Infection Prevention after Surgery for EOS… Where Are We in 2014?

2014 ICEOS
Warsaw, Poland

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Disclosures

- **No relevant financial disclosures related to this talk**

- **Based on pediatric literature**

  ……..For the most part

Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$, current practice
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

The Problem

SPINE Volume 34, Number 1, pp 60–64
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Failure of Attempted Implant Retention in Spinal Deformity Delayed Surgical Site Infections

Daniel Hedequist, MD, Anne Haugen, BS, Timothy Hresko, MD, and John Emans, MD

- **Mean hospital charges:**
  - $154,537 ($26,977-$961,722)
- **Indirect costs:**
  - Missed work, school, psychological
- **Pay for performance**
- **Bundled care**

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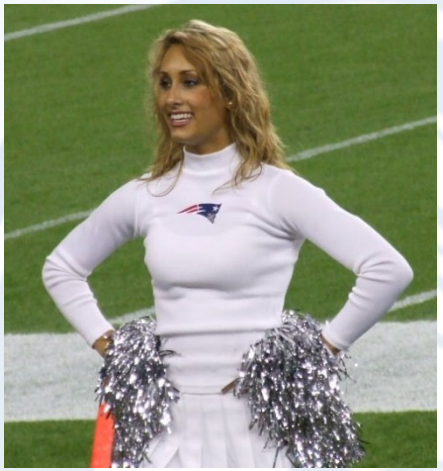
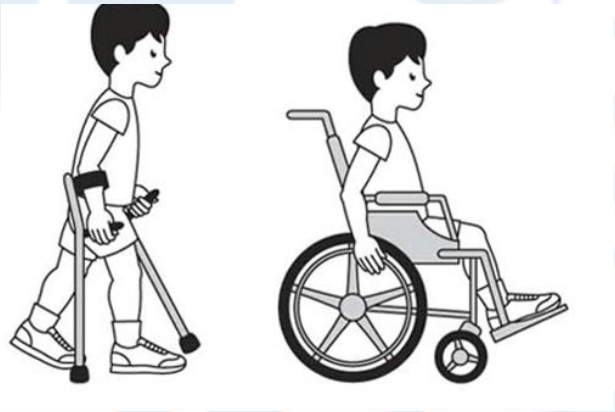
What is the Infection Rate?

Infection Rate

- **AIS:**
  - 0.5-6.7%
- **Neuromuscular:**
  - 4.3-14.3%
- **Myelodysplasia:**
  - 6.1-30%





What's the Evidence? Systematic Literature Review of Risk Factors and Preventive Strategies for Surgical Site Infection Following Pediatric Spine Surgery

Michael P. Glotzbecker, MD, Matthew D. Riedel, BA,† Michael G. Vitale, MD, MPH,† Hiroko Matsumoto, MA,† David P. Roye, MD,† Mark Erickson, MD,‡ John M. Flynn, MD,§ and Lisa Saiman, MD, MPH‖¶*

J Pediatr Orthop 2013;33:479–487

Infection Rate

- **AIS:**
  - 0.5-6.7%
- **Neuromuscular:**
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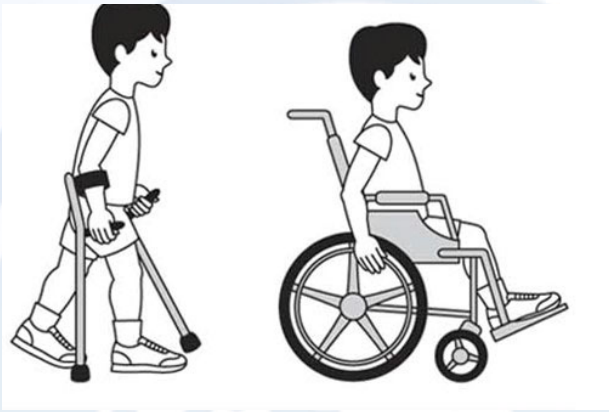
- **Myelodysplasia:**
  - 6.1-30%



- **Repetitive procedures in patients with poor nutrition and medical comorbidities**

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J Pediatr Orthop 2013;33:479–487

What is Infection Rate?

VEPTR (10-32%)

- **Emans Spine 2005:**
  - 3/31 (10%)
- **Campbell JBJS 2004:**
  - 3/27 (11%)
- **Smith et al Spine Deformity 2011:**
  - 16/97 (16%)
- **Garg Spine 2014:**
  - 38/213 (18%)
- **Sankar Spine 2010:**
  - 6/19 (32%)

Growing Rods (7-40%)

- **Klemme JPO 1997:**
  - 5/67 (7%)
- **Akbarnia Spine 2005:**
  - 2/23 (9%)
- **Yang Spine 2011:**
  - 5/49 (10%)
- **Kabirian JBJS 2014**
  - 42/379 (11%)
- **Bess JBJS 2010:**
  - 15/140 (14%)
- **McElroy Spine 2011:**
  - 11/80 (14%)
- **Sankar Spine 2010:**
  - 4/10 (40%)

What is Infection Rate for Growing Rods?

- **379 patients**
- **2344 procedures**
- **Min 2 year follow up**

- **42 patients developed infection (11.1%)**
  - 10 (2.6%) before first lengthening
  - 29 (7.7%) during lengthening
  - 3 after final fusion

Deep Surgical Site Infection Following 2344 Growing-Rod Procedures for Early-Onset Scoliosis

Risk Factors and Clinical Consequences

Nima Kabirian, MD, Behrooz A. Akbarnia, MD, Jeff B. Pawelek, BS, Milad Alam, MD, Gregory M. Mundis Jr., MD, Ricardo Acacio, MD, George H. Thompson, MD, David S. Marks, FRCS, FRCS(Ortho), Adrian Gardner, MRCS, FRCS(Tr&Ortho), Paul D. Sponseller, MD, MBA, David L. Skaggs, MD, MMM, and the Growing Spine Study Group

J Bone Joint Surg Am. 2014;96:e128(1-8)

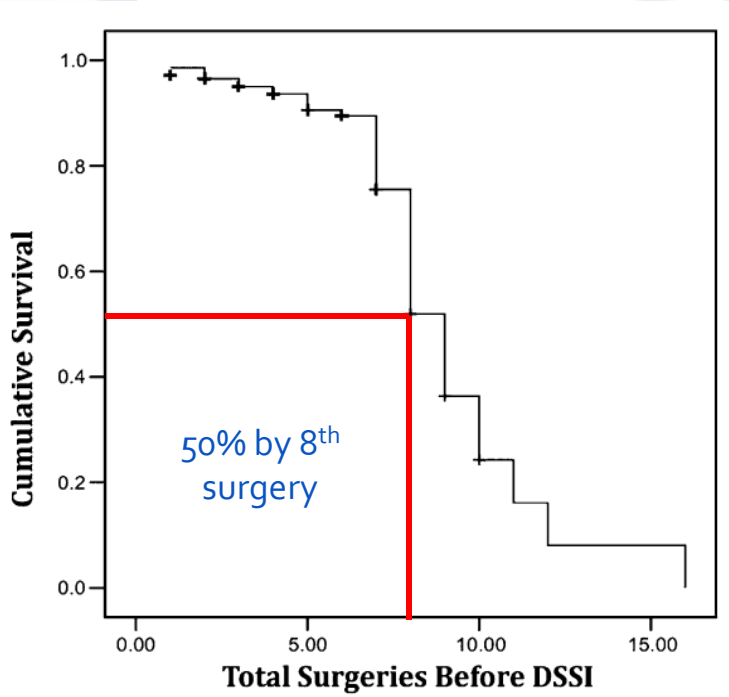

Fig. 1
Kaplan-Meier survival analysis of the cumulative survival of all patients, with deep surgical site infection (DSSI) as the end point.

