Dissanaike 2012

World Journal of Surgery
January 2018, Volume 42, Issue 1, pp 82–87 | Cite as

## The Role of Computed Tomography in the Diagnosis of Necrotizing Soft Tissue Infections

Authors | Authors and affiliations

Myriam Martinez, Thomas Peponis, Aglaia Hage, Daniel D. Yeh, Haytham M. A. Kaafarani, Peter J. Fagenholz, David R. King, Marc A. de Moya, George C. Velmahos

Original Scientific Report
First Online: 31 July 2017

3 Shares | 332 Downloads | 2 Citations


### Abstract

**Background**

The exact role of IV cor
necrotizing soft tissue i
role of CT in patients w
NSTI.

**Methods**

The medical records of
enhanced CT to rule ou
soft tissues, (b) multipl
by the IV contrast, and
confirmed only by the p
considered absent if su
successfully treated no

### Results

Of the 184 patients, 17 had a positive CT and hence underwent surgical exploration with NSTI being confirmed in 13 of them (76%). Of the 167 patients that had a negative CT, 38 (23%) underwent surgical exploration due to the high clinical suspicion for NSTI and were all found to have non-necrotizing infections; the remaining 129 (77%) were managed non-operatively with successful resolution of symptoms. The sensitivity of CT in identifying NSTI was 100%, the specificity 98%, the positive predictive value 76%, and the negative predictive value 100%.

### Conclusions

A negative IV contrast-enhanced CT scan can reliably rule out the need for surgical intervention in patients with initial suspicion of NSTI.

# CT

- Complete lack of gas, fluid collections, heterogeneity of tissue enhancement with IV contrast or fascial enhancement effectively ruled out NSTI
- Gas on CT appears diagnostic
- Good sensitivity & specificity in most series
- If you need it, use it

Velmahos 2010, 2017 Demetriades 2016 Davis 2011

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# MRI

- On T1-weighted images, necrotizing fasciitis is depicted by areas of ↓signal intensity within subcutaneous soft tissues
- ↑signal intensity on T2-weighted images which enhances with gadolinium
- Can also be seen with cellulitis

Yu 2009

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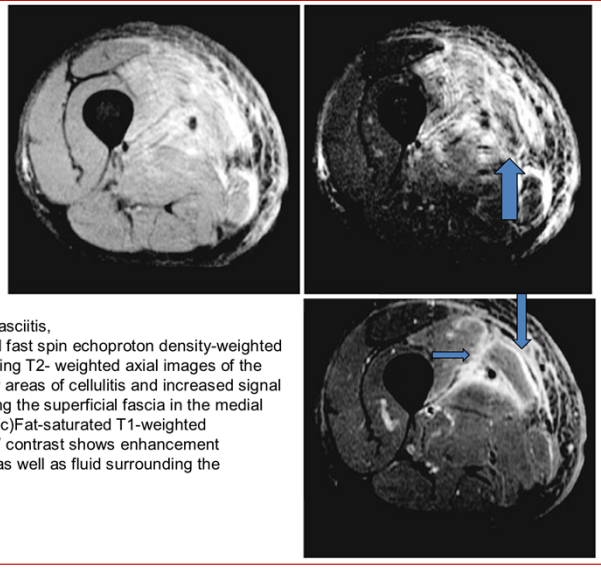

Fig. 3 Necrotizing fasciitis, early. Fat-saturated fast spin echoproton density-weighted (a) and corresponding T2- weighted axial images of the right thigh (b) show areas of cellulitis and increased signal intensity surrounding the superficial fascia in the medial aspect of the thigh(c)Fat-saturated T1-weighted axial image after IV contrast shows enhancement of the deep fascia as well as fluid surrounding the superficial fascia



Yu 2009

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# Laboratory Values

- Reflective of biochemical Δ of sepsis & MSOF
- ↑Cr, lactate, WCC, glucose, CRP
- ↓Na, Hb, Calcium
- Models to predict likelihood & severity: LRINEC most popular

