Complicanze infettive dei devices vascolari

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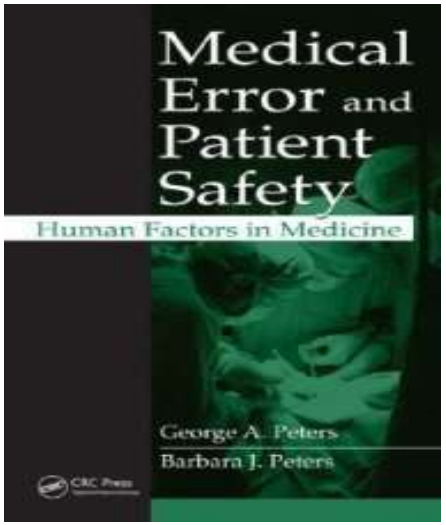
GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

STAND UP FOR PATIENT SAFETY

NATIONAL PATIENT SAFETY FOUNDATION



Annals of Internal Medicine | SUPPLEMENT

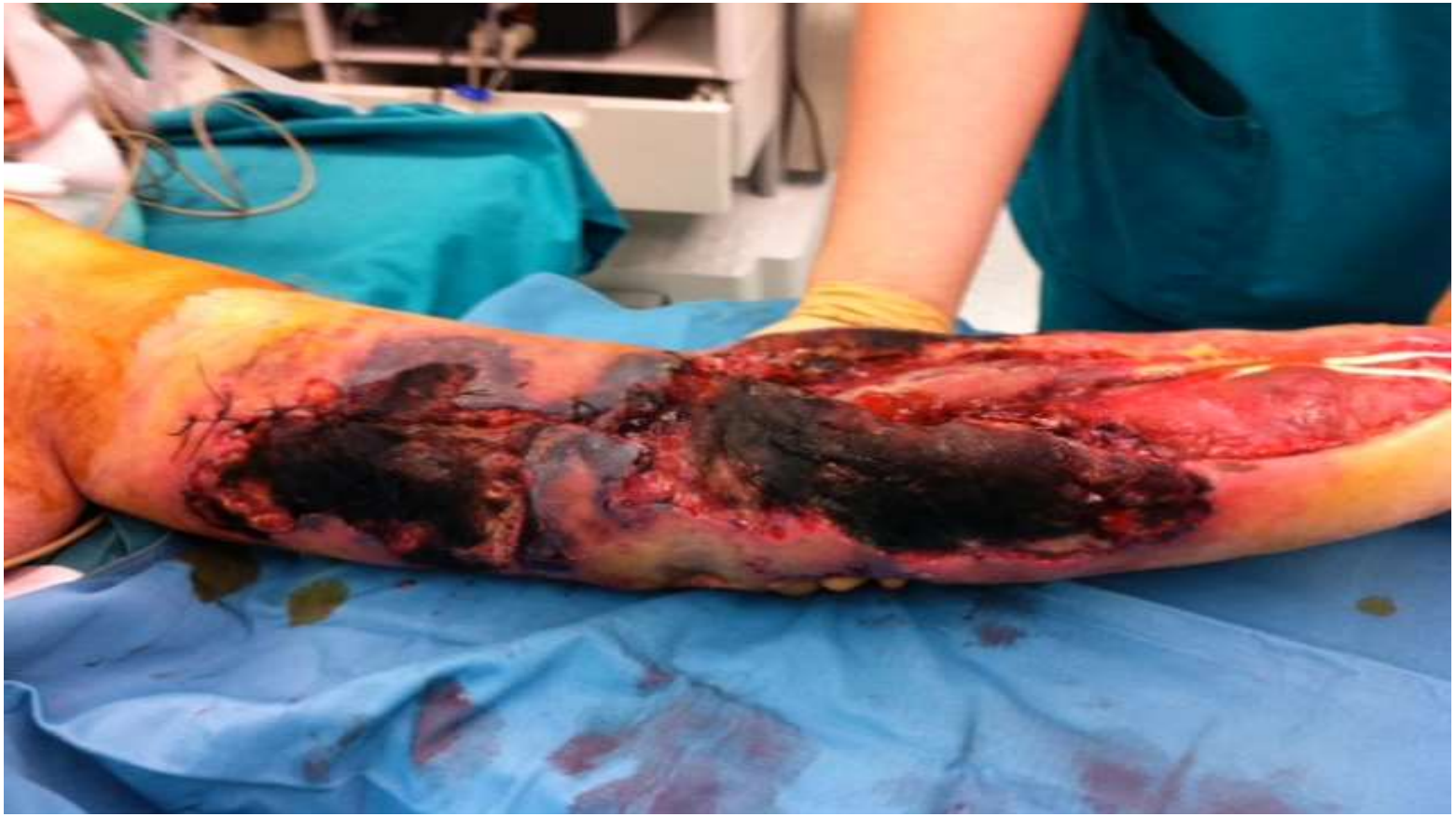
The Top Patient Safety Strategies That Can Be Encouraged for Adoption Now

Paul G. Shekelle, MD, PhD; Peter J. Pronovost, MD, PhD; Robert M. Wachter, MD; Kathryn M. McDonald, MM; Karen Schoelles, MD, SM; Sydney M. Dy, MD, MSc; Kaveh Shojania, MD; James T. Reston, PhD, MPH; Alyce S. Adams, PhD; Peter B. Angood, MD; David W. Bates, MD, MSc; Leonard Bickman, PhD; Pascale Carayon, PhD; Sir Liam Donaldson, MBChB, MSc, MD; Naihua Duan, PhD; Donna O. Farley, PhD, MPH; Trisha Greenhalgh, BM BCH; John L. Haughom, MD; Eileen Lake, PhD, RN; Richard Lilford, PhD; Kathleen N. Lohr, PhD, MA, MPhil; Gregg S. Meyer, MD, MSc; Marlene R. Miller, MD, MSc; Duncan V. Neuhauser, PhD, MBA, MHA; Gery Ryan, PhD; Sanjay Saint, MD, MPH; Stephen M. Shortell, PhD, MPH, MBA; David P. Stevens, MD; and Kieran Walshe, PhD

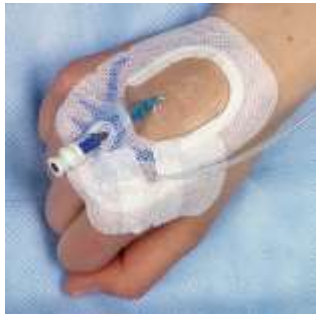
Table 2. Patient Safety Strategies Ready for Adoption Now

Strongly encouraged

- Preoperative checklists and anesthesia checklists to prevent operative and postoperative events
- Bundles that include checklists to prevent central line–associated bloodstream infections
- Interventions to reduce urinary catheter use, including catheter reminders, stop orders, or nurse-initiated removal protocols
- Bundles that include head-of-bed elevation, sedation vacations, oral care with chlorhexidine, and subglottic suctioning endotracheal tubes to prevent ventilator-associated pneumonia
- Hand hygiene
- The do-not-use list for hazardous abbreviations
- Multicomponent interventions to reduce pressure ulcers
- Barrier precautions to prevent health care–associated infections
- Use of real-time ultrasonography for central line placement
- Interventions to improve prophylaxis for venous thromboembolisms



- Agocannule periferiche
- Minimidline
- Cateteri arteriosi per monitoraggio emodinamico
- CVC non cuffiati e non tunnellizzati
  - CVC multilume
  - Cateteri di Swan-Ganz
  - Cateteri per emodialisi non tunnellizzati a doppio lume



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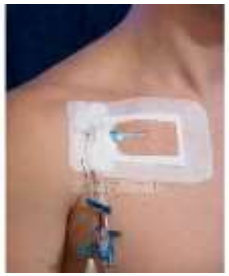
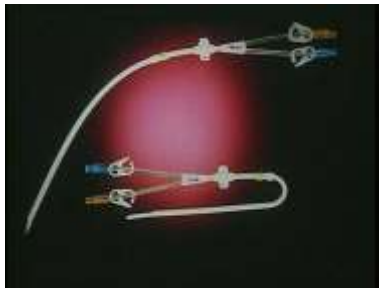
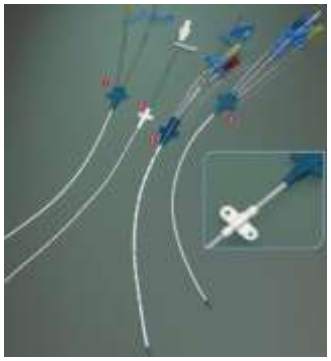


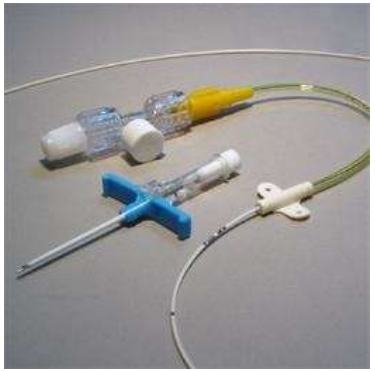
5.000.000-7.000.000

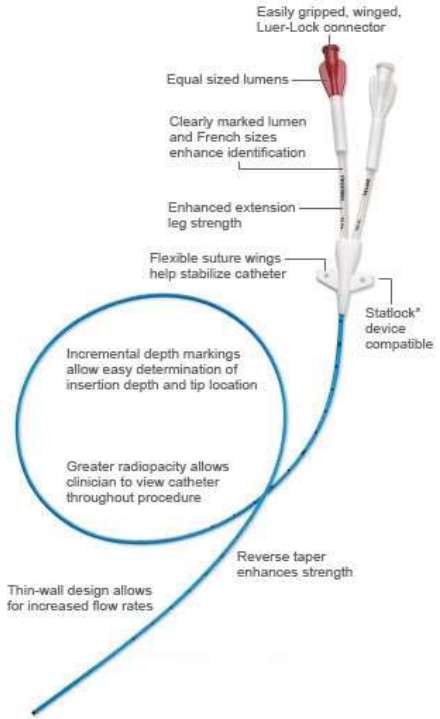
700.000

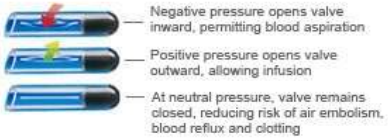
- CVC con cuffia e tunnellizzati (100.000)
  - CVC tipo Hickman/Broviac/Groshong
  - Cateteri per emodialisi tunnellizzati
- Port sottocutanei (Toracici e Picc- Port; 200.000)
- In Italia circa 30.000 cumulativamente








Easily gripped, winged, Luer-Lock connector
Equal sized lumens
Clearly marked lumen and French sizes enhance identification
Enhanced extension leg strength
Flexible suture wings help stabilize catheter
Statlock® device compatible
Incremental depth markings allow easy determination of insertion depth and tip location
Greater radiopacity allows clinician to view catheter throughout procedure
Reverse taper enhances strength
Thin-wall design allows for increased flow rates


Negative pressure opens valve inward, permitting blood aspiration
Positive pressure opens valve outward, allowing infusion
At neutral pressure, valve remains closed, reducing risk of air embolism, blood reflux and clotting

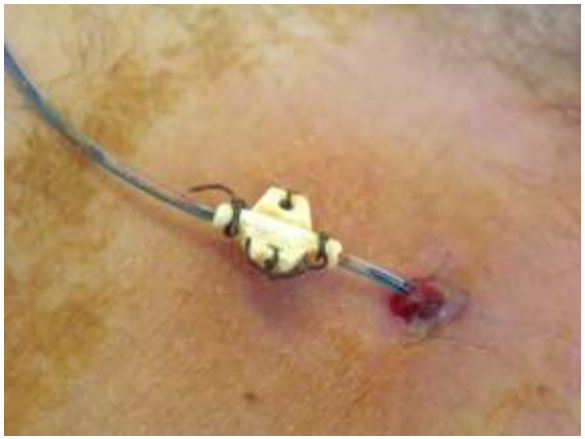
- *Le infezioni degli accesi venosi si distinguono in:*

- **Infezioni locali**
  - Infezioni della emergenza cutanea
  - Infezioni della tasca
  - Infezioni del tunnel

