SEICAV

Sociedad Española de Infecciones Cardiovasculares

I Congreso

de la Sociedad Española de Infecciones Cardiovasculares

Prevención, diagnóstico y tratamiento de infecciones causadas por catéteres endovasculares

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Escola Superior de Ciències de la Salut

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- Consultoria
  - Carefusion
- Fondos para investigación
  - Carefusion

SPECIAL ARTICLE

N ENGL J MED 348;26 WWW.NEJM.ORG JUNE 26, 2003

The Quality of Health Care Delivered to Adults in the United States

Elizabeth A. McGlynn, Ph.D., Steven M. Asch, M.D., M.P.H., John Adams, Ph.D., Joan Keesey, B.A., Jennifer Hicks, M.P.H., Ph.D., Alison DeCristofaro, M.P.H., and Eve A. Kerr, M.D., M.P.H.

Table 3. Adherence to Quality Indicators, Overall and According to Type of Care and Function.

Variable	No. of Indicators	No. of Participants Eligible	Total No. of Times Indicator Eligibility Was Met	Percentage of Recommended Care Received (95% CI)*
Overall care	439	6712	98,649	54.9 (54.3–55.5)
Type of care				
Preventive	38	6711	55,268	54.9 (54.2–55.6)
Acute	153	2318	19,815	53.5 (52.0–55.0)
Chronic	248	3387	23,566	56.1 (55.0–57.3)
Function				
Screening	41	6711	39,486	52.2 (51.3–53.2)
Diagnosis	178	6217	29,679	55.7 (54.5–56.8)
Treatment	173	6707	23,019	57.5 (56.5–58.4)
Follow-up	47	2413	6,465	58.5 (56.6–60.4)

Table 5. Adherence to Quality Indicators, According to Condition.*

Condition	No. of Indicators	No. of Participants Eligible	Total No. of Times Indicator Eligibility Was Met	Percentage of Recommended Care Received (95% CI)
Senile cataract	10	159	602	78.7 (73.3–84.2)
Breast cancer	9	192	202	75.7 (69.9–81.4)
Prenatal care	39	134	2920	73.0 (69.5–76.6)
Low back pain	6	489	3391	68.5 (66.4–70.5)
Coronary artery disease	37	410	2083	68.0 (64.2–71.8)
Hypertension	27	1973	6643	64.7 (62.6–66.7)
Congestive heart failure	36	104	1438	63.9 (55.4–72.4)
Cerebrovascular disease	10	101	210	59.1 (49.7–68.4)
Chronic obstructive pulmonary disease	20	169	1340	58.0 (51.7–64.4)
Depression	14	770	3011	57.7 (55.2–60.2)
Orthopedic conditions	10	302	590	57.2 (50.8–63.7)
Osteoarthritis	3	598	648	57.3 (53.9–60.7)
Colorectal cancer	12	231	329	53.9 (47.5–60.4)
Asthma	25	260	2332	53.5 (50.0–57.0)
Benign prostatic hyperplasia	5	138	147	53.0 (43.6–62.5)
Hyperlipidemia	7	519	643	48.6 (44.1–53.2)
Diabetes mellitus	13	488	2952	45.4 (42.7–48.3)
Headache	21	712	8125	45.2 (43.1–47.2)
Urinary tract infection	13	459	1216	40.7 (37.3–44.1)
Community-acquired pneumonia	5	144	291	39.0 (32.1–45.8)
Sexually transmitted diseases or vaginitis	26	410	2146	36.7 (33.8–39.6)
Dyspepsia and peptic ulcer disease	8	278	287	32.7 (26.4–39.1)
Atrial fibrillation	10	100	407	24.7 (18.4–30.9)
Hip fracture	9	110	167	22.8 (6.2–39.5)
Alcohol dependence	5	280	1036	10.5 (6.8–14.6)

Education of Physicians-in-Training Can Decrease the Risk for Vascular Catheter Infection

Robert J. Sherertz, MD; E. Wesley Ely, MD, MPH; Debi M. Westbrook, RN; Kate S. Gledhill, RN; Stephen A. Streed, MS; Betty Kiger, RN; Lenora Flynn, MT; Stewart Hayes, RRT; Sallie Strong, RN; Julia Cruz, MD; David L. Bowton, MD; Todd Hulgan, MD; and Edward F. Haponik, MD

Table 3. Comparison of the Number of Catheter-Related and Primary Bloodstream Infections during a 2.5-Year Period in Six Intensive Care Units and One Step-Down Unit

Period*	Catheter-Related Infections†	Primary Bloodstream Infections	All Infections
	←	*n*	→
7/95–12/95	19	39	58
1/96–6/96	13	47	60
7/96–12/96	14	33	47
1/97–6/97	8	35	43
7/97–12/97	18	22	40

* The first course was held in June 1996; the second course was held in June 1997.
† Blood cultures were negative or were not done.

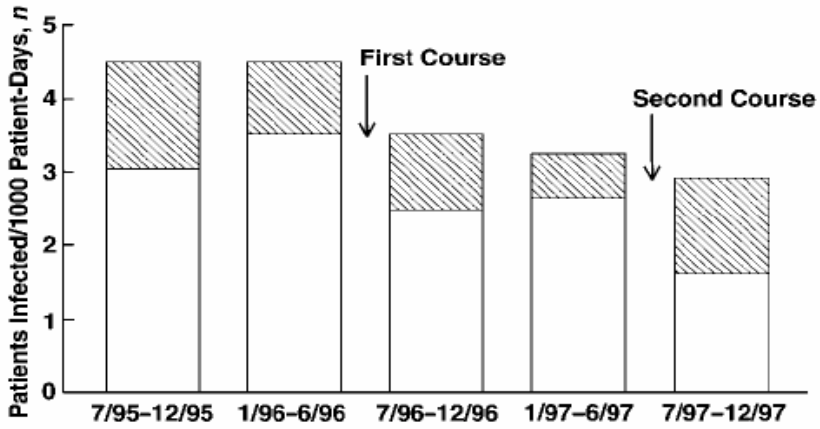

Figure. Effect of a procedure course on the risk for primary bloodstream infection (*white bars*) and catheter-related infection (*striped bars*) in six intensive care units and one step-down unit. The course was offered twice; participants were medical students and physicians completing their first postgraduate year. The difference between the total number of infections per 1000 patient-days before the first course (baseline) compared with that after the first course is statistically significant ($P = 0.01$).

Ann Intern Med. 2000;132:641-648.

EFFECT OF NURSE STAFFING AND ANTIMICROBIAL-IMPREGNATED CENTRAL VENOUS CATHETERS ON THE RISK FOR BLOODSTREAM INFECTIONS IN INTENSIVE CARE UNITS

Juan Alonso-Echanove, MD; Jonathan R. Edwards, MS; Michael J. Richards, MB, BS; Patrick Brennan, MD; Richard A. Venezia, PhD; Janet Keen, RN, MSN; Vivian Ashline, RN; Kathy Kirkland, MD; Ellen Chou, RN, BSN; Mark Hupert, MD; Abigail V. Veeder, BS; Janice Speas, RN, MSN; Judy Kaye, RN, PhD; Kailash Sharma, MD; Aliki Martin, RN, BA; V. Dianne Moroz, RN, MS; Robert P. Gaynes, MD

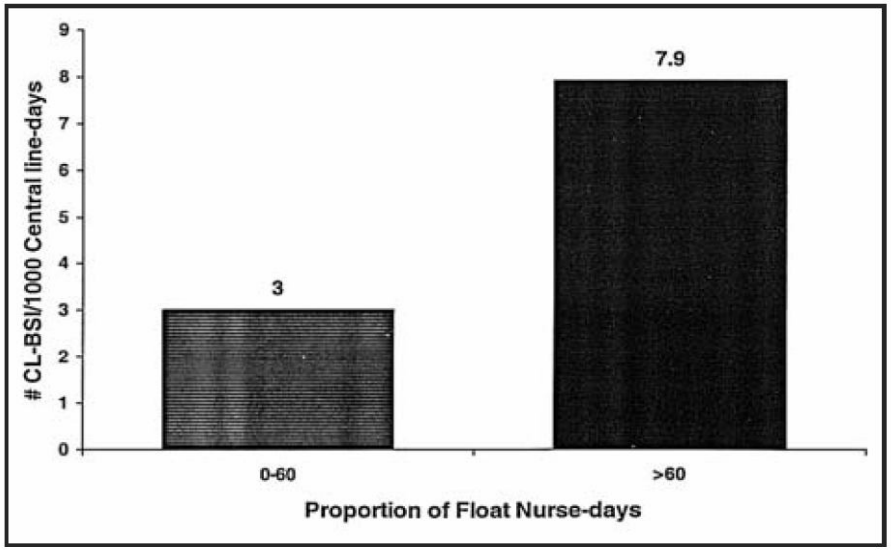

FIGURE 2. Effect of float nurses on the risk for central venous catheter–associated bloodstream infections, National Nosocomial Infections Surveillance System–Detailed ICU Surveillance Component Study, 1997 to 1999. Rate ratio, 2.61; 95 confidence interval, 1.21 to 5.59. CL-BSI = central venous catheter–associated bloodstream infection.

