Prévention de l'infection liée aux cathéters

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Conflits d'intérêt

- Expertise
  - MSD
  - Astellas
  - Carefusion
- Subvention à des partenaires publics
  - Pfizer
  - 3M
  - Astellas
- Bourses de recherche
  - 3 M
  - Ethicon / Janssen-Cilag
  - MSD
  - Novartis
  - Astra-Zeneca

Infections liées aux cathéters

- Fréquente
- Sévère
- Liée au soins
- évitable

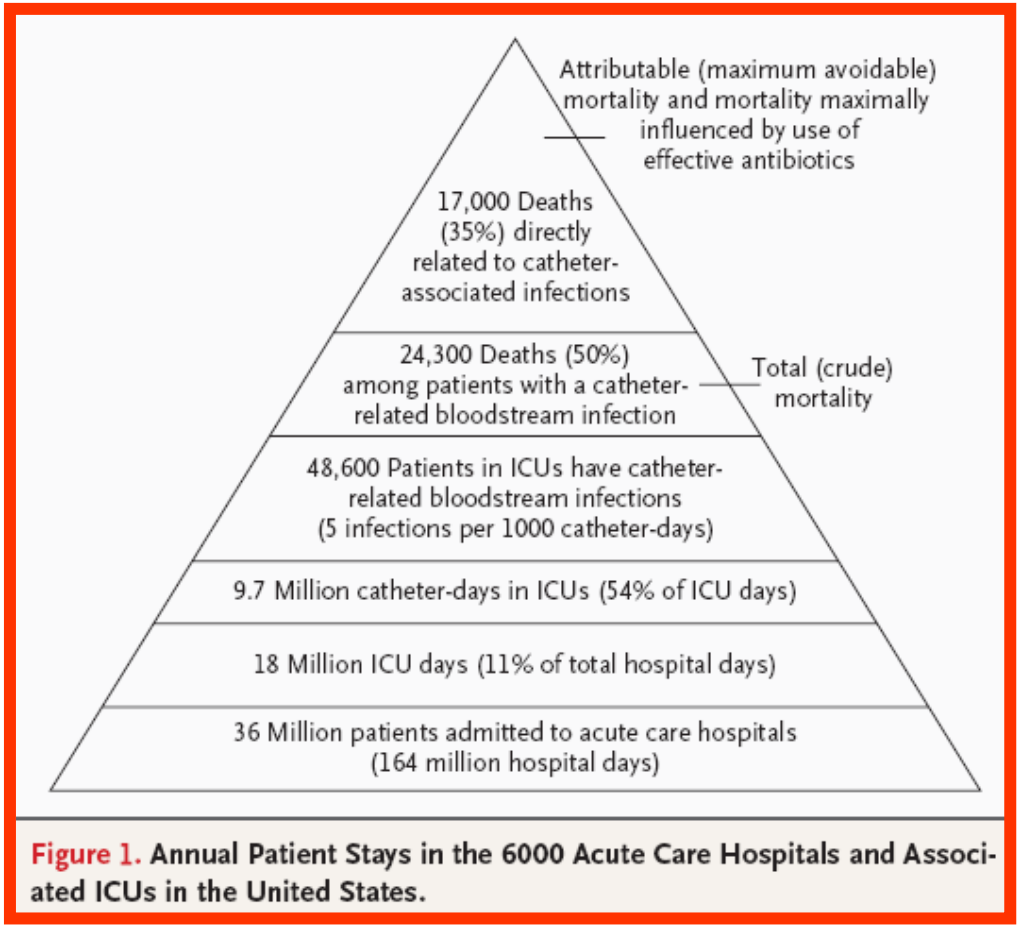


Figure 1. Annual Patient Stays in the 6000 Acute Care Hospitals and Associated ICUs in the United States.

Epidemiology (CR-BSI-CDC 2006-2007)

Type of Intensive care Unit	No. Units	No. CABSIs	Catheter-days	Pooled mean/ 1,000 catheter-days	Percentile				
					10%	25%	50%	75%	90%
Burn	22	239	42452	5.6	0	1.5	3.8	8.2	13.5
Coronary	121	373	181079	2.1	0	0	1.3	2.8	5.3
Surgical cardiothoracic	97	397	275194	1.4	0	0	1.2	1.9	3.4
Medical	144	1073	454839	2.4	0	0.6	1.9	3.6	5.3
Medical/surgical Major teaching	104	692	342214	2.0	0	0.5	1.5	3.0	4.2
Med/Surg All others	343	972	662489	1.5	0	0	0.6	2.0	3.6
Pediatric medical/surgical	71	404	140,848	2.9	0.0	0.0	2.1	3.8	6.0
Neurologic	15	31	25440	1.2	-	-	-	-	-
Neurosurgical	39	173	68550	2.5	0	0	1.9	3.8	6.2
Surgical	128	881	383126	2.3	0	0.5	1.7	3.1	5.1
Trauma	32	435	107620	4.0	0.3	1.5	4.0	5.7	7.7
Inpatient medical ward	40	111	60257	1.8	0	0	0	2.2	3.4
Inpatient medical/surgical ward	82	169	132133	1.3	0	0	0	1.6	4.0

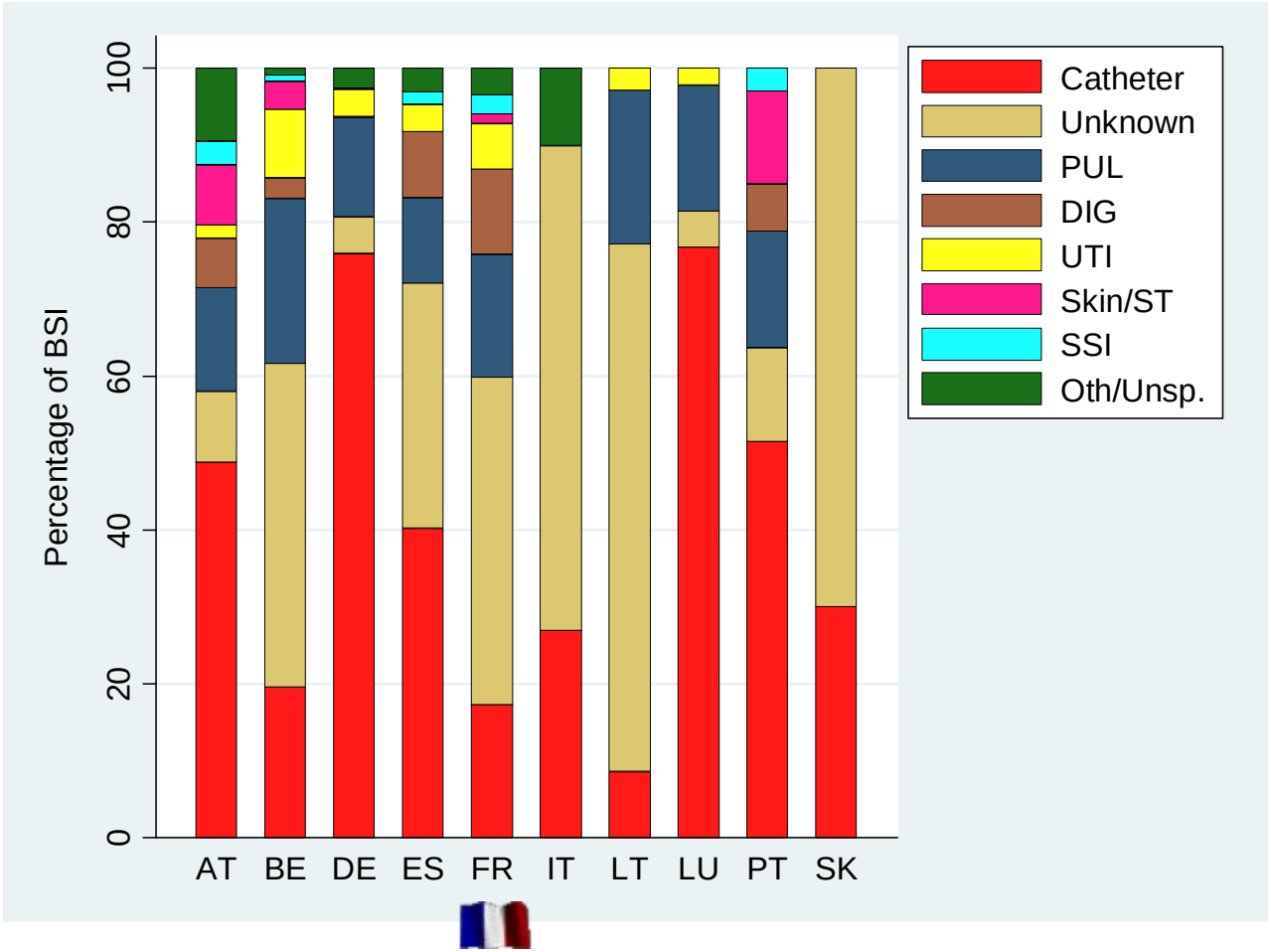
Edwards et al – AJIC 2008; 36:609

Le taux d'ILC est très variable en fonction du type de cathéter

Device	No. of prospective studies	No. of device-related BSIs			
		Per 100 catheters		Per 1000 catheter-days	
		Pooled mean	95% CI	Pooled mean	95% CI
Peripheral venous catheter	13	0.2	0.1–0.3	0.6	0.3–1.2
Arterial catheter	6	1.5	0.9–2.4	2.9	1.8–4.5
Short-term, nonmedicated CVC	61	3.3	3.3–4.0	2.3	2.0–2.4
Pulmonary-artery catheter	12	1.9	1.1–2.5	5.5	3.2–12.4
Hemodialysis catheter					
Noncuffed	15	16.2	13.5–18.3	2.8	2.3–3.1
Cuffed	5	6.3	4.2–9.2	1.1	0.7–1.6
Peripherally inserted central catheter	8	1.2	0.5–2.2	0.4	0.2–0.7
Long-term tunneled and cuffed CVC	18	20.9	18.2–21.9	1.2	1.0–1.3
Subcutaneous central venous port	13	5.1	4.0–6.3	0.2	0.1–0.2

Crnich CJ & Maki DG – Clin Infect Dis 2002; 34:1362

ECDC - 2007
Origine des bactériémies



Europe (Origine des BSI)

30.0 % **cathéter**

36.2 % **inconnue**

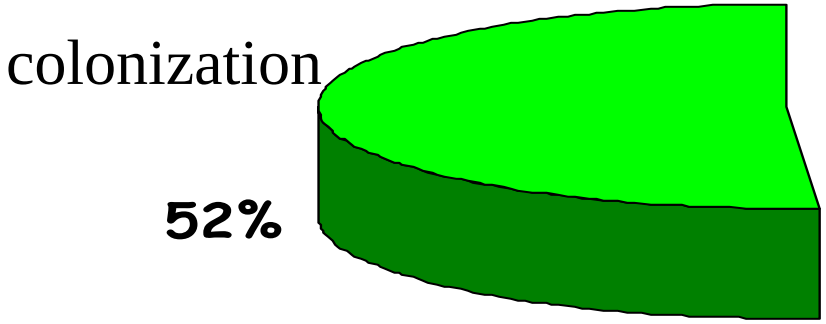
33.8 % **2aires**

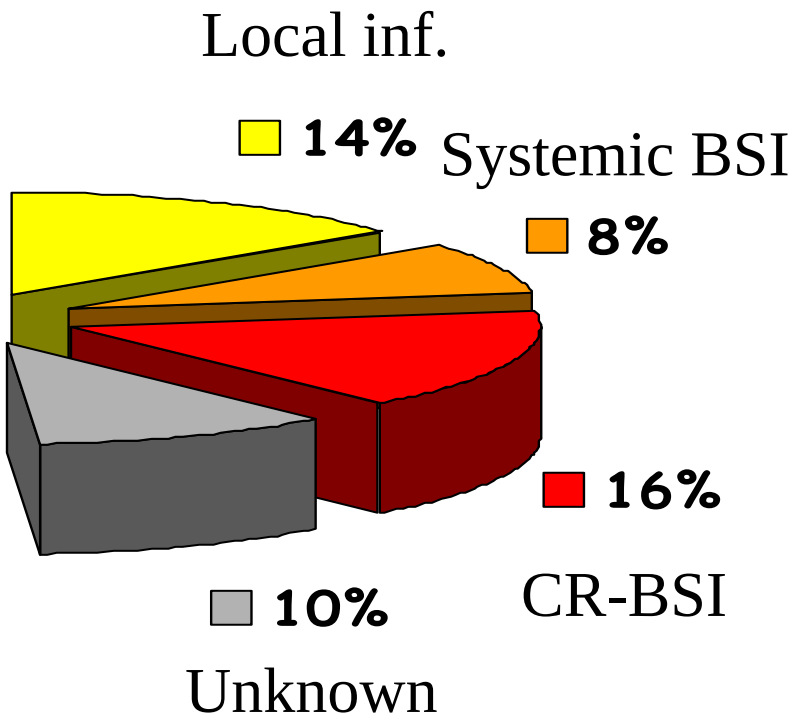
- pulm 40.2 %
- dig. 25.2 %
- urin. 12.8 %
- PeauTm 6.0 %
- ISO 4.6 %
- autres 11.2 %

Source : ECDC / Surveillance of Healthcare-Associated Infections in Europe, 2007

Epidemiology (REA-RAISIN 2007)

165 ICUs, 22927 patients





Colonization 7.45 per 1000 cvc-days
CR-BSI 1.28 per 1000 cvc-days

Des taux élevés?