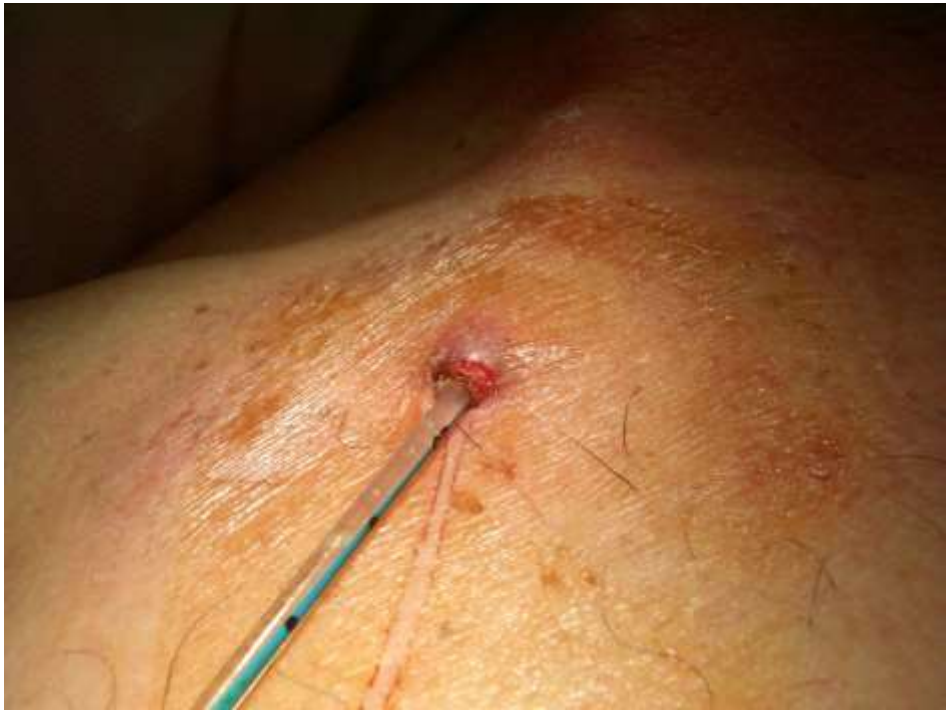
- **Infezioni sistemiche**

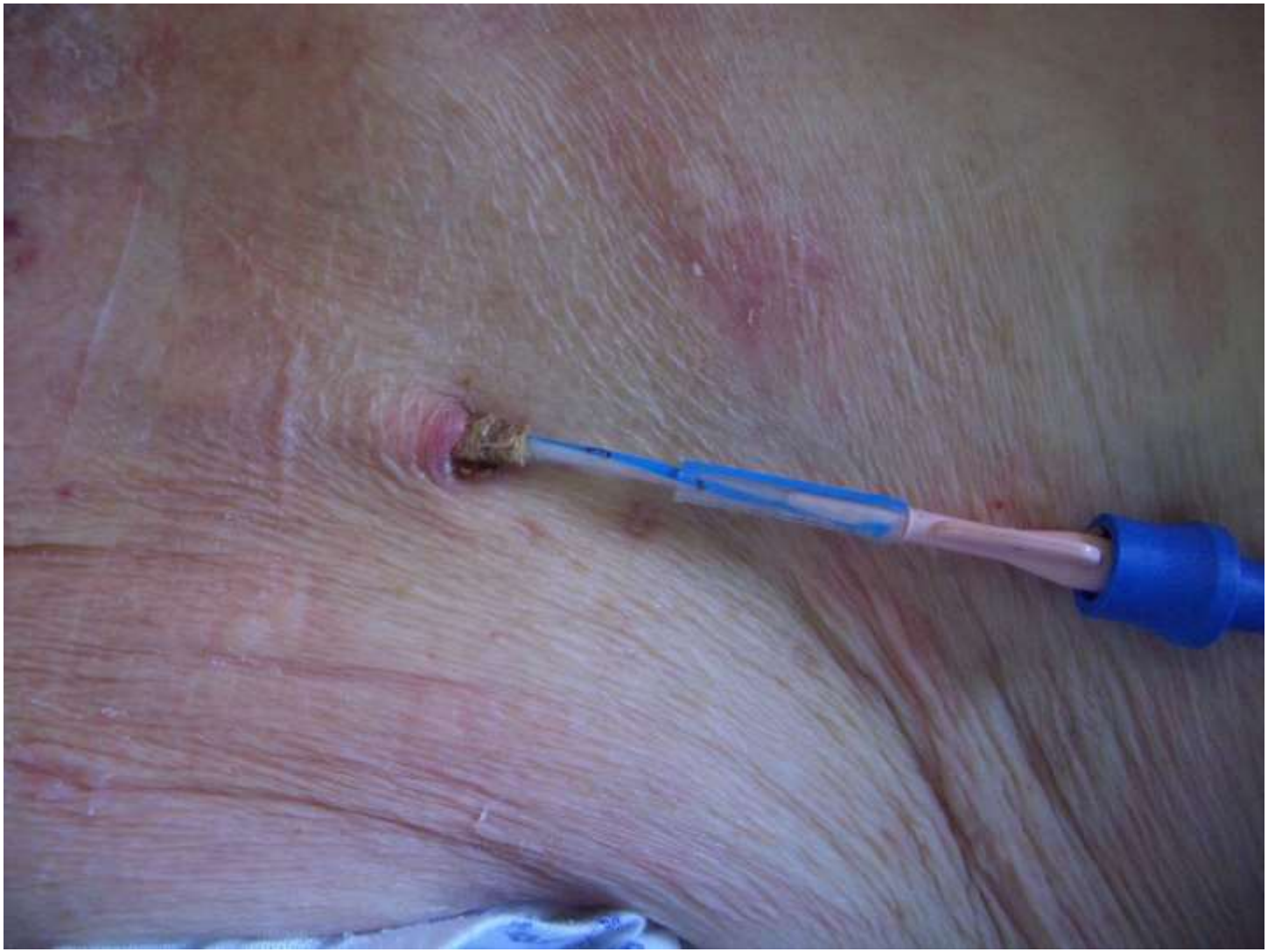
Infezione della emergenza cutanea

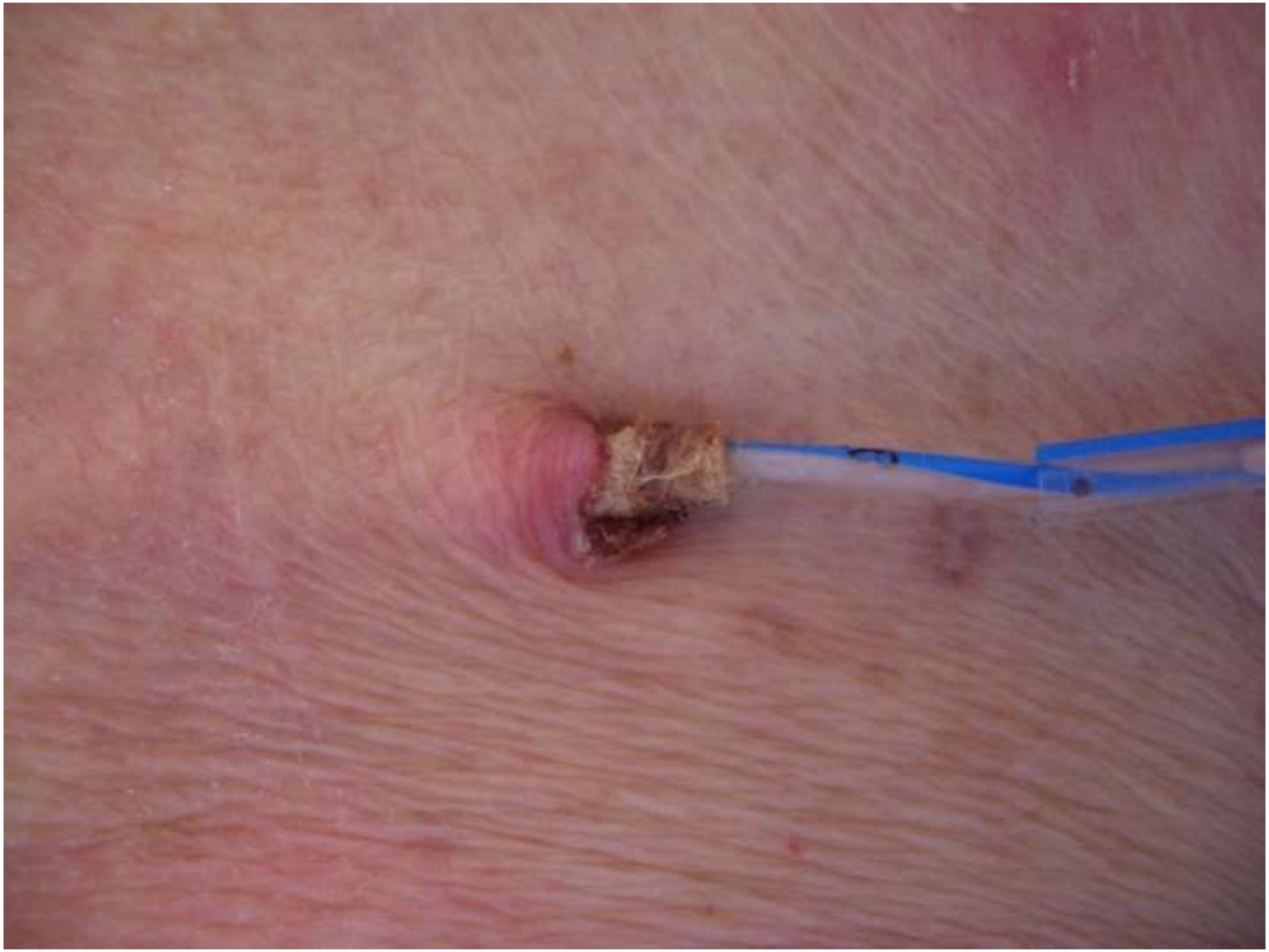
- Eritema, dolorabilità, indurimento, e/o essudato purulento entro 2 cm dal punto di emergenza cutanea del catetere

