

**SSI Prevention for Colectomy
Bowel Prep – Yes or No?
and
What About Oral Antibiotics?
and
Is there a “Best” I.V. Antibiotic?
And
What About All the Other Stuff?**

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Relative Benefit from Antibiotic Surgical Prophylaxis

<u>Operation</u>	<u>Prophylaxis (%)</u>	<u>Placebo (%)</u>	<u>NNT*</u>
Colon	4-12	24-48	3-5
Other (mixed) GI	4-6	15-29	4-9
Vascular	1-4	7-17	10-17
Cardiac	3-9	44-49	2-3
Hysterectomy	1-16	18-38	3-6
Craniotomy	0.5-3	4-12	9-29
Spinal operation	2.2	5.9	27
Total joint repl	0.5-1	2-9	12-100
Brst & hernia ops	3.5	5.2	58

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When I started my residency in 1970 all patients having colectomy got a bowel prep as inpatients before their operation, and we had just seen the first widely believed paper that demonstrated a beneficial effect of parenteral prophylactic antibiotics for patients having GI operations. Oral antibiotics were not used.

Effect of Mechanical Bowel Prep on Colon Flora (\log_{10})

	<u>Coliforms</u>	<u>Bacteroides</u>	<u>Clostridia</u>
No Prep	4.5 – 7.5	7.9 – 9.5	1.8 – 3.6
Prep	3.0 – 4.3	7.8 – 9.0	0.7 – 2.5

Nichols. Dis Col & Rect 1971; 14: 123-7

Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

	<u>Any SSI</u>
Placebo (63)	27 (43%)
Neomycin (68)	28 (41%)
Neo + Tetracycline (65)	3 (5%)

p<0.01

Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

	<u>Any SSI</u>
Placebo (63)	27 (43%)
Neomycin (68)	28 (41%)
Neo + Tetracycline (65)	3 (5%)

p<0.01

Antibiotic and Mechanical Bowel Prep for Colectomy (18 hrs)

	<u>Any SSI</u>
Placebo (56)	26 (43%)
Neo + Erythro (56)	5 (9%)
	p=0.0001

Clarke. Ann Surg 1977; 186:251-9

Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

	<u>Any SSI</u>
Placebo (59)	25 (42%)
Neo + Metronidazole (51)	9 (18%)

p<0.01

Matheson. Br J Surg 1978; 65:597-600

Antibiotic and Mechanical Bowel Prep for Colectomy (48 hrs)

	<u>Any SSI</u>
Placebo (39)	16 (41%)
Kanamycin + Erythro (38)	3 (8%)
	p<0.001

Wapnick. Surgery 1979; 85:317-21

Antibiotic and Mechanical Bowel Prep for Colectomy (18 - 48 hrs)

Bowel Prep +	<u>Placebo</u>	<u>Oral Ab</u>
1974	43%	5%
1977	43%	9%
1978	42%	18%
1979	41%	8%

Colorectal Prophylaxis: Oral vs Parenteral Duration of Operation

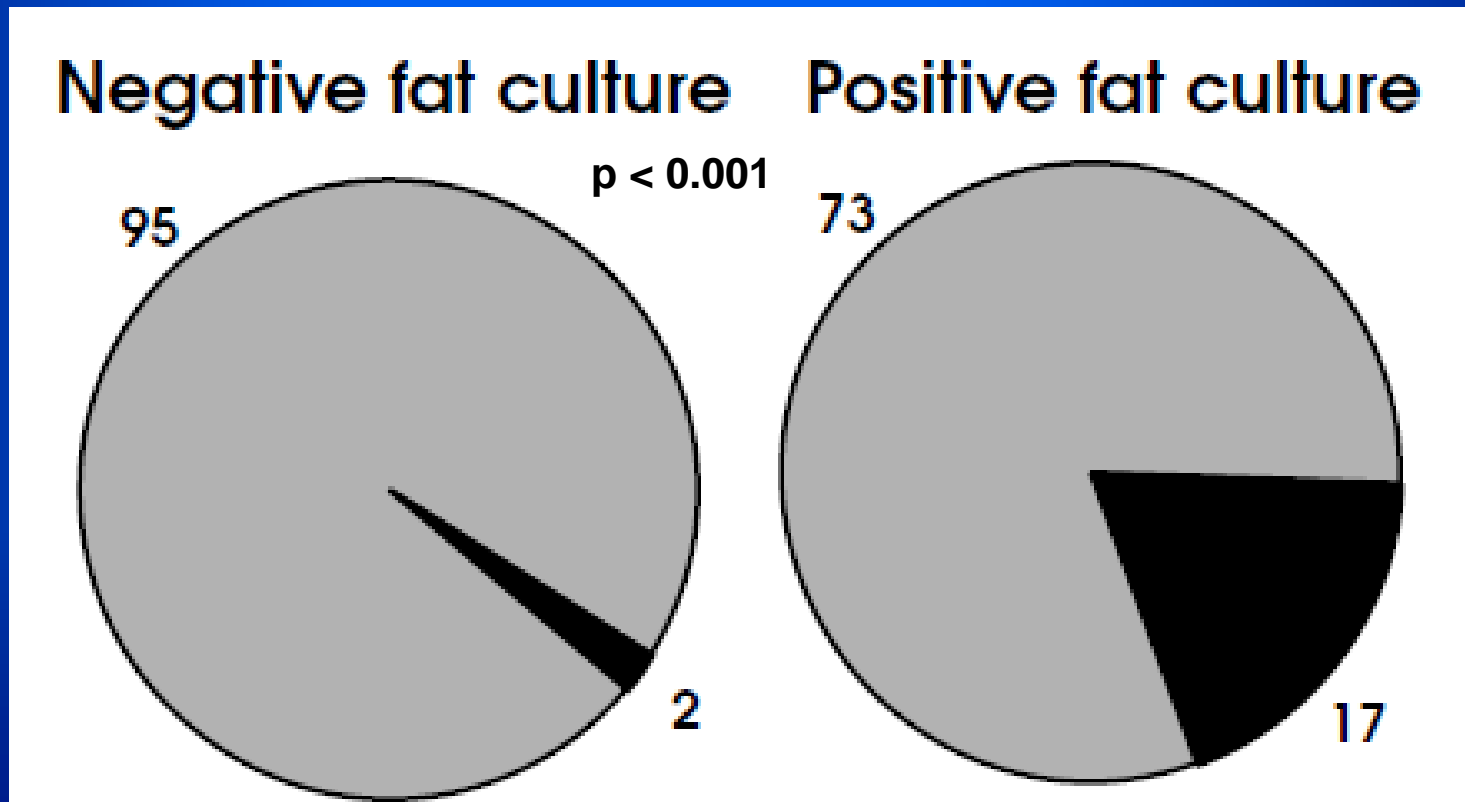
Duration	Cefoxitin	Neo/Erythro
< 4 h	5%*	4%
≥ 4 h	36%*†	0†

* $P < .01$.

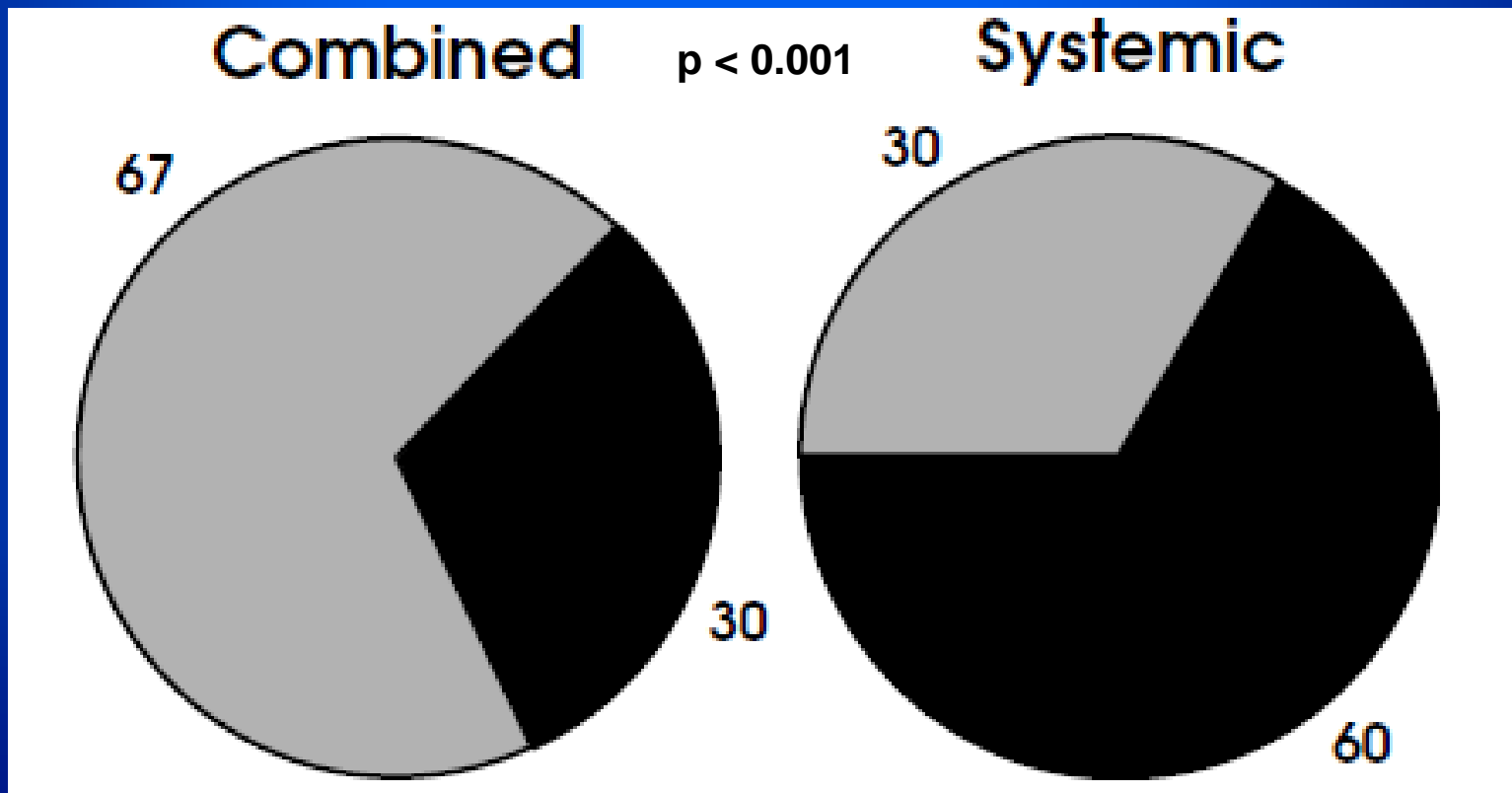
† $P < .05$.

Sometime in the 1980's most American and Canadian surgeons adopted oral antibiotic regimens while most European surgeons abandoned oral antibiotics.

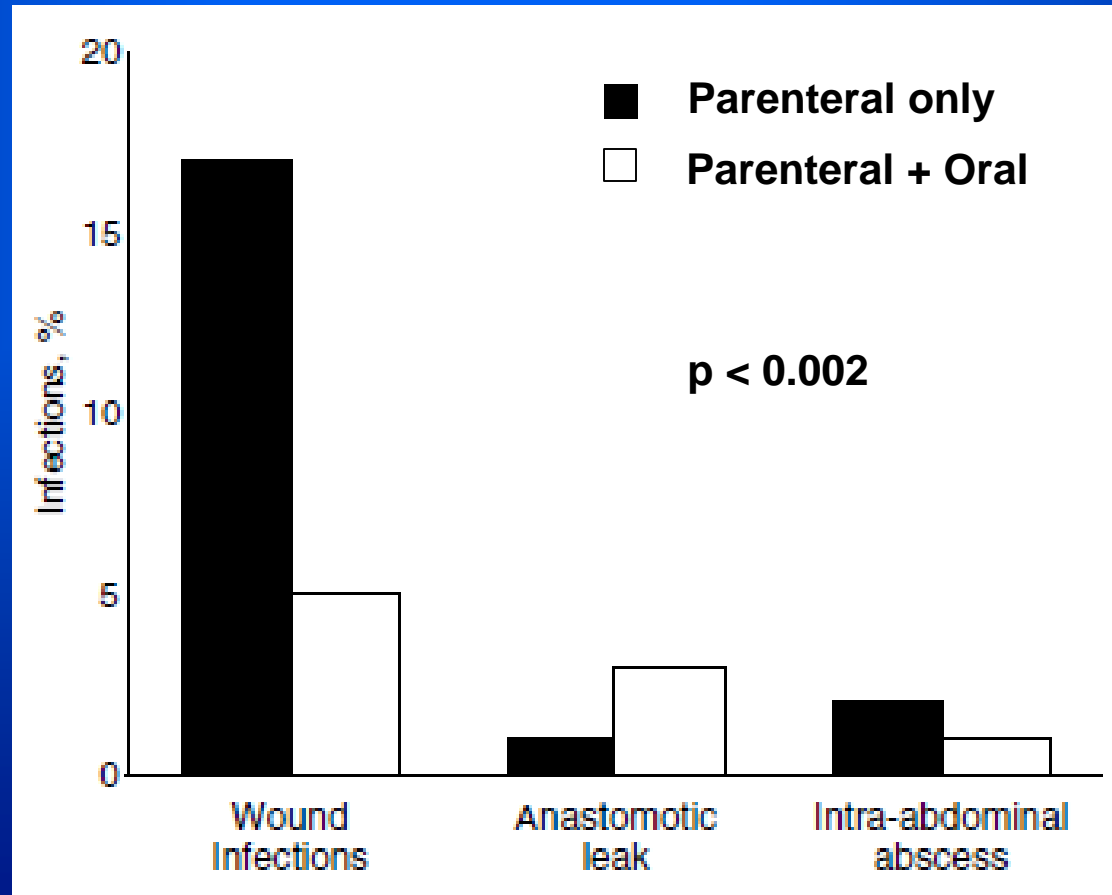
Correlation of Wound Culture with Subsequent SSI after Colectomy



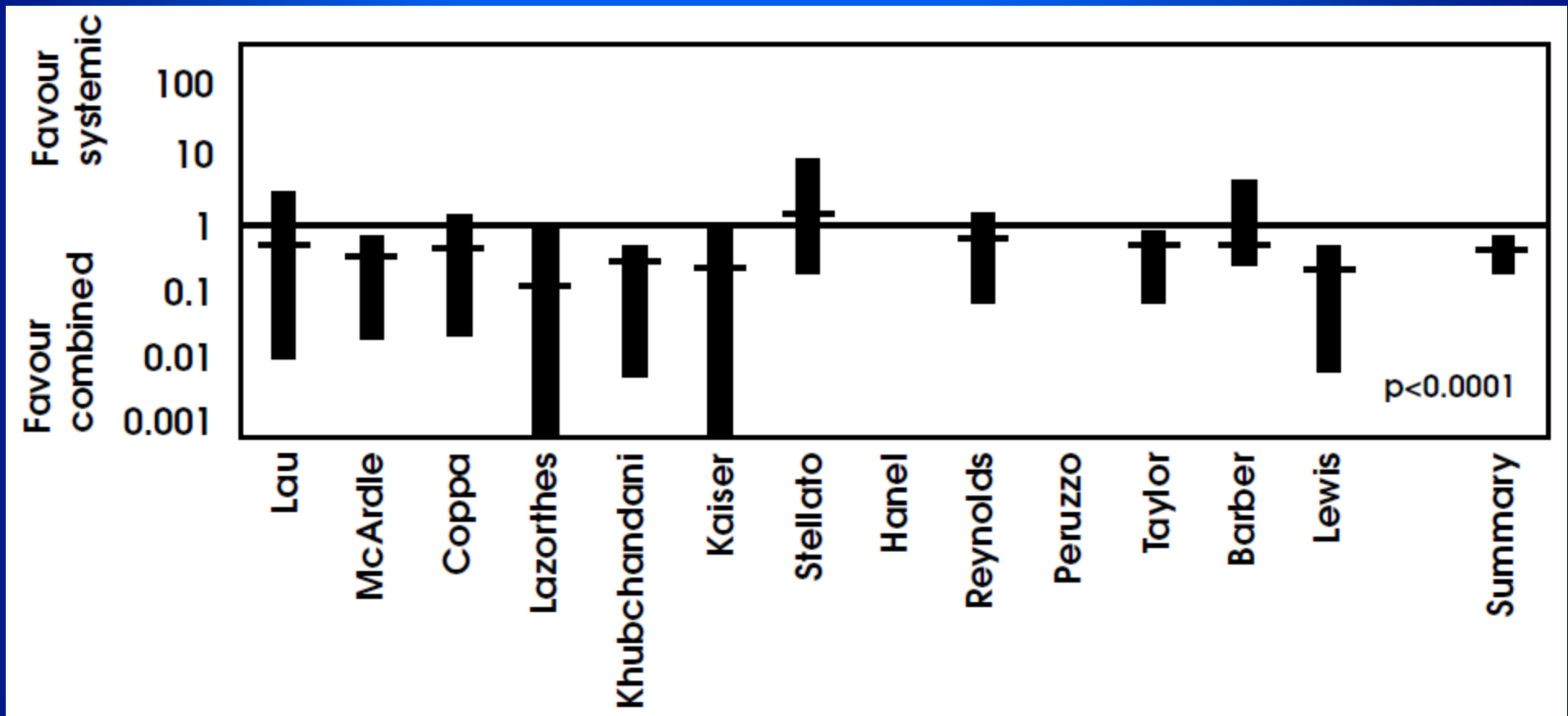
Parenteral Alone vs Parenteral and Oral Antibiotics for Colectomy Incidence of Positive Wound Cultures