Primary bacteremia = (CR-BSI NNISS definitions)
> 4 (6)/1000 catheter-days

Catheter related BSI (with + BC):
> 2 (1) /1000 catheter-days

Catheter-related infection (CR-BSI + local):
> 3 (2)/1000 catheter-days

Si vos taux sont élevés..

- Ne pas réinventer la roue…
- Accepter les évidences…

« When a thing ceases to be a subject of controversy, it ceases to be a subject of interest »

William Hazlitt, 1830

CID 2001: 33: 1733-8

Asepsie chirurgicale

		Study	Y/N	BSI
Mermel 1991	ICU	Observ.	86 (ICU) 211 (BO)	RR : 0.48 (0.19-0.91)
Raad 1994	Oncology	RCT	176 167	RR : 0.32 (0.10-0.96) (colonization)
Sherertz 2000	ICU	Before/after	2009 3093	4.51 vs 3.23 per 1000 catheter-days

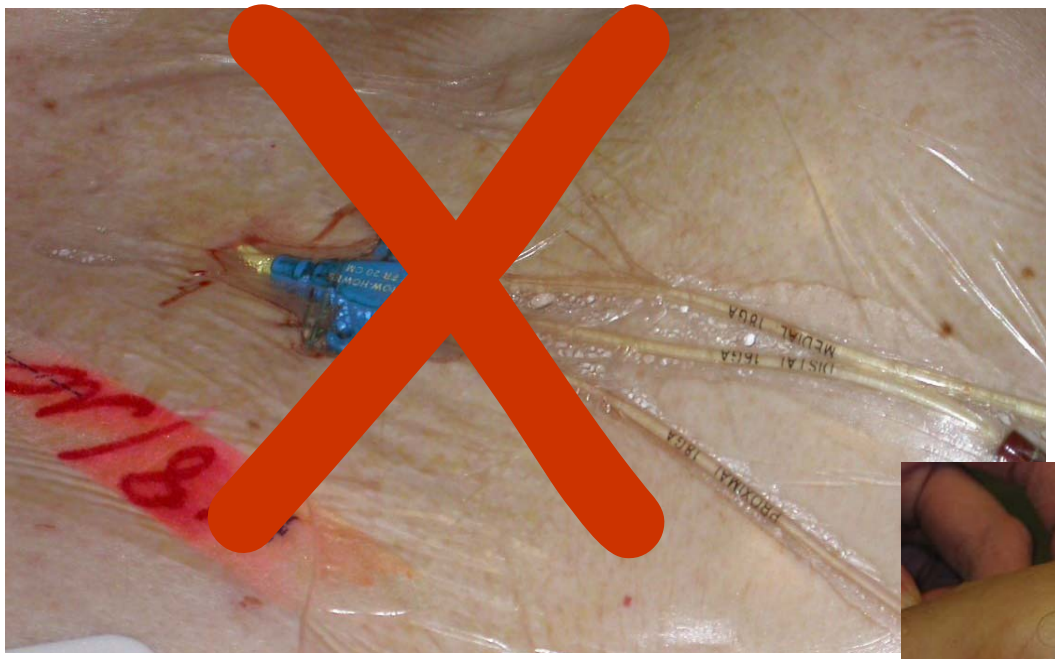
Hu KK et al, Am J Infect Control 2004

La routine est bien loin des recommandations *Rubinson et al – JAMA 2003; 2802*

Médecins internistes, USA
Juin 2002: 1000 questionnaires /526 réponses

Sterile gloves	99.4%
Mask	66.3%
Large sterile drapes	35%
The 3 measures	28.2%

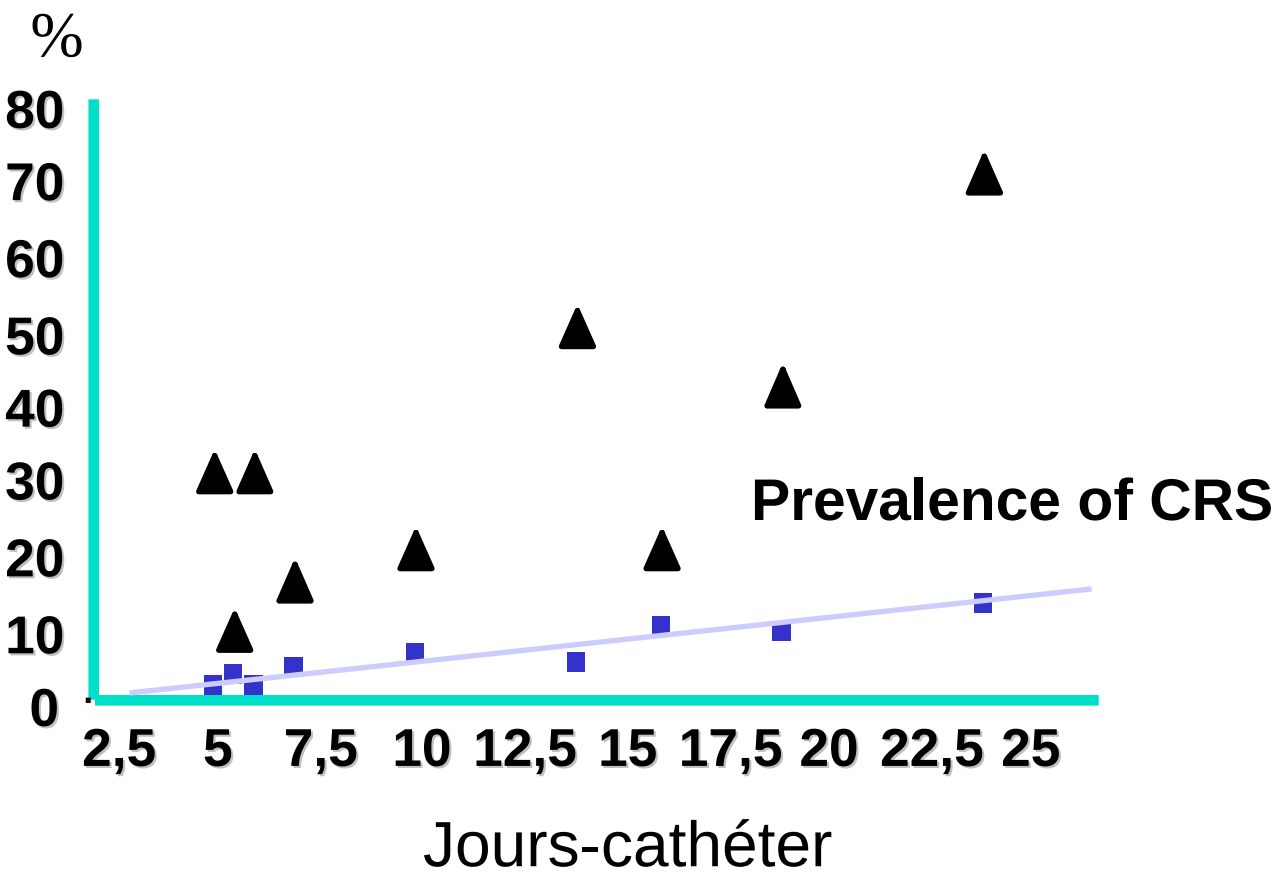
Avoid horror picture show..



40% of unplanned dressings in ICU

Dressing immediately changed if soiled or moistened

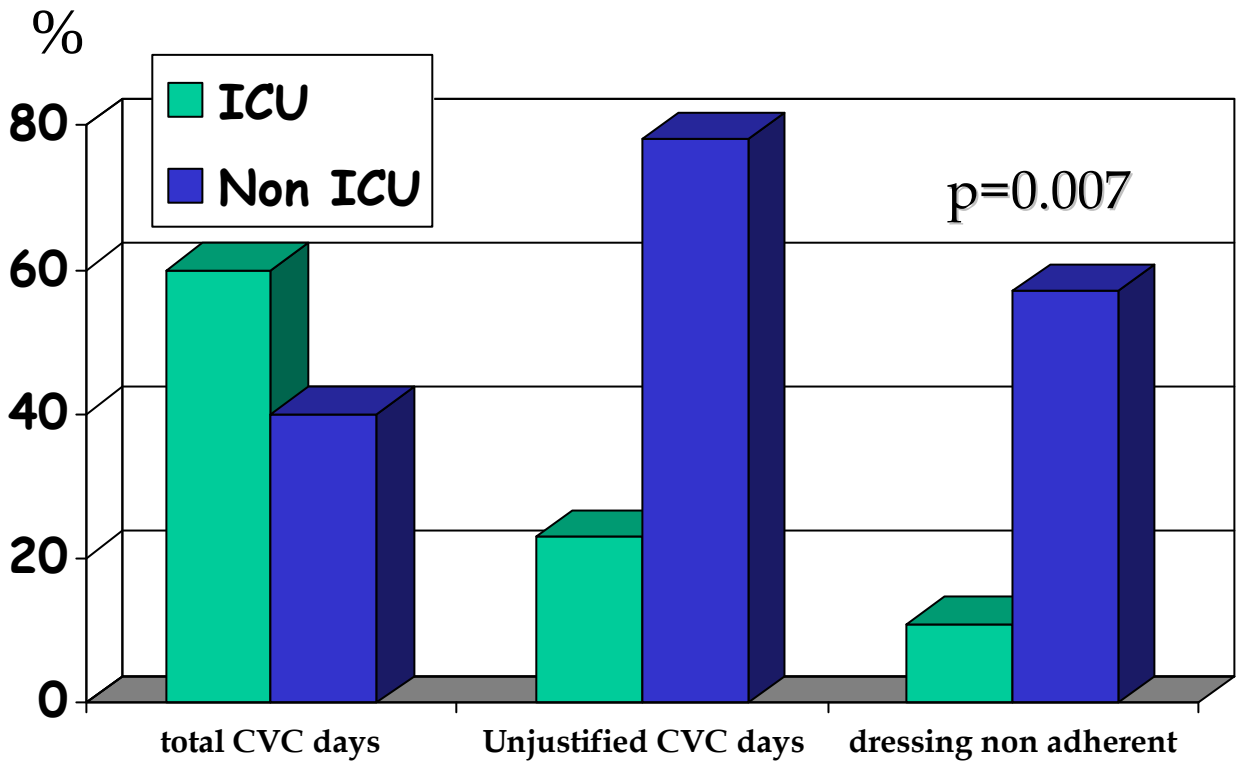
Enlever les cathéters inutiles



Sitges-Serra A 1988

Les CVCs are often no longer justified, especially outside the ICU..

- Cross sectional study, hospital
  - CVC justified in predefined conditions or decision of the staff
- 320 patients, 74 CVCs, 62 (19%) Pts (46 ICU, 28 non ICU)



Trick et al- ICHE 2004; 25:266

Continuous quality improvement programs:Many success stories

- Participating to surveillance network and feedback [1,2]
- Education of the staff [3,4,5,6,8]
  - Training program
  - Trained dedicated personnel
- Improve bedside behaviour [7]
  - Behavioral audits
  - and intervention (*pictures, demonstrations, monthly lectures)*
- Global basic very large program

1- Zuschneid ICHE 2003 2- L'hériteau J Hosp Infect 2007 3-Eggimann Lancet 2000
4- Sherertz Ann Intern Med 2000 5- Soifer Arch Int Med 1998
6-Coopersmith Crit Care Med 2002 7- Pronovost NEJM 2006 8- Barsuk Arch Int Med 2009

The NEW ENGLAND JOURNAL of MEDICINE

Peter Pronovost, DECEMBER 28, 2006 VOL. 355 NO. 26

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

- 103 ICUs, 375 757 CVC-days
- 5 CDC grade A recommendations

→

Surgical hand washing

Strict aseptic conditions

2% Chlorhexidine

Subclavian access

Remove useless CVCs

Median ICU rate, 2.7 ⇒ 0/1000 CVC days
Mean, 7.7 ⇒ 1.4/1000 CVC days ($p<0.002$)

Program	Technical Component	Social (Adaptive) Component
Reduction of central line infections in intensive care units[39]	Central line infection control bundle consisting of Hand washing Barrier precautions Chlorhexidine scrub Avoidance of femoral site Catheter removal as soon as possible	Process changes specifically related to central line infection, including Establishment of a multihospital collective Education programs on new procedures for intensive care unit staff Developing and promoting use of a specially designed central line cart, an adherence checklist, a set of stopping procedures, daily removal discussion, and feedback on infection rates Above interventions nested in a broader improvement effort that included leadership development, coaching, instruction in data collection, etc

1. Not only bundles but also « safety culture »
   (Technical vs social and behavioral process)
2. What are the effective components?
3. Generalizability to external populations?
4. Heterogeneity of the result itself..