THE INFLUENCE OF THE COMPOSITION OF THE NURSING STAFF ON PRIMARY BLOODSTREAM INFECTION RATES IN A SURGICAL INTENSIVE CARE UNIT

Jérôme Robert, MD, MPH; Scott K. Fridkin, MD; Henry M. Blumberg, MD; Betsy Anderson, RN; Nancy White, RN; Susan M. Ray, MD; Jinlene Chan, MSc; William R. Jarvis, MD

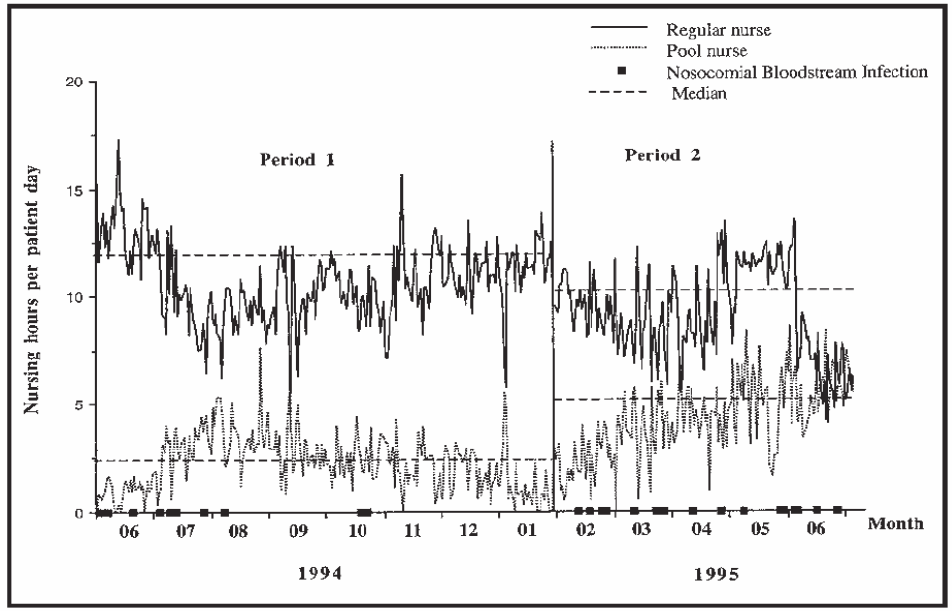

FIGURE. Nursing staffing patterns in the surgical intensive care unit, June 1994 to June 1995.

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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.

tion.[1] The recommended procedures are hand washing, using full-barrier precautions during the insertion of central venous catheters, cleaning the skin with chlorhexidine, avoiding the femoral site if possible, and removing unnecessary catheters.

Bacteriemia zero

MANEJO CVC

1. Higiene adecuada de manos
2. Desinfección de la piel con clorhexidina
3. Medidas de barrera total durante la inserción
4. Preferencia de localización subclavia
5. Retirada de CVC innecesarios
6. Manejo higiénico de los catéteres

PSI

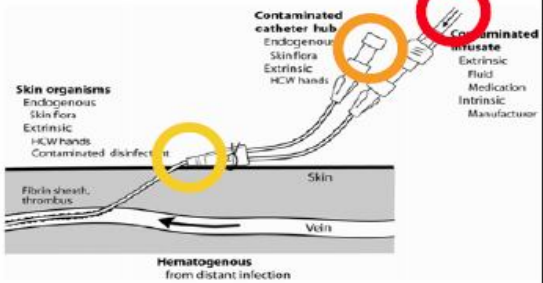
1. Evaluar la cultura de seguridad
2. Formación en seguridad del paciente
3. Identificar errores en la práctica habitual
4. Establecer alianzas con la dirección
5. Aprender de los errores

Triptychs used for the non-attendance education

HOSPITAL DE MATARÓ

EL PER QUÈ DE LES ESTRATÈGIES PER PREVENIR LES INFECCIONS PER CATÈTER

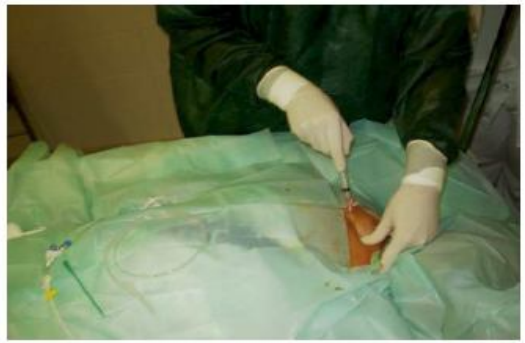
Grup per la prevenció de les infeccions associades a catèters endovasculars



Els catèters endovasculars posen en contacte una cavitat estèril (la sang) amb el mitjà extern. A la pell dels malalts i dels treballadors sanitaris hi viuen prop de 1.000 unitats formadores de colònies de bacteris per cm^2. Si la pell del malalt, les connexions o els equips d'infusió no es manipulen correctament moltes d'aquestes bactèries poden passar des de la pell del malalt o des de les mans dels treballadors sanitaris al catèter (colonització) i arribar a la sang a on la temperatura (37ºC) i la presencia de nutrients afavoreix el seu creixement i el desenvolupament d'infeccions a la sang (bacterièmies).

La inserció dels catèters es probablement el moment de major risc de contaminació. Qualsevol contacte del catèter amb una superfície no estèril provocarà la colonització del catèter pels microorganismes de l'entorn i afavorirà el desenvolupament d'una posterior bacterièmia.

La inserció del catèter s'ha d'entendre com un acte quirúrgic, pel que s'ha de procedir amb estrictes mesures d'esterilitat (rentat de mans estèril, bata i guants estèrils, mascareta i gorro, tallatge estèril ample).



Check-list inserció

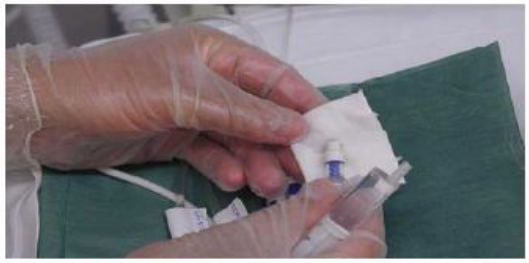
1. Està justificat insertar el catèter
2. Segons l'estat del malalt hem escollit el lloc d'inserció amb menys complicacions sèptiques i mecàniques.
3. Hem desinfectat la pell amb clorhexidina alcohòlica 1%.
4. Hem preparat un camp estèril ample, i hem adoptat mesures extremes d'asèpsia.
5. Hem col·locat un apòsit estèril amb tècnica estèril.

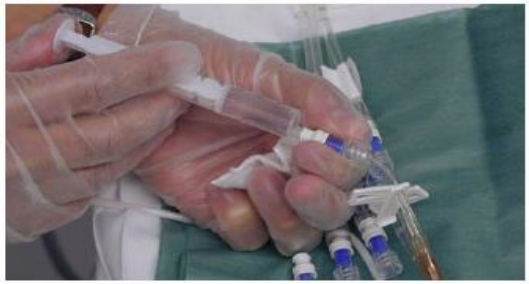
Jyebenes@csdm.cat

Triptychs used for the non-attendance education

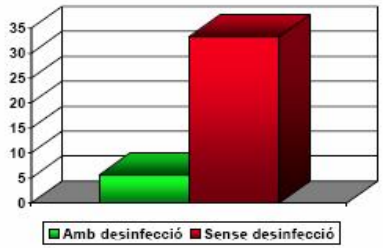
Check-list manteniment

1. He fet higiene de mans abans i després de manipular el catèter o les seves connexions
2. He netejat els connectors amb antisèptic abans d'administrar un bolus o connectar un equip d'infusió.
3. He manipulat la nutrició parenteral amb tècnica estèril.
4. He recanviat els connectors amb tècnica estèril.
5. He retirat aquells catèters que ja no calen o que presenten signes locals d'infecció.

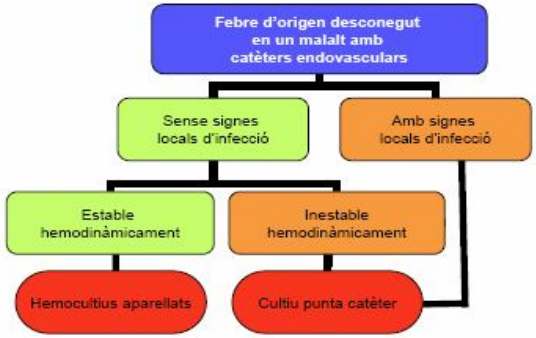




La manipulació dels connectors i dels equips d'infusió es l'origen de les bacterièmies fins en un 80% dels casos d'infecció quan els catèters estan insertats més de 1 setmana. La administració d'un bolus sense desinfecció prèvia del connector produeix el pas de microorganismes a la sang fins en un 35% dels casos, afavorint la colonització del catèter



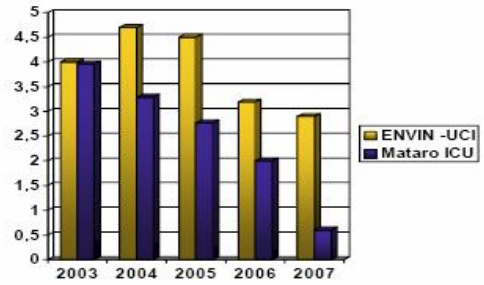
Percentatge de pas de microorganismes a través dels connectors amb o sense desinfecció



La retirada sistemàtica de catèters per febre d'origen no filiat sol ser un gest inútil en mes d'un 75% dels casos. Si el punt d'inserció es net i el malalt no està xocat no cal retirar els catèters, s'han de fer hemos aparellats. Per altre banda si no necessitem un catèter, mantenir-lo insertat incrementa el risc de infecció innecessariament.

La bacterièmia per catèter te una mortalitat directament atribuïble d'un 20% (entre un 10 i un 35% depenent del microorganisme i l'estat del malalt). Això vol dir que si evitem 5 bacterièmies...

...SALVEM UNA VIDA!!!.