**Table 1. Six different variables included in the laboratory risk indicator for necrotizing fasciitis (LRINEC) score to help discriminate between necrotizing and nonnecrotizing soft-tissue infections.**

| Value | LRINEC score, points |
|---|---|
| C-reactive protein, mg/L | |
| <150 | 0 |
| >150 | 4 |
| WBC count, cells/mm³ | |
| <15 | 0 |
| 15–25 | 1 |
| >25 | 2 |
| Hemoglobin level, g/dL | |
| >13.5 | 0 |
| 11–13.5 | 1 |
| <11 | 2 |
| Sodium level, mmol/L | |
| ≥135 | 0 |
| <135 | 2 |
| Creatinine level, mg/dL | |
| ≤1.6 | 0 |
| >1.6 | 2 |
| Glucose level, mg/dL | |
| ≤180 | 0 |
| >180 | 1 |

**Table 2. Patient categories within the laboratory risk indicator for necrotizing fasciitis (LRINEC) score according to the likelihood of necrotizing soft-tissue infection (NSTI).**

| Risk category | LRINEC score, points | Probability of NSTI, % |
|---|---|---|
| Low | ≤5 | <50 |
| Intermediate | 6–7 | 50–75 |
| High | ≥8 | >75 |

## LRINEC score

NPV 96%
PPV 92%
Equivocal results in multiple studies

Wong 2004 CCM

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# Local Exploration

- Make 2cm incision through fascia
- Dishwater pus
- Necrotic tissue
- No resistance to finger pressure
- Stat gram stain

Anaya 2007

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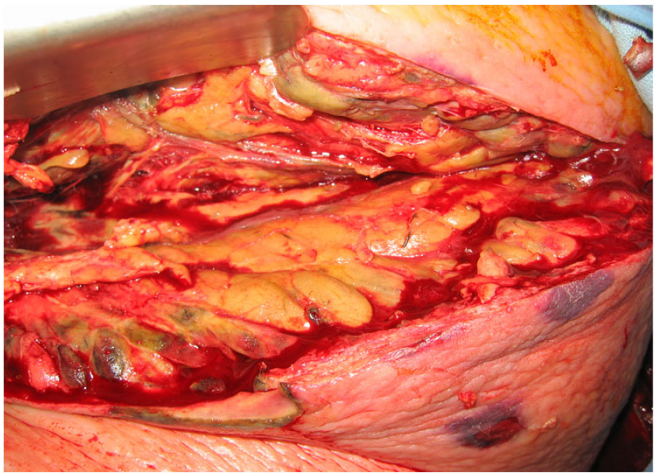
## Dermal edema, thrombosis, hemorrhagic blisters



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## Our Antibiotic Regimen

- Previously: Vancomycin + Zosyn + Clindamycin
- Vancomycin-Zosyn combination ↑nephrotoxicity
- Vancomycin retained for Enterococcus and GPC
- +Cefepime for GNR: ↓resistance potential than carbapenems, ↑effective than fluoroquinolones
- +Flagyl 500mg for better anaerobe coverage
- = Vancomycin + Cefepime + Clindamycin + Flagyl
- -Pen G: marginal improvement over broad spectrum + Vancomycin, selectively used for Staph and Strep

Karino 2016 Navalkele 2015

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# Why Clindamycin?

- Binds to 50s ribosomal subunit, inhibits translation step of protein synthesis →↓exo-toxins
- Effective in Toxis Shock Syndrome, Streptococcal (GAS), Staphylococcal and Clostridial infections
- In contrast, beta lactam antibiotics ↑α toxin production by S. aureus

Goskinski 2006 Otto 2013 Merriman 2014

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# Stop What You Start

- Take tissue cultures at initial debridement
- Cultures are volume dependent – please don't swab!
- Once you have results, de-escalate antibiotics

# Surgical Debridement

- OR as soon as feasible
- Remove ALL infected tissue
- Number of operations related to mortality – so make the first one count
- Can do a large amount of blunt dissection to achieve rapid debridement, more hemostatic
- Plan for blood loss