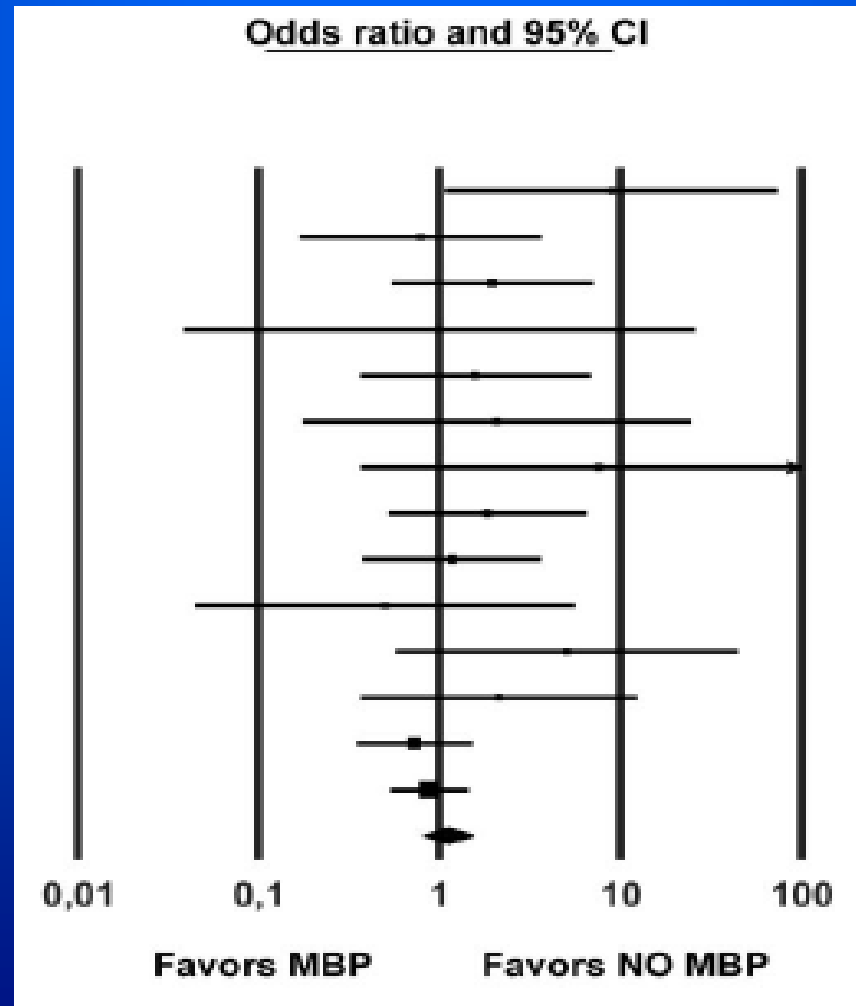
Parenteral Alone vs Parenteral and Oral Antibiotics – All with Bowel Prep for Colectomy



Parenteral Alone vs Parenteral and Oral Antibiotics – All with Bowel Prep for Colectomy – Meta-Analysis

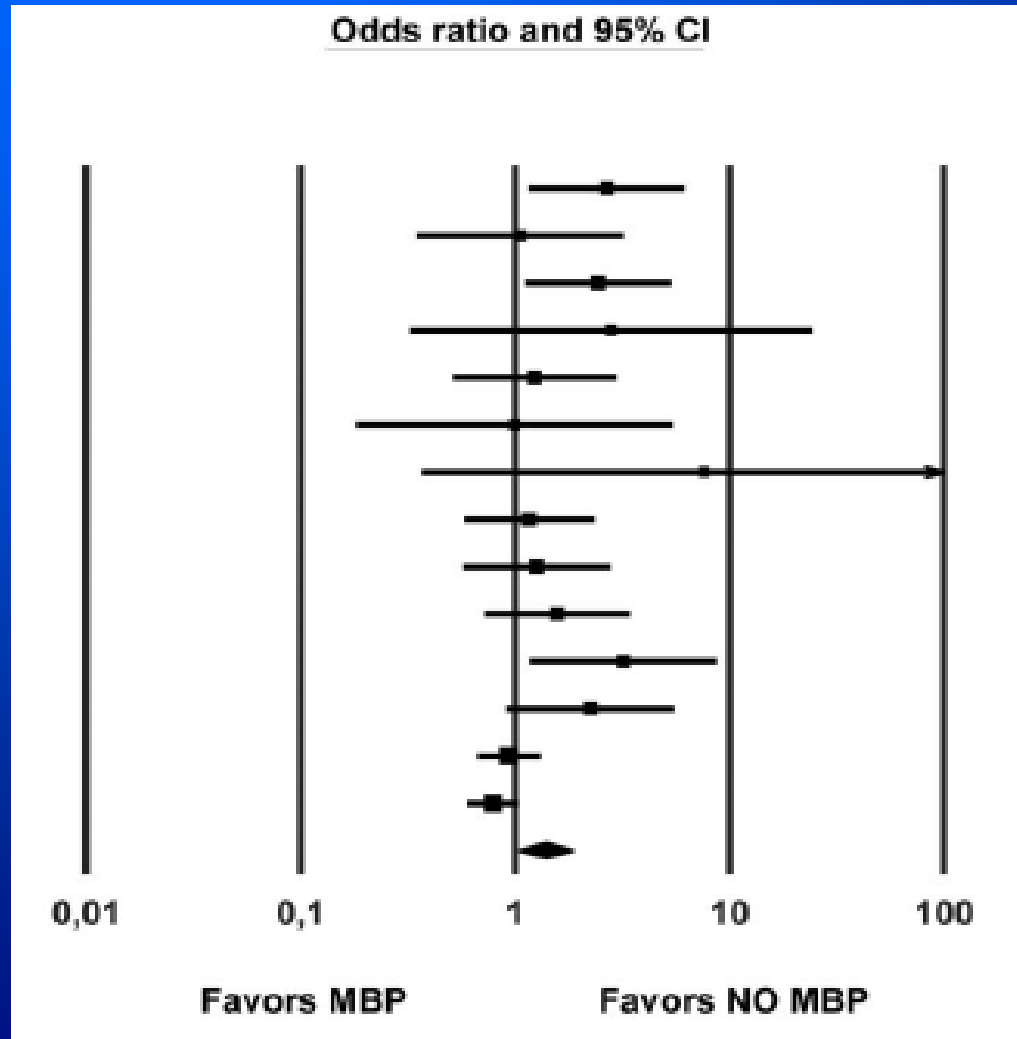


Mech. Bowel Prep and Anastomotic Leak Parenteral Ab Only



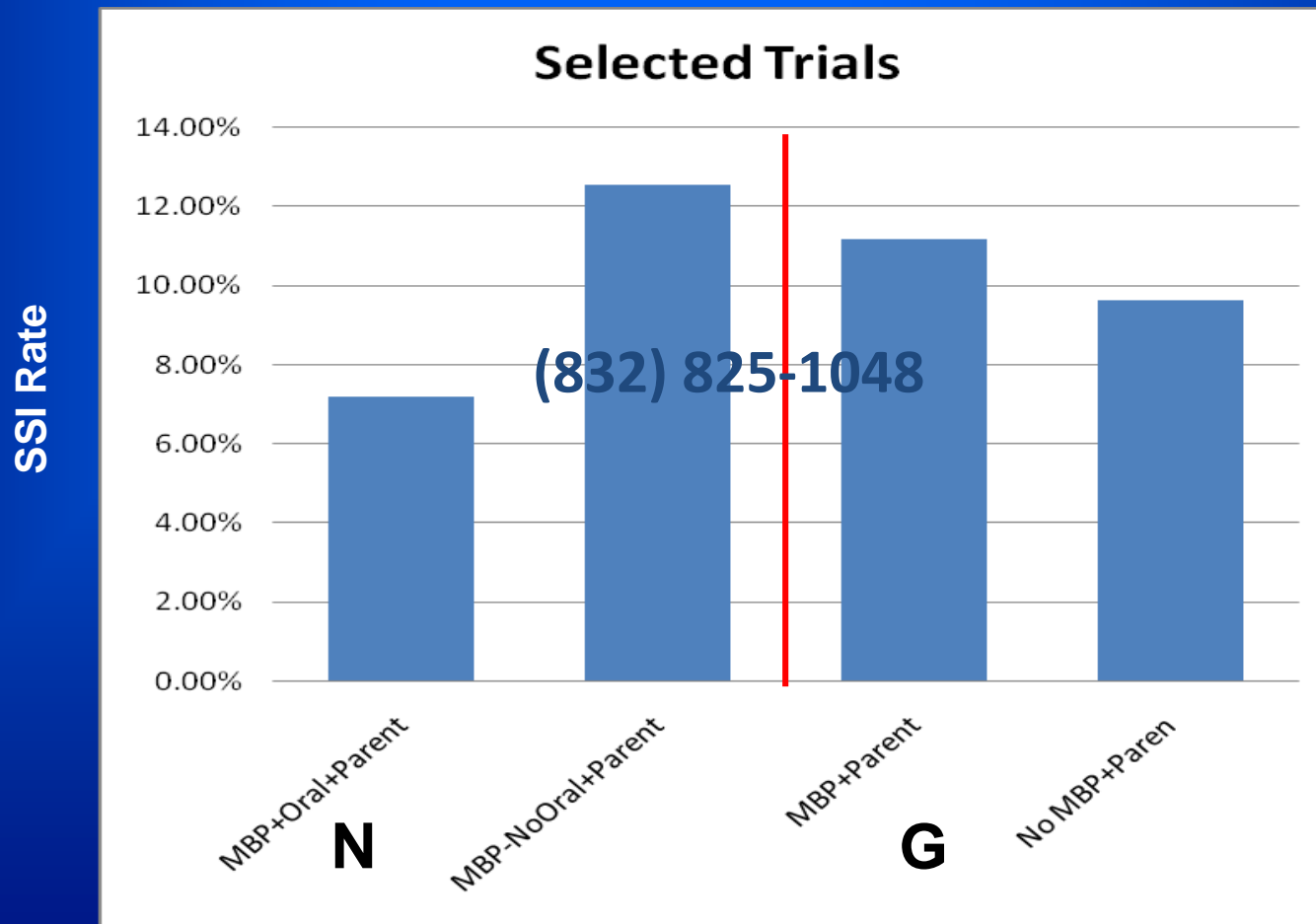
Mech. Bowel Prep and SSI

Parenteral Ab Only



MBP – yes / no?

Antibiotics – oral / I.V. / both?



Most Recent Cochrane Review

<u>Comparison</u>	<u>Odds Ratio</u>	<u>Range</u>
Ab Proph vs none	0.34	0.28 – 0.41
<u>Oral + I.V. vs I.V. only</u>	0.56	0.43 – 0.74
<u>Oral + I.V. vs Oral only</u>	0.56	0.40 – 0.76

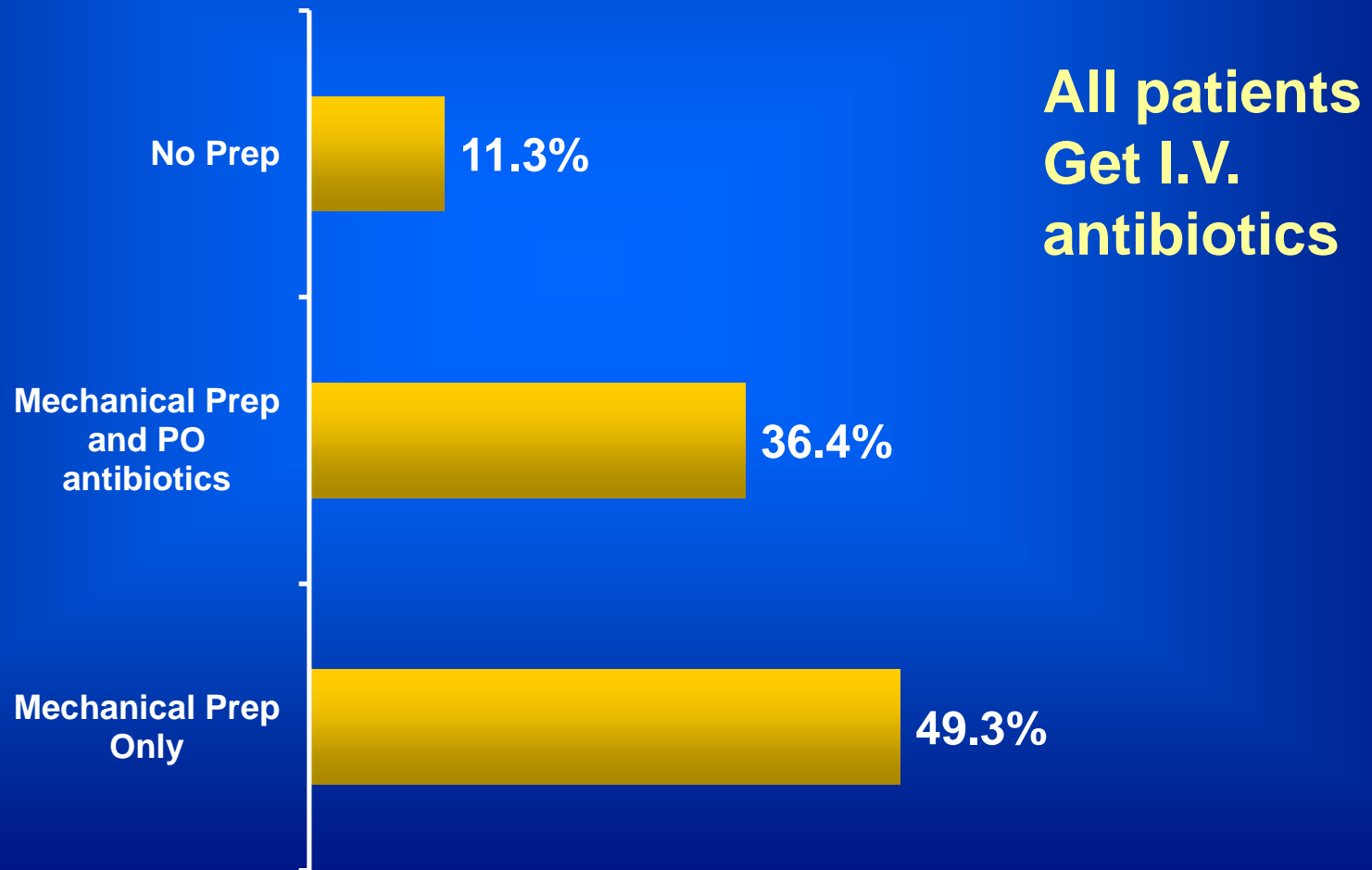
Greater than 2300 pts in each comparison

GRADE evidence quality HIGH

Nelson RL, Cochrane Rev 2014; #5: CD001181

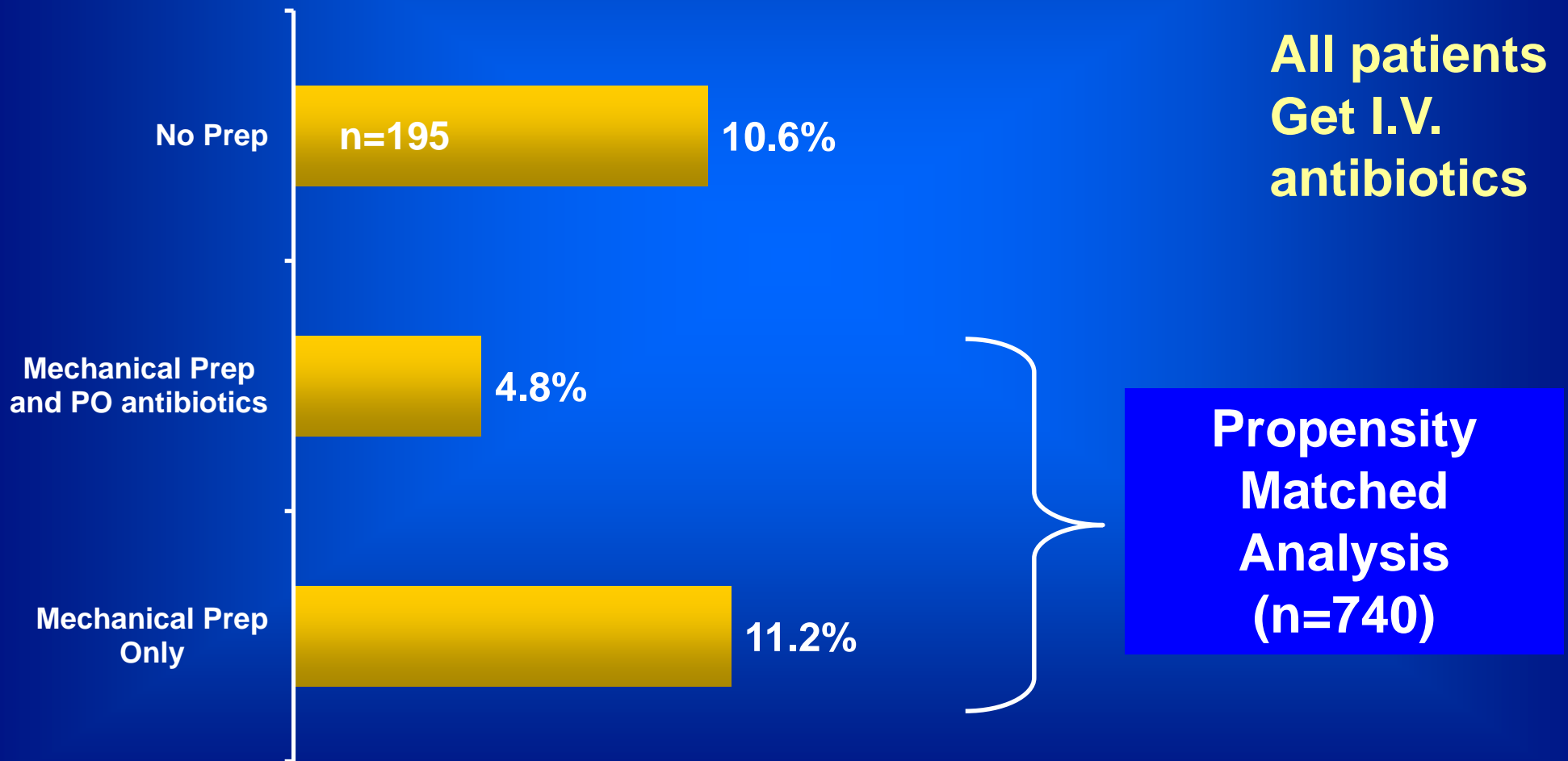
Bowel Preparation Prior to Elective Colectomy in Michigan (n=1648)

