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OR Attire: *What is the evidence?*

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Thomas H. Irving Professor and Chair

Disclosures

- No financial disclosures
- 2 things I am not going to talk about
- 2 things I do plan to talk about

OR Attire: What matters?

Recommendations for Infection Control for the Practice of Anesthesiology (Third Edition)

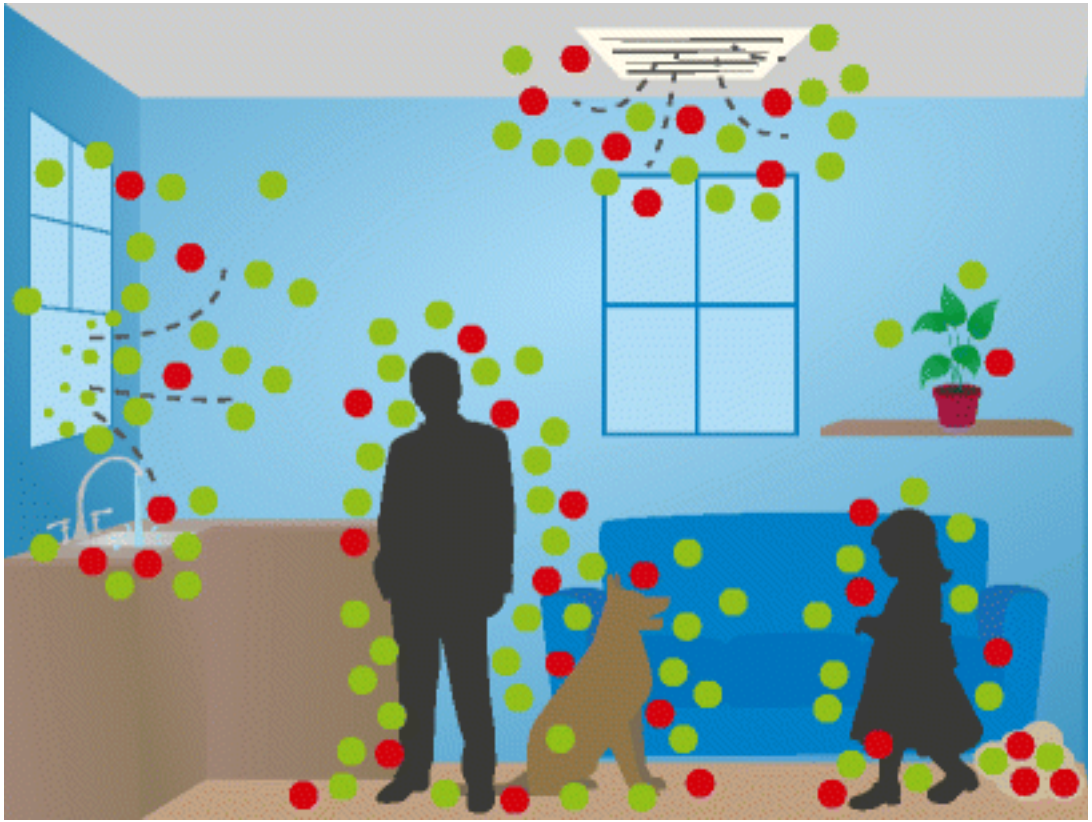
Developed by the ASA Committee on Occupational Health Task Force on Infection Control

Disclaimer:

This document has been developed by the ASA Committee on Occupational Health Task Force on Infection Control, but has not been reviewed or approved as a practice parameter or policy statement by the ASA House of Delegates. Variances from recommendations contained in this document may be acceptable based on the judgment of the responsible anesthesiologist. The recommendations are designed to encourage

Anesthesiologists®

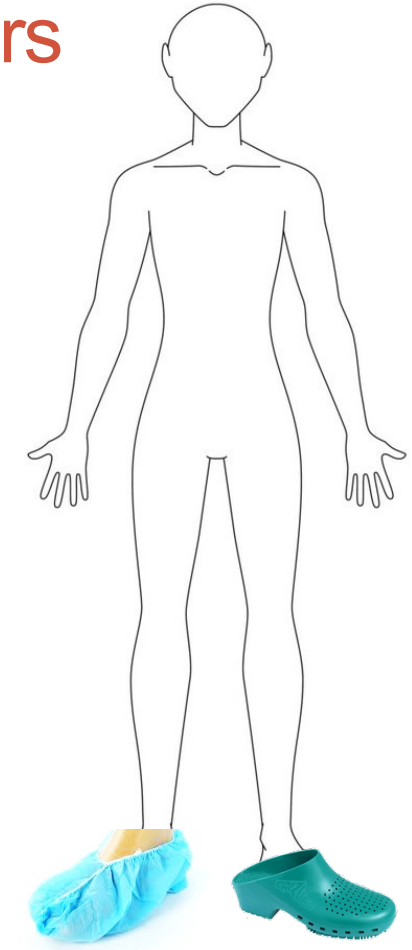
Airborne microbial particles



EU/WHO HOSPITAL AIR CONTAMINATION LIMITS

CLASS I	CLASS II	CLASS III
<10 CFU	<50 CFU	<200 CFU
Ortho OR Cardiac OR Transplant Bone Marrow Burn Unit	General OR ED Preop OR Corridors PICU SICU/MICU Acute Pt. Rooms	CICU L&D Wards Supply Areas Radiology Exam rooms Kitchen/Laundry

Shoes and shoe covers

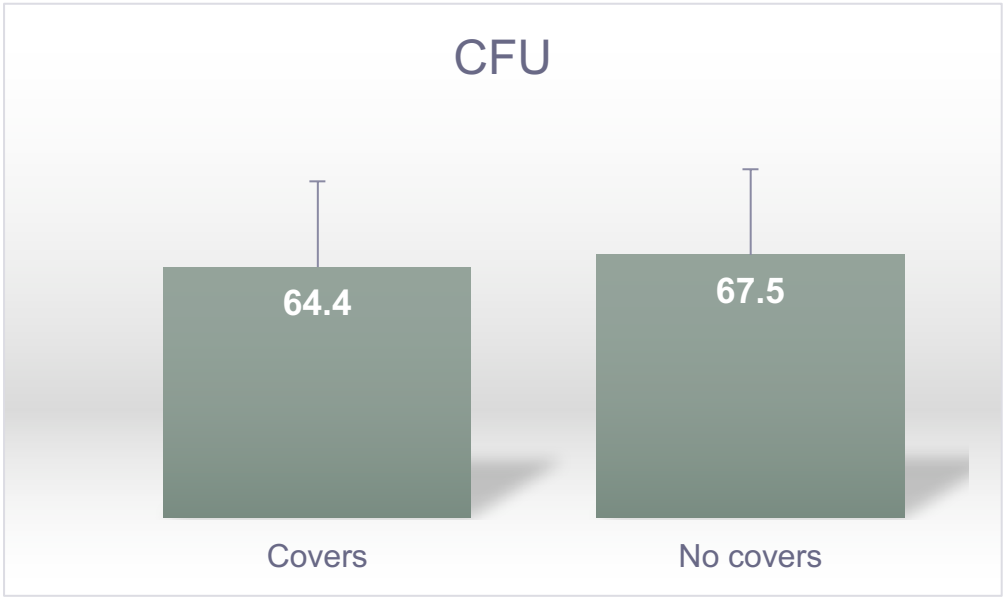


Shoes and shoe covers

- Floors get dirty throughout the OR day, counts ↓ with mopping
- “OR Shoes” are cleaner than “outside” shoes (Amirfeyz, Ann R Coll Surg Engl 2007)
- But OR floor is negligible contributor to airborne particles
  - AORN: “Bacteria on the perioperative floor may contribute up to 15% of colony forming units (CFUs), which are dispersed into the air by walking. Shoes that are worn only in the perioperative area may help to reduce contamination of the perioperative environment.”[22]
  - Actual reference (Humbraeus, J Hyg 1978): “15% thus represents a maximum value. The conclusion would therefore be that redispersal of Staph. aureus from floor dust to air hardly increases the risk for airborne infection of operation wounds.”

