Surgical Site Infection (SSI)

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THE UNIVERSITY OF ALABAMA AT BIRMINGHAM
Knowledge that will change your world

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Disclosures

- I do not have any relevant financial relationships with any commercial interest that pertains to the content of my presentation.

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Surgical Site Infections (SSI) – It's a Problem!

- **> 500,000 SSIs** in the US*
- **#1 nosocomial infections** after surgery
- **7-10 additional** hospital days per SSI
- **3.7 million total** excess hospital days
- **2-11x** higher **risk of death**
- **$10 billion excess $$$** ($3-29k per SSI)

SSIs are common, adverse and preventable events

Anderson, Deverick J. "Surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol. 2008 Oct;29 Suppl 1:S11-6. PubMed PMID: 18846589
Source: https://www.ahrq.gov/sites/default/files/wysiwyg/patients-families/consumerassessment/measures/ssi.pdf
Source: https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalAcquiredConditions/Downloads/SurgicalSiteInfection.pdf
Source: Anderson, Deverick J. "Surgical Site Infections. Center for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection. 2017. JAMA Surg. 2017 Aug 1;152(8):793-794. Doi: 10.1001/jamasurg.2017.0904. PubMed PMID: 28697192. https://www.ncbi.nlm.nih.gov/pubmed/28697192

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Surgical Site Infections (SSI) – It's a Problem!

2 - 4 % of operations result in an SSI

- Colorectal surgery 10 - 20%
- CABG 3.5%
- C section 3 - 30%
- Joint arthroplasty with prosthesis 1.5%

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Risk factors for SSI

- Patient factors
  - Obesity
  - Tobacco use
  - Hyperglycemia
  - Vascular disease
  - Immunosuppression
- Operative factors
  - Incision size
  - Length of operation
  - ? Transfusion
  - Wound classification

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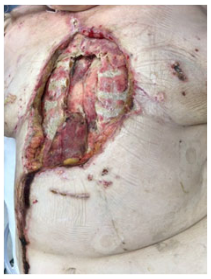

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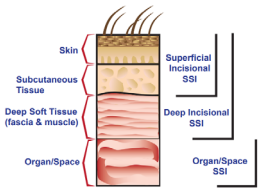
SSI Definition

- Infection near surgical site that occurs within 30 days of surgery, or 90 days if an implant was used
- Incisional SSI from skin incision down to muscle layer
- Organ space infections include intraabdominal abscess, anastomotic leak, and infected implant.



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Diagnosis

- Incisional SSI
  - Warmth
  - Erythema
  - Swelling
  - Purulent drainage
  - Pain
  - Dehiscence
- Organ Space SSI
  - Malaise
  - Fever
  - Pain
  - Imaging usually required

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Management Incisional SSI

- Opening of wound, culture, and subsequent wound care
- Antibiotics rarely required unless cellulitis or signs systemic illness
- For intestinal surgery, almost always polymicrobial
  - Antibiotics should not be narrowed to cultured pathogen
- Once wound opened, no role for culturing open wound

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Common pathogens

- Staph aureus
- Strep
- Enterococcus
- For GI: gram negative and anaerobes

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Wound care

- Basic wet to dry dressing effective
  - Can be saline or tap water
  - Does not need to be sterile
  - Provides gentle debridement at dressing changes
- Avoid betadine, hydrogen peroxide, etc as may interfere with wound healing

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NWPT (Wound Vac)

- Shorten wound healing times
- Absorb fluid
- Encourage granulation
- Only need to be changed 3x/week

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Management Organ Space SSI

- Antibiotics
- Gastrointestinal Surgery
  - Most abscesses can be drained percutaneously
  - Look for evidence ongoing contamination, ie occult bowel injury or anastomotic leak

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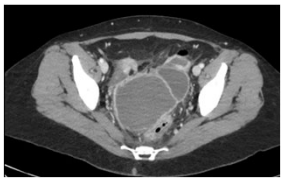
Anastomotic Leak

