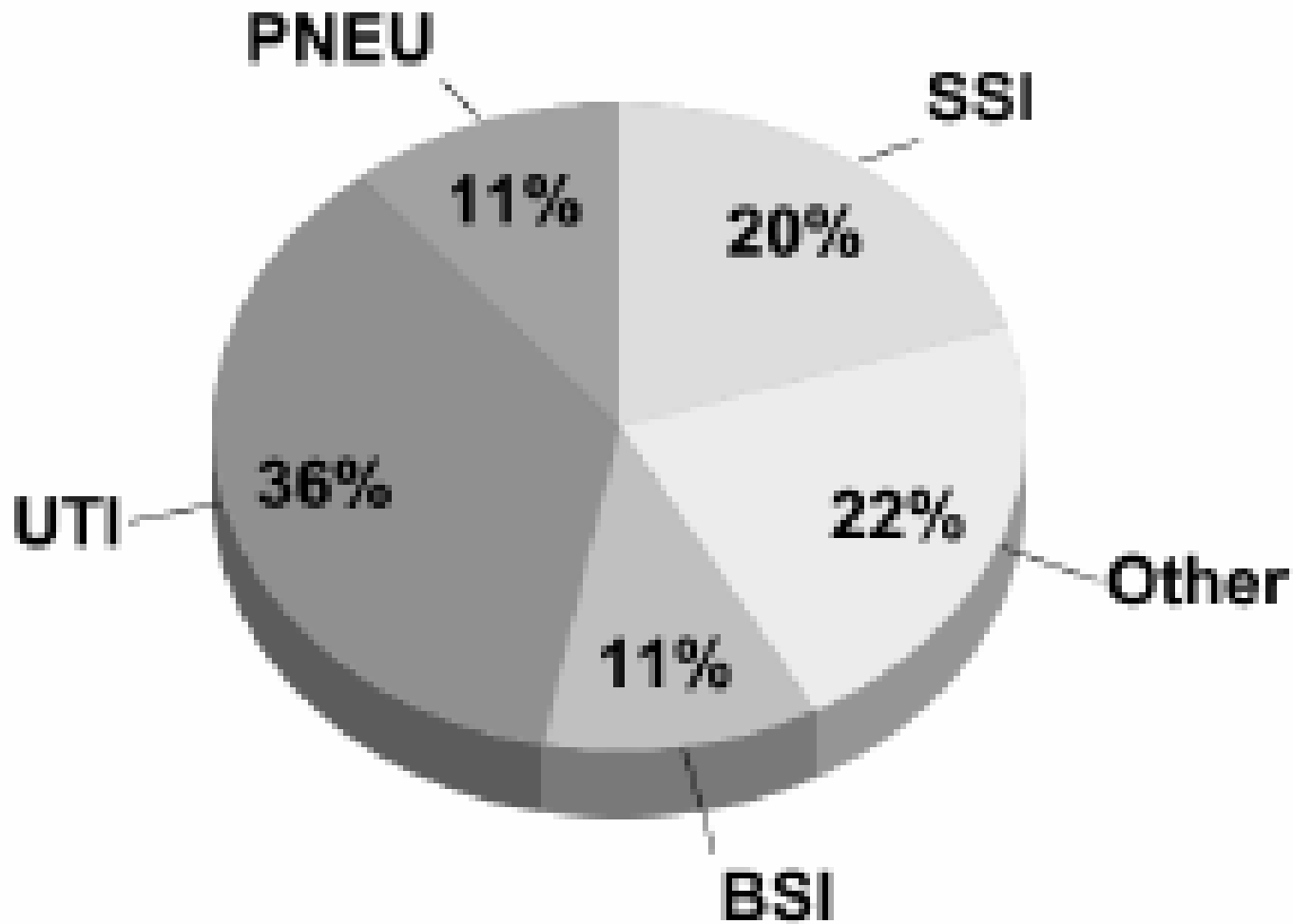


Prevention of Surgical Site Infection



PTY Ching
CICO
HA



Healthcare associated infection rate of the acute care setting

Opportunity to Prevent Surgical Infections

- An estimated 40-60% of SSIs are preventable
- Overuse, underuse, improper timing, and misuse of antibiotics occurs in 25-50% of operations

Focus on:

- Pre-operative skin prep
- Air and Environment
- Pre-operative antibiotics monitoring and effect
- Surgical wound infection rate & feedback

Recommendations for Prevention of SSI by CDC (1999)

Preoperative

Patients

- Do not remove hair unless obtruding
incision site
- Clip only and do not shave
- Pre-op shower
- use appropriate antiseptics

Wound Infection Rate & methods of Hair Removal

<u>Hair Removal</u>	<u>WIR</u>
Razor	5.6
Depilation Cream	0.6

Timing of Shaving and Wound Infection Rate

	<u>Wound Infection</u> <u>Rate (%)</u>
Night before	20
With 24 hrs	7.1
Immediately before	1.4-3.1

References on Pre-operative Skin preparation(1)

No Shaving

1. Seropian R, Reynolds BM. Wound infections after preoperative depilatory versus razor preparation. *Am J Surg* 1971 ;121:251-154.
2. Hamilton WH, Lone FJ. Postoperative hair removal. *Can J Surg* 1977; 20:269-275.
3. Cruse PJ, Foord R. The epidemiology of wound infection: a 10-year prospective study of 62939 wounds. *Surg Clin North Am* 1980;60(1):27-40
4. Mishriki SF, Law DJW, Jeffery PI. Factors affecting the incidence of postoperative wound infection. *J Hosp Infect* 1990;16: 223-230.

Recommendations for Prevention of SSI by CDC

Preoperative

Patients

- Do not remove hair unless obtruding incision site
- Clip only and do not shave
- Pre-op shower
- use appropriate antiseptics

References on Preoperative Skin Preparation (2)

On Preoperative Baths

1. Hayek LJ, Emerson JM, Gardner AMN. A placebo-controlled trial of the effect of two preoperative baths or showers with chlohexidine detergent on postoperative wound infection rate. *J Hosp Infect* 1987; 10:165-172.
2. Garibaldi RA, Skolnick D, Lerer T, et al. The impact of preoperative skin disinfection on preventing intraoperative wound contamination. *Infect Control Hosp. Epidemiol* 1988; 9:109-113.
3. Rotter ML, Larson SO, Cooke EM, et al. A comparison of the effect of preoperative whole-body with detergent alone and with detergent containing chlohexidine gluconate on the frequency of wound infections after clean surgery. *J Hosp Infect* 1988; 11:310-320.