Theatre over-shoes do not reduce operating theatre floor bacterial counts

H. Humphreys, R. J. Marshall, V. E. Ricketts, A. J. Russell and D. S. Reeves



P=0.5

Humphreys et al. *J Hosp Infect.* 1991 Feb;17(2):117-23.

Scrubs

Home vs. commercially laundered

- Healthcare Laundry Accreditation Council (HLAC)
- No systematic studies linking SSIs to home laundered (Belkin, Am J Infect Control 2001)
  - Case report Gordonia bronchialis sternal wound infections (N=3) from CRNA scrubs traced to defective home washing machine (Wright, *Infect Control Hosp Epidemiol* 2012)
  - Case series sternal wound infections (Gordonia N=3 of 22 cases); home laundered scrubs used but not linked (Ngyuen *Am J Infect Control*. 2014)
- CDC guidelines (1999) say “unresolved” and “no recommendation”

Home vs. commercially laundered

Twomey et al. *Infection Control Today* 2009.

T-shirts under scrubs

- AORN: “All personal clothing should be completely covered by the surgical attire… personal clothing that extends above the scrub top neckline or below the sleeve of the surgical attire should not be worn.”
- Data: None.

Are scrubs really an issue?

Naked Surgeons? The Debate About What to Wear in the Operating Room

Matthew Bartek,[a] Francys Verdial,[a] and E. Patchen Dellinger

Department of Surgery, University of Washington, Seattle

Clin Infect Dis 2017;65(9):1589–92

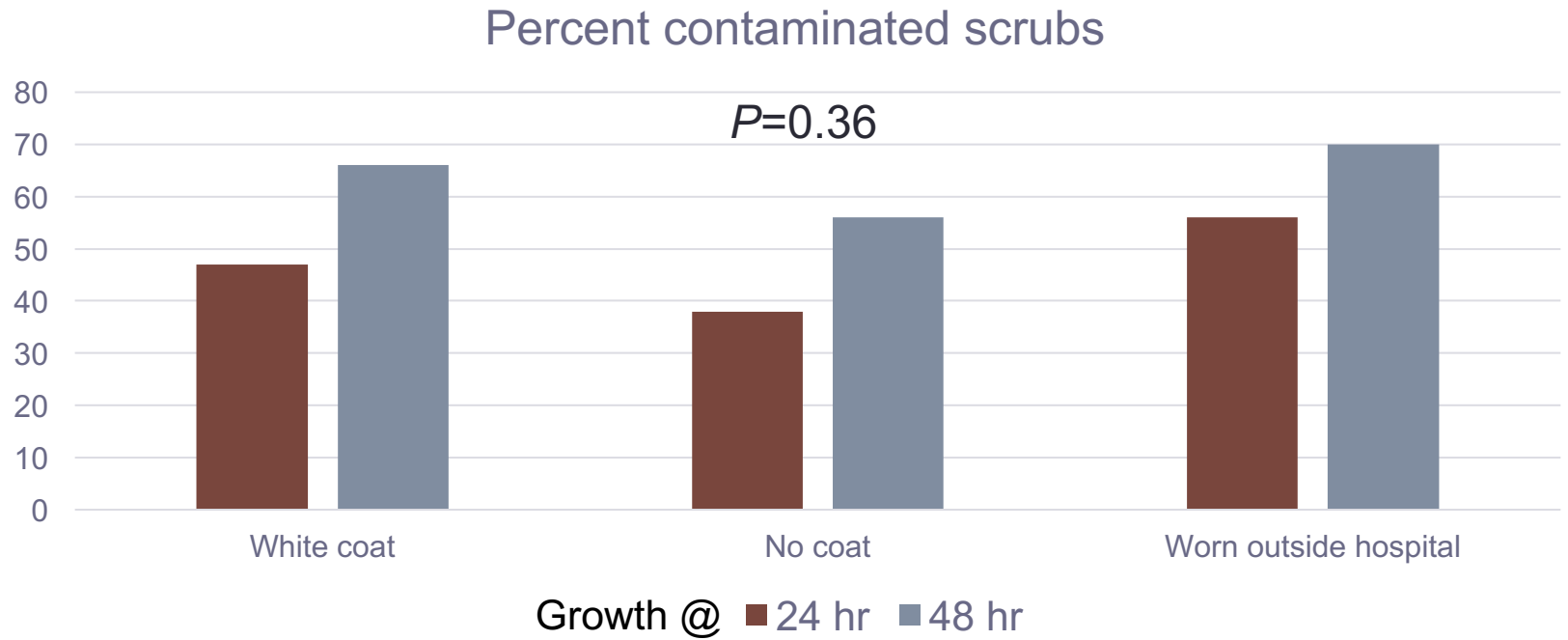
OR clothing

- S. aureus colonized volunteers in fixed chamber (Bischoff 2007)
  - OR scrubs<<street clothes
  - Gowns+scrubs<scrubs
  - Men 2X women
- Other studies disagree (Doig 1972)
  - Street clothes dispersed *less* bacteria than scrubs
- Clothing may disperse bacteria by friction (Hill 1974)
  - Street clothes<OR clothes, OR clothes ↑ over time
  - Unclothed < clothed!

