

The role of ultra clean air to prevent Surgical Site Infection (SSI)

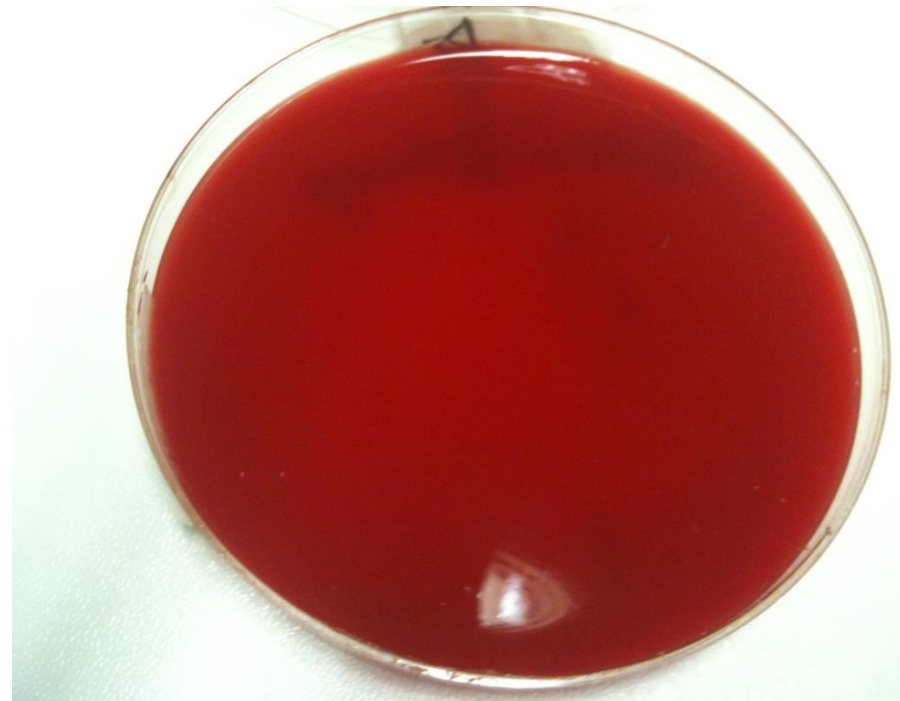
Tomas Hansson

Infection Prevention is more than using antibiotics

Healthcare regulation, science, experts, hygiene and common sense



Airborne contamination is a risk for the patient



“Everything that is to come into contact with the wound has been made sterile, except the air which is in contact with everything”

Whyte 1973

Why do we have special OR ventilation ?????

- 1. The sole and primary purpose is to prevent surgical site infections**
2. A secondary purpose is to create a good environment for the OR personnel

Surgical Site Infection (SSI) is a substantial part of Hospital Infection

Stephen T.
Abedon,
Ph.D.

15% -20% of all NI are Surgical Site Infections, SSI

- The sites of nosocomial infections,
 - urinary tract
 - **surgical wounds**
 - respiratory tract
 - skin (especially burns)
 - blood (bacteremia)
 - gastrointestinal tract
 - central nervous system

Communiqué de presse
Prévalence des infections nosocomiales en France :
une tendance à la baisse notamment pour les infections à
SARM

Prevalence of nosocomial infections in
representative German hospitals^{*1}
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Germany

Infection prevention has been equal to antibiotic protocol

”That what does not kill me, makes me stronger”

Friedrich Nietzsche, German philosopher (1844-1900)



**The
Economist**

MAY 2 2017 • 217th • 2016

Do recoveries die, or are they killed?