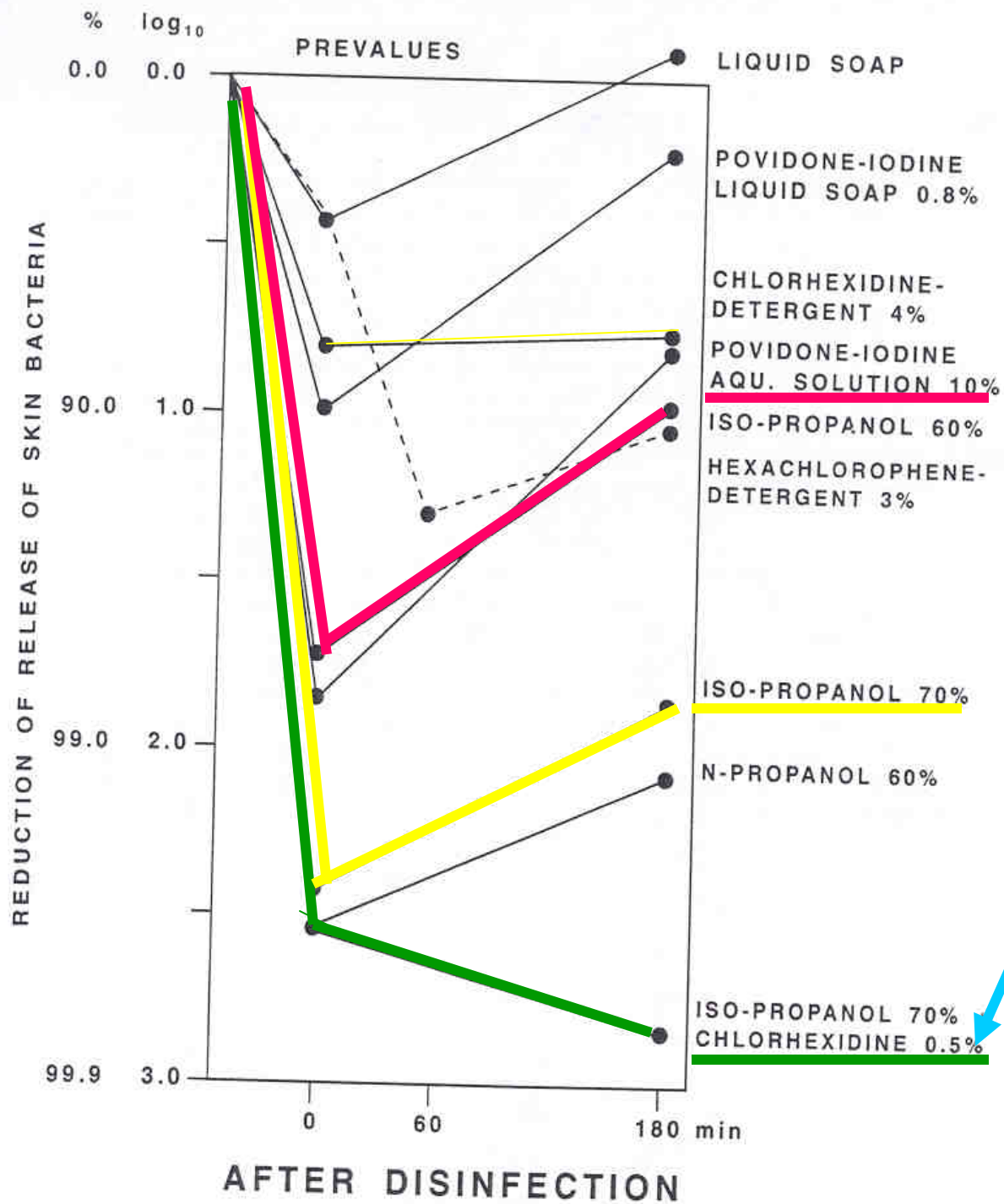
Recommendations for Prevention of SSI

Preoperative

Patients

- Treat all infections
- Do not remove hair unless obtruding incision site
- Clip only and do not shave
- Pre-op shower
- use appropriate antiseptics





Most effective Skin Prep

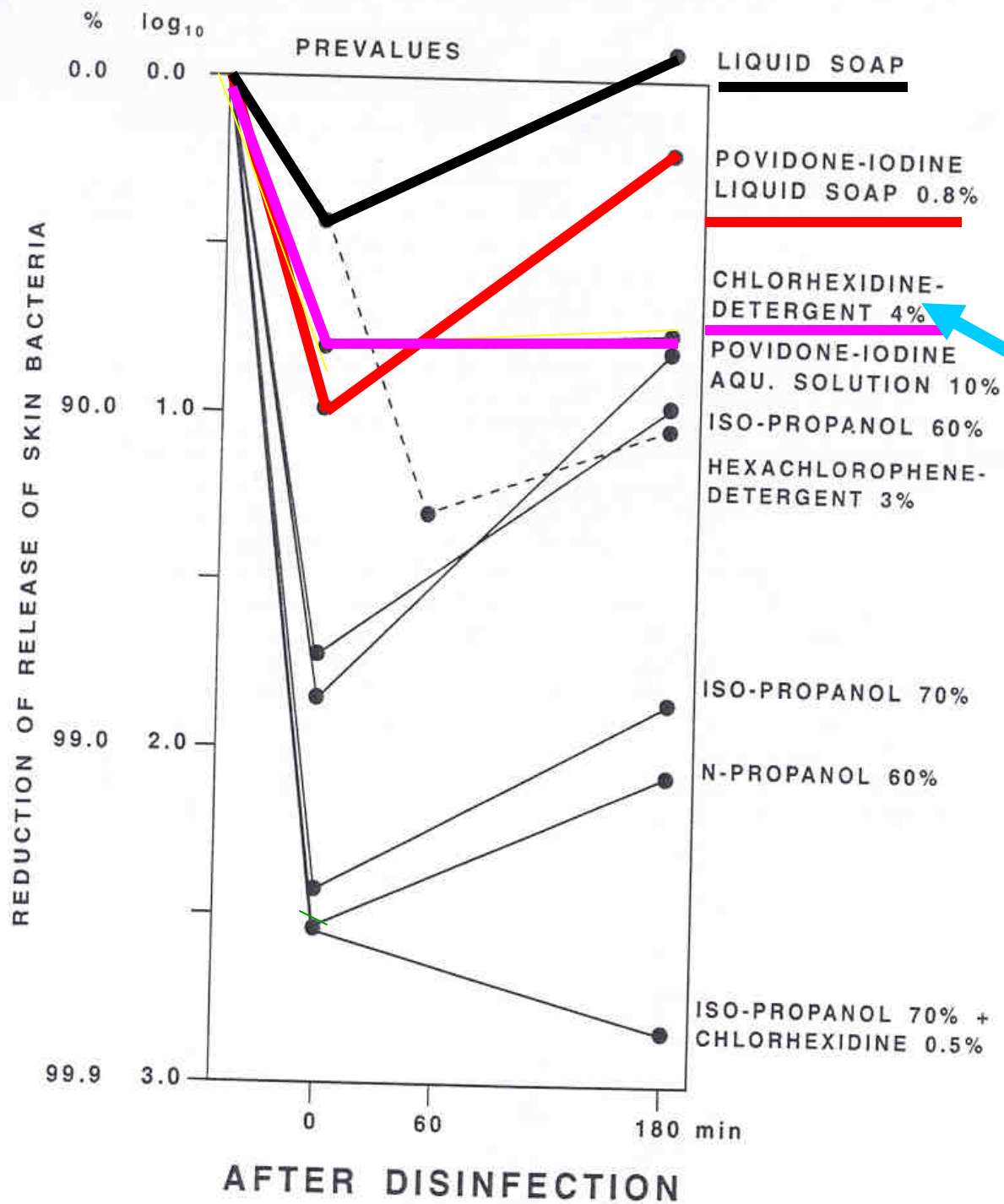
The rate of SSI was cut in half after the introduction of 2% CHG no-rinse cloths in the place of a povidone-iodine (Betadine) skin antiseptic in orthopaedic patients undergoing total joint procedures.