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What is Infection Rate In VEPTR?

- **<u>Unpublished Data:</u>**
- **Overall Infection Rate:**
  - 18% (38 of 213)
- **55 total infection events (1497 total procedures)**
- 37% increase in odds each time incision opened

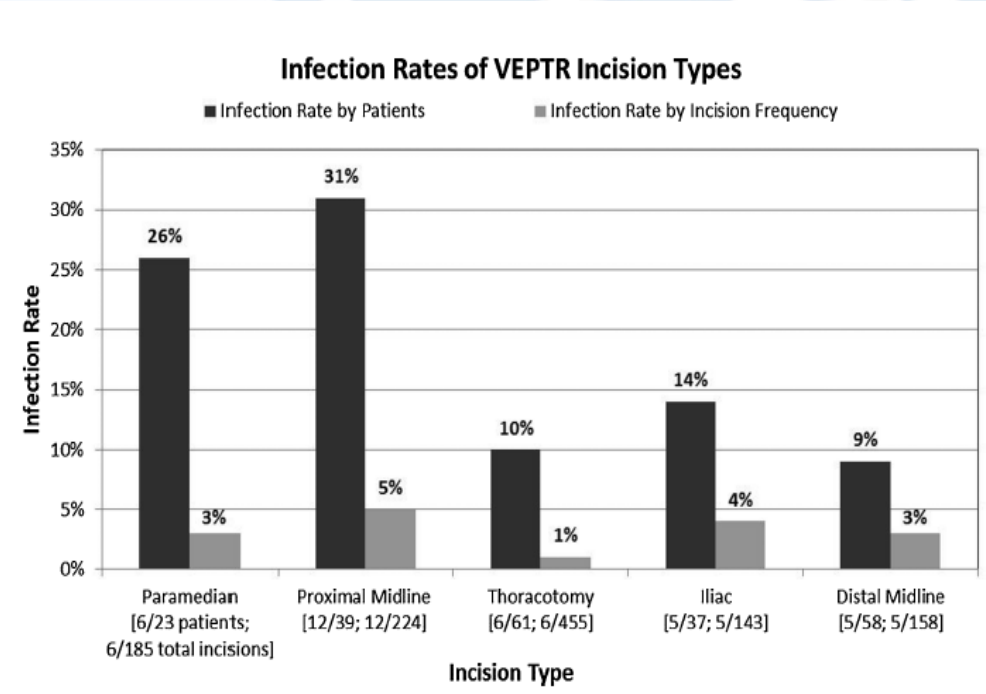
Spine

SPINE Volume 39, Number 00, pp 1-5

CLINICAL CASE SERIES

Wound Complications of VEPTR Incisions

Sumeet Garg, MD,*†‡ Jaren LaGreca, BA,* Tricia St. Hilaire, BS,‡ Dexiang Gao, PhD,†
Michael Glotzbecker, MD,‡§ Ying Li, MD,¶ John T. Smith, MD,‡‖ and Jack Flynn, MD‡**



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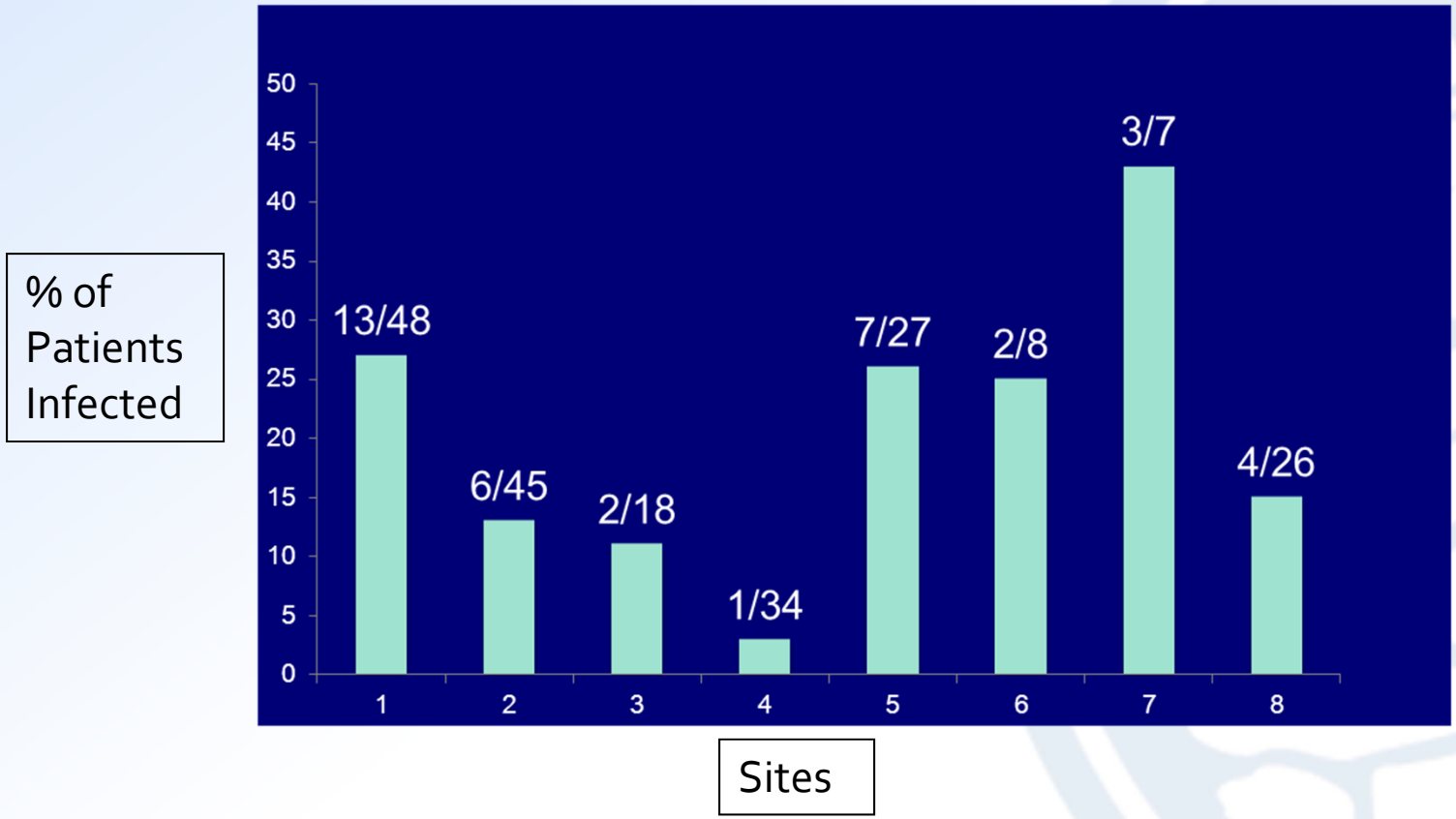
What is Infection Rate In VEPTR?

- **By site: 2.9% to 42.9% (p=0.029)**



Outline

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  - Is there a consensus?
- ***Treatment***

What do we know?