Taxes de bacterièmia sense focus i associada a catèter (per 1000 dias amb catèter) a la UCI de Mataró en comparació a las mitja de les UCIs espanyoles

Triptychs used for the non-attendance education

Check-list manteniment

1. He fet higiene de mans abans i després de manipular el catèter o les seves connexions
2. He netejat els connectors amb antisèptic abans d'administrar un bolus o connectar un equip d'infusió.
3. He manipulat la nutrició parenteral amb tècnica estèril.
4. He recanviat els connectors amb tècnica estèril.
5. He retirat aquells catèters que ja no calen o que presenten signes locals d'infecció.

4. Replace tubing used to administer blood, blood products, or fat emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion [182–185]. Category IB

182. Melly MA, Meng HC, Schaffner W. Microbiol growth in lipid emulsions used in parenteral nutrition. Arch Surg **1975**; 110:1479–81.
183. Mershon J, Nogami W, Williams JM, Yoder C, Eitzen HE, Lemons JA. Bacterial/fungal growth in a combined parenteral nutrition solution. JPEN J Parenter Enteral Nutr **1986**; 10:498–502.
184. Gilbert M, Gallagher SC, Eads M, Elmore MF. Microbial growth patterns in a total parenteral nutrition formulation containing lipid emulsion. JPEN J Parenter Enteral Nutr **1986**; 10:494–7.
185. Maki DG, Martin WT. Nationwide epidemic of septicemia caused by contaminated infusion products. IV. Growth of microbial pathogens in fluids for intravenous infusions. J Infect Dis **1975**; 131:267–72.

THE JOURNAL OF INFECTIOUS DISEASES • VOL. 131, NO. 3 • MARCH 1975

Nationwide Epidemic of Septicemia Caused by Contaminated Infusion Products. IV. Growth of Microbial Pathogens in Fluids for Intravenous Infusion

Dennis G. Maki and William T. Martin

From the Hospital Infections Section, Bacterial Diseases Branch, Epidemiology Program, Center for Disease Control, Atlanta, Georgia

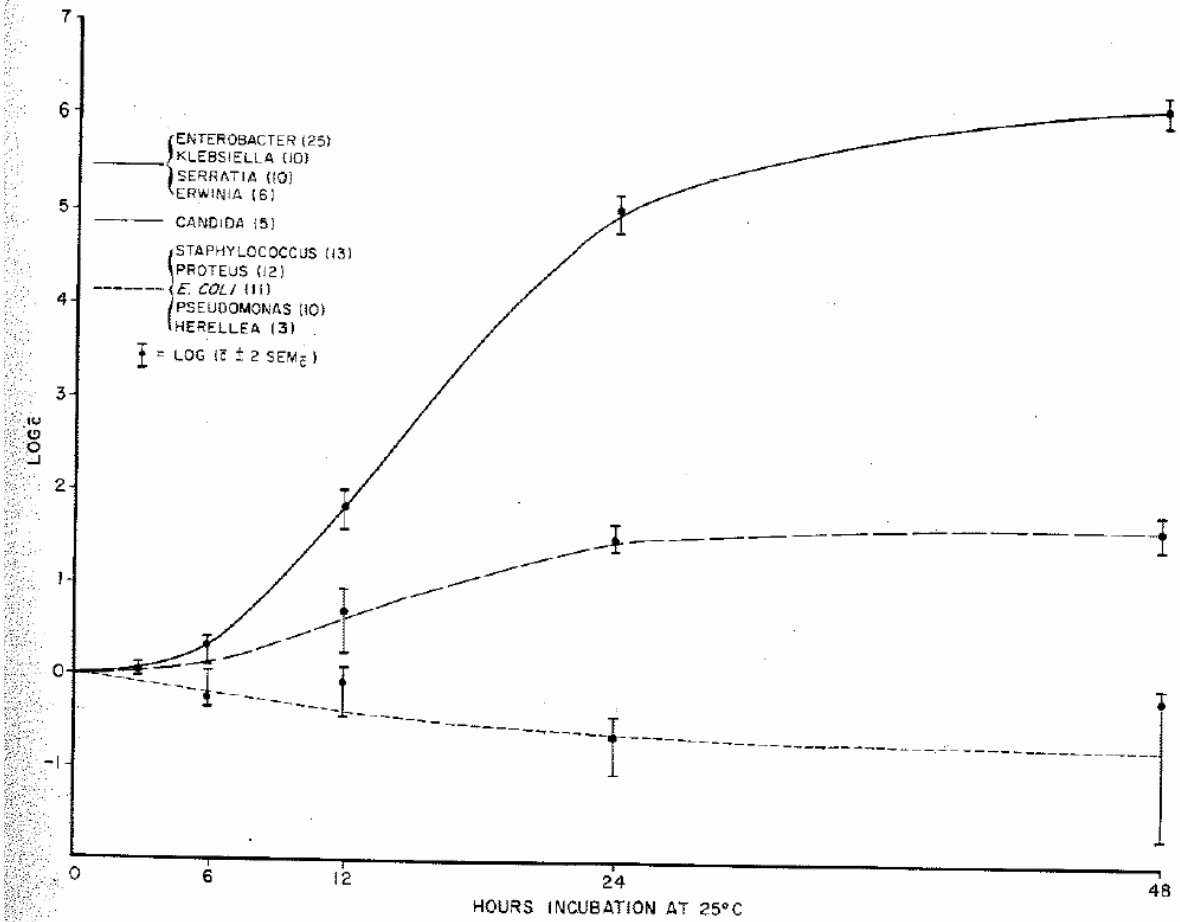


Figure 1. Growth curves of 51 strains of tribe Klebsielleae, five strains of *Candida albicans*, and 49 strains of non-tribe Klebsielleae bacteria in 5% dextrose in water at 25 C. Numbers in parentheses indicate number of strains tested. c̄ = mean normalized concentration of all strains in group.

Microbial Growth in Lipid Emulsions Used in Parenteral Nutrition

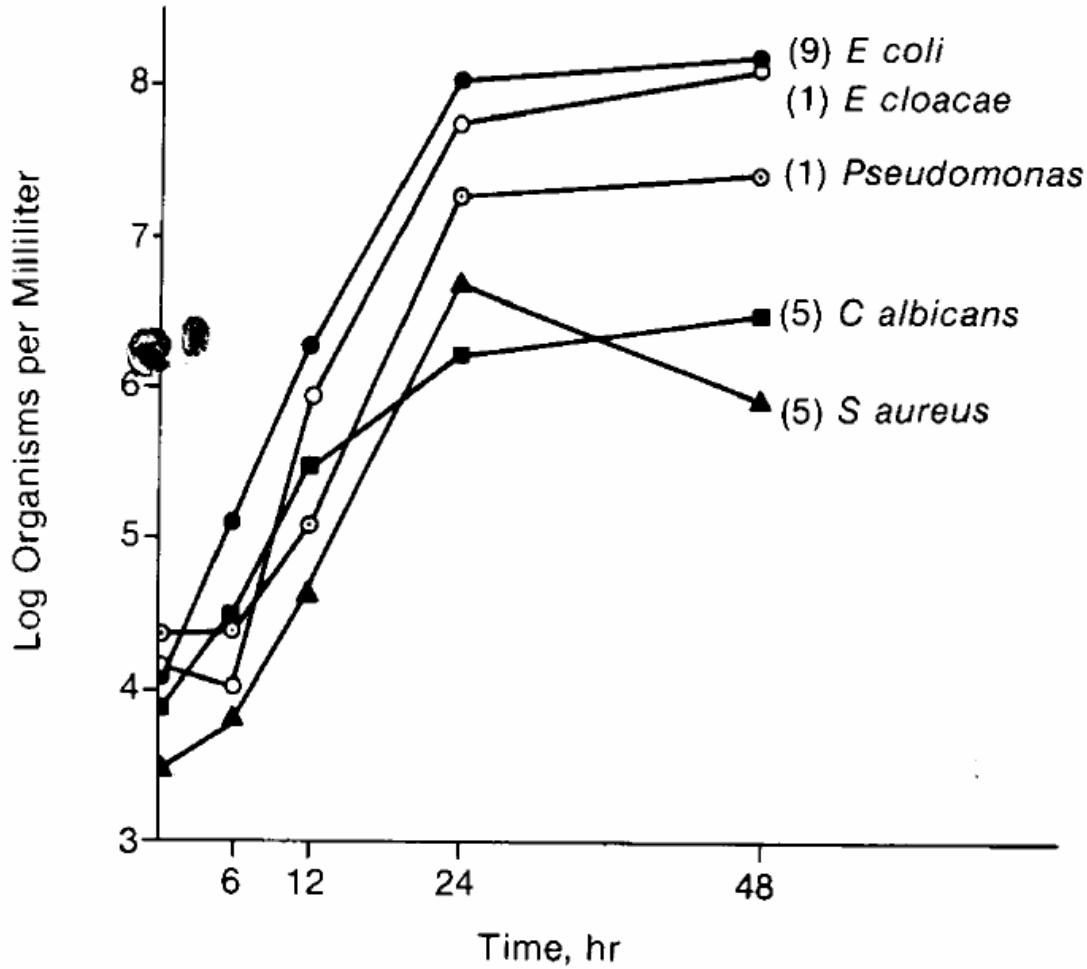


Fig 1.—Growth of representative microorganisms in lipid emulsion at room temperature.

0148-6071/86/1005-0498$02.00/0
JOURNAL OF PARENTERAL AND ENTERAL NUTRITION
Vol. 10, No. 5

Bacterial/Fungal Growth in a Combined Parenteral Nutrition Solution

JOHN MERSHON, M.S., WALLACE NOGAMI, M.D., JANICE M. WILLIAMS, PHARM.D., CARYN YODER, PHARM.D., HAROLD E. EITZEN, PH.D., AND JAMES A. LEMONS, M.D.