Eiselt D. *Orthop Nurs.* 2009 May-Jun;28(3):141-5.



3 minutes

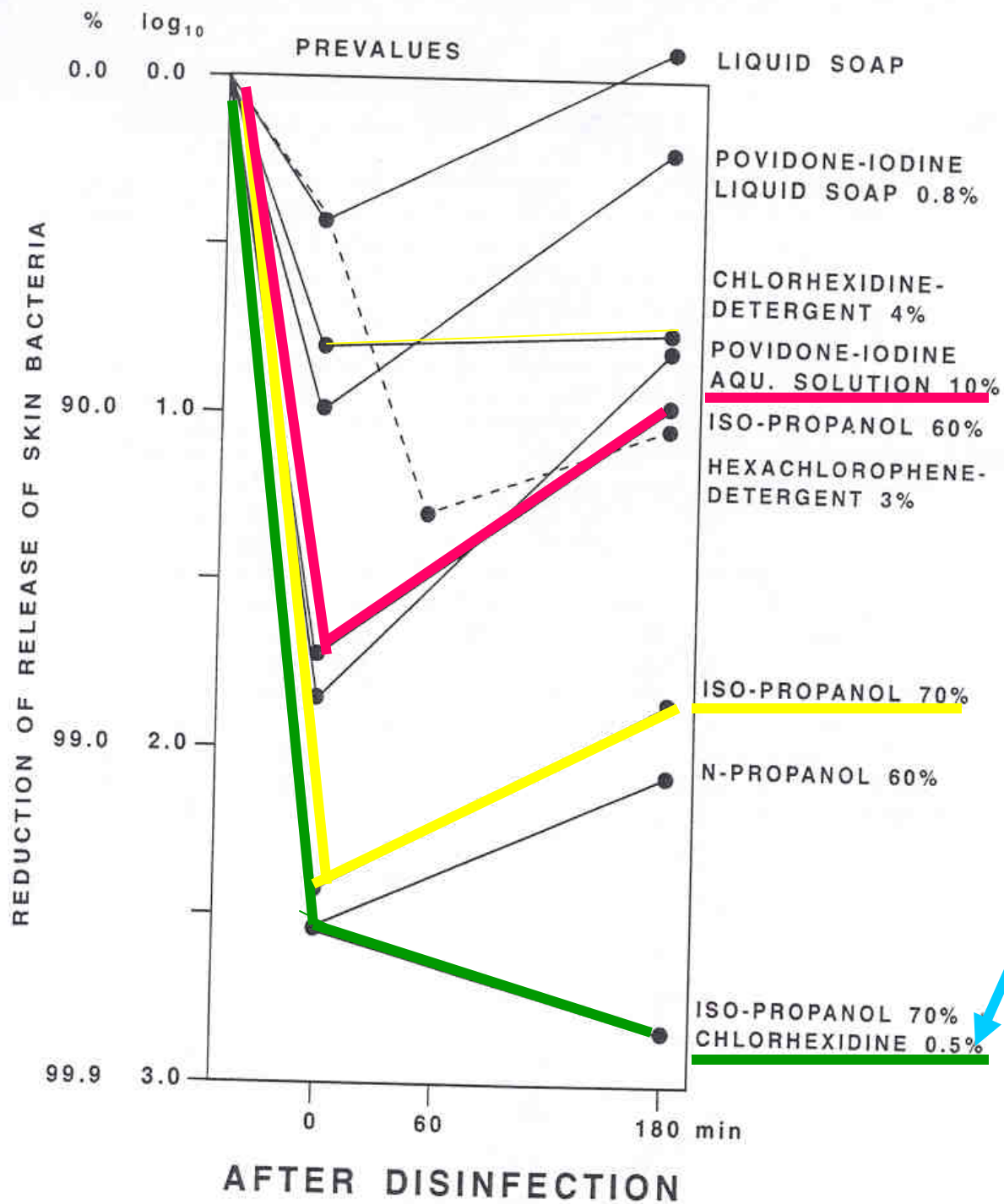
Sterile brush



Use of brush

A randomized controlled clinical trial failed to demonstrate an additional antimicrobial effect by using a brush

Loeb M B et al AJIC 1997



Most effective surgical hand rub

Recommendations for surgical hand rub

WHO 2005 & CDC 2002

- Wash hands on entry to OT and when visibly dirty with BBF
 - ❖ In changing room or perorated gloves
 - ❖ 15 s wash with soap and water
- Apply on dry hands
- Use sufficient (2 X 3 mls) AHR to wet hands and forearms
- 1.5 min rub = 45 s per hand and forearm
- Allow to dry thoroughly before donning sterile gloves

Air and Environment

Ventilation and air

Operating room air may contain dust, lint, skin flakes and is directly proportional to the number of person in the OR.