In the « non zero » group the incidence goes from 4.6 to 2.8/1000
In half of the ICUs, intervention failed to control infection 60% of the time…

Hypothesis:

Incomplete usage of the bundles?
Different population?
Statistical noise?

Davidoff F- JAMA. 2009;302(23):2580-2586

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Balancing "No Blame" with Accountability in Patient Safety

Robert M. Wachter, M.D., and Peter J. Pronovost, M.D., Ph.D.

Table 2. Examples of Patient-Safety Practices, with Suggested Penalties for Failure to Adhere to Practice.

Patient Safety Practice	Suggested Initial Penalty for Failure to Adhere to Practice*
Practicing hand hygiene	Education and loss of patient-care privileges for 1 wk
Following an institution's guidelines regarding provider-to-provider sign-out at the end of a shift	Education and loss of patient-care privileges for 1 wk
Performing a "time-out" before surgery	Education and loss of operating room privileges for 2 wk
Marking the surgical site to prevent wrong-site surgery	Education and loss of operating room privileges for 2 wk
Using the checklist when inserting central venous catheters	Counseling and review of evidence,[6] loss of catheter-insertion privileges for 2 wk

* These penalties would be applied only in cases in which a clinician did not respond to initial warnings and counseling. Continued failure to adhere to the practice after the initial penalty would lead to permanent loss of clinical privileges (for physicians) or firing, in keeping with the relevant medical staff or human resource policy. Stress management and other behavioral interventions should be considered as possible adjunct approaches when a caregiver chronically fails to adhere to agreed-upon safety standards.[32]

N engl J med 2009; 361;14 (November 1)

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Below this number…a room for new technologies?

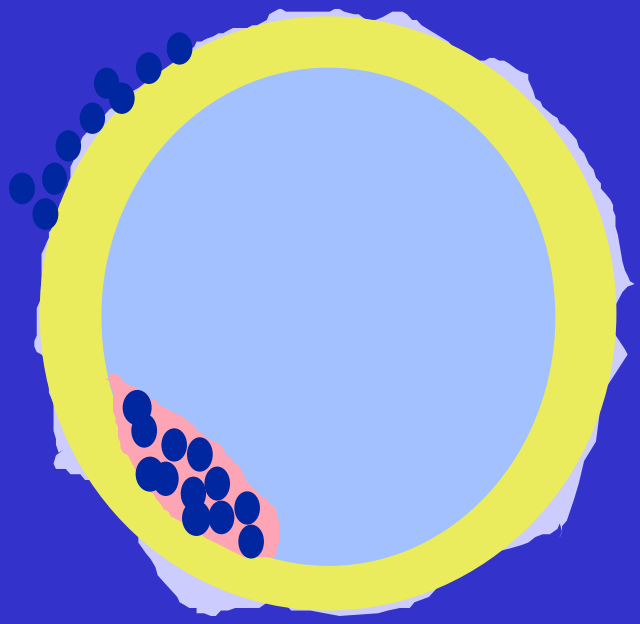
Main routes of catheter contamination

Extraluminal:

- Skin infection:
- Hematogenous seeding

Endoluminal:

- *Hub contamination*
- Infusate contamination



Scheduled catheter change is not necessary

- The daily risk of infection is constant over time (at least for CVC)
- The scheduled change increases the risk of mechanical complications
- Doute pour les cathéters artériels…

Eyer S et al – Crit Care Med 1990
Cobb et al – N Eng J Med 1992
Berthelot et al – Presse Med 1997
Cook D et al – Crit Care Med 1997
Lucet et al – Crit care med 2010

Route: If possible prefer Subclavian access

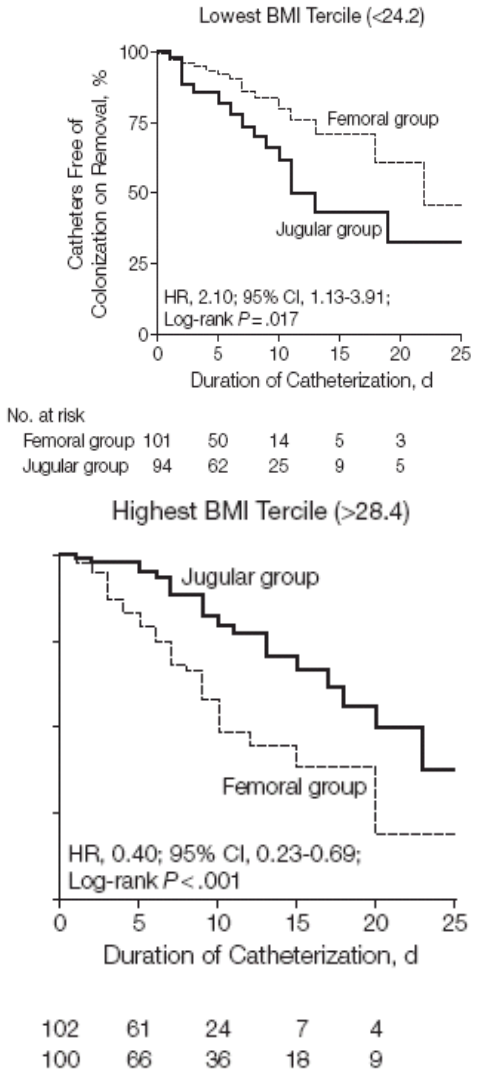
- Subclavian better than Femoral :
  - RCT (Merrer, JAMA 2001)
- Subclavian better than jugular
  - Meta-analysis of small studies (Ruech, CCM)
- If IJ or F access necessary,
  - Prefer tunneling (Timsit JAMA 96, Ann int Med 1999)
- Femoral vs Jugular?
  - One RCT on hemodialysis catheters in ICU
  - CVC: Idem when properly inserted in networks…

- Radial artery better than femoral
  - 3 cohort studies

Préférer la jugulaire pour les forts, et la fémorale pour les sveltes…

- IMC< 24.2 kg.m^{-2}
  - La Jugulaire AUGMENTE le risque de colonisation
    - HR, 2.1; 95% CI, 1.1-3.9; *P* < 0.017

- IMC>28.4 kg.m^{-2}
  - La voie jugulaire DIMINUE le risque de colonisation
    - HR, 0.4; 95% CI, 0.2-0.7, *P* < 0.0006



Parienti et al -JAMA. 2008;299(20):2413-24

Antiseptic solution: in vitro efficacy…

Antiseptic	Advantages	Disadvantages
PVI	Broad spectrum	Maximal after only 2 mn Inactivation by skin proteins++
CHG	Rapid bactericidal activity+++	Inactivation by skin proteins + Inactivation pH<5 Less active against Viruses, non sporicidal, Resistance fungi, MRSA
Ethanol	Rapid Broad spectrum Synergy with PVI and CHX	Non sporicidal Active only if >50%

Prefer preparations with CHG to aqueous 10% PVI

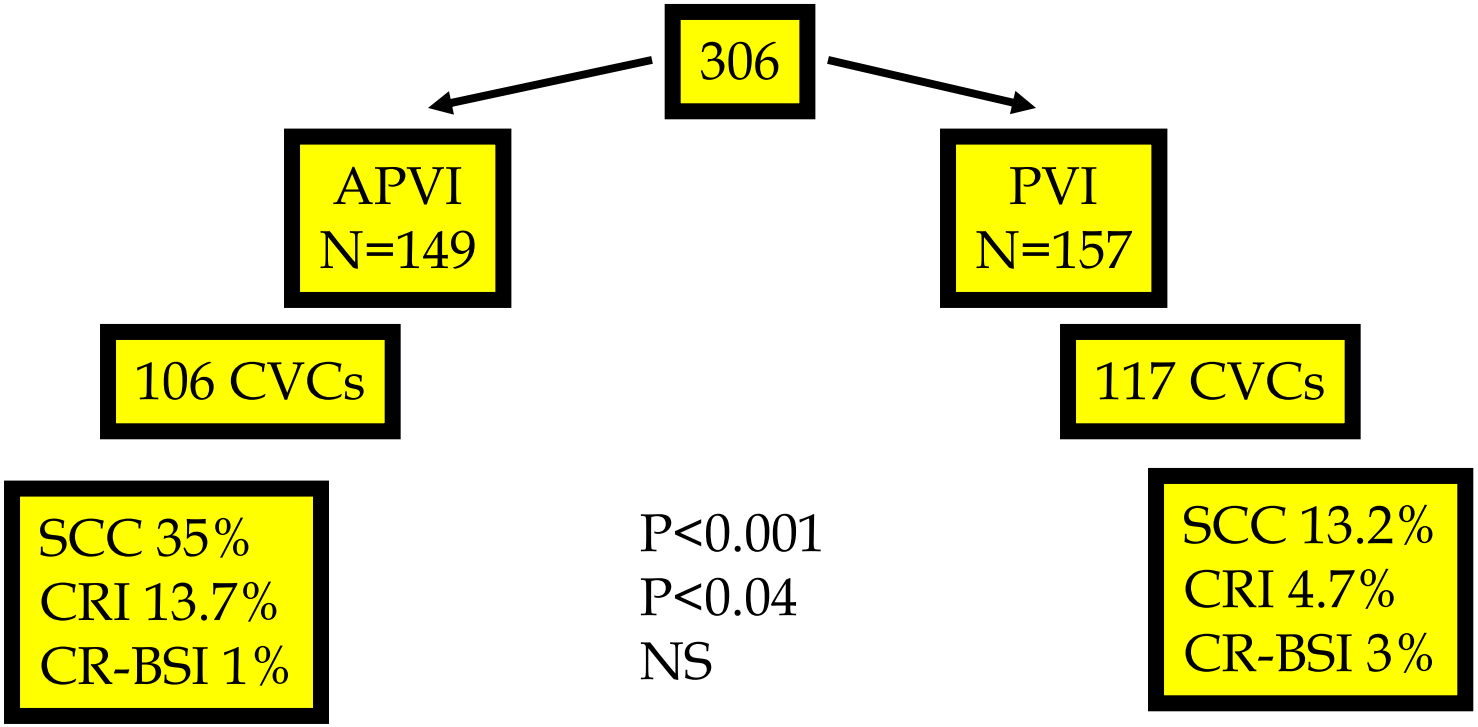
(Meta-analysis)

Chaiyakunapruk N - Ann Intern Med 2002; 136:792

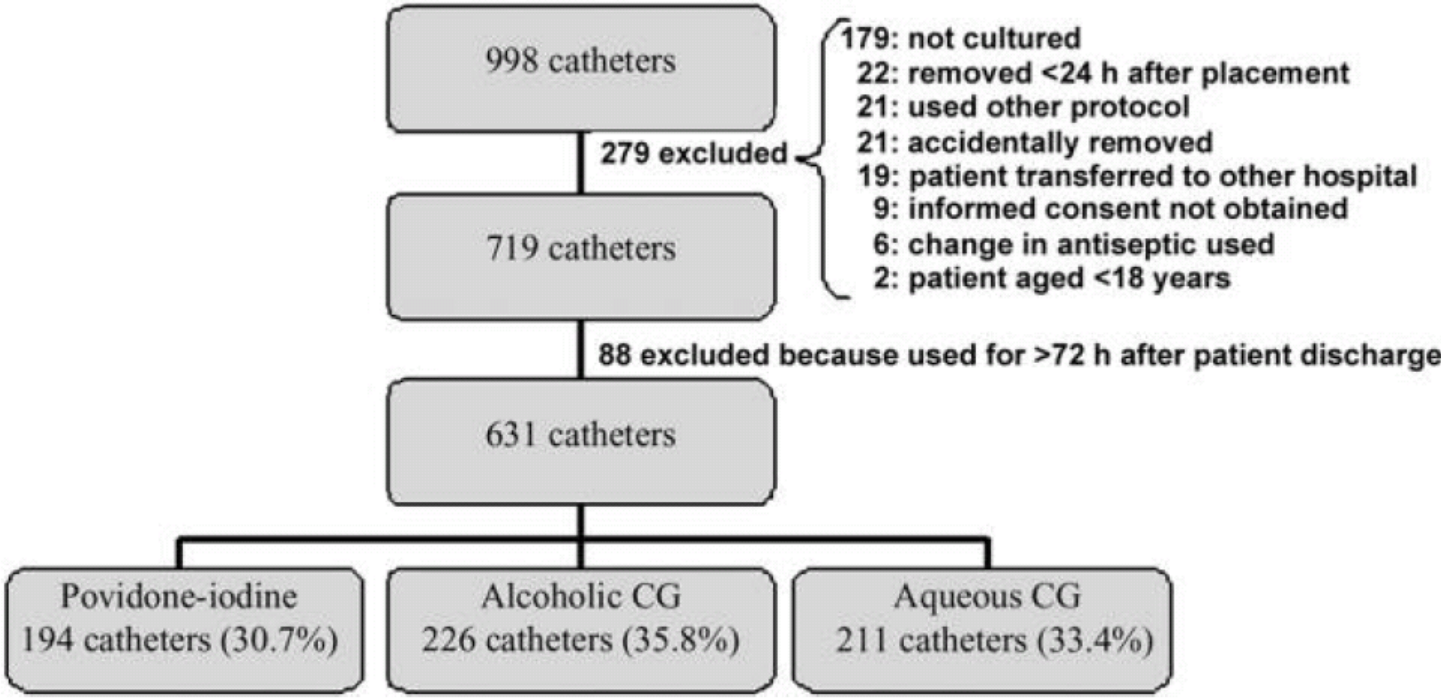
Ref	Type CHG	N	Cult +(%) CHG vs PVI	CR-BSI (%) CHG vs PVI
Maki 91	2% aqueous	441	2.3 vs 9.2	
Sheehan 93	2% aqueous	189	1.8 vs 6.8	0.4 vs 2.6
Meffreb 95	0.5% alcool	1117	1.6 vs 4	0.6 vs 0.6
Mimoz 96	Biseptine	315	7.1 vs 16.6	0.5 vs 0.5
Legras 97	0.5% alcool	190	9.1 vs 12.4	1.8 vs 2.8
Leblanc 99	0.5% alcool	244	7.2 vs 16.1	
Humar 2000	0.5% alcool	374	31 vs 23.3	2.1 vs 2.8
Knasinski 2000	1% alcool	849	9.5 vs 25.4	1.4 vs 4
Overall (OR)			OR: 0.45 (0.31-0.71)	0.49 (0.28-0.88)

