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**28<sup>th</sup> Annual Scientific Assembly**

**Sunrise Session 12**

**Disease Grading Systems in Emergency General Surgery**

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**Disney's Contemporary Resort**

**Lake Buena Vista, Florida**

# Disease Grading Systems in EGS

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## Overview

- Background of grading systems
- AAST methodology
- Sample case discussion
  - Appendicitis
  - Diverticulitis
  - Peptic ulcer disease
- Controversies in disease grading

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## The problem

- EGS needs outcome data to further define it as a specialty
- Outcome data will require standardization of the disease
- Current grading systems do not address the acute disease process or do not fit into a standard nomenclature

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### What is the goal of grading system?

- Clinical tool to guide therapy
- Research tool
- Create a language that everyone can share

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### Requirments of a grading system

- Must be universally applicable
- Must be simple
  - May be radiologist or surgeon-dependent
- Fit the anatomic requirements, increasing severity

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### Essentials of a EGS Grading System

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### Essentials of a EGS Grading System

- Standard progression from minimal disease to fulminant disease
- Granularity among levels of disease
- Ability to classify non-operative cases

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### Process of creating a AAST system

- Wanted a grade that just described the mechanical disease

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### What to partner with a mechanical grade

- Co-morbidities
- Charleson
- Physiology
- Apache
- MODS?

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## Basic Format Chosen for mechanical disease grade

Grade	AJCC Disease Grade	Clinical used for Operative criteria	Imaging and/or endoscopic criteria	Pathologic criteria	Corresponding level of an existing system*
I	Local disease Confined to the organ Minimal abnormality				
II	Local disease Confined to the organ Severe abnormality				
III	Beyond the organ Locally advanced only				
IV	Beyond the organ Regional extension				
V	Beyond the organ Widespread involvement				

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## Diverticulitis -Hinchey

- The Hinchey classification - proposed by Hinchey et al. in 1978[1] classifies a colonic perforation due to diverticular disease.
  - Hinchey I - localised abscess (para-colonic)
    - Hinchey II - pelvic abscess
  - Hinchey III - purulent peritonitis (the presence of pus in the abdominal cavity)
  - Hinchey IV - feculent peritonitis.

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## Appendicitis

- Case study

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## Anatomic description

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## Imaging

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## Appendicitis

Grade	Description	Clinical Criteria	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria
I	Acutely inflamed appendix, intact	Pain, elevated WBC and RLQ tenderness	Inflammatory changes localized to appendix <=> appendicolith <=> contrast non-filling	Acutely inflamed appendix, intact	Presence of neutrophils at the base of crypt, submucosa <=> in muscular wall
II	Gangrenous appendix, intact	Pain, elevated WBC and RLQ tenderness	Appendix of wall thickness with contrast non-enhancement <=> air in appendicolith wall	Gangrenous appendix, intact	Mucosa and muscular wall disruption, not identifiable on H&E
III	Perforated appendix with local contamination	Pain, elevated WBC and RLQ tenderness	Abscess with local peritoneal fluid <=> contrast extravasation	Abscess with evidence of local contamination	Gross perforation or focal disruption of muscular wall
IV	Perforated appendix with peritoneal phlegmon or abscess	Pain, elevated WBC and RLQ tenderness, may have peritoneal signs, duration of history >X days	Regional wall thickening, inflammatory changes, phlegmon or abscess	Abscess with abscess or phlegmon in region of appendix	N/A
V	Perforated appendix with generalized peritonitis	Generalized peritonitis	Diffuse abdominal or pelvic inflammatory changes <=> free intra-peritoneal fluid or air	Abscess with addition of generalized peritoneal contamination away from appendix	N/A

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## Discussion

- Disease grade?