Pin-striped greens take on Big Oil

Boss of the UN: worst job in the world

Win or lose, dark days for Cameron

How gangs suck El Salvador dry

When the drugs don't work

The rise of antibiotic resistance



Summary so far

7% in EU

4 million patients

40.000 deaths

7 Billion €

15-20% Surgical site infection

Prevention needs more attention

International Statistical
Classification of Diseases
and Related Health
Problems, ICD-10 (edition)
published by WHO-Y95,
Nosocomial Condition



NI= Nosocomial Infection

HAI= Hospital Acquired Infections

HCAI= Healthcare Associated Infection

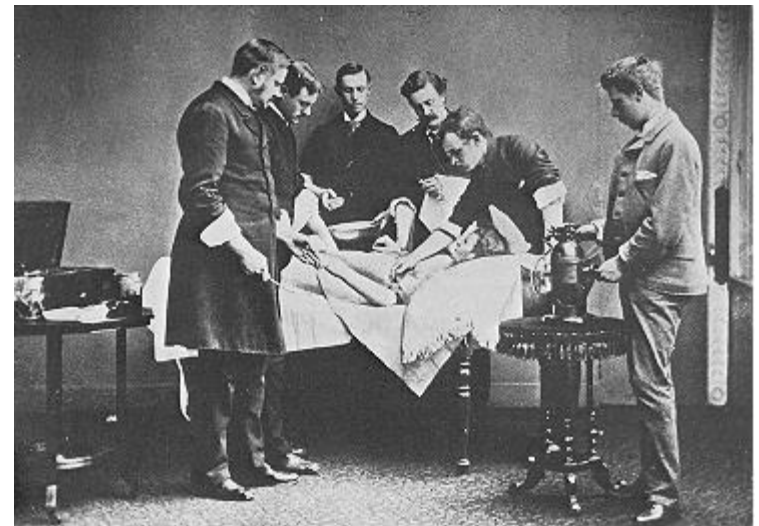
Nosocomial from Greek.
Nosokomeion, meaning hospital

The OR in the past

Transmission of bacteria

1. **droplet contact - coughing or sneezing**
2. **direct physical contact – touching**
3. **airborne transmission - if the microorganism can remain in the air for long periods**
4. indirect contact - usually by touching soil
5. fecal-oral transmission - usually from contaminated food or water sources
6. vector borne transmission - carried by insects or other animals

>50% Infection



“operation successful but the patient died”

OR today



Do not touch

Scrubbing
Sterilization
Helmets and gowns
Gloves
Drapes
Mouthpieces
Antibiotics
Ventilation systems



Laminar air flow ceiling System

HEPA 14 filter

16-20 air changes/h

Down-flow (cold air) inside
the protectors.

Mixing air system

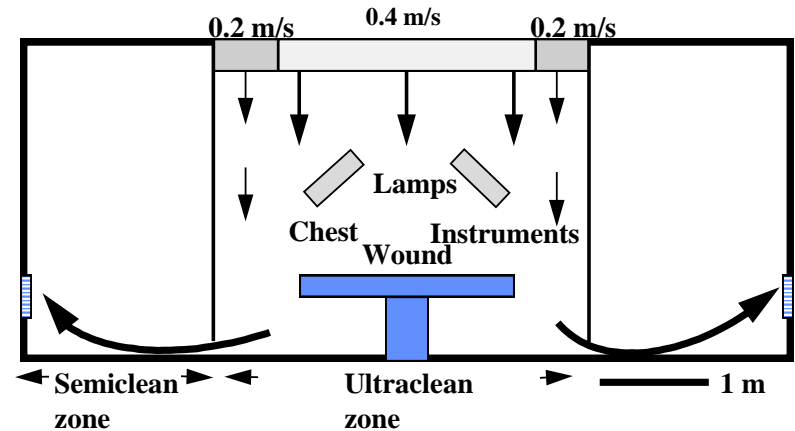
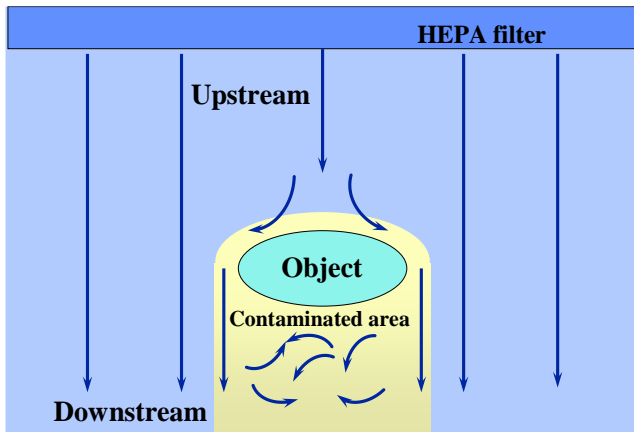
HEPA 14 filter

16-20 air changes/h



Ventilation belongs to the building
Validated at rest to fulfill standards

Theory and practice are two different things.



