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The Skin Microbiome & Surgical Site Infection

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DISCLOSURES

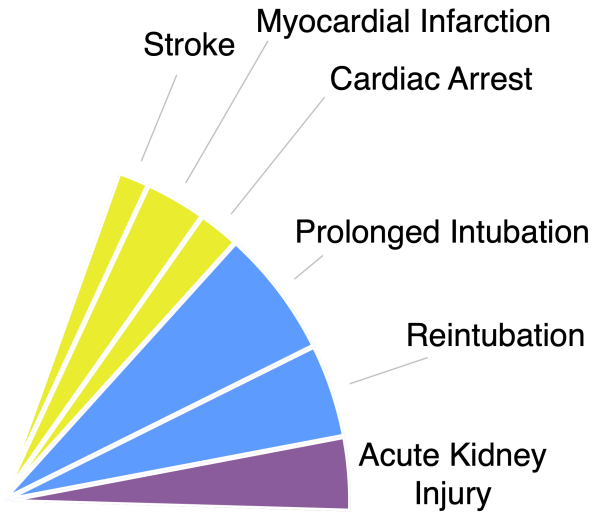
No financial conflicts of interest

Some data presented remain under peer review

WHY SURGICAL SITE INFECTION?

Why focus on SSI
(or any healthcare-associated infection)
as an anesthesiologist?

WHY FOCUS ON INFECTION?



American College of Surgeons National Surgical Quality Improvement Program
2019 Participant Use Data File (PUF)

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PMID: 35666980

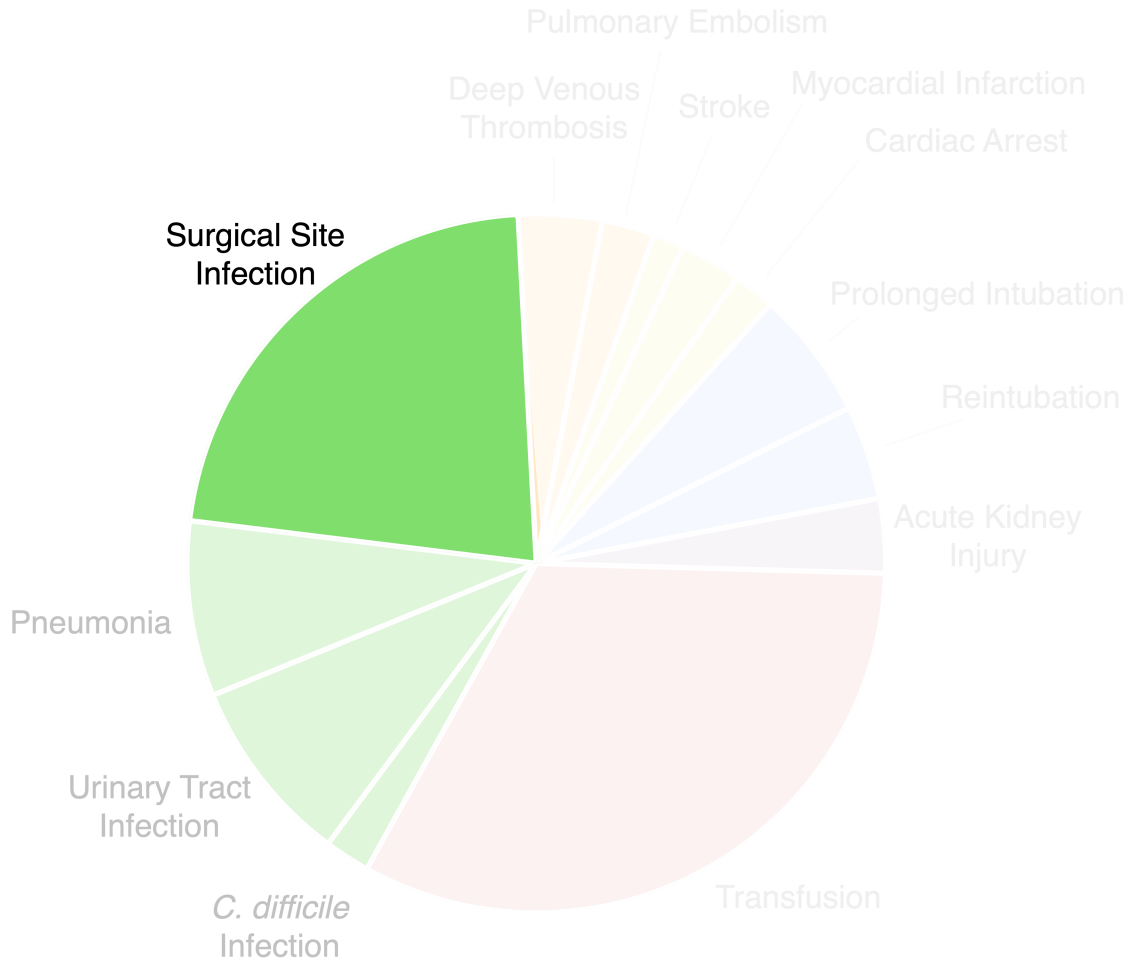
WHY FOCUS ON INFECTION?

Infection is the

most frequent

complication of modern surgery

American College of Surgeons National Surgical Quality Improvement Program 2019 Participant Use Data File (PUF)



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PMID: 35666980

WHY FOCUS ON INFECTION?

SSI is the

#1 cause of postoperative readmission

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Original Investigation

Underlying Reasons Associated With Hospital Readmission Following Surgery in the United States

Ryan P. Merkow, MD, MS; Mila H. Ju, MD, MS; Jeanette W. Chung, PhD; Bruce L. Hall, MD, PhD, MBA; Mark E. Cohen, PhD; Mark V. Williams, MD; Thomas C. Tsai, MD, MPH; Clifford Y. Ko, MD, MS, MSHS; Karl Y. Bilimoria, MD, MS

IMPORTANCE Financial penalties for readmission have been expanded beyond medical conditions to include surgical procedures. Hospitals are working to reduce readmissions; however, little is known about the reasons for surgical readmission.

OBJECTIVE To characterize the reasons, timing, and factors associated with unplanned postoperative readmissions.

DESIGN, SETTING, AND PARTICIPANTS Patients undergoing surgery at one of 346 continuously enrolled US hospitals participating in the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) between January 1, 2012, and December 31, 2012, had clinically abstracted information examined. Readmission rates and reasons (ascertained by clinical data abstractors at each hospital) were assessed for all surgical procedures and for 6 representative operations: bariatric procedures, colectomy or proctectomy, hysterectomy, total hip or knee arthroplasty, ventral hernia repair, and lower extremity vascular bypass.

MAIN OUTCOMES AND MEASURES Unplanned 30-day readmission and reason for readmission.

RESULTS The unplanned readmission rate for the 498 875 operations was 5.7%. For the individual procedures, the readmission rate ranged from 3.8% for hysterectomy to 14.9% for lower extremity vascular bypass. The most common reason for unplanned readmission was surgical site infection (SSI) overall (19.5%) and also after colectomy or proctectomy (25.8%), ventral hernia repair (26.5%), hysterectomy (28.8%), arthroplasty (18.8%), and lower extremity vascular bypass (36.4%). Obstruction or ileus was the most common reason for readmission after bariatric surgery (24.5%) and the second most common reason overall (10.3%), after colectomy or proctectomy (18.1%), ventral hernia repair (16.7%), and hysterectomy (13.4%). Only 2.3% of patients were readmitted for the same complication they

Editorial page 467

JAMA Report Video and **Author Video Interview** at jama.com

Supplemental content at jama.com

CME Quiz at jamanetworkcme.com and **CME Questions** page 518

PMID: 25647204

WHY FOCUS ON INFECTION?

SSI is a

major driver

of excess

healthcare cost

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Original Investigation

Health Care–Associated Infections
A Meta-analysis of Costs and Financial Impact on the US Health Care System

Eyal Zimlichman, MD, MSc; Daniel Henderson, MD, MPH; Orly Tamir, PhD, MSc, MHA; Calvin Franz, PhD; Peter Song, BSE; Cyrus K. Yamin, MD; Carol Keohane, BSN, RN; Charles R. Denham, MD; David W. Bates, MD, MSc

Table 3. Total Attributable Financial Impacts of Health Care–Associated Infections in US Adult Inpatients at Acute Care Hospitals, 2009[a]

Health Care–Associated Infection Type	Costs		
	Total	Lower Bound	Upper Bound
Surgical site infections	3 297 285 451	2 998 570 584	3 595 841 680
MRSA	990 539 052	93 785 080	1 935 883 296
Central line–associated blood-stream infections	1 851 384 347	1 249 464 195	2 636 608 279
MRSA	389 081 519	111 253 391	1 160 029 019
Catheter-associated urinary tract infections	27 884 193	18 765 813	37 002 574
Ventilator-associated pneumonia	3 094 270 016	2 796 898 212	3 408 445 101
Clostridium difficile infections	1 508 347 070	1 218 707 008	1 814 293 587
Total	**9 779 171 077**	**8 282 405 811**	**11 492 191 220**

PMID: 23999949

Abbreviation: MRSA, methicillin-resistant *Staphylococcus aureus*.

[a] All cost estimates reported in 2012 $US rounded to the dollar.

WHY FOCUS ON INFECTION?

SSI is

heavily weighted in

national hospital quality metrics

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CMS.gov Centers for Medicare & Medicaid Services

Infections

Healthcare-associated infections, or HAIs, are infections that people get while they're getting treatment for another condition in a healthcare setting. HAIs can occur in all settings of care, including acute care hospitals, long term acute care hospitals, rehabilitation facilities, surgical centers, cancer hospitals, and skilled nursing facilities. Many of these infections can be prevented through the use of proper procedures and precautions.

- Infections are reported using a standardized infection ratio (SIR). The SIR compares the actual number of infections at a hospital to a national benchmark based on data reported to the National Healthcare Safety Network (NHSN). Lower numbers are better.

Read less

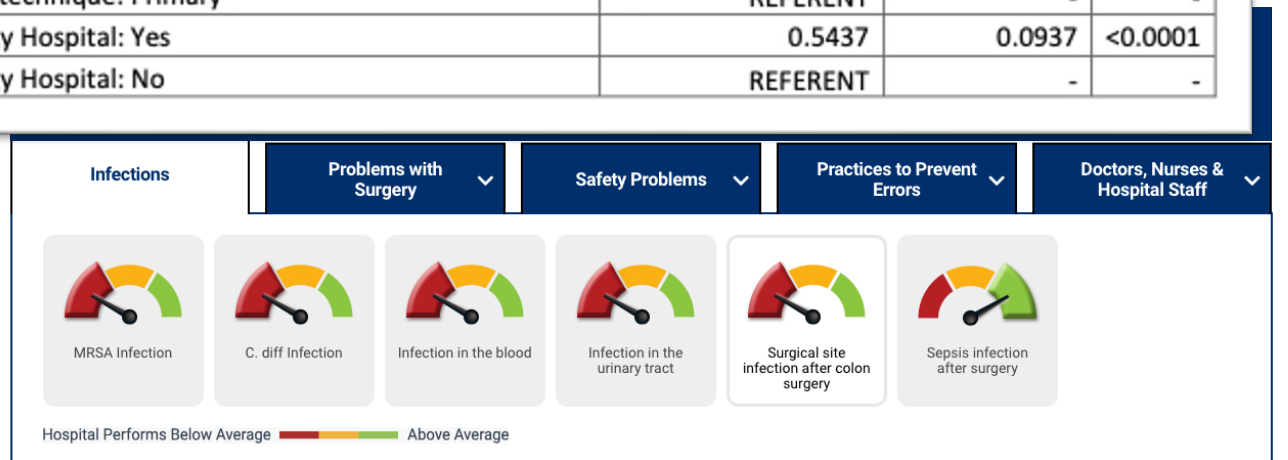
Central line-associated bloodstream infections (CLABSI) in ICUs and select wards

0.965
No different than national benchmark

Lower numbers are better

Table 3a. Colon Procedures, Complex 30-Day Model

Parameter	Parameter Estimate	Standard Error	P-value
Intercept	*-3.6601*	*0.0678*	*<0.0001*
Diabetes: Yes	0.0821	0.0303	0.0066
Diabetes: No	REFERENT	-	-
ASA score: 1, 2, 3/4/5	0.3028	0.0237	<0.0001
Gender: Male	0.1036	0.0225	<0.0001
Gender: Female	REFERENT	-	-
Age (Patient's age/10)	-0.1396	0.0075	<0.0001
BMI: ≥ 30	0.1259	0.0234	<0.0001
BMI: < 30	REFERENT	-	-
Closure technique: Other (non-Primary)	0.2383	0.0494	<0.0001
Closure technique: Primary	REFERENT	-	-
Oncology Hospital: Yes	0.5437	0.0937	<0.0001
Oncology Hospital: No	REFERENT	-	-

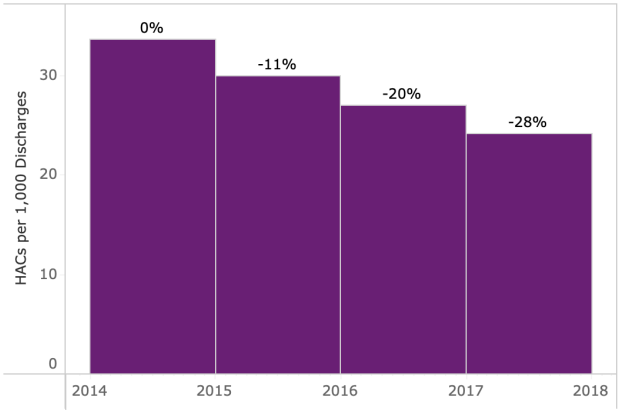


WHY SURGICAL SITE INFECTION?

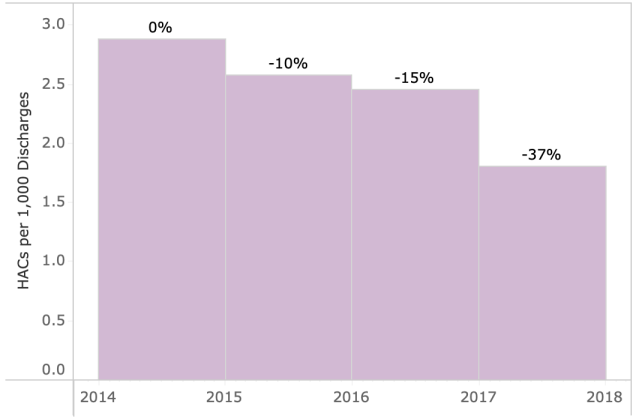
SSI is not getting better…..