70% alcoholic-5%PVI is superior to 10% Povidone iodine (PVI)

Parienti et al - Crit Care Med 2004 32: 708-713



The « new » 2% aqueous CHG or the « old » 0.5% alcoholic CHG??



Colo*	24.7%	14.2%	16.1%
CR BSI	4.63% (5.3/1000 cvc.d)	3.98% (4.3 /1000 cvc.d)	4.26% (4.3 /1000 cvc.d)

(*) P<0.05 PVI vs both CHG

Valles J et al - *Infect Control Hosp Epidemiol* 2008; 29:847– 853

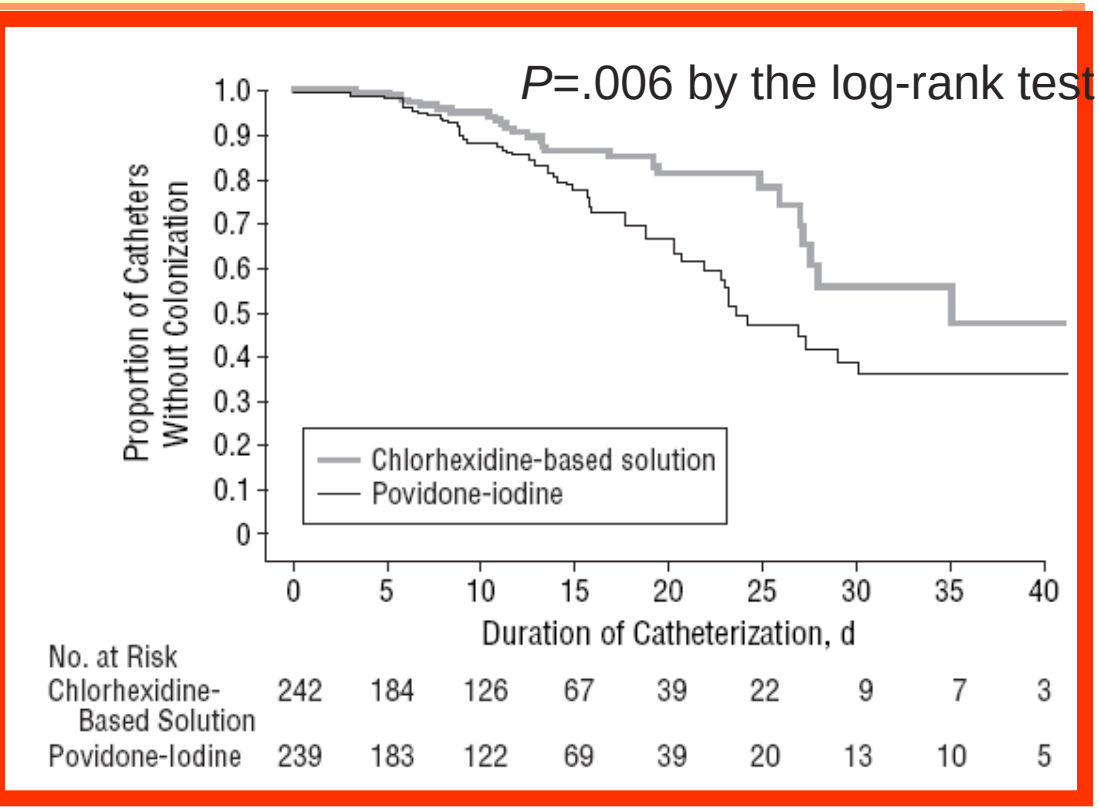
Chlorhexidine-Based Antiseptic Solution vs Alcohol-Based Povidone-Iodine for Central Venous Catheter Care

Olivier Mimoz, MD, PhD; Stéphanie Villeminey, MD; Stéphanie Ragot, PharmD, PhD; Claire Dahyot-Fizelier, MD; Leila Laksiri, MD; Franck Petitpas, MD; Bertrand Debaene, MD, PhD

0.25% chlorhexidine gluconate, 0.025% benzalkonium chloride, and 4% benzylic alcohol

vs

5% povidone-iodine in 70% ethanol (Alcoholic povidone iodine)



538 CVCs (399 patients)
481 (89%) evaluable

CVC col.
11.6% vs 22.2% [*P*=.002]
9.7 vs 18.3 per 1000 cvc-days

CR-BSI
1.7% vs 4.2% [*P*=.09]
1.4 vs 3.4 per 1000 cvc-days

Arch Intern Med. 2007;167(19):2066-207

Antisepsie de la peau

- Éviter la PVI 10% aqueuse
- Synergie éthanol-PVI/CHG
  - PVI-alc > PVI
  - 2% CHG = 0.5% alcoolique-CHG

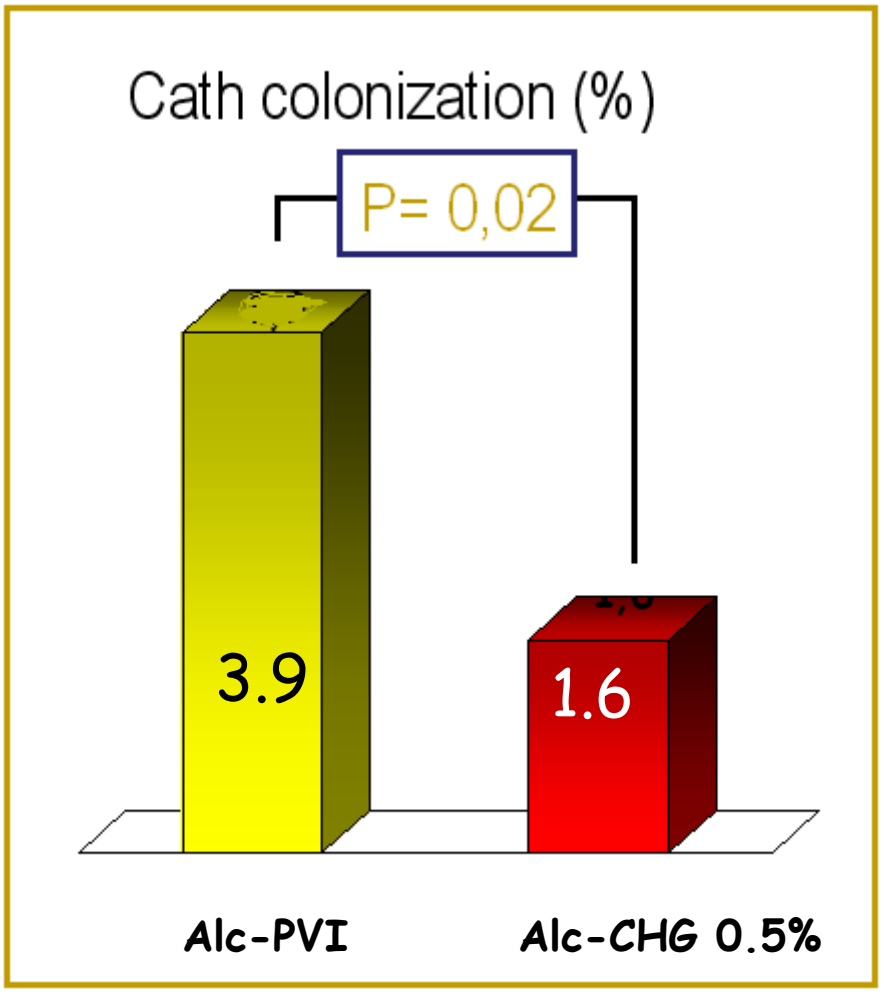
- Points non résolus:
  - Détersion?
  - 0.5% alc-CHG vs alc-PVI?
  - 2% alc-CHG vs 0.5% alc-CHG ?

0.5 % CHG-alc vs PVI-alc

- Peripheral cath. Only
  - 2 studies:
  - Meffre et al - Hygiènes 1995
  - Mimoz et al (personal data)

Detersion + skin antisepsis

- Randomized unblinded
- 16 hosp.
- 1456 short cath.
- 1138 cultured (78%)
- Median insertion time: 29 h



Meffre et al, Hygiènes 1995

Skin antisepsis without detersion

Mimoz et al - personnal communication

ICU patients
Mean duration of insertion 60 hours
Alc-PVI:192 vs 0.5%CHG:193

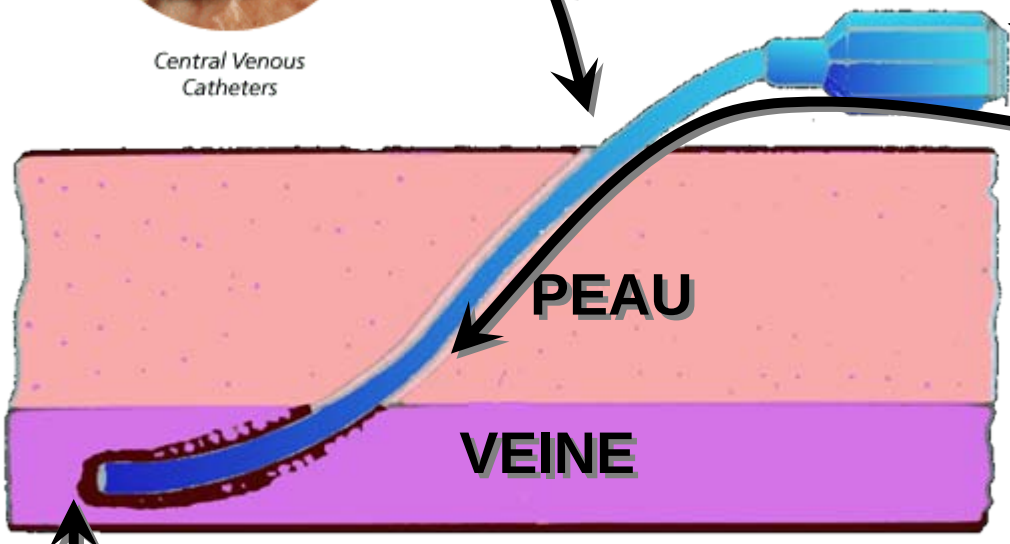
	PVI alc 5% n=164 (85%)	0.5% CHG-alc n=174 (90%)	p
Catheter culture	164	174	NS
≥1000 CFU	30 (18.3 %)	3 (1.7 %)	<0.0001
<1000 CFU	25 (15.2 %)	26 (14.9 %)	NS
sterile	109 (66.5 %)	145 (83.3 %)	0.0005

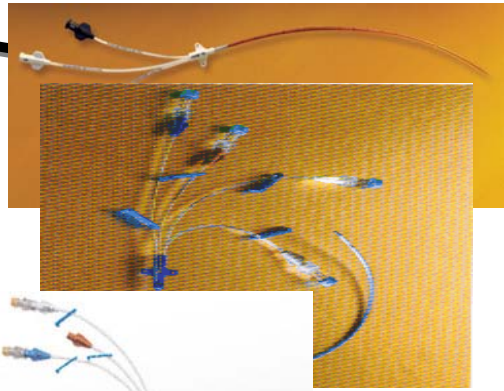
But:
Peripheral cath., monocentric, unblinded
high level of colonization in the PVI group
No correlation with local signs, no local audits during the study
Skin detersion potential effect?

