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Evaluating the Impact of OR Traffic on Airborne Microbial Counts During Hysterectomy & Colon Surgery

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2022 AAH Fall Nursing & Research Conference
OR Traffic Study Team

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- Mark Crucero MSN, RN, CNOR, CSSM, CNAMB, NE-BC
- Tanja Ramich, RN – ALGH

Center for Nursing Research, Quality & Practice
- Mary Hook, PhD, RN-BC - Principal Investigator

Funded by Advocate Aurora Health Nursing
Preventing Surgical Site Infections in the OR

- **A surgical site infection (SSI)** is an infection that occurs within 30 days after surgery in the part of the body where the surgery took place (CDC, 2019).

- SSIs can occur because of microbial contamination from skin particles or dust in the air that deposit by gravity in the sterile field.

- **Airborne microbe carrying particles** can be measured during OR procedures as an indirect measure of environmental conditions that increase risk of SSI with smaller samples.
Preventing Surgical Site Infections in the OR

- A **surgical site infection (SSI)** is an infection that occurs within 30 days after surgery in the part of the body where the surgery took place (CDC, 2019).

- SSIs can occur because of microbial contamination from skin particles or dust in the air that deposit by gravity in the sterile field.

- **Airborne microbe carrying particles** can be measured during OR procedures as an indirect measure of environmental conditions that increase risk of SSI with smaller samples.
Laminar Air Flow

- Surgical rooms are built with air handling and filter systems designed to reduce contamination.

**Question:** Does “traffic” – in and out of the doors reduce these protective effects?
Traffic in the Operating Room

- Traffic refers to personnel who enter, stay, and/or exit the OR suite during a procedure.
- Traffic may disrupt the intended airflow in the vicinity of the open wound, reducing the ability of the ventilation system to remove airborne contaminants from the sterile field.
- The AORN Practice Standards (2015) recommend limiting people and excessive door openings to reduce surgical site infections in select populations – with no specific details.
"Traffic Reports" in the Literature

Birgand, et al., 2015

No prior research re: colon/hysterectomy
Study Aims:

1) To describe current use of SSI prevention strategies and OR traffic patterns (door opening and personnel counts) during elective single-organ colon and abdominal hysterectomy cases.

2) To evaluate if traffic has an impact on airborne microbial counts.

Traffic = Door openings and People
Methodology

• Mixed methods, descriptive design
  - Facility assessments (rooms/practices)
  - Non-participant observation
  - Microbial cultures
  - Door counter cases (unable to do)

• Expedited Study approved by the IRB
  - Passive sampling
  - No direct contact
  - Waiver of patient consent
Setting/Sample from 4 Facilities

• **Setting:** Facilities selected based on SSI Rate above expected within a large integrated health care system
  - Two urban hospitals > 600 beds (colon)
  - Two community hospitals <250 beds (hysterectomy)

• **Sample Inclusion:** Adults scheduled for elective colon and hysterectomy procedures

• **Sample Exclusion:** Non-elective, multi-organ, preexisting preoperative wounds (class 3-4) or if wound class is adjusted during surgery due to major contamination or become multi-organ during the operation
Data Collection Nurses

- Baseline room assessments with microbial testing without traffic
- Case selection
- Non-participant observation (room open to incision close
- Microbial testing with agar plates:
  - Room set up
  - Sterile field creation
- Agar plate processing to lab

- Nathaniel Silgen, BSN, RN - AMC-G
- Tanja Ramich, RN - ALGH
- Daniel Kufahl, BSN RN CNOR - ASLMD
- Kaitlynn Houghton, BSN, RN - AWAMC
Observation Form

Timing and details re:
- All door openings (inner/outer, full, partial and held)
- Role of people entering
- Reason for entry
- Number of people present (highest)
Diagram Illustrating the pilot study sampling plan for study to evaluate microbial particles during non-emergent colon and abdominal hysterectomy surgery.

1) “Patient/Setup Zone” Settle Plate
   Place on the OR Table when room opened. Close and place in storage cannister prior to patient positioning.

4.5) “Wound Zone” Settle Plates
   Settle plates (2) are exposed on the sterile field when the abdominal wound area is draped; Plates are secured to drapes inside autoclavable stainless steel holders with wire frame cover to protect agar surface while allowing free airflow.

2.3) “Back Table Zone” Settle Plates:
   Settle plates (2) are exposed and placed on the back table sterile field at opening of the procedures when staff are organizing the instruments prior to incision.

2) Position plates on back table:
   Top next to mayo stand.
   Bottom back side of sterile field

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Wound Place Location
Results: Using Best Practices

(+) Use of all Established Best Practices

• Pre-op CHG shower night before procedure
• CHG cloths morning of procedure
• Clipping
• Pre-op antibiotic dosing with re-dosing if duration >3 hours
• Glycemic control
• Normothermia (patient)
• Oxygen support
• Avoid blood transfusions unless necessary
• Separate tray for wound closure for laparotomy/colon cases
Results: OR Room Characteristics

- HEPA filters
- Laminar airflow – unidirectional
- Air exchanges/hour (usual 20)
- Low wall air returns
- Measurements:
  - Number of outer & inner doors
  - Door swing time
  - Room pressure measurements
## Results: OR Room Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>#</th>
<th>(%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rooms Used / Site</td>
<td>4</td>
<td>1.2</td>
<td>3 - 5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cases / Room</td>
<td>4</td>
<td>3</td>
<td>1 - 10</td>
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<tr>
<td>HVAC Room Temp</td>
<td>66.7</td>
<td>3.0</td>
<td>58.5 - 73</td>
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<td></td>
<td>*&lt;0.001</td>
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<tr>
<td>Colon</td>
<td>68.5</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>HVAC Humidity</td>
<td>37%</td>
<td>9.8%</td>
<td>10-68%</td>
<td></td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Room Size (Cu ft)</td>
<td>6,023</td>
<td>1,375</td>
<td>4,085 – 7,650</td>
<td>4</td>
<td>100%</td>
<td>0.0822</td>
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<td>HEPA Filters</td>
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<td></td>
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</table>
### Patient Characteristics (n=60)