In the new and updated data for 2014–2017, not all types of HACs showed similar trends.

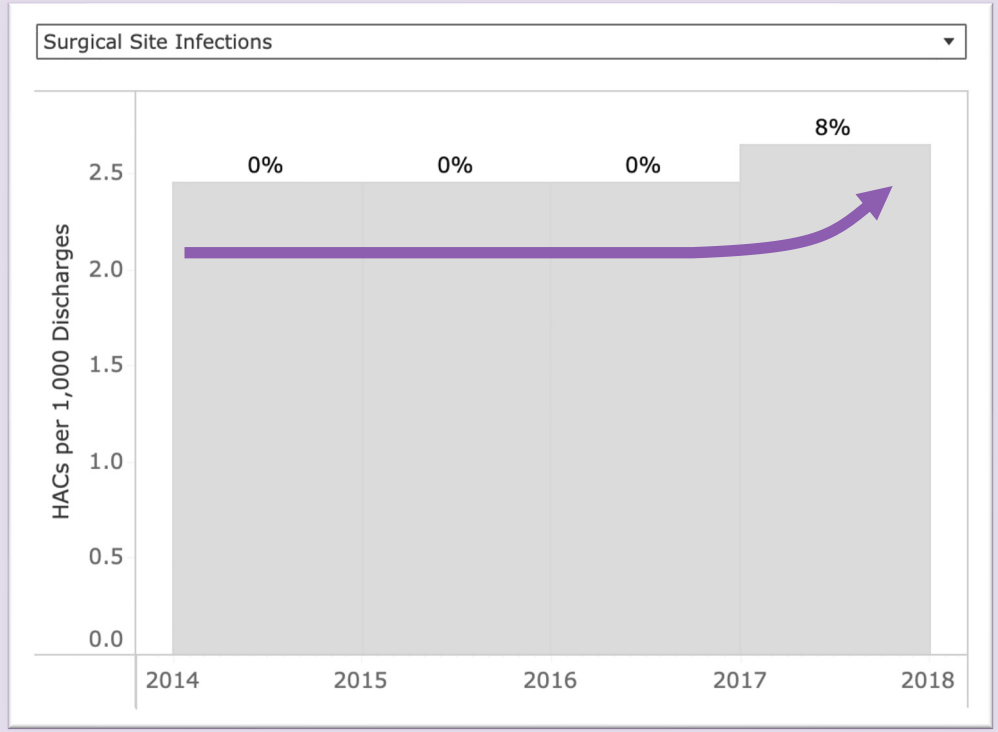
Adverse Drug Events



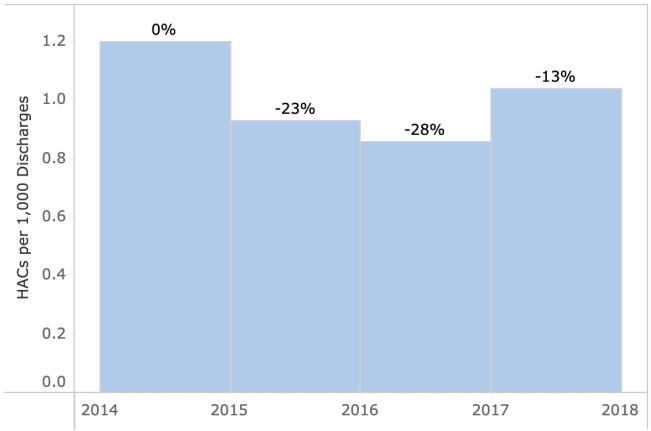
Clostridioides difficile Infections



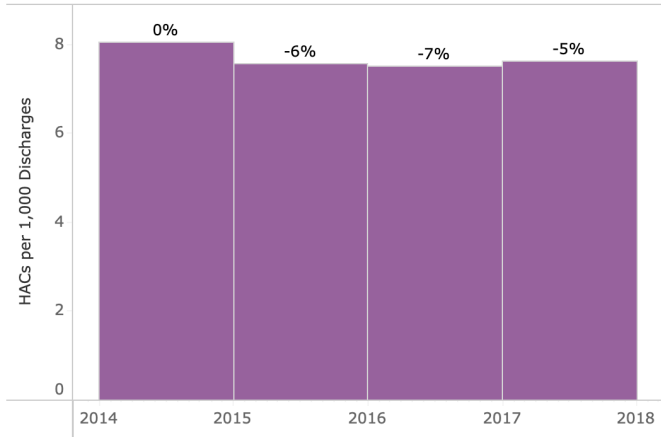
Surgical Site Infections



Ventilator-Associated Pneumonias



Falls



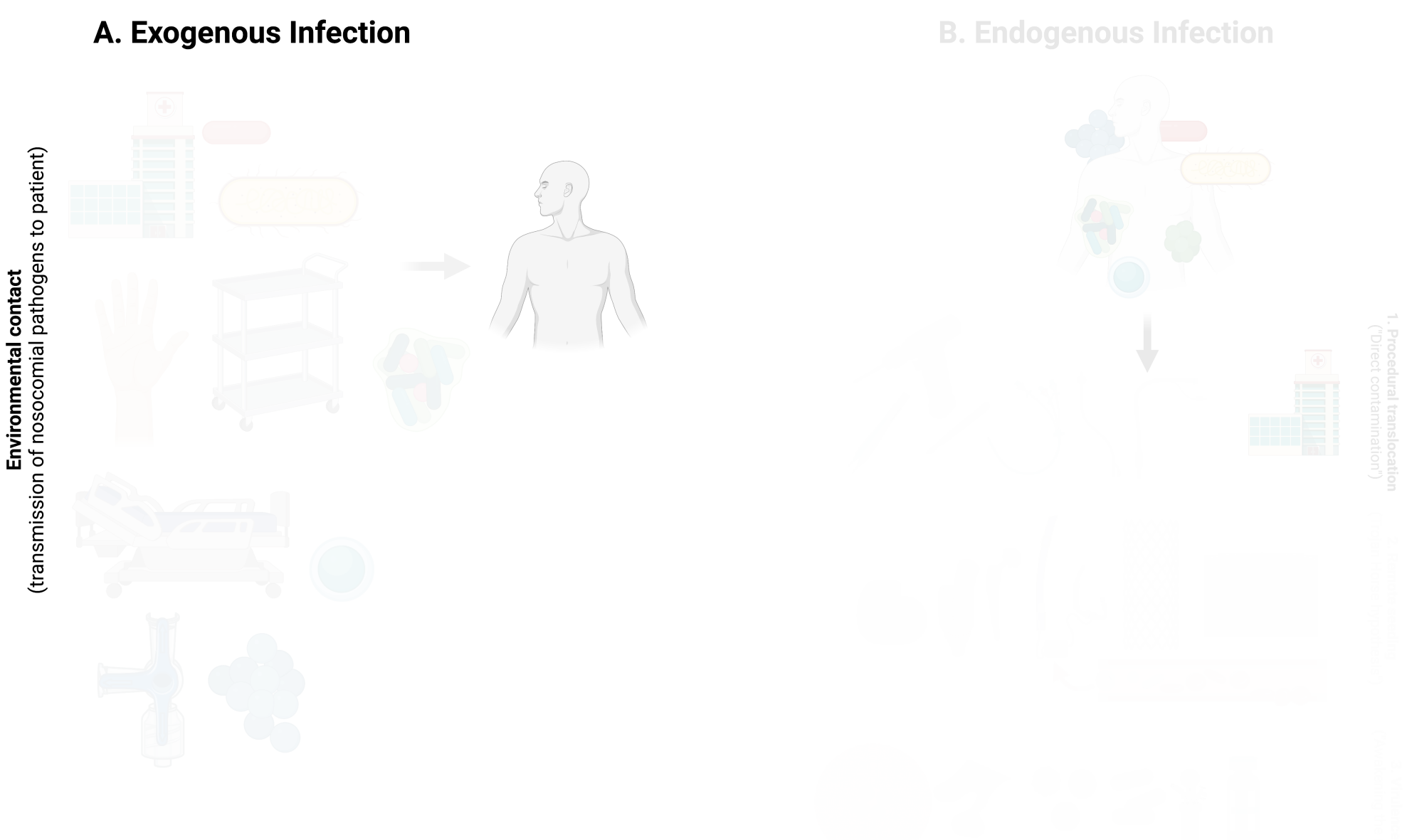
AGENDA

- The role of the patient microbiome in HAI
- The connection between the skin microbiome and SSI
- Implications for current and future prevention strategies
- How we are thinking about this at Harborview Medical Center

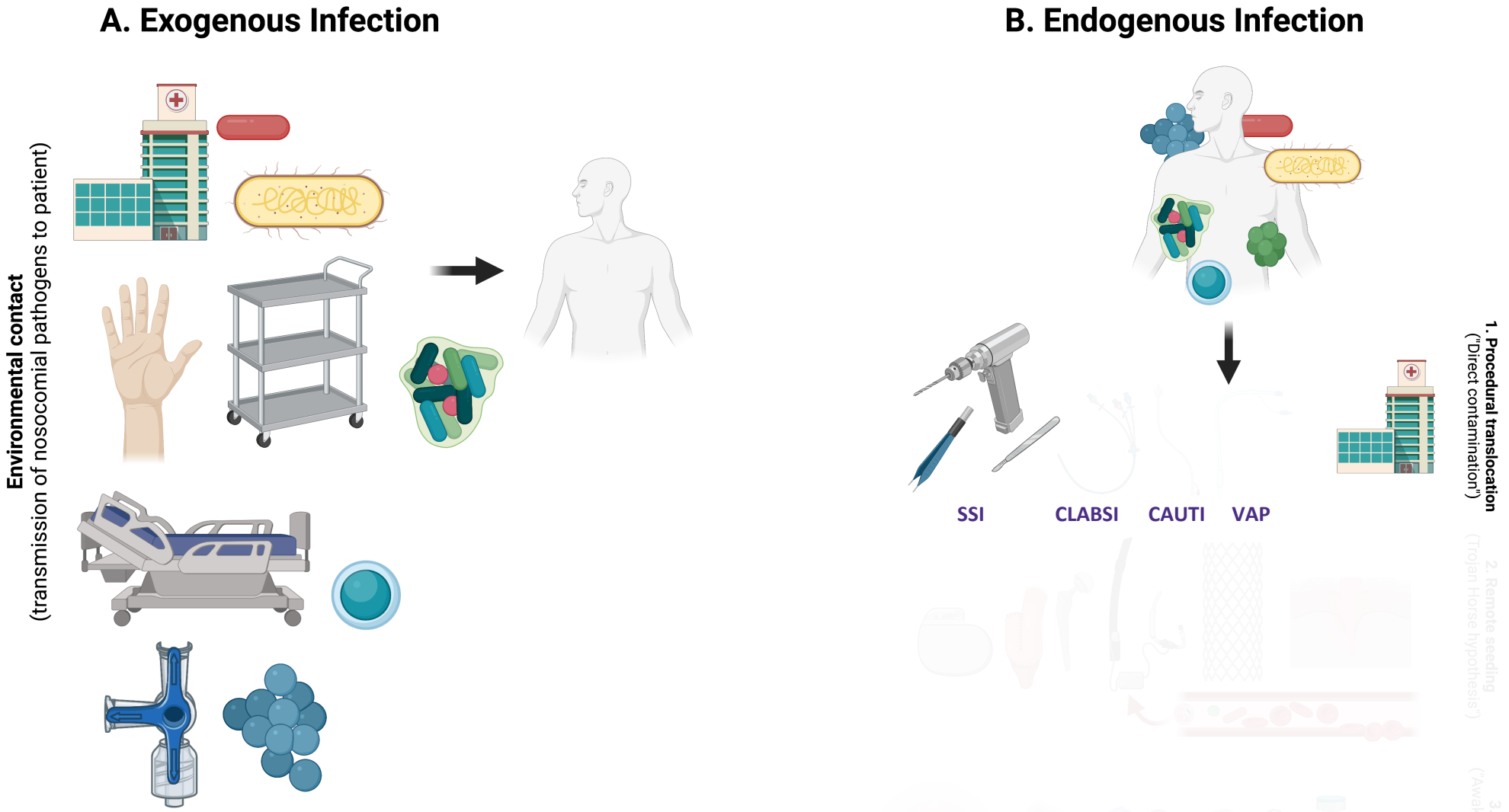
THE CENTRAL ROLE OF THE PATIENT MICROBIOME

Concept 1: *Most healthcare-associated infections arise from procedure-associated perturbations of the patient microbiome*