White coats over scrubs

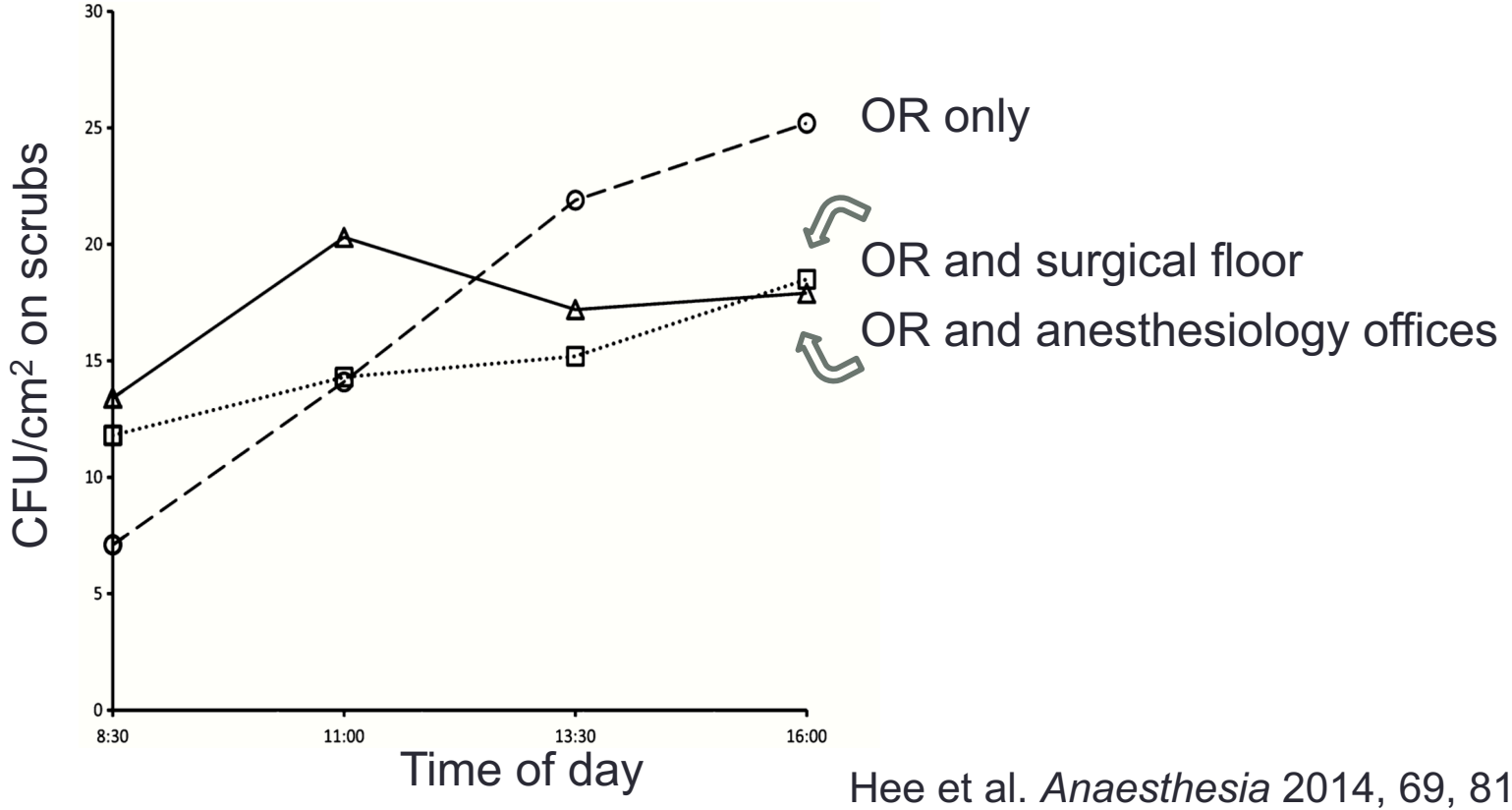
- AORN: “The use of cover apparel has been found to have little or no effect on reducing contamination of surgical attire.”
- Data suggests *reduced* contamination when *not* wearing covers

White coats don't help



Kaplan et al. Obstet Gynecol 2003;188:115

Moving around hospital OK



Hee et al. *Anaesthesia* 2014, 69, 816–825

Long sleeved scrub jacket

Long sleeved scrub jacket

- AORN: “When in the restricted areas, all nonscrubbed personnel should completely cover their arms with a long-sleeved scrub top or jacket. (2: Moderate evidence)”
- Cited ”evidence”
  - Tammelin et al 2000: compared untucked scrubs to tucked, tightly woven short-sleeved scrubs with cuffs (reduced CFU/m^3, P=.002).
  - Andersen et al 2002: compared conventional, tightly woven short-sleeved scrubs with cuffs (50% reduction in airborne bacteria, P=.001)
- ACS: in direct opposition to “bare below the elbows”, and concludes (2016): “Again, none of the available evidence supports either policy.”

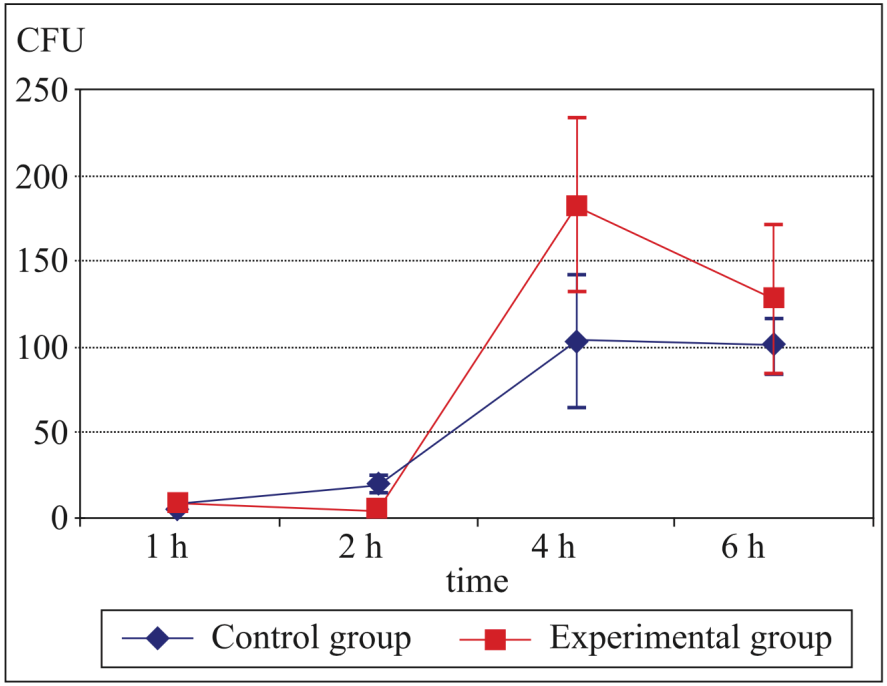
Masks

AORN on masks

- "The surgical mask should cover the mouth and nose and be secured in a manner that prevents venting at the sides of the mask" (1: Strong evidence)
  - *No actual evidence; cited CDC 2007 ref to suggest ↓ field contamination but discusses PPE effects only.*
- "The mask should be replaced and discarded whenever it becomes wet or soiled or has been taken down."
  - *Cited Barbosa, Braz J Microbiol 2006 suggesting ↓ filtering capacity over time*

INFLUENCE OF WEARING TIME ON EFFICACY OF DISPOSABLE SURGICAL MASKS AS MICROBIAL BARRIER

Maria Helena Barbosa[1]*; Kazuko Uchikawa Graziano[2]



Masks

No masks

Brazilian Journal of Microbiology (2006) 37:216-217

Masks around the neck

- AORN: “Surgical masks should not be worn hanging around the neck….the contaminated mask may cross-contaminate the scrub attire top”
- ACS: “Masks should not be allowed to hang or dangle around the neck at any time.”
- ASA: “Wear a surgical mask in surgical environments when open sterile items and equipment are present.”

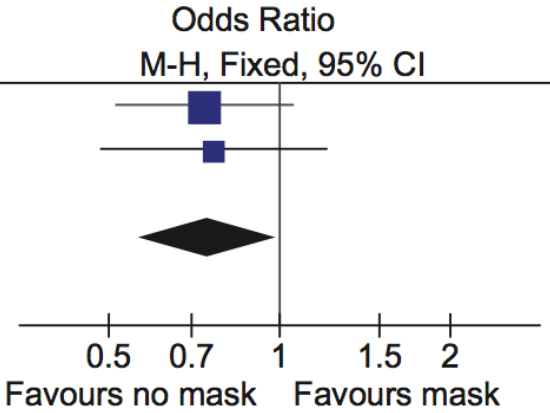
$$\frac{\text{Data}}{\text{Dogma}}$$

Do masks even matter?