Bacterial counts in the air of an operating suite

Count (cfu/m³)

of indicated organism

All S. C.

Location, circumstances bacteria *aureus* *perfringens*

Operating room

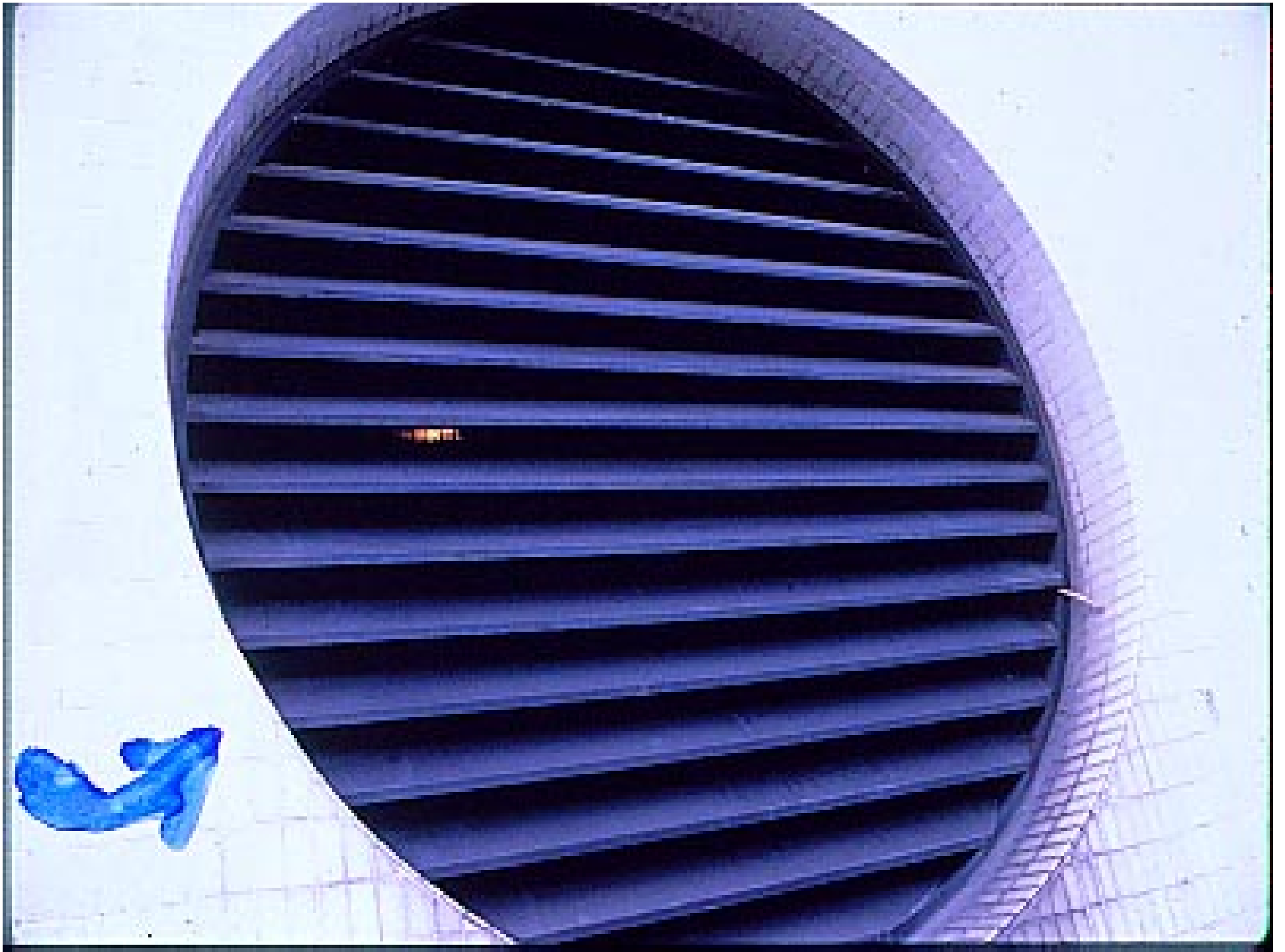
Clean and empty 2.2

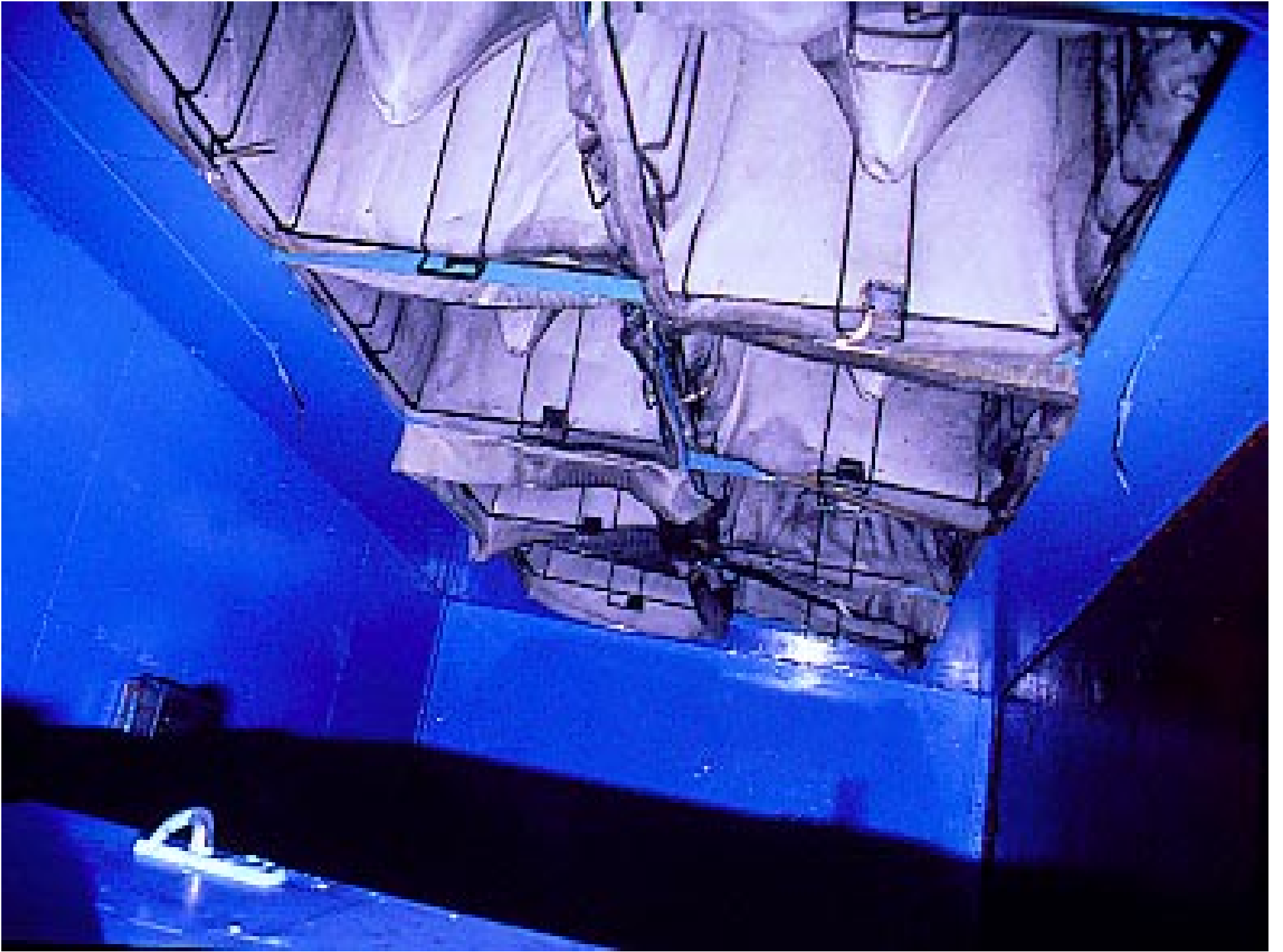
Normal operating activity 253 0.15 0.26

Moderate to high activity 342 0.37 0.54

Corridor outside operating room 565 1.04 1.17















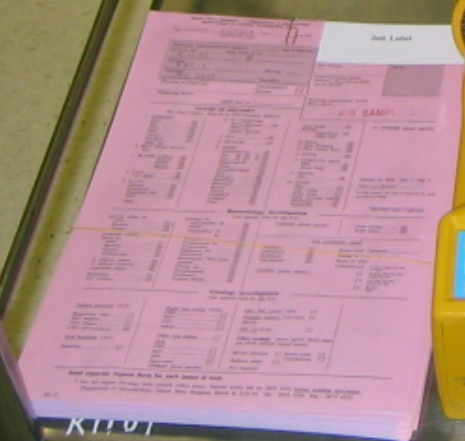
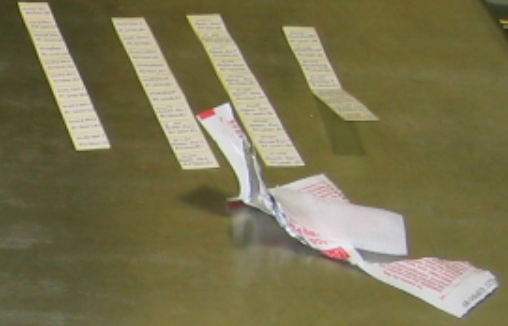


From American Institute of Architecture (AIA)

Patient care areas	Air movement	Air Change / hour	Exhaust outdoor	recirculation
OR	Positive (out)	15-25	---	No
ICU	Neutral	6	---	No
AII	Negative (in)	12	Yes	No
PE	Positive (out)	12	---	No
Isolation anteroom	In/Out	10	Yes	No
Endoscopy	Negative (in)	6	---	No
Bronchoscopy		10	Yes	No

Air changes per hour (ACH) and time in minutes required for efficiencies of 90%, 99%, and 99.9% of airborne contaminants*

ACH	Minutes required for a removal efficiency of		
	90%	99%	99.9%
1 - 5	138 - 28	276 - 55	414 - 83
6 - 10	23 - 14	46 - 28	69 - 41
11 - 15	13 - 9	25 - 18	38 - 28
16 - 20	9 - 7	17 - 14	26 - 21
25 - 50	6 - 3	11 - 6	17 - 8



110T

K1101

Sampling Collection



Standard of bio-burden

Air level 0-5 CFU / M³

Patient level ≤ 30 CFU / M³

Bacteria & fungus combine

Investigate when there is pathogen

e.g. Staph. aureus, PSA

Stop OT service when there is increase in CFU

Results of 22 New OR - Particle Count and Bio-burden

	air change /h	particle counts /L air		bacterial counts cfu/m ³
		>0.5 µm	>5 µm	
Median	25.4	5.8	0.32	<1
Range	20-70.2	2.7-29.4	0.15-1.1	0-3