PMID: 35666980



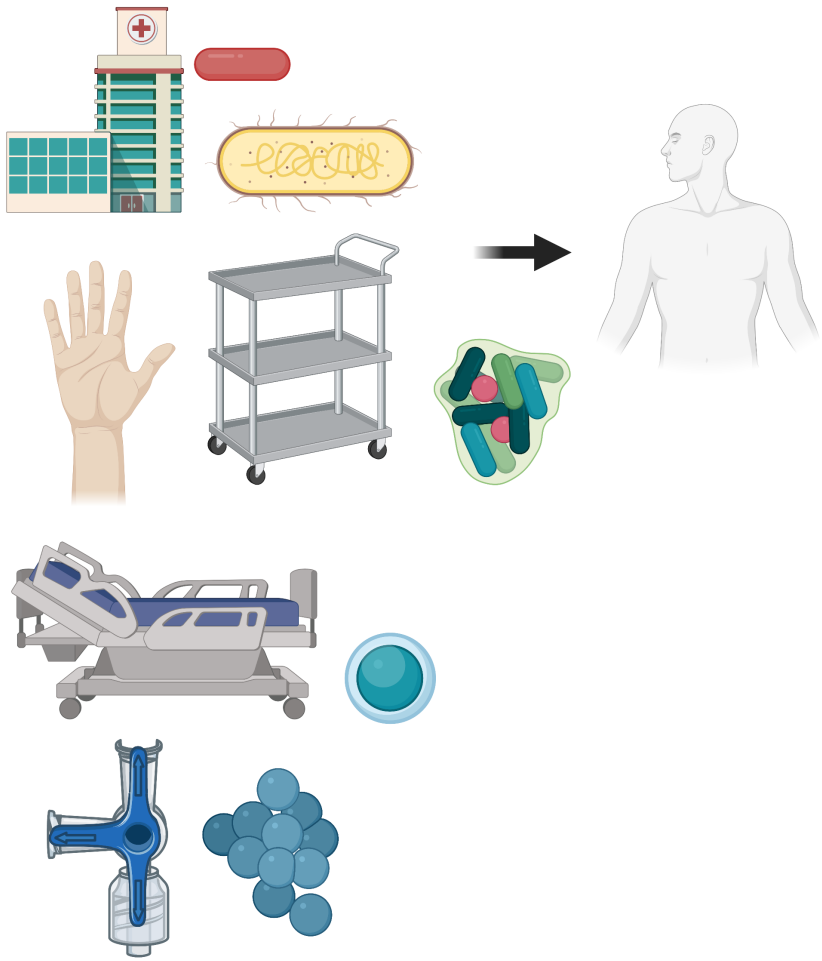
PMID: 35666980



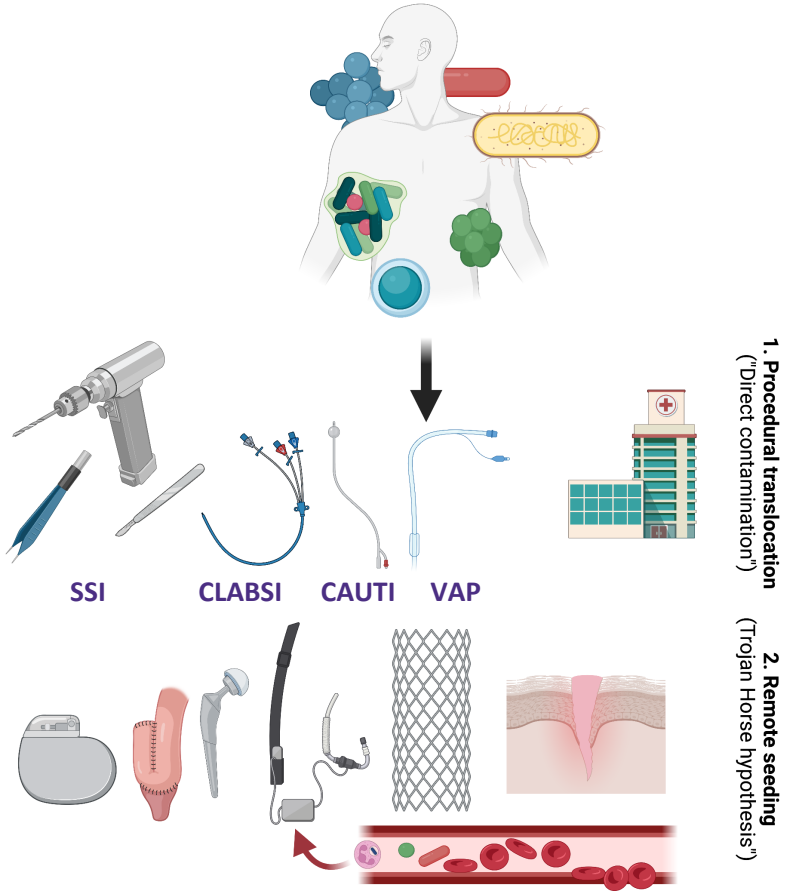
PMID: 35666980

A. Exogenous Infection ~20%

Environmental contact
(transmission of nosocomial pathogens to patient)



B. Endogenous Infection ~80%



1. Procedural translocation
("Direct contamination")

2. Remote seeding
(Trojan Horse hypothesis")

3. Virulence triggers
("Awakening the microbiome")

C. difficile Infection **>80% patient-origin** PMID: 37723252

nature medicine

Article

https://doi.org/10.1038/s41591-023-02549-4

Longitudinal genomic surveillance of carriage and transmission of *Clostridioides difficile* in an intensive care unit

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Check for updates

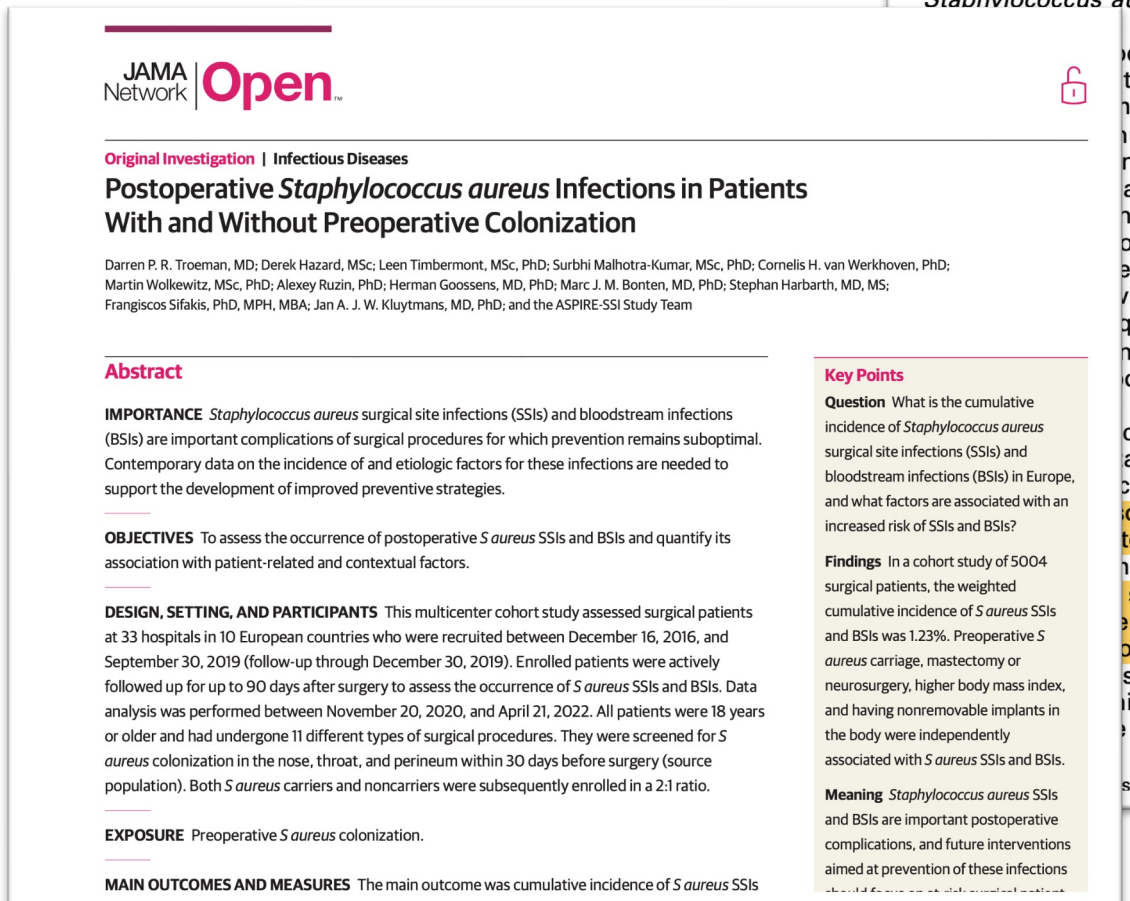
Arianna Miles-Jay[1], Evan S. Snitkin[1,2] ✉, Michael Y. Lin[3], Teppei Shimasaki[3], Michael Schoeny[3], Christine Fukuda[3], Thelma Dangana[3], Nicholas Moore[3], Sarah E. Sansom[3], Rachel D. Yelin[3], Pamela Bell[3], Krishna Rao[2], Micah Keidan[2], Alexandra Standke[2], Christine Bassis[2], Mary K. Hayden[3] & Vincent B. Young[1,2]

Despite enhanced infection prevention efforts, *Clostridioides difficile* remains the leading cause of healthcare-associated infections in the United States. Current prevention strategies are limited by their failure to account for patients who carry *C. difficile* asymptomatically, who may act as hidden reservoirs transmitting infections to other patients. To improve the understanding of asymptomatic carriers' contribution to *C. difficile* spread, we conducted admission and daily longitudinal culture-based screening for *C. difficile* in a US-based intensive care unit over nine months and performed whole-genome sequencing on all recovered isolates. Despite a high burden of carriage, with 9.3% of admissions having toxigenic *C. difficile* detected in at least one sample, only 1% of patients culturing negative on admission to the unit acquired *C. difficile* via cross-transmission. While patients who carried toxigenic *C. difficile* on admission posed minimal risk to others, they themselves had a 24-times greater risk for developing a healthcare-onset *C. difficile* infection than noncarriers. Together, these findings suggest that current infection prevention practices can be effective in preventing nosocomial cross-transmission of *C. difficile*, and that decreasing *C. difficile* infections in hospitals further will require interventions targeting the transition from asymptomatic carriage to infection.

C. difficile Infection **>80% patient-origin**

Bloodstream Infection **83-86% patient-origin**

PMIDs: 11136954, 37906196



JAMA Network | Open

Original Investigation | Infectious Diseases

Postoperative *Staphylococcus aureus* Infections in Patients With and Without Preoperative Colonization

Darren P. R. Troeman, MD; Derek Hazard, MSc; Leen Timbermont, MSc, PhD; Surbhi Malhotra-Kumar, MSc, PhD; Cornelis H. van Werkhoven, PhD; Martin Wolkewitz, MSc, PhD; Alexey Ruzin, PhD; Herman Goossens, MD, PhD; Marc J. M. Bonten, MD, PhD; Stephan Harbarth, MD, MS; Frangiscos Sifakis, PhD, MPH, MBA; Jan A. J. W. Kluytmans, MD, PhD; and the ASPIRE-SSI Study Team

Abstract

IMPORTANCE *Staphylococcus aureus* surgical site infections (SSIs) and bloodstream infections (BSIs) are important complications of surgical procedures for which prevention remains suboptimal. Contemporary data on the incidence of and etiologic factors for these infections are needed to support the development of improved preventive strategies.

OBJECTIVES To assess the occurrence of postoperative *S aureus* SSIs and BSIs and quantify its association with patient-related and contextual factors.

DESIGN, SETTING, AND PARTICIPANTS This multicenter cohort study assessed surgical patients at 33 hospitals in 10 European countries who were recruited between December 16, 2016, and September 30, 2019 (follow-up through December 30, 2019). Enrolled patients were actively followed up for up to 90 days after surgery to assess the occurrence of *S aureus* SSIs and BSIs. Data analysis was performed between November 20, 2020, and April 21, 2022. All patients were 18 years or older and had undergone 11 different types of surgical procedures. They were screened for *S aureus* colonization in the nose, throat, and perineum within 30 days before surgery (source population). Both *S aureus* carriers and noncarriers were subsequently enrolled in a 2:1 ratio.

EXPOSURE Preoperative *S aureus* colonization.

MAIN OUTCOMES AND MEASURES The main outcome was cumulative incidence of *S aureus* SSIs

Key Points

Question What is the cumulative incidence of *Staphylococcus aureus* surgical site infections (SSIs) and bloodstream infections (BSIs) in Europe, and what factors are associated with an increased risk of SSIs and BSIs?

Findings In a cohort study of 5004 surgical patients, the weighted cumulative incidence of *S aureus* SSIs and BSIs was 1.23%. Preoperative *S aureus* carriage, mastectomy or neurosurgery, higher body mass index, and having nonremovable implants in the body were independently associated with *S aureus* SSIs and BSIs.

Meaning *Staphylococcus aureus* SSIs and BSIs are important postoperative complications, and future interventions aimed at prevention of these infections

ORIGINAL ARTICLE

Nasal Carriage as a Source of *Staphylococcus aureus* Bacteremia

Christof von Eiff, M.D., Karsten Becker, M.D., Konstanze Machka, M.Sc., Holger Stammer, M.Sc., and Georg Peters, M.D.*

Abstract

Background The consequences of infection with *Staphylococcus aureus* can be severe, so strategies important. We examined *S. aureus* d and from nasal specimens to de- the organisms in the bloodstream e patient's own flora. ulticenter study, swabs for culture m the anterior nares of 219 patients acteremia. A total of 723 isolates d genotyped. In a second study, olates from nasal swabs from 1278 ected over a period of five years and ith isolates from the blood of pa- quently had *S. aureus* bacteremia. multicenter study of *S. aureus* bac- d isolates were identical to those nares in 180 of 219 patients (82.2 cond study, 14 of 1278 patients who ation with *S. aureus* subsequently cteremia. In 12 of these 14 patients olates obtained from the nares were to the isolates obtained from blood s later. substantial proportion of cases of emia appear to be of endogenous originate from colonies in the nasal sults provide support for strategies ic *S. aureus* infections by eliminat- of *S. aureus.* (N Engl J Med 2001;

sachusetts Medical Society.

concern about the development of strains resistant to all available antibiotics.[5] The severe consequences of infection with *S. aureus* heighten the importance of prevention. Colonized patients are the chief source of *S. aureus* in hospitals.[1,6] Approximately 10 to 40 percent of people tested as outpatients or on admission have nasal carriage of *S. aureus.*[7,8] Colonizing strains may serve as endogenous reservoirs for overt clinical infections or may spread to other patients. Several studies have shown that elimination of carriage in the anterior nares, the principal reservoirs of *S. aureus,* reduces the incidence of *S. aureus* infections.[6,9-13] However, previous studies did not systematically investigate the link between *S. aureus* isolated from blood and *S. aureus* isolated from nasal specimens, taken before and after bacteremia was detected, with the use of modern molecular methods. Therefore, we undertook this study to assess the correlation between strains colonizing the anterior nares and strains in the blood of patients with *S. aureus* bacteremia.