Overall SSI Rate in Michigan is 8.0%



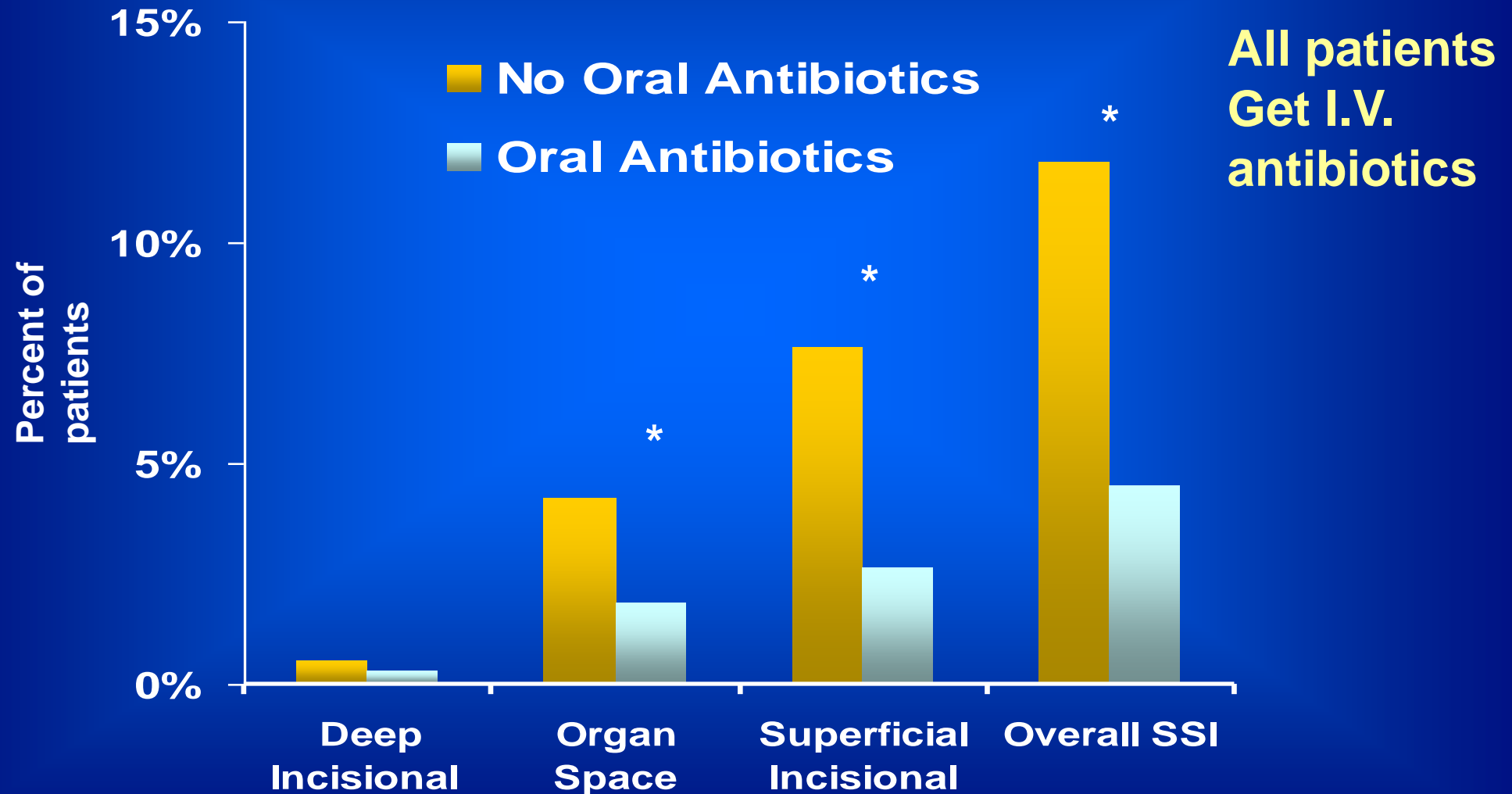
Surgical Site Infection Rates following Elective Colectomy

The Michigan Surgical Quality Collaborative



Oral Antibiotics with a Bowel Preparation

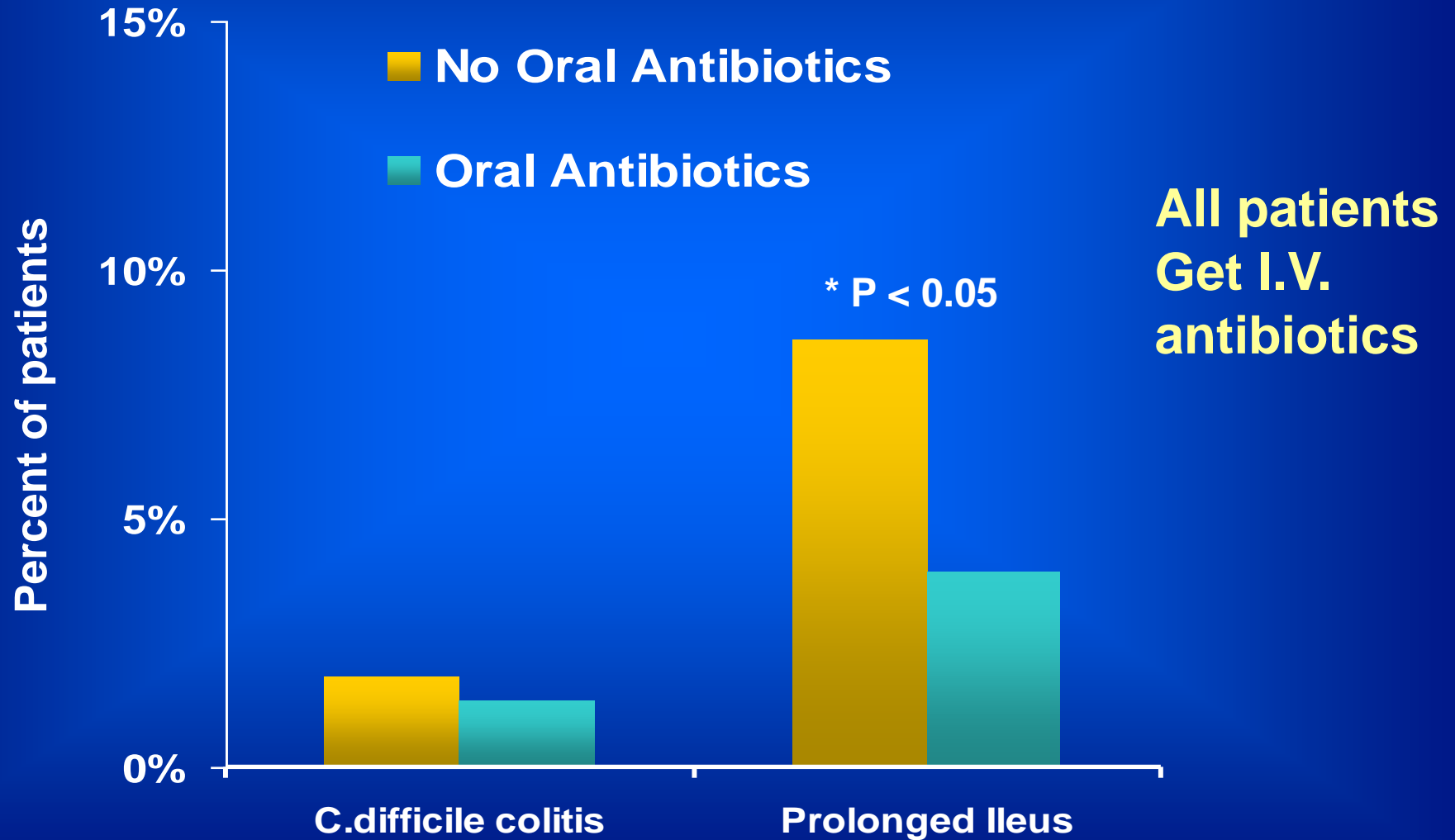
A Propensity Matched Analysis (n=740)



* P < 0.05

Oral Antibiotics with a Bowel Preparation

A Propensity Matched Analysis (n=740)



Krapohl, G.L., *Bowel preparation for colectomy and risk of Clostridium difficile infection.*

Dis Col Rectum, 2011. 54:810-7

	<u>C. diff</u>	<u>No C. diff</u>
No prep (n=578)	2.4%	97.6%
Prep (n=1685)	2.4%	97.6%
No Ab (n=1001)*	2.9%	97.1%
Oral Ab (n=684)*	1.6%	98.4%

*** p=0.09**

“Evidence Based” Bundle to Prevent SSI in Colorectal Surgery

<u>Process Measure</u>	<u>Study</u>	<u>Control</u>
Mechanical Bowel Prep	No	Yes
Oral Antibiotics	No	Yes
PreOp Warming	Yes	No
IntraOp Warming	Yes	Yes
FiO2	80%	30%
I.V. Fluids	Limited, Colloid > Crystalloid	Per Usual
Wound Protector	Yes	No
SCIP Parenteral Antibiotics	Yes	Yes

“Evidence Based” Bundle to Prevent SSI in Colorectal Surgery

<u>Process Measure</u>	<u>Study</u>	<u>Control</u>
Total Fluids	1800 ml	2500 ml
Crystalloid Fluids	1500 ml	2250 ml
First PACU Temp	36.7	36.3
Duration of Op	170 min	150 min
Any SSI*	45%	24%
Organ/Space SSI	9%	6%

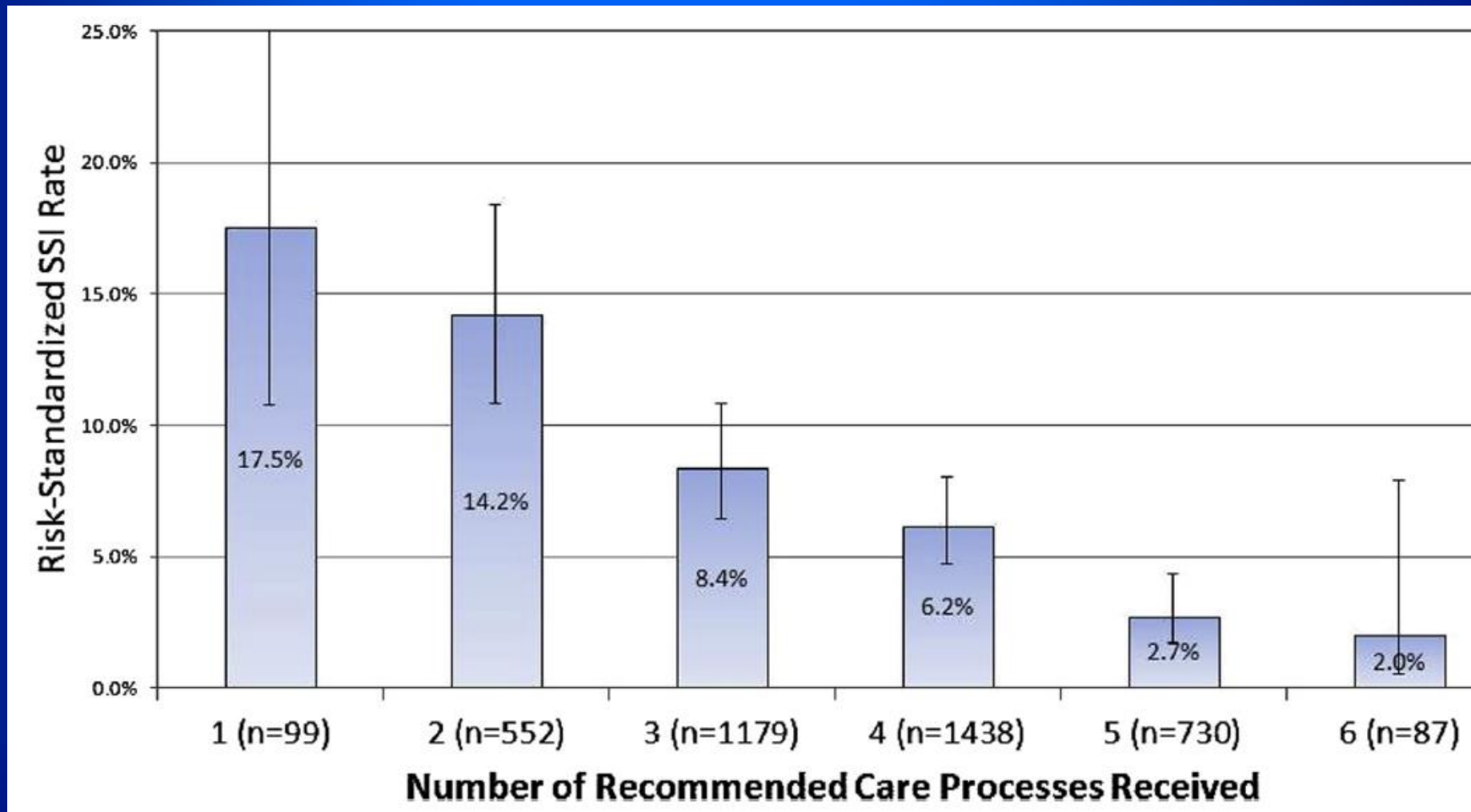
*p=0.003

Anthony. Arch Surg 2010; 146: 263-9

“Evidence Based” Bundle to Prevent SSI in Colorectal Surgery

- 1. Appropriate SCIP IV prophylactic antibiotics**
- 2. Postop normothermia (T>98.6/37)**
- 3. Oral antibiotics and bowel prep**
- 4. Minimally invasive surgery**
- 5. Short operative duration (<100 min)**

“Evidence Based” Bundle to Prevent SSI in Colorectal Surgery

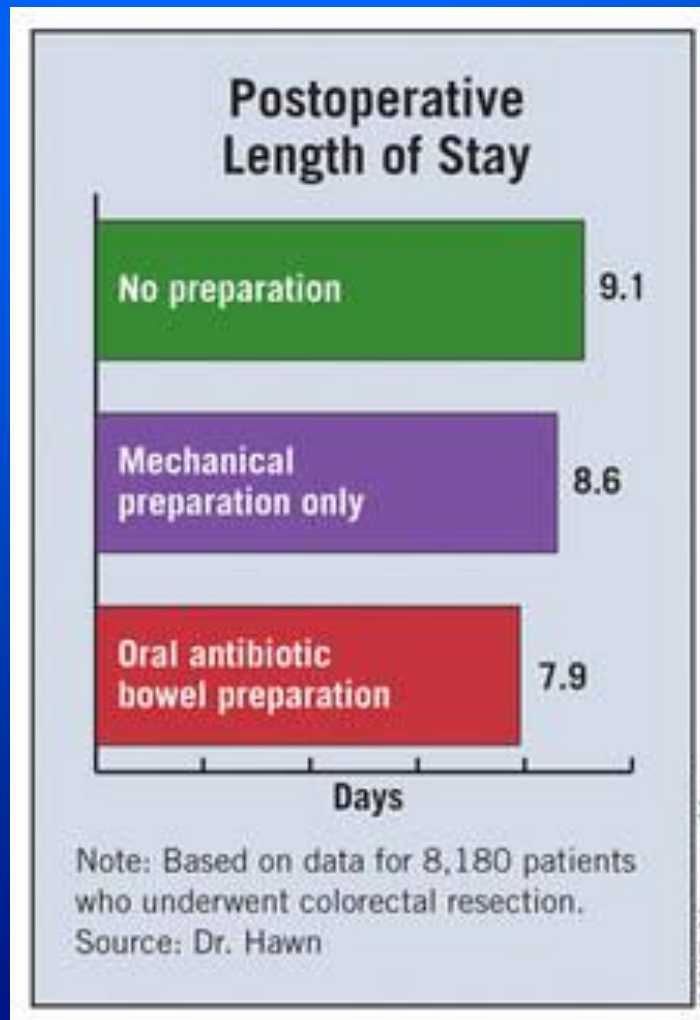


Bowel Prep & Oral Antibiotics VASQIP Data – 8180 patients

Oral antibiotic bowel prep	44%
Mechanical prep alone	39%
No prep at all	17%

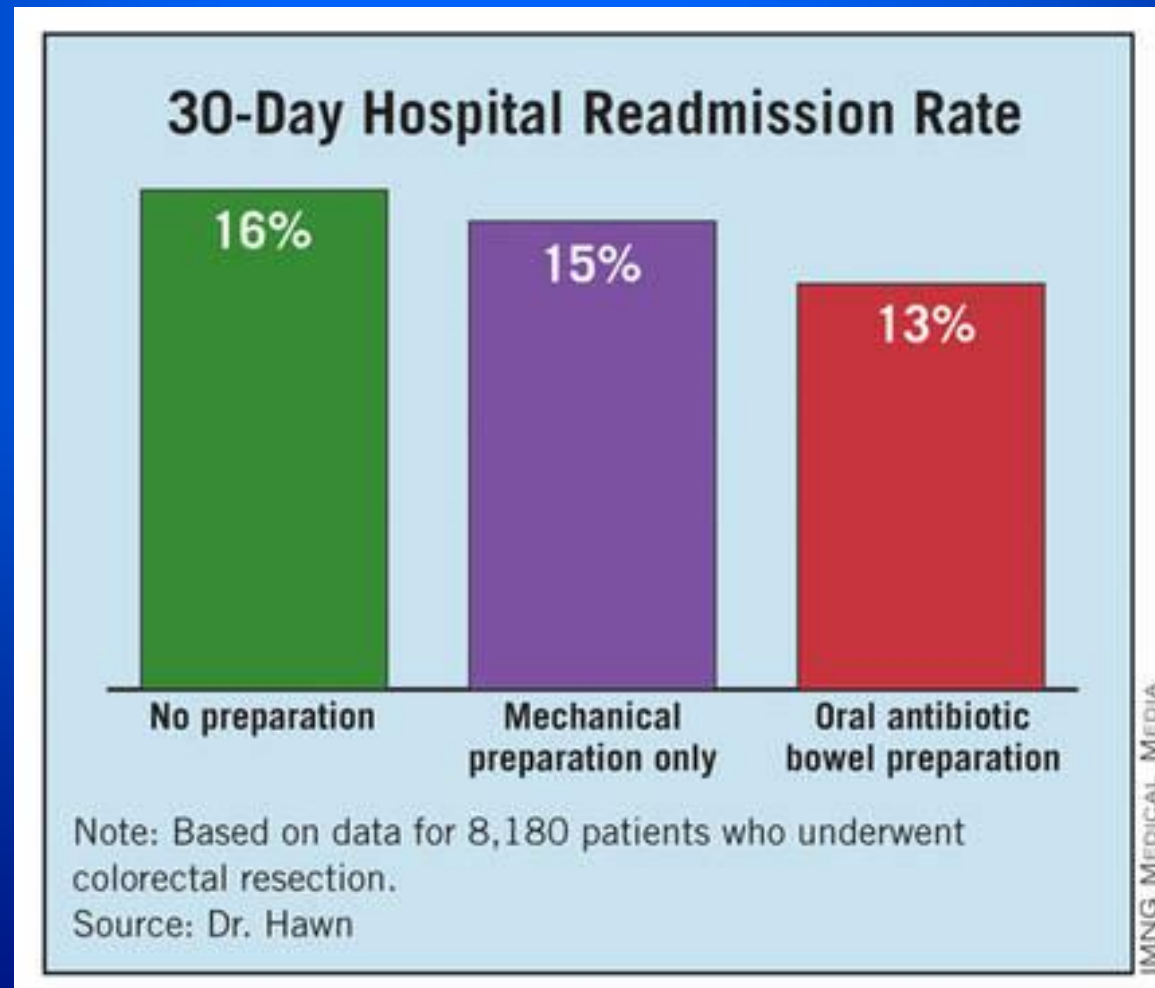
Hawn. So Surgical Assoc. Palm Beach, FL, 12 Dec 2012