In conclusion, a TPN solution which combines dextrose, amino acids, and lipid into one container had the advantage of decreased expense and a more balanced administration of nutrients over time. While there is the potential for decreased in-use contamination of the three-in-one solution, further studies are required to confirm or deny this. If contamination of the parenteral solution were to occur, the rate of microbial growth in the three-in-one preparation would be the same or less than that observed in lipid alone, but greater than that which would occur in the nonlipid containing solutions. In addition growth appears to continue over at least 72 hr as determined in the present study.

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JOURNAL OF PARENTERAL AND ENTERAL NUTRITION
Vol. 10, No. 5

Microbial Growth Patterns in a Total Parenteral Nutrition Formulation Containing Lipid Emulsion

MICHAEL GILBERT, R.PH., S. CATHY GALLAGHER, M.S., MICHAEL EADS, M.D., AND MICHAEL F. ELMORE, M.D.

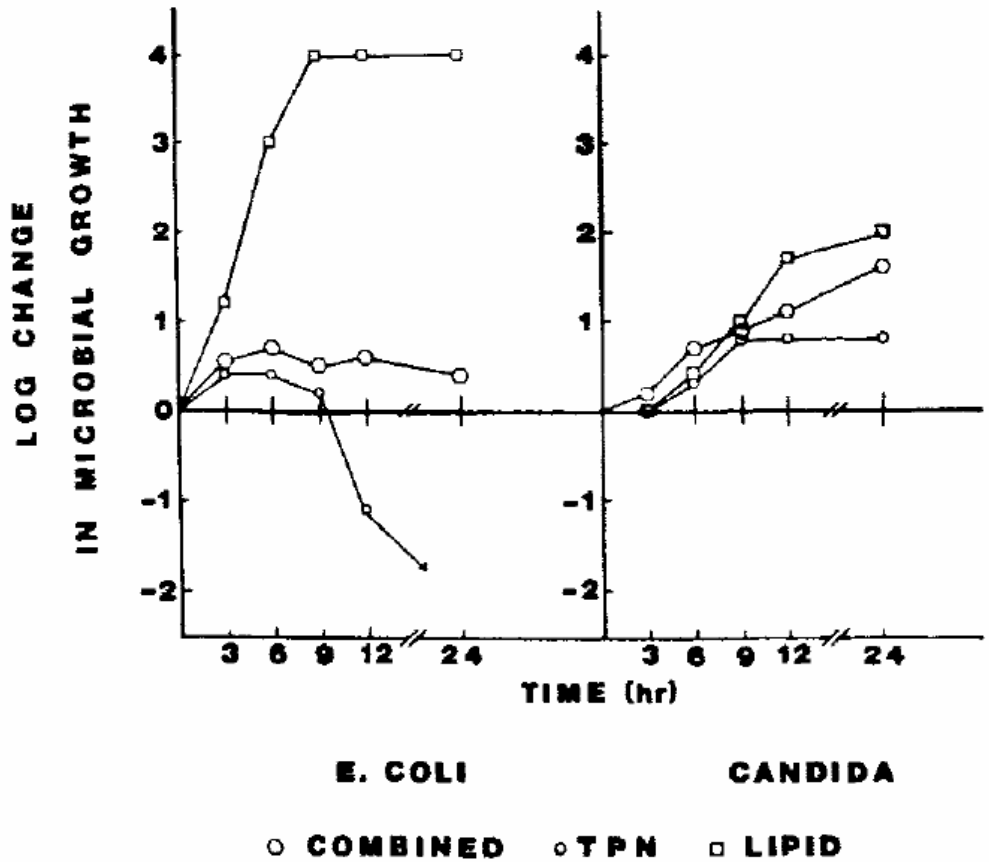


FIG. 2. *Phase II*, 24-hr microbial growth pattern of *E. coli* and *Candida* in the three test formulations at an initial inoculum of 10^4 CFU/ml.

0148-6071/85/0903-0322$02.00/0
JOURNAL OF PARENTERAL AND ENTERAL NUTRITION
Vol. 9, No. 3

A Randomized Trial on the Effect of Tubing Changes on Hub Contamination and Catheter Sepsis during Parenteral Nutrition

A. SITGES-SERRA, M.D., J. LIÑARES, M.D. J. L. PÉREZ, M.D., E. JAURRIETA, M.D., AND L. LORENTE, PHARM.D.

TABLE II
Comparison of hub and catheter cultures between trial group and historical patients

	Sterile	Colonized	Infected
Hub			
Trial (n = 52)	43	5	4
Historical (n = 43)	22	0	21
		$\chi^2 = 58.1, p < 0.001$	
Tip			
Trial (n = 52)	47	2	3
Historical (n = 43)	24	2	17
		$\chi^2 = 27.3, p < 0.001$	

Microorganisms causing catheter-related sepsis

	Group A	Group B	Historical controls
Coagulase negative staphylococci	0	0	16
S. haemolyticus			3
S. epidermidis			11
S. saprophyticus			2
S. faecalis	0	1	0
Candida sp.	0	1	0
P. mirabilis	1	0	0
Y. enterocolitica	0	0	1

A RANDOMIZED TRIAL OF 72- VERSUS 24-HOUR INTRAVENOUS TUBING SET CHANGES IN NEWBORNS RECEIVING LIPID THERAPY

Anne G. Matlow, MD; Ian Kitai, MD; Haresh Kirpalani, MD; Nicola H. Chapman, MSc; Mary Corey, PhD; Max Perlman, MD; Paul Pencharz, MD; Sue Jewell, RN, BA; Cindy Phillips-Gordon, RN, BScN; Richard Summerbell, PhD; E. Lee Ford-Jones, MD

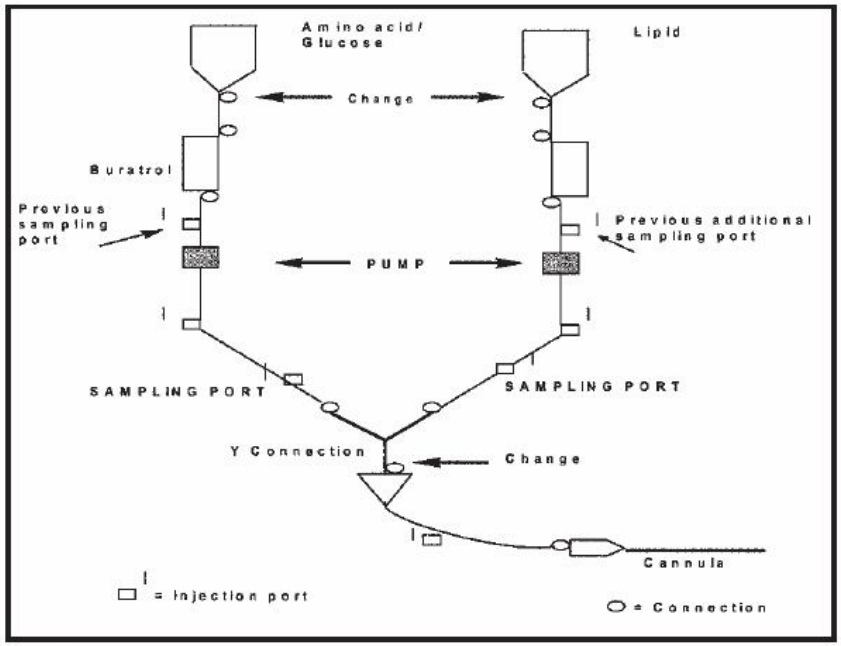


FIGURE. Standard intravenous delivery system for total parenteral nutrition at the neonatal intensive-care unit, Hospital for Sick Children, Toronto, Ontario, Canada. In the current study, apparatus between the "Change" arrows is changed every 24 or 72 hours. Initial and current sites of specimen sampling are indicated.

TABLE 5
CONTAMINATION RATES BY TUBING-CHANGE GROUP AND LINE INFUSATE

Microbial Growth	Tubing-Change Group		
	72-h	24-h	*P**
All sets	51/2,196 (2.32%)	19/2,213 (0.86%)	.001
Amino acid lines	12/1,095 (1.10%)	4/1,101 (0.36%)	.076
Lipid lines	39/1,101 (3.54%)	15/1,112 (1.35%)	.001

In nine patients, bloodstream infection with the same organism was detected within 48 hours of sampling the contaminated lipid. This included six patients with coagulase-negative staphylococcal bacteremia and one each with *Escherichia coli, Malassezia furfur,* and *Candida parapsilosis.* The distribution of cases with concurrent bloodstream infection and contaminated infusate between the two tubing-change groups paralleled the number of blood cultures performed in each group and was not statistically significant.