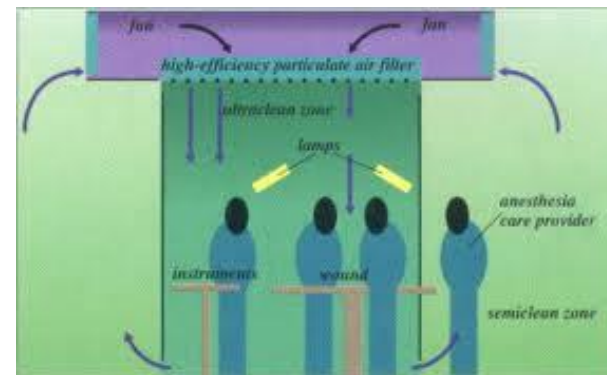
Deflection →



← Upward stream

The clean zone inside an OR is often small. Difficulty to give a total cover of wound and instruments

- Every person in the OR emits approximately 10.000 particles/minute.
- 10% of these are carrying bacteria. The average size of a skin flake is 10micro meter.
- These particles sediments with a velocity of 30 cm/minute.
- Unprotected wound area and instruments exposed to the ambient air at risk.



A forgotten risk factor

“98% of the bacteria in the wound at the end of operation came from the air of which 30% was direct sedimentation. The remaining 70% could be traced to indirect sedimentation, such as through contaminated surgical instruments that had been contaminated by airborne sedimenting bacteria”