What Do We Know?
Microbiology

- ***Staphylococcus aureus (25%)***
  - *MRSA (10.7%)*
- ***Coag neg Staphylococcus (17%)***
- **Pseudomonas**
- **P. acnes (late)**
- **47% polymicrobial (Gram neg)**

Table 2. Infecting Pathogen

Pathogen	Patients (n = 53)
Coagulase negative *Staphylococcus*	47% (25)
S. aureus	17% (9)
Polymicrobial	15% (8)
Enterococcus	6% (3)
Pseudomonas	6% (3)
No growth	6% (3)
E. coli	4% (2)
Enterobacter	4% (2)
Pepetostreptococcus	4% (2)

DICAL SCHOOL
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Surgical Site Infection Following Spinal Instrumentation for Scoliosis

A Multicenter Analysis of Rates, Risk Factors, and Pathogens

W.G. Stuart Mackenzie, BS, MA, Hiroko Matsumoto, MA, Brendan A. Williams, BA, Jacqueline Corona, MD, Christopher Lee, MD, Stephanie R. Cody, BS, Lisa Covington, RN, MPH, Lisa Saiman, MD, MPH, John M. Flynn, MD, David L. Skaggs, MD, David P. Roye Jr., MD, and Michael G. Vitale, MD, MPH

SPINE Volume 32, Number 24, pp 2739–2744

Management of Infection After Instrumented Posterior Spine Fusion in Pediatric Scoliosis

Christine Ho, MD,* David L. Skaggs, MD,† Jennifer M. Weiss, MD,† and Vernon T. Tolo, MD†

What Do We Know? Microbiology

Kabirian et al, Smith et al, Garg et al

Infecting Organism	N
MSSA	25
MRSA	9
Escherichia Coli	5
Enterococcus spp.	3
No Growth	3
Coag Neg Staph	2
Streptococcus spp.	2
Other	2
Bacillus spp.	1
Stenotrophomonas maltophilia	1
Staphylococcus Warneri	1
Klebsiella oxytoca	1
Candida Albicans	1
Staphylococcus epidermidis	1

TABLE III Microorganisms Detected at the Initial Infection and Subsequent Recurrences

	Initial Infection	First Recurrence	Second Recurrence	Third Recurrence	Fourth Recurrence	Total No.	Total %
Single isolate							
Staphylococcus aureus	24	6	4			34	49
Methicillin-resistant *Staphylococcus aureus* (MRSA)	2	1				3	4
Staphylococcus epidermidis	2	2				4	6
Enterococcus faecalis	2	2				4	6
Escherichia coli	1		1			2	3
Pseudomonas aeruginosa	1					1	1
Group-A Streptococcus	1					1	1
Propionibacterium acnes	1					1	1
Mixed isolates							
Skin flora		1	1			2	3
Pseudomonas aeruginosa, Staphylococcus aureus	1	1				2	3
Enterococcus faecalis, Escherichia coli, and Streptococcus	1					1	1
Proteus mirabilis, Staphylococcus aureus	1					1	1
Escherichia coli, Staphylococcus aureus, Streptococcus	1					1	1
Acinetobacter baumannii, Staphylococcus aureus		1				1	1
Culture not specified	4	3	2	2	1	12	17
Total	42	17	8	2	1	70	100

TABLE 1. Organisms Identified and Associated With VEPTR Infection

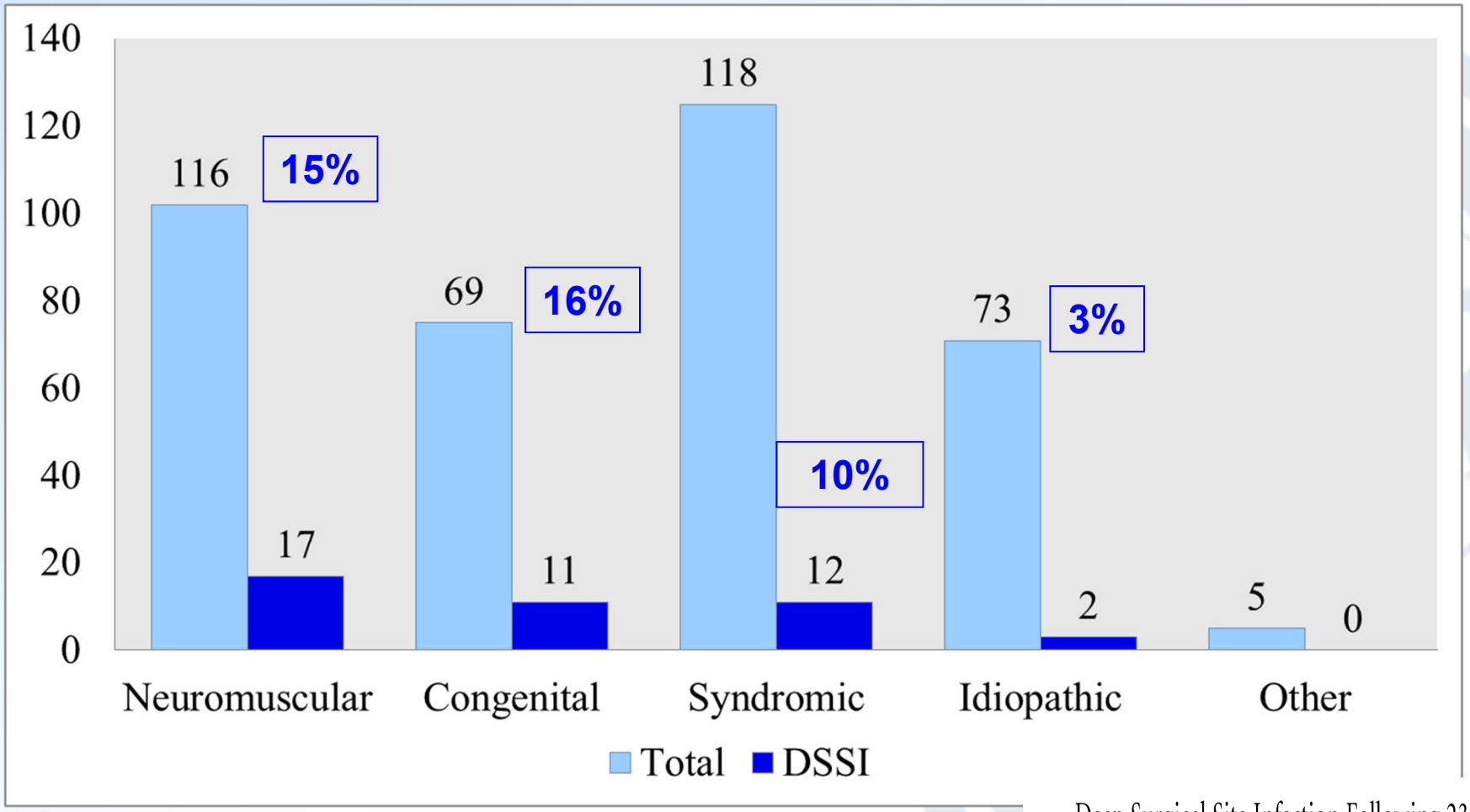
Organism	
Staphylococcus aureus	15
Propionibacterum acnes	1
Gram + cocci	1
Pseudomonas	1
Staphylococcus epidermidus	1

What Do We Know?
Risk Factors

- **Patient Related**
  - Diagnosis, ASA, obesity, malnutrition

- **Surgery Related**
  - Hypothermia, OR time, drains, metal type, instrumentation to pelvis

Incidence of DSSI in different etiologies



Deep Surgical Site Infection Following 2344 Growing-Rod Procedures for Early-Onset Scoliosis