Jowitt D J Hosp Infect ,2005



Particle counter

ParticleScan™
 精準量測的微粒偵測儀
 精準量測室內空氣中可吸入微粒濃度

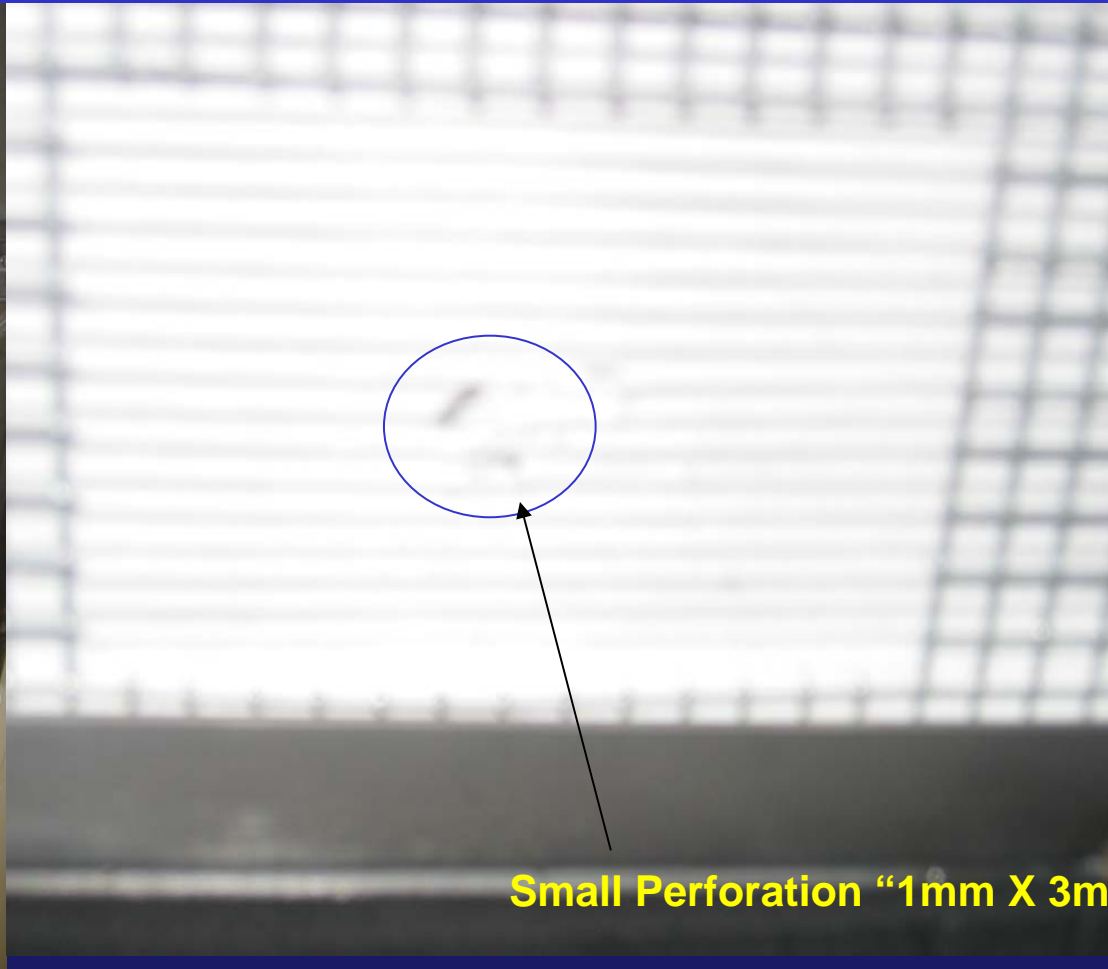


icleen® Traveler
 Accurate portable air quality monitor for the quick and accurate measurement of airborne particle concentrations in indoor environments.

icleen® Traveler is the most accurate portable air quality monitor in the world. It uses the same technology as the most accurate stationary air quality monitors. It is accurate to within 10% of the reference instrument. It is also the only portable air quality monitor that can measure all three major types of particles (PM10, PM2.5, and PM1) and provides real-time data on particle concentrations and counts. It is also the only portable air quality monitor that can measure all three major types of particles (PM10, PM2.5, and PM1) and provides real-time data on particle concentrations and counts. It is also the only portable air quality monitor that can measure all three major types of particles (PM10, PM2.5, and PM1) and provides real-time data on particle concentrations and counts.



Defect of HEPA Filter



Small Perforation "1mm X 3mm"



CDC Recommendations

Ventilation in OT

- Positive-pressure ventilation
- 15-(25) AC/ hour
- At least 3 must be fresh air
- HEPA filter
- Air in from ceiling & exhaust near floor
- Keep doors closed
- Ultra-clean air for orthopaedics
- Limit number of personnel

Laminar air flow

- Design to move particle-free air (ultra-clean air) with uniform velocity at 0.3 - 0.5 $\mu\text{m}/\text{sec}$.
- Vertical is better than horizontal
- HEPA filter removes particles $>0.3 \mu\text{m}$
- Efficiency of 99.97%
- Commonly used in orthopaedic prosthetic surgery

Sepsis after total joint replacement

Ventilation type	Staff clothing	(cfu/m ³)	Incidence of sepsis
a. Control (turbulent)	Conventional	158	36 (2%)
Ultra-clean (LAF)	Conventional	7	16 (1%)
b. Control (turbulent)	Conventional	133	27 (1.3%)
Ultra-clean (LAF)	Body-exhaust	0.5	6 (0.3%)

a, b=10 hospital each

Lidwell, 88



Effect of prophylactic antibiotics and ventilation on joint sepsis

<u>Ventilation type</u>	<u>Staff clothing</u>	<u>Antibiotics</u>	
		<u>Not given</u>	<u>Given</u>
Control (turbulent)	Conventional	39/1161 (3.4%)	24/2968 (0.8%)
Ultraclean (LAF)	Conventional	8/516 (1.6%)	9/1279 (0.7%)
Ultraclean (LAF)	Body-exhaust	5/544 (0.9%)	1/1584 (0.06%)



Lidwell et al. compared the effect of ultraclean air alone, antimicrobial prophylaxis alone and combination of both in prosthesis replacement. Result shown antimicrobials is more beneficial than ultraclean air.

J Hosp Infect, 1988



Organisms once reach the floor or inanimate surfaces are re-suspended into the air only with difficulty.

Disinfection vs Cleaning of Floor

<u>Uses</u>	<u>bacterial reduction</u>
Disinfectant	90-95%
Detergent	>80%

Unexpectedly, in this analysis, which controlled for many patient and hospital-based confounders, OR ventilation with laminar airflow showed no benefit and was even associated with a significantly higher risk for severe SSI after hip prosthesis.

Brandt C Ann Surg. 2008 Nov;248(5):695-700.

Environmental surfaces

Floor, wall and other surfaces not in close contact with the surgical wound are unlikely to pose a major infection risk.

Do not use tacky mat for infection control

Assessment in 10 ORs

wall 6.2 / 100cm³ stable for
3-6 mons

Floor 120 / 100cm³ plateau*

0.47cfu - *S. aureus*

1.57 cfu - *Clostridium perfringens*

*deposition=death / removal

CDC reviewed from 1986-1990, most nosocomial infection are related to products, procedures or devices. Thus airborne outbreaks of nosocomial infection have not been prominent, at least on a simple statistical basis.



Microbiologic sampling

- Do not perform routinely
- Only as part of epidemiologic investigation

Causes of Surgical Site Infections (SSI) is multi-factorial

- **Host resistance**
- **Surgical technique**
- **Staff dispersers**
- **Touch contamination**
- **Puncture glove**

Without surgical antimicrobial prophylaxis, glove perforation increases the risk of SSI.