Bowel Prep & Oral Antibiotics VASQIP Data



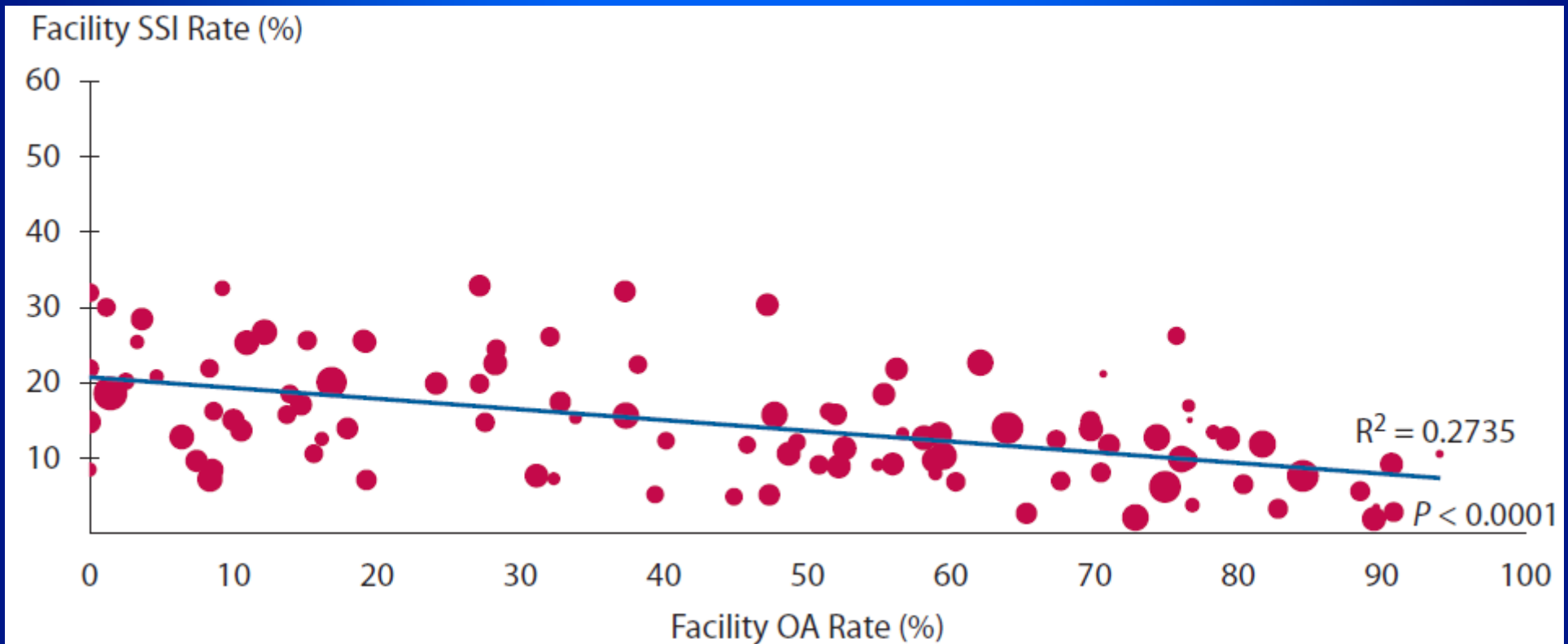
Hawn. So Surgical Assoc. Palm Beach, FL, 12 Dec 2012

Bowel Prep & Oral Antibiotics VASQIP Data



Hawn. So Surgical Assoc. Palm Beach, FL, 12 Dec 2012

Oral Antibiotics for Colorectal Operations



Cannon. Dis Col Rectum 2012; 55: 1160-6

Bowel Prep & Oral Antibiotics VASQIP Data

Length of Stay and Readmissions

**Lower with oral prep and
oral antibiotics**

Cannon. Dis Col Rectum 2012; 55: 1160-6

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates and Readmission Rates in Elective Colorectal Surgery

NSQIP data on 8,415 colectomy pts
Open and Laparoscopic

No Prep	2150	25%
Mech Prep Only	3779	45%
Oral Ab <u>±</u> Mech Prep	2486	30%

Morris. Ann Surg 2015; in press

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates and Readmission Rates in Elective Colorectal Surgery

NSQIP data on 8,415 colectomy pts
Open and Laparoscopic

	<u>SSI</u>
Oral Ab	6.5%
No Oral Ab	13%

Oral Antibiotic Bowel Prep Significantly Reduces Complication Rates in Elective Colorectal Surgery

<u>Reduced</u>	<u>P</u>
Anastomotic leak	< 0.001
Ileus	< 0.001
Return to O.R.	0.02
Readmission	< 0.001
Mortality	0.001

Morris. Ann Surg 2015; in press

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates and Readmission Rates in Elective Colorectal Surgery

Targeted Colorectal NSQIP data on 4,999 pts, Open and Laparoscopic with detailed data on mechanical prep, use of oral antibiotics, operative approach and multiple other risk factors.

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates and Readmission Rates in Elective Colorectal Surgery

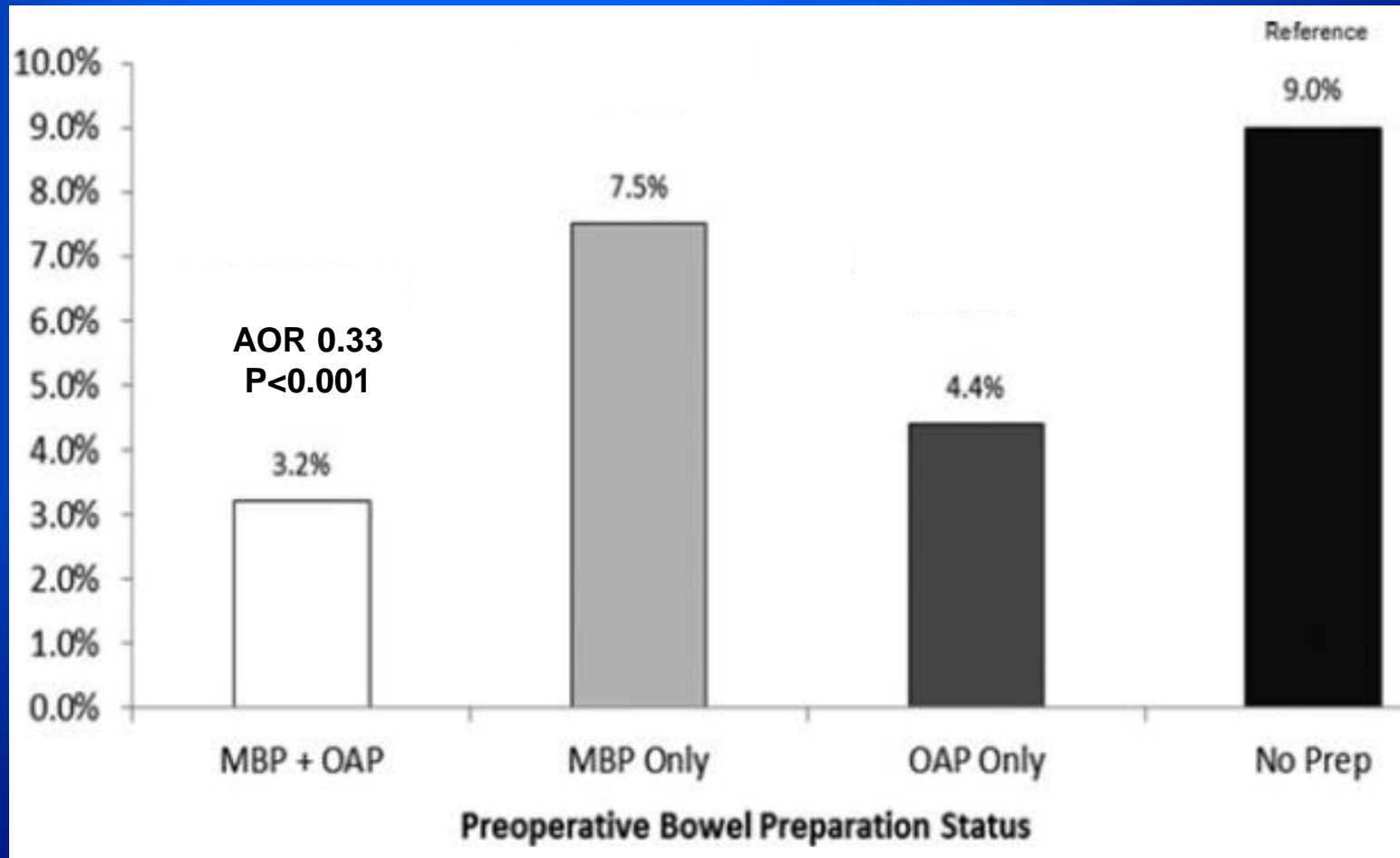
Mech Prep + Oral Ab (MBP+OAP)	1494	(30%)
Mech Prep Only (MBP)	2322	(47%)
Oral Ab Only (OAP)	91	(2%)
No Preop Prep at all (No Prep)	1092	(22%)
Total	4999	

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates and Readmission Rates in Elective Colorectal Surgery

	<u>ReAdm</u>	<u>AOR</u>	<u>p</u>
MBP+OAP	5.4%	0.72	0.04
MBP	6.4%	0.81	0.15
OAP	3.3%	0.41	0.14
No Prep	7.9%	Ref	

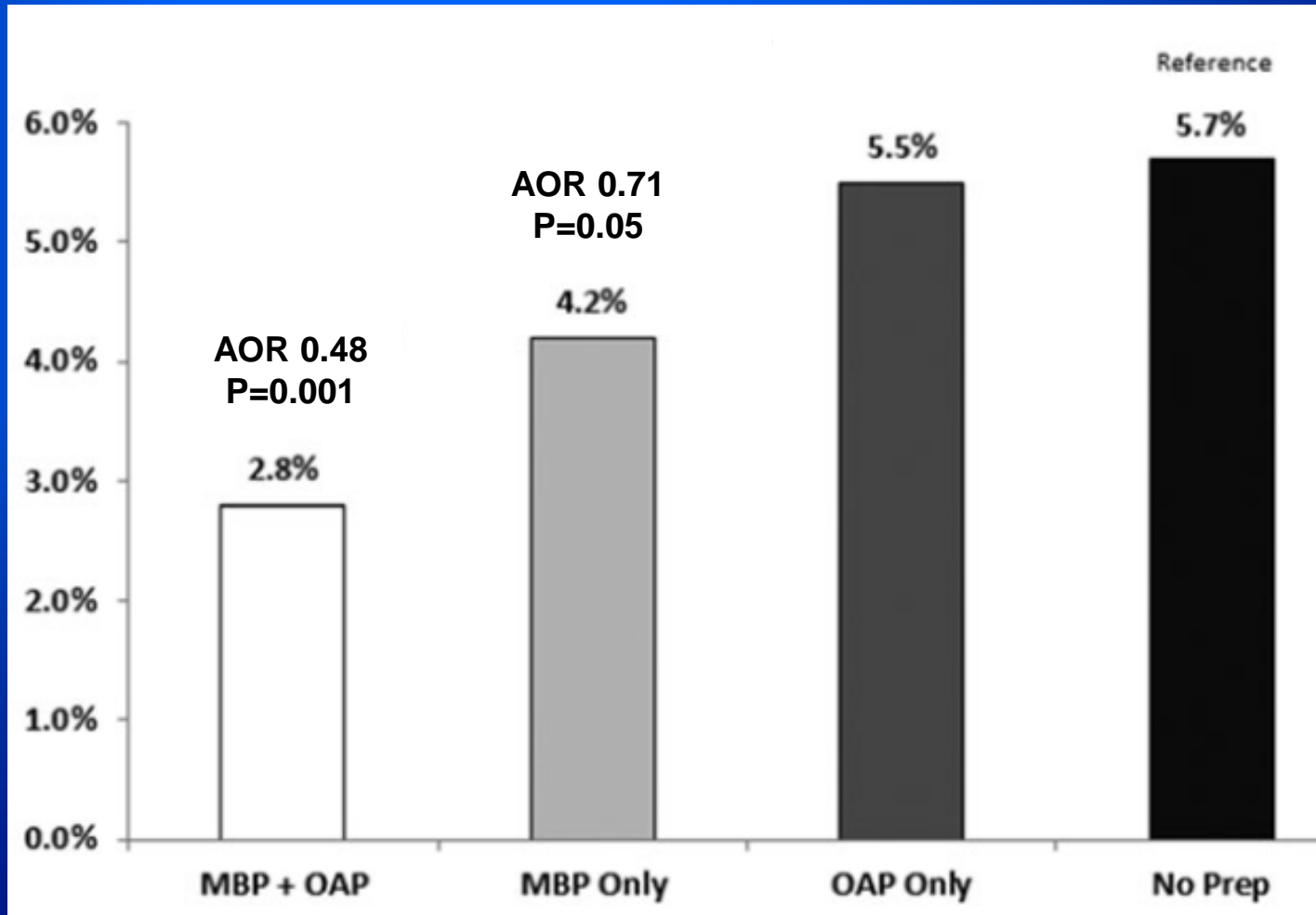
Scarborough. Ann Surg 2015; in press

Oral Antibiotic Bowel Prep Significantly Reduces SSI Rates



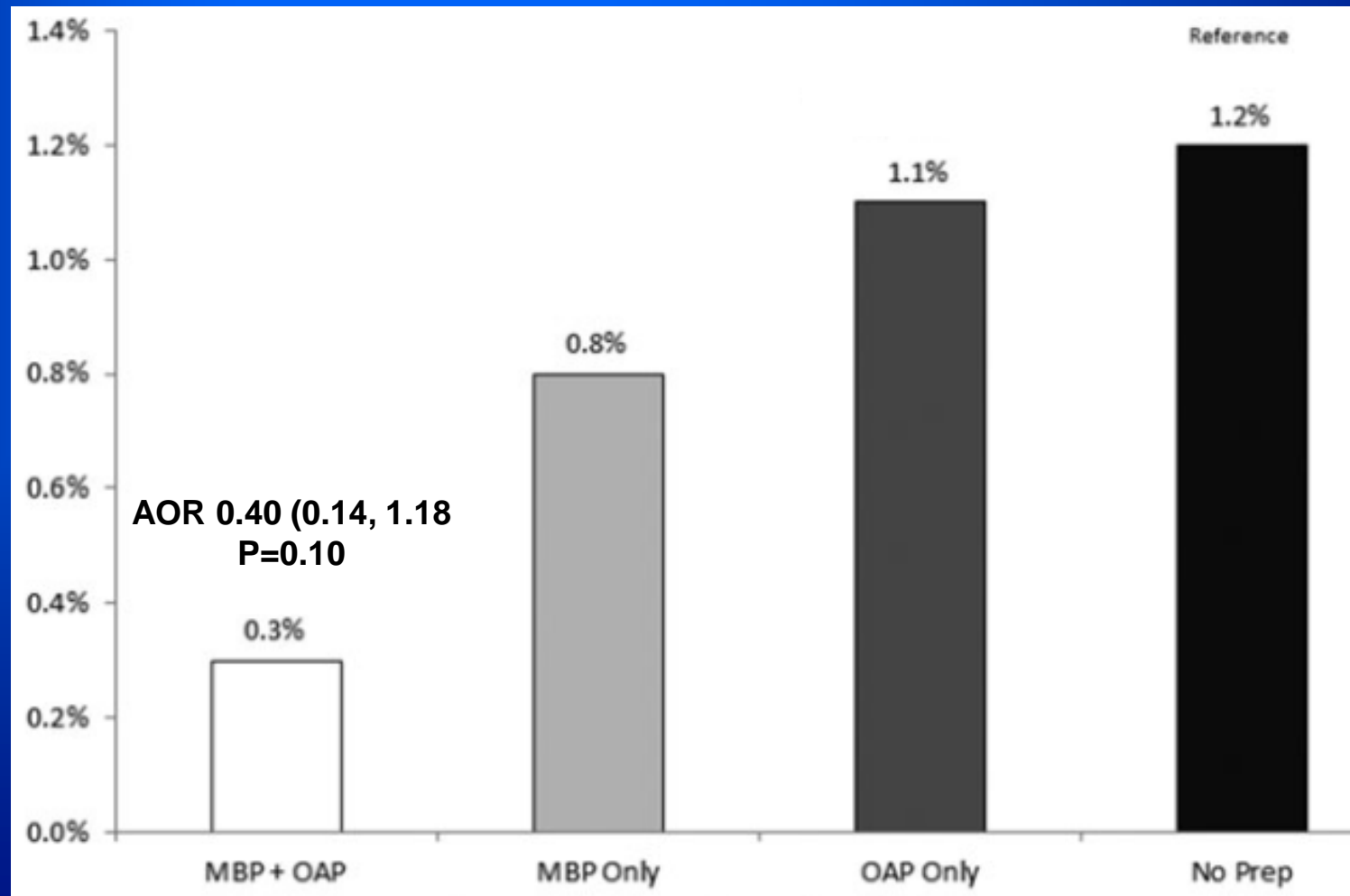
Scarborough. Ann Surg 2015; in press

Oral Antibiotic Bowel Prep Significantly Reduces Anastomotic Leak



Scarborough. Ann Surg 2015; in press

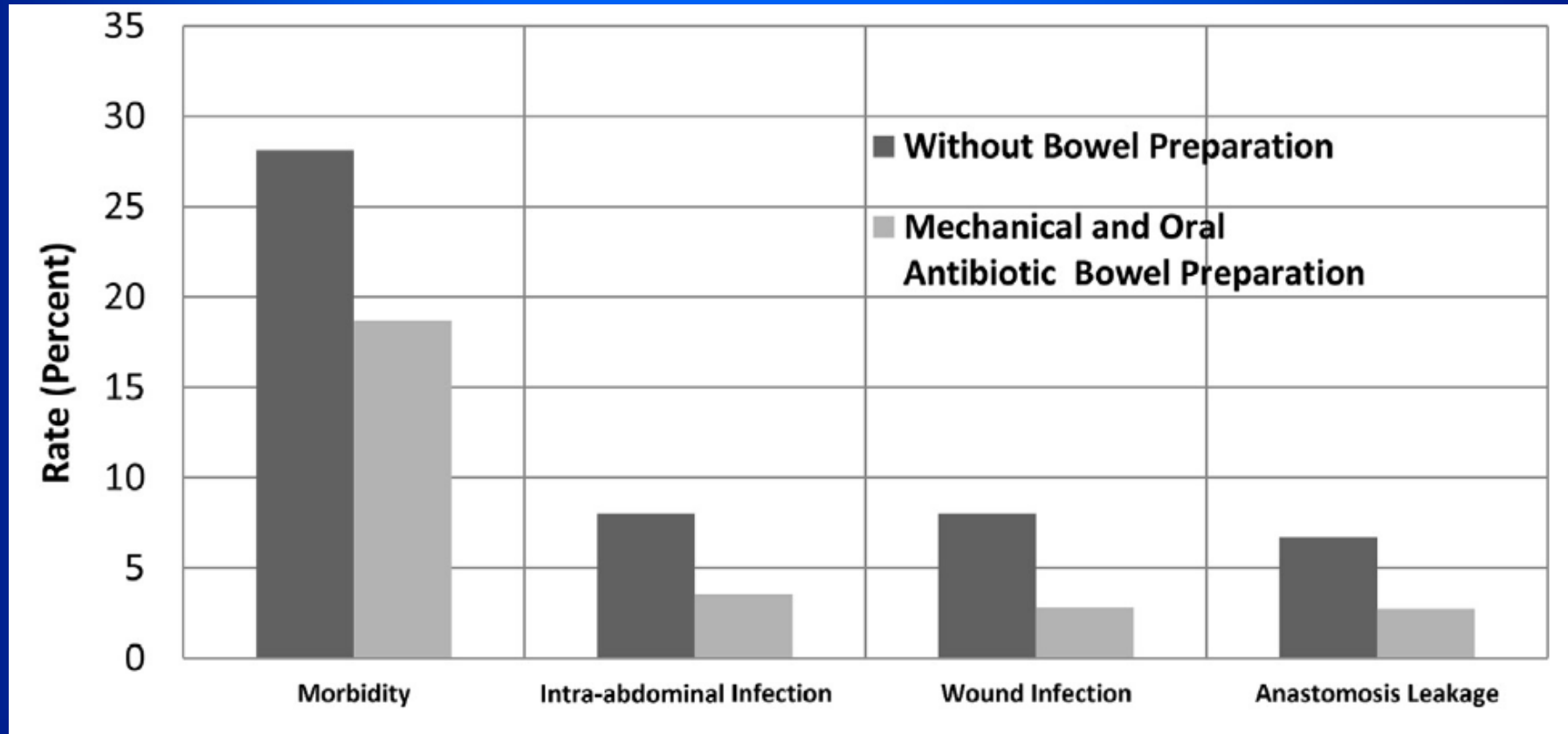
Oral Antibiotic Bowel Prep Might Reduce Mortality