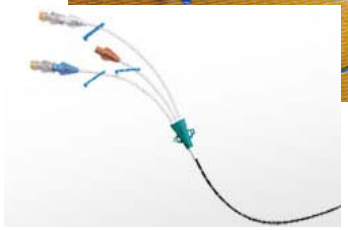
Before definitely decreasing antiseptic diversity, a RCT involving CVCs and arterial cath with and without skin detersion sufficiently powered to detect effect on CR-BSI is needed : CAVIAR™ French PHRC proposal

Les armes fatales?

Central Venous Catheters

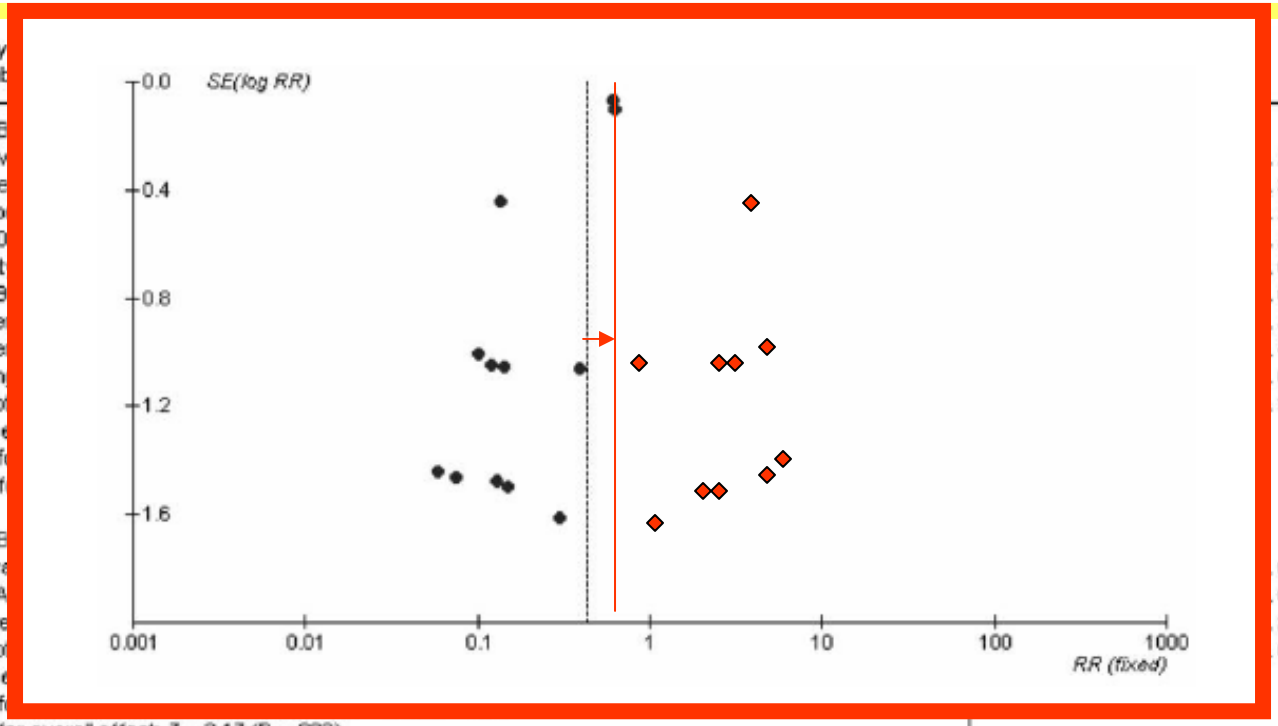






Antibioprophylaxis

Antimicrobial lock in HD patients



Study or sub

RR (fixed) [95% CI]

01 AE
Al-Hv .14 [0.05, 0.40]
Bleye .30 [0.01, 7.42]
Coop .15 [0.01, 3.00]
Kim 0 .14 [0.02, 1.15]
McInt .08 [0.01, 0.59]
Nori .09 [0.01, 0.79]
Saxe .53 [0.38, 0.73]
Saxe .46 [0.31, 0.69]
Zhan .09 [0.00, 1.80]
Subto .39 [0.31, 0.50]
Total
Test f
Test f

02 AE
Dogra .05 [0.00, 0.94]
Nori .06 [0.00, 1.20]
Perve .20 [0.02, 1.82]
Subto .09 [0.02, 0.41]
Total
Test f
Test for overall effect: Z = 3.17 (P = .002)

Total (95% CI) 111,099 65,233 0.37 [0.30, 0.47]
Total events: 140 (Treatment), 207 (Control)
Test for heterogeneity: X^2 = 18.24, df = 11 (P = .08), I^2 = 39.7%
Test for overall effect: Z = 8.40 (P < .00001)

0.001 0.01 0.1 1 10 100 1000
Favors treatment Favors control

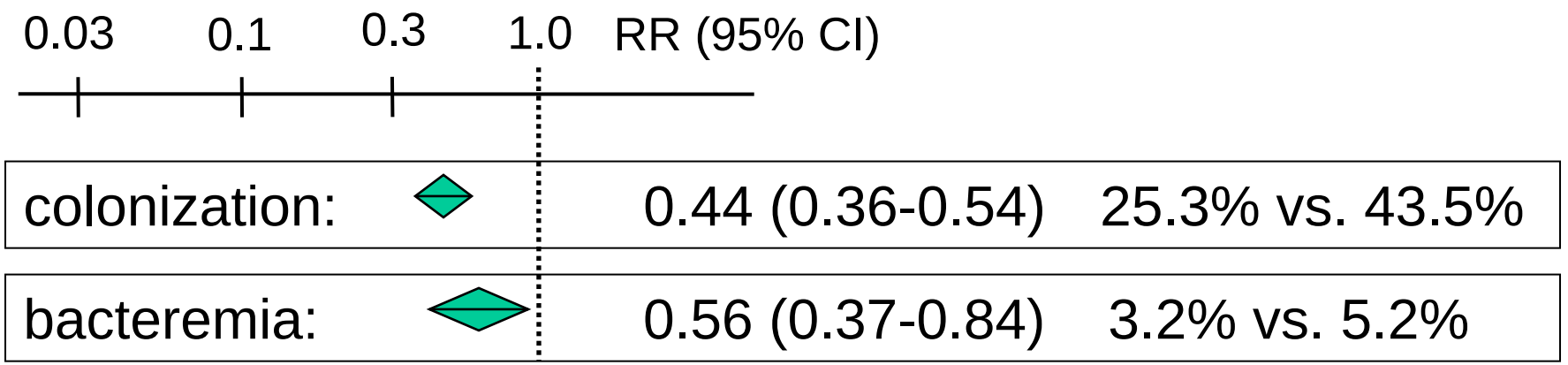
Publication bias

Antibiotic selection pressure → a place for ethanol lock?

Yahav et al - Clinical Infectious Diseases 2008; 47:83-93

Prevention: impregnated catheters

Meta-analysis: First generation externally coated Silver-sulfadiazine-chlorhexidine
11 studies 2602 CVCs (2-10 days)



Cost-effectiveness analysis :

Absolute reduction of bacteremias: 1.2% to 3.4%
Cost savings: 68 $ to 391 $ per catheter used

Veenstra JAMA 1999

PREVENTION OF BLOODSTREAM INFECTIONS WITH CENTRAL VENOUS CATHETERS TREATED WITH ANTI-INFECTIVE AGENTS DEPENDS ON CATHETER TYPE AND INSERTION TIME: EVIDENCE FROM A META-ANALYSIS

Bernhard Walder, MD; Didier Pittet, MD, MSc; Martin R. Tramèr, MD, DPhil

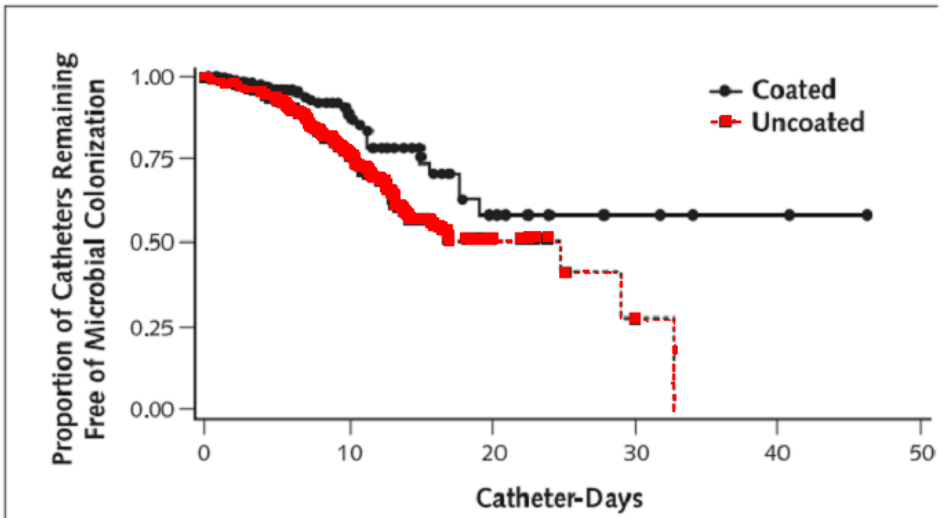
Intervention Anti-Infective	Time Insertion Average	No. of Bloodstream Infections/Total No. Catheter Anti-Infective	Catheter Control	OR (CI[95])
coating	Long term	35/1761 (4.3%)	32/1783 (4.2%)	0.84 (0.28 to 1.24)
silver sulfadiazine	Short term[8]	15/635 (1.8%)	36/637 (4.1%)	0.48 (0.25 to 0.91)
Chlorhexidine–	All	44/1,393 (3.3%)	67/1,450 (4.3%)	0.73 (0.20 to 1.09)

First-generation externally-impregnated cath are effective in catheter left in place for less than 7 days

Effect of a Second-Generation Venous Catheter Impregnated with Chlorhexidine and Silver Sulfadiazine on Central Catheter–Related Infections

Mark E. Rupp *Ann Intern Med.* 2005;

Figure 2. Kaplan–Meier curve demonstrating initial study catheters free of microbial colonization versus time.



Catheters remaining, *n*	Day 0	Day 10	Day 20	Day 30
Antiseptic CVC	345	68	13	3
Control CVC	362	68	16	1

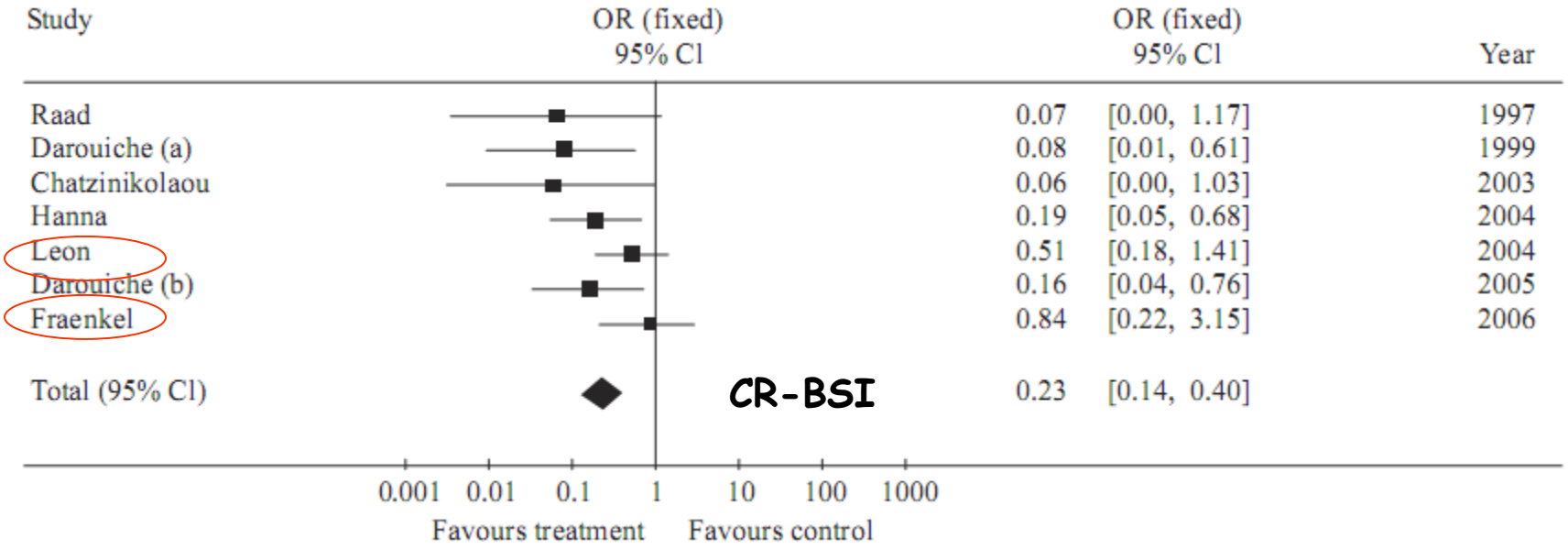
CR BSI:1.24 vs 0.42 /1000 CVC-days, P=0.6