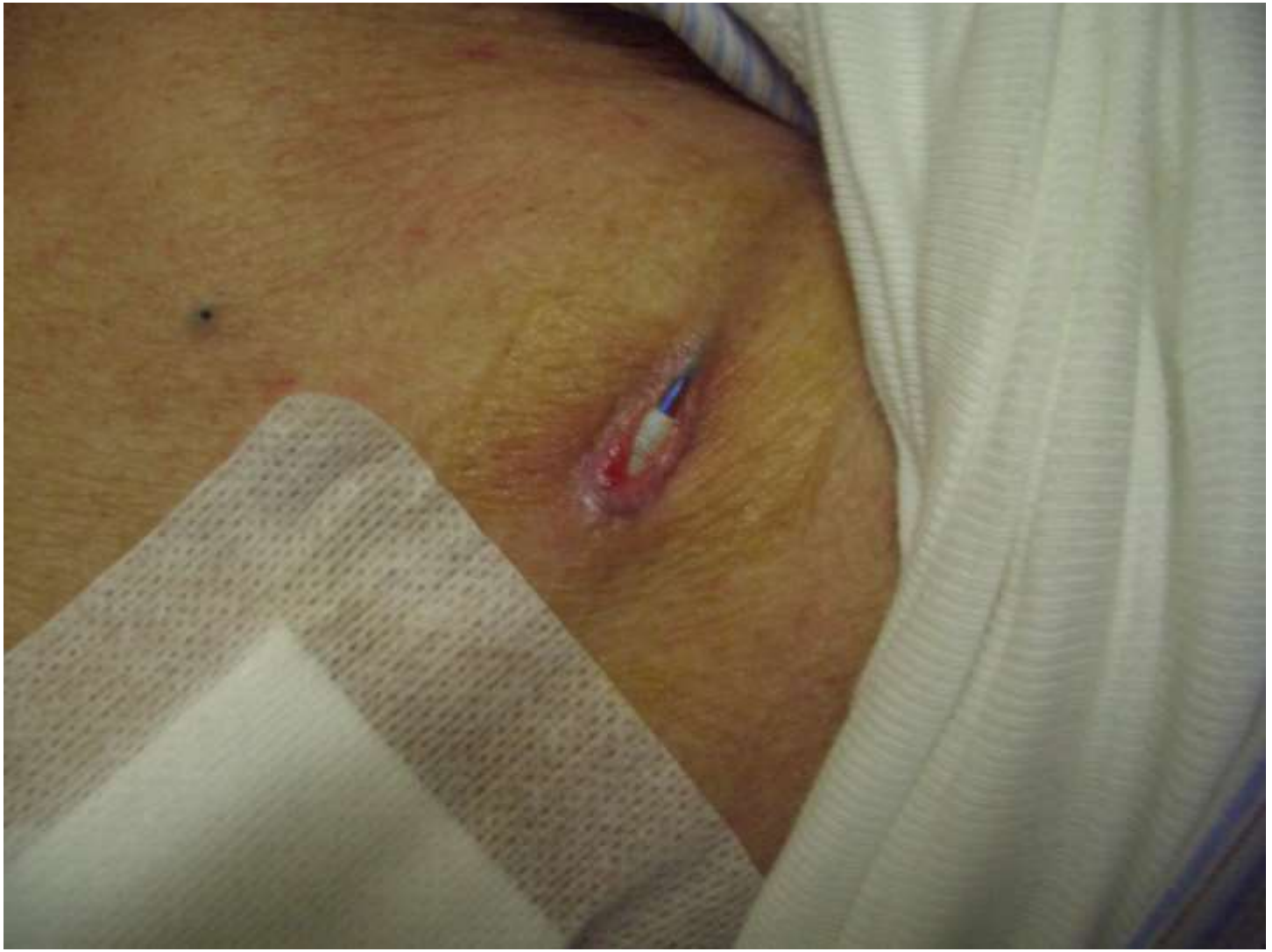


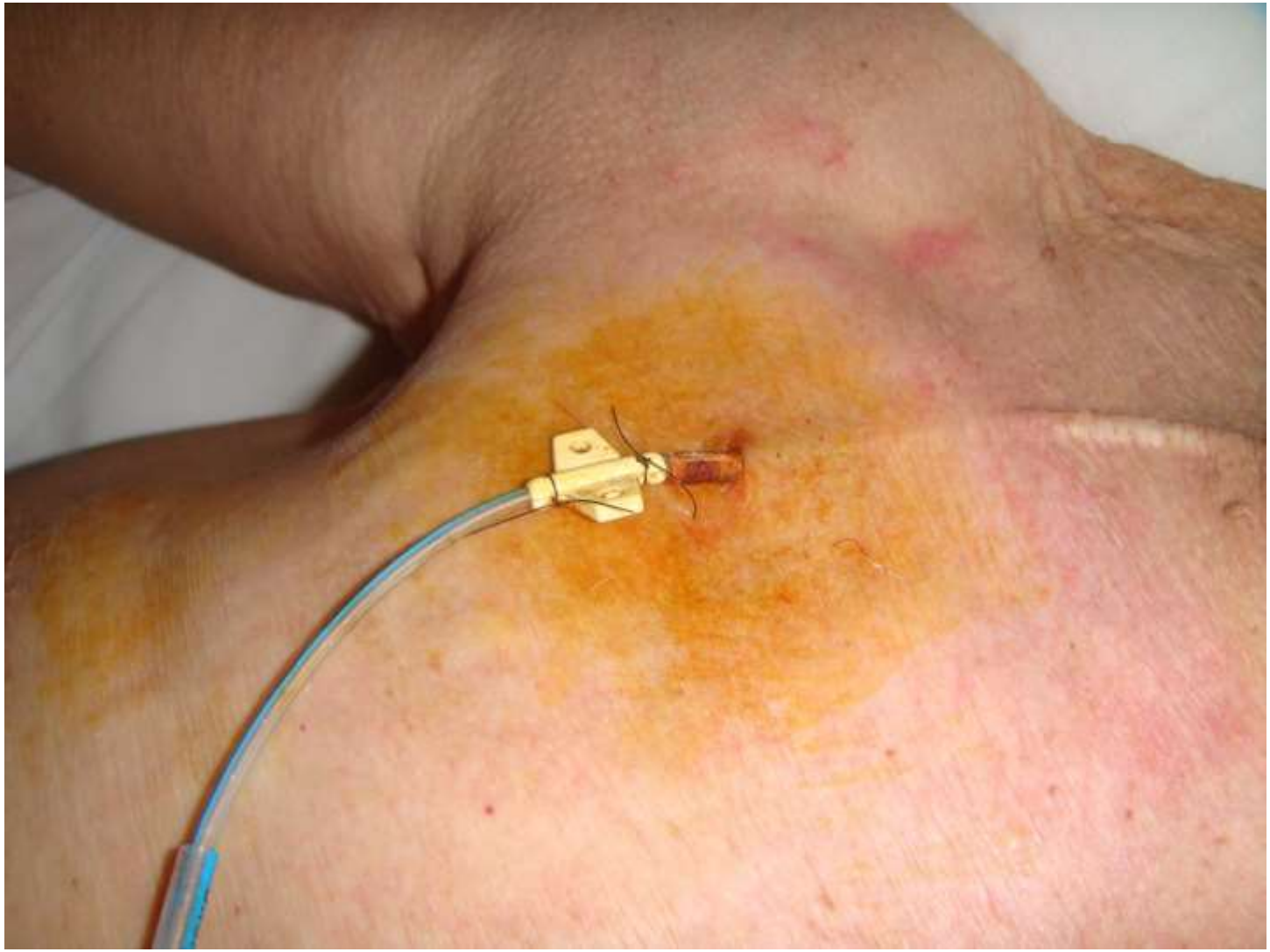
Infezione della emergenza cutanea

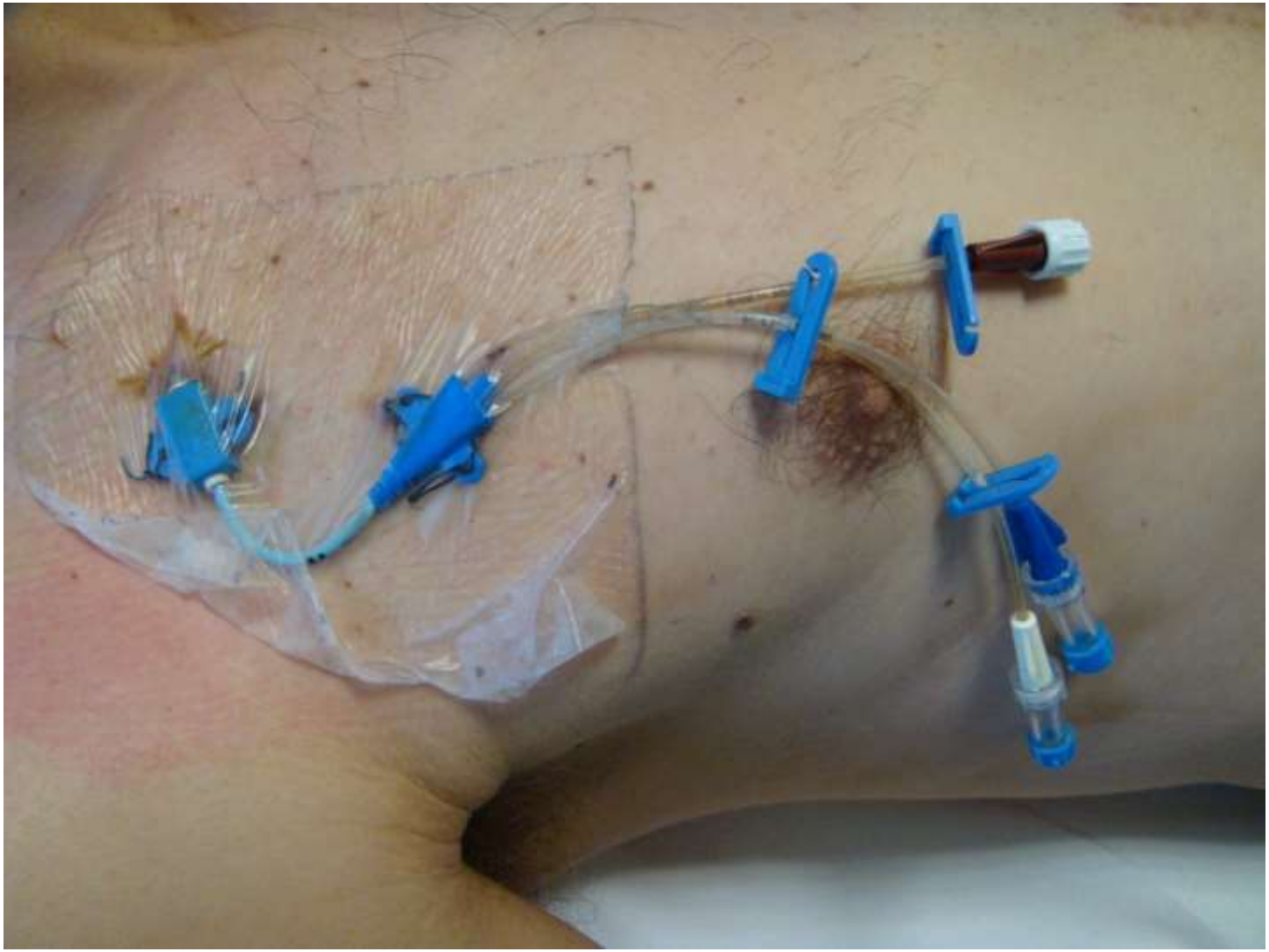


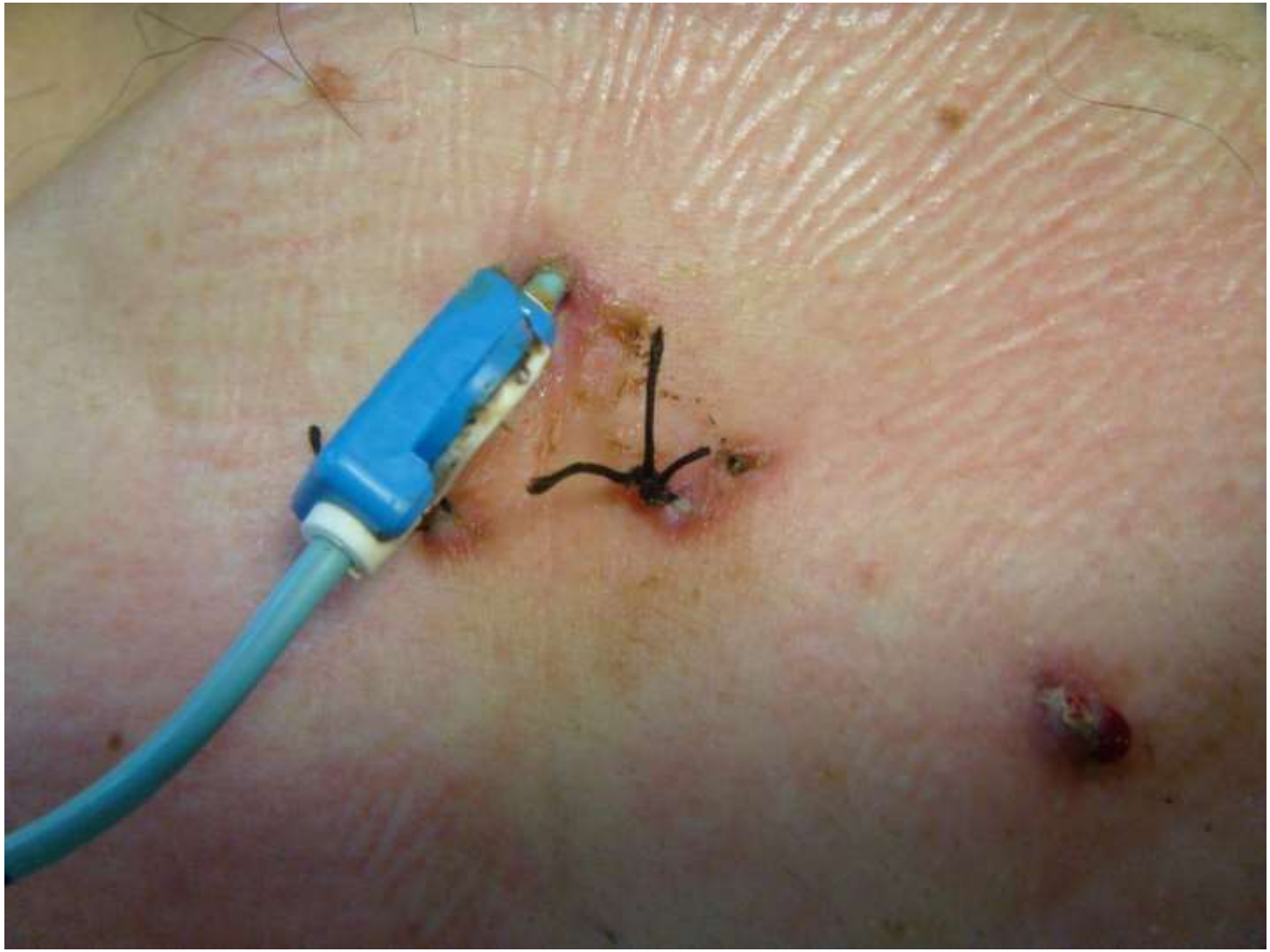


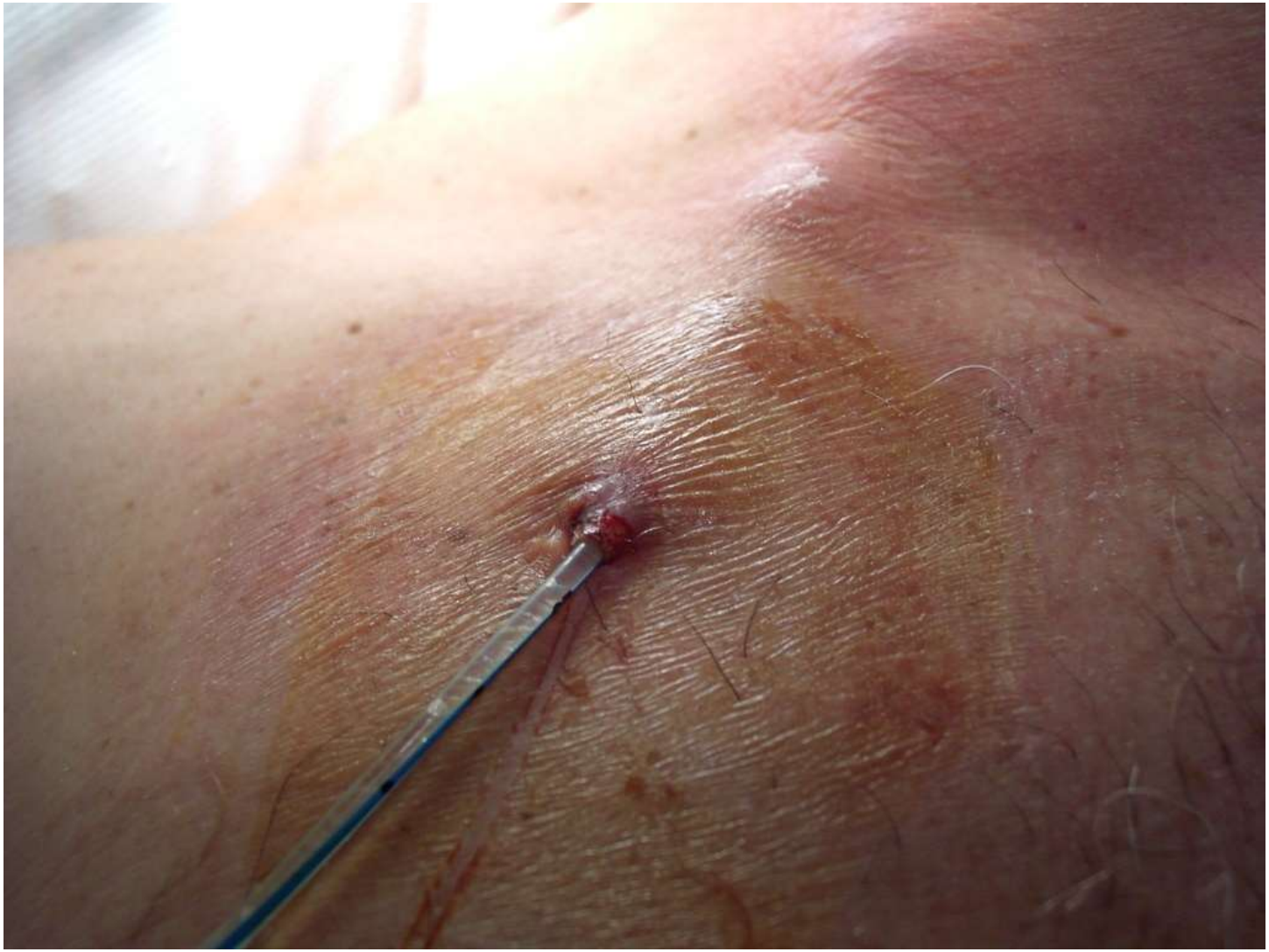


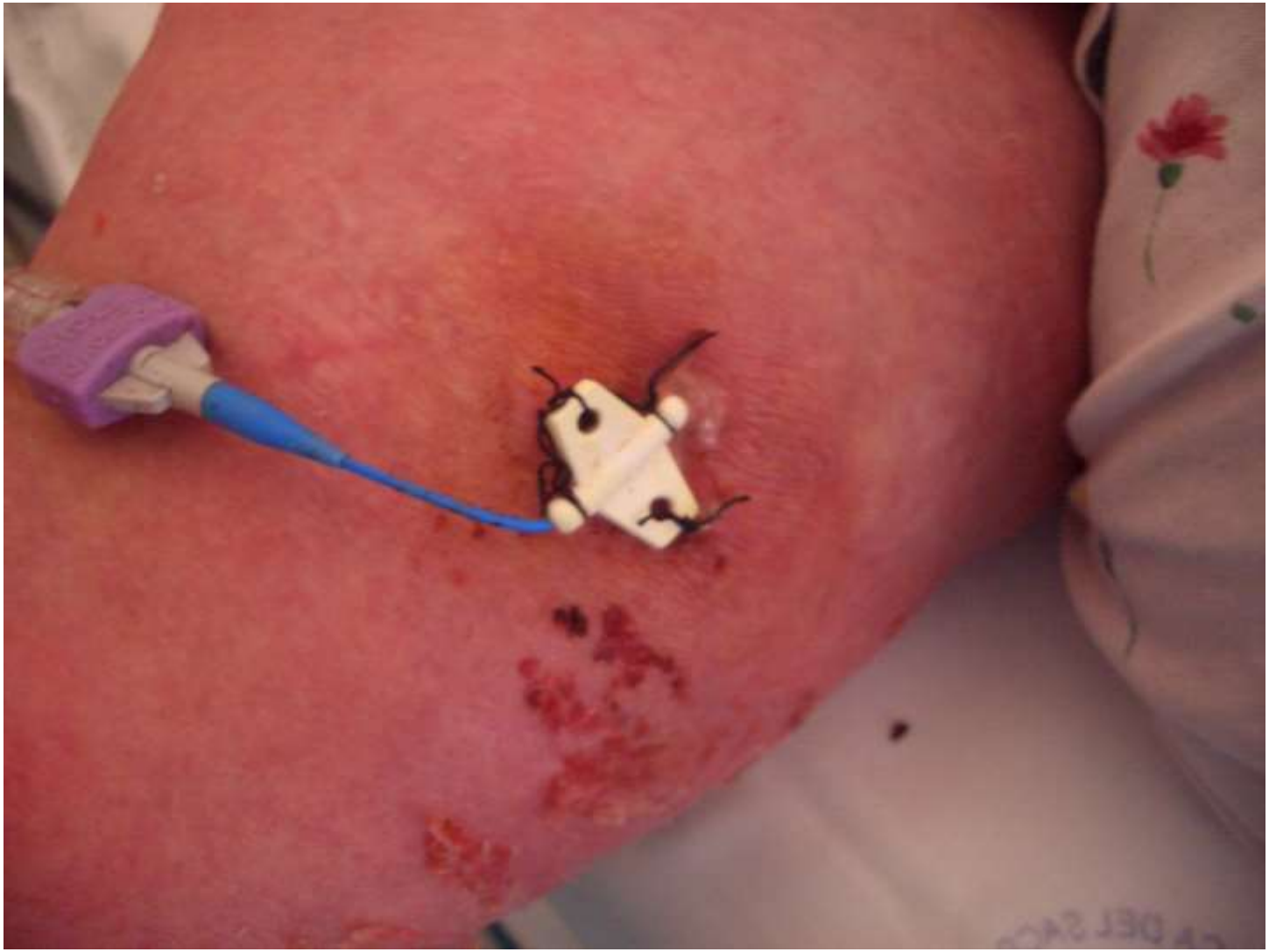






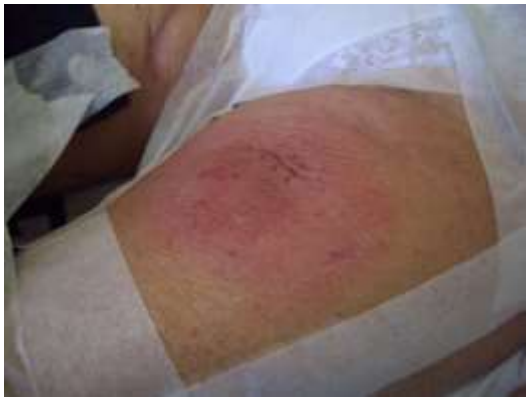


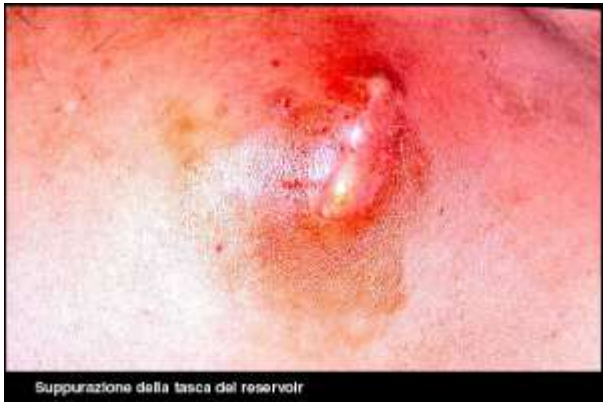




Infezione della tasca

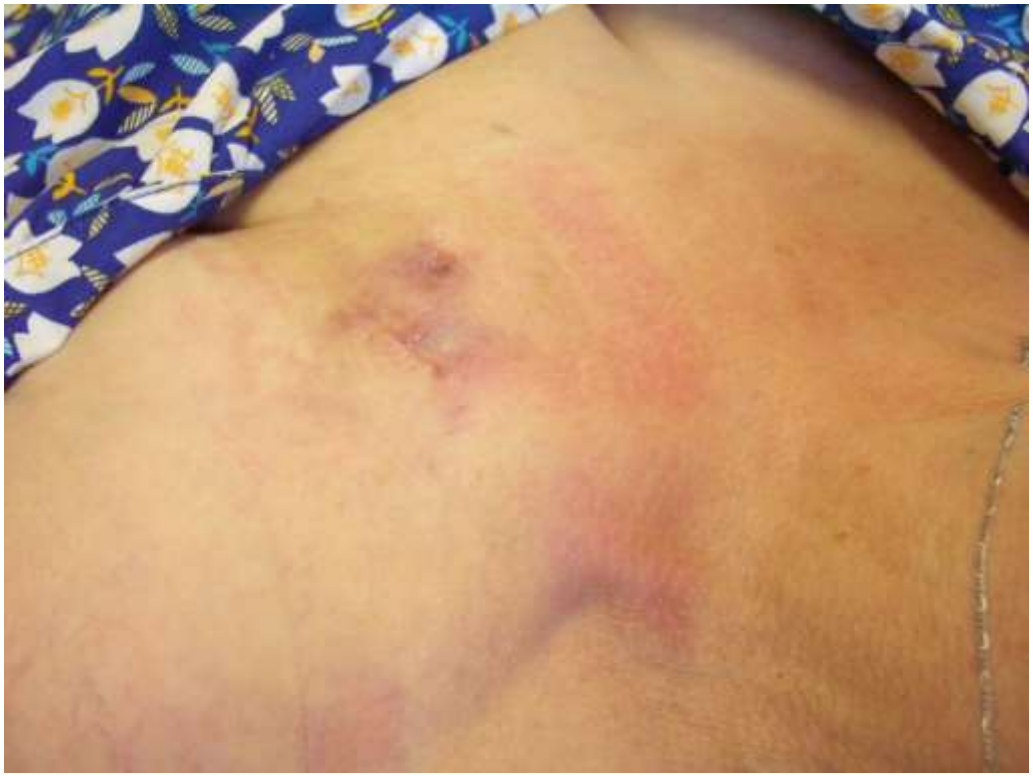
- Eritema e/o necrosi della cute sovrastante il reservoir di un sistema venoso totalmente impiantabile, oppure essudato purulento nella tasca sottocutanea dove è alloggiato il reservoir





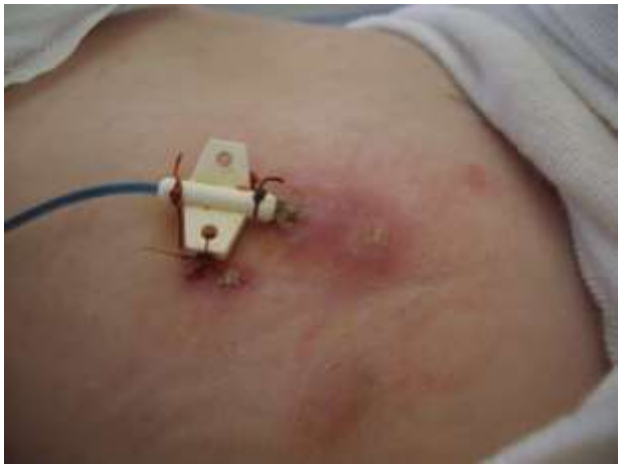
Suppurazione della tasca del reservoir

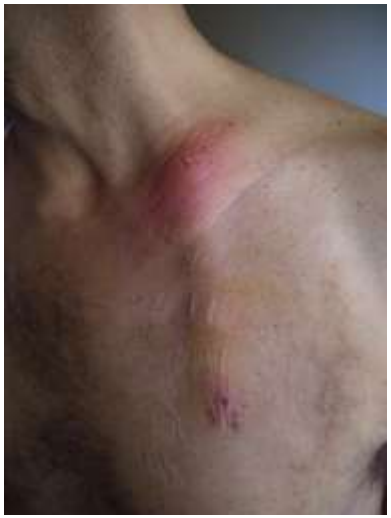
Infezione della tasca



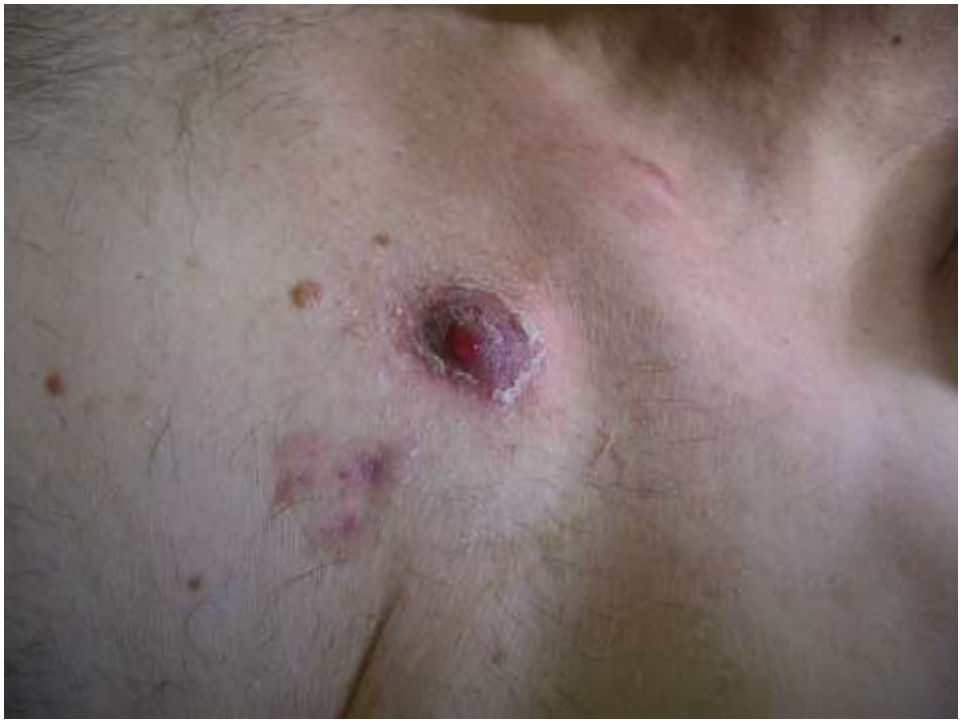
Infezione del tunnel

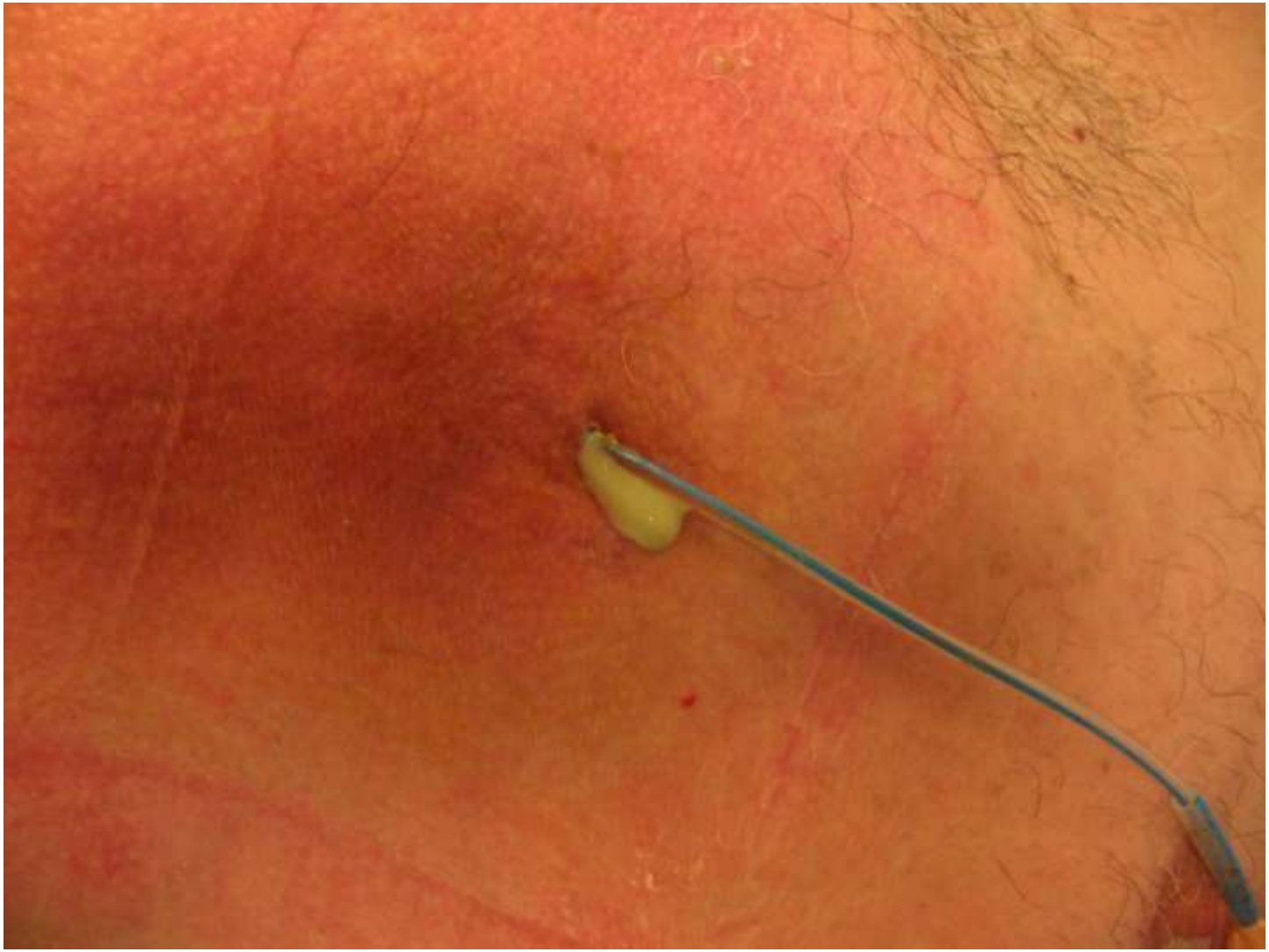
- Eritema, dolorabilità, e/o indurimento dei tessuti sovrastanti il tratto sottocutaneo di un catetere esterno tunnellizzato