Simple Abscess



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Implant associated SSI

- Orthopedic hardware, hernia mesh, vascular grafts
- Represent 50% of all SSI
- Much harder to treat
- Implant harbors bacteria
- Must weigh the risk of explantation with infection risk

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Necrotizing Soft Tissue Infection

- Uncommon in SSI, but requires high level of suspicion
- Severe pain
- Sepsis
- Copious dishwater like drainage
- Skin discoloration
- Hyponatremia
- Requires urgent OR

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Not all erythema is SSI

- "Stitch abscess"
- Contact dermatitis
- Normal inflammation
- Dependent inflammation

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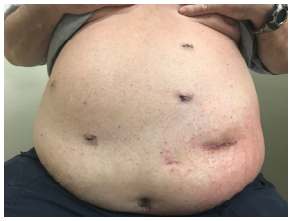

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Seroma

- Can be impressive on physical exam
- Can be tense but lacking erythema or surrounding edema
- Avoid aspiration as can become infected

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Surgical Site Infections (SSI) – Prevention

Colorectal Resections (NSQIP)

	Robotic N=45	Laparoscopic N=67	Open N=112	P value
SSI	*1 (2.2)*	*5 (7.5)*	*17 (15.1)*	*.04*

Understanding the value of both laparoscopic and robotic approaches compared to the open approach in colorectal surgery.

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Reducing incision size

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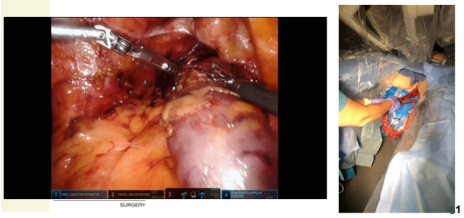
Total Abdominal Colectomy with Transanal Extraction



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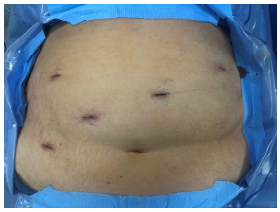
Reducing incision size



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History of SSI Reduction Efforts

1970 CDC established **National Nosocomial Infections Surveillance** (NNIS) System

1999 CDC published 1st ***Guideline for Prevention of SSI***

2002 CDC and CMS instituted **Surgical Infection Prevention (SIP) project**

2003 CMS, CDC and 10+ org. **Surgical Care Improvement Project (SCIP)**

2006 CMS/JC SIP → SCIP **Expanded processes** (hair, glycemic control, normothermia)

2009 US Department of HHS **National Action Plan to Prevent Healthcare-Associated Infections**

Road Map to Elimination 5-year goal of a **25% reduction** in SSIs on admission and readmission

2012 CMS required SSI outcome data through CDC **National Healthcare Safety Network** (NHSN)

2016 **WHO** Global guidelines on prevention of SSI | **ACS/SIS** Guidelines for SSI Prevention

2017 **CDC** Updated Guidelines

Bratzler DW, Hunt DR. The surgical infection prevention and surgical care improvement projects: national initiatives to improve outcomes for patients having surgery. *Clin Infect Dis.* 2006;43(3):322–330. file:///C:/Users/dchu/Downloads/50CS70001supp1_prod.pdf

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Original SCIP Measures

SCIP infection measure designator	*Performance measure title*
INF-1	Prophylactic Antibiotic Received Within One Hour Prior to Surgical Incision
INF-2	Prophylactic Antibiotic Selection for Surgical Patients
INF-3	Prophylactic Antibiotics Discontinued Within 24 H after Surgery End-Time
INF-4	Cardiac Surgery Patients With Controlled 6 AM Postoperative Blood Glucose
INF-6	Surgery Patients with Appropriate Hair Removal
INF-9	Urinary Catheter Removed on Postoperative Day 1 or Postoperative Day 2 with Day of Surgery being Day 0
INF-10	Surgery Patients with Peri-operative Temperature Management