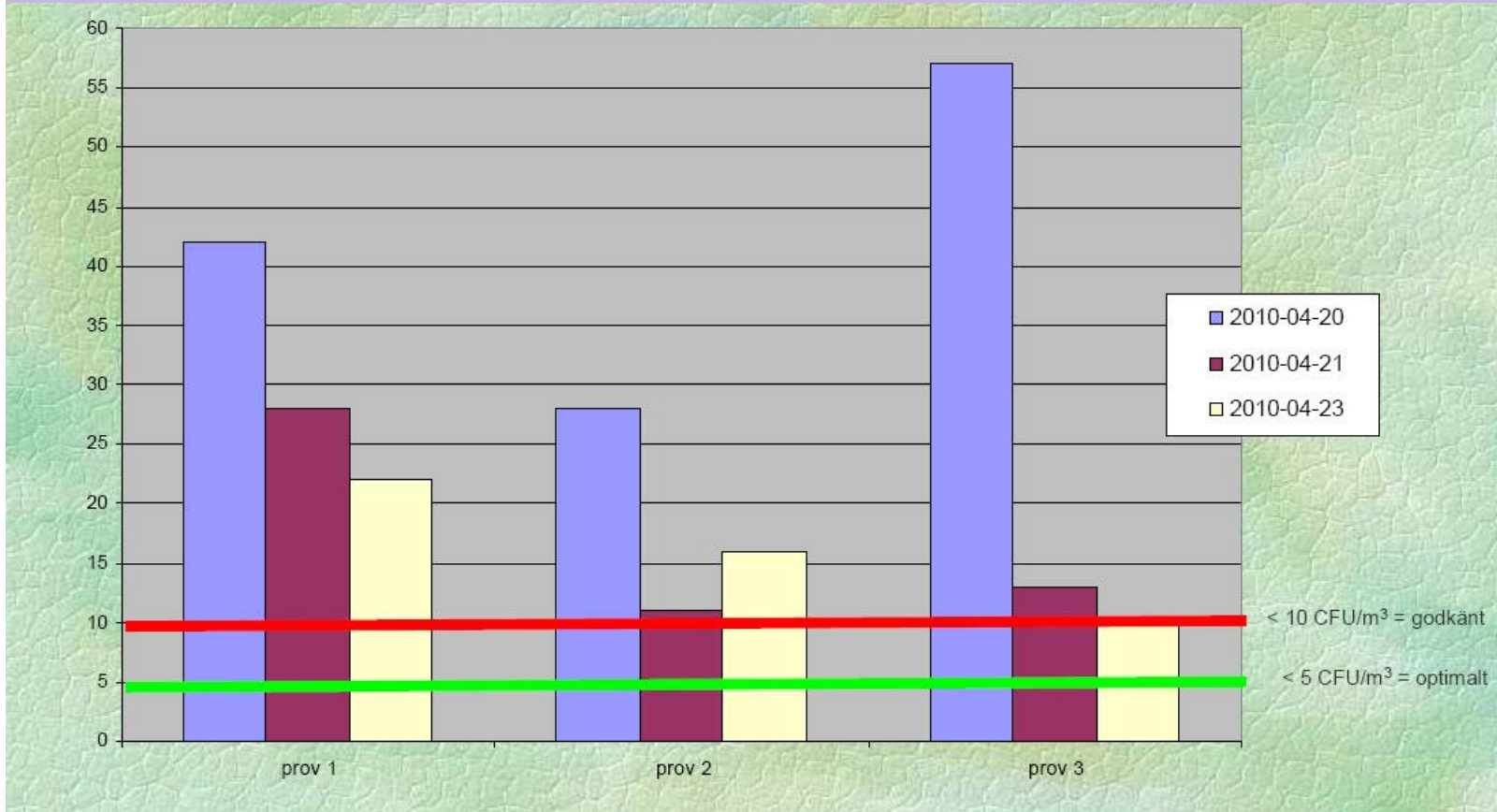
Whyte et al 1982 (hip joint surgery)

