

# Air supply in operating theatres – the German view



Differences and similarities in infection prevention in  
European countries

Berlin

26.06.2015

Frank Wille, HYBETA GmbH, Münster, Germany

**Knowing more. Thinking ahead.**

# Surgical site infections

- SSI are the most frequent hospital infection in Germany (ca. 225.000) (Gastmeier, Dtsch med Wochenschr. 2008; 133(21))
- reasons are multicausal
- 30 % – 55 % der SSI are avoidable (Gastmeier, Dtsch med Wochenschr. 2010; 135 (3), DGKH Hygiene-Tipp (02/2012))
- Influence of the air is an unsolved question in Germany (rki; Epidemiologisches Bulletin 04/2010)



## Surgical site infections - reasons

- Endogenous factors (90 %)
  - Microbiological colonization within the wound area (95 %)
  - Microbiological colonization outside the wound area (5 %)
- Exogenous factors (10%)
  - surgical staff and ventilation (99 %)
  - environment (1%)

(Swissnoso Bulletin, Postoperative Wundinfektionen: eine Übersicht, 03/1996)



# KRINKO-Guideline: Prevention of SSI

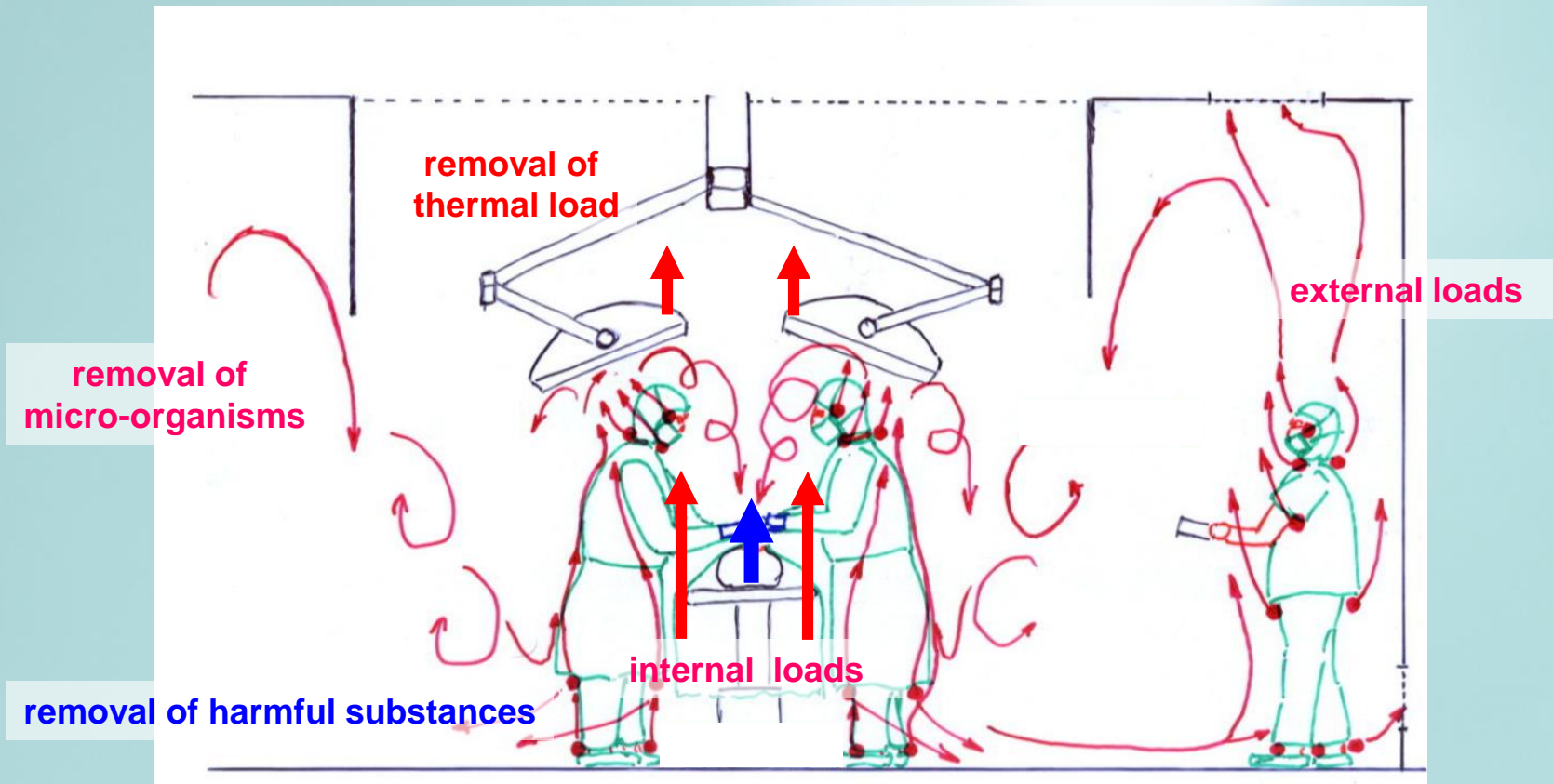
## Anteil der bei Wundinfektionen gewonnenen Isolate (%) je nach Fachgebiet