# Debridement

# We can rebuild him..

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# Skin Sparing Surgery

- If NSTI affects muscle or fascia only, why sacrifice healthy skin?
- Parallel lines can allow for subQ debridement without sacrificing skin
- Need to ensure adequate debridement and viable skin
- Can allow for simpler, better reconstruction

# Skin Sparing Incisions

Avoid flexor creases

Images courtesy of Kari Keys MD, UW

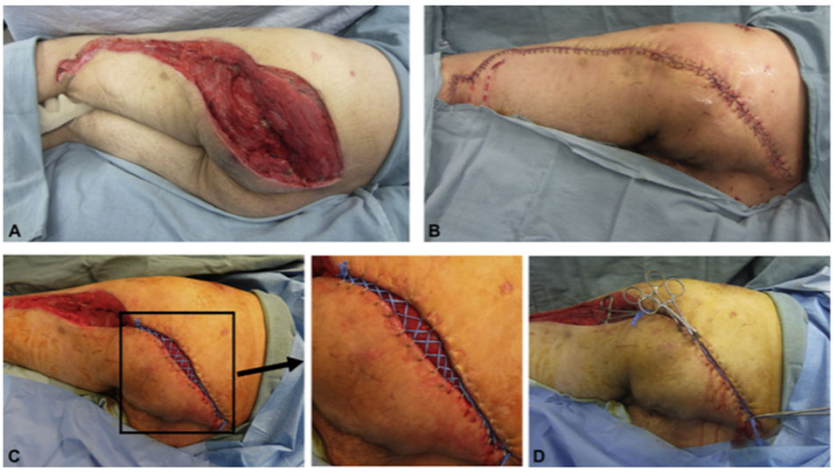


**Figure 7.** Delayed primary closure and external tissue-expander placement, "Roman sandal." (A) Debridement result with a skin-sparing approach for a necrotizing soft-tissue infection after intramuscular heroin injection. (B) Delayed primary closure was obtained for the entire incision. Drains were placed distally in the dependent position. The knee flexure surface was approached with a z-shaped incision. (C) External expanders were placed at the time of closure using a Roman sandal configuration. (D) Mechanical creep was used and the external expanders were tightened, allowing delayed primary closure of the incision line.

Kari Keys MD, UW

# Part II

Microbe/ Host/ Environment

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## Global Microbiology

- 105 studies, 8718 patients
- Polymicrobial 53% Monomicrobial infections 38%
- Monomicrobial infections are rising globally (p = 0.003) with an annual increment of 1.1%
- Most common organism in N.America, Asia, Middle East and Africa is Staphylococcus aureus
- Europe = Escherichia coli
- Oceania = Streptococcus pyogenes
- Central and South America = Acinetobacter baumannii in
- MRSA 7.5%

Dhanasekera, Dissanaike et al 2021

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# US Microbiology

Dhanasekera, Dissanaike et al 2021

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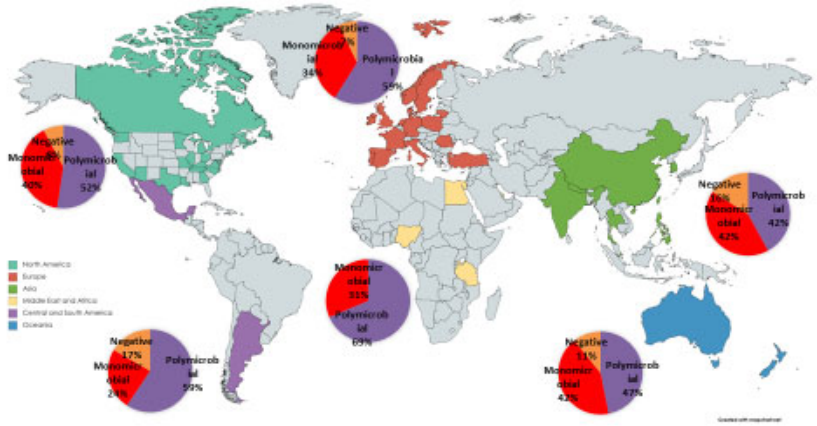


