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Impact of intraoperative staff behaviours on the infectious risk: a systematic review and meta-analysis

Gabriel Birgand*¹, Rachael Troughton², Raheela Ahmad³, Esmita Charani⁴, Nick Sevdalis⁵, Jean-Christophe Lucet⁶, Alison H. Holmes⁷

¹*Imperial College London*

²*Imperial College London; Nih Health Protection Research Unit in Healthcare Associated Infections and Antimicrobial Resistance*

³*Imperial College London*

⁴*Imperial College London; Medicine*

⁵*Kings College London*

⁶*Inserm Umr 1137, Iame*

⁷*Imperial College London; Health Protection Research Unit, National Institute for Health Research*

Background: Traditional preventive measures based on the improvement of technical factors significantly improve surgical site infections (SSI) rates. However, SSI remains a critical burden with an estimated 799,185 cases annually in Europe. Staff behaviours in the operating room (OR) present opportunities for potentially significant improvement, and recent WHO guidelines failed to cover this field. We conducted a systematic literature review on the impact of intraoperative behaviours on infectious risk and improvement interventions.

Material/methods: We searched the Medline, Embase, Ovid, and Web of Science databases for original articles about the impact of intraoperative behaviours on the risk of SSI published in English

until 22/10/2016. This study was conducted in accordance with the PRISMA guidelines, the ICROMs appraisal instrument was used to assess the quality of the retrieved evidence.

Results: Out of 2774 hits, 24 studies focusing on the link between OR staff behaviours and infectious risk were identified. Among them, 9 assessed the impact of doors openings (DO) and/or number of persons (NoP) on air contamination in the OR or SSI rates, and 4 evaluated the impact of the intraoperative discipline, safety culture, noise and communication on SSI rates. The pooled correlation coefficient for the relation between DO or NoP and the air bacterial count was 0.36 (0.31-0.4), and 0.37 (0.33-0.42), respectively. The pooled odds ratio among the 2 studies assessing DO vs the air bacterial count was 1.03 (1.02 - 1.05, $p < 0.001$). The pooled odds ratios for the association between DO or NoP and SSI rate were 0.97 (0.9 – 1.04, $p = 0.35$) and 1.48 (0.73-3, $p = 0.27$), respectively. The pooled odds ratio for the association of the noise and SSI rates was 1.13 (0.71-1.79, $p = 0.6$). Case-relevant communications prevented organ/space SSI (odds ratio: 0.86, 0.77-0.97, $p = 0.01$) and case-irrelevant communications increased the risk of superficial SSI (1.19, 1.04-1.36, $p = 0.01$). Only one study assessed safety culture, and found 9/12 culture dimensions significantly associated with lower SSI rates. Among the 11 interventional studies, 8 targeted staff behaviour. 6/8 described a significant decrease of DO (11 to 78%) and noise (-3 ± 3 dB) and 1 on post-operative complications using education and/or process changes. The 3 remaining studies included the improvement of the traffic flow in a broader bundle of measures with a significant decrease of SSI rates.

Conclusions: Evidence (of a low quality) indicates a relationship between DO/NoP in the OR and the environmental contamination, and low evidence on SSI rates. Stronger evidence suggests an impact of intangible behaviours (noise and communication factors) on infectious risk. Interventional studies significantly improved DO/NoP and noise with potential consequences on infectious outcomes. Processes (ie optimization of communications and traffic flow) and skills training and education of surgical staff are probably the key to improving quality of care.

Study	Type of surgery	Behavior	Endpoint	Number of operations	OR/IRR (95% CI)	p	OR (95% IC)
Impact of doors openings on air bacterial counts							
Erichssen Andersson LAF	Orthopedics	DO	ABC	24	0.99 (0.927-1.058)	0.78	
Erichssen Andersson CV	Orthopedics	DO	ABC	24	1.033 (0.014-1.05)	<0.001	
Mathijssen	Orthopedics	DO	ABC	69	1.05 (1.02-1.09)	0.003	
Summary					1.03 (1.02 - 1.05)	0.001	
<i>Abreviation: ABC, air microbial count</i>							
Impact of doors openings on SSI rates							
Tschan	Abdominal	DO	Organ/space SSI	167	0.99 (0.90 - 1.09)	0.787	
Tschan	Abdominal	DO	Incisional SSI	167	0.93 (0.83 - 1.05)	0.245	
Summary					0.97 (0.9-1.04)	0.35	
<i>Abreviation: DO, doors openings; SSI, surgical site infections</i>							
Impact of the number of persons on air bacterial counts							
Erichssen Andersson LAF	Orthopedics	NoP	ABC	24	0.925 (0.806-1.062)	0.27	
Erichssen Andersson CV	Orthopedics	NoP	ABC	32	1.127 (1.079-1.177)	<0.001	
Mathijssen	Orthopedics	NoP	ABC	69	1.02 (0.72-1.45)	0.9	
Summary					1.04 (0.89 - 1.2)	0.65	
<i>Abreviation: NoP, number of persons</i>							
Impact of the number of persons on SSI rates							
Pryor	Clean	NoP	SSI	3259	2.23 (1.34 - 3.71)	0.001	
Wanta	Clean	NoP	SSI	1277	1.08 (1.03-1.13)	0.0013	
Summary					1.54 (0.99 - 2.4)	0.053	
Impact of the noise on SSI rates							
Beldi	General	Discipline score	SSI	961	2.02 (1.05-3.88)	0.04	
Tschan	Abdominal	Noise	Organ/space SSI	167	0.84 (0.71 - 1.01)	0.057	
Tschan	Abdominal	Noise	Incisional SSI	167	0.97 (0.82 - 1.15)	0.723	
Summary					1.13 (0.71 - 1.79)	0.6	
Impact of communications on SSI rates							
Tschan	Abdominal	Case-relevant communication	Organ/space SSI	167	0.86 (0.77 - 0.97)	0.014	
Tschan	Abdominal	Case-relevant communication	Incisional SSI	167	1.08 (0.95 - 1.23)	0.239	
Summary					0.96 (0.77-1.20)	0.73	
Tschan	Abdominal	Case-irrelevant communication whole procedure	Organ/space SSI	167	1.00 (0.86 - 1.17)	0.955	
Tschan	Abdominal	Case-irrelevant communication during closure	Incisional SSI	167	1.29 (1.08 - 1.55)	0.006	
Tschan	Abdominal	Case-irrelevant communication whole procedure	Incisional SSI	167	1.19 (1.04 - 1.36)	0.012	
Tschan	Abdominal	Case-irrelevant communication during closure	Organ/space SSI	167	0.98 (0.81 - 1.2)	0.869	
Summary					1.11 (0.98-1.26)	0.1	
Tschan	Abdominal	Side-conversations	Incisional SSI	167	1.08 (0.95 - 1.23)	0.229	
Tschan	Abdominal	Side-conversations	Organ/space SSI	167	0.98 (0.87 - 1.10)	0.674	
Summary					1.02 (0.93-1.13)	0.27	