Scarborough. Ann Surg 2015; in press

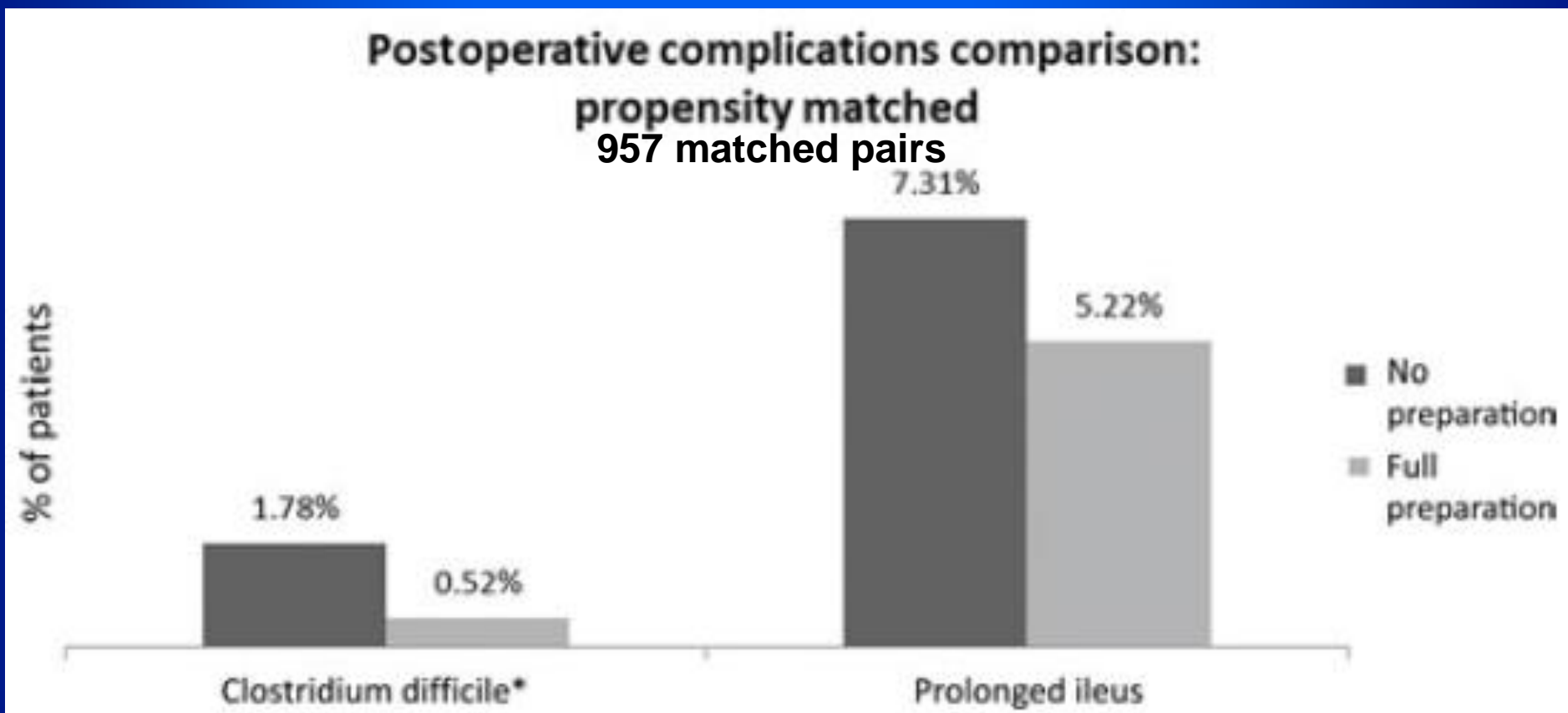
AOR 0.71
P=0.05

Bowel Prep in Colon Cancer Surgery



Left Colectomy

Elective Segmental Colectomy Propensity Matching Oral + Mech Prep vs. No Prep



Conclusions - ?

- **If you are not going to give any oral antibiotics then the MBP is not necessary and there is a suggestion of harm along with more GI symptoms.**
- **However, if you are going to take my colon out I will suffer through the bowel prep and take oral antibiotics in advance of the operation for the lowest SSI rate!**

Parenteral Prophylactic Antibiotics For Colectomy

**Are some parenteral antibiotics
better than others?**

Anaerobic Coverage for Colectomy

SSI

I.V. Cefotaxime, 2 g (n=280) 44 (16%)

I.V. Cefotaxime +
Metronidazole, 1.5 g (n=130) 19 (7%)

$p < 0.001$

Häkansson. Eur J Surg 1993; 159: 177-80

Aerobic Coverage for Colectomy

SSI

I.V. Ticarcillin (n=131)
3 g preop and 2 h later

10 (8%)

P.O. Tinidazole (n=130)
2 g 10 hr preop

26 (20%)

p < 0.007

Aerobic Coverage for Colectomy

SSI

Oral neomycin/erythromycin
+ I.V. cefazolin (n=55)

4 (7%)

I.V. metronidazole
alone (n=47)

14 (30%)

$p < 0.007$

Gentamicin Levels and SSI Risk for Colectomy

	Closing Gent level (mg/L)	<u>D.M. (%)</u>	<u>Stoma (%)</u>	<u>Age</u>
<u>SSI</u>	1.3_±1.0	29	50	59_±14
<u>No SSI</u>	2.1_±0.9	2	24	55_±19
<u>p</u>	0.02	0.02	0.04	0.05

Gent level < 0.5 at close had 80% SSI rate (p=0.003).

New ASHP / IDSA / SHEA / SIS Antibiotic Prophylaxis Guidelines

Cefazolin	≥ 80 kg	2 g
	≥ 120 kg	3 g

Vancomycin	15 mg/kg
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Gentamicin	5 mg/kg
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dosing wgt = ideal wgt + 40% of excess wgt

Dose of Antibiotic for Prophylaxis

- Always give at least a full therapeutic dose of antibiotic.
- Consider the upper range of doses for large patients and/or long operations.
- Repeat doses for long operations.

Antibiotic Choice & SSI After Colectomy - Multivariate Analysis Premier Data Base, n = 4634

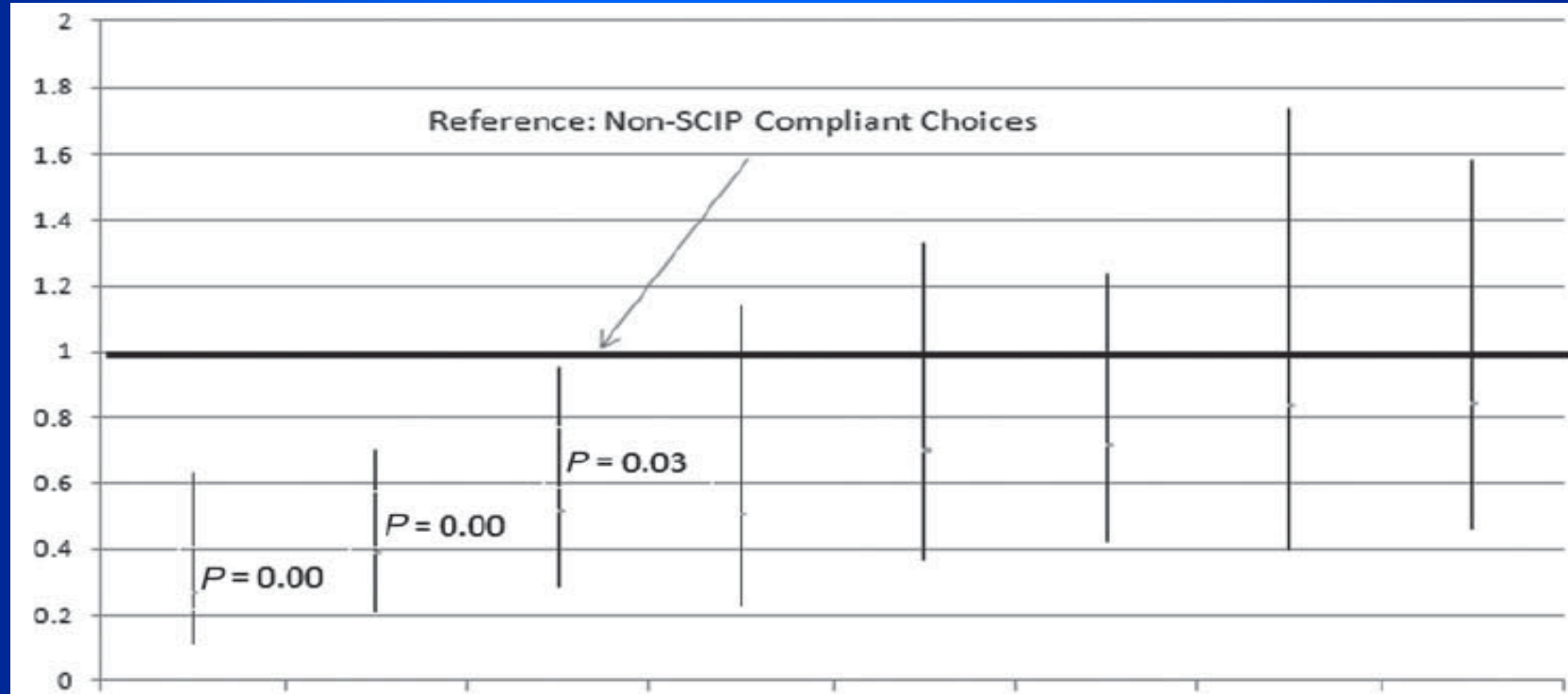
<u>Agent</u>	<u>O.R.</u>	<u>Range</u>
Cefoxitin	1.0	
Ertapenem	0.53	0.34 - 0.82
Cefazolin/Metron	0.58	0.33 - 1.04
Levo/Metron	0.59	0.30 - 1.14
Amp/sulbactam	0.62	0.33 - 1.15
Cefotetan	0.86	0.45 - 1.67

Antibiotic Choice & SSI After Colectomy - Multivariate Analysis MSQC, n = 4331

	<u>O.R.</u>	<u>P</u>
Ab SCIP compliant	0.67	0.04
Post-Op temp ≥ 36	0.40	0.01
POD #1 glucose >140	1.52	0.00
Oral antibiotics	0.54	0.00
Laparoscopic	0.59	0.00
Open time >100 min	1.65	0.00
BMI >30	1.36	0.03

Antibiotic Choice & SSI After Colectomy

Adjusted Odds Ratios



Cipro/Metronid

Cefaz/Metronid

Ertapenem

Amp/Sulbact

Cefazolin

Cefoxitin

Clinda/Gent

Cefotetan

Antibiotic Choice & SSI After Colectomy

Cefazolin and metronidazole are compatible in the same I.V. bag, and the UWMC pharmacy has this combination pre-mixed and available in the O.R. pharmacy.

Principles of Prophylaxis

- Use prophylaxis when indicated
- Bacteroides?
 - Yes – cefazolin + metronidazole
 - No - cefazolin
- Give intravenously just before operation
- Large patient - large dose
- Long operation - repeat dose
- Stop at end of operation

Prophylactic Antibiotics

1. Risk is reduced for all procedures. Benefit depends on baseline risk and morbidity of SSI
2. Choose a drug that is effective against bugs that show up in SSI for that procedure
3. If you're going to give some, give a lot
4. Give it very shortly before the procedure
5. Repeat for long cases (2 half-lives)
6. Stop when the operation is over

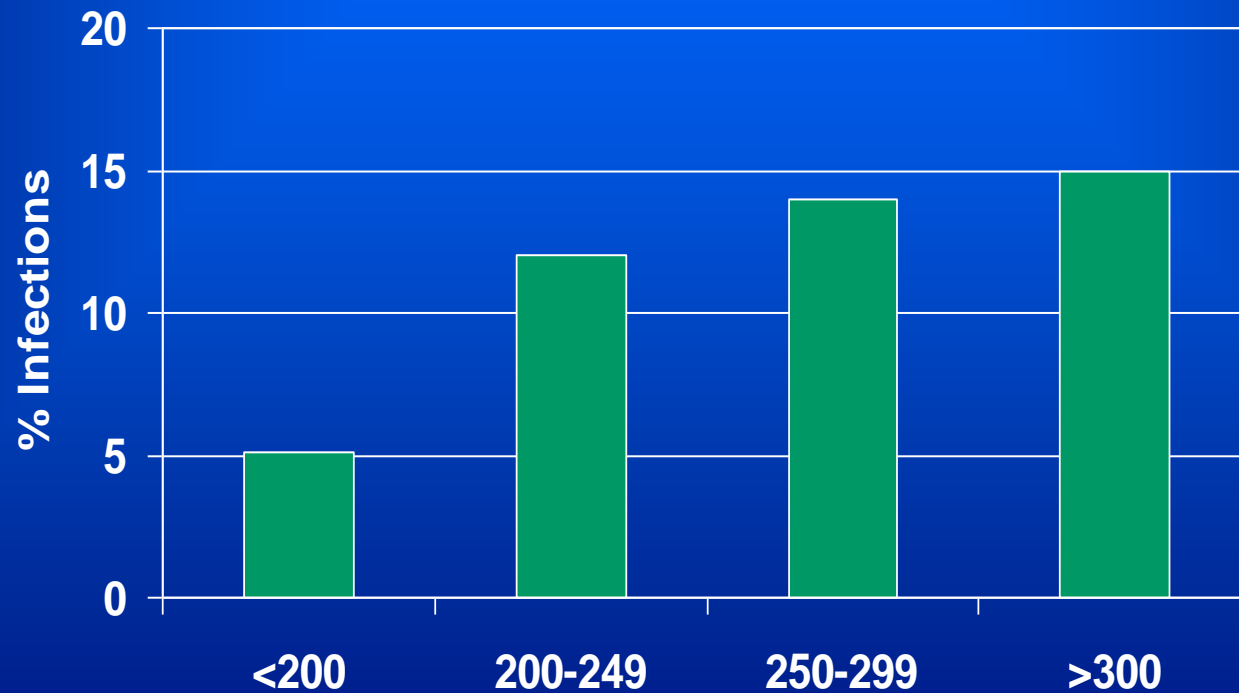
Preventing SSI

- Have good teamwork at all times
- Prewarm the patient
- Enough of the right antibiotic at the right time and repeat if necessary
- Don't shave
- Thorough skin prep
- Warm the patient in the O.R.
- High FiO_2
- Control glucose
- Good teamwork

Glucose and SSI

Diabetes, Glucose Control, and SSIs

After Median Sternotomy

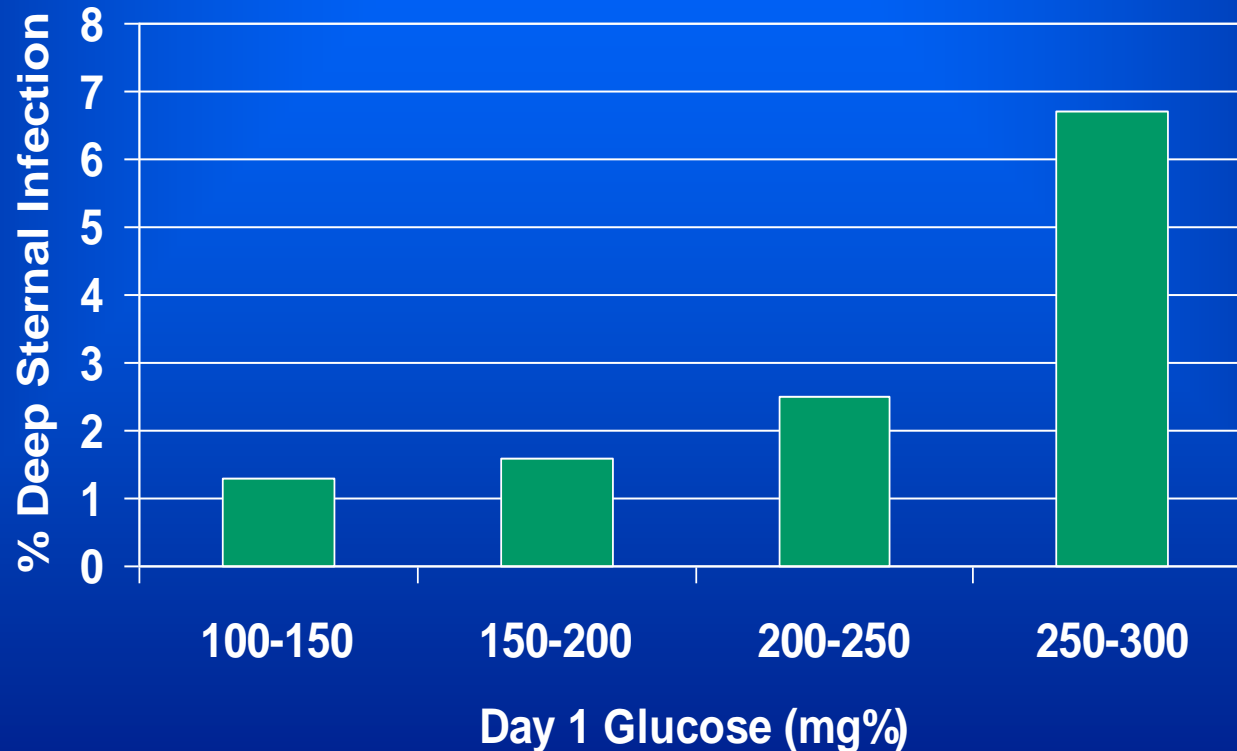


Hyperglycemia and Risk of SSI after Cardiac Operations

- Hyperglycemia - doubled risk of SSI
- Hyperglycemic:
 - 48% of diabetics
 - 12% of nondiabetics
 - 30% of all patients
- **47% of hyperglycemic episodes were in nondiabetics**