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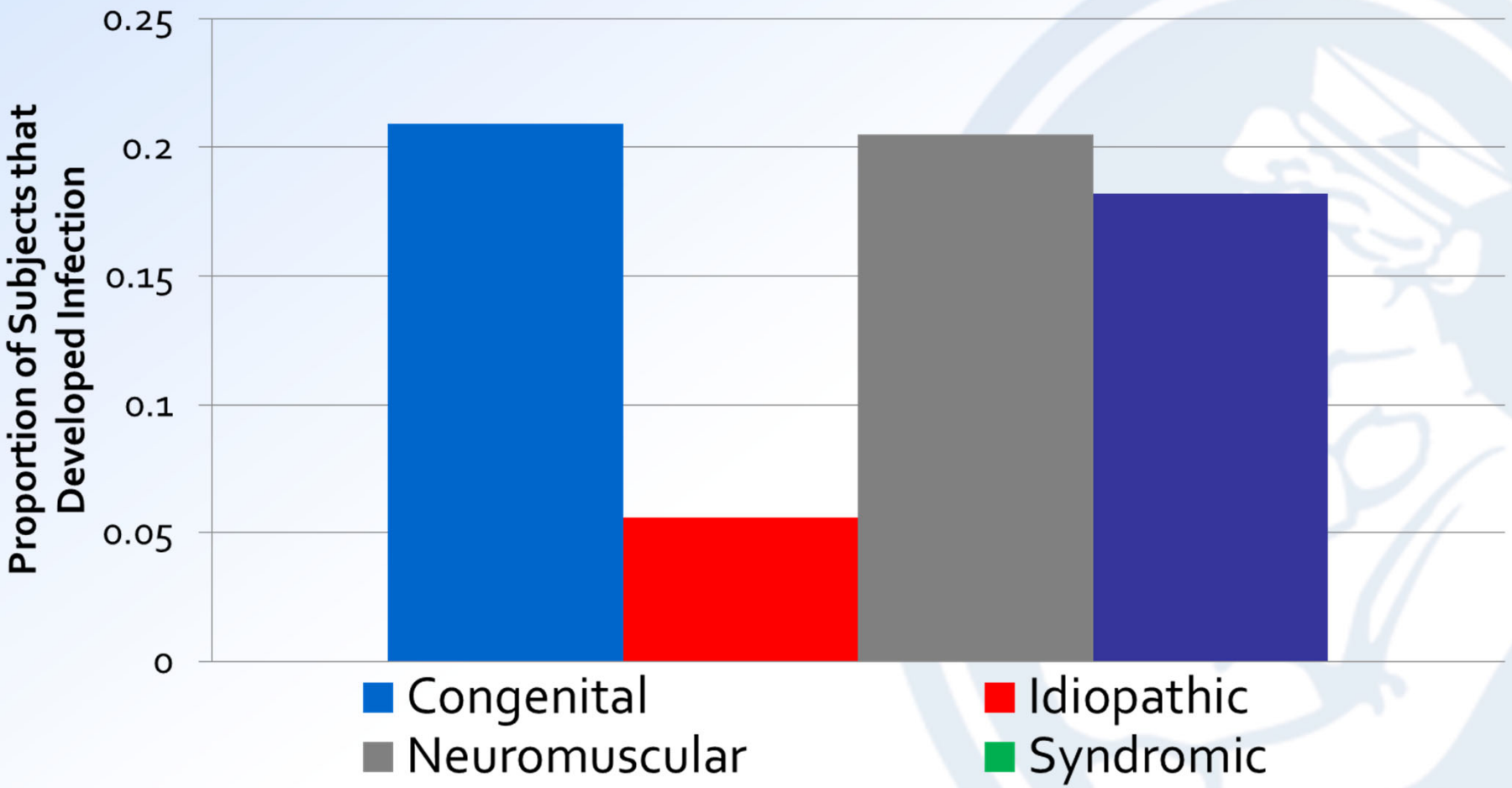
VEPTR



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Garg et al

Risk Factors—Specific to EOS

- **<u>Increased risk of infection:</u>**
  - Stainless steel (OR=5.7)
    - 30/221 (13.6%) vs 12/150 (8%)
  - Non-ambulatory status (OR=2.9)
  - Number of revisions (OR=3.3)


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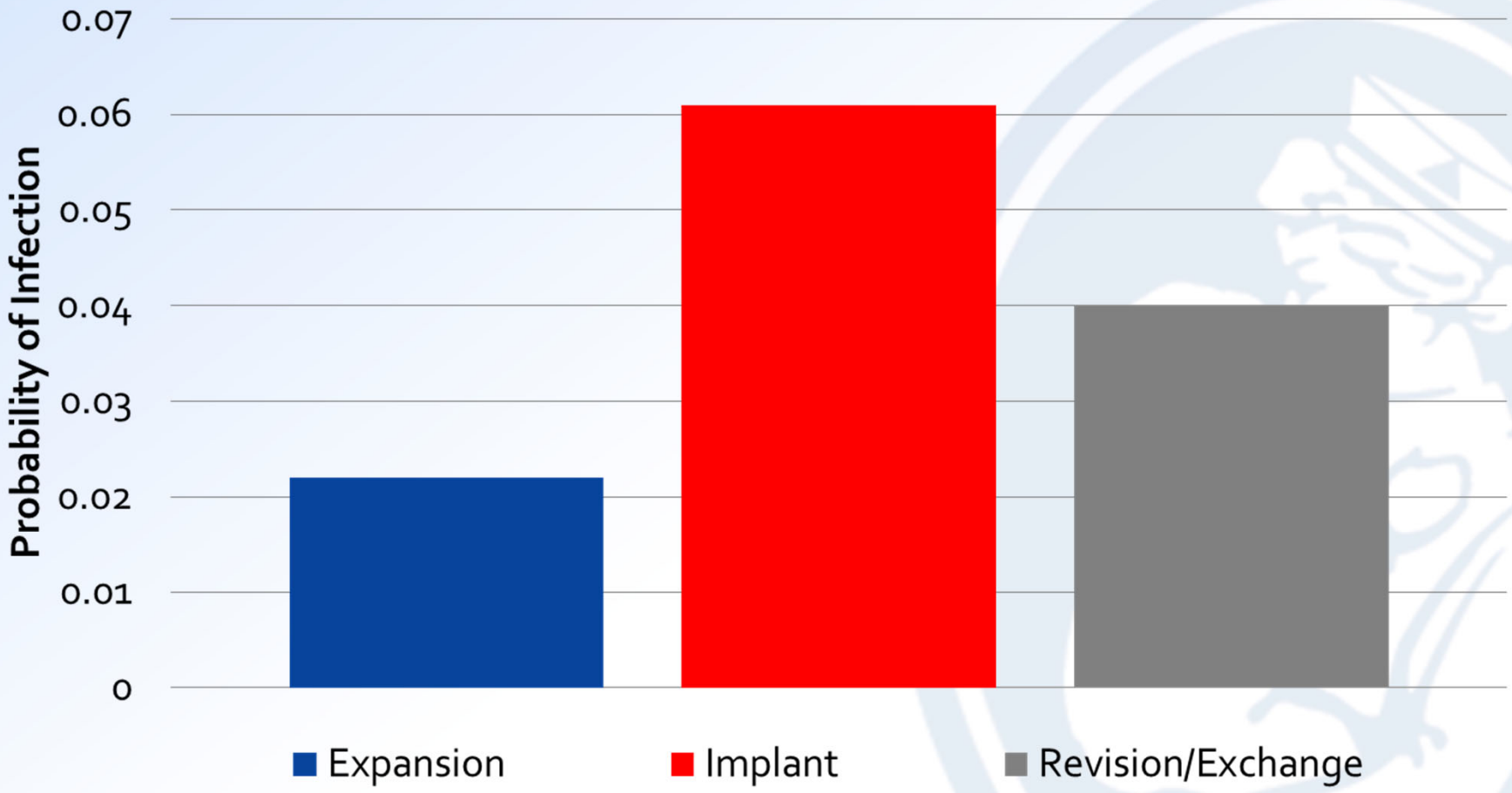
VEPTR