ROUTINE CHANGING OF INTRAVENOUS ADMINISTRATION SETS DOES NOT REDUCE COLONIZATION OR INFECTION IN CENTRAL VENOUS CATHETERS

Claire M. Rickard, RN, BN, GradDipN (CritCare); Jeff Lipman, FFA (CritCare), FJFICM; Mary Courtney, RN, PhD; Rosemary Siversen, RN, CertNurs, CertICU; Peter Daley, RN, BHSc, CertICU

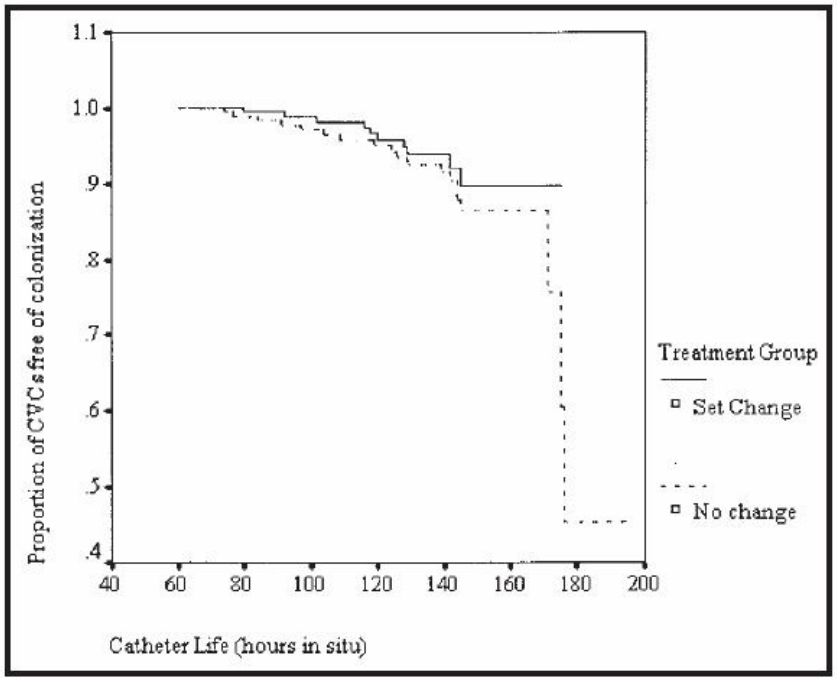


FIGURE 1. Survival curve for central venous catheters (CVCs) to remain free of colonization by treatment group.

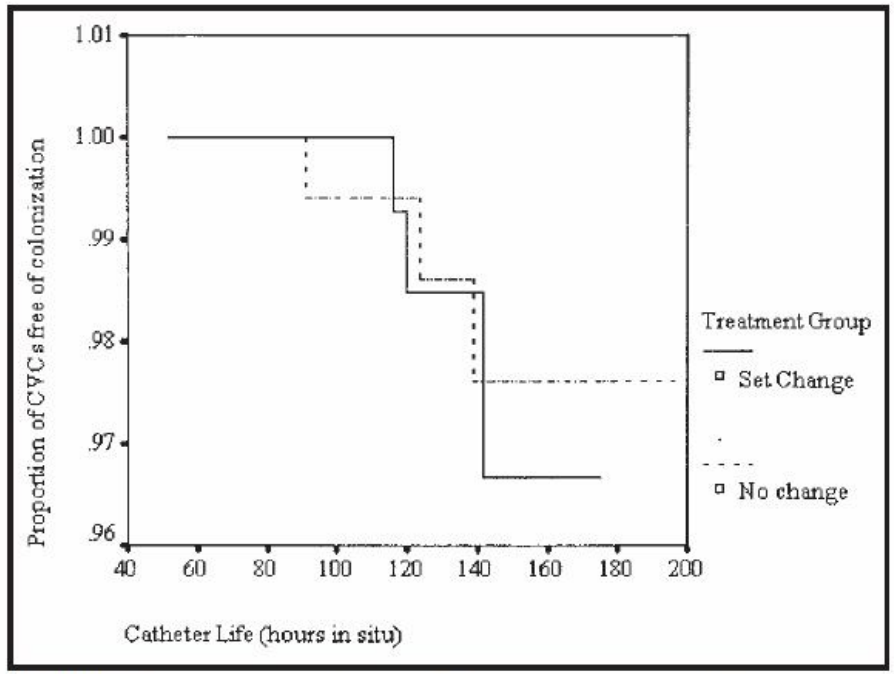


FIGURE 2. Survival curve for central venous catheters (CVCs) to remain free of catheter-related bacteremia by treatment group.

Optimal timing for intravenous administration set replacement (Review)

Gillies D, Wallen MM, Morrison AL, Rankin K, Nagy SA, O'Riordan E

Analysis 3.4. Comparison 3 Subgroup analysis: 2. infusate; less versus more frequent, Outcome 4 Catheter-related BSI.

Review: Optimal timing for intravenous administration set replacement

Comparison: 3 Subgroup analysis: 2. infusate; less versus more frequent

Outcome: 4 Catheter-related BSI

Study or subgroup	Less frequent n/N	More frequent n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
1 PN				
Rickard 2004	0/5	0/7		0.0 [0.0, 0.0]
Sitges-Serra 1985	2/32	1/20		1.25 [0.12, 12.91]
Subtotal (95% CI)	**37**	**27**		**1.25 [0.12, 12.91]**
Total events: 2 (Less frequent), 1 (More frequent)				
Heterogeneity: Chi^2 = 0.0, df = 0 (P = 1.00); I^2 =0.0%				
Test for overall effect: Z = 0.19 (P = 0.85)				
2 Non-PN				
Raad 2001	0/188	0/240		0.0 [0.0, 0.0]
Rickard 2004	0/69	0/73		0.0 [0.0, 0.0]
Snydman 1987	2/65	5/105		0.65 [0.13, 3.23]
Subtotal (95% CI)	**322**	**418**		**0.65 [0.13, 3.23]**
Total events: 2 (Less frequent), 5 (More frequent)				
Heterogeneity: Chi^2 = 0.0, df = 0 (P = 1.00); I^2 =0.0%				
Test for overall effect: Z = 0.53 (P = 0.60)				
Total (95% CI)	**359**	**445**		**0.79 [0.21, 2.94]**
Total events: 4 (Less frequent), 6 (More frequent)				
Heterogeneity: Chi^2 = 0.21, df = 1 (P = 0.65); I^2 =0.0%				
Test for overall effect: Z = 0.35 (P = 0.73)				

Triptychs used for the non-attendance education

Check-list manteniment

1. He fet higiene de mans abans i després de manipular el catèter o les seves connexions
2. He netejat els connectors amb antisèptic abans d'administrar un bolus o connectar un equip d'infusió.
3. He manipulat la nutrició parenteral amb tècnica estèril.
4. He recanviat els connectors amb tècnica estèril.
5. He retirat aquells catèters que ja no calen o que presenten signes locals d'infecció.

Appendix A

FDA SAFETY ALERT:

Needlestick and Other Risks from Hypodermic Needles on Secondary LV. Administration Sets - Piggyback and Intermittent I.V.

April 16, 1992

To Hospital Administrators, Directors of Nursing, Risk Managers, and Infection Control Directors:
This is to alert you to the risk of needlestick injuries from the use of hypodermic needles as a connection between two pieces of intravenous (I.V.) equipment.[1, 2, 3] The use of exposed hypodermic needles on I.V. administration sets or the use of syringes to access I.V. administration set ports or injection sites are unnecessary and should be avoided. Hypodermic needles should only be used in situations where there is a need to penetrate the skin.

INCREASED BLOODSTREAM INFECTION RATES IN SURGICAL PATIENTS ASSOCIATED WITH VARIATION FROM RECOMMENDED USE AND CARE FOLLOWING IMPLEMENTATION OF A NEEDLELESS DEVICE

Susan Temporado Cookson, MD; Melanie Ihrig, DVM; Edward M. O'Mara, MD;
Mark Denny, MBA, CIC; Helen Volk, RN, CIC; Shailen N. Banerjee, PhD;
Alan I. Hartstein, MD; William R. Jarvis, MD

ABSTRACT

OBJECTIVE: To determine if an apparent increase in bloodstream infections (BSIs) in patients with central venous catheters (CVCs) was associated with the implementation of a needleless access device.

DESIGN: Retrospective cohort study using a derived CVC-days factor for estimating appropriate denominator data.