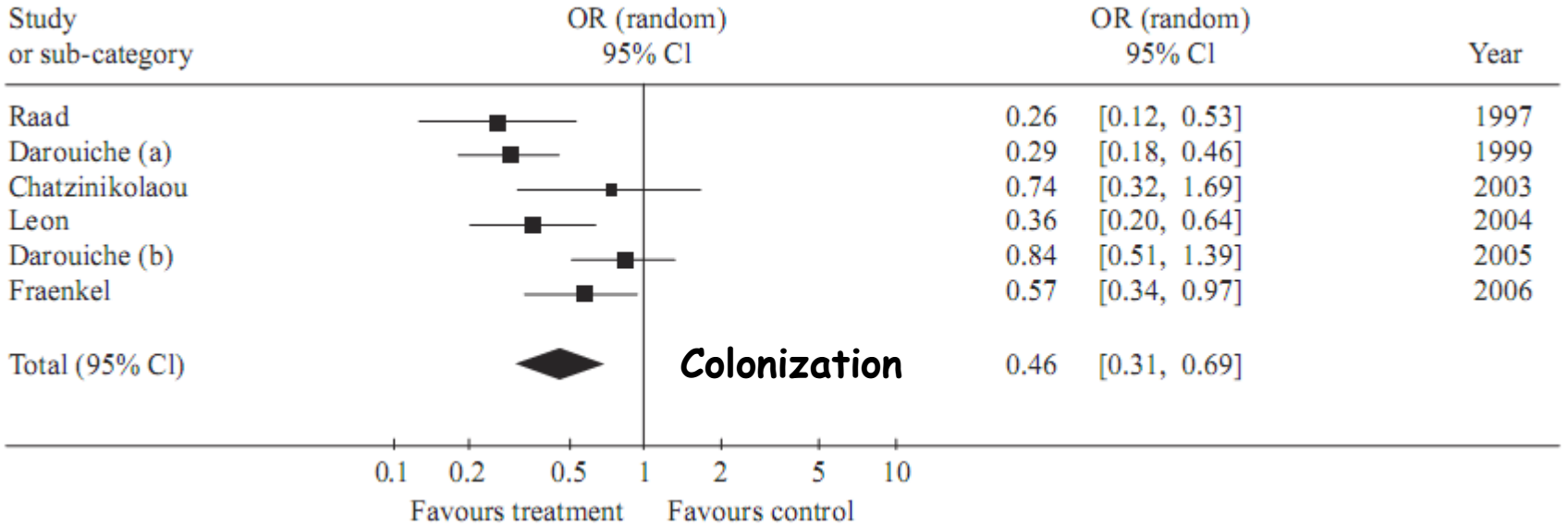
If other procedures failed…
In particular sub-populations
In case of epidemy

Rifampicin-impregnated central venous catheters: a meta-analysis of randomized controlled trials

Matthew E. Falagas

Journal of Antimicrobial Chemotherapy (2007)

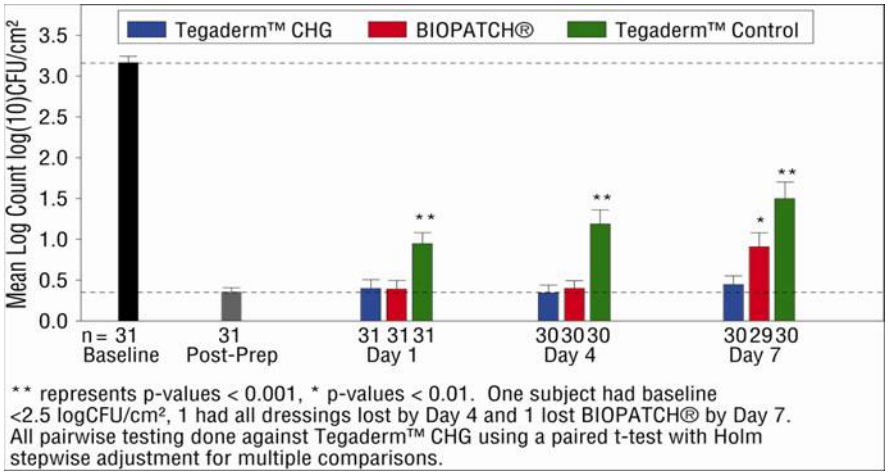




Minocyclin-RMP catheters

- Are probably more effective than first generation CHG-Silver sulfadiazine coated cath. *Darrouiche RO et al. N Engl J Med 1999; 340: 1-8*
- …because antimicrobial effect persists for more than 30 days *Darrouiche RO et al* - Ann Surg *2005;242: 193–200*
- However MIN-RMP have very little effect on *Pseudomonas* and *Candida* sp. *Sampath et al Infect Control Hosp Epidemiol 2001; 22: 640-6*
- No comparison with second generation CHG-silver-sulfadiazine coated cath.

CHG dressings: *Bacterial growth on healthy volunteers*



There is a bacterial regrowth under occlusive dressing one day after skin desinfection (Chloraprep)

The bacterial regrowth is limited by both CHG-sponge and CHG-gel-dressings

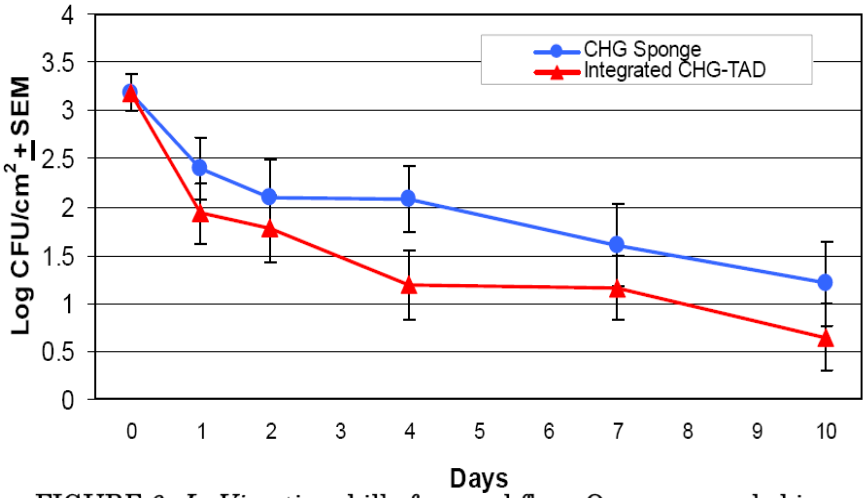


FIGURE 6. *In Vivo* time kill of normal flora On unprepped skin with the two CHG-impregnated dressings in healthy volunteers.

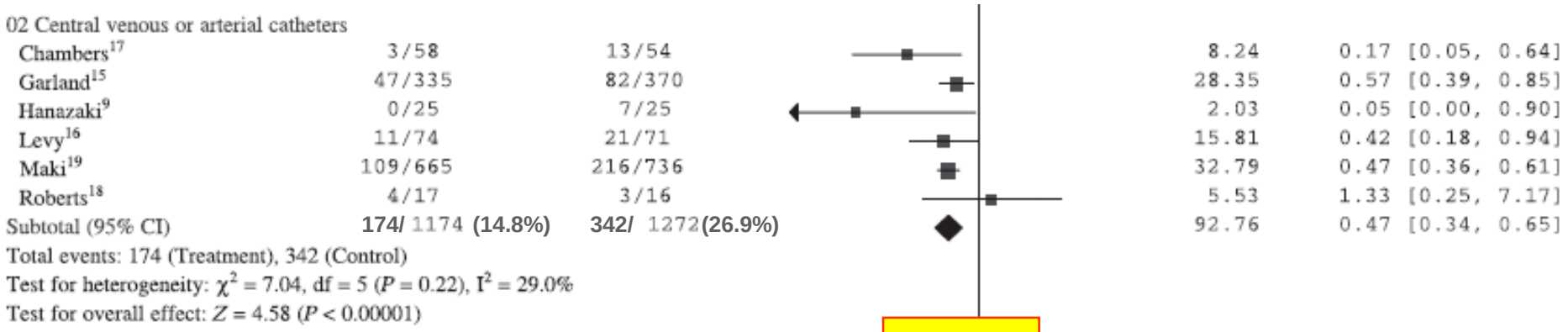
CHG-dressings decrease normal unprepped skin flora for up to 7 days

Maki DG et al – SHEA 2008 and Bashir MH ICAAC 2008

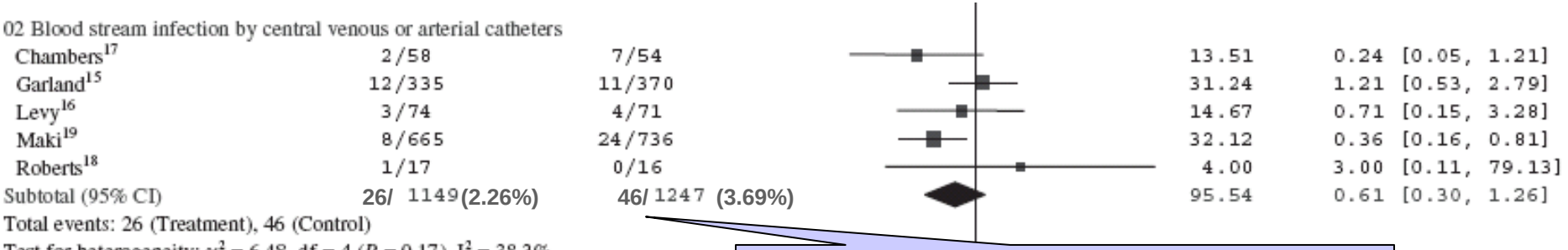
Biopatch ™ (métanalysis)

Ho et al -Journal of Antimicrobial Chemotherapy (2006) 58, 281–287

Catheter colonization



CR- BSI



≈ **5/1000 cvc days >>> 1.4/1000 cvc days**

Is it useful with acceptable baseline levels?

Chlorhexidine-Impregnated Sponges and Less Frequent Dressing Changes for Prevention of Catheter-Related Infections in Critically Ill Adults
A Randomized Controlled Trial

JAMA. 2009;301(12):1231-1241

But

- Évaluer l'effet d'éponges imprégnées de CHG (CHG-IS) sur l'ILC quand le niveau du groupe contrôle est à un niveau acceptable

- Évaluer si un changement programmé de pansement tous les 7 jours est suffisant en réanimation pour les cathéters veineux centraux et les cathéters artériels.

Inclusion/exclusion criteria

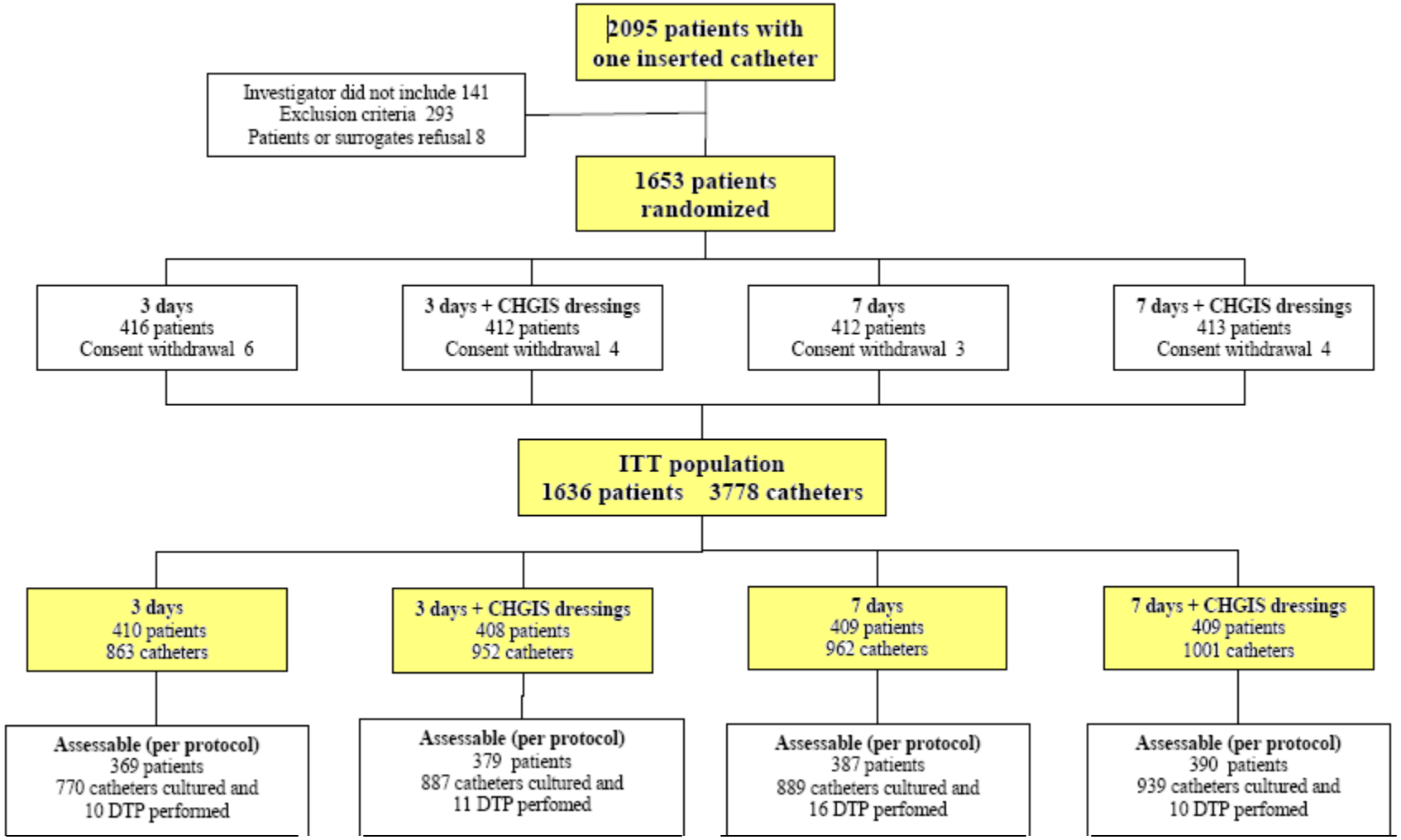
- CVC and/or arterial catheter > 48 hours

