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OR traffic: Summary

Children's Mercy Kansas City

Office of Evidence Based Practice – Specific Care Question: Operating Room Traffic

Specific Care Question
Does decreased Operating Room (OR) traffic versus status quo result in lower surgical-site infections (SSIs) in pediatric patients?

Question Originator
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Clinical Bottom Line
A direct correlation cannot be made between operating room traffic and SSIs. However there is indirect evidence, that processes to reduce OR traffic should be in place to manage health-care associated infections.

Plain Language Summary from The Office of Evidence Based Practice
Based on very low quality evidence, it is recommended that operating room traffic be reduced to decrease the risk for SSIs. SSIs account for 17% of all healthcare-associated infection and affect 2-5% of patients undergoing inpatient surgery (Center for Disease Control and Prevention, 2009). Risk factors for SSIs fall into three main categories: patient related characteristics, surgical procedure, and surgical environment (Birgand, Saliou, & Lucet, 2015). Foot traffic in and out of the OR can lead to airflow disruption and may increase risk of SSIs (Jacob, Kasali, Steinberg, Zimring, & Denham, 2013). Disrupted air quality has been associated with SSIs (Lidwell et al., 1983) and enhancing air quality has been advocated as a means of decreasing air contamination and wound colonization (Mangram, Horan, Pearson, Silver, & Jarvis, 1999, National Institute for Health and Clinical Excellence, 2008). Door movement has been correlated directly with an elevated level of airborne bacteria-caring particles in the OR (Andersson, Bergh, Karlsson, Eriksson, & Nilsson, 2012). However, no randomized control trials have reported a direct causation between operating room traffic and SSIs.

Birgand et al. (2015) conducted a systematic review to assess impact of surgical-staff behaviors on the risk of SSI. Twenty seven studies were identified. The outcomes fell into five categories of which two were relevant to the topic of OR traffic: (a) door opening (n=11 studies) and (b) compliance with traffic measures (n=6 studies) (Table 1). There was a large variation in reported number of door openings per procedure and door openings per hour. Panahi, Stroh, Casper, Parvizi, and Austin (2012) reported the main reason for door opening in orthopedic surgery was the need for supplies (23.3%), information (11.5%), and scrubbing (7.3%); the reason was unknown for 47.3% of the door openings. The largest contributors to door openings were the circulating nurses (26%). Andersson et al. (2012) reported that out of 529 door openings, 169 (32%) were deemed unnecessary. Anderson et al. (2012) reported that 52 of the 91 (57%) air samples collected, the Colony-forming unit/m3 (CFU) values exceeded the recommended level of <10 CFU/m3. In addition, they showed a strong positive correlation (r=0.74; p=0.001; n=24) between the total CFU/m3 per operation and total traffic flow per operation.

Review by Outcome

Surgical Sight Infection
Two guidelines on surgical site infections (he Center for Disease Control and Prevention, 2009; National Institute for Health and Care Excellence [NICE], 2008) identified excessive OR traffic as a modifiable risk factor for surgical-site infections. While no direct evidence was given, both guidelines recommended reducing surgical traffic as an important step to prevent surgical site infections. The AGREE II instrument (Brouwers et al., 2010) was used to grade and evaluate the guidelines. The guidelines was recommended for use by the authors of this synthesis based on the overall high quality of the guideline.

Birgand et al. (2015) conducted a systematic review to assess impact of surgical-staff behaviors on the risk of SSI. Four of the included studies look at door opening alone or in combination with a bundle on its impact on SSI (table 2).

Young et al. (2010) reported the mean door opening of 92.9 (range, 45–205)/ case. This is equivalent to openings of 19.2 (6.4–38.2)/h, 31 min per case, and 10.7% every hour. Complex procedures were associated with higher door openings. There was a trend toward increased SSIs with increased level of door opening during surgery but it was not statistically significant (data nor p-values were reported).

Babkin et al. (2007) performed a retrospective chart review of 180 total knee replacement surgeries to identify the number of SSIs. Investigation of the problem showed three problems, one included significant traffic through the OR doors. The changes made included a horizontal air conditioner was disconnected and the OR door was locked during surgery. One and a half years after the improvements were made, a small prospective survey of 45 consecutive patients demonstrated only one SSI (2.2%) (p=0.5).

Two studies assessed the impact of a bundle, related to preventive measures that included restricted door openings, on the SSI rate (Crolla et al., 2012; van der Slegt et al., 2013). The Crolla et al. (2012) study of vascular surgery compliance with door-opening guidelines improved from 10% to 80% (p<0.001) and the SSI rate decreased concurrently by 36% (not significant). The van der Slegt et al. (2013) study evaluated gastric surgical procedures which yielded similar results with a 51% (p<0.05) decrease in SSI rates over a three years period after implementing OR bundles which included restricted door openings.