Instrument table with continuous HEPA filtered airflow

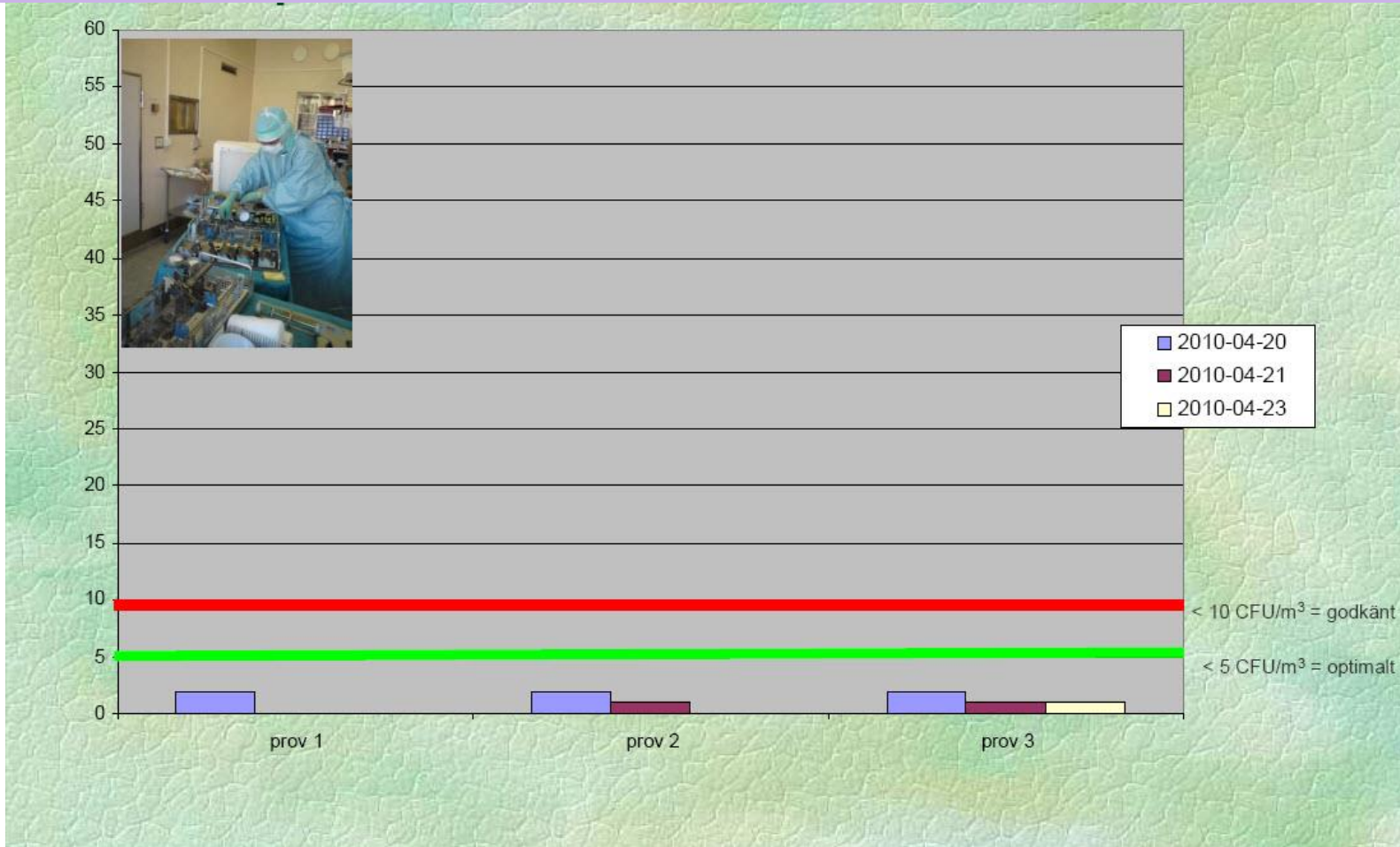
- Instrument table SteriStay 100% protection, **both sides** of the instruments
- Works in every OR , LAF or no LAF, preparation room, etc
- Expanding Ultra clean zone , protection area