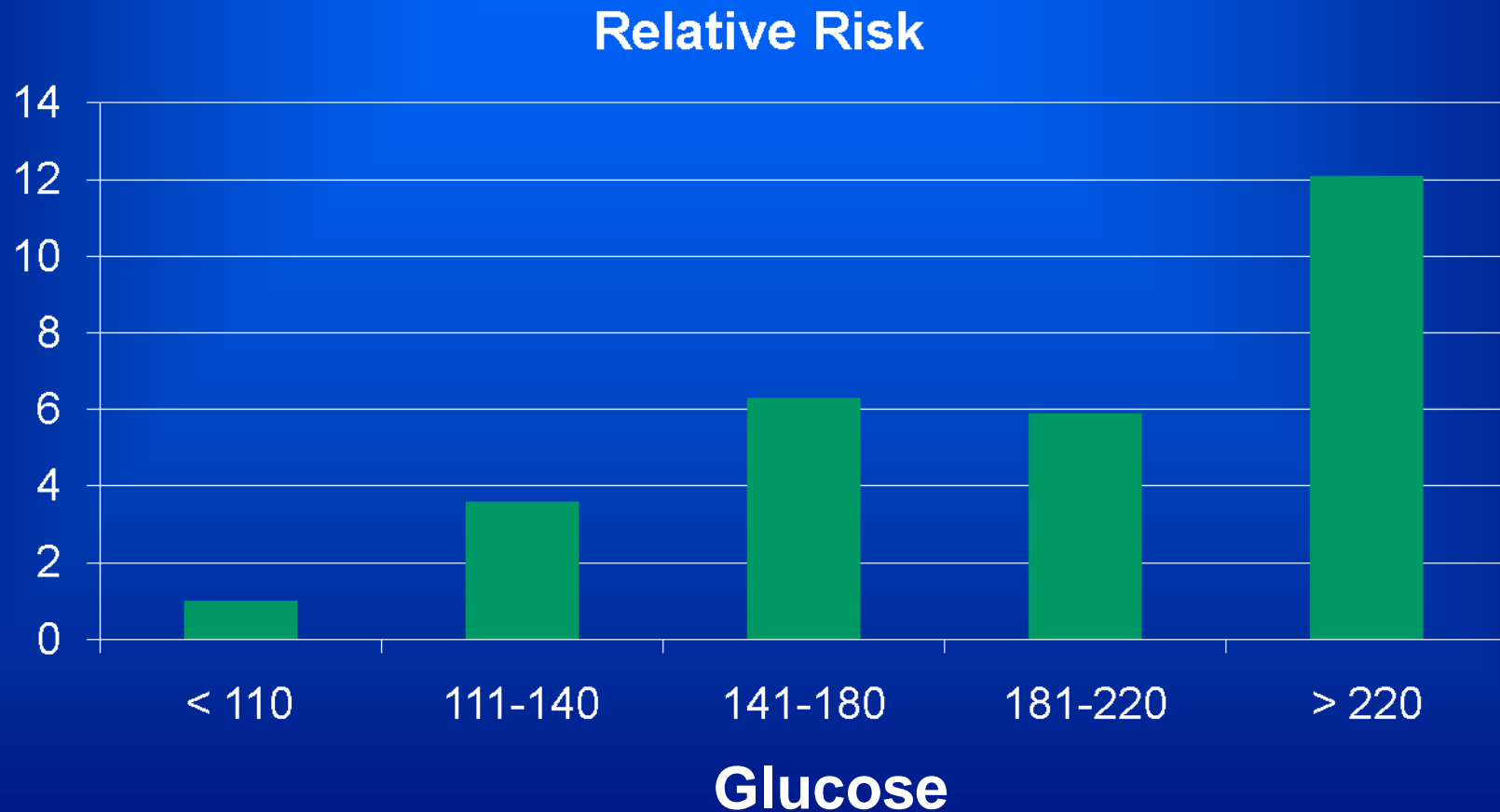
Latham. Inf Contr Hosp Epidemiol. 2001;22:607
Dellinger. Inf Contr Hosp Epidemiol. 2001;22:604

Deep Sternal SSI and Glucose



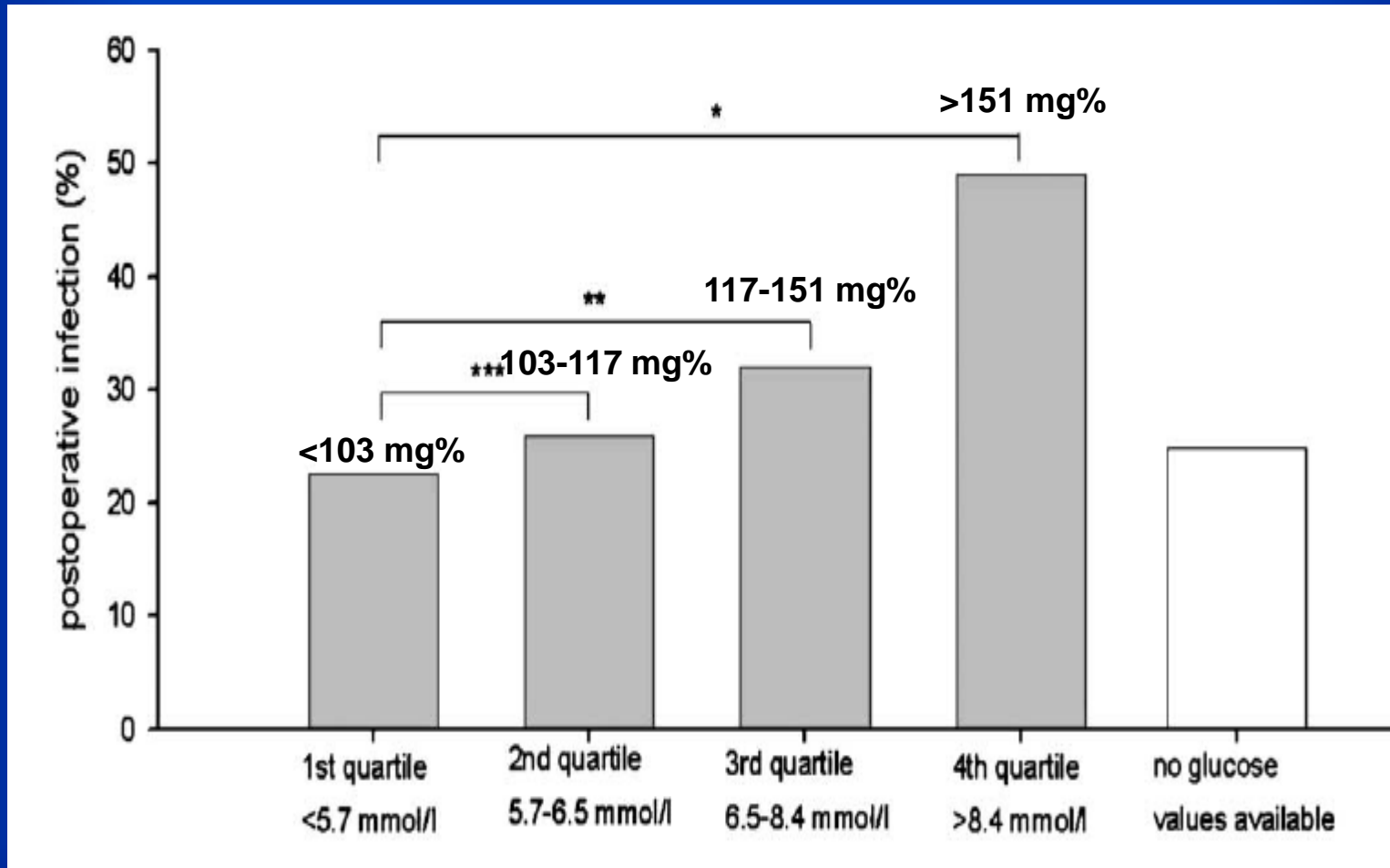
Zerr. Ann Thorac Surg 1997;63:356

Postop Glucose (within 48h) and SSI – General Surgery

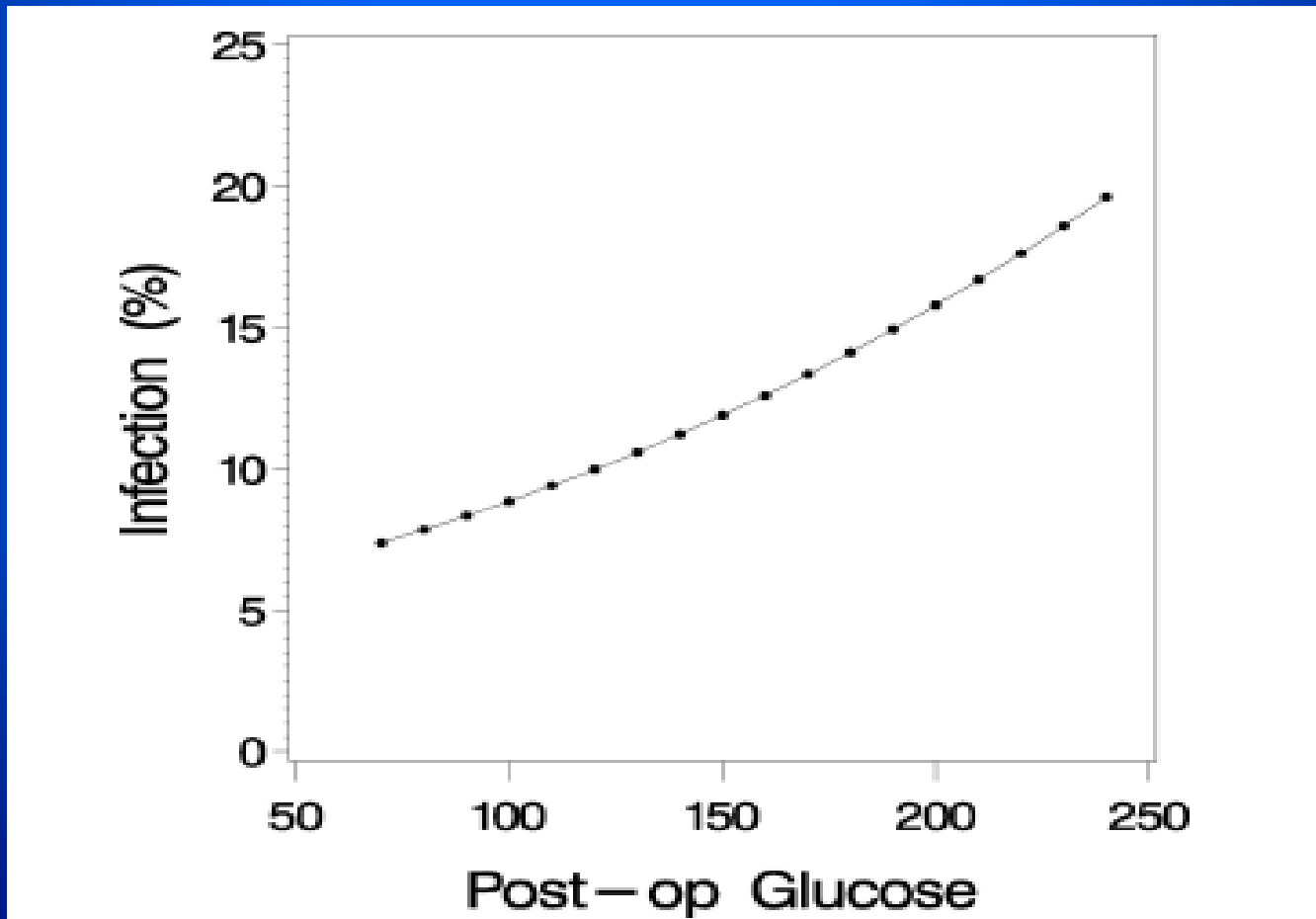


Ata. Arch Surg 2010; 145: 858-864

Early (48h) Postoperative Glucose Levels and SSI after Vascular Surgery



Perioperative Hyperglycemia in Noncardiac Surgical Patients

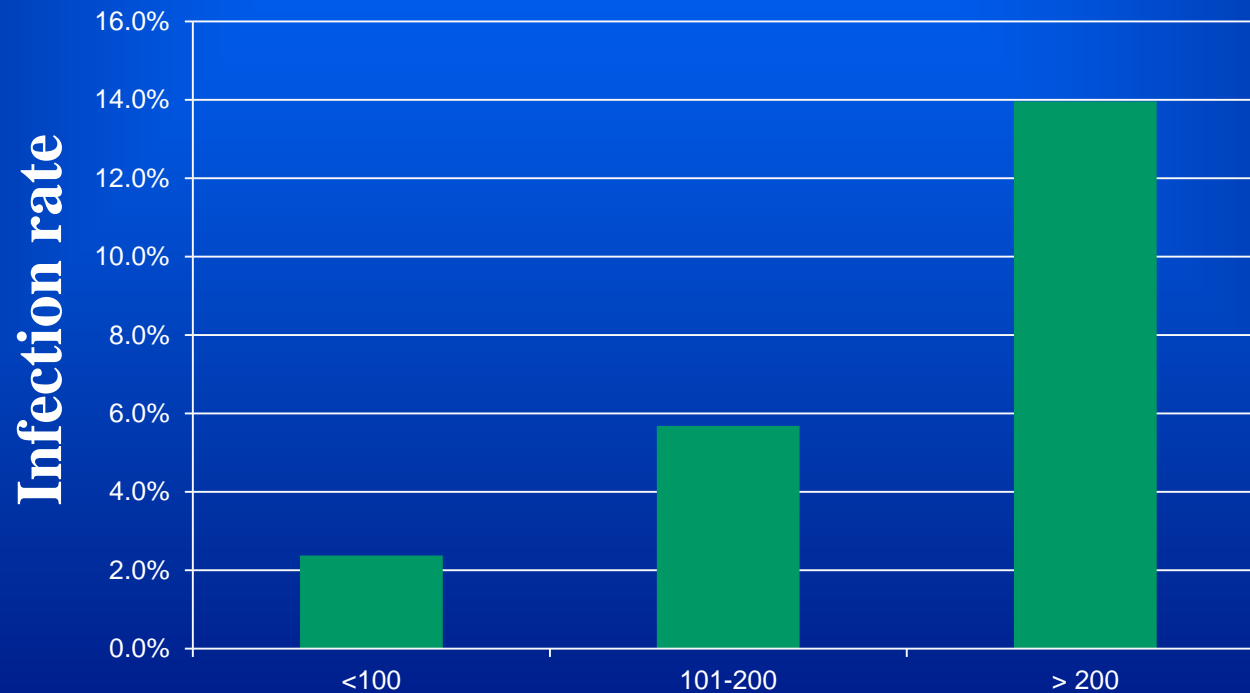


Mastectomy, Hyperglycemia, and SSI

260 patients, 5 glucose determinations (pre-op, at anesthesia induction, intra-op, in PACU, at 24 hrs)

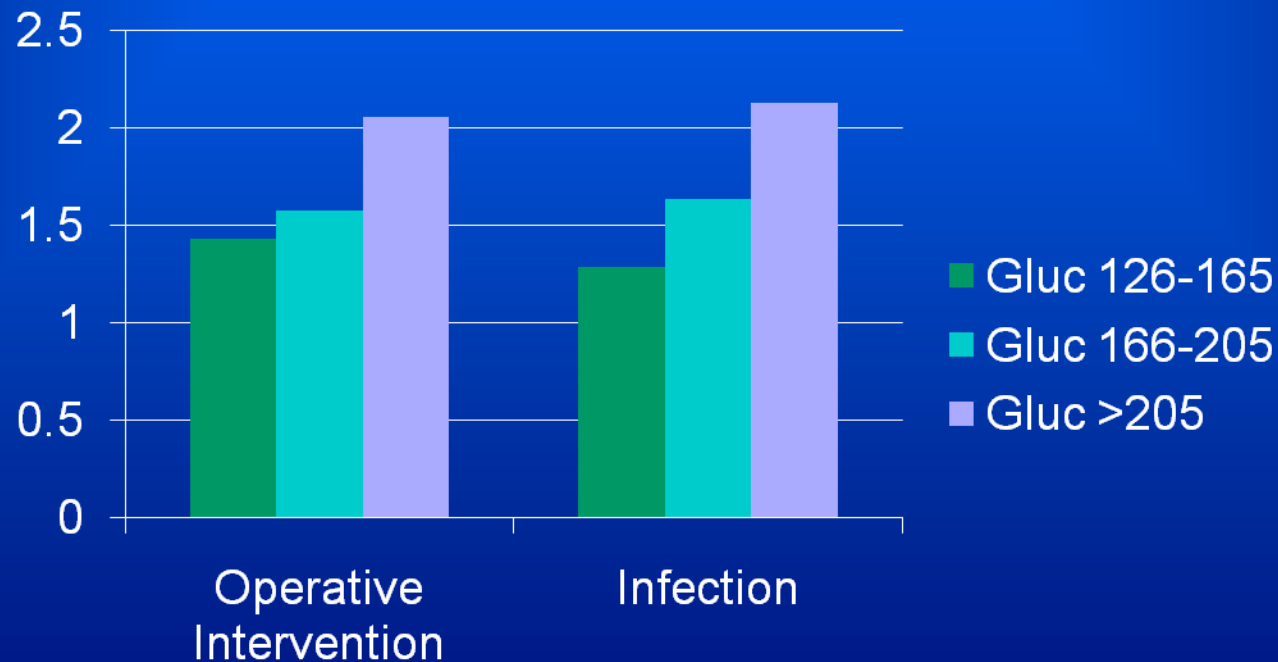
<u>Risk Factor</u>	<u>Odds Ratio</u>	<u>C.I.</u>
Age > 50	3.7	(1.5-9.2)
Pre-Op ChemoRads	2.8	(1.4-5.8)
Any gluc \geq 150 mg%	2.9	(1.2-6.2)

Perioperative Hyperglycemia and Total Knee or Hip Arthroplasty Fasting Blood Glucose POD #1



Mraovic. J Diab Science & Technol 2011; 5: 412-8

Risk Adjusted Odds Ratios for Infection and Operative Intervention Colectomy and Bariatric Operations