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Garg et al

Patient Related Risk Factors: Nutrition

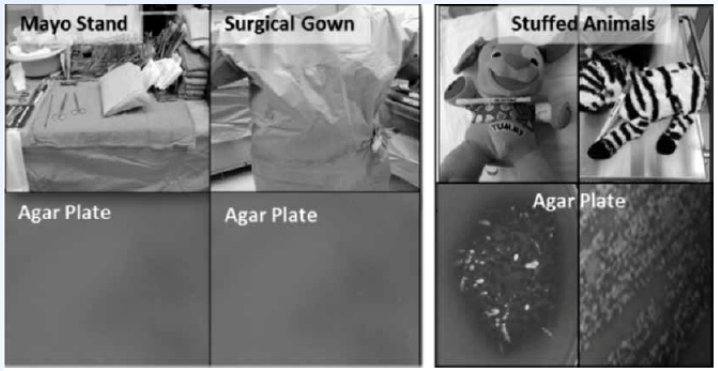
- **Lower infection in CP/Myelo:**
  - **Albumin >3.5 mg/dL**
  - **TLC >1500 cells/mm³**
  - **HCT>33g/L**

- **VEPTR population:**
  - **Low BMI (16.2)**
  - **Low ANC (8.2)**

NOT PROVEN BUT PROBABLY APPLIES TO THIS POPULATION

Wound/Implant Contamination

- **23% positive intraoperative tissue cultures**



- 9.5% contamination rate
  - Covered implants: 2%
  - Uncovered implants: 16.7%

Spine (Phila Pa 1976). 2013 Apr 15;38(8):E482-6. doi: 10.1097/BRS.0b013e3182893be1.

Prevalence of intraoperative tissue bacterial contamination in posterior pediatric spinal deformity surgery.

Nandyala SV[1], Schwend RM.

Sat., 5/4/13 Infection, Paper #105, 9:32 AM POSNA–2013

Stuffed Animals in the Operating Room: A Reservoir of Bacteria?

Jonathan G. Schoenecker, MD, PhD; Michael Held; Michelle Wise; Lynda O'Rear
Vanderbilt University Medical Center, Nashville, Tennessee

ELSEVIER
The Spine Journal 13 (2013) 637–640
THE SPINE JOURNAL

Clinical Study

Implant contamination during spine surgery

Jesse E. Bible, MD, MHS[a,*], Kevin R. O'Neill, MD[a], Colin G. Crosby, MD[a], Jonathan G. Schoenecker, MD, PhD[a], Matthew J. McGirt, MD[b], Clinton J. Devin, MD[a]

What Do We Know?: Reducing Risk with Intrawound Antibiotics

NO DATA FOR THIS POPULATION

Basic Science: Intrawound Vancomycin

Intrawound Vancomycin Powder Eradicates Surgical Wound Contamination

An in Vivo Rabbit Study

Lukas P. Zebala, MD, Tapanut Chuntarapas, MD, Michael P. Kelly, MD, Michael Talcott, DVM, Suellen Greco, DVM, and K. Daniel Riew, MD

Investigation performed at the Departments of Orthopaedic Surgery and Comparative Medicine, Washington University in St. Louis, St. Louis, Missouri

- **20 rabbits laminectomy + wire placement**
- **Wound innoculated**
  - Cefazolin and vanco sensitive *S. Aureus*
- **Intrawound vanco given in half**
- **Tissue bacteria growth@ day 4**
  - 39/40 and 0/40

What Do We Know?: Reducing Risk with Intrawound Antibiotics

- **Sweet et al:**
  - Infection rate 2.6% vs 0.2%
- **O'Neill et al:**
  - Vancomycin powder reduced risk 13% to 0% after traumatic injuries
- **Molinari et al:**
  - Low rate of infection (0.86%), no complications
- **Rahman et al:**
  - Infection rate 5% vs 0.7%, no complications

Spine
SURGERY

SPINE Volume 36, Number 24, pp 2084–2088
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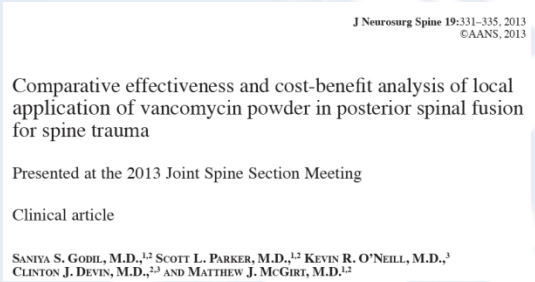
Intrawound Application of Vancomycin for Prophylaxis in Instrumented Thoracolumbar Fusions

Efficacy, Drug Levels, and Patient Outcomes

Fred A. Sweet, MD, Michael Roh, MD, and Christopher Sliva, MD



J Neurosurg Spine 19:331–335, 2013
©AANS, 2013

Comparative effectiveness and cost-benefit analysis of local application of vancomycin powder in posterior spinal fusion for spine trauma

Presented at the 2013 Joint Spine Section Meeting

Clinical article

Saniya S. Godil, M.D.,[1,2] Scott L. Parker, M.D.,[1,2] Kevin R. O'Neill, M.D.,[3] Clinton J. Devin, M.D.,[2,3] and Matthew J. McGirt, M.D.[1,2]

Sweet, F., C. Silva, and M. Roh, *Intra-wound application of vancomycin for prophylaxis in instrumented thoracolumbar fusions.* Proceedings of the NASS 24th Annual Meeting, 2009.

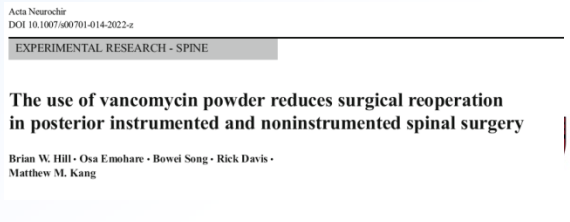
O'Neill, K.R., et al., *Reduced surgical site infections in patients undergoing posterior spinal stabilization of traumatic injuries using vancomycin powder.* Spine J, 2011. **11**(7): p. 641-6.

Molinari, W.J., O. Khera, and R.W. Molinari, *Prophylactic Operative Site Powdered Vancomycin and Postoperative Deep Spinal Wound Infection: 1512 Consecutive Surgical Cases during a Six-Year Period [Abstract 37].* Presented at teh Scoliosis Research Society 46th Annual Meeting and Course, Louiville, Kentucky. September 14-17, 2011.

Rahman, R.K., et al., *Intrawound Vancomycin Lowers the Acute Deep Wound Infection Rate in Adult Spinal Deformity Patients.* Presented at teh Scoliosis Research Society 46th Annual Meeting and Course, Louiville, Kentucky. September 14-17, 2011.