Measured CFU over instruments in normal ventilation



Measured CFU over instruments in special Ultra clean airflow



Operio mobile

A mobile horizontal ultraclean air for the wound and instruments



Operio Ceiling

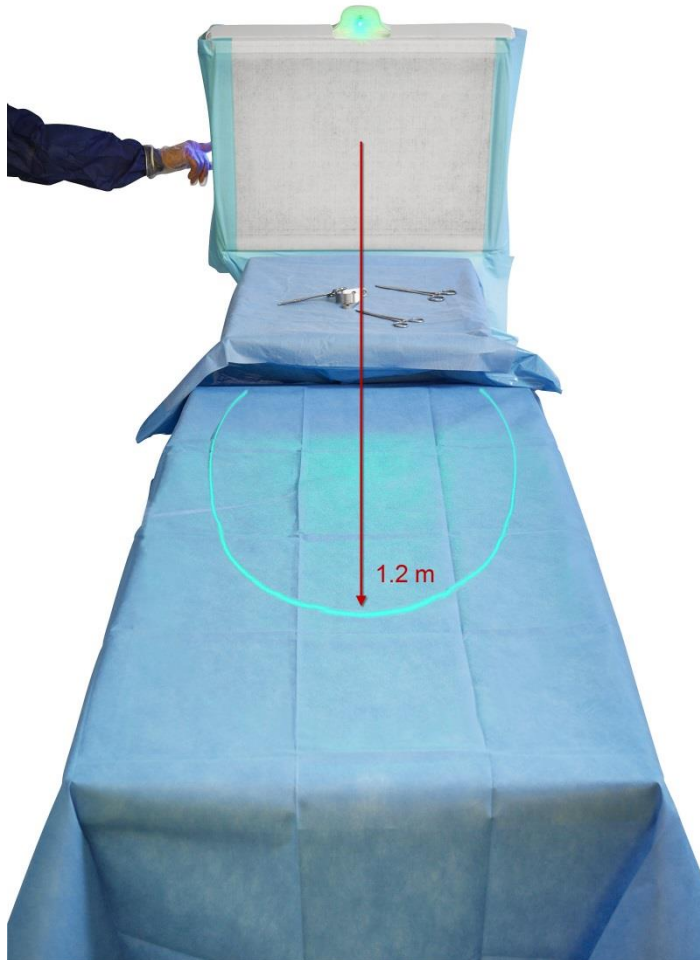


Operio mobile

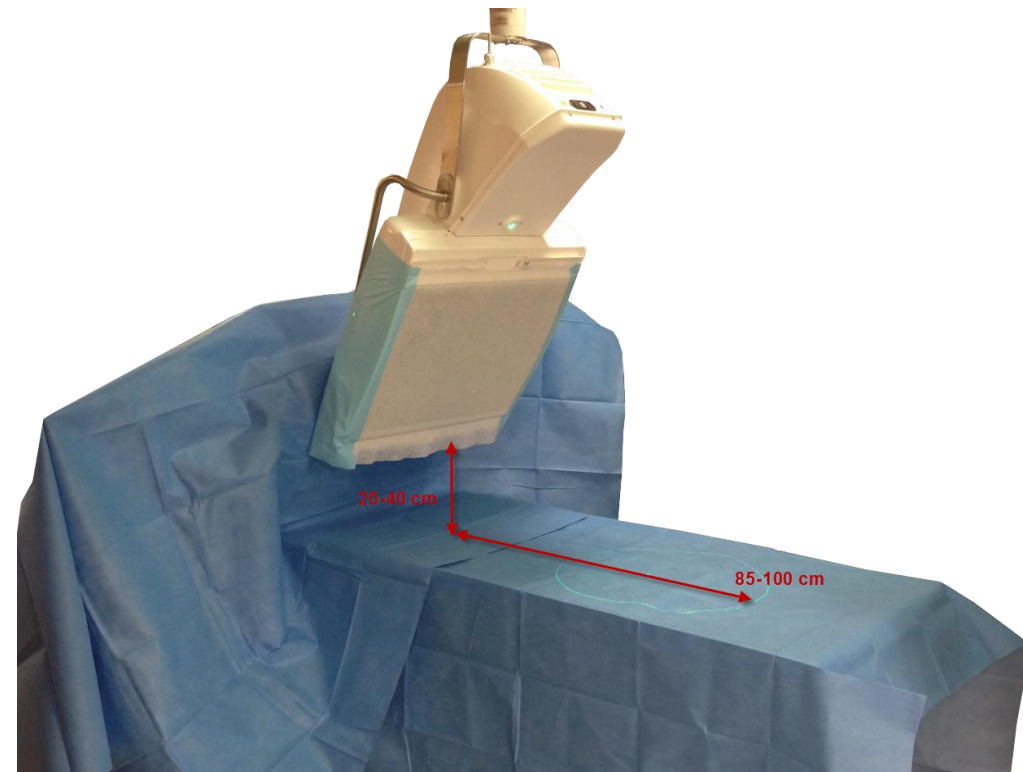


The sterile zone - Laser indicator

Operio Mobile



Operio Ceiling







MOBILE LAMINAR AIRFLOW UNITS TO REDUCE AIRBORNE BACTERIAL CONTAMINATION IN THE OPERATING ROOM: EXPERIENCES FROM A SWEDISH NEUROSURGERY DEPARTMENT

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Introduction

Exogenous surgical site infections are caused by contamination of the surgical site during the actual operation. Contamination can be airborne or through contact with instruments or fluids, which may be contaminated during the operation.

The unit of measurement for airborne bacteria is colony-forming unit (CFU) per m³. The microbiological quality in the operating room (OR) depends on numbers of staff, their clothing and level of activity, type of ventilation and door openings.