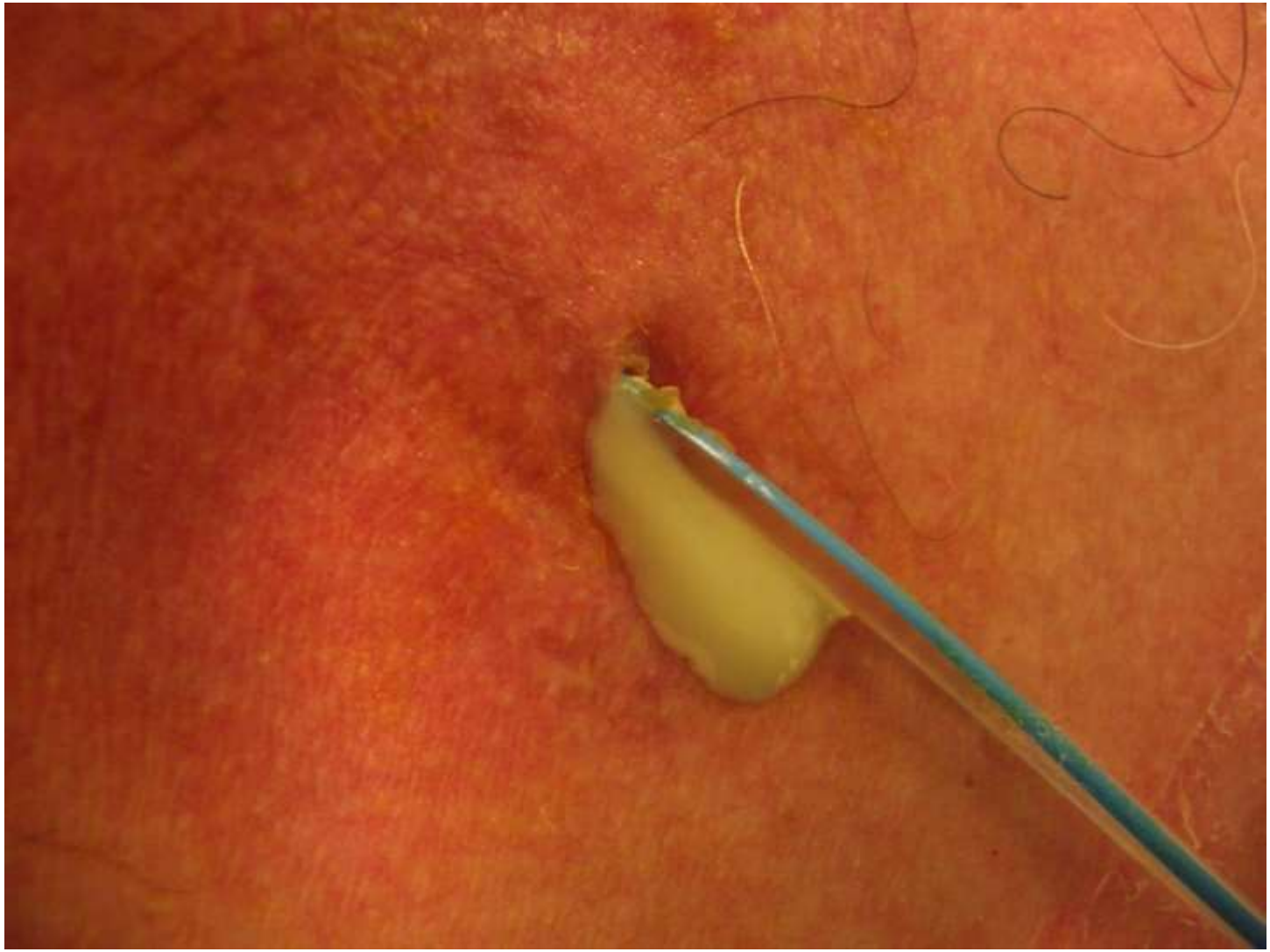


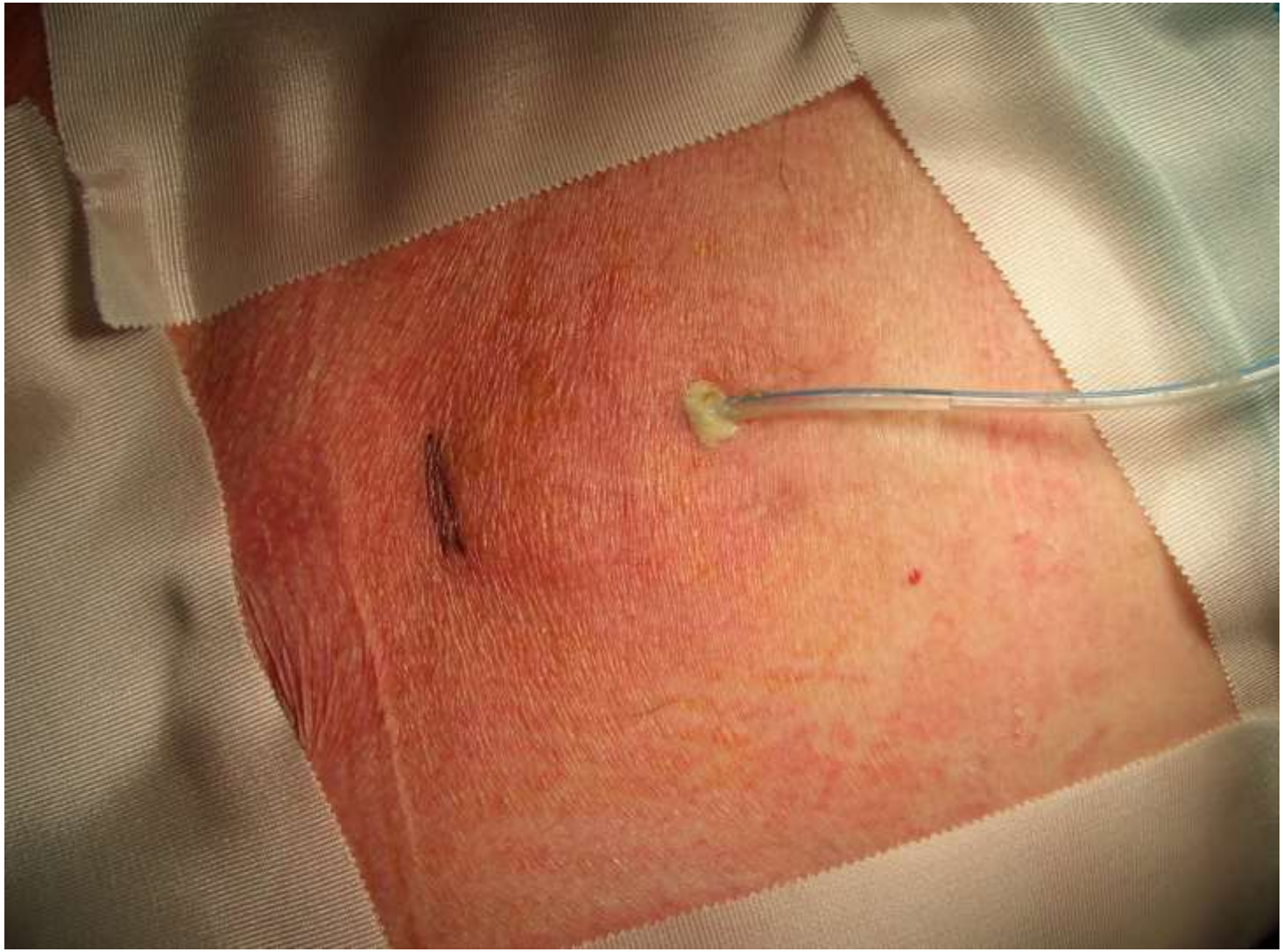


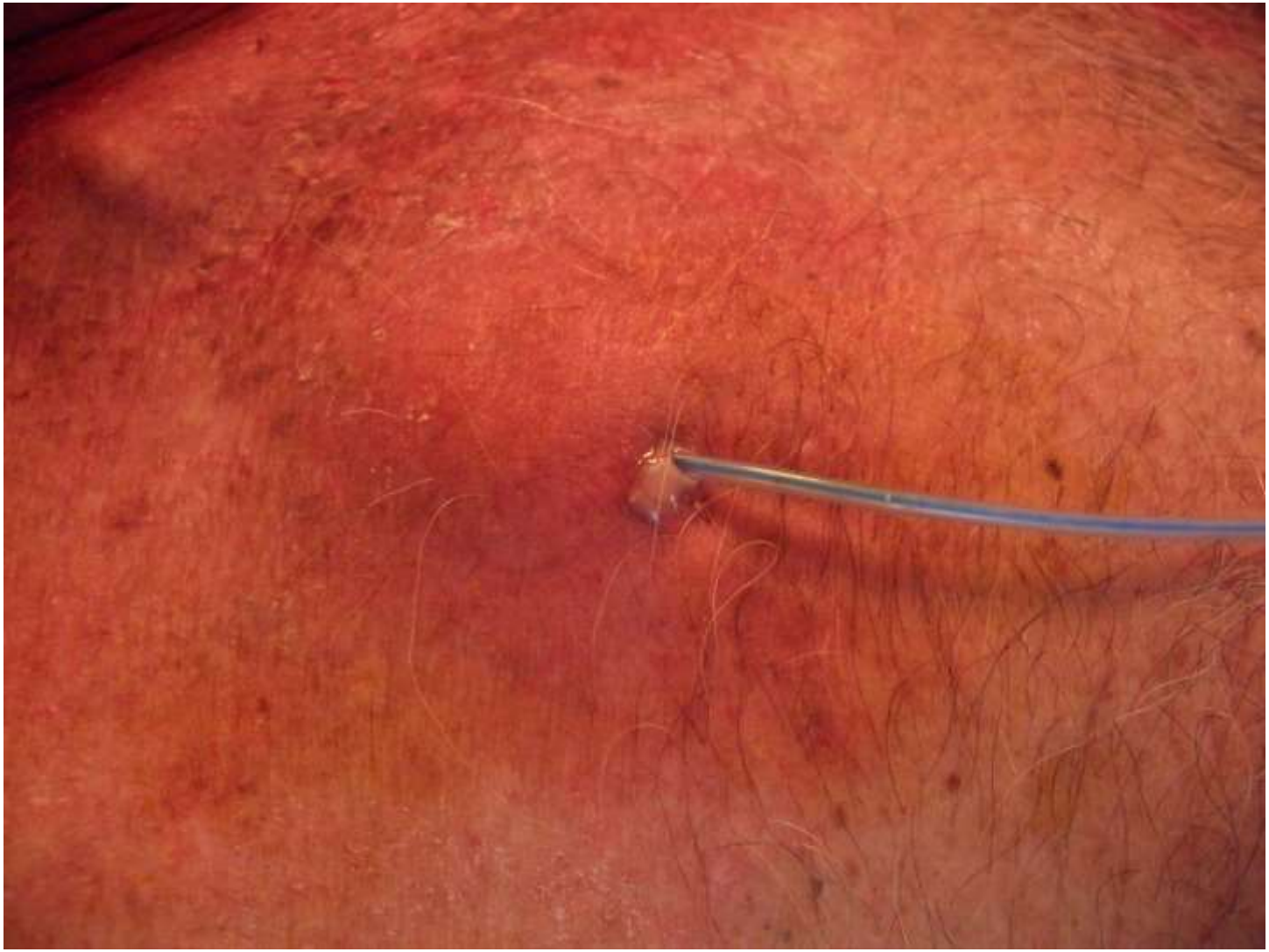
Infezione del tunnel











Infezioni sistemiche

- Infezioni batteriemiche associate a catetere (CRBSI):
  - Infezione batteriemica in un paziente portatore di catetere intravascolare, manifestazioni cliniche di infezione (febbre, brividi, e/o ipotensione), senza fonti apparenti di infezione e con almeno uno dei seguenti criteri:

- Coltura quantitativa o semiquantitativa di un catetere con l'isolamento dello stesso microrganismo (stessa specie e antibiogramma) dal sangue e dal catetere;
- Emocolture quantitative da sangue periferico e da sangue da catetere con un rapporto di crescita $\geq$ 5:1 (CVC vs sangue periferico);
- Positivizzazione di emocolture da sangue periferico 2 o più ore dopo la positivizzazione di emocolture da catetere.

Mermel LA et al. Guidelines for the management of intravascular catheter-related infections. CID, 2009

Emocolture

- Quante?
- Quando?
- Quanto sangue?
- Quale antisettico?

Purpose of Blood Cultures

- Culture of blood is the MOST SENSITIVE method for detection of bacteremia or fungemia.
- Blood cultures should be obtained PRIOR to initiation of antimicrobial therapy in any patient with fever, leukocytosis or leukopenia.
- A normal WBC does NOT rule out bacteremia.
- Timely, early initiation of goal-directed therapy, can be life-saving!

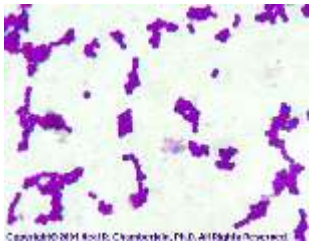
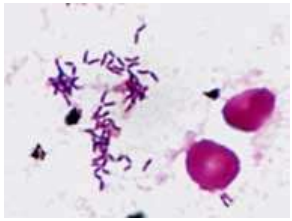
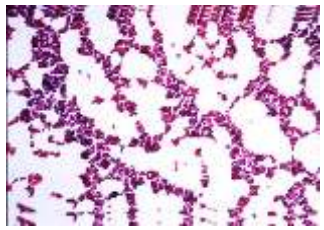
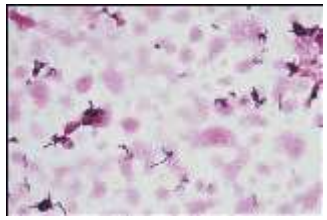
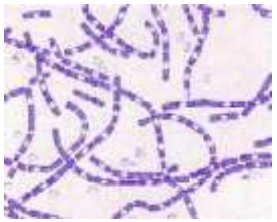
Accurate Blood Culture Results

- Accurate, careful blood culture collection is critical to:
  - Accurate identification of the offending microorganism
  - Allowing tailored antimicrobial therapy
  - Avoiding false positives

Emocolture "contaminate"

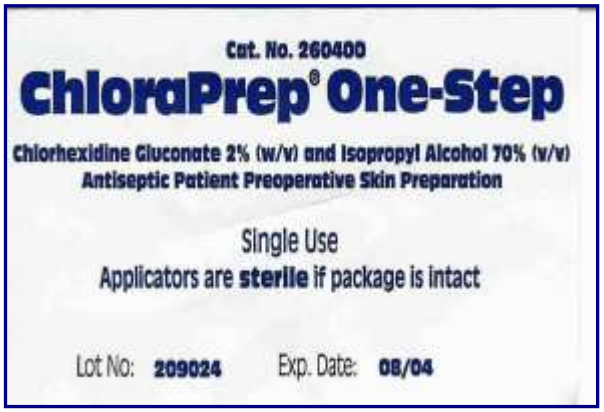
E' definita "contaminata" una singola emocoltura tra diverse effettuate positiva per:

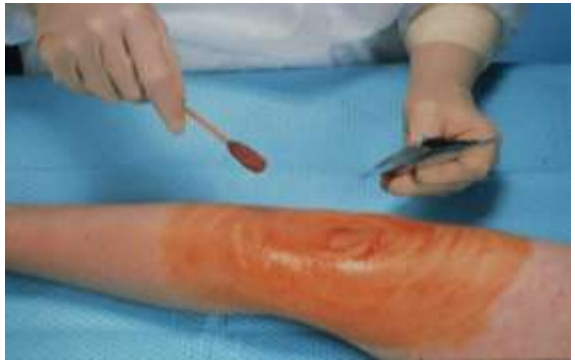
- Stafilococchi coagulasi negativi
- Corynebacterium spp
- Micrococcus
- Propionibacterium
- Bacillus

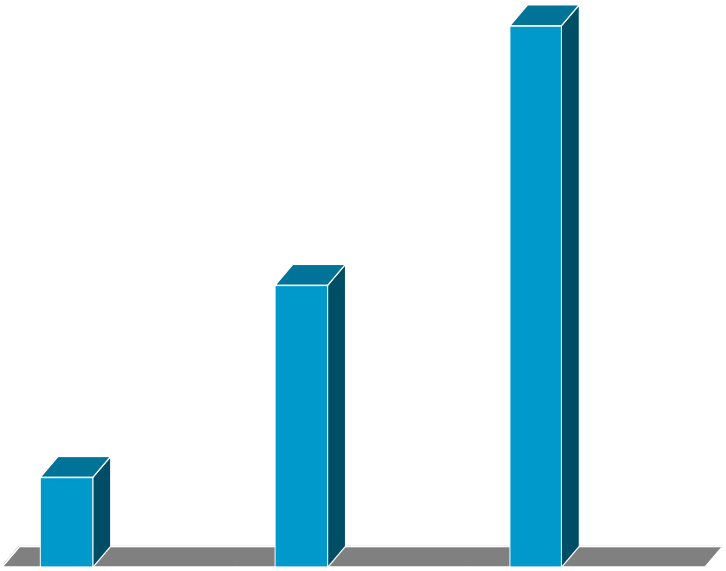






Baron, AVA 2006

Contaminazione delle emocolture rispetto all'antisettico impiegato





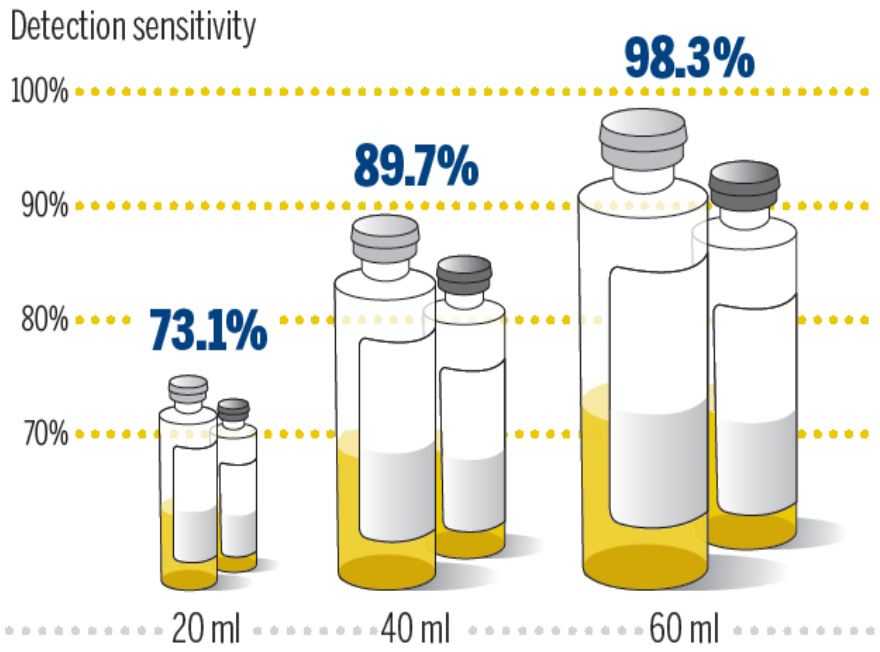


Baylor, 2006

QUANTI SET DI EMOCOLTURE DOVREBBERO ESSERE RACCOLTI?