METHODS

Study Design

To investigate the correlation between *S. aureus* isolates from the anterior nares and *S. aureus* isolates from blood, two approaches were used. First, in a multicenter study performed from November 1993 to September 1994, which comprised general and intensive care units of 32 university and community hospitals in Germany, swabs were obtained from the anterior nares of patients with *S. aureus* bacteremia and cultured. As defined by the protocol,

C. difficile Infection	**>80% patient-origin**
Bloodstream Infection	**83-86% patient-origin**
Ventilator-Associated Pneumonia	**49-95% patient-origin (by geographic variation)**

PMID: 32997125

JAMA Network Open

Original Investigation | Critical Care Medicine

Association of *Staphylococcus aureus* Colonization and Pneumonia in the Intensive Care Unit

Fleur P. Paling, MD; Derek Hazard, MSc; Marc J. M. Bonten, MD, PhD; Herman Goossens, MD, PhD; Hasan S. Jafri, MD, PhD; Surbhi Malhotra-Kumar, MSc, PhD; Frangiscos Sifakis, MSc, PhD; Susanne Weber, MSc, PhD; Jan A. J. W. Kluytmans, MD, PhD; for the ASPIRE-ICU Study Team

Abstract

IMPORTANCE Carriage of *Staphylococcus aureus* is associated with *S aureus* infection. However, associations between *S aureus* carriage and the development of *S aureus* intensive care unit (ICU) pneumonia (SAIP) have not been quantified accurately, and interpretation of available data is hampered because of variations in definitions.

OBJECTIVE To quantify associations of patient-related and contextual factors, including *S aureus* colonization status, with the occurrence of SAIP.

DESIGN, SETTING, AND PARTICIPANTS This cohort study was conducted in ICUs of 30 hospitals in 11 European countries, geographically spread across 4 regions. Among patients with an anticipated length of stay 48 hours or longer who were undergoing mechanical ventilation at ICU admission, *S aureus* colonization was ascertained in the nose and lower respiratory tract. From this group, *S aureus*–colonized and noncolonized patients were enrolled into the study cohort in a 1:1 ratio. Data analysis was performed from May to November 2019.

MAIN OUTCOMES AND MEASURES SAIP was defined as any pneumonia during the ICU stay developing 48 hours or more after ICU admission with *S aureus* isolated from lower respiratory tract specimens or blood samples. The incidence of SAIP was derived in the study cohort and estimated on the weighted incidence calculation for the originating overarching population, while taking competing events into account. Weighted risk factor analysis was performed using Cox multivariable regression.

RESULTS The study cohort consisted of 1933 patie
patients (64.8%) were men, and 950 patients (49.1
304 patients (15.7%) developed ICU-acquired pneu
Weighted SAIP incidences were 11.7 events per 100
patients and 2.9 events per 1000 patient-days in th
incidence, 4.9 events per 1000 patient-days in the
with SAIP was *S aureus* colonization status at ICU ad
2.2-6.0; $P < .001$). There were marked regional diffe
hazard ratios for colonization status.

CONCLUSIONS AND RELEVANCE SAIP incidence
patients undergoing mechanical ventilation at ICU a
SAIP was 3.6 times higher in patients colonized with
noncolonized patients.

Key Points

Question What is the incidence density of *Staphylococcus aureus* intensive care unit pneumonia (SAIP) in Europe, and which factors are associated with the risk of SAIP?

Findings In this cohort study of 1933 participants, the weighted incidence density of SAIP was 4.9 events per 1000 intensive care unit patient-days, and *S aureus* colonization was the only factor independently associated with SAIP.

Meaning These findings suggest that SAIP incidence may be higher than initially perceived, and future interventions to prevent SAIP should focus on patients colonized with *S aureus* to achieve a higher efficacy.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

Colonizing vs Infecting Strains

Ninety-nine patients developed SAIP after prior *S aureus* colonization at ICU admission. Genetic comparison of *S aureus* isolates associated with colonization and infection within these individual patients was possible for 84 of 99 episodes, because of unavailability of either the infecting strain (10 episodes) or the colonizing strain (5 episodes) in the central laboratory. In 57 of these 84 paired strains (68%), multilocus sequence types were identical for the colonizing and infecting strains. Proportions of similarity ranged from 95% (19 of 20 pairs) in the western region to 49% (16 of 33 pairs) in the southern region. The most dominant multilocus sequence types were ST239 (19 strains, of which 11 were in 1 region) for infecting and ST30 (11 strains) for colonizing strains.

JAMA Network Open. 2020;3(9):e2012741. doi:10.1001/jamanetworkopen.2020.12741

PMIDs: 20054045, 12063371, 24897735, 37906196

C. difficile Infection	**>80% patient-origin**
Bloodstream Infection	**83-86% patient-origin**
Ventilator-Associated Pneumonia	**49-95% patient-origin (by geographic region)**
Surgical Site Infection	**79-86% patient-origin**

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 7, 2010 VOL. 362 NO. 1

Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus*

INTRANASAL MUPIROCIN TO PREVENT POSTOPERATIVE *STAPHYLOCOCCUS AUREUS* INFECTIONS

Surgical Site Infections in Orthopaedic Surgery Demonstrate Clones Similar to Those in Orthopaedic *Staphylococcus aureus* Nasal Carriers

JAMA Network Open

Original Investigation | Infectious Diseases

Postoperative *Staphylococcus aureus* Infections in Patients With and Without Preoperative Colonization

Darren P. R. Troeman, MD; Derek Hazard, MSc; Leen Timbermont, MSc, PhD; Surbhi Malhotra-Kumar, MSc, PhD; Cornelis H. van Werkhoven, PhD; Martin Wolkewitz, MSc, PhD; Alexey Ruzin, PhD; Herman Goossens, MD, PhD; Marc J. M. Bonten, MD, PhD; Stephan Harbarth, MD, MS;

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Preventing Surgical-Site Infections in Nasal Carriers of *Staphylococcus aureus*

INTRANASAL MUPIROCIN TO PREVENT POSTOPERATIVE *STAPHYLOCOCCUS AUREUS* INFECTIONS

GET ZIMMERMAN, PH.D.,
. FRENCH, M.D., M.P.H.,
AUREUS STUDY TEAM*

hospitalization.[3] The eco-
the anterior nares, and 25
ation is colonized at a given
arriers are at higher risk for
fter invasive medical or sur-
hose who do not carry this
aureus are also two to nine
ers to have surgical-site in-

calcium ointment (Bac-
Kline) is a topical antibiotic
or nares.[11,12] Decolonization
ars to prevent *S. aureus* in-
who are receiving dialysis,
ations and costs.[13-16] Several
er rates of surgical-site in-
o received mupirocin than
subjects.[17-19] However, the
ot been studied rigorously

Surgical Site Infections in Orthopaedic Surgery Demonstrate Clones Similar to Those in Orthopaedic *Staphylococcus aureus* Nasal Carriers

Bukholm, MD, PhD

atory Sciences (EpiGen),

nd it adds considerable
have an increased risk
nvestigate whether the
were the same as the
ctions.

JAMA Network Open

Original Investigation | Infectious Diseases

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How could this change our thinking?

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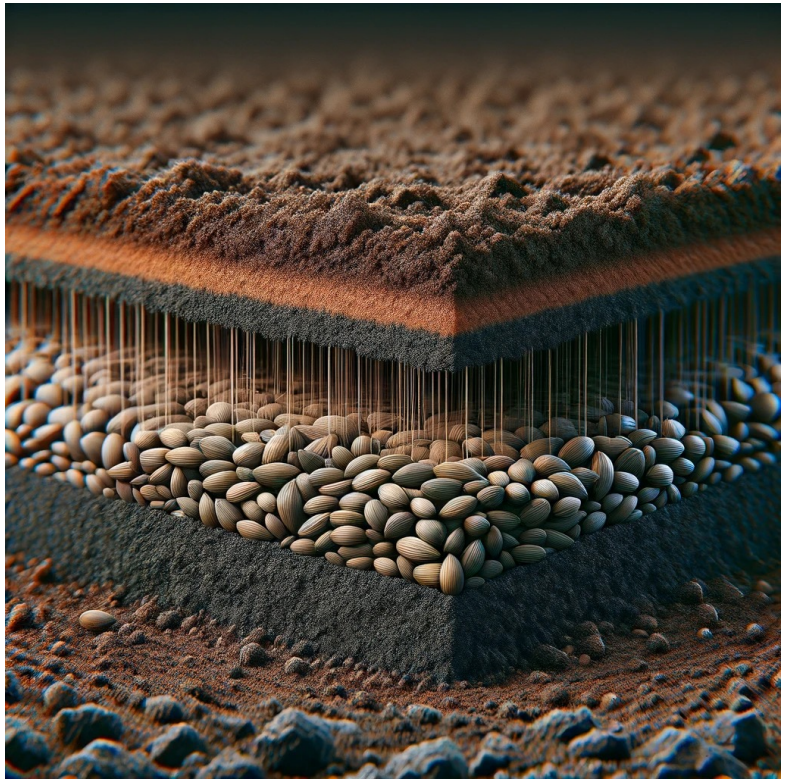

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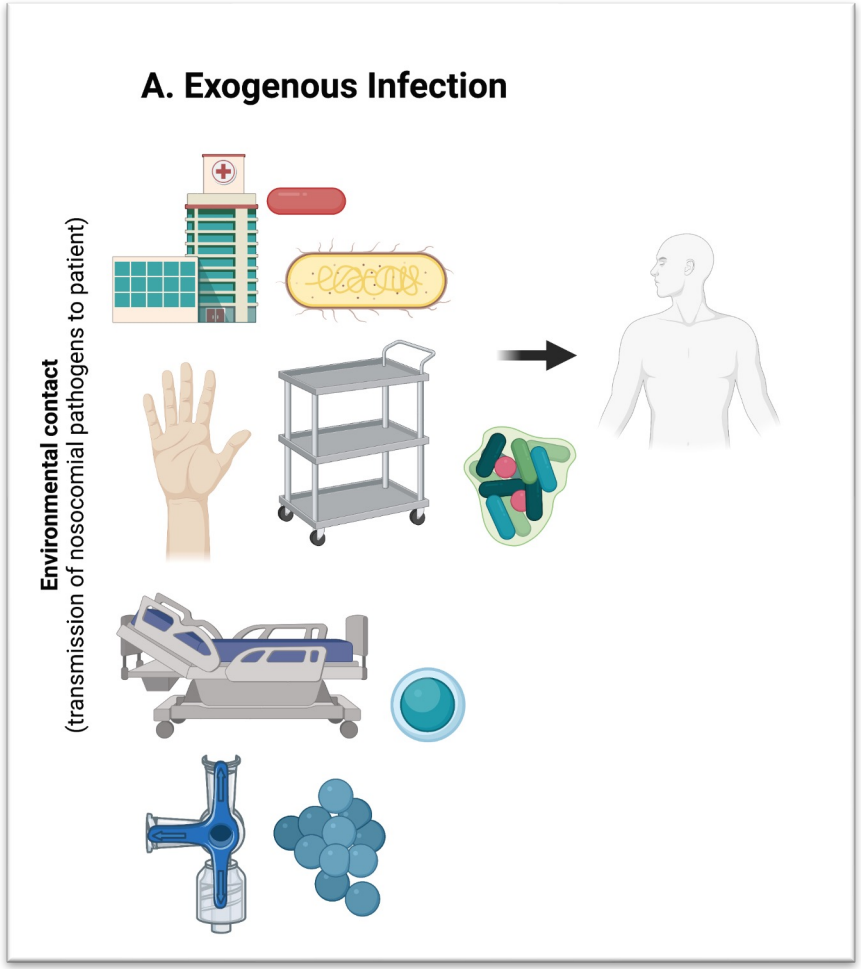
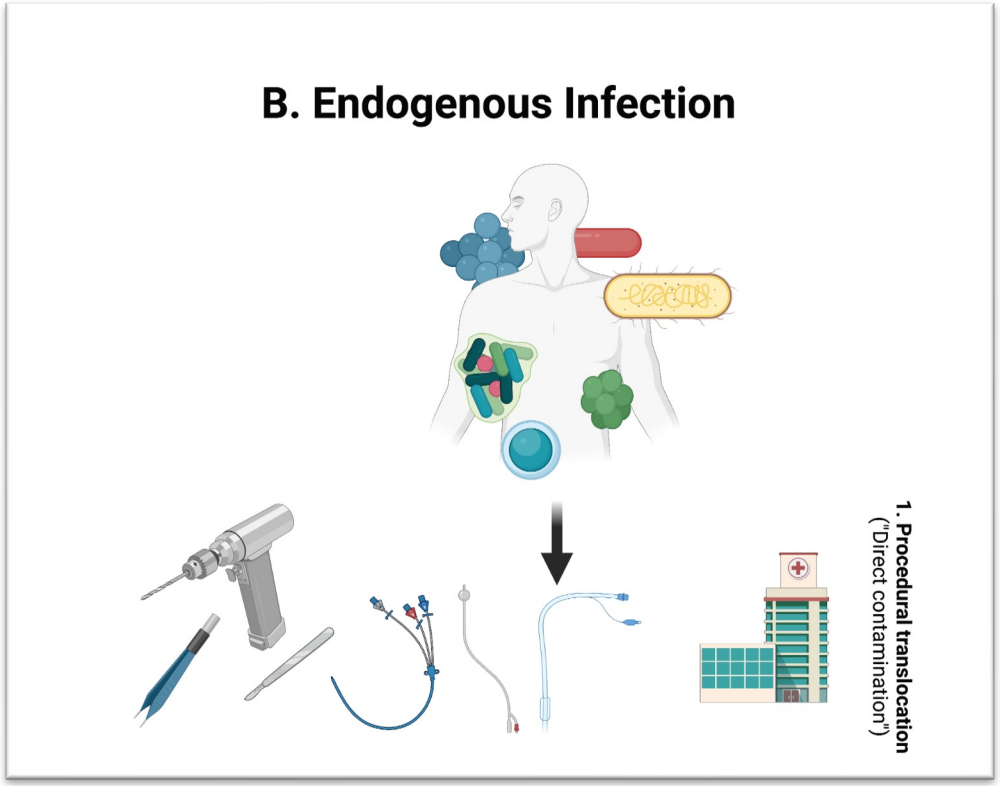
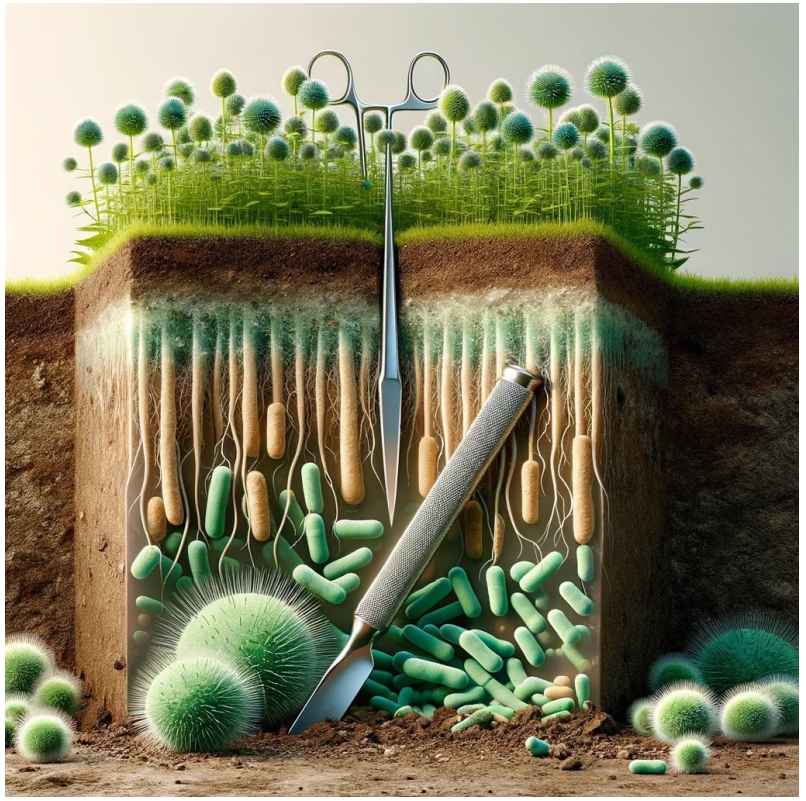
How could this change our thinking?