The majority of neurosurgical operations are classified as infection-prone clean surgeries since artificial implants are used, and thus require ultra clean air in the OR. A mean value of =5 CFU/m³ in sampled air is used as a guideline to ensure ultra clean air.

Despite the fact that surgical site infections after neurosurgery could be devastating, there are no previous studies assessing air quality during neurosurgical operations.

The aim of the study was to assess the effect of mobile laminar airflow (MLAF) units on the microbiological air quality in ORs with conventional turbulent ventilation.



Figure 1. SteriStay MLAF unit



Figure 2. Operio MLAF unit



Figure 3. Draping of air sampler



Figure 4. Air sampling during surgery



Figure 5. Incubation of agar plates

Methods

This study had a quasi-experimental design and was part of a larger project; Innovation Against Infection, coordinated by Research Institutes of Sweden (RISE).

Active air sampling was performed according to Swedish Standards Institute technical specification SIS-TS 39:2012, during neurosurgical operations; in ordinary conditions and using additional MLAF units.

The following MLAF units were used: SteriStay (Figure 1) protecting the instruments from airborne bacterial contamination, and Operio (Figure 2), directed towards the surgical site and protecting both instrument and the surgical site.

An air sampler was used to collect airborne microorganisms on agar plates. In each measurement, an agar plate was inserted in the air sampler and the sampler was draped (Figure 3).

Sampling was conducted peripheral in the OR, =0.5 m from the surgical site and above the instrument table (Figure 4). The agar plates were incubated before the bacterial count (Figure 5).

Data was collected monthly during 16 months.

Results

The data collection was concluded in June 2016. A total of 199 agar plates were sampled during 38 neurosurgical operations, 19 with conventional ventilation, and 19 using additional MLAF.

The data was not normally distributed, thus non-parametric statistical methods were used.

The results showed significant reduction of CFU/m³ when using MLAF: in the surgical site (CFU range 1-13, median=2 in MLAF, and range 1-127, median=15 without MLAF, p<0.001), and above the instrument table (CFU range 1-13, median=0 in MLAF, and range 1-147, median=12 without MLAF, p<0.001).

Figure 6 show an incubated agar plate after sampling in MLAF, while Figure 7 show an agar plate incubated during the same operation (brain tumor extirpation) outside MLAF.

A regression analysis showed that only one variable significantly affected CFU/m³: the use of MLAF. Numbers of staff or door openings were non-significant variables.



Figure 6. Agar plate, sampling in MLAF (2 CFU)



Figure 7. Agar plate, sampling outside MLAF (111 CFU)

Conclusion

The MLAF units significantly improve the microbiological air quality into ultra clean air levels in the sterile zone when used in conventional turbulent ventilation.

Contact

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Installation in
Drammen / Norway
2015 , all
orthopedics
operations

Infection rate before
Toul installation was
about 2%

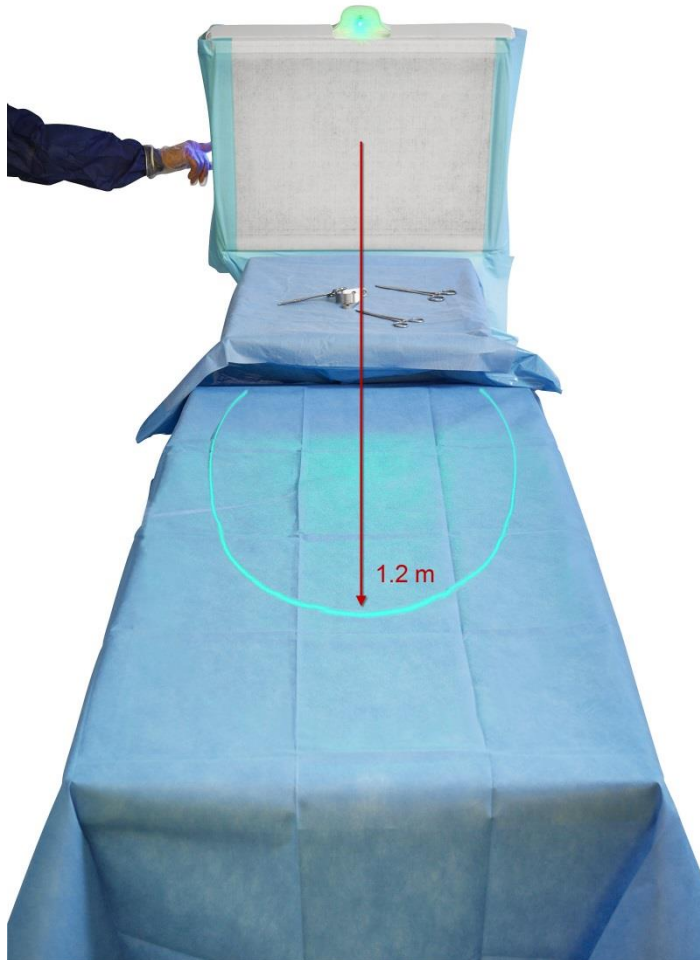
Infection statistics
from 2018-01-08
Shows: in 645 knee
implant 0.3 %.
and in 646 Hip
implants 0%