- Exclusion:
  - Known allergy to CHG or adhesive transparent dressing
  - PAC, PICCs, Antibiotic or antiseptic catheters.
  - Emergent insertion
  - Informed consent refusal

Unique procedure

- Catheters
  - Maximal barrier precaution
  - Subclavian and radial accesses as often as possible
  - Skin detersion (PVI scrub) + alcoholic (70%) PVI (5%) (>1mn)
  - Immediate removal if no longer needed or suspicion of CRI
- Transparent dressings (Tegaderm 3M Saint Paul MN)
  - Alcoholic PVI for skin disinfection
  - Immediate dressing if leakage or soiling
  - With or without Biopatch ™ (Ethicon Inc., Somerville, NJ)
- Continuous monitoring
  - Teaching, Audit
  - Data monitoring in an electronic datafile

Diagramme d'inclusion



3778 catheters/ 28,931 jours-cathéter

Patients

Characteristic	All Patients, ITT Analysis (N = 1636)	Dressing		Dressing Change Interval	
		Control (n = 819)	CHGIS (n = 817)	3 d (n = 818)	7 d (n = 818)
Age, median (IQR), y	62 (50-74)	63 (50-74)	62 (50-73)	62 (50-74)	62 (50-73)
Men	1052 (64.3)	518 (63.2)	534 (65.4)	542 (66.3)	510 (62.3)
≥1 Chronic disease	536 (32.8)	288 (35.2)	248 (30.4)	269 (32.9)	267 (32.6)
Immune deficiency	93 (5.7)	48 (5.9)	45 (5.6)	50 (6.2)	43 (5.3)
Hematologic malignancy	52 (3.2)	28 (3.4)	24 (3)	28 (3.5)	24 (2.9)
Metastatic cancer	64 (3.9)	33 (4)	31 (3.8)	28 (3.5)	36 (4.4)
AIDS	54 (3.3)	30 (3.7)	24 (3)	24 (3)	30 (3.7)
SAPS II, median (IQR)[a]	53 (40-65)	53 (40-67)	52 (40-65)	52 (40-67)	53 (40-65)
SOFA, median (IQR)[b]	12 (9-15)	12 (9-15)	12 (9-15)	12 (9-15)	12 (9-15)
Admission category					
Medical	1143 (69.9)	568 (69.4)	575 (70.4)	578 (70.7)	565 (69)
Scheduled surgery	107 (6.5)	66 (8.1)	41 (5.0)	50 (6.1)	57 (7)
Emergency surgery	386 (23.6)	185 (22.5)	201 (24.6)	190 (23.2)	196 (24)
Main reason for ICU admission					
Septic shock	349 (21.3)	163 (19.9)	186 (22.8)	180 (22)	169 (20.7)
Cardiogenic shock	155 (9.5)	66 (8.1)	89 (10.9)	80 (9.8)	75 (9.2)
De novo respiratory failure	326 (19.9)	167 (20.4)	159 (19.5)	160 (19.6)	166 (20.3)
Coma	225 (13.8)	115 (14)	110 (13.5)	107 (13.1)	118 (14.4)
Trauma	178 (10.9)	84 (10.3)	94 (11.5)	83 (10.1)	95 (11.6)
Mechanical ventilation	1411 (86.9)	693 (85.1)	718 (88.8)	689 (85.3)	722 (88.6)
Length of ICU stay, median (IQR), d	11 (5-22)	10 (5-21)	12 (5-25)	10 (5-22)	11 (5-23)
ICU death	549 (33.6)	280 (34.2)	269 (32.9)	261 (31.9)	288 (35.2)
Hospital death	645 (39.4)	333 (40.7)	312 (38.2)	314 (38.4)	331 (40.5)

Cathéters

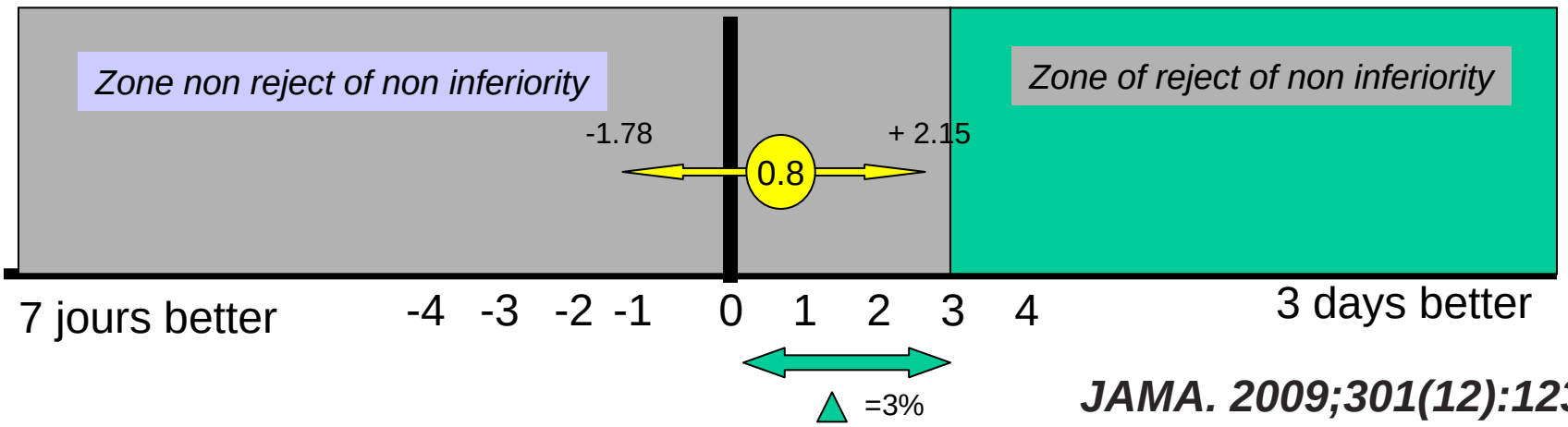
Variable	All Catheters, ITT Analysis (N = 3778)	Dressing		Dressing Change Interval	
		Control (n = 1825)	CHGIS (n = 1953)	3 d (n = 1815)	7 d (n = 1963)
Time in place, median (IQR), d	6 (4-10)	6 (4-10)	6 (4-10)	6 (4-10)	6 (4-10)
Experience of the operator					
<50 procedures	2586 (68.4)	1221 (66.9)	1365 (69.9)	1248 (68.7)	1338 (68.2)
≥50 procedures	1135 (30.1)	578 (31.7)	557 (28.5)	544 (30)	591 (30.1)
Junior operator with help from a senior	57 (1.5)	26 (1.4)	31 (1.6)	23 (1.3)	34 (1.7)
Arterial catheter	1727 (45.7)	830 (45.5)	897 (45.9)	821 (45.2)	906 (46.2)
Femoral	708 (41)	355 (42.8)	353 (39.4)	345 (42)	363 (40)
Radial	1019 (59)	475 (57.2)	544 (60.6)	476 (58)	543 (60)
Venous Catheters Only					
Venous catheter	2051 (54.3)	995 (54.5)	1056 (54.1)	994 (54.8)	1057 (53.8)
Jugular	560 (27.3)	248 (24.9)	312 (29.6)	272 (27.4)	288 (27.3)
Subclavian	819 (39.9)	407 (40.9)	412 (39.0)	390 (39.2)	429 (40.6)
Femoral	672 (32.8)	340 (34.2)	332 (31.4)	332 (33.4)	340 (32.2)
Guidewire exchange	85 (4.1)	28 (2.8)	57 (5.4)	47 (4.7)	38 (3.6)
No. of lumens in venous catheters					
0	37 (1.8)	21 (2.1)	16 (1.5)	17 (1.7)	20 (1.9)
2	209 (10.2)	110 (11.1)	99 (9.4)	109 (11)	100 (9.5)
3	1805 (88)	864 (86.8)	941 (89.1)	868 (87.3)	937 (88.6)
Use of lipids	777 (37.9)	379 (38.1)	398 (37.7)	389 (39.2)	388 (36.7)
Use of heparin	708 (34.5)	336 (33.8)	372 (35.3)	341 (34.3)	367 (34.7)
Packed red blood cells transfused	602 (29.4)	266 (26.7)	336 (31.8)	283 (28.5)	319 (30.2)
Tunneled catheters	6 (0.3)	5 (0.5)	1 (0.1)	2 (0.2)	4 (0.4)

JAMA. 2009;301(12):1231-1241

7-day is not inferior to 3-day scheduled change in ICU

	All assessable catheters N=3532	3-day changes* n=1657	7-day changes* n=1828
Significant catheter colonization	**310 (8.8)**	**142 (8.6)**	**168 (9.2)**
S. aureus	16	7	9
Coag.-negative staphylococci	153	73	80
Other gram positive cocci	34	17	17
Pseudomonas spp.	53	30	23
Enterobacter spp.	82	33	49
Escherichia coli	15	5	10
Acinetobacter baumannii	15	5	10
Fungi	13	5	8
		Hazard ratio: 0.992 [0.771 to 1.276], *P*=0.949	

10.4/1000 catheter-days vs 11 /1000 catheter-days



JAMA. 2009;301(12):1231-124

% de pansements non programmés en réanimation

Fréquent

	All		Arterial		CVC	
	rate of unplanned	number of dressing per catheter	rate of unplanned	number of dressing per catheter	rate of unplanned	number of dressing per catheter
ICUs						
1	45,1%	3,4	50,7%	3,6	39,4%	3,3
2	55,6%	4,3	62,5%	4,6	50,3%	4,1
3	56,9%	4,3	57,9%	4,3	56,0%	4,2
4	38,4%	3,0	43,3%	2,8	34,7%	3,1
5	35,3%	3,0	38,9%	3,0	31,6%	3,0
6	32,7%	3,1	31,5%	2,5	33,2%	3,5
7	28,9%	3,0	30,8%	2,2	28,3%	3,5

Associés à la colonisation de la peau à l'ablation ($p<10^{-4}$)

Variable	Percentage unplanned dressing <= 25% (n= 1811)	Percentage unplanned dressing > 25% (n= 1721)
Sterile	1018 (70.2)	870 (59.8)
1 to 9 cfu	156 (10.8)	170 (11.7)
10 to 99 cfu	184 (12.7)	278 (19.1)
Greater or equal than 100 cfu	92 (6.3)	137 (9.4)

Associés à la colonisation des cathéters

OR = 3.45 [2.25 – 5.30], $p<10^{-4}$ per percent of unplanned dressings

Les éponges imprégnées de chlorhexidine diminuent l'infection liée aux cathéters

Variable	All assessable catheters N=3532	Control dressings n=1685	CHXIS dressings n=1847
Significant catheter colonization	310 (8.8)	213 (12.6)	97 (5.3)
*S. aureus***	16	14	2
Coag.-negative staphylococci	153	106	47
Other gram positive cocci	34	28	6
Pseudomonas spp.	53	38	15
Enterobacter spp.	82	54	28
Escherichia coli	15	11	4
Acinetobacter baumannii	15	11	4
Fungi	13	10	3
		15.8 vs 6.3 per 1000 catheter-days **Hazard ratio: 0.36 [0.28 to 0.46], *P*<0.0001**	
Catheter-related bloodstream infection	23 (0.7)	17 (1)	6 (0.3)
		1.3 vs 0.40 per 1000 catheter-days **Hazard ratio: 0.24 [0.096 to 0.65], *P*=0.005**	
Major catheter-related infections	**29 (0.8)**	**19 (1.1)**	**10 (0.5)**
*S. aureus***	5	4	1
Coag.-negative staphylococci	4	2	2
Other gram-positive cocci	1	1	0
Pseudomonas spp.	9	6	3
Enterobacter spp.	14	11	3
Escherichia coli	1	1	0
Acinetobacter baumannii	1	1	0
Fungi	1	0	1
		1.4/1000 vs. 0.6/1000 catheter-days **Hazard ratio: 0.39 [0.16 to 0.93], *P*=0.030**	

Nombre de cathéters à traiter
117 KT

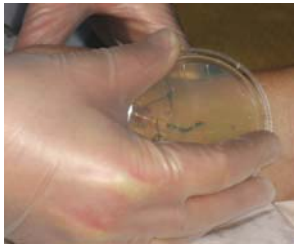
si la durée de cathétérisation est en moyenne de 10 jours

Quels sites? Quels types?