Study or Subgroup	No mask Events	Total	Mask Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Tunevall 1992	55	1551	73	1537	62.6%	0.74 [0.52, 1.05]
Webster 2010	37	410	46	401	37.4%	0.77 [0.48, 1.21]
Total (95% CI)		1961		1938	100.0%	0.75 [0.56, 0.99]
Total events	92		119			

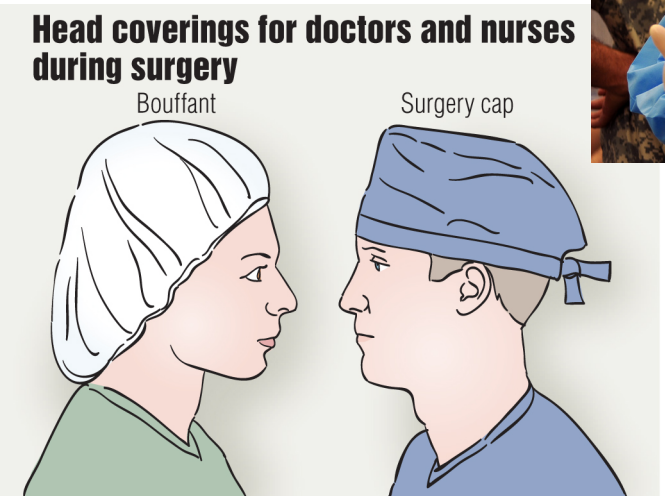
Heterogeneity: Chi² = 0.02, df = 1 (P = 0.90); I² = 0%

Test for overall effect: Z = 2.02 (P = 0.04)



Webster et al. ANZ J Surg 80 (2010) 169–173

Head coverings



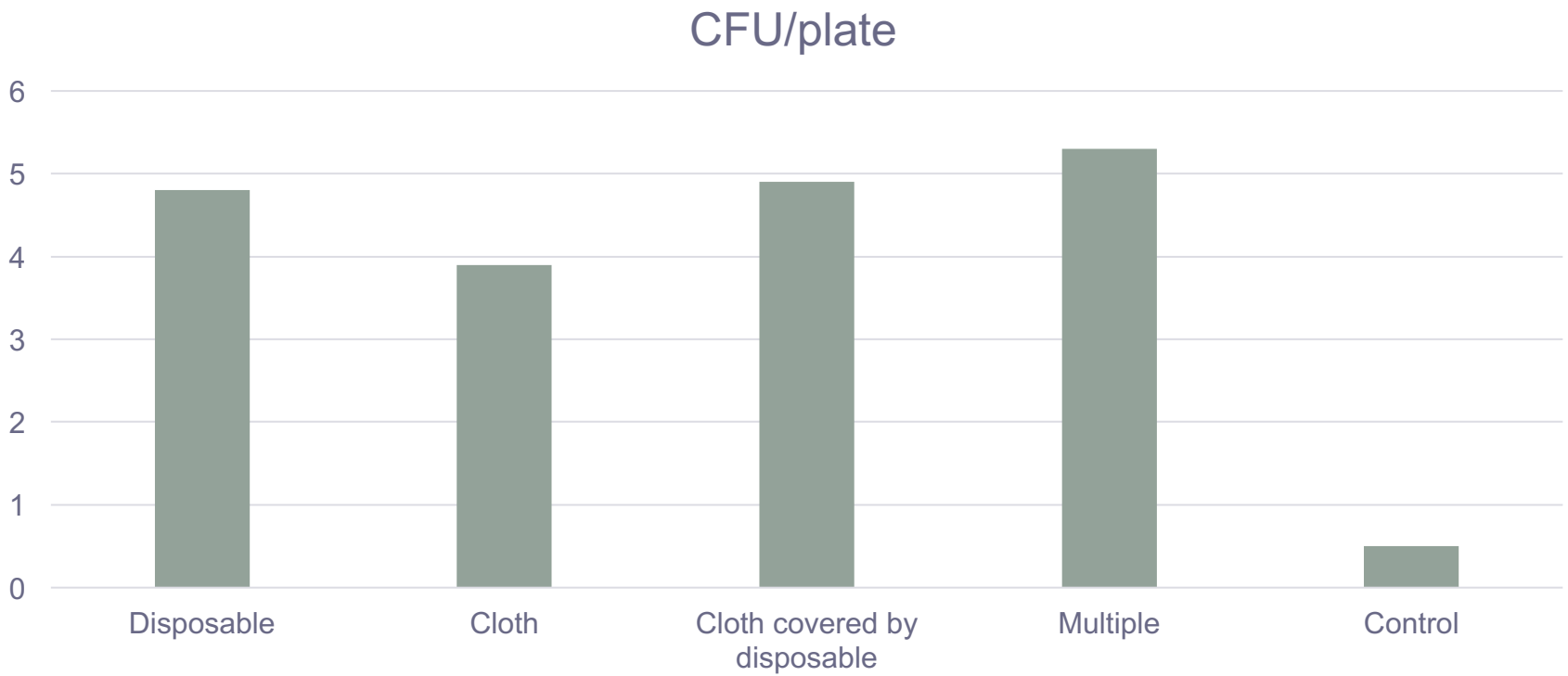
Head covering: AORN vs. ACS

- AORN: “A clean surgical head cover or hood that confines all hair and completely covers the ears, scalp skin, sideburns and nape of the neck should be worn.”
  - “Skull caps are not recommended because they do not completely cover the wearer’s hair and skin…Perioperative nurses can talk with their department managers and materials management department personnel to eliminate the availability of skull caps.”
- ACS: “The skullcap is symbolic of the surgical profession. The skullcap can be worn when close to the totality of hair is covered by it and only a limited amount of hair on the nape of the neck or a modest sideburn remains uncovered.”
- AORN (5/2017): “The AORN guideline makes no reference to ‘skull caps,’ and there is no recommendation that boufant caps should be worn…[but only one that] “confines all hair and completely covers the ears, scalp skin, sideburns, and nape of the neck”

Head covering: the evidence

- AORN cites 2 case reports of SSI linked to bacteria OR staff scalps
  - Then cites *3 reviews showing no effect*
  - 2017 review (N=27 studies): "there is no conclusive evidence that wearing a head covering can help prevent surgical site infections"
    - Much of the data is >10 yr old
    - No RCTs
    - Can't do RCTs because "the patients would be placed at risk in this type of study"
    - Concludes: we should do it anyway because no reason not to
- ACS cites 2 studies showing no effect of cap type