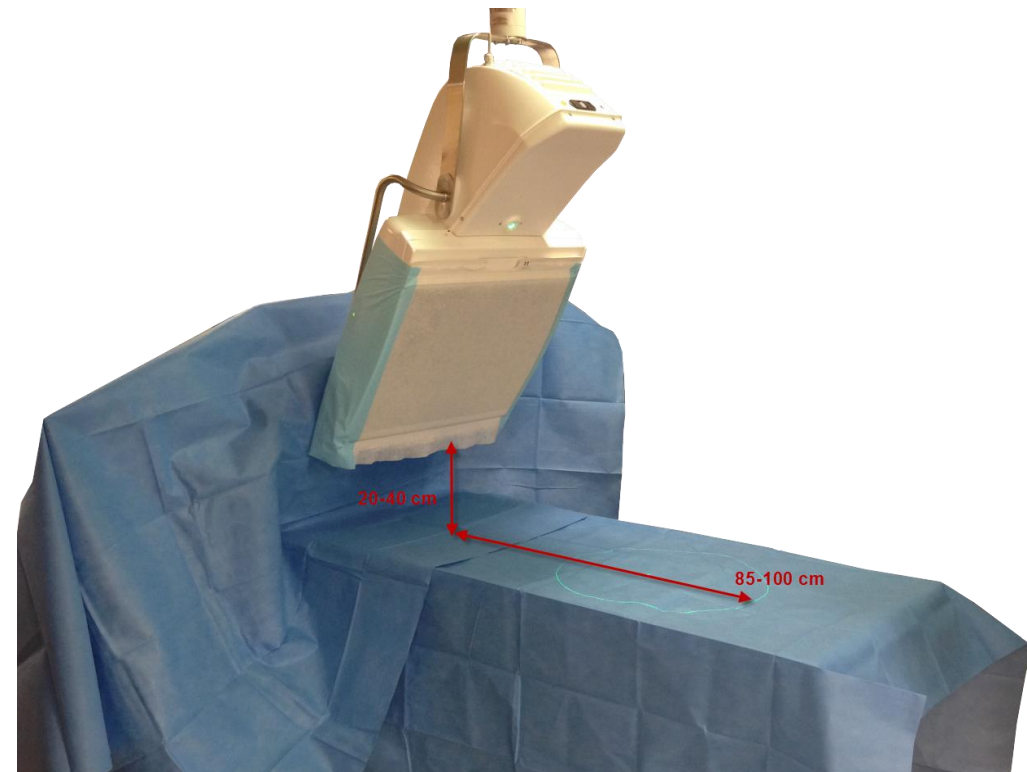


The sterile zone - Laser indicator

Operio Mobile



Operio Ceiling



General Surgery



Neuro op



Orthopedics



“It doesn't matter if the glass has been cleaned if the water is dirty”



Thank you for your attention