Other Favorable Studies

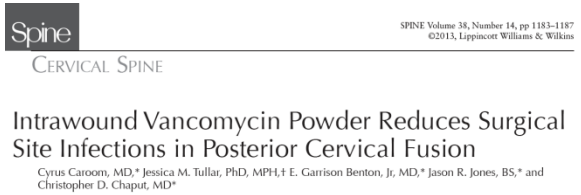
- **Strom et al:**
  - 10.9→2.5% C spine
- **Caroom et al:**
  - 15→0% C spine
- **Hill et al:**
  - 4→0% various procedures
- **Heller et al:**
  - 3.8→1.1% adult deformity


Acta Neurochir
DOI 10.1007/s00701-014-2022-z

EXPERIMENTAL RESEARCH - SPINE

The use of vancomycin powder reduces surgical reoperation in posterior instrumented and noninstrumented spinal surgery

Brian W. Hill · Osa Emohare · Bowei Song · Rick Davis · Matthew M. Kang


Spine

SPINE Volume 38, Number 14, pp 1183–1187
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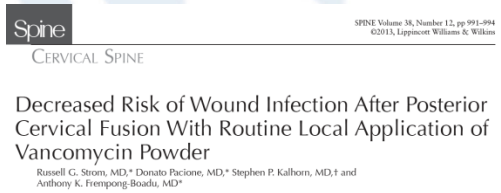
CERVICAL SPINE

Intrawound Vancomycin Powder Reduces Surgical Site Infections in Posterior Cervical Fusion

Cyrus Caroom, MD,* Jessica M. Tullar, PhD, MPH,† E. Garrison Benton, Jr, MD,* Jason R. Jones, BS,* and Christopher D. Chaput, MD*


Spine

SPINE Volume 38, Number 12, pp 991–994
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CERVICAL SPINE

Decreased Risk of Wound Infection After Posterior Cervical Fusion With Routine Local Application of Vancomycin Powder

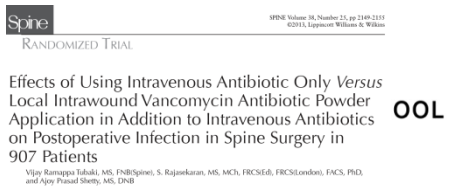
Russell G. Strom, MD,* Donato Pacione, MD,* Stephen P. Kalhorn, MD,† and Anthony K. Frempong-Boadu, MD*

Wait a Minute….

- **Martin et al:**
  - Adult deformity surgery: 5.1 vs 5.3%
- **Ghobrial et al:**
  - High incidence of seromas and polymicrobial/gram negative
- **Tubaki et al:**
  - 1.68 vs 1.61% various adult surgeries
  - No difference if infection rate low?


Spine
SURGERY

Experience With Intrawound Vancomycin Powder for Spinal Deformity Surgery


Spine
RANDOMIZED TRIAL

Effects of Using Intravenous Antibiotic Only *Versus* Local Intrawound Vancomycin Antibiotic Powder Application in Addition to Intravenous Antibiotics on Postoperative Infection in Spine Surgery in 907 Patients

OOL

Are we creating resistant organisms?

But What About Kids?

- **87 consecutive patients**
- **500mg local vanco children >25 lbs**
- **Creatinine:**
  - No change
- **Serum Vanco:**
  - Undetectable in serum day 1 and 4

Spine
SURGERY

SPINE Volume 38, Number 19, pp 1703-1707

Adjunctive Vancomycin Powder in Pediatric Spine Surgery is Safe

Itai Gans, BS,*† John P. Dormans, MD,* David A. Spiegel, MD,* John M. Flynn, MD,*
Wudbhav N. Sankar, MD,* Robert M. Campbell, MD,* and Keith D. Baldwin, MD, MSPT, MPH*†

Can We Use What We Know About Older Children?

What's the Evidence? Systematic Literature Review of Risk Factors and Preventive Strategies for Surgical Site Infection Following Pediatric Spine Surgery

Michael P. Glotzbecker, MD, Matthew D. Riedel, BA,† Michael G. Vitale, MD, MPH,† Hiroko Matsumoto, MA,† David P. Roye, MD,† Mark Erickson, MD,‡ John M. Flynn, MD,§ and Lisa Saiman, MD, MPH‖¶*

TABLE 3. Perioperative Factors Associated With Surgical Site Infections After Pediatric Spinal Surgery

Grades of Evidence	Recommended Intervention
Grade A	Compared to autograft, ceramic bone graft substitute does not increase risk of SSI
Grade B	Gram-negative pathogens are more frequent in neuromuscular populations
	Inappropriate perioperative antibiotic prophylaxis increases risk of SSI
	Increased implant prominence increases risk of SSI
	Compared to newer generation titanium implants, first-generation stainless steel implants increases risk of *delayed* SSI
Grade C	Blood loss increases risk of SSI
	Blood transfusions increases risk of SSI
	No. levels fused increases risk of SSI
	Extension of fusion to the sacrum/pelvis increases risk of SSI
	Prolonged operative time increases risk of SSIType of allograft increases risk of SSI
	Use of drains reduces risk of SSI

SSI indicates surgical site infection.

TABLE 2. Association of Patient-related Risk Factors and SSI After Pediatric Spinal Surgery

Grades of Evidence	
Grade A	None
Grade B	Underlying medical condition/neuromuscular disease increases risk of SSI
	Urinary or bowel incontinence increases risk of SSI
Grade C	Positive urine culture increases risk of SSI
	Preoperative or postoperative malnutrition increases risk of SSI
	Obesity increases risk of SSI

SSI indicates surgical site infection.

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- ***What is the problem?***
  - Infection rate, benchmarks, $$, current practice
- ***What do we know?***
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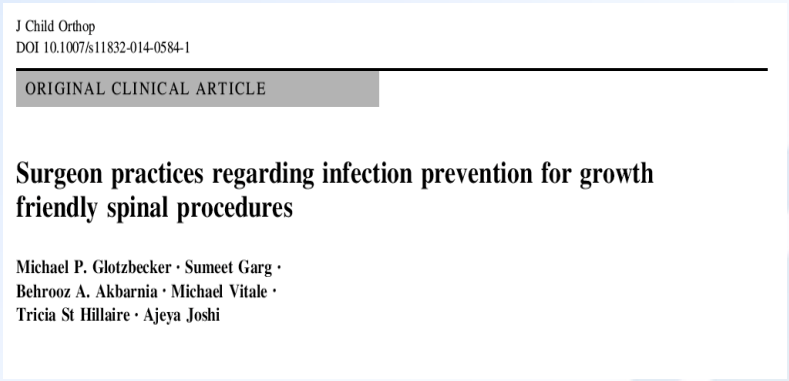
- ***Treatment***

What is Current Practice?



J Child Orthop
DOI 10.1007/s11832-014-0584-1

ORIGINAL CLINICAL ARTICLE

Surgeon practices regarding infection prevention for growth friendly spinal procedures

Michael P. Glotzbecker · Sumeet Garg · Behrooz A. Akbarnia · Michael Vitale · Tricia St Hillaire · Ajeya Joshi

- **19 question survey developed by authors**
  - Survey monkey
  - Tested amongst authors prior to sending to group
- **Sent to 57 GSSG and CSSG members**
  - 40 responses (70%)

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GSF Growing Spine Foundation

CHILDREN'S SPINE STUDY GROUP

What is Current Practice?