Right agent → **dose** → **timing** → **duration** → **…, …,**

Bratzler DW, Hunt DR. The surgical infection prevention and surgical care improvement projects: national initiatives to improve outcomes for patients having surgery. *Clin Infect Dis.* 2006;43(3):322–330. file:///C:/Users/dchu/Downloads/50CS70001supp1_prod.pdf

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Bundling works better than single process (2010)

June 23 2010

Adherence to Surgical Care Improvement Project Measures and the Association With Postoperative Infections

Jonah J. Stulberg, MD, PhD; MPH; Conor P. Delaney, MD, PhD; Donna V. Neuhauser, PhD; et al.

Individual SCIP Measures

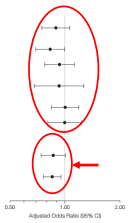
INF-1: patients who received prophylactic antibiotics within 1 hour prior to surgical incision (2 hours if receiving vancomycin).

INF-2: patients who received prophylactic antibiotics recommended for their specific surgical procedure.

INF-3: patients whose prophylactic antibiotics were discontinued within 24 hours after surgery end time (48 hours for coronary artery bypass graft surgery or other cardiac surgery).

Figure 1. Surgical Care Improvement Project (SCIP) Infection–Prevention Process Measures

	Nonadherent Discharges		Adherent Discharges		
	Postoperative Infections	Discharges	Postoperative Infections	Discharges	Adjusted Odds Ratio (95% CI)
Individual SCIP measures					
INF-1: prophylactic antibiotic received within 1 h prior to surgical incision	251	18 147	1384	190 925	0.89 (0.75–1.06)
INF-2: prophylactic antibiotic selection for surgical patients	266	12 670	1486	198 002	0.83 (0.69–1.00)
INF-3: prophylactic antibiotics discontinued within 24 h after surgery end time	310	26 499	1024	173 228	0.94 (0.75–1.13)
INF-4: cardiac surgery patients with controlled 6 AM postoperative blood glucose	65	4168	362	21 512	0.93 (0.68–1.27)
INF-6: surgery patients with appropriate hair removal	194	21 308	3539	360 111	1.00 (0.85–1.18)
INF-7: colorectal surgery patients with immediate postoperative normothermia	181	4564	676	18 101	1.00 (0.81–1.23)
Composite measures					
S-INF-Core: all 3 original Surgical Infection Prevention (SIP) project perioperative infection prevention measures	511	44 417	816	154 963	0.86 (0.74–1.01)
S-INF: all patients with at least 2 reported SCIP infection-prevention measures in a single visit	843	59 356	1070	158 304	0.85 (0.76–0.95)



Each estimate accounts for the surgical procedure performed, patient characteristics, and hospital characteristics. CI indicates confidence interval.

Stulberg JJ, Delaney CP, Neuhauser DV, Aron DC, Fu P, Koroukian SM. Adherence to surgical care improvement project measures and the association with postoperative infections. JAMA. 2010;Jun 23;303(24):2479-85. PubMed PMID: 20571016 http://www.ncbi.nlm.nih.gov/pubmed/20571604

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Institutional Benefits of SSI Reduction Bundles (2014)

Original Investigation

The Preventi
In Colorectal
An Effective A

Preoperative | Operative | Postoperative

Table 3. Outcomes for the ACS-NSQIP Sampled Colorectal Surgical Procedures Subdivided by the Use of the Bundle After Propensity Matching[a]

Characteristic	Prebundle Period (n = 212)	Postbundle Period (n = 212)	*P* Value
Superficial SSI, No. (%)	41 (19.3)	12 (5.7)	<.001
Deep SSI, No. (%)	3 (1.4)	0	.25
Organ-space SSI, No. (%)	11 (5.2)	6 (2.8)	.32
Wound disruption, No. (%)	5 (2.4)	3 (1.4)	.72
Postoperative sepsis, No. (%)	18 (8.5)	5 (2.4)	.009
Length of stay, median (Q1-Q3), d	5.5 (4-8)	5.0 (3-7)	.05
30-d Readmission, No. (%)	32 (15.1)	19 (9.0)	.14
Variable direct costs, median (Q1-Q3), $	8391 (6781-11 311)	9681 (7915-11 745)	.70