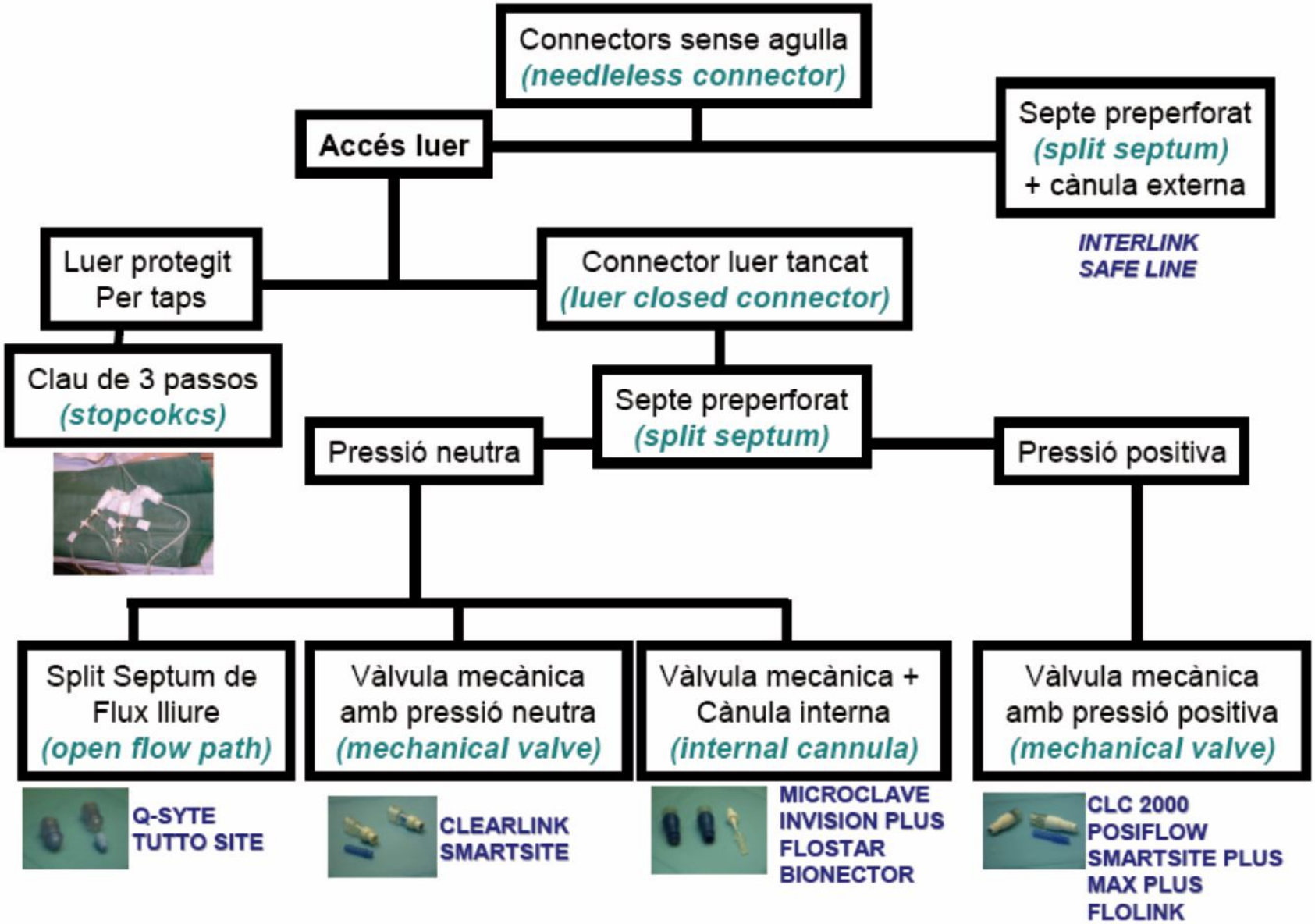
SETTING: A 350-bed urban, acute, tertiary-care hospital.

METHODS: BSI surveillance data were obtained, and high-risk areas for BSIs were determined. A random 5% sample of medical records was used to estimate CVC days, and a cohort study was conducted to compare BSI rates before and during needleless device use. A survey was conducted of nursing needleless-device practices.

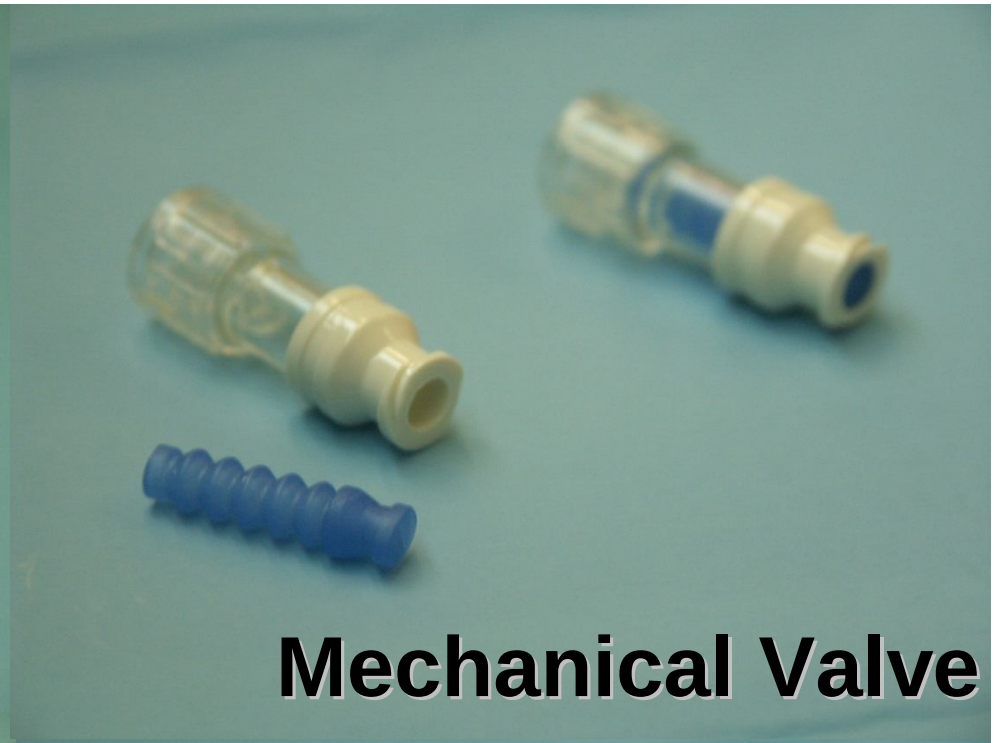
RESULTS: The surgical intensive-care unit (SICU), the medical intensive-care unit, and the solid organ transplant unit (OTU) were identified as high-risk units. Using existing surveillance BSI data and the estimated CVC days, the catheter-related BSI rates in the high-risk surgical patients were significantly higher during the needleless-device period compared with the preneedleless-device period (SICU, 9.4 vs 5.0/1,000 CVC days; OTU, 13.6 vs 2.2/1,000 CVC days). A survey of the nurses revealed that 60% to 70% were maintaining the needleless devices correctly.

CONCLUSION: We observed a significant increase in the BSI rate in two surgical units, SICU and OTU, associated with introduction of a needleless device. This increase occurred shortly after the needleless device was implemented and was associated with nurses' unfamiliarity with the device, and needless-device use and care practices different from the manufacturer's recommendations. (*Infect Control Hosp Epidemiol* 1998;19:23-27).

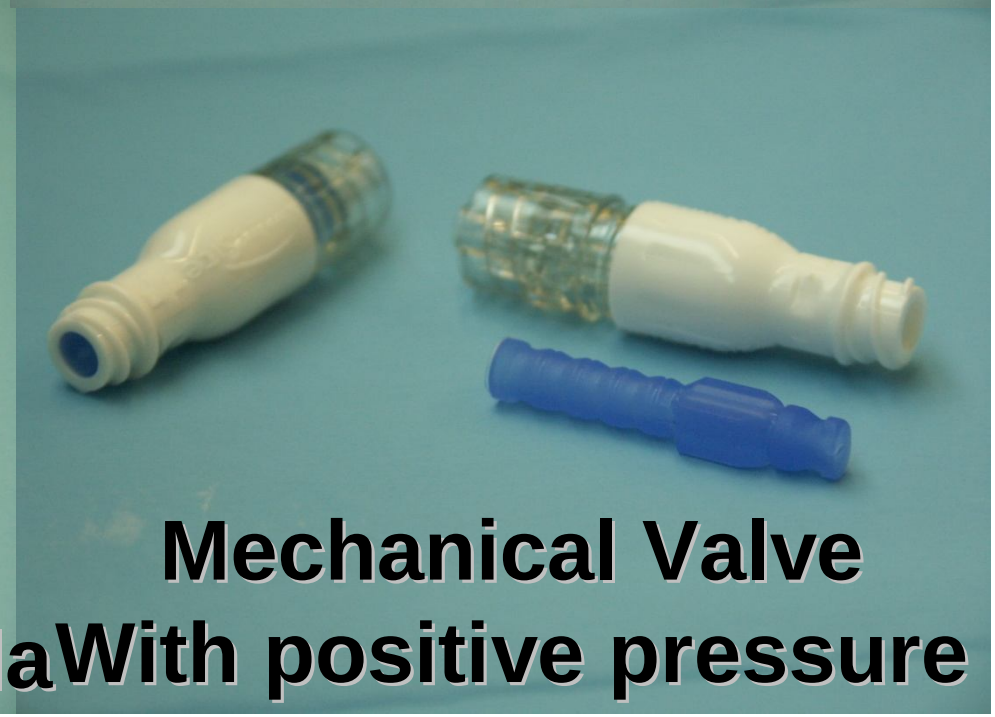
CLASSIFICACIÓ DELS CONNECTORS




Split Septum


Mechanical Valve


Mechanical Valve
with Endoluminal Canula


Mechanical Valve
With positive pressure

Prevention of catheter-related bloodstream infection in critically ill patients using a disinfectable, needle-free connector: A randomized controlled trial

(Am J Infect Control 2004;32:291-5.)

Table 1. Baseline characteristics of both groups

	Disinfectable, needle-free connector, N = 139	3-way stopcock, N = 139	*P* value
Patient characteristics			
Age (in years)*	55.3 ± 19.0	58.7 ± 18.0	NS
Sex (% male)	75.5%	70.5%	NS
Pathological group:			NS
Medical	32.3%	32.8%	
Surgical	35.3%	37.4%	
Trauma	32.3%	29.8%	
Sepsis on admission	43.5%	40.3%	NS
SAPS*	34.1 ± 12.1	33.8 ± 12.2	NS
TISS*	32.8 ± 13.3	32.1 ± 13.8	NS
Catheter characteristics			
Insertion (% Subclavian/jugular)	81.2 / 18.8	84.8 / 15.2	NS
Number of lumen (% 3 lumen)	47.5%	45.3%	NS
Total parenteral nutrition	29.6%	28.5%	NS

SAPS, Simplified acute physiology scores; *TISS*, therapeutic intervention scoring system; *NS*, not significant.
*Mean ± standard deviation.