How could this change our thinking?

- What new tools could we use for SSI prevention?
- How can our approach to preoperative decolonization be better?
- Or surgical prophylaxis?
- How do bacteria get from sites of colonization (nose) to the wound and “germinate” to mount an infection?
- If coming directly from the skin, why isn’t this effectively addressed the by surgical prep?
- If we know in advance the bacterial strains most likely to cause infection, can we use that knowledge to individualize prevention?



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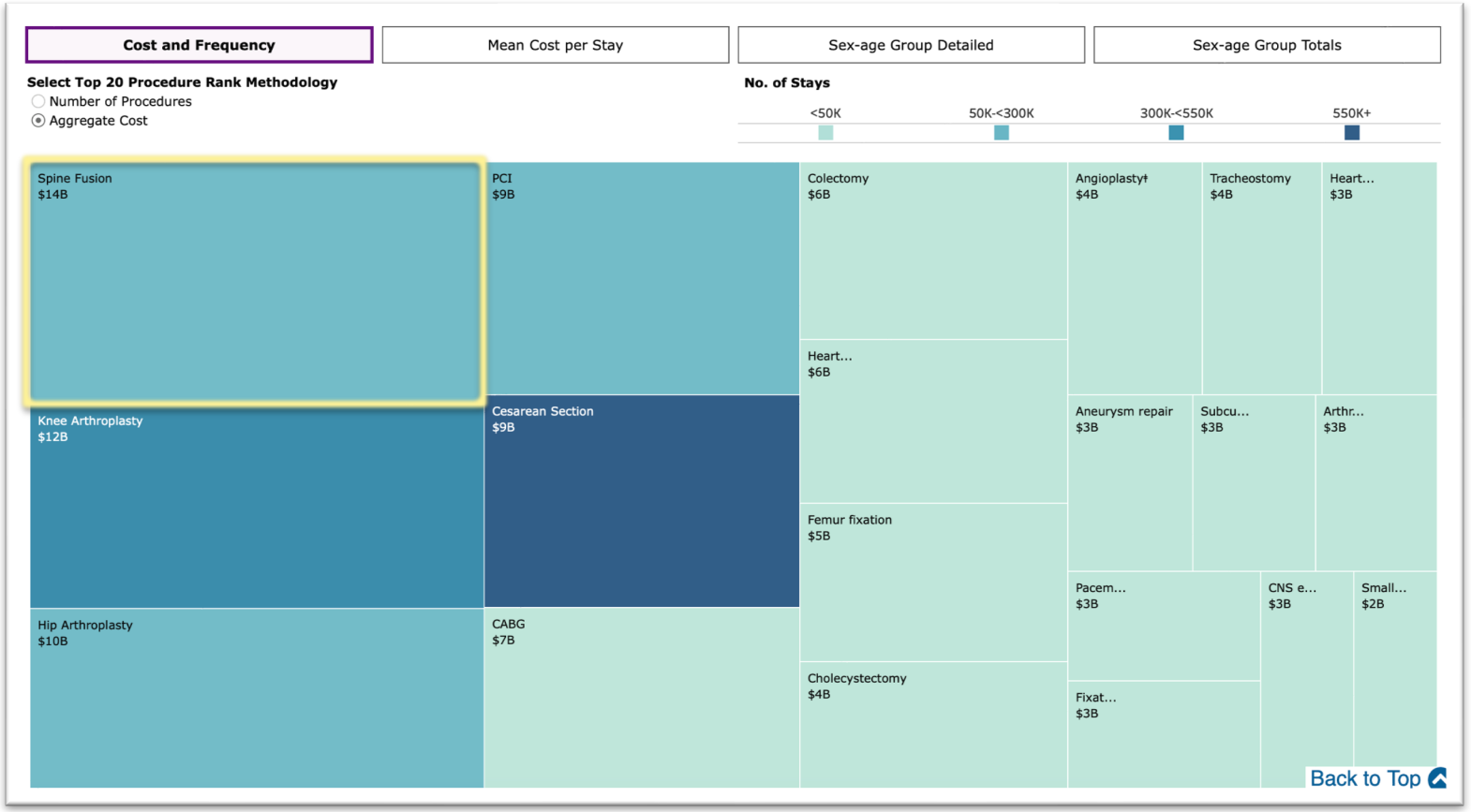
Skin Microbiome & Surgical Site Infection

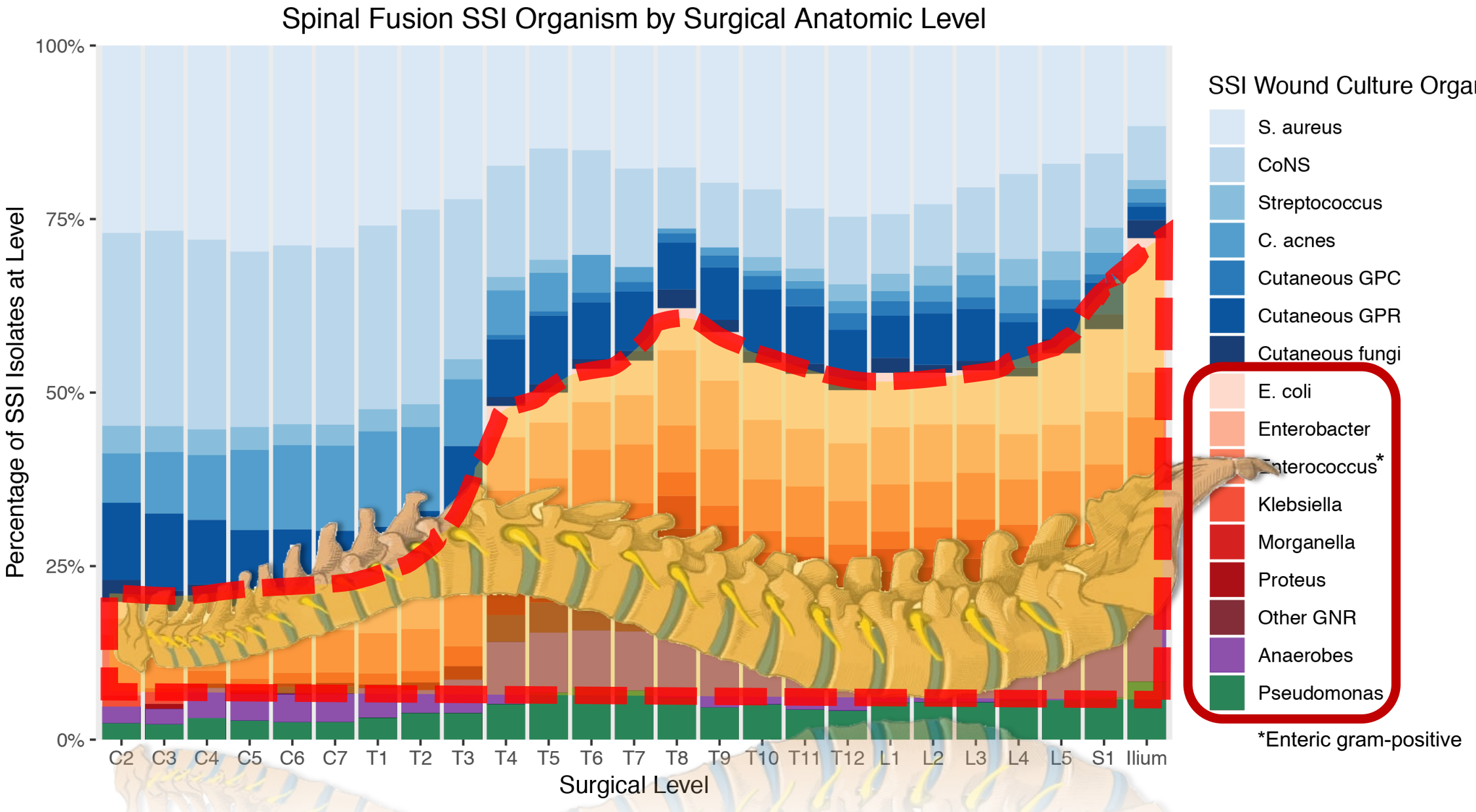
Concept 2: *The skin is a complex, resilient community of potential pathogens and resistance genes, built up over a lifetime, and just waiting for an opportunity to cause an infection.*

Why study SSI in spine surgery?

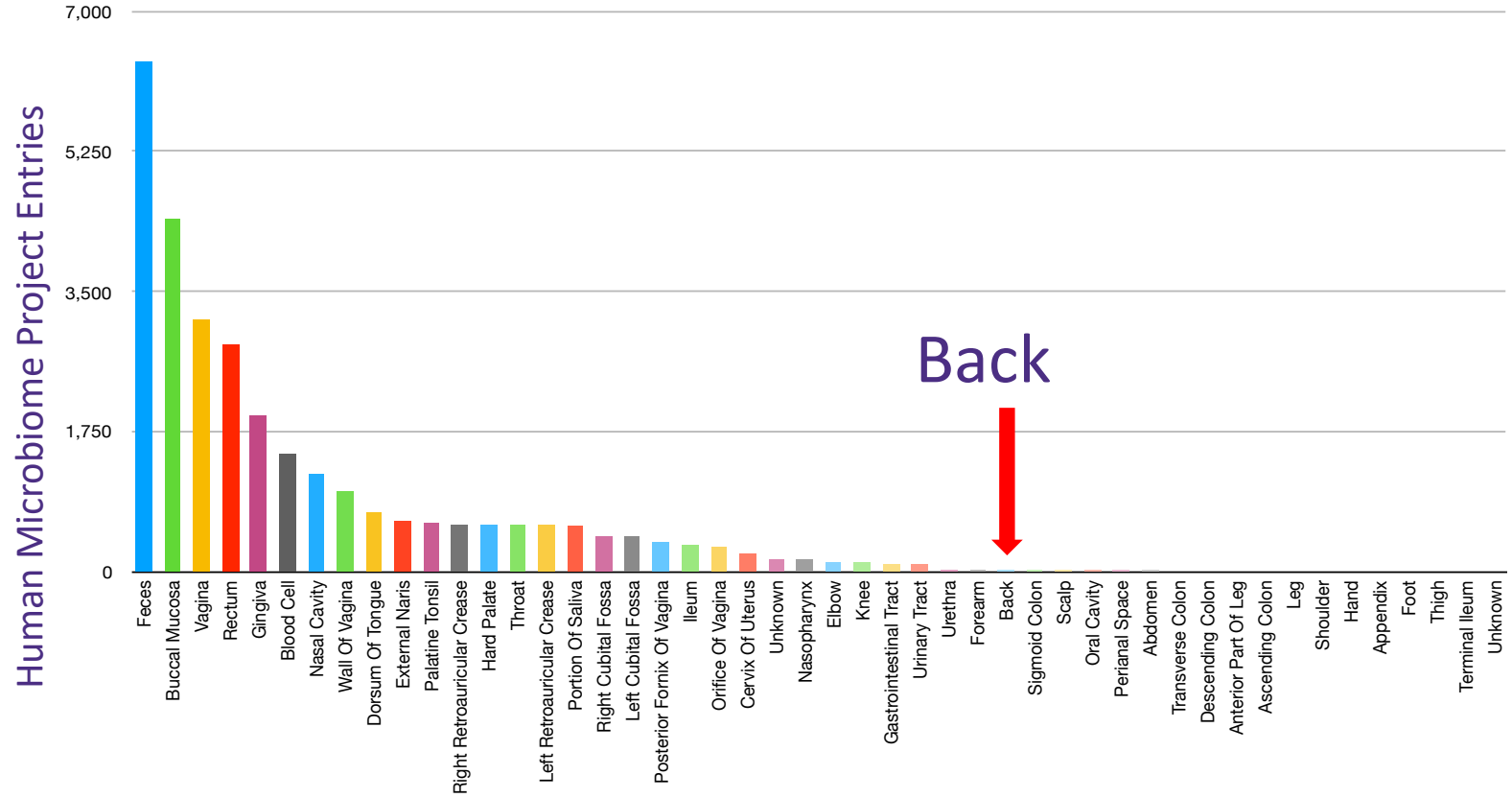
- **High volume**
  - US ~1M/year
  - More $ expenditure than any other elective surgery
- **High risk**
  - 1 in 30
- **Major consequences**



Spinal Fusion SSI Microbiology



WHAT DO WE KNOW ABOUT THE "MICROBIOME 0F THE BACKSIDE"?