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## Perforated Gastric Ulcer

- Case study

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## Anatomic description

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## Imaging

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## Perforated Peptic Ulcer

Grade	Description	Clinical Criteria	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria
I	Minor perforation without peritonitis	Discomfort in the epigastric region	Extraluminal gas with no associated inflammatory changes	Presence of normal anatomy with distention required to identify the perforation	Perforation with minimal bowel wall inflammation
II	Contained perforation with localized peritonitis	Tenderness confined to the right upper quadrant	Extraluminal gas confined to a limited collection or the retroperitoneum	Presence of inflammation and evidence of perforation with contained collection	Perforation with bowel wall inflammation
III	Perforation with localized peritonitis and localized fluid collection in lower one or right upper quadrant	Tenderness confined to the right upper quadrant	Perforation with associated collection that is not contained in a mesenteric space or absence for an abdominal wall defect	Inflammation and contamination of peritoneal cavity confined to the right upper quadrant	Perforation with bowel wall inflammation
IV	Free perforation with peritonitis	Diffuse peritonitis	Perforation with dissemination of air and fluid	Perforation with dissemination of air or protein peritonitis	Perforation with bowel wall inflammation
V	Perforation with disseminated peritonitis, a perforation into adjacent organs and generalized peritonitis	Diffuse peritonitis	Perforation with dissemination of air and fluid with loss of local anatomic planes or the site of perforation	Perforation with disseminated air or protein peritonitis and entrance into adjacent structures	Dissective erosion of involved structures

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## Discussion

- Disease grade?

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## Diverticulitis

- Case study

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## Anatomic description

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## Imaging

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# Diverticulitis

Grade	Description	Clinical Criteria	Imaging Criteria (CT findings)	Operative Criteria	Pathologic Criteria
I	Colitis inflammation	Pain Elevated WBC count Mucosal Neutrophilia	Mucosal thickening Colitis wall thickening	N/A	N/A
II	Colitis mucropurulent or purulent phlegmon without abscess	Local tenderness (single or multiple areas) No perforation	Purulent phlegmon Pne of air (single or multiple locations) No abscess	Purulent phlegmon No abscess	Inflamed colon with mucropurulent perforation
III	Localized purulent abscess	Localized peritonitis	Purulent abscess	Purulent abscess	Perforation
IV	Distant and/or multiple abscesses	Localized peritonitis at multiple locations	Abscess phlegmon away from the colon	Abscess phlegmon away from the colon	N/A
V	Pure colonic perforation with generalized peritonitis	Generalized peritonitis	Pne air and free fluid	Perforation with generalized local and purulent contamination	N/A

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## Discussion

- Disease grade?

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## Controversies in disease scoring

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## Validation of the Grading System

- Inter-observer reliability
- Dependent on radiographic, anatomic, and pathologic analysis
- Analogous to AAST Organ Injury Scale
  - Basis for multiple future studies

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## ICD Mapping

- Would be necessary if automated coding were to occur
- Needs the ICD codes to deliver enough granularity to place the patients into mechanical grades
- There exists the ability to petition ICD-10 codes to refine the code definitions.

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## Diverticulitis

Grade	Description	Clinical Criteria	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria	ICD-9-CM Codes	ICD-10-CM Codes
I	Colonic inflammation	Pain Elevated WBC count Mucosa/No tenderness	Mucosal swelling Colonic wall thickening	N/A	N/A	562.11 or 562.11	K57.31 or K57.32 or K57.32 or K57.32 or K57.32
II	Colonic perforation or perforic phlegmon without abscess	Local tenderness (single or multiple areas) No peritonitis	Pericolic phlegmon Foci of air (single or multiple locations) No abscess	Pericolic phlegmon No abscess	Inflamed colon with mucosal perforation	562.11 or 562.11	K57.31 or K57.32 or K57.32 or K57.32 or K57.32
III	Localized pericolic abscess	Localized peritonitis	Pericolic abscess	Pericolic abscess	Perforation	562.11 or 562.11 and 562.12 or 562.12	K57.31 or K57.32 or K57.32 or K57.32 or K57.32
IV	Dissect and/or multiple abscesses	Localized peritonitis at multiple locations	Abscess/phlegmon away from the colon	Abscess/phlegmon away from the colon	N/A	562.11 or 562.11 and 562.12 or 562.12	K57.31 or K57.32 or K57.32 or K57.32 or K57.32
V	Free colonic perforation with generalized peritonitis	Generalized peritonitis	Free air and free fluid	Perforation with generalized fecal and purulent contamination	N/A	562.11 or 562.11 and 562.20	K57.31 or K57.32 or K57.32 or K57.32 or K57.32