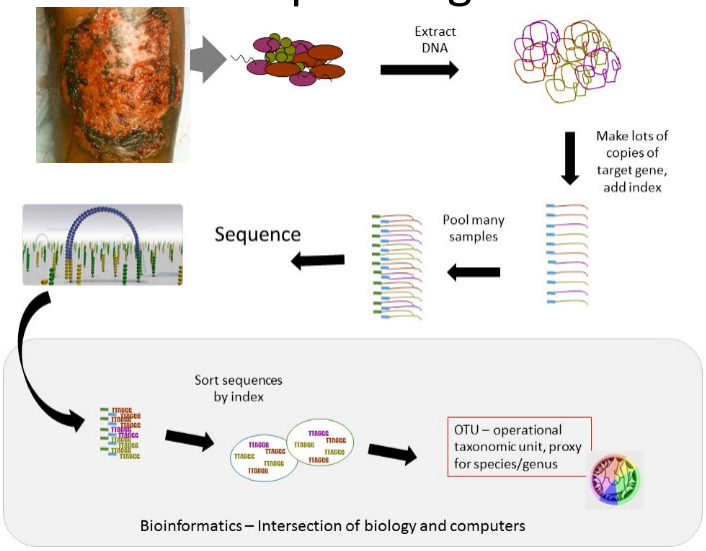

Dhanasekera, Dissanaike et al 2021 (in press)

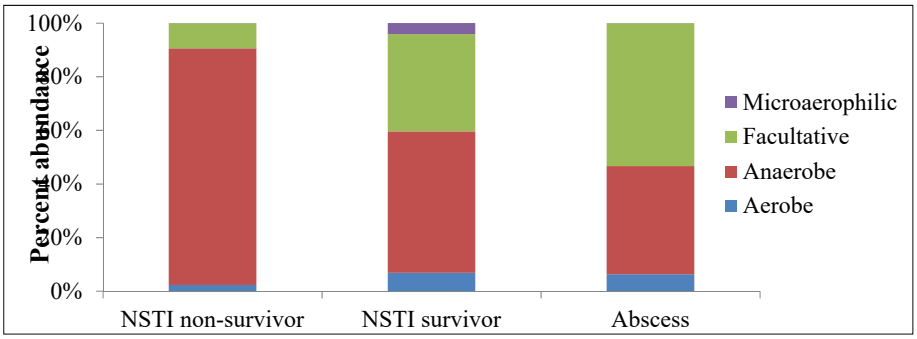
# Microbiology Matters!

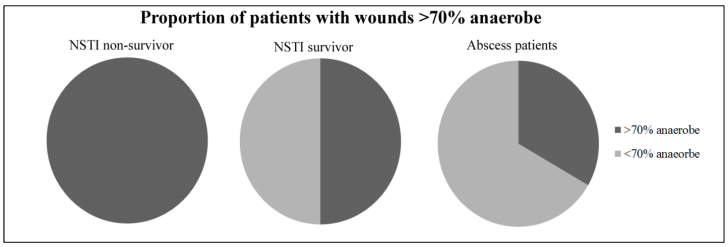
- Enterococci had strong association with mortality – 50% of all deaths
- Enterococcus fecalis 96% sensitive to Vancomycin, but E. faecium only 44% - fortunately rare
- Pseudomonas 40% ,Streptococcus 27%
- Fungi – 3x mortality