Isolate	Allgemein- und Thoraxchirurgie (2527)	Traumatologie/ Orthopädie (1631)	Herzchirurgie (714)	Gefäßchirurgie (431)	Geburtshilfe (653)
S. aureus	11,4	42,7	39,6	39,0	19,8
Enterokokken	12,9	10,9	8,7	10,7	6,9
E. coli	22,6	4,1	2,7	6,7	4,4
P. aeruginosa	3,8	3,2	3,6	2,6	0,5
Klebsiella spp.	3,7	1,2	0,8	3,0	0,5
Koagulase neg. Staphylokokken	4,2	19,4	21,1	9,3	8,7
Enterobacter spp.	12,9	2,4	4,3	3,3	0,3
Streptokokken	4,8	4,8	1,5	5,3	6,4
Candida	1,4	0,2	0,5	0,2	0,1

Bundesgesundheitsbl - Gesundheitsforsch -  
Gesundheitsschutz 2007 · 50:377–393



# Tasks of the ventilation system



Source: Dr. Peter Lüderitz



## Technical standard

- DIN 1946-4: 1963/1978/1989/1999
- E-VDI 2167: 2004
- E-DIN 1946-4: 2005
- E-DIN 1946-4: 2007
- VDI 2167-1: 2007



DIN 1946-4:2008-12



# Hygienic requirements of the ventilation system depend on kind of surgery

- The requirements depending on:
  - Implantation of extraneous material
  - Size of the wound area
  - Time of surgery
  - Blood circulation



## Room classes according to DIN 1946-4

- Room classes
- OR: Room class Ia
  - Total endoprothetic, transplantations, thorax surgery
- OR: Room class Ib
  - “common” surgery, colon, micro invasive surgery
- Room class II
  - All peripheral rooms





## Room class Ia

- 3-stage supply-air filtration
- (F7/ F9 ventilation unit) and terminal HEPA filters (H13)
- Plenum-type laminar-airflow-style diffusers
- Size: 3.2 m x 3.2 m
- Supply-air velocities LAF:  $0.22 - 0.25 \text{ m} \cdot \text{s}^{-1}$
- Outdoor air flow rate min.  $1,200 \text{ m}^3/\text{h}$ ,
- Whole amount of air :  $9,000 - 10,000 \text{ m}^3/\text{h}$
- Positive pressure