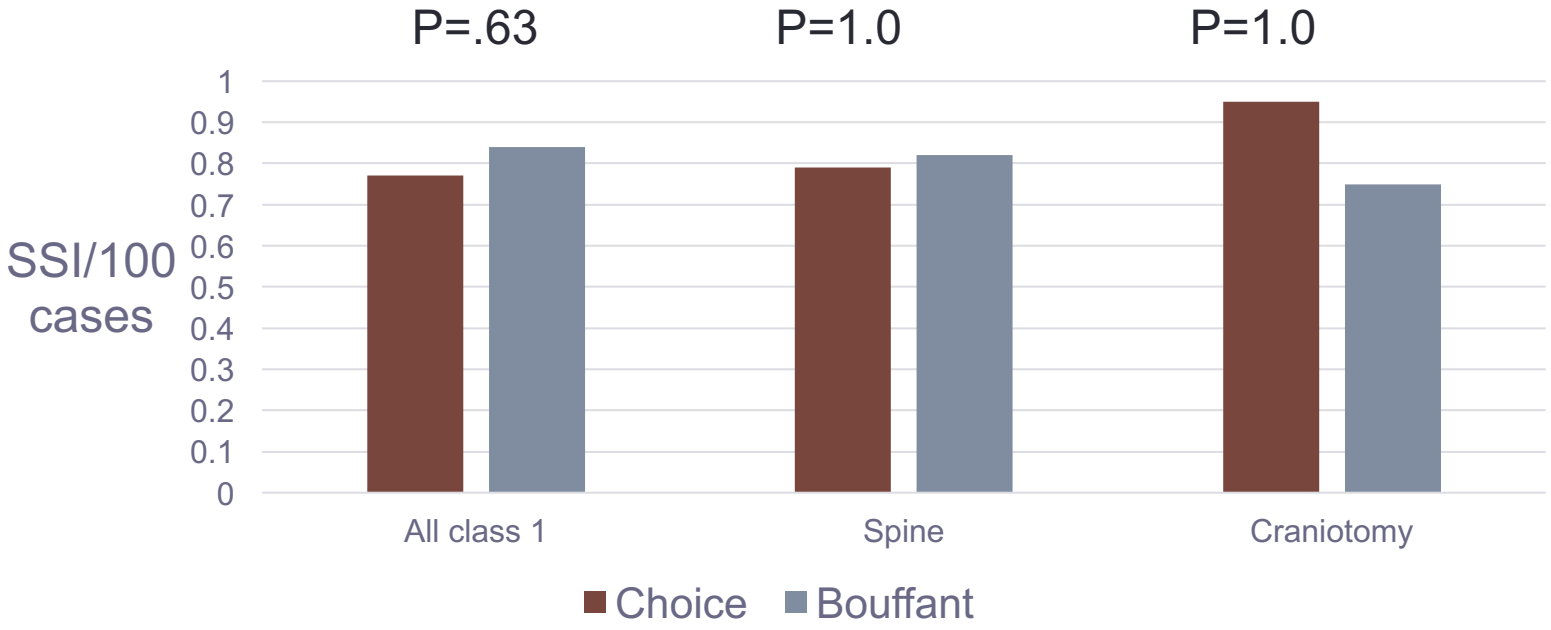
Settle plate investigation



Head coverings: epidemiology

- Rosen M 2017 (abstract): surgeon cap preference and SSIs
  - 6210 ventral hernia repairs, 86 surgeons
  - Cloth or disposable, bouffant or skull cap
  - No differences across all surgeons
  - Other risks did affect SSI: female, obesity, hypertension, surgery > 2h
- Before-after study of mandatory bouffant caps (Shallwani et al. 2017)

Mandatory Change From Surgical Skull Caps to Bouffant Caps Among Operating Room Personnel Does Not Reduce Surgical Site Infections in Class I Surgical Cases: A Single-Center Experience With More Than 15 000 Patients



Neurosurgery, 2017 (ePub); 2018 Apr 1;82(4):548-554

ACS/ASA experimental study

Hats Off: A Study of Different Operating Room Headgear Assessed by Environmental Quality Indicators

Markel et al., J Am Coll Surg 2017;225:573-581

J Am Coll Surg 2017;225:573-581

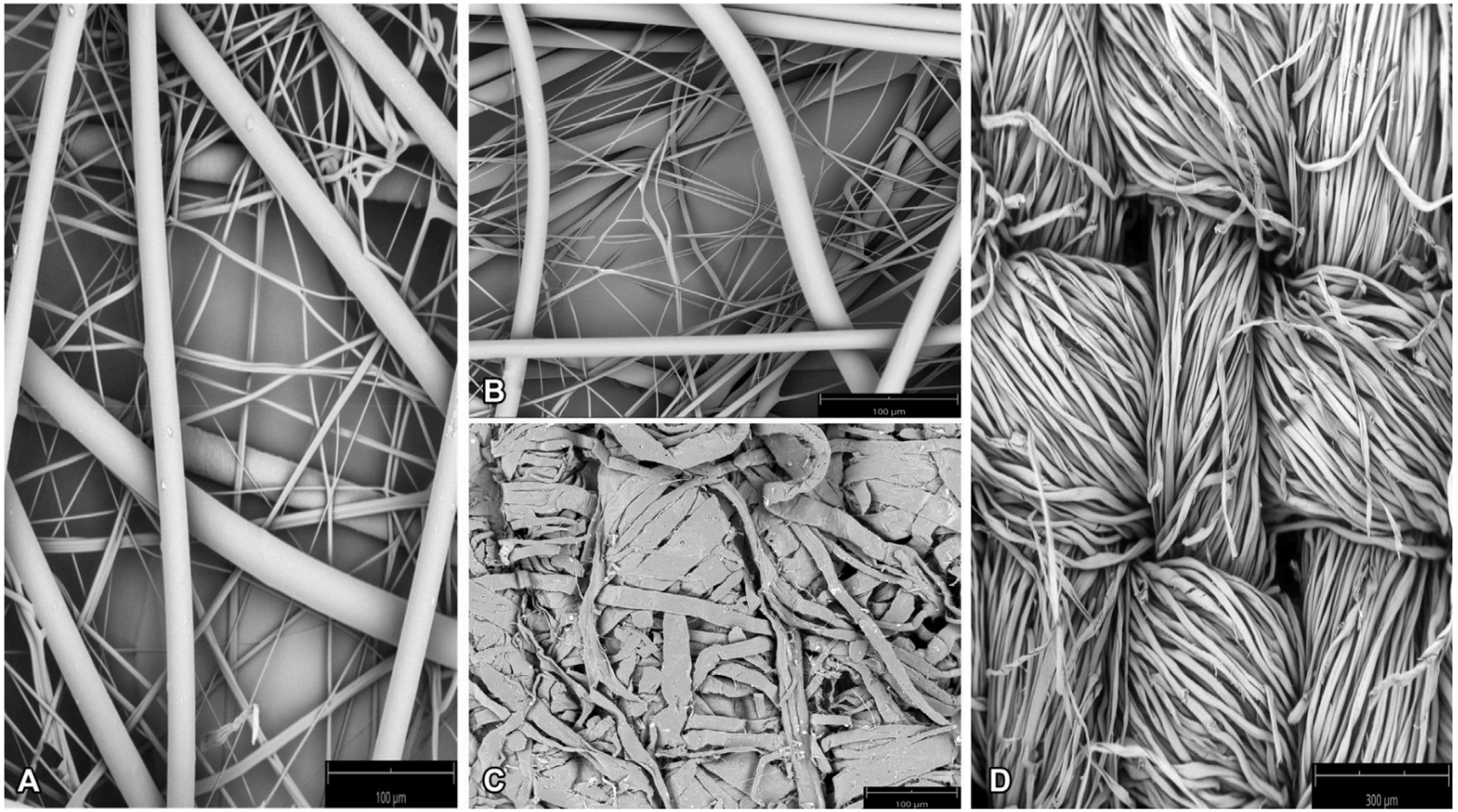


Figure 7. Electron microscopy. (A) Bouffant hats were visually identified with electron microscopy as having fairly porous material. (B) The crown of disposable skull caps also was made of a visually porous material. (C) The sides of the skull caps were visually less porous, as were (D) the cloth skull caps.