	Central-vein cath. HR, 95%CI	Arterial cath. HR, 95%CI
CR BSI	0.31, 0.099- 0.970	0.15, 0.019-1.130
Colonization	0.42, 0.317- 0.552	0.33,0.225- 0.483
M CRI	0.42, 0.159-1.125	0.39, 0.101-1.470

	Jugular HR, 95%CI	Subclavian HR, 95%CI	Femoral HR, 95%CI	Radial HR, 95%CI
CR BSI	0.48, 0.116-1.980	0.18, 0.023-1.360	0.36, 0.063-2.043	infinite
Colonization	0.52, 0.331-0.802	0.54, 0.304-0.951	0.33, 0.219-0.505	0.29, 0.169-0.491
M CRI	0.49, 0.137-1.775	0.18, 0.023-1.360	1.61, 0.336-7.694	infinite

Cutanous colonization*

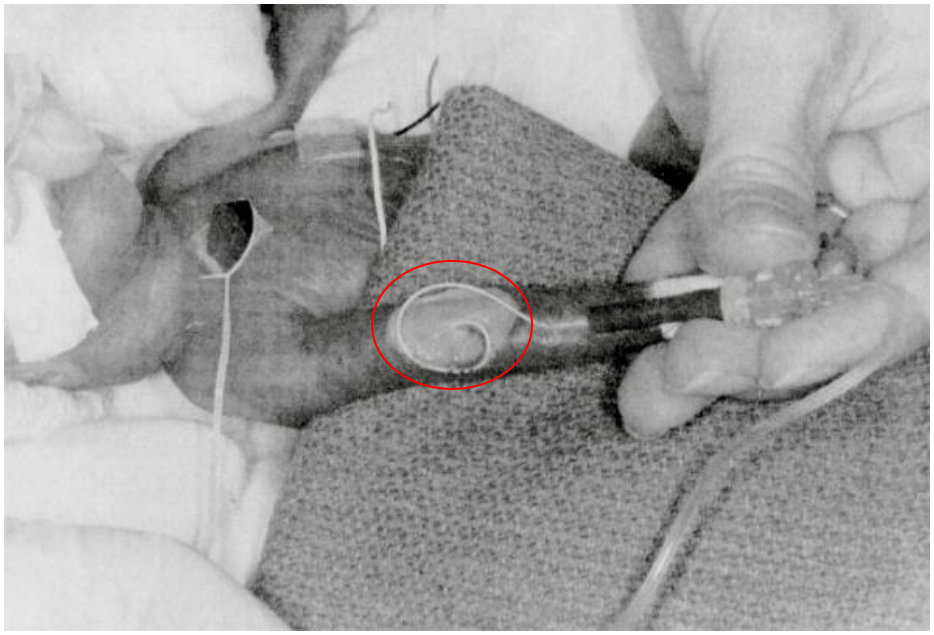


Countact	All N=2903 (629 missing)		Control dressings n=1358 (327 missing)	CHX dressings n=1545 (302 missing)
Sterile	1887 (65.0)		786 (57.8)	1101 (71.3)
1 to 9 cfu	326 (11.2)		148 (10.9)	178 (11.5)
10 to 99 cfu	462 (15.9)		261 (19.2)	201 (13)
Greater or equal than 100 cfu	228 (7.90)		163 (12)	65 (4.2)

P<10^{-4} Cochrane Armitage test for trend

(*) Insertion site sampled before catheter removal by pressing a nutritive trypticase-soy agar plate (Count-tact; Biomerieux, Crapone,France) on the skin for 5 seconds, centering the plate on the insertion site.

Side effects in neonates



. Contact dermatitis occurring in a 560-g, 22.5-week-gestation infant. The central venous catheter was placed on Day 1 of life and the reaction was noted on Day 3 of life. The photograph was taken on Day 4 of life.

19/335 neonates
15/98 (15%) if < 1000g
4/237 (1.5%) if > 1000g

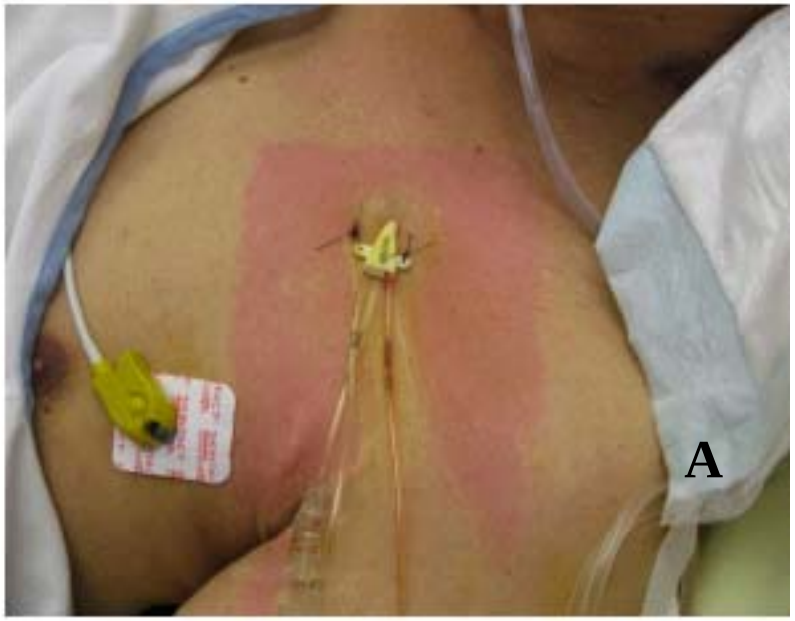
No systemic reactions

Garland et al – Pediatrics 2001; 107:1431

Garland J et al- Pediatric Infectious Disease Journal. 15(10):912-914, October 1996.

Side effects in adults

- Severe contact dermatitis in 8 CHG-IS patients
  - *10 catheters, 10.4/1000 patients and 5.3/1000 catheters)*



CHG sponge or CHG gel?

Biopatch

- 92mg of CHG per disk
  - (diameter 2.5 cm) = 86.5 µg of CHG /mg of sponge
- Reduce bacterial count over time and suppress regrowth during at least 7 days
- Continuous inspection of the insertion site not possible
- Absortion of 8-fold sponge-weight of exsudate
- Better release of CHG due to better skin contact if properly placed (discordant results)
- Learning curve for application, Perfect application difficult (jugular++) and sometimes impossible
- Clinical studies

Tegaderm CHG

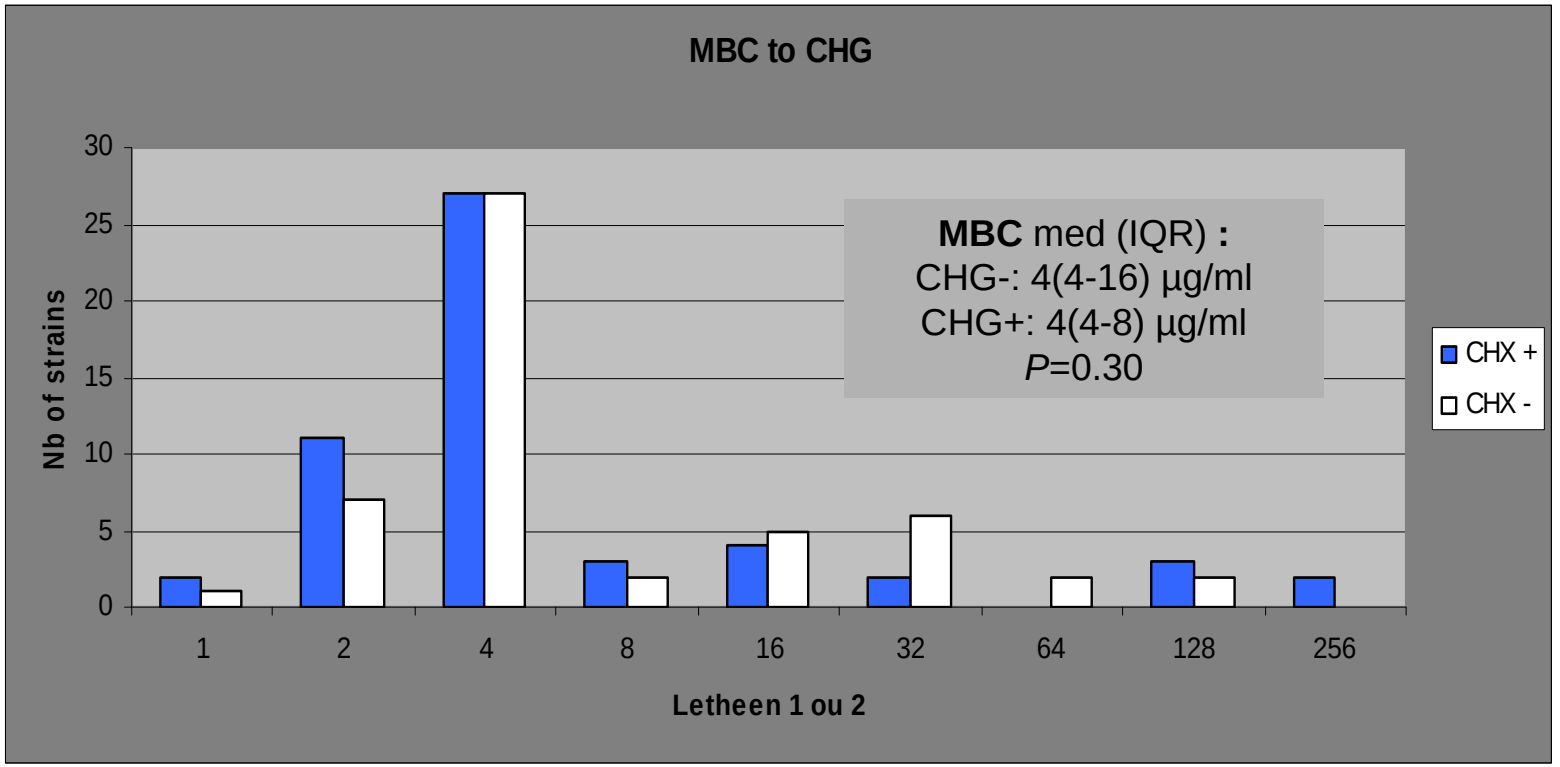
- 45 mg of CHG – (3 X 4 cm)
  - 20 µg of CHG /mg of gel
- Identical or slightly better *in vivo* time-kill of flora on unprepped skin (> 7 days) and prepped skin
- Continuous inspection possible although inf. to transparent dressings
- Absorbtion possible but slower than the sponge
- Dressing under the catheter is not in contact with CHG (discordant results)
- Application and removal easiest
- No clinical studies supporting efficacy

Resistance to CHG

- Gram pos > Gram neg
- Decrease in bactericidal activity: *Proteus sp. Providencia, P. aeruginosa*
- Induced chromosomal resistance by repeated CHG passage: *P aeruginosa, Providencia* sp., *P. cepacia*
- Induced resistance in MRSA (qac A gene)

In Fleurette J, Freney J and Reverdy ME – Antisepsie and desinfection – Eska ed 1995 Paris

MBC of strains recovered in a panel of positive countact in CHG and control dressings n=106*



(*) A random sample of 25 germs recovered from skin cultures in each study group

Controling catheter related infections

- Use simple measures
  - Education and training of the personnel
  - Safety culture
  - Strict aseptic conditions
  - Antiseptic solution with alcohol
  - Avoid routine replacement

  AND
  - Participation to national or international networks
  - Appropriate surveillance
  - Process indicators

  Most often a rewarding experience
- If levels remain high..
  - Impregnated catheters
  - Impregnated dressings…