Heidi Misteli et al. Archives of Surgery. Chicago: Jun 2009. Vol. 144, Iss. 6; pg. 553

Pre-op Antibiotic Prophylaxis
and feedback

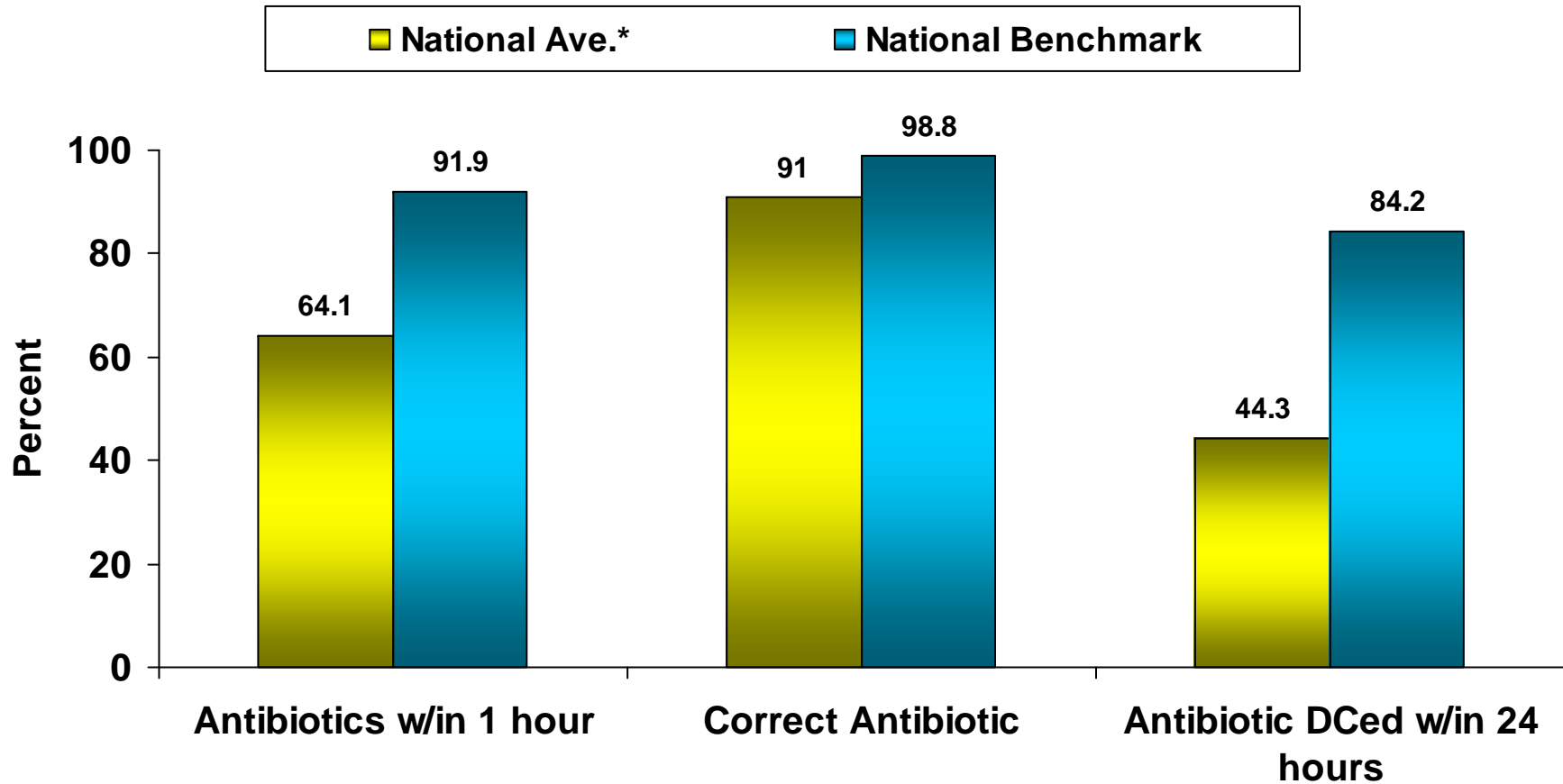


Principles in Surgical Antibiotics Prophylaxis

1. Not for clean operations except :
 - Prosthesis
 - Drastic outcomes if infected (eg.CNS)
 - High risk (eg. age or prolonged duration)
2. Whenever possible use first generation cephalosporin
3. Avoid antibiotics that are used for treatment
4. Given on induction
5. Post-operative coverage are generally unwarranted

Surgical Infection Prevention

National Baseline Performance



* Based on medical record abstraction from the charts of patients discharged in the 1st quarter of 2004. Benchmark rates were calculated for all hospitals in the US based on discharges during calendar year 2003 using the *Achievable Benchmarks of Care™* methodology (<http://main.uab.edu/show.asp?durki=14527>).

Antimicrobial Prophylaxis

- Only when indicated
- Administered on induction
- Non absorbable orally for colorectal surgery
- High risk CS, administer after clamping cord
- Do not routinely use Vancomycin

I.C.F.

Immediate - feedback occurs on day of audit

Concurrent - patient still in hospital

Feedback - specific for doctor & prescription

Help of an Audit Nurse & Pharmacy

Issue memo signed by microbiologist

System changes for AP given in OTS

- Consensus from anaesthetist
- Stock drug in OTS
- Topping up system by pharmacy

Post-op incision care

- Dressing intact primary closed wound for 24-48 hrs
- Aseptic technique for wound care
- Pt to report S/S of wound infection
- No recommendation for incision closed beyond 48 hours on dressing change or bath

MRSA screening and eradication

5,094 patients surveyed

MRSA SSI decreased from 0.23% to 0.09%.

Joint-replacement procedures (0.30% to 0%; $p = 0.04$)

Four had positive MRSA screens; none had received preoperative eradication of MRSA

CONCLUSIONS: Surveillance for MRSA and eradication of the carrier state reduces the rate of MRSA SSI

Pofahl WE J Am Coll Surg. 2009 May;208(5):981-6

Hospitals with antibiogram data that reveal high Staphylococcus resistance should consider use of vancomycin as a prophylactic antibiotic.

Meehan J, *J Bone Joint Surg Am.* 2009 Oct;91(10):2480-90.