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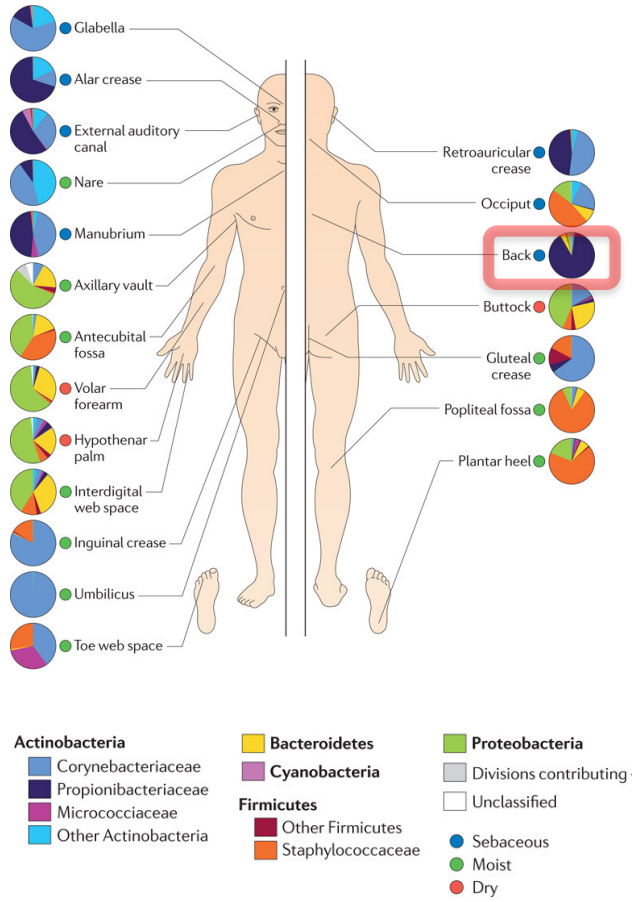

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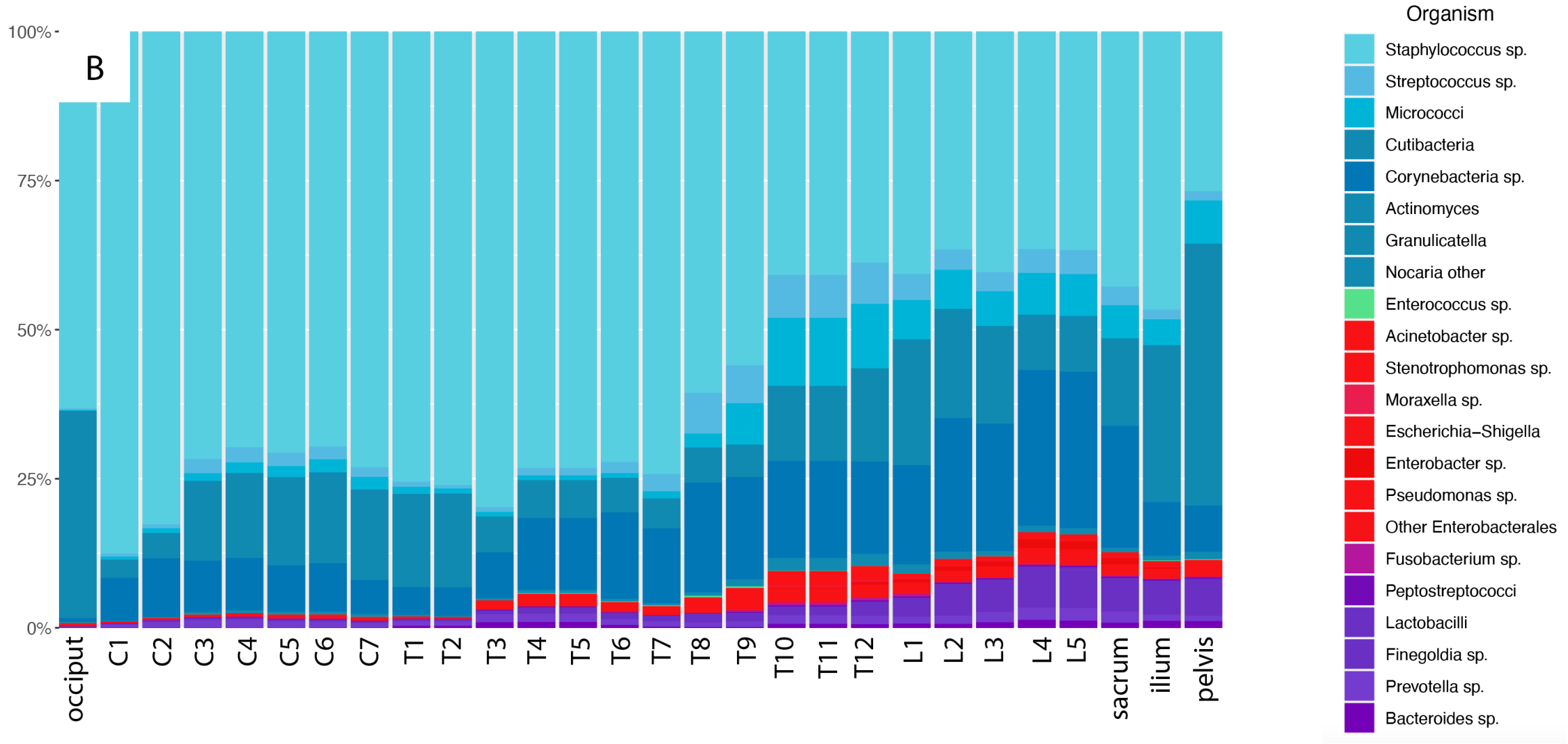
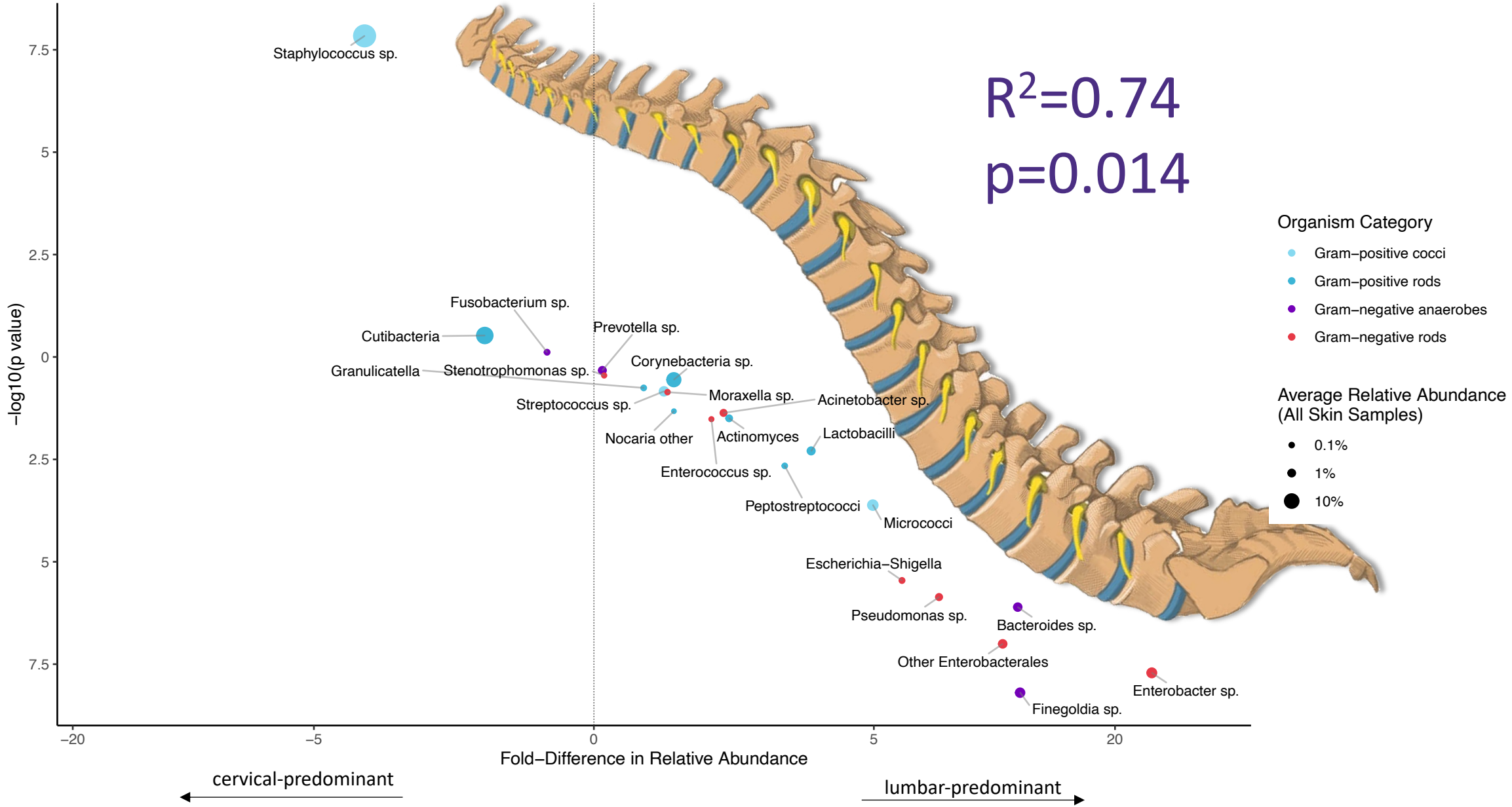
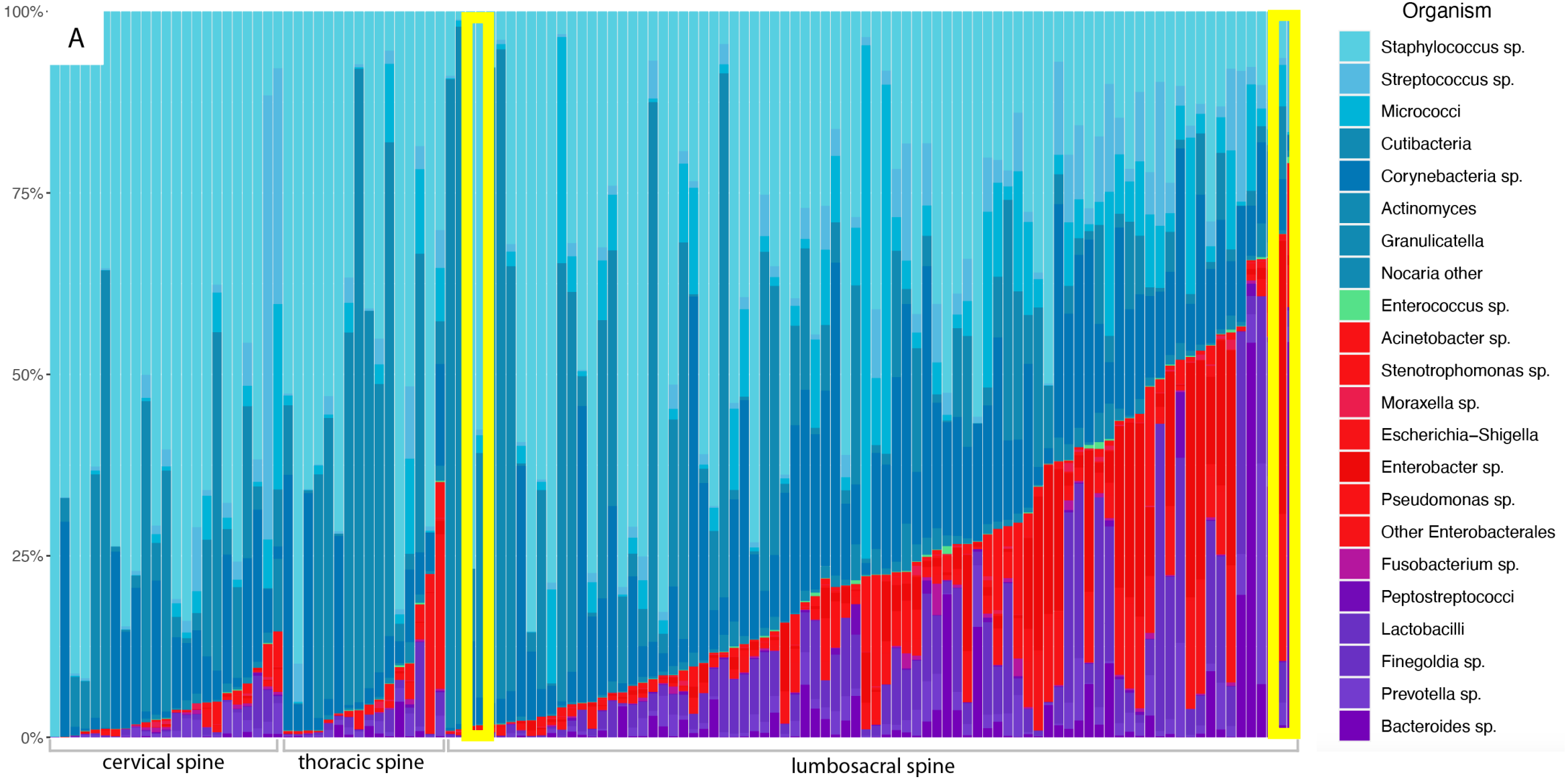
Preoperative Skin Microbiome