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Search Strategy and Results:

"traffic" AND (MH "Operating Rooms"), foot traffic" AND (MH "Operating Rooms"); (("operating rooms"[MeSH Terms] OR ("operating"[All Fields] AND "rooms"[All Fields]) OR "operating rooms"[All Fields] OR ("operating"[All Fields] AND "room"[All Fields]) OR "operating room"[All Fields]) AND ("foot"[MeSH Terms] OR "foot"[All Fields]) AND ("Traffic"[Journal] OR "traffic"[All Fields])) OR (("Traffic"[Journal] OR "traffic"[All Fields]) AND ("surgical wound infection"[MeSH Terms] OR ("surgical"[All Fields] AND "wound"[All Fields] AND "infection"[All Fields]) OR "surgical wound infection"[All Fields] OR ("surgical"[All Fields] AND "site"[All Fields] AND "infection"[All Fields]) OR "surgical site infection"[All Fields]))

Studies included in this review:

Birgand, G., Saliou, P., & Lucet, J. C. (2015). Influence of staff behavior on infectious risk in operating rooms: what is the evidence? *Infect Control Hosp Epidemiol, 36*(1), 93-106. doi: 10.1017/ice.2014.9

Mangram, A. J., Horan, T. C., Pearson, M. L., Silver, L. C., & Jarvis, W. R. (1999). Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control, 27*(2), 97-132; quiz 133-134; discussion 196.

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Method Used for Appraisal and Synthesis:

The Cochrane Collaborative computer program, Review Manager (RevMan 5.1.7) (Higgins & Green, 2011) was used to synthesize the included studies. AGREE II (Brouwers et al., 2010) was used to assess the guidelines. GRADEpro GDT (Guideline Development Tool) (Schunemann, 2002) is the tool used to create Summary of Findings Tables for this analysis.

Table 1
Grade Summary
Question: Does decreased OR traffic versus status quo result in lower SSIs in pediatric patients?

Quality assessment							Impact	Quality	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**			
Surgical Site Infection									
4	observational studies	very serious [1,2,3]	serious [4]	serious [5]	not serious	none	Young et al. (2010) reported a trend toward increased SSIs with increased level of door opening during surgery but it was not statistically significant. No numbers or p-value reported. Babkin et al. (2007) reported improvements included a horizontal air conditioner was disconnected and the OR door was locked during operations. One and a half years after the improvements were made, a small, prospective survey of 45 consecutive patients demonstrated only one SSI (2.2%) (p=0.5). The Crolla et al. (2012) study of vascular surgery compliance with door-opening rules improved from 10% to 80% (p<0.001) and the SSI rate decreased concurrently by 36% (not significant). The van der Slegt et al. (2013) study evaluated gastric procedures and yielded similar results with a 51% (P<0.05) decrease in SSI rates over a three years period after implementing OR bundles.	⊕◯◯◯ VERY LOW	Critical

CI: Confidence interval

1. Unclear primary outcome measure
2. Incomplete outcome data
3. Selective outcome reporting
4. Large amount of heterogeneity between the studies
5. Patient population differ from those of interest.

Table 2.
Birgand 2015

Methods	Systematic Review
Outcomes	A systematic review was performed to assess the impact of surgical-staff behaviors on the risk of surgical site infections.
Results	Twenty seven articles reported data on number of people in the operating room (n=14 studies), door opening number (n=6 studies), door opening frequency (n=7 studies), door opening reasons (n=4 studies), door opening reasons (n=4 studies), surgical team discipline (n=4 studies), compliance with traffic measures (n=6 studies).

Number of people in the OR /Number of Door Openings

Reference	Design	Observation	End Point	Number of OR/procedures	Type of Surgery	Number/Type of Hospital	Results	Conclusion
Parikh et al. 2010	Cross-sectional	Direct	None	3/26	Orthopedic	1/University	2 phases: 83 and 102 DO/h; NoP, 11 (range, 7–15) and 11 (8–20)	All traffic should be considered essential
Andersson et al. 2012	Cross-sectional	Direct	Air bacterial count	3/30	Orthopedic	1/University	Median: 5 (range, 3–10) people. Correlation CFU/m3 -traffic flow (r =0.74), CFU/m3 - NoP (r =0.22); 32% unnecessary DO	Correlation air bacterial count and door openings
Panahi et al. 2012	Cross-sectional	Direct	None	Unknown/116	Orthopedic	1/University	DO, 83.2; 41/h; 39/h. vs 50/h. for revisions (P< 0.01); 63.1% after skin incision; 47.3% with no reason.	Measures to reduce OR traffic may decrease 1 etiology of SSI
Rackham et al. 2010	Cross-sectional	Direct	None	3/7	Orthopedic	3/Private and Public	DO, 27 to 169 and 68 to 169 entries/exits per operation; 26 to 60/h (pediatric)	Theater traffic can be substantial and need staff education
Accadbled et al. 2011	Cross-sectional	Direct	None	Unknown	Orthopedic	3/Private and Public	Mean DO, 25.2/h in PrH to 60/h in pediatrics; Higher in adults	Difference public/private; -13.5%; – 30% if signalization