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**Applicable ICD codes**

**ICD-9-CM code descriptions:**

- 562.11 Diverticulitis of colon (without mention of hemorrhage)
- 562.13 Diverticulitis of colon with hemorrhage
- 567.21 Peritonitis (acute) generalized
- 567.22 Peritoneal abscess
- 567.29 Other suppurative peritonitis
- 567.31 Psoas muscle abscess

**ICD-10-CM code descriptions:**

- K57.20 Diverticulitis of large intestine with perforation and abscess without bleeding
- K57.21 Diverticulitis of large intestine with perforation and abscess with bleeding
- K57.32 Diverticulitis of large intestine without perforation or abscess without bleeding
- K57.33 Diverticulitis of large intestine without perforation or abscess with bleeding
- K57.40 Diverticulitis of both small and large intestine with perforation and abscess without bleeding
- K57.41 Diverticulitis of both small and large intestine with perforation and abscess with bleeding
- K57.52 Diverticulitis of both small and large intestine without perforation or abscess without bleeding
- K57.53 Diverticulitis of both small and large intestine without perforation or abscess with bleeding
- K57.80 Diverticulitis of intestine, part unspecified, with perforation and abscess without bleeding
- K57.81 Diverticulitis of intestine, part unspecified, with perforation and abscess with bleeding
- K57.92 Diverticulitis of intestine, part unspecified, without perforation or abscess without bleeding
- K57.93 Diverticulitis of intestine, part unspecified, without perforation or abscess with bleeding

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**Where to find this data?**

- UHC
- NSQIP
  - Only operative cases are included
  - Very few emergent cases are included

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**Severity estimation with  
UHC, NIS, NSQIP, NHSN**

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## UHC and NIS: Quantification of EGS and markers of severity

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### UHC background

- Quality tool started in 1984
- Most data avail from 2008-present
- 116 academic hospitals and 276 affiliates
- Intended to be used a comparison tool
- Drilling down
  - Individual patients
    - By diagnosis, procedure, complication, etc.
  - Individual practitioner
  - Individual institution
- Differing stratification schemes

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### NIS background

- Data from 8M admits, 20% of admissions
- States participating in HCUP (96% of population)
- Data available from 1988-present (2010 most recent)
  - Primary and secondary diagnoses
  - Primary and secondary procedures
  - Admission and discharge status
  - Patient demographics (e.g., gender, age, race, median income for ZIP Code)
  - Expected payment source
  - Total charges
  - Length of stay
  - Hospital characteristics (e.g., ownership, size, teaching status)

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## UHC severity modeling

- All patient related diagnosis-related grouping
- Categorical modeling severity, risk of mortality
  - Mild
  - Moderate
  - Major
  - Extreme
- Modeling = MS-DRG in academic centers
- Bias
  - Omitted risk factors
  - Biased reporting of risk factors (over vs under-reporting)
  - Statistical bias
    - May over- or underfit depending on factor reporting per hospital
- Recalibrated for each fiscal year

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## NIS severity modeling

- APR-DRG like UHC
- 30 AHRQ comorbidity indices
- Disease staging
  - Stage 1: no complications or minimal severity
  - Stage 2: single organ/system, increased risk of compl
  - Stage 3: multi-site involvement, systemic, poor px
  - Stage 4: death
- Disease LOS, mortality, resource demand scale
  - Very low (<5% of patients)
  - Low (5-25% of patients)
  - Medium (25-75% of patients)
  - High (75-95% of patients)
  - Very high (>95% of patients)

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## Pros/cons

- UHC
  - Pros
    - How are we doing compared to our peers?
    - How is XXX surgeon performing?
    - Outcome questions by diagnosis, DRG, clinical category, etc.
    - Can access the entire dataset at the patient level
  - Cons
    - Doesn't answer the question of "What is EGS"
    - Dependent on ongoing recruitment, incomplete populations
    - Doesn't provide hospital characteristics
    - Limited stratification power

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## Pros/cons

- NIS
  - Pros
    - More complete dataset
    - 20% sample of majority of admits in US
    - OR utilization vs non OR procedures
    - More complete population, date range
  - Cons
    - Severity of illness dep on diagnoses > physiology
    - Massive dataset (~9GB/ year)
    - Cost (\$50 per year for students, \$350 for faculty)
    - In-hospital outcome

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## NSQIP Purpose and Structure