Stratification of Individual Species

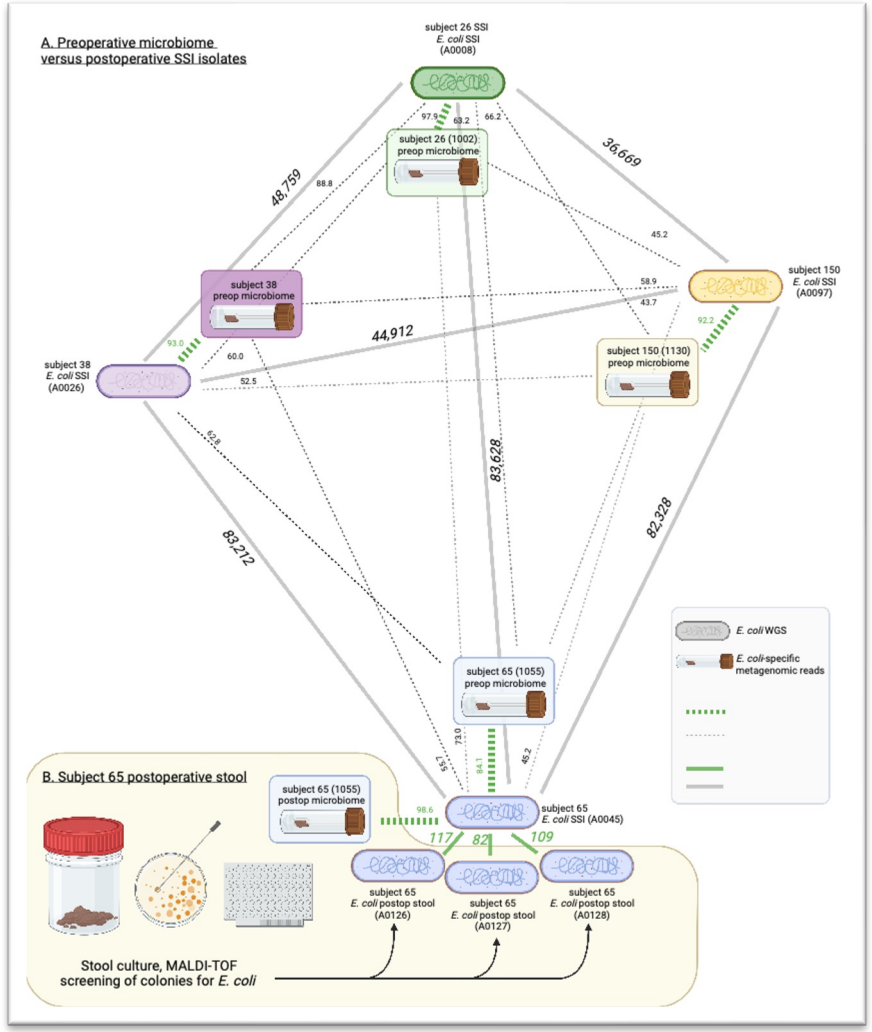


ANATOMIC VARIATION
BUT ALSO INDIVIDUAL VARATION



WHAT WE ARE LEARNING

80-90% of SSIs in spine surgery arise from the **patient microbiome** (not the hospital environment)



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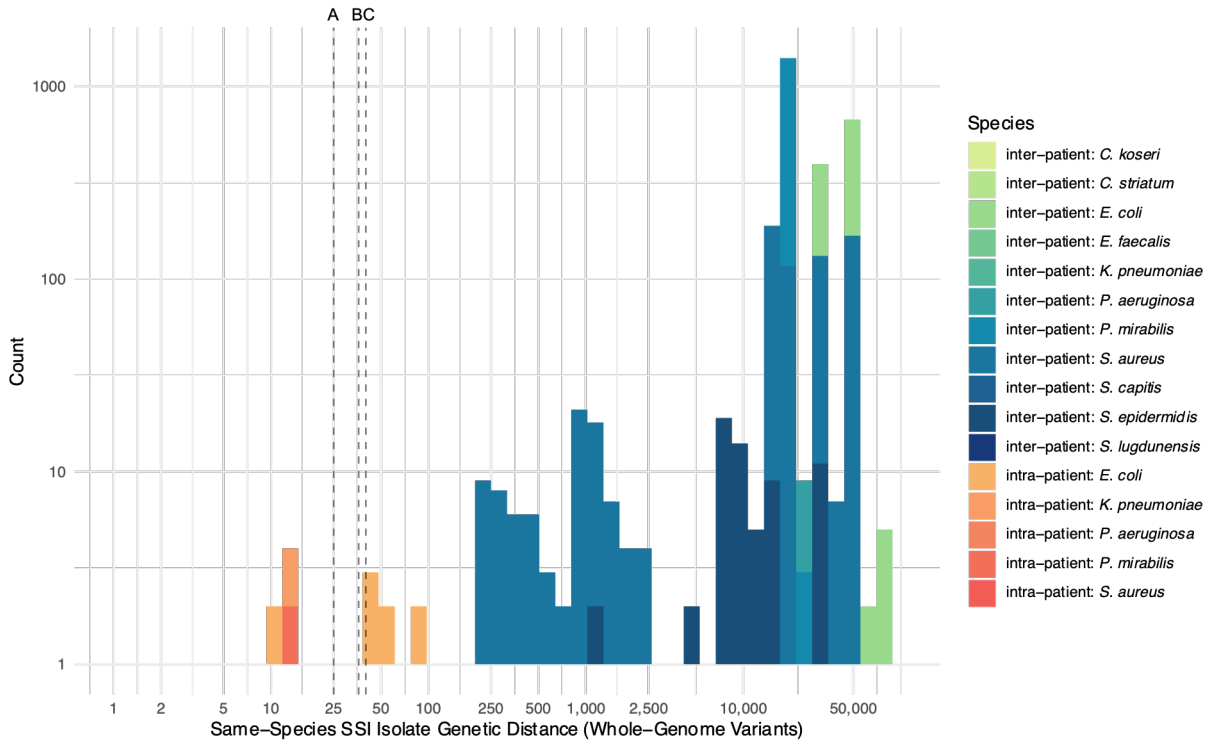
WHAT WE ARE LEARNING

No evidence of same-strain SSI between patients

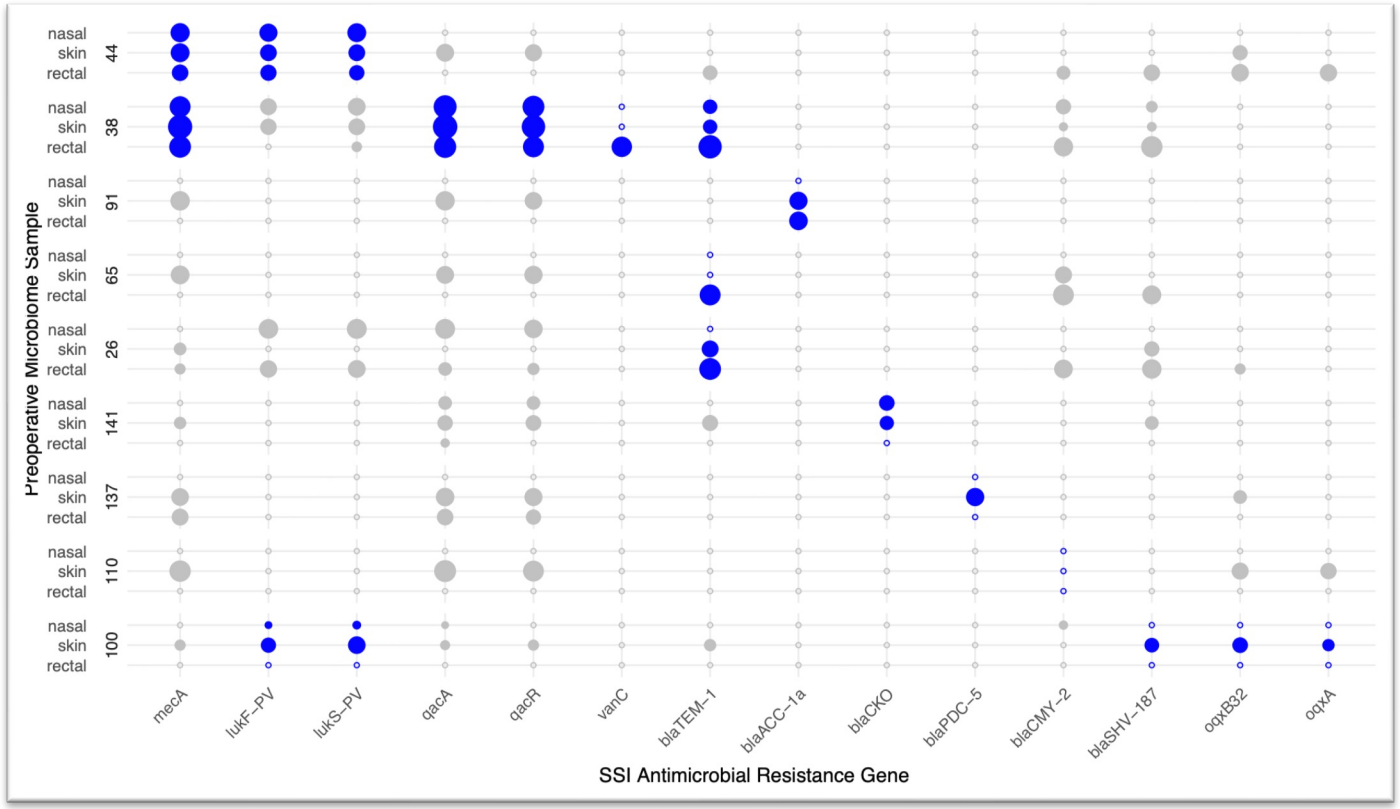


WHAT WE ARE LEARNING

50-60% are

resistant to the surgical prophylaxis

administered



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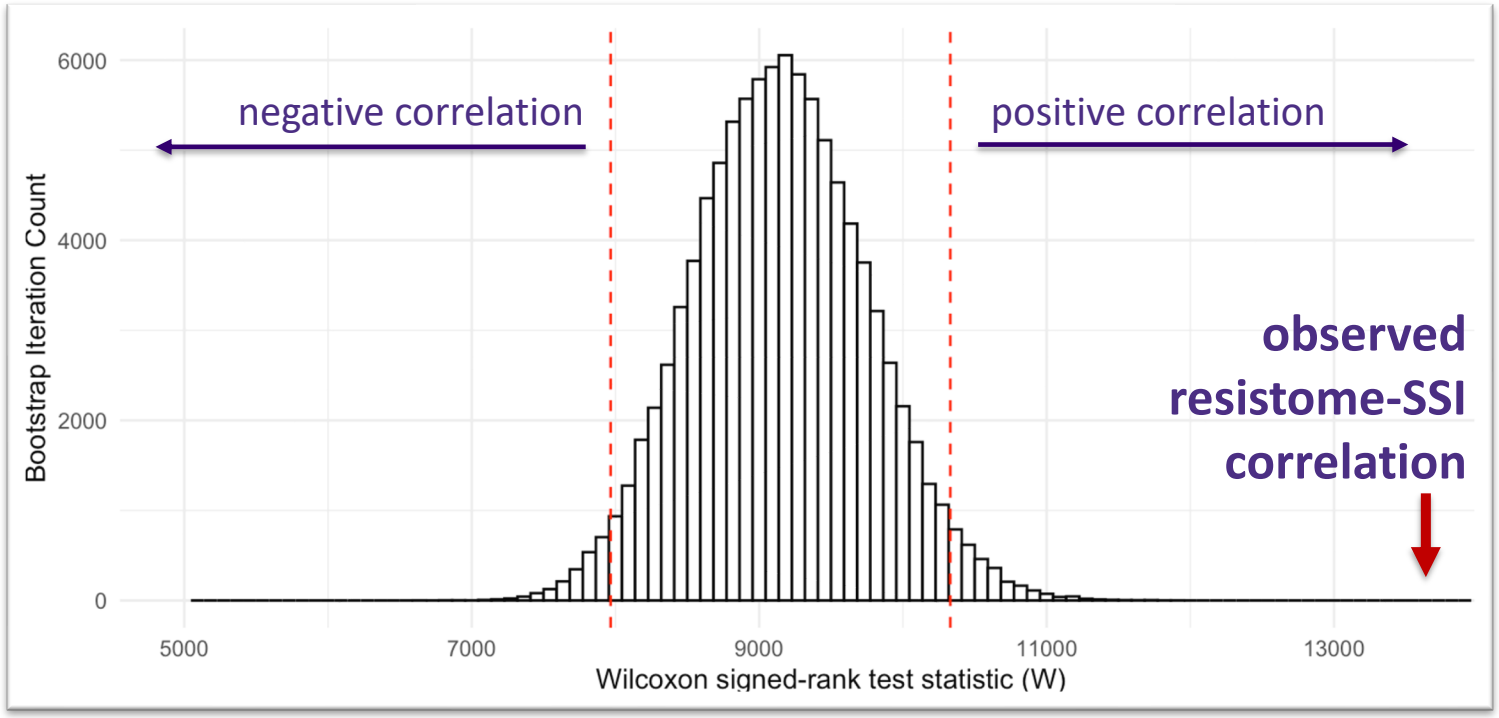
WHAT WE ARE LEARNING

resistance genes also come from the patient and are **detectable prior to surgery**