The art and science of surgery: Do the data support the banning of surgical skull caps?☆

Arturo J. Rios-Diaz, MD[a,*], Guillaume Chevrollier, MD[a], Hunter Witmer, BS[b], Christine Schleider, RN, BSN, CNOR[a], Scott Cowan, MD[a], Michael J. Pucci, MD[a], Francesco Palazzo, MD, FACS[a]

[a] *Department of Surgery, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA*
[b] *Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, PA*

- Before/after study of strict implementation of AORN recs
- 1951 cases, general and vascular
- SSI rate 5.3% before, 5.5% after (P=0.81)
- Multivariable model correcting for numerous potential confounders: OR 1.12 [0.73–1.71]; P=0.59

Surgery 2018; 164(5):921–925

Bouffant vs Skull Cap and Impact on Surgical Site Infection: Does Operating Room Headwear Really Matter?

Shanu N Kothari, MD, FACS, Madeline J Anderson, BS, Andrew J Borgert, PhD, Kara J Kallies, MS, Todd J Kowalski, MD

- Reanalysis of RCT of hair clipping, N=1543
- Surgeon preference for caps analyzed: 61% skull caps
- Overall SSI 8% bouffant vs. 5% skull caps, P=0.016
- Adjusting for case types, OR 1.0, P=NS

J Am College of Surgeons, 2018; *227*(2): 198–202

Operating Room Attire Policy and Healthcare Cost: Favoring Evidence over Action for Prevention of Surgical Site Infections

Adham Elmously, MD, Katherine D Gray, MD, Fabrizio Michelassi, MD, FACS, Cheguevara Afaneh, MD, FACS, Michael D Kluger, MD, FACS, Arash Salemi, MD, FACS, Anthony C Watkins, MD, Alfons Pomp, MD, FACS

- Before/after study of strict implementation of AORN recs
- Gen, neuro, cardiac, ortho, gyn over 4 years, N=30,493
- Propensity score matched for likelihood of surgery after recs implemented
- SSI rate 1.1% before, 1.0% after (odds ratio [OR], 0.9; 95% CI, 0.7-1.4, P=0.7)

J Am Coll Surg 2019; 228:98-106

Softening of recommendations coming?

- “In February, 2018, The Association of periOperative Registered Nurses (AORN) met with a task force comprised of the American College of Surgeons, American Society of Anesthesiologists, Association for Professionals in Infection Control and Epidemiology, Association of Surgical Technologists, and The Joint Commission to discuss the body of the evidence on surgical attire.”
- 1/2/19-2/22/19 public comments, “ready for publication in April, 2019”

Proposed AORN revisions

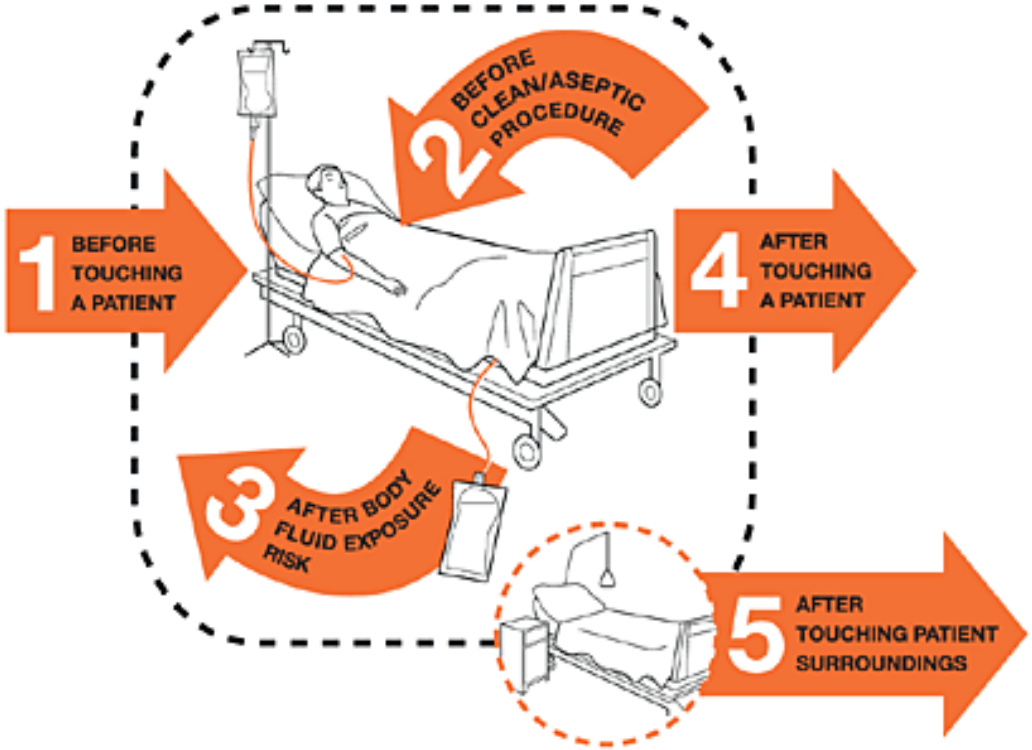
- Scrubs
  - Acknowledges conflicting evidence home laundering
  - Continues rec for hospital laundering, OK to home launder if high temp, tumble dry, iron
  - No recommendation: clothes under scrubs
- No recommendation: long sleeves in OR
- Masks moved out of document
- No recommendation: head covering type; rec's inter-disciplinary team determine policy

Conclusions

- Attire: almost no strong evidence regarding effect on SSI, other HAI
  - Modest effect of facility-based laundering on garment contamination
  - Shoes, shoe covers, caps, masks, long-sleeves: no supporting data
  - Covering apparel (white coats, etc): detrimental

Hand hygiene

HH opportunities in the OR and WHO 5 moments



HH opportunities/hour in the OR

- 34-54/hr (Masquerading RNs; Biddle, *Am J Inf Control,* 2012)
- 149 ± 10.3/hr (Video; Rowlands, *Am J Inf Control,* 2014)
  - Would require hand hygiene every 24 seconds
- Elsewhere: 4/patient contact, up to 20/hr in ICU (Boyce, *Am J Inf Control,* 2002)

Frequency, compliance of in-the-OR HH opportunities

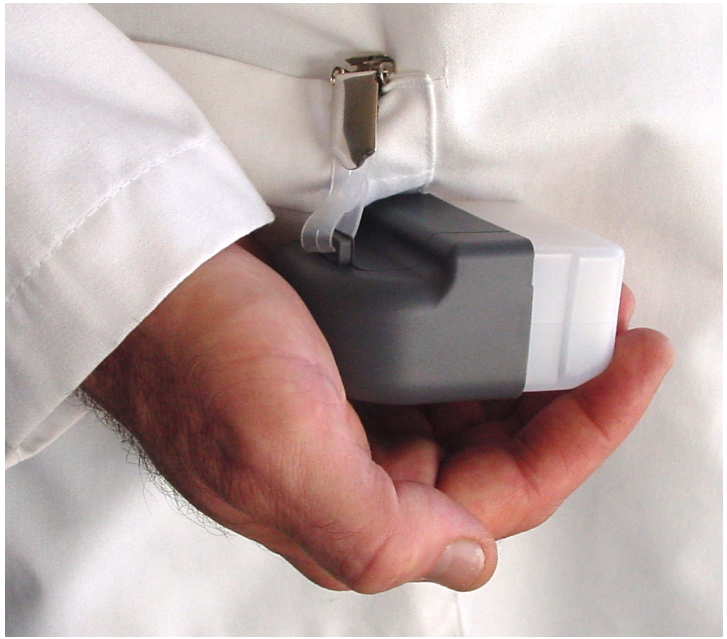
Overall compliance rates for hand hygiene (HH) (expressed as number of observed HH events relative to total observed opportunities) during 5 surgical cases requiring general anesthesia