- **Significant Variability**

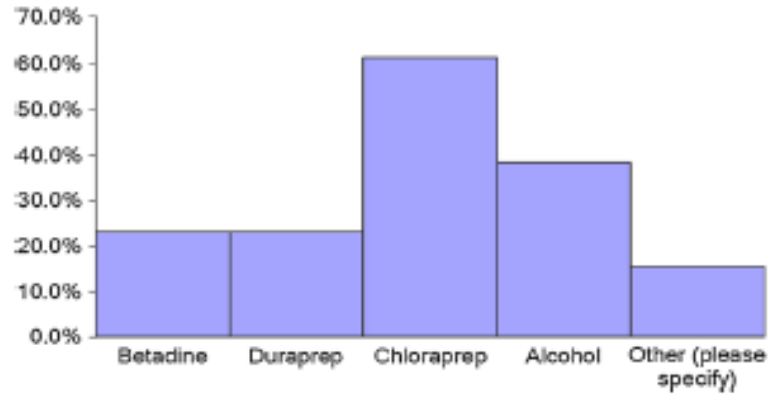


Fig. 1 Graphical depiction of variability in skin preparation prior to surgery amongst surgeons surveyed

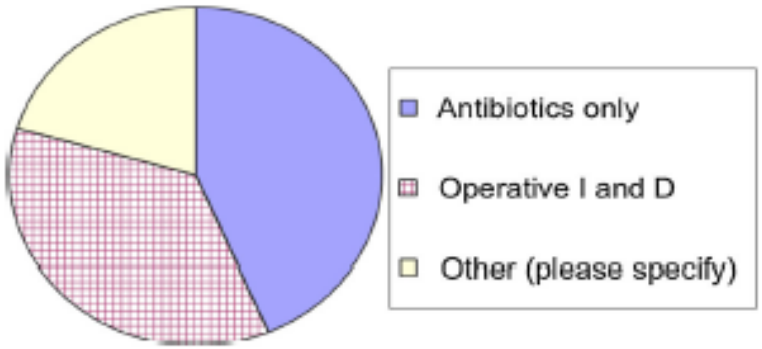


Fig. 2 Variable approach of surgeons toward a superficial infection

Conclusions: Lots of Equipoise

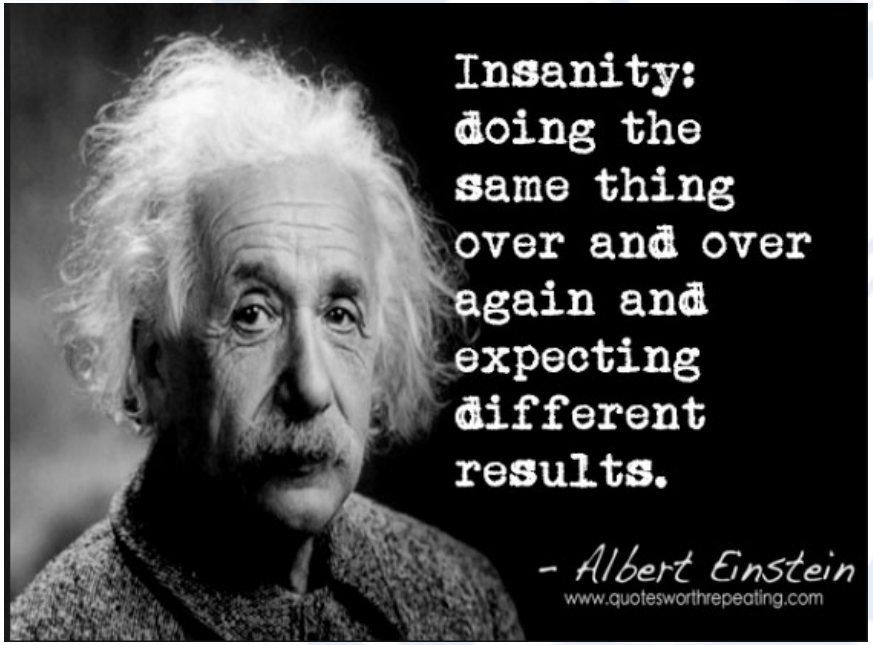
Table 1:
Surveyed questions with relative equipoise or wide variability

Intervention	Responses	
Preoperative MRSA screening	30.8% yes	69.2% no
Preoperative chlorhexidine baths	46.1% yes	51.3% no
Postoperative antibiotic duration after insertion	64.1% 24 hours or less	33.3% greater than 24 hours
Use of topical antibiotics (vancomycin)	41% yes	49% no
Use of drains for insertion procedures	41.1% yes	48.7% no
Use of IV gram negative coverage	12.8% routinely	10.2% in incontinent patients
Use of perioperative IV vancomycin	5.1% routinely	17.9% used based on MRSA culture
Skin preparation	Betadine (23.1%) duraprep® (23.1%) chloraprep® (61.5%) alcohol (38.5%)	

Is There a Consensus?

Best Practice Guidelines

- Need to strive to achieve best practices
- Reduce variability



Best Practice Guidelines

- **Consensus statement for what is best practice**
  - Systematic literature review (done)
  - Current practice survey (done)
  - ARS/Delphi method

  - Define steps to a work product
    - Is it possible in this population?
    - Should we just recommend using BPG for high risk?

Best Practice Guidelines

Building Consensus: Development of a Best Practice Guideline (BPG) for Surgical Site Infection (SSI) Prevention in High-risk Pediatric Spine Surgery

Michael G. Vitale, MD, MPH, Matthew D. Riedel, BA,* Michael P. Glotzbecker, MD,† Hiroko Matsumoto, MA,* David P. Roye, MD,* Behrooz A. Akbarnia, MD,‡ Richard G. E. Anderson, MD, FACS, FAAP,§ Douglas L. Brockmeyer, MD,‖*

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TABLE 4. Final Best Practice Guidelines: Consensus Recommendations to Prevent Surgical Site Infections in High-risk Pediatric Spine Surgery

	Consensus (%)		
	Total	Strongly Agree	Agree
1. Patients should have a chlorhexidine skin wash at home the night before surgery.*	91	61	30
2. Patients should have preoperative urine cultures obtained and treated if positive.*	91	26	65
3. Patients should receive a preoperative Patient Education Sheet.*	91	48	43
4. Patients should have a preoperative nutritional assessment.*	96	57	39
5. If removing hair, clipping is preferred to shaving.†	100	61	39
6. Patients should receive perioperative intravenous cefazolin.*	91	65	26
7. Patients should receive perioperative intravenous prophylaxis for gram-negative bacilli.*	95	65	30
8. Adherence to perioperative antimicrobial regimens should be monitored (ie, agent, timing, dosing, redosing, cessation).*	96	61	35
9. Operating room access should be limited during scoliosis surgery whenever practical.*	96	61	35
10. Ultraviolet lights need not be used in the operating room.*	87	48	39
11. Patients should have intraoperative wound irrigation.*	100	83	17
12. Vancomycin powder should be used in the bone graft and/or the surgical site.†	91	48	43
13. Impervious dressings are preferred postoperatively.†	91	56	35
14. Postoperative dressing changes should be minimized before discharge to the extent possible.†	91	52	39

*These interventions reached consensus after the first round of voting.

Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$, current practice
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

Growing Rods

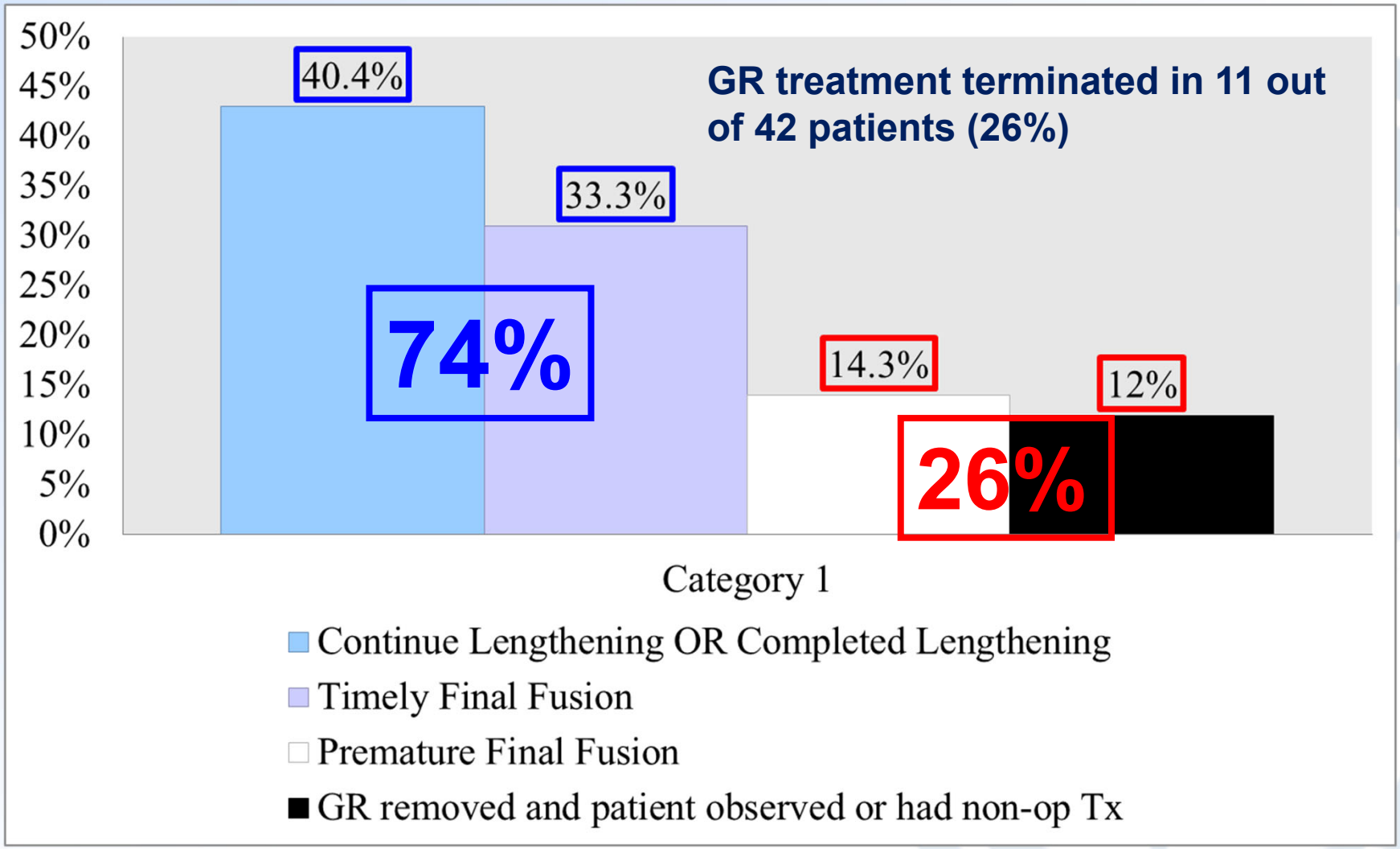
Deep Surgical Site Infection Following 2344 Growing-Rod Procedures for Early-Onset Scoliosis

Risk Factors and Clinical Consequences

Nima Kabirian, MD, Behrooz A. Akbarnia, MD, Jeff B. Pawelek, BS, Milad Alam, MD, Gregory M. Mundis Jr., MD, Ricardo Acacio, MD, George H. Thompson, MD, David S. Marks, FRCS, FRCS(Ortho), Adrian Gardner, MRCS, FRCS(Tr&Ortho), Paul D. Sponseller, MD, MBA, David L. Skaggs, MD, MMM, and the Growing Spine Study Group

- **52% (22) implant removal**
  - Complete 13, partial 9
- **14/22 after first SSI, 8/22 after recurrence**
- **Average duration between initial detection of infection and implant removal 1.6 yrs**
- **74% (31/42) completed GR treatment (16) or were still lengthening (15) at latest follow up**

Final outcome at final FU



VEPTR

Spine
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DEFORMITY

Can Infection Associated With Rib Distraction Techniques Be Managed Without Implant Removal?

John T. Smith, MD, and Melissa S. Smith, CPNP

TABLE 2. Rate of Treatment Success With Debridement and Antibiotics

Resolution	
Initial treatment	13
Second treatment	3
Third treatment	2
Fourth treatment	1

- **97 patients, 678 procedures**
- **19 infections, 16 patients**
- **IV abx avg 58 day, oral 34 days**
- **None required implant removal**

Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

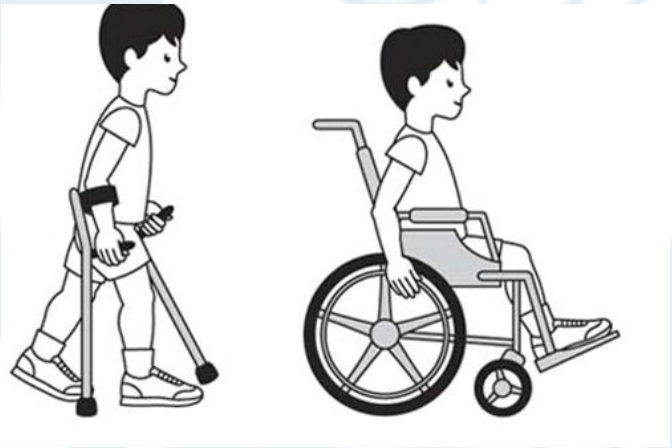
-Infections expensive
-Rates too high
-True risk unknown

Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

-Disease matters

-? Many factors to sort out



Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

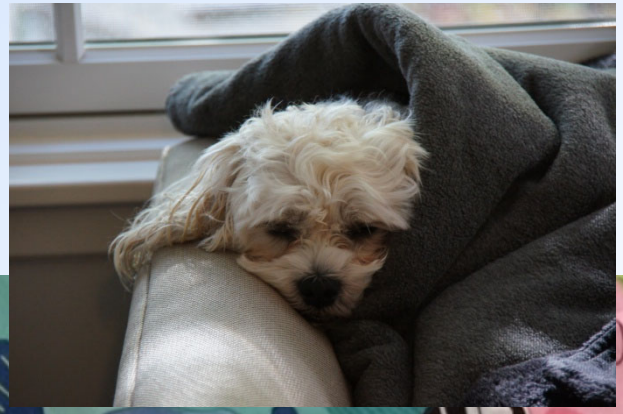
-No consensus
-Multicenter effort
-CPG/SCAMPS needed

Outline

- ***What is the problem?***
  - Infection rate, benchmarks, $$
- ***What do we know?***
  - What are the risk factors?
  - What reduces infection risk?
- ***Where are we going?***
  - Is there a consensus?
- ***Treatment***

May be able to retain implants and/or continue lengthening

Michael.glotzbecker@childrens.harvard.edu



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