Figure 2: Cumulative sensitivity of blood culture sets[22]

Adapted from Lee A, Mirrett S, Reller LB, Weinstein MP. **Detection of Bloodstream Infections in Adults: How Many Blood Cultures Are Needed?** *J Clin Microbiol* 2007;45:3546-3548.



Si consiglia inoltre di utilizzare due o tre set di flaconi (due flaconi per set) per episodio settico, vale a dire, per gli adulti, da 40 a 60 ml di sangue prelevato dal paziente per 4-6 flaconi, con 10 ml per flacone .

Per ogni millilitro aggiuntivo di sangue coltivato, la resa di microrganismi recuperati dal sangue adulto aumenta in proporzione diretta fino a 30 ml.

Questa correlazione è correlata al numero relativamente basso di CFU in un millilitro di sangue adulto.

Quando o quanto?

Numerosi studi hanno rilevato che il timing delle emocolture è meno importante del volume di sangue prelevato

Relativamente al "quando", la sensibilità è lievemente maggiore da 0.5-2.5 ore prima del picco febbrile fino ad alcune ore dopo

QUALE VOLUME DI SANGUE DOVREBBE ESSERE RACCOLTO?

La carica batterica o fungina nella sepsi può essere inferiore a 1 unità formante colonia (CFU) per ml di sangue.

Un adeguato volume di sangue è il parametro più importante per la rilevazione di microrganismi nel torrente circolatorio

Maggiore è il volume di sangue coltivato e maggiore è la resa

Impact of Volume Sampled on BCs Yield

Data available could be summarized as follows: "The higher the blood volume cultured, the higher the yield." Indeed, adequate volume sampling is the most important parameter for the detection of bloodstream microorganisms because bacterial or fungal density in blood is very low in most patients with BSI. Basically, the likelihood of detecting a BSI depends on the bacterial or fungal concentration, and on the volume collected

Ogni set include un flacone aerobio e un flacone anaerobio e ogni flacone deve essere inoculato con circa 10 ml di sangue.

PER I PAZIENTI PEDIATRICI

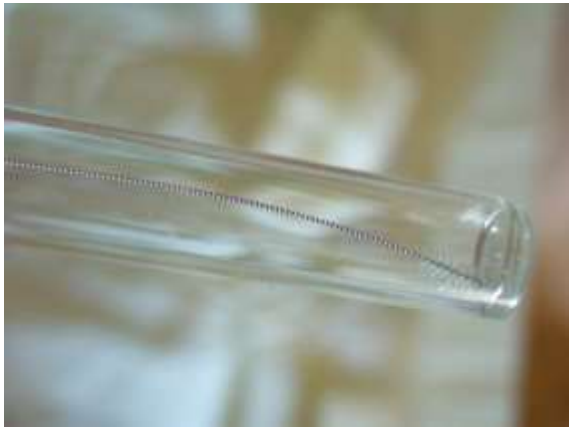
Table 1: Blood volumes suggested for cultures from infants and children[20]

Adapted from Kellogg *et al*. **Frequency of low-level bacteremia in children from birth to fifteen years of age**. *J Clin Microbiol*. 2000; 38:2181-2185.

Weight of patient		Patient's total blood volume (ml)	Recommended volume of blood for culture (ml)		Total volume for culture (ml)	% of patient's total blood volume
kg	lb		Culture no.1	Culture no.2		
≤1	≤2.2	50-99	2		2	4
1.1-2	2.2-4.4	100-200	2	2	4	4
2.1-12.7	4.5-27	>200	4	2	6	3
12.8-36.3	28-80	>800	10	10	20	2.5
>36.3	>80	>2,200	20-30	20-30	40-60	1.8-2.7

Colonizzazione del catetere

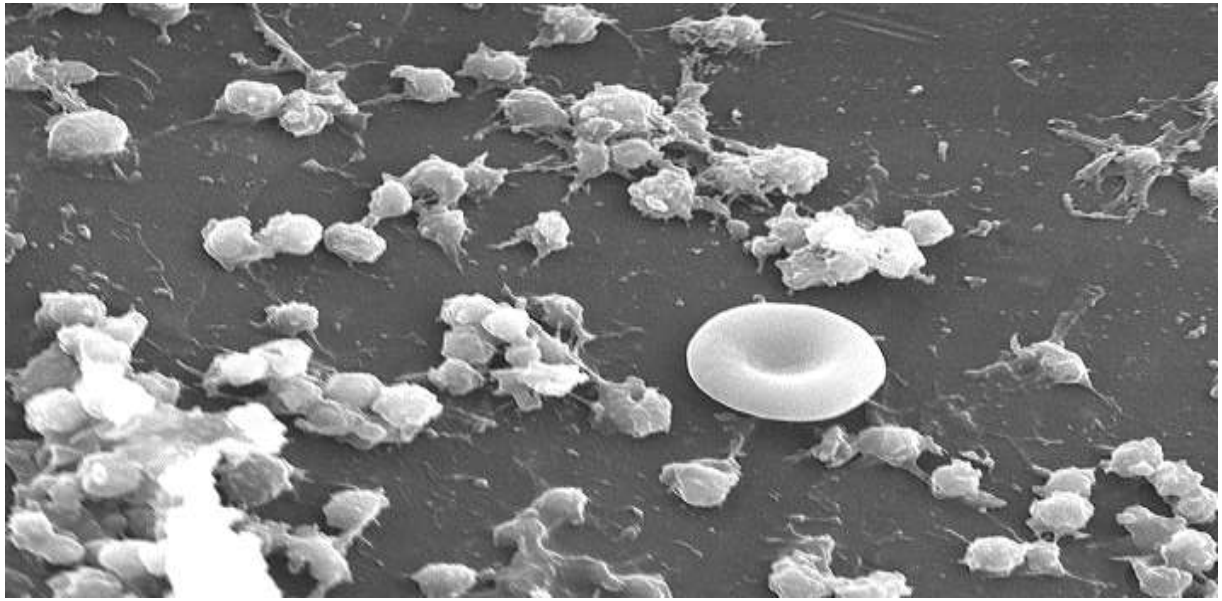
- Colonizzazione = presenza di un microrganismo in un ospite, con crescita e moltiplicazione ma senza interazioni (risposta immune o manifestazioni cliniche)
- Crescita significativa di microorganismi dalla coltura di un catetere (> 15 CFU con metodo semiquant., oppure > 1000 con metodo quant.), in assenza di sintomatologia clinica



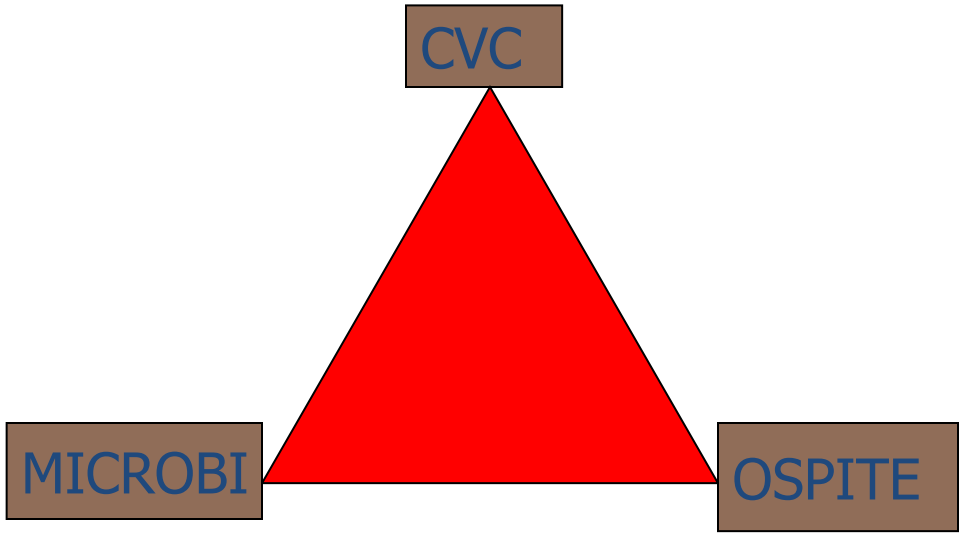
Mermel, 2009; Ryder, 2005; Raad 2007

Colonizzazione

- Tutti i CVC vengono colonizzati dopo l’ inserzione
- Disfunzione del CVC pur non provocando una vera e propria infezione



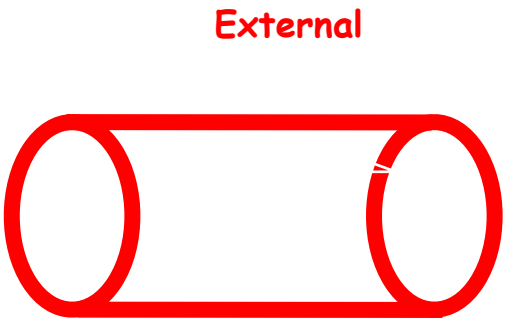
Colonizzazione/infezione



Eggimann, 2007; Byrnes, 2007; Raad, 2007

Colonizzazione

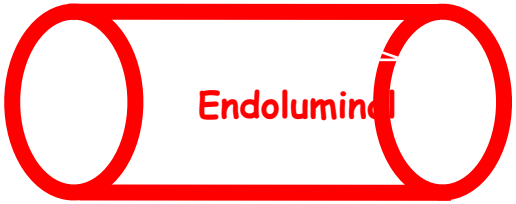
- La colonizzazione di un dispositivo intravascolare può avvenire per via EXTRALUMINALE:
  - Microrganismi dalla cute circostante
  - Colonizzazione per via ematogena



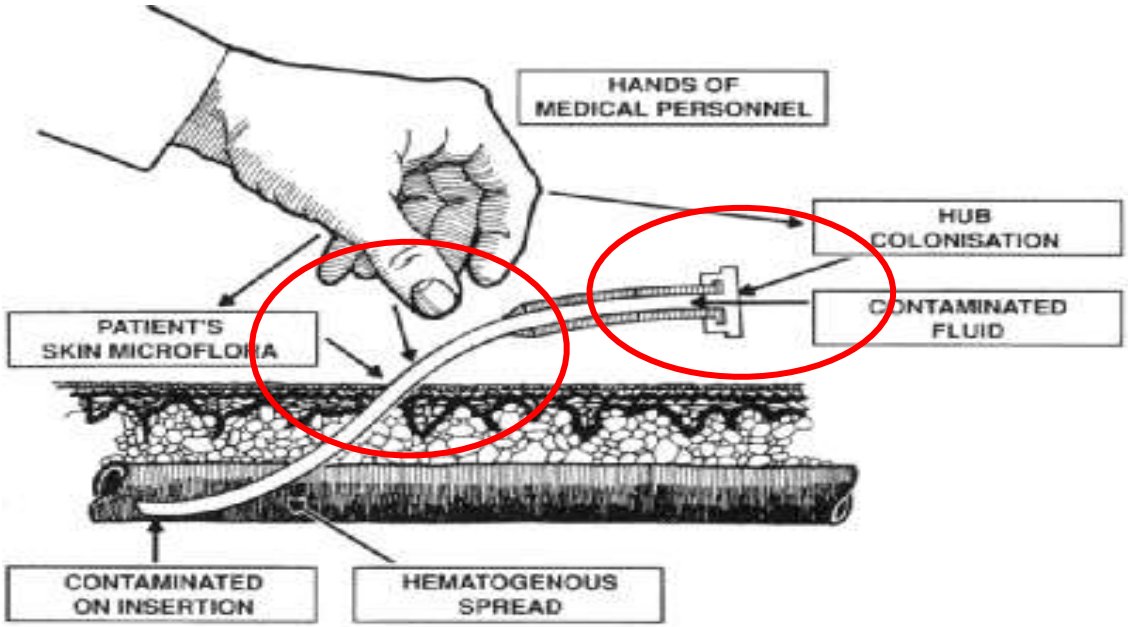
Eggimann, 2007; Byrnes, 2007; Raad, 2007

Colonizzazione

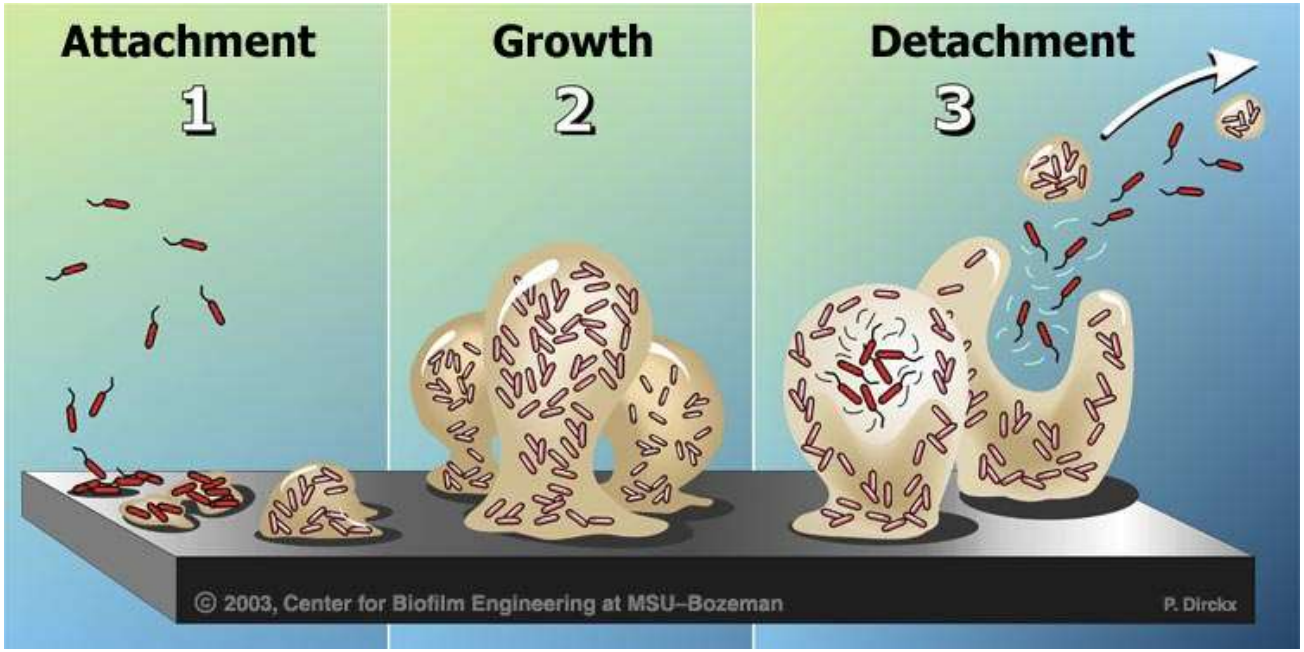
- La colonizzazione di un dispositivo intravascolare può avvenire per via INTRALUMINALE:
  - Contaminazione dai raccordi (rubinetti, rampe) delle vie di infusione
  - Somministrazione di infusioni contaminate



PATOGENESI


HANDS OF
MEDICAL PERSONNEL
HUB
COLONISATION
CONTAMINATED
FLUID
PATIENT'S
SKIN MICROFLORA
CONTAMINATED
ON INSERTION
HEMATOGENOUS
SPREAD

Formazione del Biofilm



Biofilm

- Le caratteristiche fondamentali delle infezioni correlate alla presenza di un biofilm sono:
- Resistenza agli antibiotici
- Resistenza alle cellule del sistema immunitario
  - Alcune infezioni croniche si presentano con cicliche esacerbazioni e remissioni proprio perché rifornite da un biofilm.

Formazione del biofim

- La velocità della colonizzazione dipende in maniera diretta dalla colonizzazione del sito di inserzione del catetere, che è di 1.000/10.000 UFC per cmq al sito della giugulare e della succlavia e 10 UFC nella zona antecubitale.

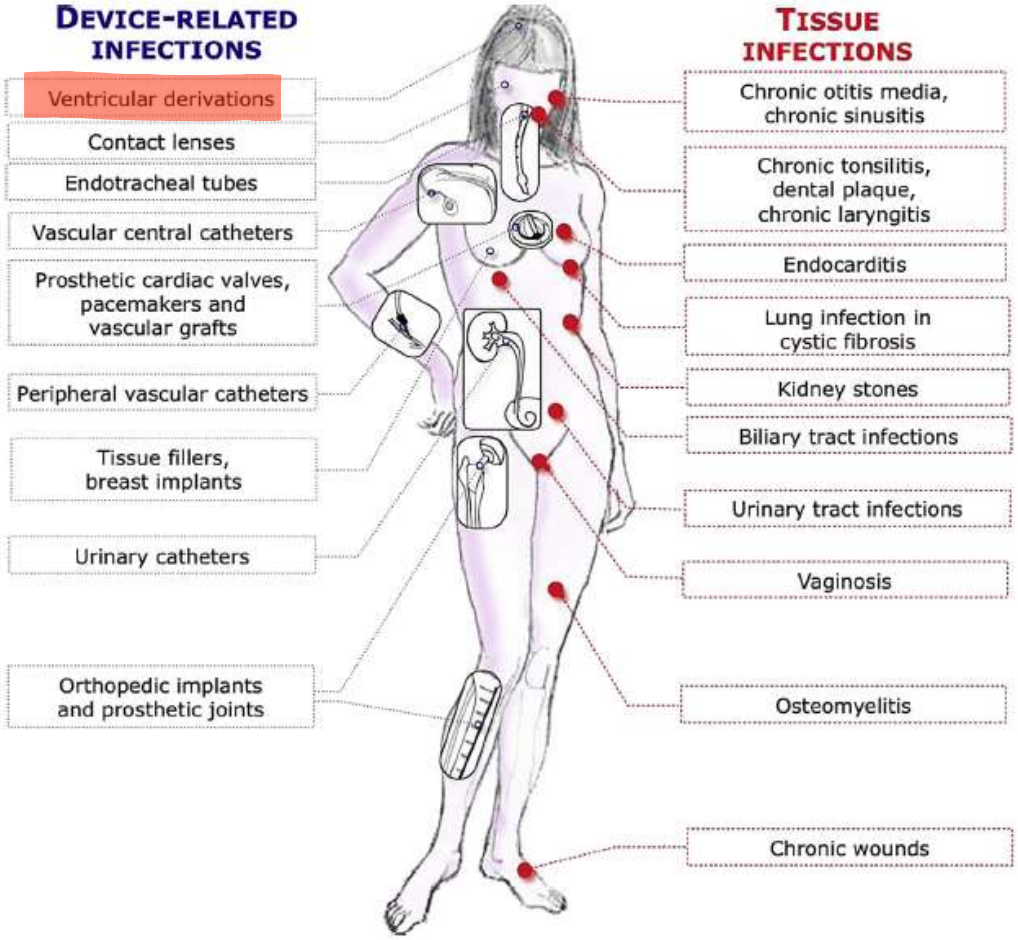


FIG. 1. Typical biofilm infections (3) (reproduced with permission).

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REVIEWS

The biofilm matrix

Hans-Curt Flemming and Jost Wingender

Abstract | The microorganisms in biofilms live in a self-produced matrix of hydrated extracellular polymeric substances (EPS) that form their immediate environment. EPS are mainly polysaccharides, proteins, nucleic acids and lipids; they provide the mechanical stability of biofilms, mediate their adhesion to surfaces and form a cohesive, three-dimensional polymer network that interconnects and transiently immobilizes biofilm cells. In addition, the biofilm matrix acts as an external digestive system by keeping extracellular enzymes close to the cells, enabling them to metabolize dissolved, colloidal and solid biopolymers. Here we describe the functions, properties and constituents of the EPS matrix that make biofilms the most successful forms of life on earth.