- Semiannual report of risk-adjusted morbidity and mortality
- Interim reports: ongoing assessment/comparison
- 1680 cases per year; ~100 variables collected
  - 100% colectomy, proctectomy, ventral hernia repair
  - General Surgery and Vascular random sample
  - Inclusion / Exclusion Criteria
    - Service
    - CPT code
    - Trauma / Transplant excluded during that admission

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## Data Collection

### Preoperative data

- Demographics
- Clinical laboratory variables

### Intraoperative data

- Surgical Profile
- Clinical variables and complications

### Postoperative data

- 30-day outcomes (inpatient and outpatient)
- Complications and discharge variables

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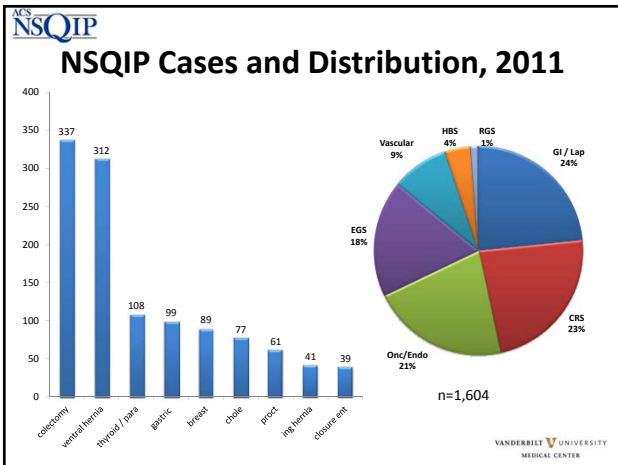
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- ### Risk-Adjustment
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| <p><b>Mortality</b></p> <ul style="list-style-type: none"> <li>• ASA Class</li> <li>• CPT Code</li> <li>• Albumin</li> <li>• Age</li> <li>• Sepsis</li> <li>• Disseminated Cancer</li> <li>• Functional Status</li> <li>• Emergency Surgery</li> </ul> | <p><b>Morbidity</b></p> <ul style="list-style-type: none"> <li>• CPT Code</li> <li>• ASA</li> <li>• Albumin</li> <li>• Sepsis</li> <li>• Dyspnea</li> <li>• Work RVU</li> <li>• &gt; Creatinine</li> <li>• Emergency Surgery</li> </ul> | <p><b>SSI</b></p> <ul style="list-style-type: none"> <li>• CPT Code</li> <li>• BMI</li> <li>• Inpatient</li> <li>• ASA</li> <li>• Smoker</li> <li>• Wound Class</li> <li>• Sepsis</li> <li>• Sodium &lt; 135</li> </ul> |
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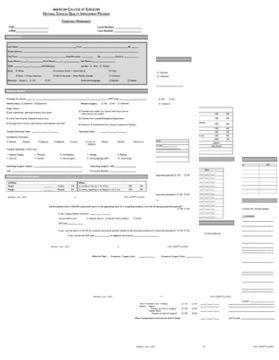
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- ### Data Collection
- 
- Entire chart is reviewed for risk and occurrence variables
  - Follow-up continues for 30 days postop
  - If documentation is not available in the VUMC record, the patient is contacted directly
  - If the patient's condition is not complete up to 30 days, the record is considered incomplete

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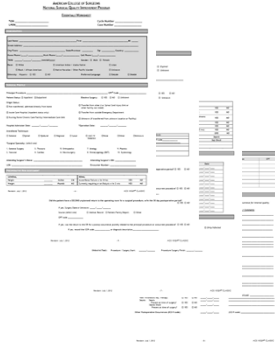
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## Data Collection



- Entire chart is reviewed for risk and occurrence variables
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## Preoperative Risk Factors

- BMI
- Diabetes
- Smoking
- Dyspnea
- Functional status
- Vent dependence
- COPD
- Ascites
- CHF
- Hypertension
- Renal Failure with or without dialysis requirement
- Disseminated Cancer
- Open wound
- Steroid / immunosuppression use
- > 10% loss of body weight
- Bleeding disorders
- Preop transfusion
- SIRS / Sepsis / septic shock
- Laboratory testing

Colectomy only: mechanical bowel prep, oral antibiotic prep, chemotherapy w/n 90 days

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## Preoperative Risk Factors Disseminated Cancer