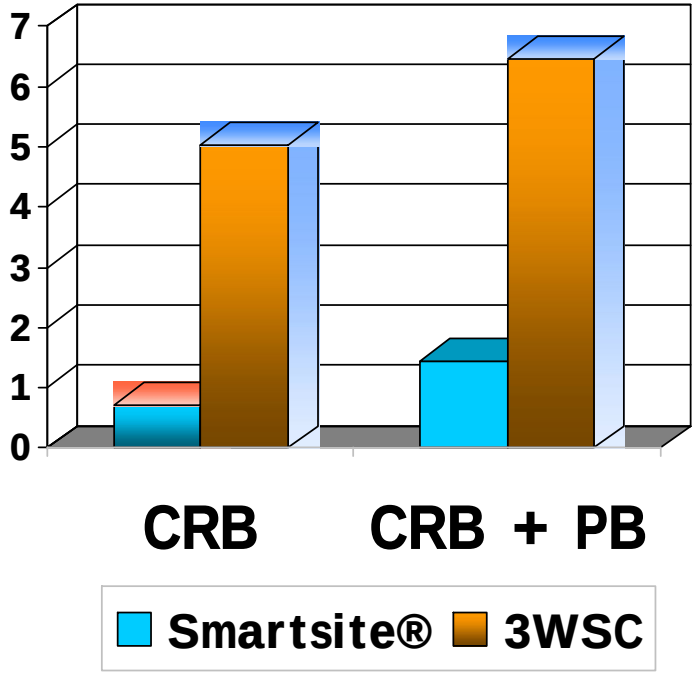


Table 2. Main characteristics of catheter-related bloodstream infection

Catheter insertion	Diagnosis	Connection type	No. lumen	No. days inserted	Microorganism
Subclavian	Ingestion of caustics	TWS	2	19	*Enterobacter aerogenes*
Subclavian	Peritonitis	TWS	3	15	*Staphylococcus epidermidis*
Subclavian	Status epilepticus	TWS	2	6	*Staphylococcus epidermidis*
Subclavian	ANHP	TWS	3	20	*Enterococcus faecium*
Subclavian	Polytraumatism	DNFC	2	10	*Klebsiella oxytoca*
Jugular	CAP	TWS	2	5	*Staphylococcus epidermidis*
Subclavian	Polytraumatism	TWS	2	19	*Enterococcus faecium*
Subclavian	Polytraumatism	TWS	3	9	*Staphylococcus aureus*

ANHP, Acute necro-hemorrhagic pancreatitis; *CAP*, community-acquired pneumonia; *DNFC*, disinfectable, needle-free connector; *TWS*, 3-way stopcock.

Journal of Hospital Infection (2003) 54, 279-287

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A needleless closed system device (CLAVE) protects from intravascular catheter tip and hub colonization: a prospective randomized study☆

E. Bouza[a,*], P. Muñoz[a], J. López-Rodríguez[b], M. Jesús Pérez[b], C. Rincón[b], P. Martín Rabadán[a], C. Sánchez[a], E. Bastida[b]

Table II Characteristics of the catheters and catheter-related infections

	CLAVE ($N = 865$)	COS ($N = 909$)	P
Type of catheter			0.164
Swan-Ganz	187 (21.6%)	192 (21.1%)	
Jugular central line	186 (21.5%)	187 (20.6%)	
Subclavian central line	20 (2.3%)	31 (3.4%)	
Femoral central line	9 (1.0%)	11 (1.2%)	
Radial-humeral arterial line	209 (24.2%)	203 (22.3%)	
Femoral arterial line	5 (0.6%)	11 (1.2%)	
Peripheral	249 (28.8%)	274 (30.1%)	
Use of the catheters			0.621
Medication (fluid or drug therapy)	436 (50.4%)	466 (51.3%)	
Parenteral nutrition	18 (2.1%)	27 (3%)	
Haemodynamic monitoring	400 (46.2%)	404 (44.4%)	
Haemofiltration	11 (1.3%)	12 (1.3%)	
Mean days of catheter exposure (catheter-days)	8.9 ± 11.1	10.7 ± 15.9	0.22
Number of dressing changes (median ± SD)	2.36 ± 3.3	2.67 ± 3.7	0.061
Cause of withdrawal			0.273
End of therapy	681 (78.7%)	685 (75.4%)	
Suspicion of infection	53 (6.1%)	75 (8.3%)	
Dysfunction	56 (6.5%)	62 (6.8%)	
Others	75 (8.7%)	87 (9.6%)	
Tip colonization	94 (10.9%)	156 (17.2%)	0.0001
Density per 1000 catheter-days	59.2	83.6	0.003
Density per 100 days of ICU stay	92.8	123	0.0002
Episodes of CRBSI	6 (3.4%)	11[a] (6.3%)	0.22
Cumulative incidence/100 catheters	0.72	1.21	1
Density per 1000 catheter-days	3.78	5.89	0.4
Catheters with surveillance cultures	279 (32.3%)	324 (35.6%)	0.133
Skin colonization	66 (23.7%)	110 (33,9%)	0.002
Density per 1000 catheter-days	41.5	58.9	0.038
Hub colonization	12 (4.3%)	46 (14.2%)	0.0001
Density per 1000 catheter-days	7.5	24.6	0.0017

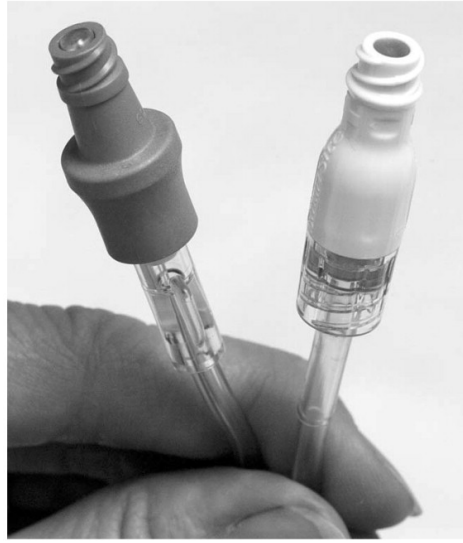
[a] In nine patients.

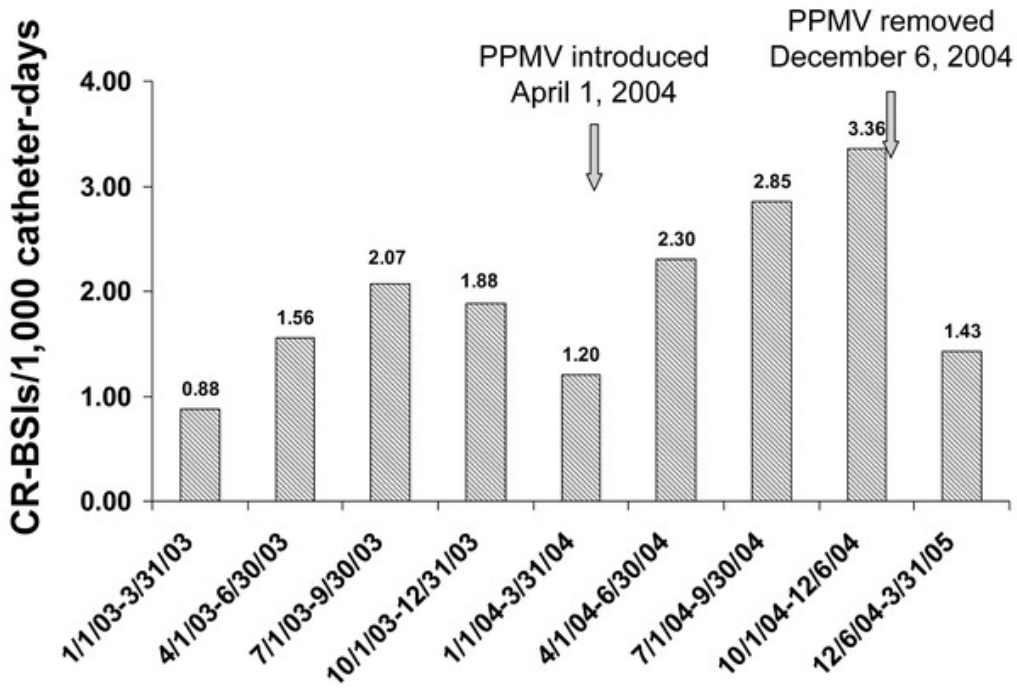
Increased Catheter-Related Bloodstream Infection Rates After the Introduction of a New Mechanical Valve Intravenous Access Port

Lisa L. Maragakis, MD; Karen L. Bradley, RN, BSN; Xiaoyan Song, MD, MS; Claire Beers, RN, MSN; Marlene R. Miller, MD, MSc; Sara E. Cosgrove, MD, MS; Trish M. Perl, MD, MSc

The technology of intravenous catheter access ports has evolved from open ports covered by removable caps to more-sophisticated, closed versions containing mechanical valves. We report a significant increase in catheter-related bloodstream infections after the introduction of a new needle-free positive-pressure mechanical valve intravenous access port at our institution.

Infect Control Hosp Epidemiol 2006; 27:67-70





Journal of Hospital Infection (2007) 67, 30–34

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Bloodstream infection related to catheter connections: a prospective trial of two connection systems

F. Esteve*, M. Pujol, E. Limón, M. Saballs, M.J. Argerich, R. Verdaguer, R. Mañez, X. Ariza, F. Gudiol

group and 29 in the 3WSC group. Therefore CVC-BSI rates were 4.26 per 1000 days of catheter use in the NFVCS group and 5.27 in the 3WSC group (OR: 1.24; 95% CI: 0.69–2.21; $P = 0.4$). The incidence rate of AC-BSI was 5.004 per 1000 days of catheter use (24 cases) in the NFVCS group, compared with 2.83 per 1000 days of catheter use (14 cases) in the 3WSC group (OR: 0.57; 95% CI: 0.28–1.14; $P = 0.08$).