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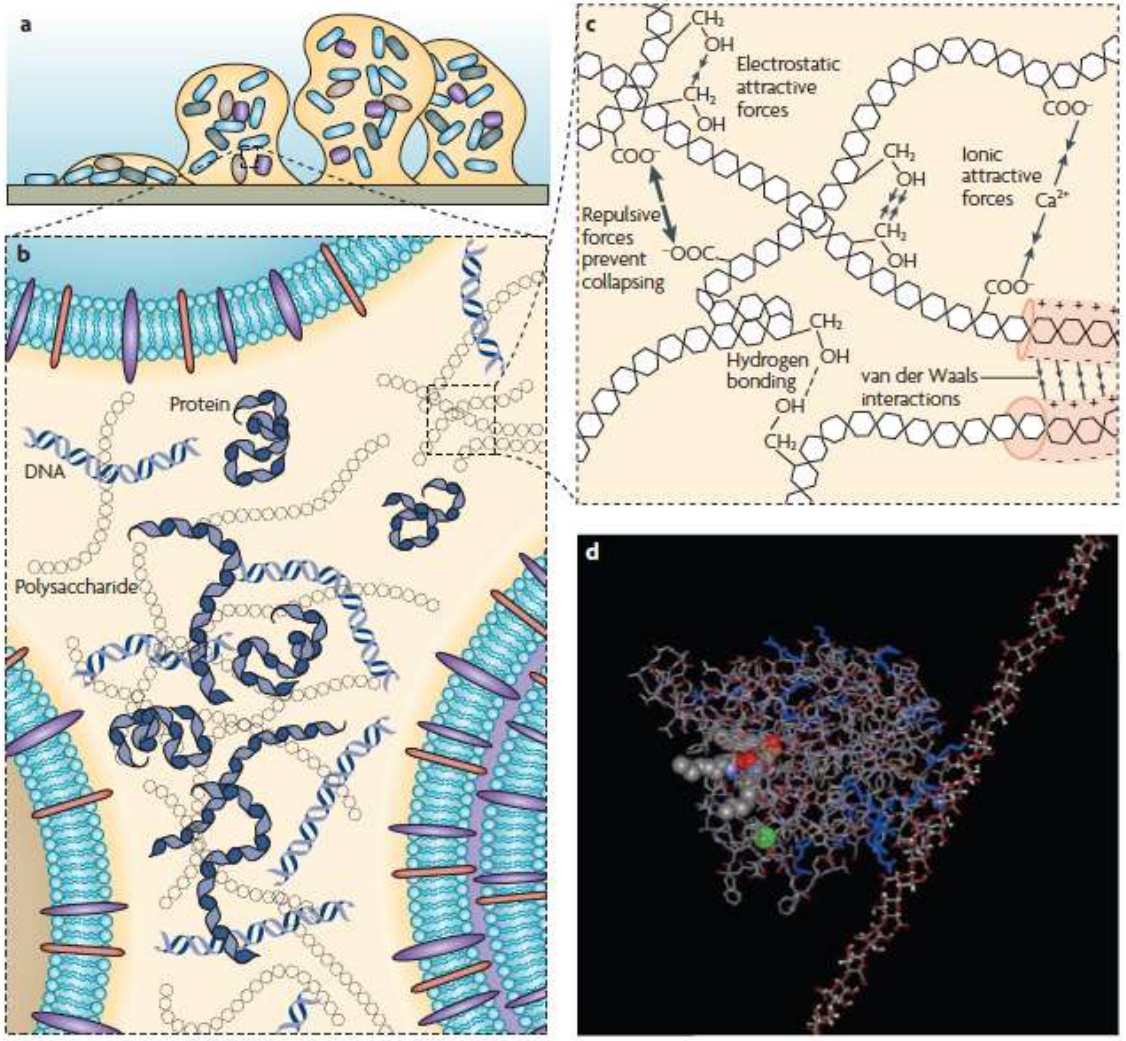
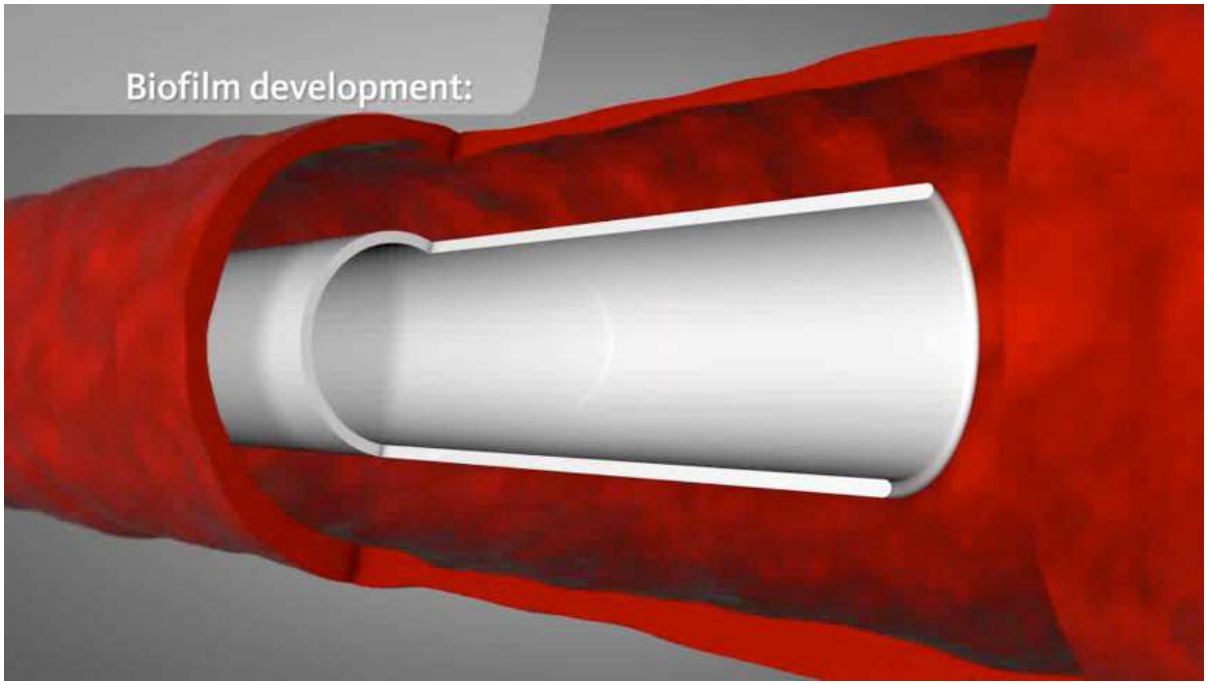


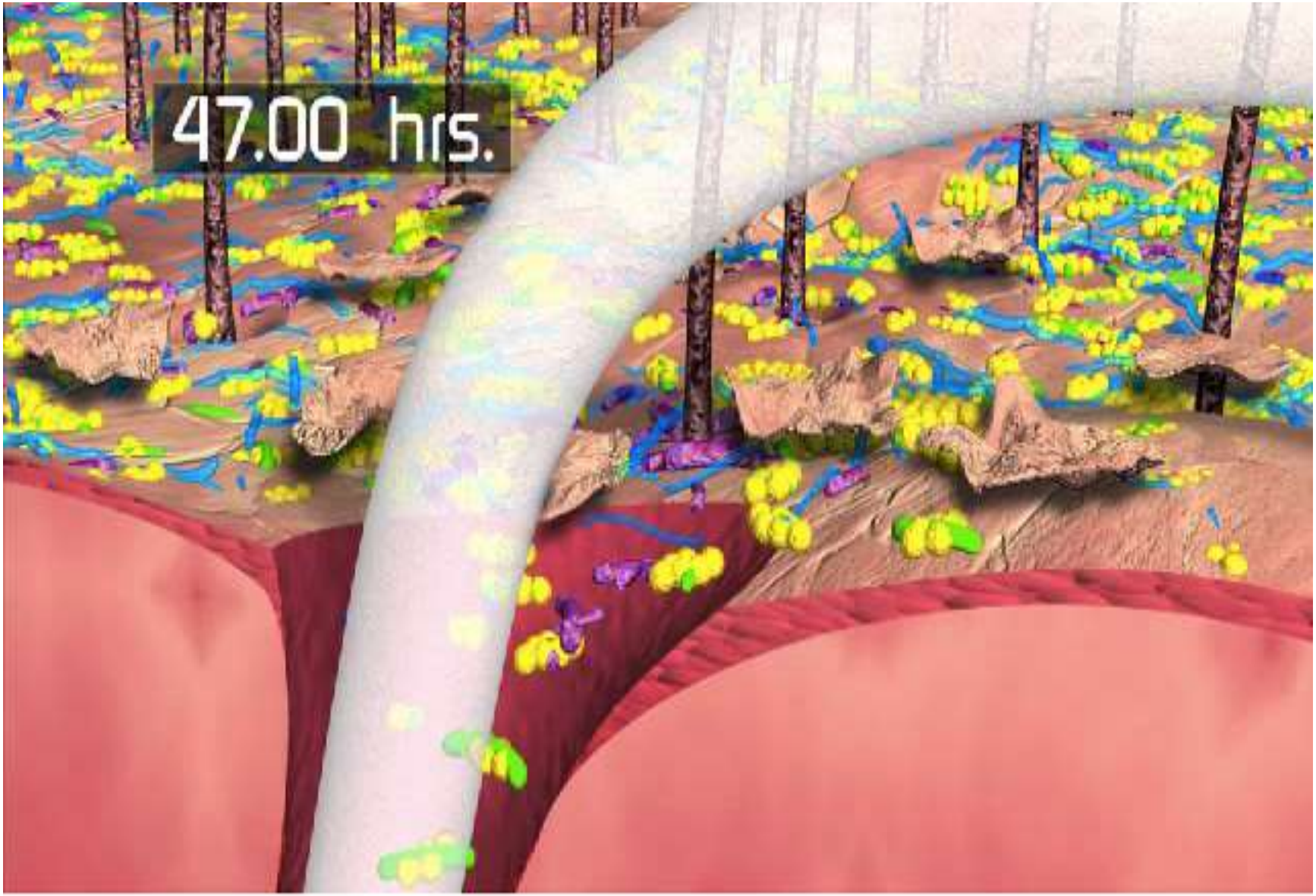
The ECM is composed of water, polysaccharides, proteins, extracellular DNA and lipids (12, 18, 20, 21). ECM provides mechanical stability to biofilms, improve their adhesion onto catheters and form a cohesive, three-dimensional polymer network that interconnects biofilm cells. It also protects microbial cells against external aggressions including host immune defences and antibiotics (20).

Table 1 Summary of biofilm penetration for select antibiotics

Antibiotic class/agent	Microorganism	Extent of penetration	Rate of penetration	Reference
Fluoroquinolones				
Ciprofloxacin	*Bacillus cereus, Pseudomonas fluorescens*	100%	NR	10
	Pseudomonas aeruginosa	100%	Rapid	74
	P. aeruginosa	25%–50%	Rapid	75
	Klebsiella pneumoniae	80%–100%	Rapid	11
	Staphylococcus aureus, Staphylococcus epidermidis	86%–100%	NR	76
Levofloxacin	*P. aeruginosa*	100%	Rapid	75
Rifamycins				
Rifampin	*S. epidermidis*	79% to >90%	Rapid	77,78
Oxazolidinones				
Linezolid	*S. epidermidis*	~100%[a]	Rapid	79
Lipopeptides				
Daptomycin	*S. epidermidis*	≥100%[b]	Rapid	80
Tetracyclines				
Tetracycline	*B. cereus, P. fluorescens*	88%–93%	NR	10
Macrolides				
Erythromycin	*B. cereus, P. fluorescens*	72%–86%	NR	10
	S. epidermidis	45%–93%	Variable/slow	81

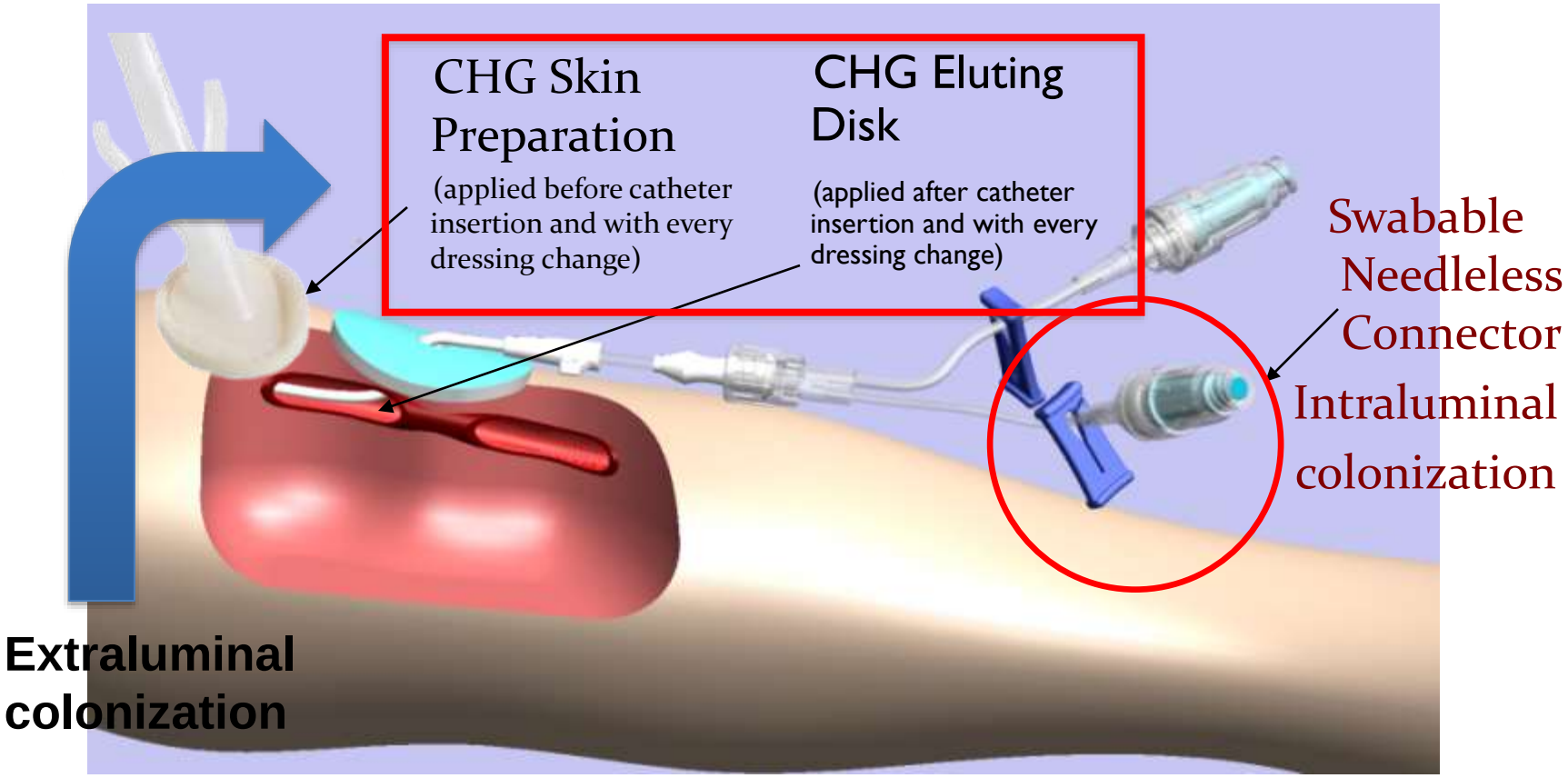
Colonizzazione intraluminale





Courtesy of M. Ryder

Prevention of extra and intraluminal colonization



Modified, Courtesy of R. Garcia, MD

Table 2
Organisms isolated from catheter tip samples

EU countries (n = 132)		Non-EU countries (n = 36)	
Organism	No. (%)	Organism	No. (%)
CNS	68 (51.5%)	CNS	14 (40%)
Candida spp	12 (9.1)	*S aureus*[a]	12 (34.3)
S aureus[a]	8 (6.1)	*Acinetobacter* spp	2 (5.7)
Pseudomonas spp	7 (5.3)	*Corynebacterium* spp	2 (5.7)
Enterobacter spp	6 (4.5)	*Enterococcus* spp	2 (5.7)
Enterococcus spp	6 (4.5)	*Enterobacter* spp	1 (2.9)
Acinetobacter spp	5 (3.8)	*Klebsiella* spp	1 (2.9)
Klebsiella spp	5 (3.8)	*Pseudomonas* spp	1 (2.9)
Proteus spp	4 (3)	Others	1 (2.9)
Escherichia coli	3 (2.3)		
Corynebacterium spp	2 (1.5)		
Others	6 (4.5)		

Abbreviations: CNS, coagulase-negative staphylococci; EU, European Union.

[a] $P < .0001$.

Data from Munoz P, Bouza E, San Juan R, et al. Clinical-epidemiological characteristics and outcome of patients with catheter-related bloodstream infections in Europe (ESGNI-006 Study). Clin Microbiol Infect. 2004;10(9):843–5.

IMPACT OF 500,000 CVC-RELATED BSIs / YEAR IN U.S. HEALTHCARE CENTERS

Prolongation of hospitalization, 11 - 23 days

- Arnow PM, et al. *Clin Infect Dis* 1993;16:778-784
- Pattet D, et al. *JAMA* 1994;271:1598-1601
- Collignon PJ. *Med J Aust* 1994;161:374-378
- Rello J, et al. *Am J Respir Crit Care Med* 2000;162:1027-1030

Cost to healthcare system, $33,000-$35,000/episode

- Arnow PM, et al. *Clin Infect Dis* 1993;16:778-784
- Pattet D, et al. *JAMA* 1994;271:1598-1601
- Rello J, et al. *Am J Respir Crit Care Med* 2000;162:1027-1030

Attributable mortality, 12-25%

- Smith RL, et al. *Chest* 1991;100:164-167
- Arnow PM, et al. *Clin Infect Dis* 1993;16:778-784
- Pattet D, et al. *JAMA* 1994;271:1598-1601
- Collignon PJ. *Med J Aust* 1994;161:374-378

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REVIEW

Epidemiology, medical outcomes and costs of catheter-related bloodstream infections in intensive care units of four European countries: literature- and registry-based estimates

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[b] *Department of Microbiology, Royal Liverpool Hospital, Liverpool, UK*
[c] *NeosHealth, Binningen, Switzerland*
[d] *Cemka Eval, Bourg-la-Reine, France*
[e] *Johnson&Johnson Wound Management (a division of Ethicon), Issy-Les-Moulineaux, France*

Received 5 November 2008; accepted 18 December 2008

Table I Key results for the four European countries

	France	Germany	Italy	UK
Total population 2005[a] (millions)	60.2	82.5	57.5	59.8
No. of implanted central venous and arterial catheters in ICUs	1 000 000	1 750 000	490 000	210 000
Incidence rate of CRBSIs (per 1000 catheter days)	1.23	1.5	2.0	4.2
No. of CRBSIs per year	14 400	8400	8500	8940
Estimate of mortality related to CRBSI	1580	1000–1300	1500	NA
Additional LOS per CRBSI episode (in days)	9.5–14	4.8–7.2 (modelled)	12.7	1.9–4.0 (modelled)
No. of ICU days due to CRBSIs per year	136 700–201 475	40 000–60 000	109 220	15 960–33 600
Additional cost per CRBSI episode	€7,730–€11,380	€4,200	€13,030	£2,949–£6,209 (€4,392–€9,251)
Annual costs related to CRBSIs (€ million) for the healthcare systems	100.0–130.0	59.6–78.1	81.6	£19.1–£36.2 (€28.5–€53.9)

ICU, intensive care unit; CRBSI, catheter-related bloodstream infections; LOS, length of stay.
[a] Data from Organisation for Economic Co-operation and Development (OECD).