Dissanaike 2015 Bochichio 2017

# Anaerobe Impact – Metagenomic Sequencing






Zhao-Fleming, Dissanaike, Rumbaugh 2019

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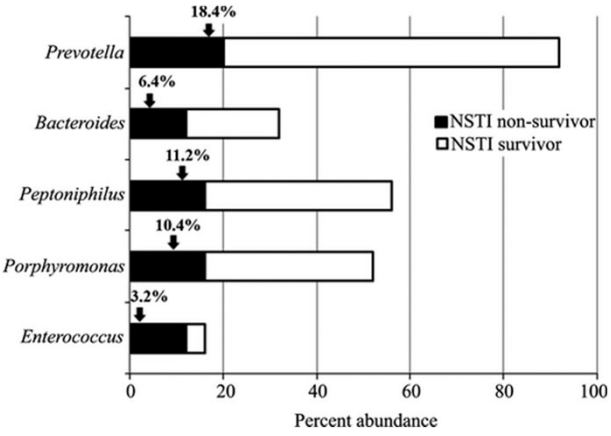
# Anaerobe species matters




Zhao-Fleming, Wilkinson, Larumbe, Dissanaike, Rumbaugh 2019

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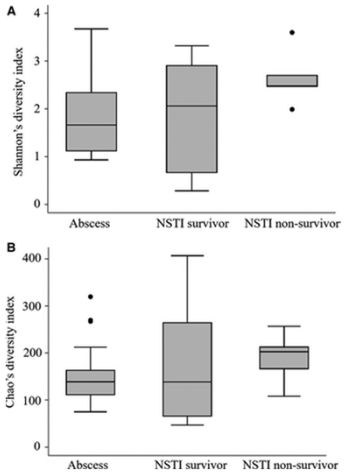
# Diversity Matters here too




Zhao-Fleming, Wilkinson, Larumbe, Dissanaike, Rumbaugh 2019

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# An Idea

- If the whole point of aggressive debridement is to un-roof the tissue..
- Why do we immediately cover it up again with dressings?
- What about leaving it open to air with heat on it instead?

# Open To Air Protocol

- Leave wound open to air for 48 hours
- Heat lamps if feasible
- Spritz of Dakin's solution or Sulfamylon prn to keep wound moist
- Lubricant over tendons or other areas sensitive to drying
- Replaces mandatory "second look" operation
- Transition to vacuum therapy after 48h

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# Results

- 96 pts, 672 days of wound care
- 69 OTA, 127 vacuum, 200 gauze, 126 ointment
- 67% men, mortality overall 6.75%
- OTA slightly *less* painful than other modalities such as wound vac and wet-to-dry!
  - median pain score 1.6 vs 2.18, $p<0.05$
- ..even after adjustment for ↑ Morphine equivalents given

**Yang, Burge, Keaty, Dissanaike et al 2018**

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# Results of Open to Air protocol

- OTA had more operative debridements (2.08 vs 1.75)
- Unfortunately time to OR not recorded
- OTA mortality 3.8% vs. 7.1% (NS)

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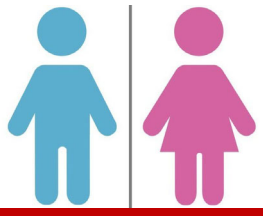
# Does Sex Matter?

- Women have worse outcomes than men in several series including our own
- ? Influence of sex hormones?
- ? Does menopause make a difference?
- ? Different patterns of fat distribution?



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# Does Obesity Matter?

- More common in South and Southwest – ↑ obesity
- Fat has poor perfusion; more hospitable environment for microbial growth?

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# NSTI, Sex and Obesity

- Retrospective review in patients who had an abdominal CT ordered as part of initial evaluation
- Measured visceral fat distribution, subcutaneous fat distribution, and BMI
- Compared outcomes in women and men, and stratified by obesity markers
- Multivariate analysis

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# Results

- Women had higher mortality 27% versus 15%
- Mortality↑ torso > extremity, latter more common
- Women had ↑ subcutaneous fat thickness (55.7 mm vs 36.9 mm, p = 0.028)
- Body fat measurements did not affect survival
- Only correlation with outcome: ↑ BMI in those who developed acute kidney injury (p=0.034)

Zhao, Rumbaugh, Dissanaike et al 2019 Surgical Infections

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# Conclusion

- NSTI is a variable group of infections that require high resource utilization and multidisciplinary care
- No longer rare, or even uncommon
- Global heterogeneity with surprisingly similar outcomes
- ? Impact of microbiome

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# THANK YOU!