Procedure	Observed HH events	Observed HH opportunities	Compliance rate (%)
Open repair of forearm fracture	4	174	2.3
Lumbar disc excision	7	226	3.1
Metacarpal pin placement	5	185	2.7
Hardware removal from ankle	6	167	3.6
Repair nasal septal deviation	6	200	3
Mean			2.9
Standard error of the mean			0.2

J. Rowlands et al. / American Journal of Infection Control 42 (2014) 698-701

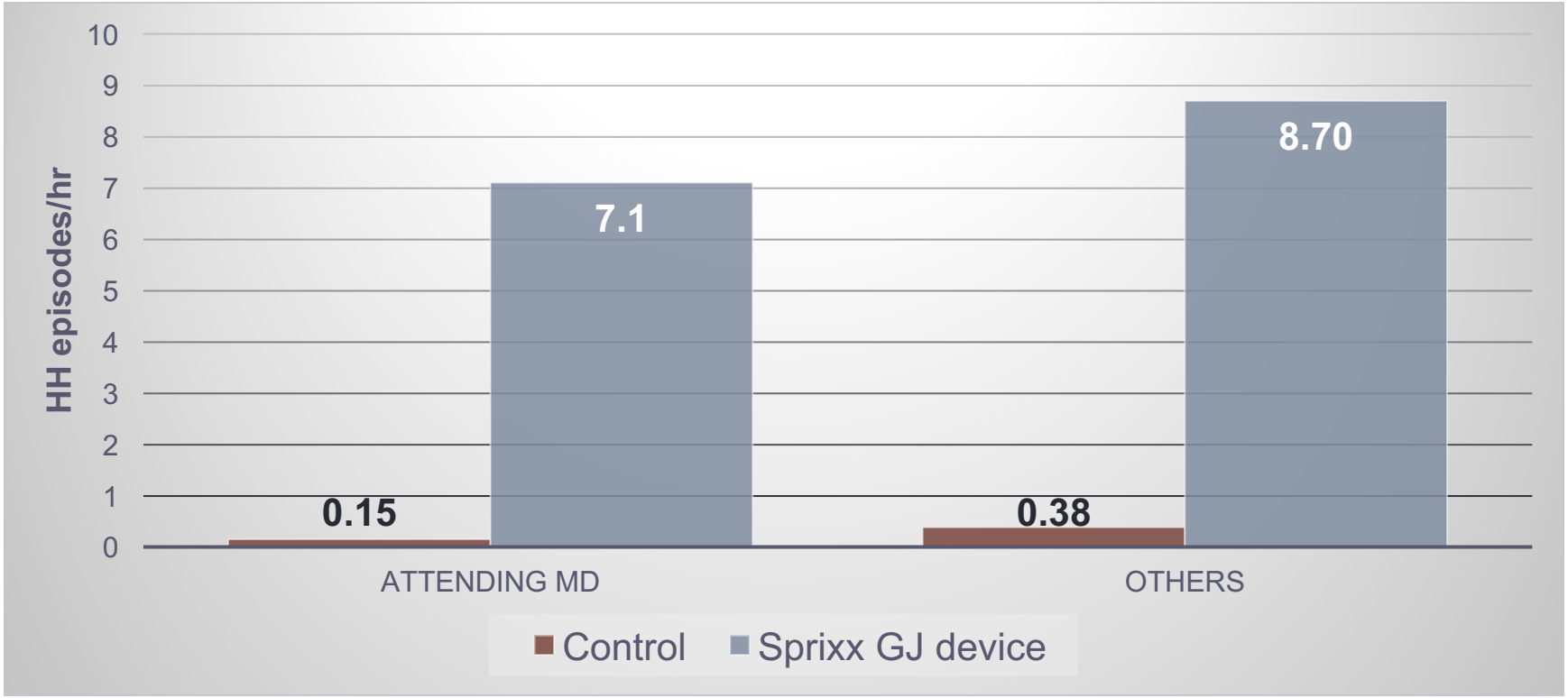
An evidence-based target

- Dartmouth Medical School attempts to ↑ HH



Koff et al. *Anesthesiology* 200

Increase in HH use



Increased HH improved outcomes

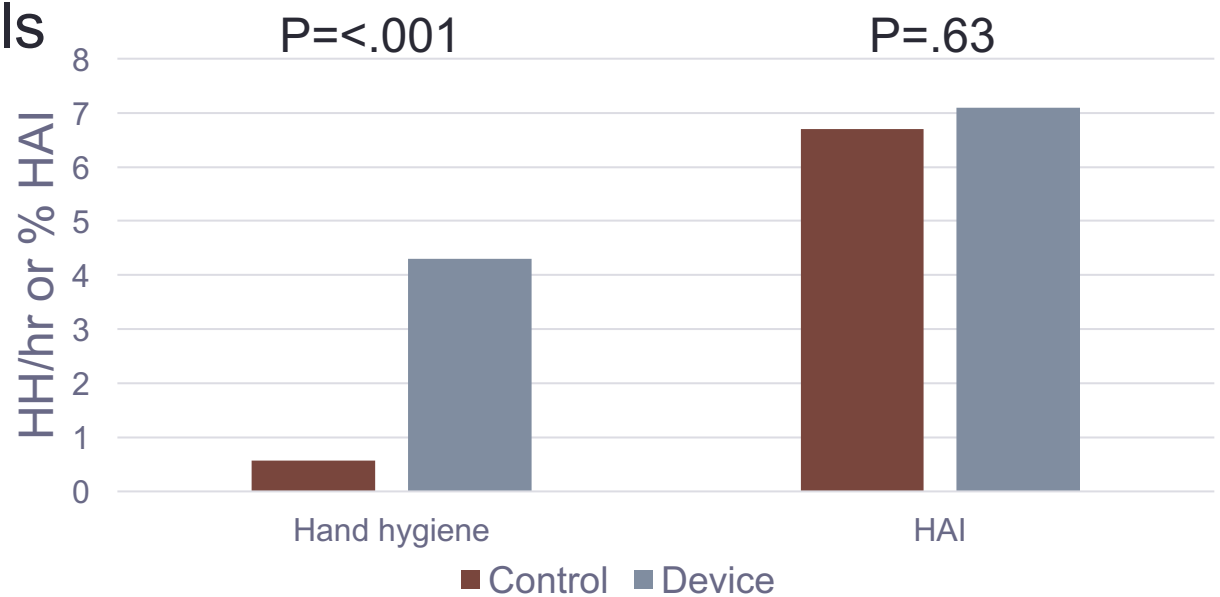
Outcome	Control	Device	OR
Stopcock contamination	32.8%	7.5%	0.17
Nosocomial infection (HAI)	17.2%	3.8%	0.19

Editorial (Hopf, Rollins): "The conclusion is inescapable: Poor hand hygiene by anesthesia providers contributes to HCAI, and we need to correct the problem."