Original Investigation

Health Care–Associated Infections
A Meta-analysis of Costs and Financial Impact on the US Health Care System

Eyal Zimlichman, MD, MSc; Daniel Henderson, MD, MPH; Orly Tamir, PhD, MSc, MHA; Calvin Franz, PhD; Peter Song, BSE; Cyrus K. Yamin, MD; Carol Keohane, BSN, RN; Charles R. Denham, MD; David W. Bates, MD, MSc

IMPORTANCE Health care–associated infections (HAIs) account for a large proportion of the harms caused by health care and are associated with high costs. Better evaluation of the costs of these infections could help providers and payers to justify investing in prevention.

OBJECTIVE To estimate costs associated with the most significant and targetable HAIs.

DATA SOURCES For estimation of attributable costs, we conducted a systematic review of the literature using PubMed for the years 1986 through April 2013. For HAI incidence estimates, we used the National Healthcare Safety Network of the Centers for Disease Control and Prevention (CDC).

STUDY SELECTION Studies performed outside the United States were excluded. Inclusion criteria included a robust method of comparison using a matched control group or an appropriate regression strategy, generalizable populations typical of inpatient wards and critical care units, methodologic consistency with CDC definitions, and soundness of handling economic outcomes.

DATA EXTRACTION AND SYNTHESIS Three review cycles were completed, with the final iteration carried out from July 2011 to April 2013. Selected publications underwent a secondary review by the research team.

MAIN OUTCOMES AND MEASURES Costs, inflated to 2012 US dollars.

RESULTS Using Monte Carlo simulation, we generated point estimates and 95% CIs for attributable costs and length of hospital stay. On a per-case basis, central line–associated bloodstream infections were found to be the most costly HAIs at $45 814 (95% CI, $30 919-$65 245), followed by ventilator-associated pneumonia at $40 144 (95% CI, $36 286-$44 220), surgical site infections at $20 785 (95% CI, $18 902-$22 667), *Clostridium difficile* infection at $11 285 (95% CI, $9118-$13 574), and catheter-associated urinary tract infections at $896 (95% CI, $603-$1189). The total annual costs for the 5 major infections were $9.8 billion (95% CI, $8.3-$11.5 billion), with surgical site infections contributing the most to overall costs (33.7% of the total), followed by ventilator-associated pneumonia (31.6%), central line–associated bloodstream infections (18.9%), *C difficile* infections (15.4%), and catheter-associated urinary tract infections (<1%).

CONCLUSIONS AND RELEVANCE While quality improvement initiatives have decreased HAI incidence and costs, much more remains to be done. As hospitals realize savings from prevention of these complications under payment reforms, they may be more likely to invest in such strategies.

Editor's Note page 2046

Supplemental content at jamainternalmedicine.com

CME Quiz at jamanetworkcme.com and **CME Questions** page 2100

Author Affiliations: Author affiliations are listed at the end of this article.

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JAMA Intern Med. 2013;173(22):2039-2046. doi:10.1001/jamainternmed.2013.9763
Published online September 2, 2013.

Table 1. Estimates of Costs and LOS Attributed to the 5 Major Health Care–Associated Infections for the US Adult Inpatient Population at Acute Care Hospitals[a]

Health Care–Associated Infection Type	Cost, 2012 $US	LOS (as Total, ICU), d
Surgical site infections	20 785 (18 902-22 667)[b]	11.2 (10.5-11.9)[b]
MRSA	42 300 (4005-82 670)[b]	23.0 (14.3-31.7)[b]
Central line-associated bloodstream infections	45 814 (30 919-65 245)[b,c]	10.4, 6.9 (6.9-15.2, 3.5-9.6)[b,c]
MRSA	58 614 (16 760-174 755)[c]	15.7 (7.9-36.5)[c]
Catheter-associated urinary tract infections	896 (603-1189)[b]	NR
Ventilator-associated pneumonia	40 144 (36 286-44 220)[b,c]	13.1, 8.4 (11.9-14.3, 7.8-9.0)[b,c]
Clostridium difficile infections	11 285 (9118-13 574)[b]	3.3 (2.7-3.8)[b]

Abbreviations: ICU, intensive care unit; LOS, length of hospital stay; MRSA, methicillin-resistant *Staphylococcus aureus*; NR, not reported.

[a] Data are reported as mean (95% CI) values.

[b] Estimates obtained from literature and 100 000-trial Monte Carlo simulations using triangular distribution.

[c] Estimates obtained from literature and 100 000-trial Monte Carlo simulations, using general distribution.

Table 2. Epidemiology of Health Care–Associated Infections Among US Adult Inpatients (Including ICUs) at Acute Care Hospitals, 2009[a]

Health Care-Associated Infection Type	Incidence Rate	Population at Risk	Cumulative Incidence
Surgical site infections	1.98[b]	8 020 658	158 639
MRSA	0.29[b]	8 020 658	23 417
Central line–associated bloodstream infections	1.27[c]	31 695 922	40 411
MRSA	0.21[c]	31 695 922	6638
Catheter-associated urinary tract infections	1.87[c]	41 115 000	77 079
Ventilator-associated pneumonia	1.33[c]	23 392 785	31 130
Clostridium difficile infections	3.85[d]	34 716 079	133 657
Total health care–associated infections	NA	NA	440 916

Abbreviations: ICU, intensive care unit; MRSA, methicillin-resistant *Staphylococcus aureus*; NA, not applicable.

[a] Estimates based on data from National Healthcare Safety Network (2009) and National Inpatient Sample (2009). Incidence rate for *Clostridium difficile* infections based on systematic review of literature.

[b] Incidence rate in cases per 100 patient procedures; population at risk in total patient procedures.

[c] Incidence rate in cases per 1000 device-days; population at risk in total device-days.

[d] Incidence rate in cases per 1000 patient-days; population at risk in total patient-days.

Table 3. Total Attributable Financial Impacts of Health Care–Associated Infections in US Adult Inpatients at Acute Care Hospitals, 2009[a]

Health Care-Associated Infection Type	Costs		
	Total	Lower Bound	Upper Bound
Surgical site infections	3 297 285 451	2 998 570 584	3 595 841 680
MRSA	990 539 052	93 785 080	1 935 883 296
Central line-associated blood-stream infections	1 851 384 347	1 249 464 195	2 636 608 279
MRSA	389 081 519	111 253 391	1 160 029 019
Catheter-associated urinary tract infections	27 884 193	18 765 813	37 002 574
Ventilator-associated pneumonia	3 094 270 016	2 796 898 212	3 408 445 101
Clostridium difficile infections	1 508 347 070	1 218 707 008	1 814 293 587
Total	**9 779 171 077**	**8 282 405 811**	**11 492 191 220**

Abbreviation: MRSA, methicillin-resistant *Staphylococcus aureus*.

[a] All cost estimates reported in 2012 $US rounded to the dollar.

The Risk of Bloodstream Infection in Adults With Different Intravascular Devices: A Systematic Review of 200 Published Prospective Studies

Dennis G. Maki, Dalniel M. Kluger, Christopher J. Crnich

Mayo Clin Proc. September 2006; 81 (9): 1159-1171

TABLE 3. **Rates of Intravascular Device–Related Bloodstream Infection Caused by Various Types of Devices Used for Vascular Access***

Device	No. of studies	No. of catheters	No. of IVD (d)	No. of BSIs	Rates of IVD-related bloodstream infection			
					Per 100 devices		Per 1000 IVD-days	
					Pooled mean	95% CI	Pooled mean	95% CI
Peripheral IV catheters								
Plastic catheters	110	10,910	28,720	13	0.1	0.1-0.2	0.5	0.2-0.7
Steel needles	1	148	350	3	2.0	0.0-4.3	8.6	0.0-18.2
Venous cutdown	1	27	111	1	3.7	0.0-10.8	9.0	0.0-26.6
Midline catheters	3	514	9251	2	0.4	0.0-0.9	0.2	0.0-0.5
Arterial catheters for hemodynamic monitoring	14	4366	21,397	37	0.8	0.6-1.1	1.7	1.2-2.3
Peripherally inserted central catheters								
Inpatient and outpatient	15	3566	105,839	112	3.1	2.6-3.7	1.1	0.9-1.3
Inpatient	6	625	7137	15	2.4	1.2-3.6	2.1	1.0-3.2
Outpatient	9	2813	98,702	97	3.5	2.8-4.1	1.0	0.8-1.2
Short-term noncuffed central venous catheters								
Nonmedicated								
Nontunneled	79	20,226	322,283	883	4.4	4.1-4.6	2.7	2.6-2.9
Tunneled	9	741	20,065	35	4.7	3.2-6.2	1.7	1.2-2.3
Medicated								
Chlorhexidine-silver-sulfadiazine	18	3367	54,054	89	2.6	2.1-3.2	1.6	1.3-2.0
Minocycline-rifampin	3	690	5797	7	1.0	0.3-1.8	1.2	0.3-2.1
Silver impregnated	2	154	1689	8	5.2	1.7-8.7	4.7	1.5-8.0
Silver iontophoretic	2	396	4796	16	4.0	2.1-6.0	3.3	1.7-5.0
Benzalkonium chloride	1	277	2493	12	4.3	1.9-6.7	4.8	2.1-7.5
Pulmonary artery catheters	13	2057	8143	30	1.5	0.9-2.0	3.7	2.4-5.0
Hemodialysis catheters								
Temporary, noncuffed	16	3066	51,840	246	8.0	7.0-9.0	4.8	4.2-5.3
Long-term, cuffed and tunneled	16	2806	373,563	596	21.2	19.7-22.8	1.6	1.5-1.7
Cuffed and tunneled central venous catheters	29	4512	622,535	1013	22.5	21.2-23.7	1.6	1.5-1.7
Subcutaneous venous ports								
Central	14	3007	983,480	81	3.6	2.9-4.3	0.1	0.0-0.1
Peripheral	3	579	162,203	23	4.0	2.4-5.6	0.1	0.1-0.2
Intra-aortic balloon pumps	1	101	414	3	3.0	0.0-6.3	7.3	0.0-15.4
Left ventricular assist devices	3	157	19,653	41	26.1	19.2-33.0	2.1	1.5-2.7

*BSI = bloodstream infection; CI = confidence interval; IV = intravenous; IVD = intravascular device.

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A Review of Risk Factors for Catheter-Related Bloodstream Infection Caused by Percutaneously Inserted, Noncuffed Central Venous Catheters

Implications for Preventive Strategies

NASIA SAFDAR, M.D., DANIEL M. KLUGER, M.D., AND DENNIS G. MAKI, M.D.

TABLE 1. Risk factors for catheter-related bloodstream infection with noncuffed percutaneously inserted CVCs

Risk Factor (No. of Studies)	Risk*
Patient characteristics	
Age (3)	1.0
Female sex (6)	0.1–1.0
Underlying disease	
AIDS (2)	4.8
Low CD4 (1)	3.45
Neutropenia (2)	1.0–15.1
GI disease (1)	2.4
Surgical service (1)	4.4
ICU/CCU placement (3)	0.4–6.7
Extended hospitalization (3)	1.0–6.7
Coexistence of other intravascular devices (2)	1.0–3.8
Systemic antibiotics (3)	0.1–0.45
Active infection at any other site (2)	8.7–9.2
Low birthweight (2)	5.13–9.1
High APACHE III score (1)	4.19
Mechanical ventilation (1)	1.97–2.5
Transplantation (1)	2.6
Features of insertion site	
Insertion by house-staff or student (1)	1.0
Difficult insertion (1)	5.4
Maximal sterile barriers (1)	0.2
Tunneling a noncuffed CVC (2)	0.3–1.0
Insertion in an old site over a guidewire (8)	1.0–3.3
Insertion site	
Internal jugular vein (6)	1.0–3.3
Subclavian vein (5)	0.4–1.0
Femoral vein (2)	3.3–4.83
Defatting insertion site (1)	1.0
Cutaneous antiseptic used	
Chlorhexidine vs povidone-iodine (2)	0.2–0.9
Topical anti-infective cream	
Povidone-iodine (1)	1.1
Mupirocin (1)	0.3
Chlorhexidine-impregnated dressing (3)	0.3–1.2
Type of dressing (transparent vs gauze) (6)	0.7–2.8
Colonization of insertion site (4)	6.3–56.5

Catheter characteristics	
Multi-lumen vs single-lumen catheter (8)	1.0–6.5
Anti-infective coating	
Antibacterial (2)	0.1–0.3
Antiseptic (10)	0.2–1.0
Antibiotic vs antiseptic (2)	0.1–1.0
Silver-impregnated cuff (6)	0.3–1.0
Contamination-resistant hub (1)	0.2
Subsequent catheter management	
Routine change of IV set (2)	1.0
Staffing in SICU (Nurse: patient ratio) (1)	
1:2.0	61.5
1:1.5	15.6
1:1.2	4.0
1:1	1.0
Inappropriate catheter usage (1)	5.3
Duration of catheter > 7 days (5)	1.0–8.7
Colonization of catheter hub (3)	17.9–44.1
Disinfection of catheter hub (1)	1.2
Blood sampling (1)	1.4
Heparinization (1)	0.9
Parenteral nutrition (2)	1.04–4.79

Abbreviations: CVC = central venous catheter; AIDS = acquired immunodeficiency syndrome; GI = gastrointestinal tract; ICU = intensive care unit; CCU = critical care unit; SICU = surgical intensive care unit.

*Relative risk or odds ratio.

GUIDELINES

Guidelines for the Prevention of Intravascular Catheter–Related Infections

Naomi P. O'Grady,[1] Mary Alexander,[2] E. Patchen Dellinger,[5] Julie L. Gerberding,[6] Stephen O. Heard,[3] Dennis G. Maki,[8] Henry Masur,[1] Rita D. McCormick,[9] Leonard A. Mermel,[10] Michele L. Pearson,[7] Issam I. Raad,[11] Adrienne Randolph,[4] and Robert A. Weinstein[12]

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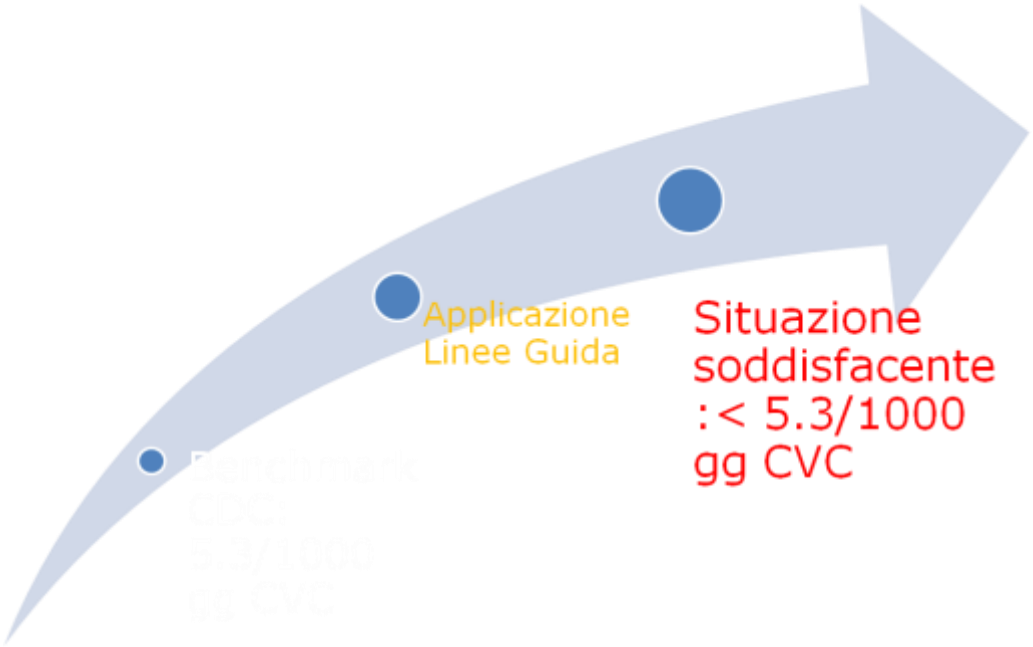
1058-4838/2002/3511-0001

IDSA
Infectious Diseases Society of America


Applicazione
Linee Guida
Situazione
soddisfacente
:< 5.3/1000
gg CVC

Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

The goal of an effective prevention program should be the elimination of CRBSI from all patient-care areas. Although this is challenging, programs have demonstrated success, but sustained elimination requires continued effort. The goal of the measures discussed in this document is to reduce the rate to as low as feasible given the specific patient population being served, the universal presence of microorganisms in the human environment, and the limitations of current strategies and technologies.


LEI HA UN TUMORE.
E SONO 10.
MAURO BIANI 2008

Mr MRSA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HOSPITAL
YOU ARE
HERE
CHAFF.


UNIVERSAL HEALTHCARE

For HAIs, it is widely demonstrated that all are preventable, but some are partly preventable and some others (CLABSI), on the contrary, are completely preventable and avoidable.

Journal of Hospital Infection (2007) 65(S2) 3-9

Available online at www.sciencedirect.com

SCIENCE DIRECT

www.elsevierhealth.com/journals/jhin

The United States approach to strategies in the battle against healthcare-associated infections, 2006: transitioning from benchmarking to zero tolerance and clinician accountability[1]

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Jason and Jarvis Associates, Hilton Head Island, SC, USA

KEYWORDS
Nosocomial infections;
Healthcare-associated infections;
Infection control;
Prevention

Summary Approximately 2,000,000 healthcare-associated infections (HAIs) annually occur in US healthcare facilities and lead to approximately 60,000–90,000 deaths and cost $17–29 billion dollars. Such HAIs are an equal, if not more common problem, worldwide. Many evidence-based HAI prevention guidelines exist. However, despite knowing what to do, the challenge remains of getting clinicians to comply with these recommendations. In the USA, a variety of forces, including the public and legislators, are demanding HAI prevention. This is illustrated by the Consumers Union's effort to get legislation in every state for public HAI rate reporting. In addition, a number of profit-making and non-profit-making organizations have initiated major HAI prevention interventions. At least three common themes for these interventions exist. First, no single intervention prevents any HAI; rather a "bundle" approach, using a package of multiple interventions based on evidence provided by the infection control community and implemented by a multidisciplinary team is the model for successful HAI prevention. Second, benchmarking is inadequate and a culture of zero tolerance is required. Third, a culture of accountability and administrative support is required. Such interventions have illustrated that much greater levels of HAI prevention can be accomplished than ever estimated in the past. Implementation of evidence-based HAI prevention interventions should be a high priority for all healthcare facilities to reduce preventable HAIs to the greatest extent possible.