**Enter "Yes" if the patient has a primary cancer that has metastasized to a major organ (i.e. AJCC Stage IV), and the patient meets at least one of the following criteria:**

- the patient has received active treatment for the cancer within one year of their ACS NSQIP assessed procedure surgery date. If the ACS NSQIP assessed surgical procedure is the treatment for the metastatic cancer, assign disseminated cancer to the case.
- the extent of disease is first appreciated at the time of the surgical procedure in question.
- the patient has elected not to receive treatment for the metastatic disease
- the patient's metastatic cancer has been deemed untreatable

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## Preoperative Risk Factors Functional Status

- **Independent:** The patient does not require assistance from another person for any activities of daily living. This includes a person who is able to function independently with prosthetics, equipment, or devices.
- **Partially dependent:** The patient requires some assistance from another person for activities of daily living. This includes a person who utilizes prosthetics, equipment, or devices but still requires some assistance **from another person** for ADLs.
- **Totally dependent:** The patient requires total assistance for all activities of daily living.

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## Intraoperative Variables

- Emergency Case
- Wound classification
- Surgical wound closure
- ASA Class
- Operative start / finish times
- Other / concurrent procedures
- Colectomy only
  - Primary indication
  - Operative approach
  - Positive margins
  - Pathologic staging

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## Intraoperative Variables

Emergency Case: An emergency case is usually performed within a short interval of time between patient diagnosis or the onset of related preoperative symptomatology. It is implied that the patient's well-being and outcome is potentially threatened by unnecessary delay and the patient's status could deteriorate unpredictably or rapidly.

The emergency case variable distinguishes between urgent/semi-elective/elective cases and true emergent surgeries. Urgent/semi-elective cases are not considered emergencies. Assign 'YES' if the surgeon and/or anesthesiologist report the case as emergent.

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## Postoperative Occurrences

- Superficial, Deep, and Organ/Space SSI
- Wound disruption
- Pneumonia
- Unplanned intubation
- On ventilator > 48 hours
- Urinary Tract Infection
- Progressive Renal Insufficiency
- Acute Renal Failure
- Stroke / CVA
- Cardiac arrest requiring CPR
- Myocardial infarction
- Transfusion within 72 hours
- Venous thromboembolism
- Sepsis / Septic Shock
- Death
- Readmission

Colectomy only: Anastomotic leak, prolonged ileus

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## NSQIP Mortality

- All cause 30-day mortality
- Unlike institutional mortality data, post-discharge deaths are captured
  - 37 deaths / 1603 patients = 2.31%
  - 14 deaths were post discharge

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<b>Procedure Selection</b>	ICD-9 Procedure Code from hospital billing; All surgical services included. May be principal or secondary procedure	CPT Codes: OR Schedule, review of operative note, surgeon billing. General and vascular surgery patients reviewed for inclusion. <b>Ostomies and takedowns are not in the Colectomy category</b>
<b>Exclusion Criteria</b>	Patients with wound left open at the index procedure	Trauma and Transplant patients Patients with proc w/in 30 days prior to index operation Wound closure noted; <b>no exclusion for wounds left open</b>
<b>Surveillance Period</b>	30 days for most with exception of <b>365 days if implant</b> placed	30 days for all procedures
<b>Multiple Procedures</b>	Infection ascribed to most likely site or prioritized by risk	Primary procedure is CPT Code with highest work RVU; SSI is not assigned to specific procedure
<b>Risk Adjustment</b>	Stratified by risk index that incorporates the following <ul style="list-style-type: none"> <li>• Duration of operation</li> <li>• Wound class</li> <li>• ASA classification</li> </ul> [New regression model risk stratification implemented in Jan 12]	Odds Ratio: multivariate regression analysis models every six months; significant factors include <ul style="list-style-type: none"> <li>• Wound class</li> <li>• Body mass index</li> <li>• Preoperative sepsis</li> <li>• ASA classification</li> <li>• Patient age</li> <li>• Emergent operation</li> </ul>

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**Potential Opportunities for Standardization**

- Examine best practices and standardize
  - Bowel isolation training
  - Bowel prep and oral antimicrobial prophylaxis
  - Maintenance of normothermia
  - Bowel isolation/technique
  - ? Prevent hypoxia

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