Major reductions in superficial SSIs with SSI Reduction Bundles

Keenan JE, Speicher PJ, Thacker JK, Walter M, Kuchibhatla M, Mantyh CR. The preventive surgical site infection bundle in colorectal surgery: an effective approach to surgical site infection reduction and health care cost savings. JAMA. Surg. 2014 Oct;149(10): 1045-52. PubMed PMID: 25160227. https://www.ncbi.nlm.nih.gov/pubmed/25160227

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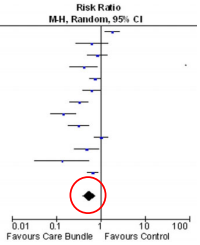
2015 Meta-Analysis | Clear benefits of SSI bundles

Study or Subgroup	Care Bundle Events	Care Bundle Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI
Anthony 2010	45	100	24	97	8.7%	1.82 [1.21, 2.74]
Berenguer 2010	7	84	15	113	6.2%	0.63 [0.27, 1.47]
Bull 2011	22	175	27	180	8.1%	0.84 [0.50, 1.41]
Cima 2012	8	198	52	531	6.9%	0.41 [0.20, 0.85]
Crolla 2012	61	377	86	394	9.3%	0.74 [0.55, 1.00]
Hedrick 2007	21	132	45	175	8.4%	0.62 [0.39, 0.99]
Keenan 2014	18	212	55	212	8.2%	0.33 [0.20, 0.54]
Liau 2010	11	2408	33	1040	7.2%	0.14 [0.07, 0.28]
Lutfiyya 2012	13	195	91	430	7.9%	0.32 [0.18, 0.55]
Pastor 2010	49	253	45	238	9.0%	1.02 [0.71, 1.47]
Tillman 2013	12	104	19	79	7.3%	0.48 [0.25, 0.93]
Waits 2013	2	87	17	99	3.6%	0.13 [0.03, 0.56]
Wick 2012	59	324	76	278	9.3%	0.67 [0.49, 0.90]
Total (95% CI)		**4649**		**3866**	**100.0%**	**0.55 [0.39, 0.77]**
Total events	328		585			

Heterogeneity: Tau² = 0.30; Chi² = 73.22, df = 12 (P < 0.00001); I² = 84%
Test for overall effect: Z = 3.47 (P = 0.0005)



Included 8,515 patients | 2010-2014 | 13 high-quality studies

Tanner J, Padley W, Assadian O, Leaper D, Kiernan M, Edmiston C. Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery. 2015 Jul;158(1):66-77. Epub 2015 Apr 25. Review. Published PMID: 25920911. https://www.ncbi.nlm.nih.gov/pubmed/25920911

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Core Themes in SSI Reduction Bundles


1. **Effective antibiotic prophylaxis**
   - Administered within 1-2 hours before incision
   - Base selection on procedure/local antibiogram
2. **Prepare all skin**
   - Pre-Op: Full-body bathing for patients
   - Op: Patient skin w alcohol-based antiseptic
   - Op: Surgeon skin w surgical hand scrub


3. **Maintenance of normothermia**
4. **Glycemic control**
5. **FiO2 (80%) intra-op and post-op**



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Summary Points

- SSIs are a major **but addressable** problem in surgery
- Minimally invasive surgery and smaller incisions reduce SSI
- Interventions exist and **work better in bundles**
- Superficial SSI generally treated with opening of wound alone
- Organ space SSI need to rule out ongoing source of infection
- Infections involving an implant are particularly challenging to manage and may require long term antibiotics

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