Babkin et al. 2007	Retrospective cohort	OR charts	SSI	1/181	Orthopedic	1/University	NoP and surgeon position increased SSI rate	Impact of the NoP on the air microbial contamination
Tjade et al. 1980	Cross-sectional	Unknown	Air bacterial count	1/49	Orthopedic	1/Public	Mean DO higher before incision, 26.2/h vs. 15.4/h after; Correlation DO – air bacteria count (r =0.55)	Close relationship between air bacterial count and DO
Young et al. 2010	Prospective cohort	Automatic	SSI	2/46	Cardiac	1/Public	Mean DO: 92.9 (range, 45–205), 19.2 (6.4–38.2)/h, 31 min per case, and 10.7% of every hour. Complex procedures associated with higher DO	Trend toward increased SSI with increased level of DO
Castella et al. 2006	Cross-sectional	Direct	None	Unknown/799	General	49/All types	Mean NoP, 6; DO, 12 (percentile 75=15); >50 DO in 3% of operations; NoP higher in teaching hospitals (P=0.001)	Feedback with healthcare worker was an effective instrument to audit infection control practices
Durando et al. 2012	Cross-sectional	Direct	None	13/717	General	1/University	Mean NoP, 6.6 healthcare workers and 3.1 for "clean" team; >90% of interventions with <10 HCW; Doors remained opened >50% of operative time in 36.3%	The number of surgical personnel present in the OR was that expected for a typical operation in a teaching hospital
Scaltriti	Cross-sectional	Direct	Air bacterial count/air particle count	3/23	Clean/ contaminated	1/University	NoP at surgical cut, 7 (range, 5–8); DO, 56 (range, 22–97); No correlation; Positive correlation surgical technique/ air particle count>5 µm but not between NoP/dust level or DO/dust level	DO representing staff movement predicted a decreases air particle count and a raise of air bacterial count
Lynch et al. 2009	Cross-sectional	Direct	None	Unknown/28	Clean/ contaminated	1/University	DO, 13 to 316, 5 to 87/h; 30% to 50% during pre-incision period; 17% of the operative time; 27%–54%	The rate of traffic was remarkably high supporting the need for

							to give/get information; 37%–57% by circulating nurse	improvement
Pryor et al. 1998	Retrospective cohort	OR charts	SSI	Unknown/3259	Clean	1/University	NoP 0 to 8: 26% SSI rate: 1.5% NoP 13–16: 22.2% → SSI rate: 3.8%	Correlation between NoP and SSI rate
Wan et al. 2011	Cross-sectional	Direct	Air bacterial count/ air particle count	8/165	Clean/ contaminated	1/University	Mean NoP, 5 to 7; correlation NoP - Particulate matter 10 micron (r= 0.37), NoP – air bacterial count (r =0.23), air bacterial count – particulate matter 10 micron (P< 0.01)	NoP in the OR affect particulate matter 10 micron and air particle count; the particulate matter level is associated with air bacterial count
Note: ABC, air bacterial count; APC, air particle count; CFU, colony-forming unit; CS, cross-sectional; DO, door openings; DO/h, door openings per hour; HCW, healthcare worker; NoP, no. of persons; OR, operating room; PC, prospective cohort; PM10, particulate matter 10 µm; PrH, private hospital; PuH, public hospital; RC, retrospective cohort; SSI, surgical-site infection; UH, university hospital								

Checklist, bundles, and compliance with control measures

Reference	Design	Observation	End point	Number of OR/ procedures	Type of surgery	Number/Type of hospital	Results	Conclusion
Tartari et al. 2011	Cross-sectional	Direct	None	1/30	Cardiac	1/University	Compliance, 29%	Poor compliance with room traffic practices
Borer et al. 2001	Cross-sectional	Unknown	SSI	2/118	Cardiac	1/University	Compliance period 1 and 2, 62.5%and 71%, P=0.09	Active monitoring practices resulted in decreased SSI rate
Yinnon et al. 2012	Cross-sectional	Direct	Bacteriology cultures	70/ unknown	General	3/Public	SSI rate decreased in the checklist group (4% to 3%, P<0.05); no decrease in the control group; Traffic rules poorly followed (25%) especially for anesthetists	The use of detailed checklists and monthly reports was effective in reducing SSI rates
Van der Slegt et al. 2013	Cross-sectional	Direct	SSI	Unknown/100	Vascular	1/University	Bundle compliance improved from 10% in 2009 to 60% in 2011; DO had	Bundle improved compliance with

							the lowest compliance: increase from 30% to 80%	51% reduction of SSI rate
Crolla et al. 2012	Cross-sectional	Direct	SSI	Unknown/100	Digestive	1/University	Door movements had the lowest compliance: increase from 30% to 80%	Bundle improved compliance with 36% reduction of SSI rate
Moro 2006	Cross-sectional	Direct	None	92/Unknown	All types	Unknown	38% surgeons, 40% nurses claimed paid little attention to DO and NoP; 62% surgeons, 64% nurses had good practices	Surgeons and nurses paid little attention to intraoperative behaviors

Note: ABC, air bacterial count; APC, air particle count; CFU, colony-forming unit; CS, cross-sectional; DO, door openings; DO/h, door openings per hour; HCW, healthcare worker; NoP, no. of persons; OR, operating room; PC, prospective cohort; PM10, particulate matter 10 µm; PrH, private hospital; PuH, public hospital; RC, retrospective cohort; SSI, surgical-site infection; UH, university hospital

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