Composite Infection in Hyperglycemic Patients With and Without Use of Insulin

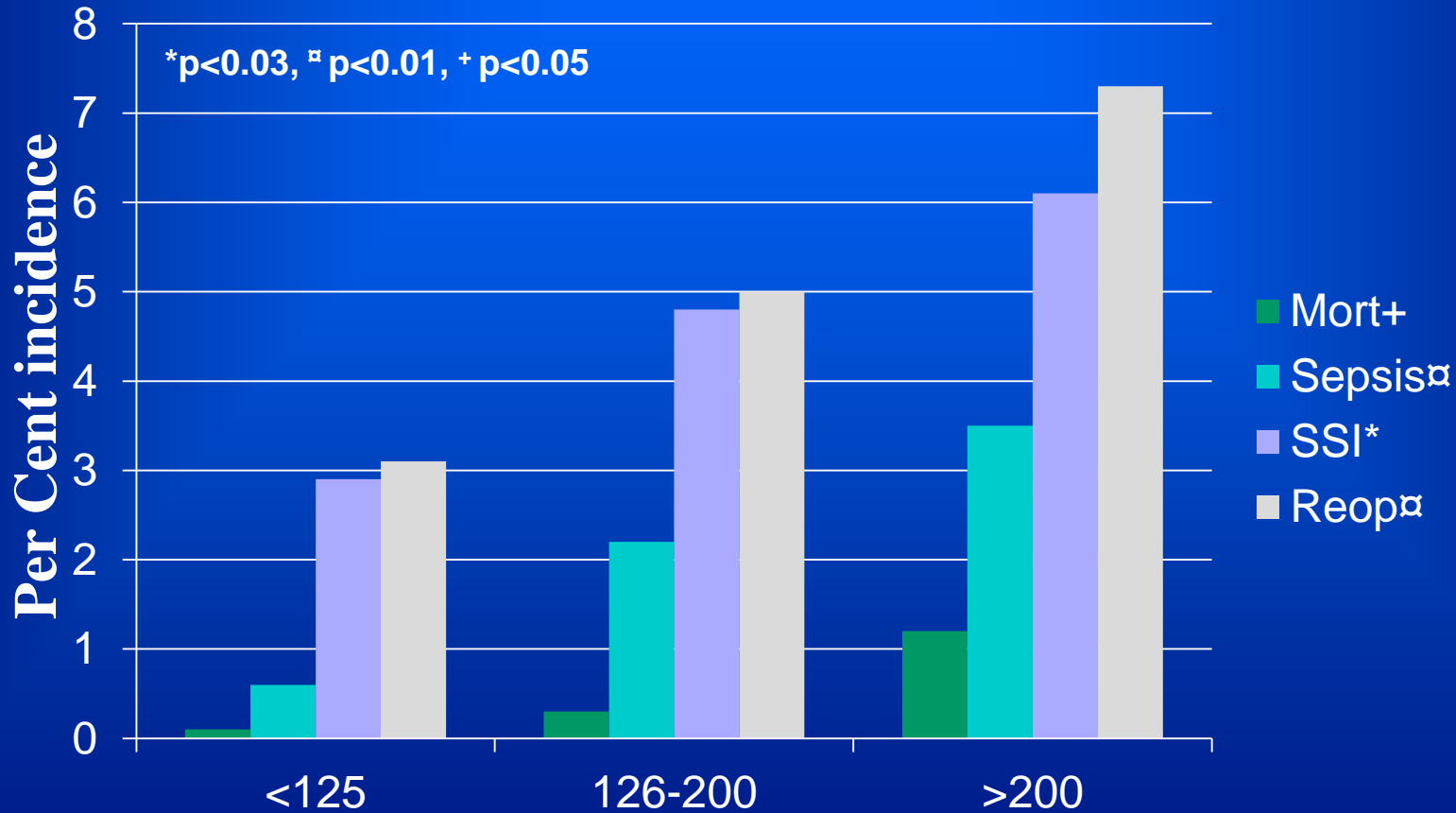


Glucose in NonDiabetics having Colectomy at Cleveland Clinic

<u>Highest Gluc</u>	<u>N (%)</u>
≤ 125 mg%	816 (33%)
126-200 mg%	1289 (53%)
200 mg%	342 (14%)
All patients	2447 (100%)

} 67%

Glucose in NonDiabetics having Colectomy at Cleveland Clinic

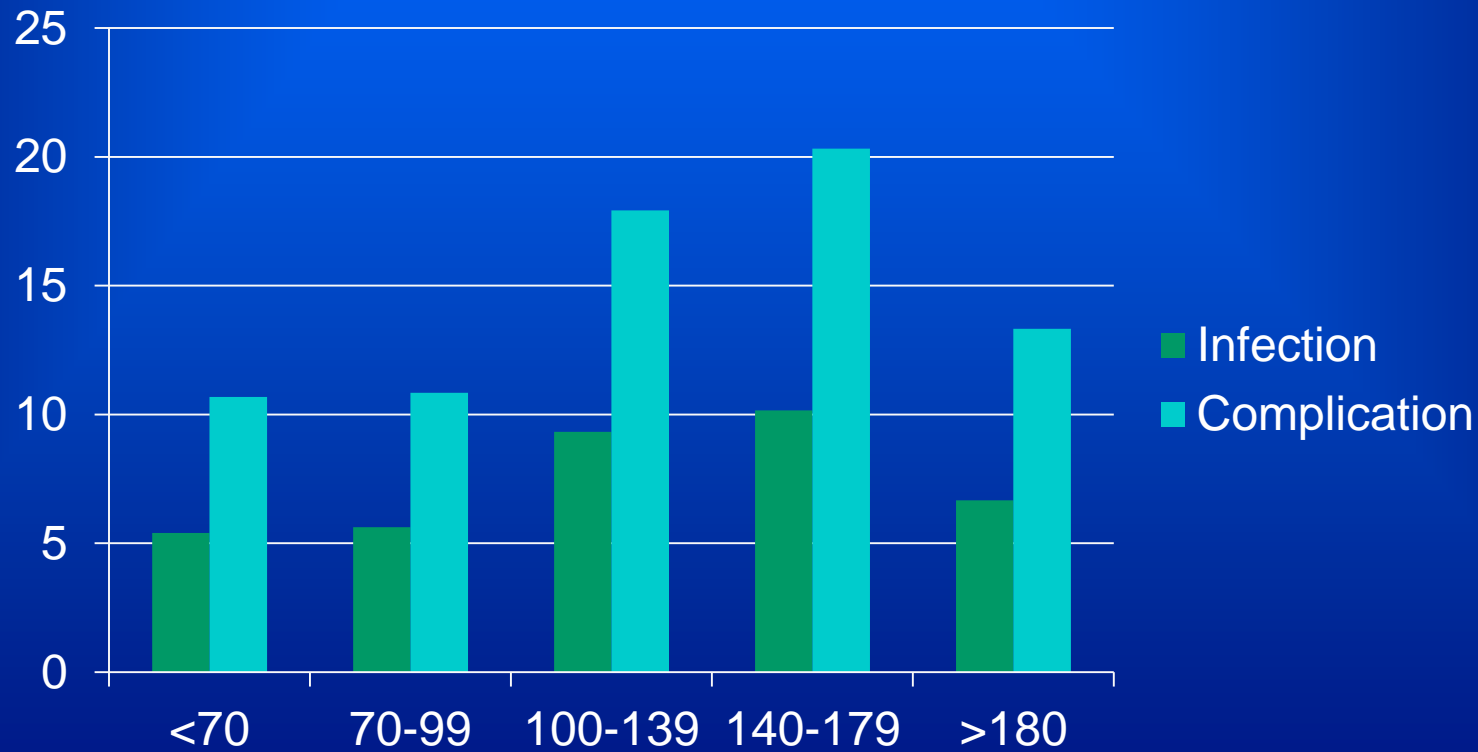


Kiran, Ann Surg 2013; 258: 599-605

Preoperative Glucose as a Screening Tool for Patients Without Diabetes

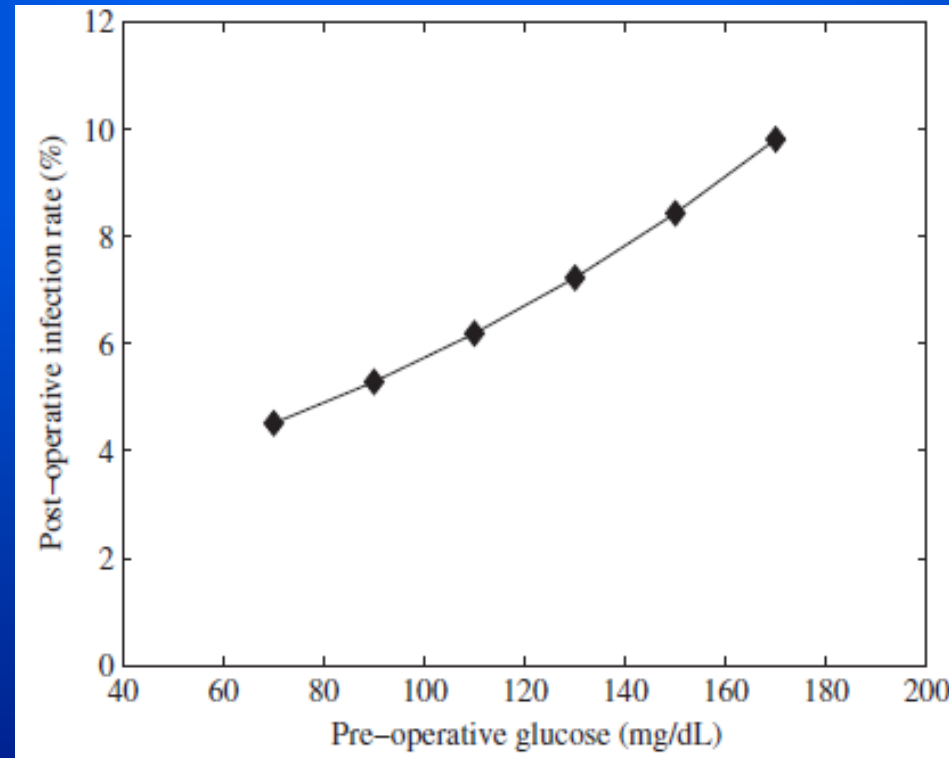
- **Random glucose** within 30 days of operation
 - Average 8 days before operation
 - 16% within one day and 29% within 3 days
 - 6683 patients
 - <70 384 pts
 - 70-99 4251 pts
 - 100-139 1801 pts
 - 140-179 187 pts
 - >180 60 pts
- } 31%

Preoperative Glucose as a Screening Tool for Patients Without Diabetes



Wang. J Surg Res. 2014; 186: 371-8

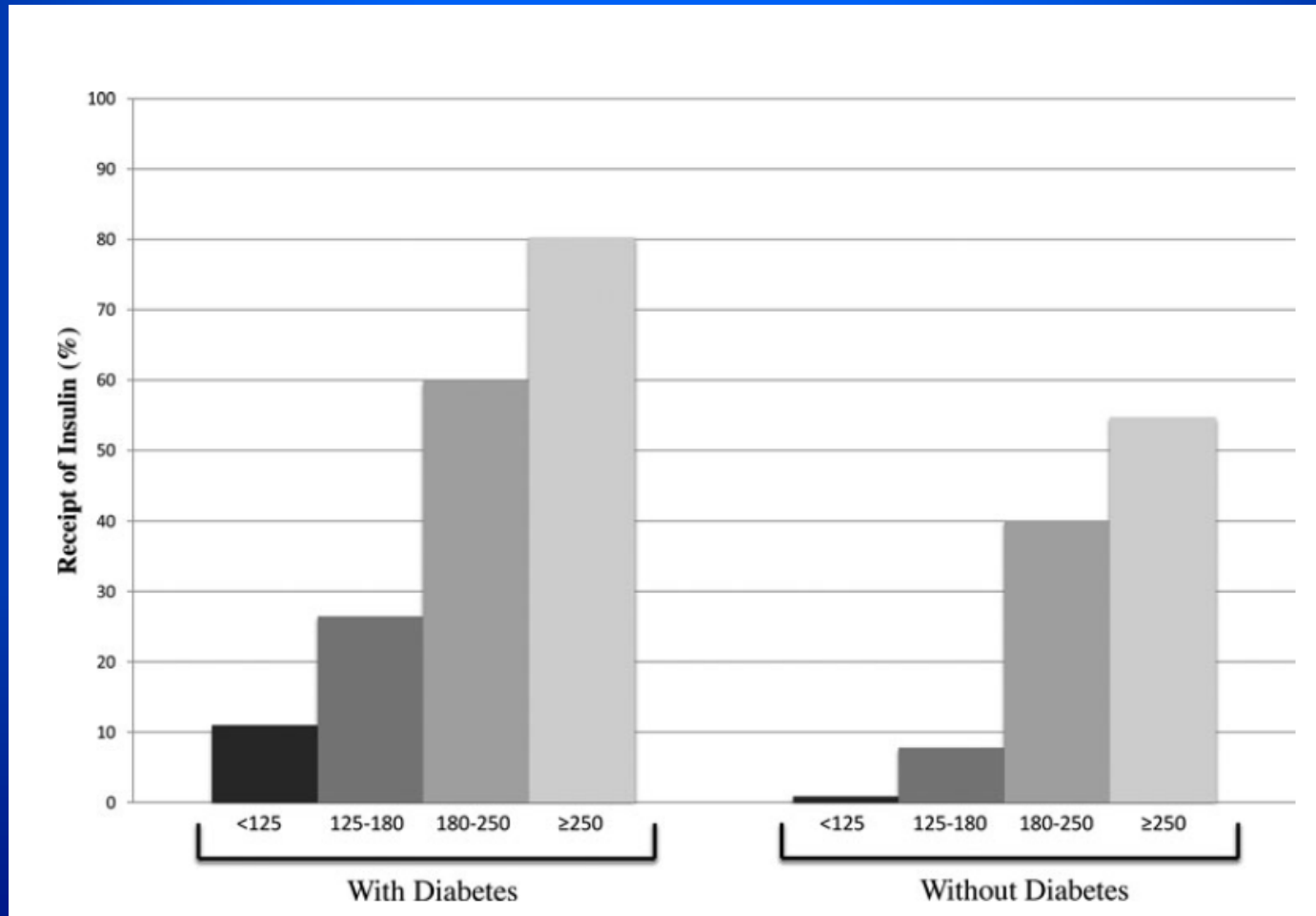
Preoperative Glucose as a Screening Tool for Patients Without Diabetes



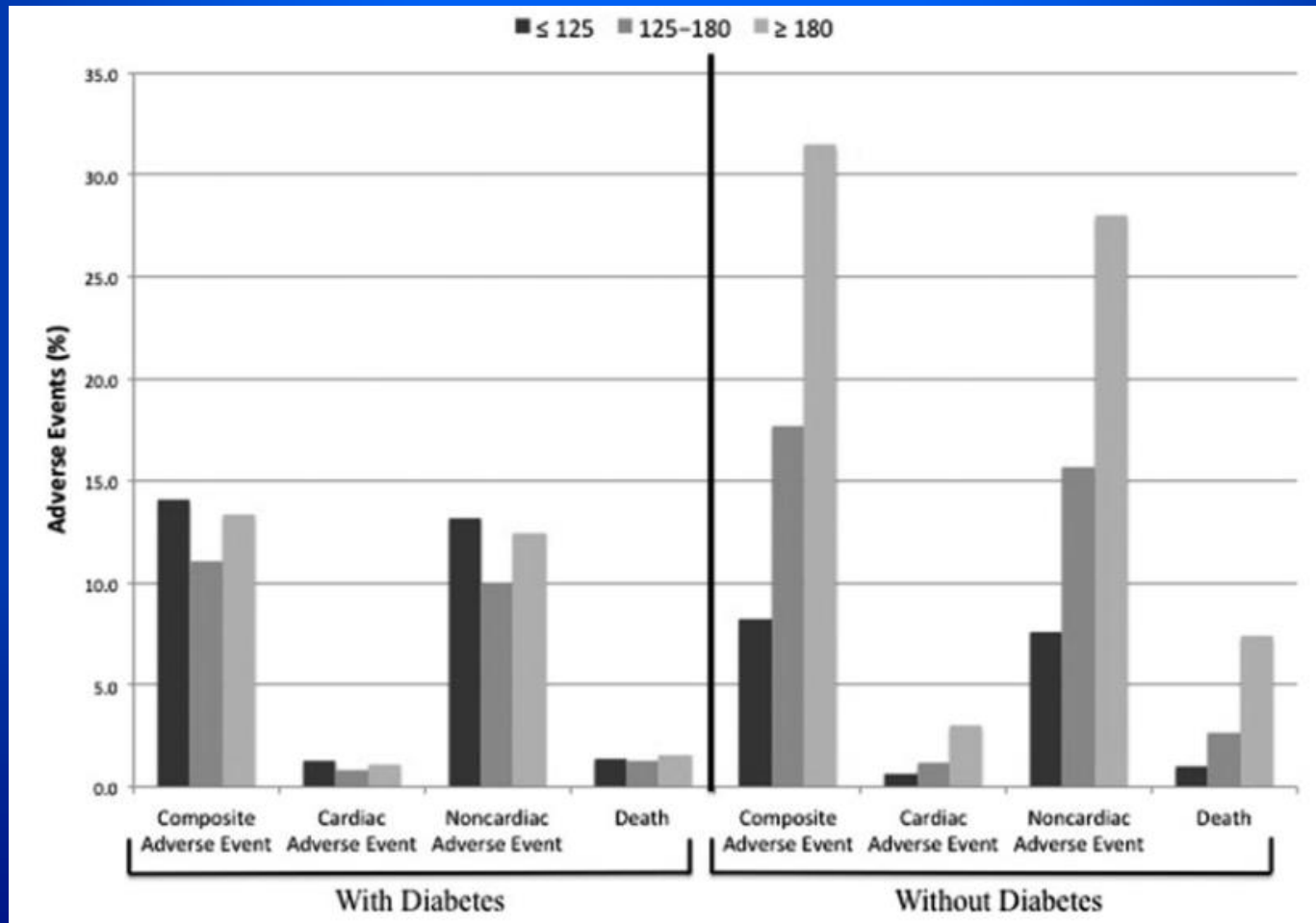
Pre-Op Glucose vs. Post-Op Infection, adjusted for age, gender, BMI, ASA, & type of operation.

Wang. J Surg Res. 2014; 186: 371-8

Perioperative Insulin for Hyperglycemia



Complications with Perioperative Hyperglycemia



Glucose Levels & SSI

- The exact “best” level of glucose control in the perioperative period is not known.
- High glucose levels unequivocally increase the risk of SSI and other perioperative infections.
- Tight glucose control in the perioperative period is tricky.
- Hypoglycemia increases the risk of morbidity and mortality.