SOUNDING BOARD

Balancing "No Blame" with Accountability in Patient Safety

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

This year marks the 10th anniversary of the Institute of Medicine's report *To Err Is Human*,[1] the document that launched the modern patient-safety movement. Although the movement has spawned myriad initiatives, its main theme, drawn from studies of other high-risk industries that have impressive safety records, boils down to this: Most errors are committed by good, hardworking people trying to do the right thing. Therefore, the traditional focus on identifying who is at fault is a distraction. It is far more productive to identify error-prone situations and settings and to implement systems that prevent caregivers from committing errors, catch errors before they cause harm, or mitigate harm from errors that do reach patients.[2,3]

Most health care providers embraced the "no blame" model as a refreshing change from an errors landscape previously dominated by a malpractice system that was generally judged as punitive and arbitrary. And this shift has unquestion-

Many health care organizations (including our own) have recognized that a unidimensional focus on creating a blame-free culture carries its own safety risks. But despite this recognition, finding the appropriate balance has been elusive, and few organizations have implemented meaningful systems of accountability, particularly for physicians. In this article, we describe some of the barriers to physician accountability, enumerate patient-safety practices that are ready for an accountability approach, and suggest penalties for the failure to adhere to such practices. We focus on situations in which the action (or inaction) of individual physicians poses a clear risk to patients, rather than on the broader issues of clinical competence or disruptive behavior; readers who are interested in the latter issues are referred to other sources.[7,12,13]

"NO BLAME" VERSUS ACCOUNTABILITY

APIC - Targeting Zero

According to IHI's experiences and Campaigns, the best tool to Target Zero Infections is the "Bundle"

What is a "bundle"?

IHI developed the concept of "bundles" to help health care providers more reliably deliver the best possible care for patients undergoing particular treatments with inherent risks. A bundle is a structured way of improving the processes of care and patient outcomes: a small, straightforward set of practices — generally three to five — that, when performed collectively and reliably, have been proven to improve patient outcomes.

IHI.org | A resource from the Institute for Healthcare Improvement

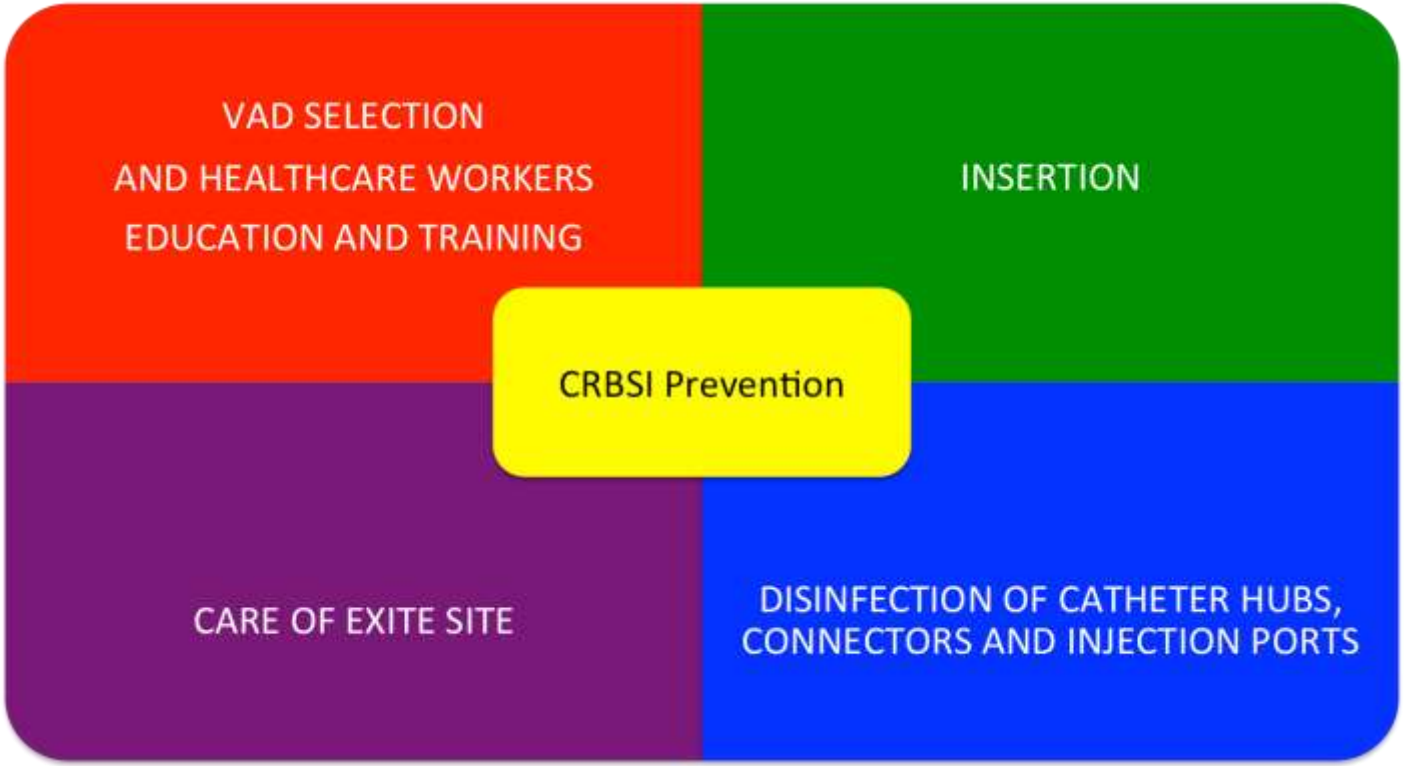
2008

Linee Guida di Riferimento per la prevenzione delle CRBSI

- ❖CDC Atlanta 2002 (Centers for Disease Control, USA)
- ❖RCN 2005 (Royal College of Nurses, UK)
- ❖INS 2006 (Infusion Nursing Society, USA)
- ❖BCSH 2006 (British Committe for Standards in Hematology, UK)
- **❖EPIC 2007 (Evidence -Based Practice in Infection Control, UK)**
- **❖SHEA/IDSA 2008**
- **❖ESPEN 2009**
- **❖RCN 2010**
- **❖INS 2011**
- ***❖CDC 2011***
- ***❖EPIC 3 2014***
- ***❖SHEA 2014***
- ***❖INS 2016***
- ***❖RCN 2016***


epic2: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England

R.J. Pratt[a*], C.M. Pellowe[a], J.A. Wilson[a,b], H.P. Loveday[a], P.J. Harper[a], S.R.L.J. Jones[a], C. McDougall[b], M.H. Wilcox[c]


VAD SELECTION
AND HEALTHCARE WORKERS
EDUCATION AND TRAINING
INSERTION
CRBSI Prevention
CARE OF EXITE SITE
DISINFECTION OF CATHETER HUBS,
CONNECTORS AND INJECTION PORTS

Central Line Bundle

- Hand Hygiene
- Maximal Barrier Precautions Upon Insertion
- Chlorhexidine Skin Antisepsis
- Optimal Catheter Site Selection, with Subclavian Vein as the Preferred Site for Non-Tunneled Catheters
- Daily Review of Line Necessity with Prompt Removal of Unnecessary Lines

www.ihi.org, 2008

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 DECEMBER 28, 2006 VOL. 355 NO. 26

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

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., and Christine Goeschel, R.N., M.P.A.

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RESEARCH GROUP

JOHNS HOPKINS QUALITY AND SAFETY RESEARCH GROUP (QSRG)

ON THE CUSP: STOP BSI

CENTRAL LINE-ASSOCIATED BLOOD STREAM INFECTION TOOLKIT

How to Use This Toolkit

The purpose of this toolkit is to support your efforts to implement evidence-based practices and eliminate Central Line Associated Blood Stream Infections (CLABSIs) in your clinical area. The strategies in this toolkit have nearly eliminated CLABSIs in participating Michigan ICUs (Appendix A). These strategies have been adopted by over 100 ICUs in large and small, academic and community hospitals that we have worked with to date. Most of these ICUs have demonstrated a significant reduction in their CLABSI rates and many have not had a CLABSI in >6 months.

Nevertheless, your leadership is needed to achieve these results in your clinical area. Most of your efforts will be working with staff that insert and assist with the insertion of central lines. We developed a model to help disseminate this, and other, interventions. This model includes 4 stages that answer the following questions:

1. **Engage**: How will this make the world a better place?
2. **Educate**: How will we do this?
3. **Execute**: What do I need to do?
4. **Evaluate**: How will we know we made a difference?

This toolkit provides details of what you should do in each of these stages. In the appendices, we provide all the tools you will need to eliminate CLABSIs in your clinical area; the rest is up to you.

Checklist for Prevention of Central Line Associated Blood Stream Infections

Based on 2011 CDC guideline for prevention of intravascular catheter-associated bloodstream infections: http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf

For Clinicians:

Promptly remove unnecessary central lines

- ☐ Perform daily audits to assess whether each central line is still needed

Follow proper insertion practices

- ☐ Perform hand hygiene before insertion
- ☐ Adhere to aseptic technique
- ☐ Use maximal sterile barrier precautions (i.e., mask, cap, gown, sterile gloves, and sterile full-body drape)
- ☐ Perform skin antisepsis with >0.5% chlorhexidine with alcohol
- ☐ Choose the best site to minimize infections and mechanical complications
  - Avoid femoral site in adult patients
- ☐ Cover the site with sterile gauze or sterile, transparent, semipermeable dressings

Handle and maintain central lines appropriately

- ☐ Comply with hand hygiene requirements
- ☐ Scrub the access port or hub immediately prior to each use with an appropriate antiseptic (e.g., chlorhexidine, povidone iodine, an iodophor, or 70% alcohol)
- ☐ Access catheters only with sterile devices
- ☐ Replace dressings that are wet, soiled, or dislodged
- ☐ Perform dressing changes under aseptic technique using clean or sterile gloves

For Facilities:

- ☐ Empower staff to stop non-emergent insertion if proper procedures are not followed
- ☐ "Bundle" supplies (e.g., in a kit) to ensure items are readily available for use
- ☐ Provide the checklist above to clinicians, to ensure all insertion practices are followed
- ☐ Ensure efficient access to hand hygiene
- ☐ Monitor and provide prompt feedback for adherence to hand hygiene
  http://www.cdc.gov/handhygiene/Measurement.html
- ☐ Provide recurring education sessions on central line insertion, handling and maintenance

Supplemental strategies for consideration:

- 2% Chlorhexidine bathing
- Antimicrobial/Antiseptic-impregnated catheters
- Chlorhexidine-impregnated dressings

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

Bundle' GAVeCeLT per la prevenzione delle infezioni associate a cateteri venosi centrali non tunnellizzati a breve e medio termine

- Igiene delle mani e Massime precauzioni di barriera durante l'impianto del catetere venoso
- Scelta appropriata del sito di inserzione (in ordine di preferenza: metà braccio, zona sottoclaveare, zona sopraclaveare, collo, inguine)
- Impianto ecoguidato, ovunque possibile, sia per i cateteri a inserzione centrale che per i cateteri a inserzione periferica
- Utilizzo di clorexidina al 2% per la disinfezione cutanea prima dell'inserzione nonché per la disinfezione continua o discontinua dell'exit site
- Impiego di "sutureless devices" per il fissaggio del catetere, ovunque possibile
- Impiego di medicazioni semipermeabili trasparenti, ovunque possibile
- Rimozione immediata del catetere venoso centrale non più indispensabile

GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

Targeting zero CLABSI in patients with PICC lines: a case-control study

G. Scoppettuolo§, L. Dolcetti§, C. Taraschi§, C. Chiarini§, C. Donato§, S. Lardo§, A. La Greca*, M. Pittiruti*
§ Clinic of Infectious Diseases, * Dpt. of Surgey, Catholic University, Rome

AVA 2011

Patients and Methods

- Setting: Clinic of Infectious Diseases, Catholic University, Rome
- Study: Case-Control (1:3)
- Duration: 12 months

Results

	CASES (Infectious Diseases)	CONTROLS (Other wards)	P
CLABSI	0	14	< 0.001
CLABSI/1000 catheter days	0	2.66	< 0.001
Diagnosis - **DTP** - **Blood culture + tip culture**		10 4	
Median time for CLABSI onset	NA	21+12	
Etiology of CLABSI - **Candida albicans** - **Candida parapsilosis** - **CONS** - **S. aureus** - **E. coli** - **K. pneumoniae**	NA	3 2 3 1 3 2	
CLABSI related deaths	0	0	NS

Pittiruti et al. Critical Care 2012, 16:R21
http://ccforum.com/content/16/1/R21

CRITICAL CARE

RESEARCH Open Access

Clinical experience with power-injectable PICCs in intensive care patients

Mauro Pittiruti[1*], Alberto Brutti[2], Davide Celentano[2], Massimiliano Pomponi[2], Daniele G Biasucci[2], Maria Giuseppina Annetta[2] and Giancarlo Scoppettuolo[3]

See related Letter by Zampieri,

http://ccforum.com/content/16/2/425

Abstract

Introduction: In the ICU, peripherally inserted central catheters (PICCs) may be an alternative option to standard central venous catheters, particularly in patients with coagulation disorders or at high risk for infection. Some limits of PICCs (such as low flow rates) may be overcome with the use of power-injectable catheters.

Methods: We retrospectively reviewed all of the power-injectable PICCs inserted in adult and pediatric patients in the ICU during a 12-month period, focusing on the rate of complications at insertion and during maintenance.

Results: We collected 89 power-injectable PICCs (in adults and in children), both multiple and single lumen. All insertions were successful. There were no major complications at insertion and no episodes of catheter-related bloodstream infection. Non-infective complications during management were not clinically significant. There was one episode of symptomatic thrombosis during the stay in the ICU and one episode after transfer of a patient to a non-intensive ward.

Conclusion: Power-injectable PICCs have many advantages in the ICU: they can be used as multipurpose central lines for any type of infusion including high-flow infusion, for hemodynamic monitoring, and for high-pressure injection of contrast media during radiological procedures. Their insertion is successful in 100% of cases and is not associated with significant risks, even in patients with coagulation disorders. Their maintenance is associated with an extremely low rate of infective and non-infective complications.

Format: Abstract Send to

J Vasc Access. 2017 Nov 8:0. doi: 10.5301/jva.5000797. [Epub ahead of print]

Targeting zero catheter-related bloodstream infections in pediatric intensive care unit: a retrospective matched case-control study.

Biasucci DG[1], Pittiruti M[2], Taddei A[3], Picconi E[1], Pizza A[1], Celentano D[1], Piastra M[1], Scoppettuolo G[4], Conti G[1].

Author information

Abstract

INTRODUCTION: The aim of this study was to evaluate the effectiveness and safety of a new three-component 'bundle' for insertion and management of centrally inserted central catheters (CICCs), designed to minimize catheter-related bloodstream infections (CRBSIs) in critically ill children.

METHODS: Our 'bundle' has three components: insertion, management, and education. Insertion and management recommendations include: skin antisepsis with 2% chlorhexidine; maximal barrier precautions; ultrasound-guided venipuncture; tunneling of the catheter when a long indwelling time is expected; glue on the exit site; sutureless securement; use of transparent dressing; chlorhexidine sponge dressing on the 7th day; neutral displacement needle-free connectors. All CICCs were inserted by appropriately trained physicians proficient in a standardized simulation training program.

RESULTS: We compared CRBSI rate per 1000 catheters-days of CICCs inserted before adoption of our new bundle with that of CICCs inserted after implementation of the bundle. CICCs inserted after adoption of the bundle remained in place for a mean of 2.2 days longer than those inserted before. We found a drop in CRBSI rate to 10%, from 15 per 1000 catheters-days to 1.5.

CONCLUSIONS: Our data suggest that a bundle aimed at minimizing CR-BSI in critically ill children should incorporate four practices: (1) ultrasound guidance, which minimizes contamination by reducing the number of attempts and possible break-down of aseptic technique; (2) tunneling the catheter to obtain exit site in the infra-clavicular area with reduced bacterial colonization; (3) glue, which seals and protects the exit site; (4) simulation-based education of the staff.

PMID: 29148002 DOI: 10.5301/jva.5000797

BUNDLE 2017

- VERIFICA DELLA CORRETTA INDICAZIONE ALL'INSERIMENTO DEL CVC
- IGIENE DELLE MANI CON GEL IDROALCOLICO PRIMA DELL'IMPIANTO E PRIMA E DOPO OGNI MANOVRA SUL CVC E IMPIEGO DI KIT DI INSERIMENTO CONTENENTI ANCHE LE MASSIME PRECAUZIONI DI BARRIERA
- SCELTA CORRETTA DEL SITO DI INSERZIONE, UTILIZZANDO I PICC COME CATETERI DI SCELTA
- IMPIANTO ECOGUIDATO, OVUNQUE POSSIBILE, SIA PER I CATETERI A INSERZIONE CENTRALE CHE PER I CATETERI A INSERZIONE PERIFERICA
- UTILIZZO DI CLOREXIDINA AL 2% IN APPLICATORI MONODOSE STERILI PER L'ANTISEPSI CUTANEA AL MOMENTO DELL'IMPIANTO E PER LA GESTIONE DELL'EXIT SITE AL CAMBIO DI MEDICAZIONE
- UTILIZZO DI DISPOSITIVI A RILASCIO CONTINUO DI CLOREXIDINA PER LA PROTEZIONE DELL'EXIT SITE
- IMPIEGO DI "SUTURELESS DEVICES" PER IL FISSAGGIO DEL CATETERE
- IMPIEGO DI MEDICAZIONI SEMIPERMEABILI TRASPARENTI, OVUNQUE POSSIBILE

BUNDLE 2017

- UTILIZZO DI CIANOACRILATO STERILE PER LA PROTEZIONE DELL'EXIT SITE AL MOMENTO DELL'IMPIANTO
- DISINFEZIONE DEI PUNTI DI ACCESSO (HUB O NEEDLEFREE CONNECTORS DI UN CVC MEDIANTE SCRUBBING CON SOLUZIONI ALCOLICHE (PREFERIBILMENTE CLOREXIDINA 2% IN SOLUZIONE ALCOLICA) OPPURE DISINFEZIONE PASSIVA DEI NFC MEDIANTE PORT PROTECTORS.
- UTILIZZO DI SIRINGHE PRERIEMPITE STERILI PER IL FLUSH E IL LOCK DEI CVC
- UTILIZZO DI UN CARRELLO DEDICATO PER L'IMPIANTO
- UTILIZZO DI CHECKLIST PER LA VERIFICA DELLA CORRETTA APPLICAZIONE DEL BUNDLE
- RIMOZIONE IMMEDIATA DEL CATETERE VENOSO CENTRALE NON PIÙ INDISPENSABILE

Gemelli

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GAVePed
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Grazie per l'attenzione!

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