Koff et al. *Anesthesiology* 200

RCT of HH device

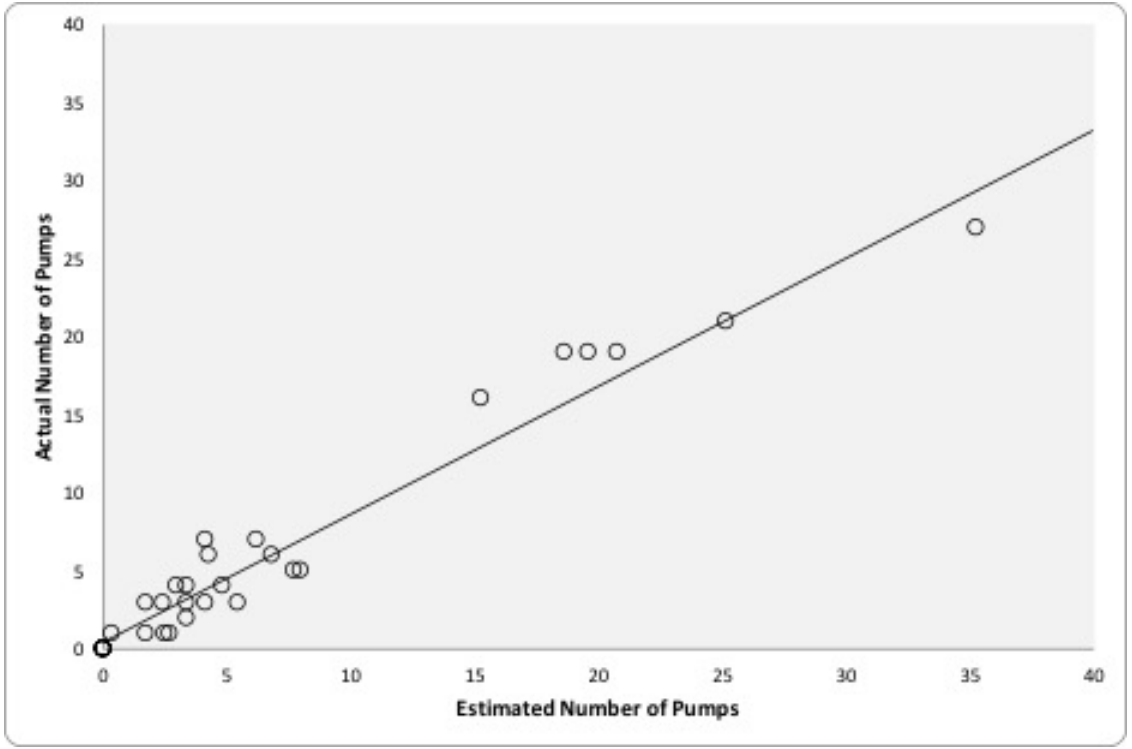
- Same group, randomized ORs to use of HH device or control (wall, anesthesia cart dispensers) at 2 academic hospitals



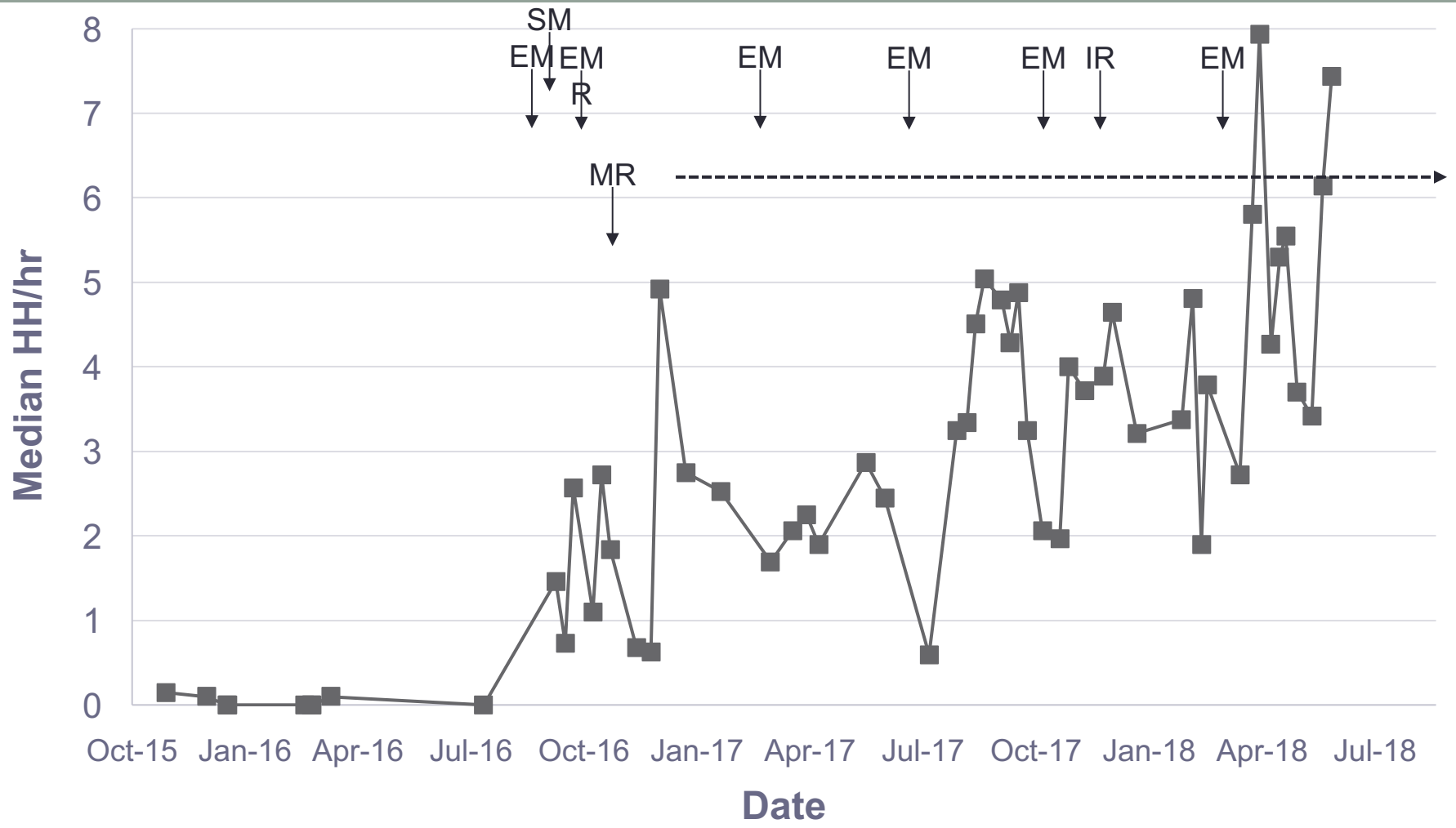
Koff et al., *Infect Control Hosp Epidemiol* 2016

A simpler method

- Container weighing before/after each case
- Weight/pump measured *in vitro*
- Weight change converted to estimated pumps
- Validated with ~100 hr video observation



Segal et al., in review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Conclusions

- Attire: almost no strong evidence regarding effect on SSI, other HAI
  - Modest effect of facility-based laundering on garment contamination
  - Shoes, shoe covers, caps, masks, long-sleeves: no supporting data
  - Covering apparel (white coats, etc): detrimental
- Hand hygiene: biologically plausible, some data supports positive effects