<table>
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<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>#</th>
<th>(%)</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td><strong>Patient Age (yrs)</strong></td>
<td>57.2</td>
<td>15.9</td>
<td>26-90</td>
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<tr>
<td>Colon</td>
<td>66.2</td>
<td>13.5</td>
<td>33 - 90</td>
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<td>&lt;0.001</td>
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<tr>
<td>Hysterectomy</td>
<td>48.1</td>
<td>12.7</td>
<td>26 - 86</td>
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<tr>
<td>BMI</td>
<td>28.7</td>
<td>6.4</td>
<td>17 - 46</td>
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<tr>
<td>Female</td>
<td>48</td>
<td>80</td>
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<td>&lt;0.001</td>
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<tr>
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<td>56</td>
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<tr>
<td>Current Smoker</td>
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<td>Diabetes</td>
<td>9</td>
<td>15</td>
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<td></td>
<td>NS</td>
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<tr>
<td>Prior Hospital Stay</td>
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<td>5</td>
<td></td>
<td></td>
<td></td>
<td>NS</td>
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</tbody>
</table>
Duration: Average Time (hrs)

*Missing 5 values

*Colon cases are significantly longer ($p=0.0034$) than hysterectomy
Colon procedures had significantly higher door swings per minute during set up ($p=.0007$) and total ($p=0.022$).
Door Opening by Role & Phase

All Cases (N=60)

<table>
<thead>
<tr>
<th>Role</th>
<th>Set up</th>
<th>Case</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN Circulator/Leads</td>
<td>30</td>
<td>18</td>
<td>48</td>
</tr>
<tr>
<td>Scrub/Surg Tech</td>
<td>15</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>Anesthesia Staff</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Surgeon</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>PA/NP</td>
<td>6</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Vendor</td>
<td>2</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>6</td>
<td>14</td>
</tr>
</tbody>
</table>

% Total

- RN Circulator/Leads: 38%
- Scrub/Surg Tech: 10%
- Anesthesia Staff: 15%
- Surgeon: 6%
- PA/NP: 3%
- Vendor: 18%
- Other: 9%

Set up: RN Circulator/Leads + Scrub/Surg Tech + Anesthesia Staff + Surgeon + PA/NP + Vendor + Other
Case: RN Circulator/Leads + Scrub/Surg Tech + Anesthesia Staff + Surgeon + PA/NP + Vendor + Other
Total: RN Circulator/Leads + Scrub/Surg Tech + Anesthesia Staff + Surgeon + PA/NP + Vendor + Other
Door Opening Reasons: Set up vs. Ongoing
Door Opening Reasons: Set up vs. Ongoing by Surgery Type

Colon (n=30)

Hysterectomy (n=30)
Baseline Microbial Counts

Simulated Cases with set up & no traffic

• Agar plates (6)
• Surgery time 2.5 hours
• 92% of plates had no growth
• 8% with 1-2 CFUs had growth
  - 65% back table plates
Airborne Microbial Carrying Particle (MCP) Counts – (360 plates)

- 83% had CFU counts 5 or less
- 16% had CFU counts between 6-30
  - 17% were on Wound Plates (NS by type)
  - 81% were on Back Table Plates (higher Colon)
- 2 significant outliers on set-up plates (2 colon cases)
- (1) Colon Case had an SSI (limited risks)

**Calculations:** Microbial Deposit Total (MDT) and Rate (MDR)
- MDT: CFU counts based on area of the settle plate
- MDR: MDT adjusted for duration of exposure
  (used to standardize comparisons for cases with variable duration)
Evaluating Microbial Deposit Rate: Wound vs. Back Table

Note: 510 MCPs/m²/hr = upper limit for cases with less stringent requirements than orthopedic joint replacement.
Evaluating Microbial Deposit Rate: Wound vs. Back Table by Case

Colon

Hysterectomy

Case Number
1-30 = Colon, 31-60 = Hyst

MDR_BT
MDR_W
Linear (MDR_W)
Limitations

• Convenience sample

• Small sample: 15 cases/site; 30 cases/surgery type)

• Clinical nurse data collectors during real-world surgery (vs. simulations)

• Potential for non-participant observer bias (Hawthorne effect; Trained; OR Staff Member)

• Unable to do counter only to study without observer

• Impact of COVID-19 (Omicron surge): Affected surgery protocols, case volumes, and staffing
Conclusions

• All sites are using established “best practices”.

• Observations described limited non-essential traffic.

• Most traffic by nurses & scrub staff - opportunity to intervene.

• Microbial deposit rates were lower and within upper limit of acceptable range for shorter procedures and lower door opening rates.

• Microbial deposit testing has been established for orthopedic cases; Study represents the opportunity to establish processes and standards for other surgery types.
Implications for Practice

- Utilize established best practices for SSI prevention
- Increase staff awareness of traffic
- Identify modifiable traffic (e.g. standardize supplies, reduce variation, minimize reasons to go in and out)
- Identify opportunities to use data to change practice
Acknowledgements

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- Dr. Mary Hook, Principal Investigator
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- Site OR Directors, Surgeons, and Surgical Services Teams
- Dr. Eric Beck, ACL
- Vicky Liao, MS – ARI Biostatistician
References