Glucose Control

Proven important for SSI risk:

Cardiac surgery

General surgery

Colorectal surgery

Vascular surgery

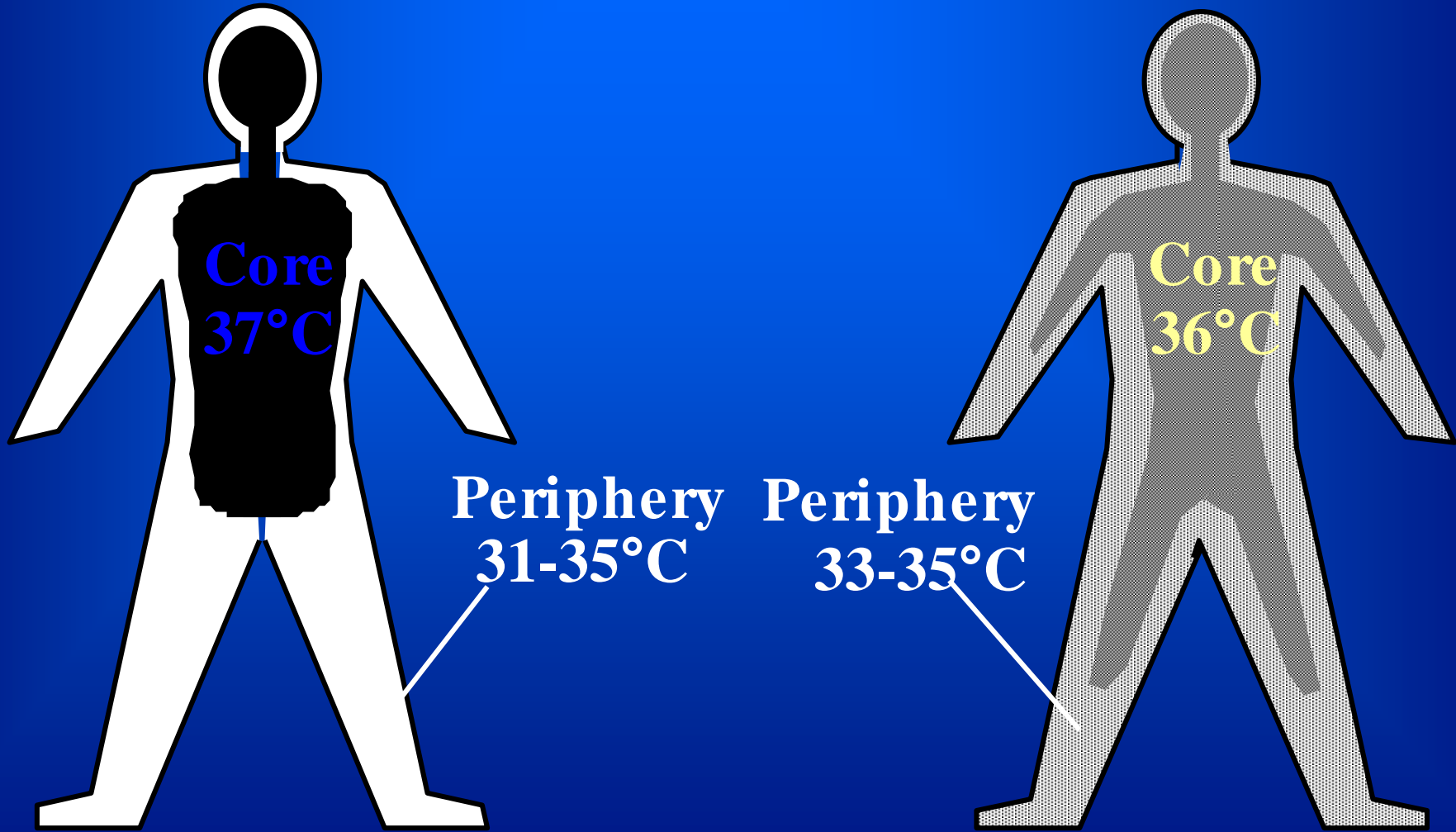
Breast surgery

Hepato-pancreatico-biliary surgery

Orthopedic surgery

Trauma surgery

Redistribution Hypothermia

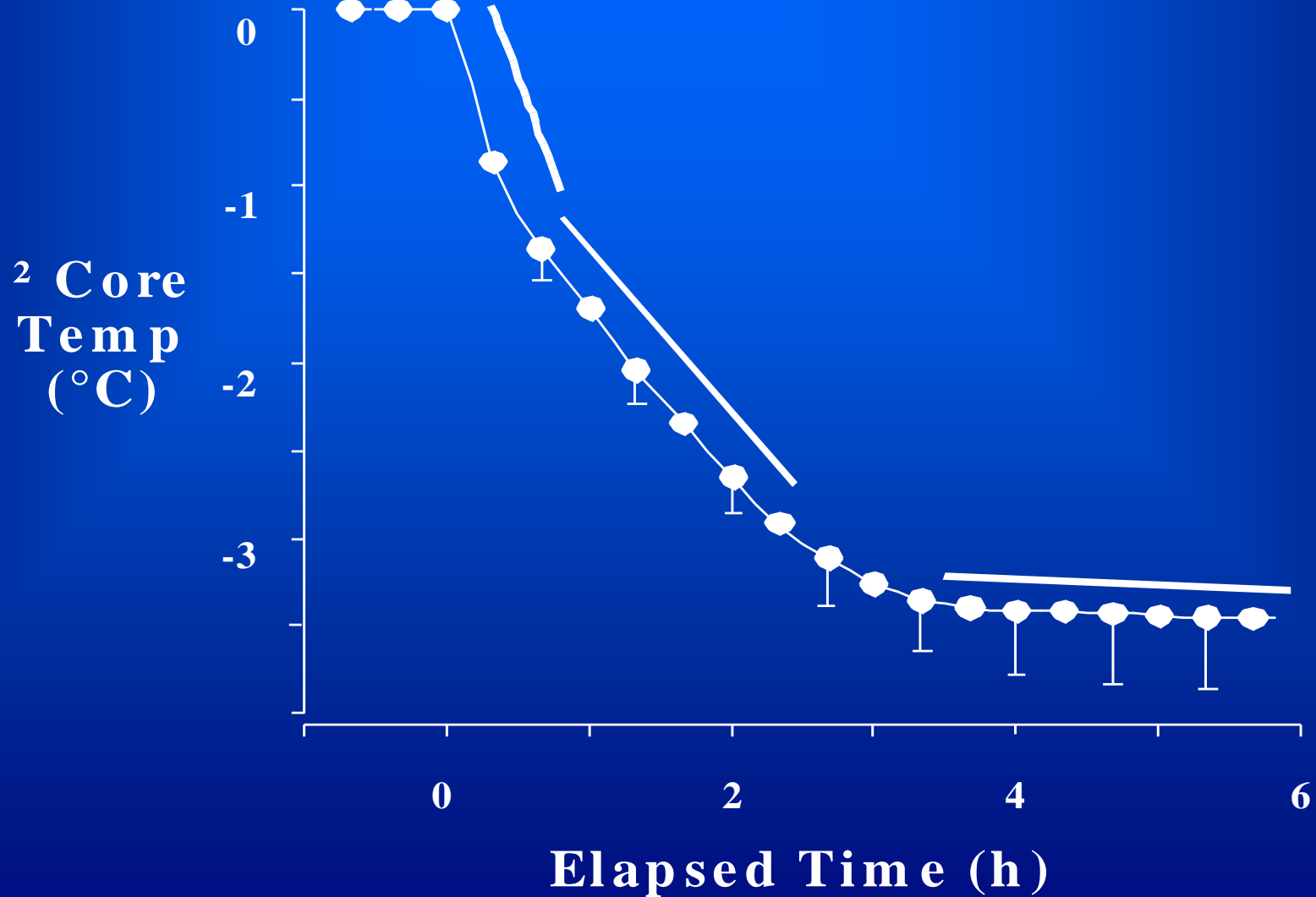


Vasoconstricted

Anesthesia

Vasodilated

Hypothermia During Anesthesia



Keeping Your Patient Warm in the O.R.

- Prewarming and active warming in the O.R. is much more important than the O.R. room temperature.
- If you raise O.R. room temperature from 20° to 27° , you still have an 10° gradient between the patient's temperature and the room temperature and everyone in the room is miserable.

Prewarming at UWMC & First Postoperative Temperature Post Anesthesia Care Unit (PACU) 2006

$> 36^{\circ}$	7836/8132	(96.4%)
$> 36^{\circ} \text{ \& \< } 36.5^{\circ}$	1047/2647	(40%)
$> 36.5^{\circ}$	1491/2647	(56%)

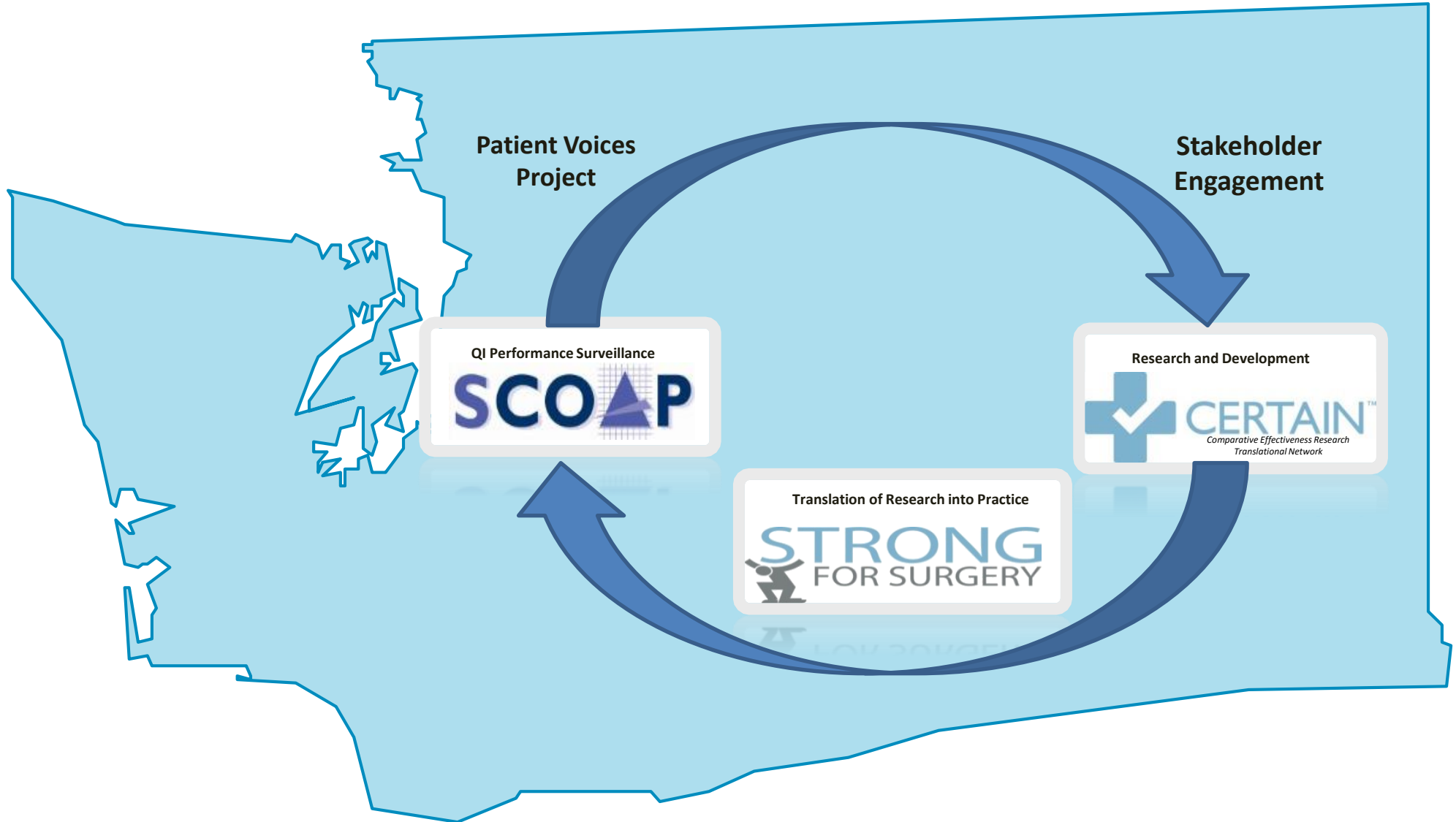
Perioperative Warming, Intraoperative Temperature and Complications

Open Abdominal Bowel Resections

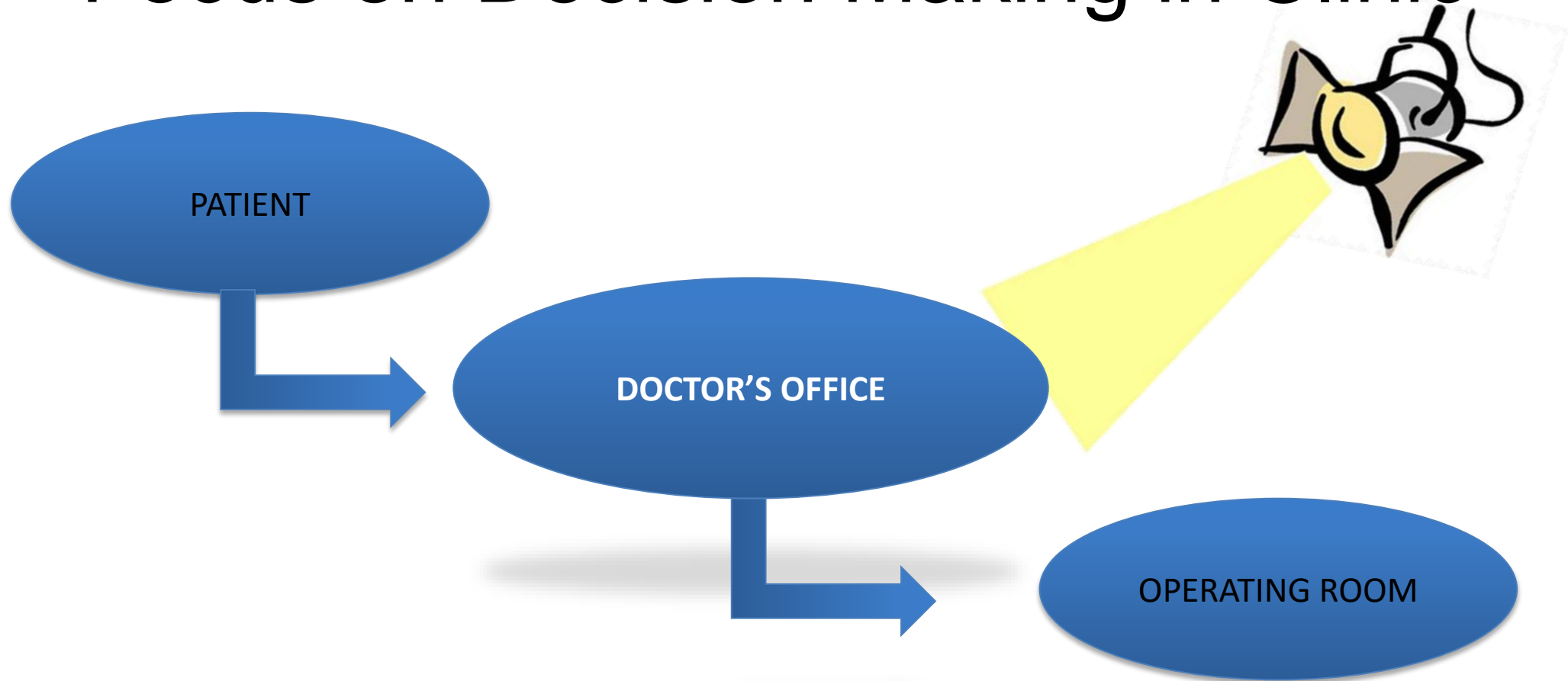
	Periop N=47	Standard N=56	P value
Blood loss	200 ml	400 ml	0.011
Any complication	32%	54%	0.027
SSI	13%	33%	0.09

Wong. Br J Surgery 2007; 94: 423-6

Learning Healthcare System in Washington State



Focus on Decision Making in Clinic





STRONG
FOR SURGERY

The logo features the word "STRONG" in large, blue, sans-serif capital letters. Below it, the words "FOR SURGERY" are written in a smaller, grey, sans-serif font. To the left of the text is a grey silhouette of a person standing with their arms raised in a 'V' shape, symbolizing strength or achievement.

STRONG FOR SURGERY



➤ Blood sugar control



➤ Optimizing nutrition



➤ Smoking cessation



➤ Optimizing medications

Blood Sugar Control



All Patients

Does the patient have a prior diagnosis of diabetes?

Yes No

Patient's age > 45?

Yes No

Patient's BMI ≥30?

Yes No

If YES to any of the questions:

Check fasting blood sugar level on the morning of surgery prior to OR case

If fasting blood glucose level > 200, then recommend use of insulin drip during OR case

Diabetic Patients

Degree of Blood Sugar Control:

Hemoglobin A1c level > 7.0%?

OR

Has any fingerstick reading in the past 2 weeks been >200?

Yes No

If YES or UNKNOWN then:

Referral for diabetes management

Diabetic Patients

Perioperative Management:

Will the patient be NPO after midnight?

Yes No

Is the patient having bowel prep?

Yes No

If YES, while NPO and

Stop all diabetic medication for pioglitazone (Acto-

Reduce Lantus by 50%

Check blood sugars use sliding scale as

Nutrition Screening Checklist



Screening for Malnutrition

Is BMI less than 19?

Yes No

Has the patient had unintentional weight loss of over 8 pounds in the last 3 months?

Yes No

Has the patient had a poor appetite – eating less than half of meals or fewer than two meals per day?

Yes No

Is the patient unable to take food orally (ex. dysphagia, vomiting)?

Yes No

If YES to any of the questions:

Referral to Registered Dietitian for evaluation unless currently receiving nutrition therapy

Lab Tests for Risk Stratification

If YES then:

Is the patient having inpatient surgery?

Yes No

Check albumin level to assess complication risk after surgery

Supplementation

If YES then:

Is the patient having complex surgery (example: GI anastomosis)?

Yes No

Give evidence-based immune modulating supplementation

Smoking Cessation Checklist



Risk Stratification

Has the patient ever smoked?

Yes No

If YES then:

Record patient's smoking status (smoker OR ex-smoker)

Record the number of pack-years (packs per day x years smoking)

Does the patient currently smoke?

Yes No

If YES then:

Establish and document a plan to stop

Help patient choose a quit date and smoking cessation method

Encourage support from family and friends

Highlight stress reduction activities

Smoking cessation programs

1-800-quit-now

www.smokefreewashington.com

Local Resources:

Medication Checklist



Bleeding Risks

Is the patient on a prescribed anti-coagulant (ex. Coumadin, Plavix, other)?

Yes No

If YES then:

Discuss with prescribing MD the safety of stopping medication 1 week prior to surgery

Is the patient taking over the counter medications that increase bleeding risk (ex. NSAIDS)?

Yes No

If YES then:

Consider stopping all over the counter medications that can increase risk of bleeding 2 weeks prior to surgery

Is the patient taking herbal supplements containing ingredients that may increase bleeding risk (ex. Garlic, Ginger, Ginkgo Biloba, St. John's Wort)?

Yes No

If YES then:

Consider stopping all herbal supplements that can increase risk of bleeding 2 weeks prior to surgery

Beta-Blockers

If YES then:

Is the patient taking a beta-blocker?

Yes No

Patient should take throughout perioperative period

Aspirin

If YES then:

Is the patient taking aspirin for cardiac protection?

Yes No

Patient should take throughout perioperative period





All Patients

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Patient's age > 45?

Yes No

Patient's BMI ≥ 30 ?

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Referral for diabetes management

Diabetic Patients

Peroperative Management:

Will the patient be NPO after midnight?

Yes No

Is the patient having bowel prep?

Yes No

If YES, while NPO and during prep:

Stop all diabetic medications except for pioglitazone (Actos)

Reduce Lantus by 50%

Check blood sugars frequently and use sliding scale as needed



All Patients

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Yes No

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Yes No

Patient's BMI ≥ 30 ?

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If **YES** to any of the questions:

- Check fasting blood sugar level on the morning of surgery prior to OR case
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Get Involved

- Attend Campaign Events
- E-mail
- Inform Your Colleagues and Constituents



- Visit the website: <http://www.strongforsurgery.org>