## Room class Ia

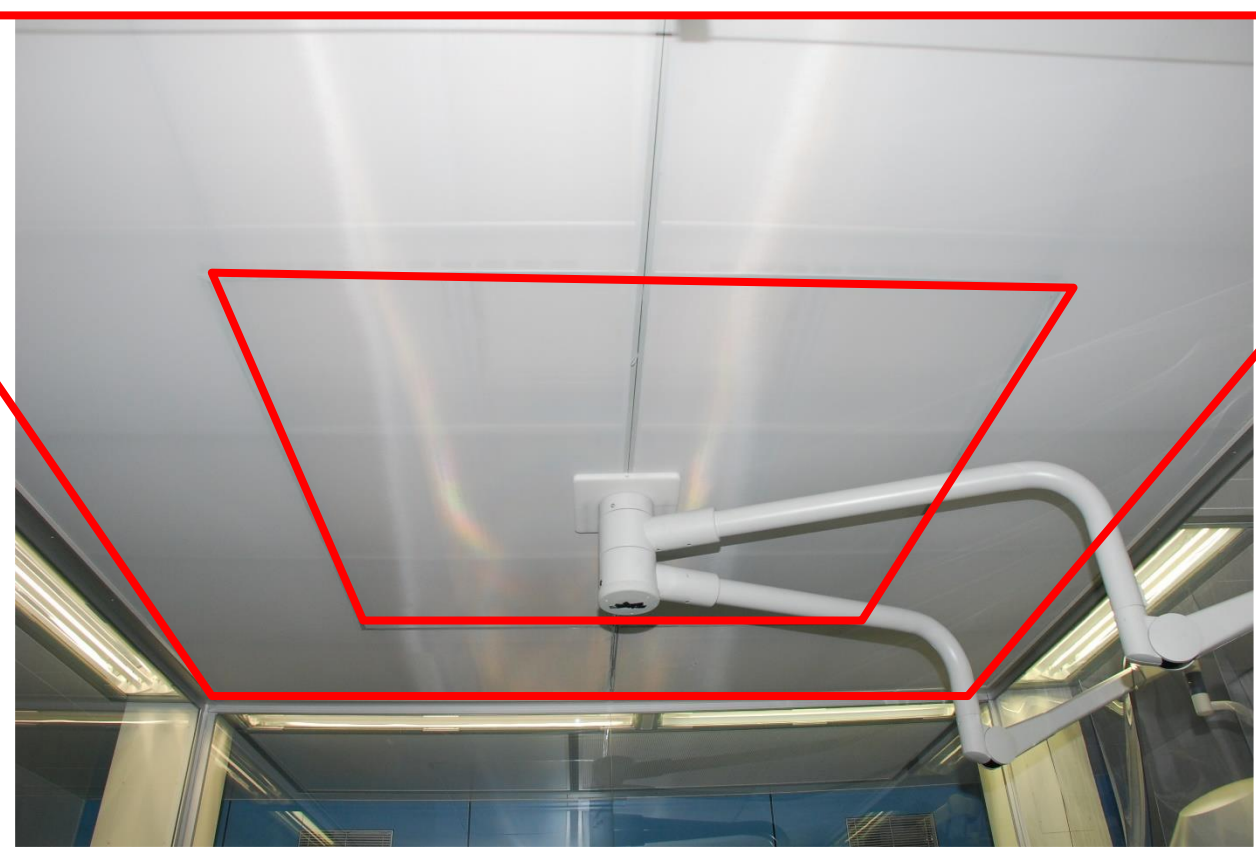


## Diferential flow

- Supply-air diffuser is the same
- Air volume flow is the same
- Supply-air velocities in the center is faster then in the boundaries
- Center:  $0.40 \text{ m}^*\text{s}^{-1}$ , boundaries:  $0.20 \text{ m}^*\text{s}^{-1}$
- Smaller lee areas behind lamps



# Diferential flow



## Poor ventilation





# Good ventilation



## Room class Ib

- 3-stage supply-air filtration
- (F7/ F9 ventilation unit) and terminal HEPA filters (H13)
- Small supply-air diffusers or simple filter outlets
- Turbulent air distribution
- Outdoor air flow rate min. 1.200 m<sup>3</sup>/h
- Whole amount of air : 3,000 – 4,000 m<sup>3</sup>/ h
- Positive pressure







## Room class II

- 2-stage supply-air filtration (F7/F9)
- Filter outlets or overspill air from theatre
- Turbulent air distribution
- Outdoor air flow 40 m<sup>3</sup>/ person
- All peripheral rooms in the surgical suite belong to room class II



## Room class II: intervention room



# Influence of different ventilation systems upon the contamination of medical device



# Results

**Table 3: Comparison of contamination levels on sedimentation plates and Crile clamps, of an equivalent size surface area, for the different ventilation systems.**

	Ia-OR protected area	Ia-OR outside protected area	Ib-OR
Sedimentation plates [cfu/50 cm <sup>2</sup> ]	0.4	2.8	3.4
Crile clamps [cfu/50 cm <sup>2</sup> ]	1.6	7.0	7.8

**Table 4: Individual results for Crile clamp contamination levels with the different ventilation systems.**

	Ia-OR protected area	Ia-OR outside protected area	Ib-OR
Number of clamps	48	49	50
Clamps with 0 cfu	33	26	17
Proportion of contaminated clamps	31 %	47 %	66 %
Mean value [cfu]	0.7	2.8	3.6
Maximum value [cfu]	7.4	64.0	44.3

Benen T., Wille F, Clausdorff, L Influence of different ventilation systems upon the contamination of medical device. HygMed 2013; 38-4:



# overnight shutdown of the ventilation system in the OR

- Ventilation runs 24 h, 365 d per year and costs a lot of energy
- DIN 1946-4: 2008 for the peripheral rooms possible
  - point 6.9: shutdown room class II possible
  - roomclass I: reversal of positiv pressure should be avoided
- OENORM H 6020: 2007
  - point 5.9.1: shutdown for OR-ventilation possible
  - default: lead time from 30 min before the start of use





## Hygienic review of overnight shutdown

- no patients in the OR → no risk
- no stuff in the OR → no risk
- nobody in the OR → no comfort requirements
- entry of particles and germs during the out of the use time is low
- by lead time the sufficient purging of the room is ensured



## Conclusions

- Ventilation is just one part to avoid surgical site infections
- The importance of the ventilation system in infection control is unsure but cannot be denied
- German standard: DIN 1946-4: 2008
- 3 room classes: Ia LAF, Ib turbulent for OR, II “normal” rooms
- Intersurgical contamination of medical devices depends on the ventilation system
- Overnight shutdown of the ventilation is possible



Thank you for your attention!  
Any questions?



HYBETA GmbH | Head Office

Nevinghoff 20 | 48147 Münster

T +49 (0)251 2851-0 | F +49 (0)251 2851-129

Info@hybeta.com | www.hybeta.com

**Knowing more. Thinking ahead.**