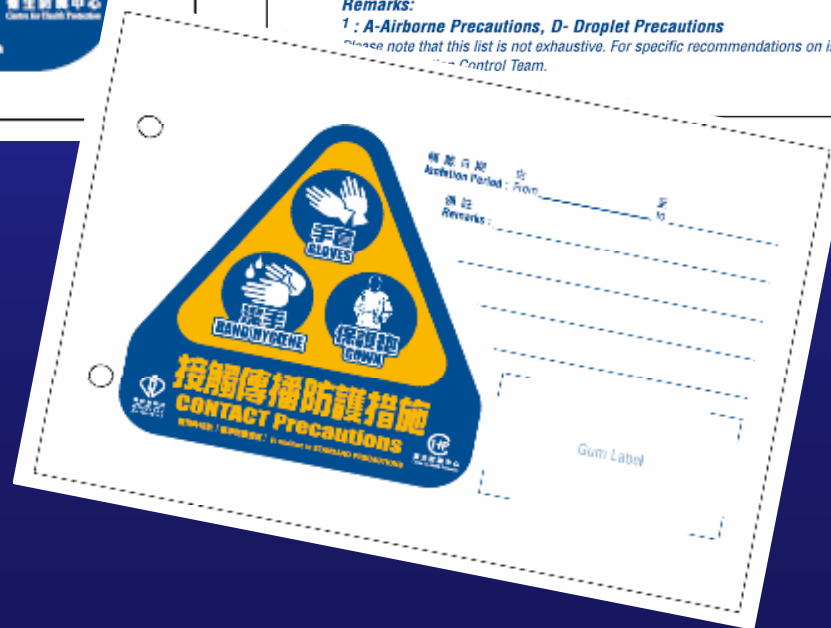
Contact Precautions

	Additional ¹	
	A	D
Chickenpox	√	
Gastroenteritis caused by <i>Clostridium difficile</i> , Norovirus or Rotavirus		
Herpes simplex – neonatal or mucocutaneous, disseminated, primary, severe		
Herpes zoster – localized in immunocompromised patient or disseminated	√	
Impetigo		
Multidrug – resistant organisms (as advised by hospital IC team)		
Respiratory infections (in infants and young children) caused by Adenovirus, Parainfluenza virus or Respiratory syncytial virus (RSV)		√
Scabies		


Remarks:

1: A-Airborne Precautions, D- Droplet Precautions

Please note that this list is not exhaustive. For specific recommendations on isolation precautions, please consult the Infection Control Team.



Prevention and control of MDRO

- Additional precautions
 - Hand hygiene
 - Glove use
 - Training & education
 - Surveillance
- 

- Surgical attire and drapes
- Asepsis and surgical technique
- Sterilization of surgical instrument

Where should our hands put ?

1. Contamination rates were greater at levels 24 inches and 48 inches (ground & elbow creases)
2. The chest and operative field had the lowest contamination rates.
3. The chest and operative field to be the most sterile

*Bible JE, Clin Orthop Relat Res. 2009 Mar;467(3):825-30.
Epub 2008 Jul 1*

Surveillance

- Use CDC definition of wound infection
 - pus issued
- SSWIR-surgeon specific wound infection rate







* Smear positive : When 10 or more WBC is helpful in ascertaining evidence of pus / purulent discharge

NNIS surgical Site Infection Rate 3 Risk Index

1. Wound Class = Dirty

2. ASA 3-5

3. OT duration > T

(T= 75 percentile of the operation time used)

e.g. appendicetomy from 15min - 125 min

T is at 60 mins & at 75th percentile

Score '1' when one of the above is present

Benefit of Surveillance for SSI

- Benchmark with hospitals in the US
- SSWIR for influencing surgeons for reduction of WD infections
- Survey on the appropriateness of antibiotic resulting in drug cost saving
- Surveillance on post-op infections, thus capturing >40% of post-op patients

Percentile of SSIR by Operative Procedures and Risk index (CDC 1992-1998)

OP	RI	Pool mean	<u>Percentile</u>				
			10%	25%	50%	75%	90%
CBGB	1	3.46	1.09	1.92	2.95	4.29	6.57
CBGB	2	5.82	1.30	3.09	5.43	7.80	10.8
CRAN	0	0.58	0.00	0.00	0.00	1.34	2.38
CRAN	1,2,3	1.57	0.00	0.00	0.92	2.36	3.23
HPRO	0	0.78	0.00	0.00	0.00	1.09	2.81
HPRO	1	1.55	0.00	0.00	1.04	2.35	3.85
HPRO	2,3	2.07	0.00	0.00	1.06	3.80	6.29

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- Benchmark with hospitals in the US
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SSWIR and Feedback

<u>Dr. Code</u>	<u>Rate</u>
A	0%
B	2%
C	5%
D	10%
E	25%

You are Dr. E

Impact of feedback on Surgical Wound Infection

	<u>Before</u> (n=875)	<u>After</u>	
		<u>1st report</u> (n=305)	<u>2nd report</u> (n=1169)
Infection Rates:	9.7% _a	8.2%	5.6% _a

Subscript differ significant ($\chi^2 = 12.0$ P<0.001)

SSI rate in Surgery

<u>Period</u>	<u>SSWIR</u>
Before (1988)	9.6%
After (1992)	5.6%
Present (after 2000)	4.0%

Benefit of Surveillance for SSI

- Benchmark with hospitals in the US
- SSWIR for influencing surgeons for reduction of WD infections
- Survey on the appropriateness of antibiotic resulting in drug cost saving
- Surveillance on post-op infections, thus capturing >40% of post-op patients

Result of education and ICF in the surgical unit

	<u>>3 does post-op</u>	<u>use 3rd gen. Cephalosporin</u>
July - Sept/92	65%	17%
----- Education Programme -----		
Oct - Dec/92	61%	26%
----- Start ICF -----		
January/93	30%	30%
February	26%	21%
March	18%	16%
April	14%	6%
May	12%	4%

Benefit of Surveillance for SSI

- Benchmark with hospitals in the US
- SSWIR for influencing surgeons for reduction of WD infections
- Survey on the appropriateness of antibiotic resulting in drug cost saving
- Surveillance on post-op infections, thus capturing >40% of post-op patients

ORTHOPEDIC UNIT 97, 98, 99 & 2000

Infection & Complication

	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>
	n=1525	n=1600	n=1620	n=1560
SWI	2.60%	3.10%	2.30%	2.30%
OSI	0.80%	1.70%	1.20%	0.50%
LRTI	0.40%	0.20%	0.10%	0.00%
	(n=1323)	(n=1396)	(n=1402)	(n=1352)
VAP	16.70%	0.00%	3.10%	6.20%
(ventilators)	(n=18)	(n=13)	(n=32)	(n=16)
CA UTI	4.30%	1.70%	2.40%	3.60%
(catheters)	(n=186)	(n=179)	(n=170)	(n=166)
IVC BSI	0.20%	0.10%	0.00%	0.00%
IVCath	(n=1456)	(n=1438)	(n=1453)	(n=1362)

100k *lives* Campaign

SOME IS NOT A NUMBER. SOON IS NOT A TIME.

www.ihl.org/campaign

Steps to Prevent SSI

1. Appropriate use of antibiotics
2. Appropriate hair removal
3. Post-operative glucose control (major cardiac surgery patients)*
4. Post-operative normothermia (colorectal surgery patients)*

* These components of care are supported by clinical trials and experimental evidence in the specified populations; they may prove valuable for other surgical patients as well.

Thank you