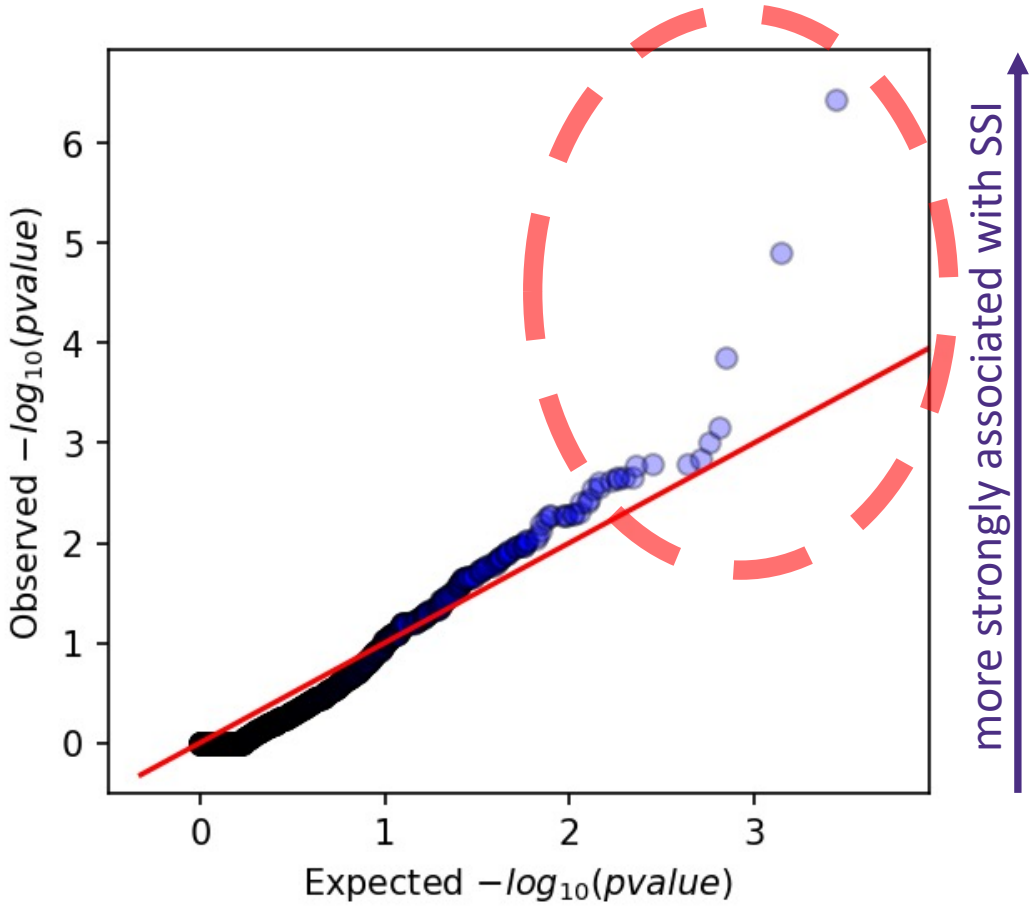


WHAT WE ARE LEARNING

resistance not only to antibiotic prophylaxis

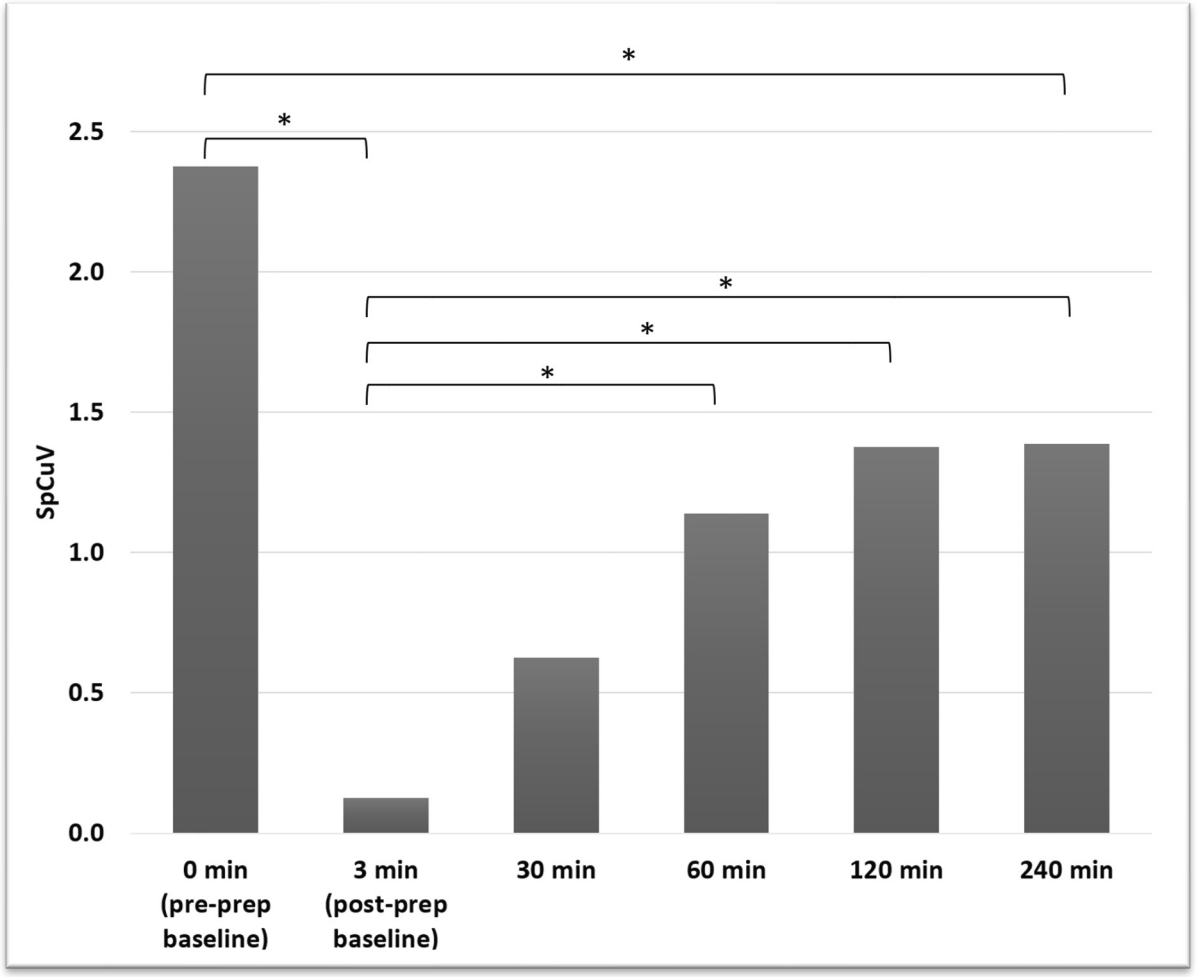
but also

chlorhexidine?!



WHAT WE ARE LEARNING

effect of
surgical prep is
shorter than most surgeries



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Skin Microbiome Extends Surprisingly Deep

nature COMMUNICATIONS

ARTICLE

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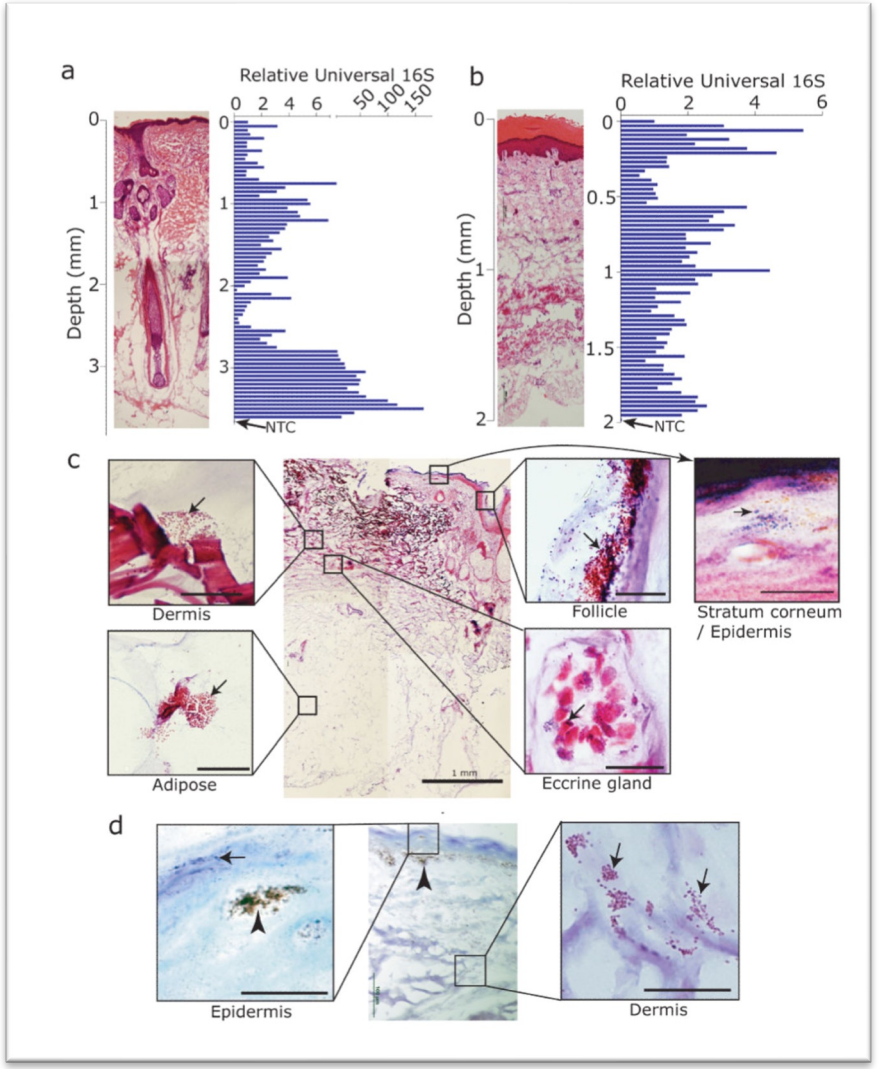
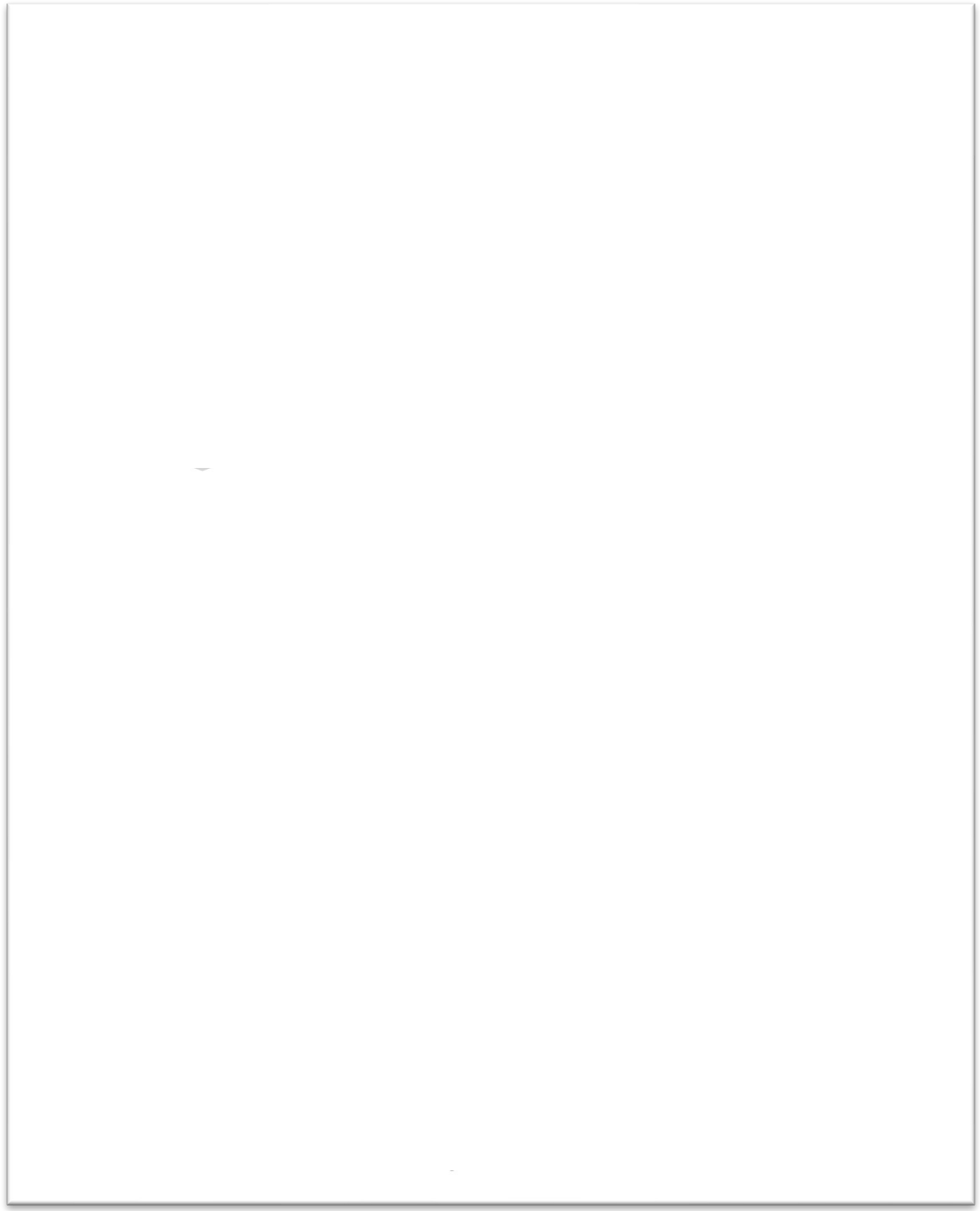
The microbiome extends to subepidermal compartments of normal skin

Teruaki Nakatsuji[1,2], Hsin-I. Chiang[3,4], Shangi B. Jiang[1], Harish Nagarajan[3], Karsten Zengler[3] & Richard L. Gallo[1,2]

Commensal microbes on the skin surface influence the behaviour of cells below the epidermis. We hypothesized that bacteria or their products exist below the surface epithelium and thus permit physical interaction between microbes and dermal cells. Here to test this hypothesis, we employed multiple independent detection techniques for bacteria including quantitative PCR, Gram staining, immunofluorescence and *in situ* hybridization. Bacteria were consistently detectable within the dermis and dermal adipose of normal human skin. Sequencing of DNA from dermis and dermal adipose tissue identified bacterial 16S ribosomal RNA reflective of a diverse and partially distinct microbial community in each skin compartment. These results show the microbiota extends within the dermis, therefore, enabling physical contact between bacteria and various cells below the basement membrane. These observations show that normal commensal bacterial communities directly communicate with the host in a tissue previously thought to be sterile.



CONCEPTUAL MODEL



Is it the right model?

Is it the only model?

How are we thinking about this at HMC?

1. Doubling down on preoperative MRSA screening
    1. Moving from pre-anesthesia to surgical clinic
2. Revisiting our approach to decolonization
3. General focus on bathing practices for inpatients, CHG use in select high-risk populations
4. Strategically moving some SSI prevention work from IPC to Surgical Services in a joint model
5. Thinking about targeted, individualized approaches to prophylaxis
6. All in the context of a hand-hygiene push and keeping the pressure on environmental sources

TAKE AWAYS

- Many HAIs arise from the patient microbiome as a result of stresses/procedures that uniquely occur in hospital environments
- This does NOT relieve hospitals of responsibility for infection prevention, but may change our approach

TAKE AWAYS

- The skin microbiome varies across body regions
- Within regions, it varies further between individuals
- Gram-negative bacteria are routinely members of these normal skin communities, we just don’t see them using traditional culture methods

TAKE AWAYS

- Both anatomic and individual variation in the skin microbiome of the surgical site correlate with the causes of SSI
- Community-acquired resistance genes contribute to prophylaxis resistant SSI

TAKE AWAYS

- The microbiome is more than “skin deep” and may extend beyond the epidermis to layers not penetrated by surgical prep
- Within a matter hours, the skin surface is subtantially repopulated from deeper reservoirs
- Some skin commensals harbor genes for chlorhexidine resistance

TAKE AWAYS

- The optimal approach and timing for decolonization are uncertain
- Should probably include both nasal and skin decolonization, and begin days before surgery to reduce the overall bioburden of organisms across body, including the skin over the surgical site

QUESTIONS/DISCUSSION

BE BOUNDLESS