Table II General characteristics of the catheters

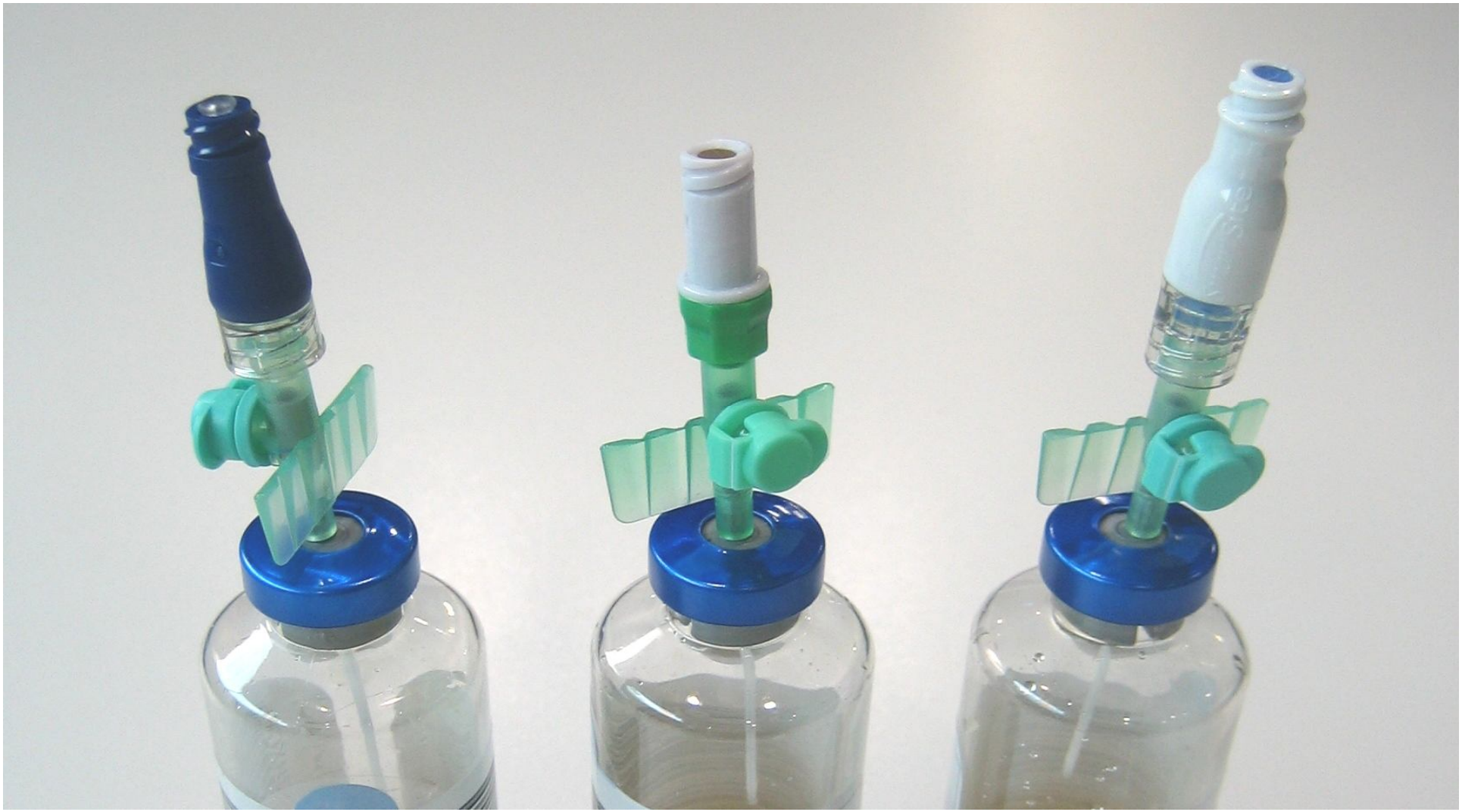
	NFVCS ($N = 1078$)	3WSC ($N = 1100$)	P
Central venous catheters	$N = 559$	$N = 581$	
Time of insertion (days)[a]	9.61 ± 6.14	9.47 ± 5.36	NS
Localization			
Femoral	224 (40.1)	287 (43.8)	NS
Subclavia	192 (34.3)	170 (29.3)	NS
Jugular	143 (25.6)	151 (26)	NS
N lumen			
One	3 (0.5)	4 (0.7)	NS
Two	208 (37.4)	196 (34.1)	NS
Three	336 (60.4)	366 (63.8)	NS
Four	9 (1.6)	8 (1.4)	NS
Arterial catheters	$N = 519$	$N = 519$	
Time of insertion (days)[a]	9.17 ± 5.4	9.51 ± 6.06	NS
Localization			
Femoral	235 (45.3)	250 (48.2)	NS
Radial	284 (54.7)	269 (51.8)	NS

NFVCS, needle-free valve connection system; 3WSC, three-way stopcock; NS, not significant.
Values in parentheses are percentages.
[a] Mean ± SD.

Efficacy of three different valve systems of needle-free closed connectors in avoiding access of microorganisms to endovascular catheters after incorrect handling*

Juan Carlos Yébenes, MD, PhD; Maria Delgado, MD; Goretti Sauca, MD; Mateu Serra-Prat, MD, PhD, Phm; Manel Solsona, MD; Jordi Almirall, MD, PhD; Josep Antón Capdevila, MD, PhD; Xavier Balanzó, MD, PhD

Crit Care Med 2008 Vol. 36, No. 9



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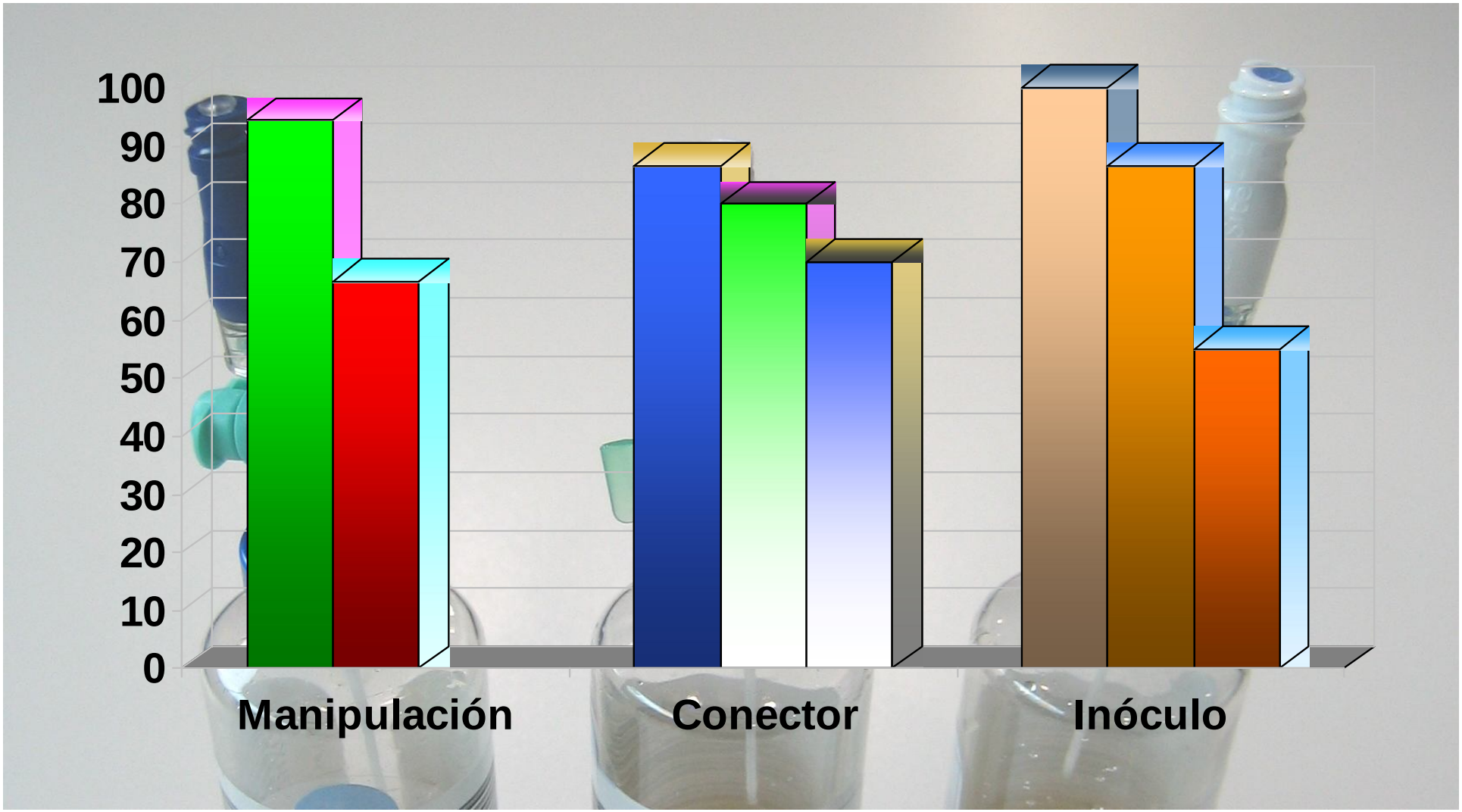
Crit Care Med 2008 Vol. 36, No. 9



Prevention of catheter-related bloodstream infection in critically ill patients using a disinfectable, needle-free connector: A randomized controlled trial

Juan C. Yébenes, PhD, MD,[a] Loreto Vidaur, MD,[a] Mateu Serra-Prat, MD, MPH,[b] Josep M. Sirvent, PhD, MD,[a]

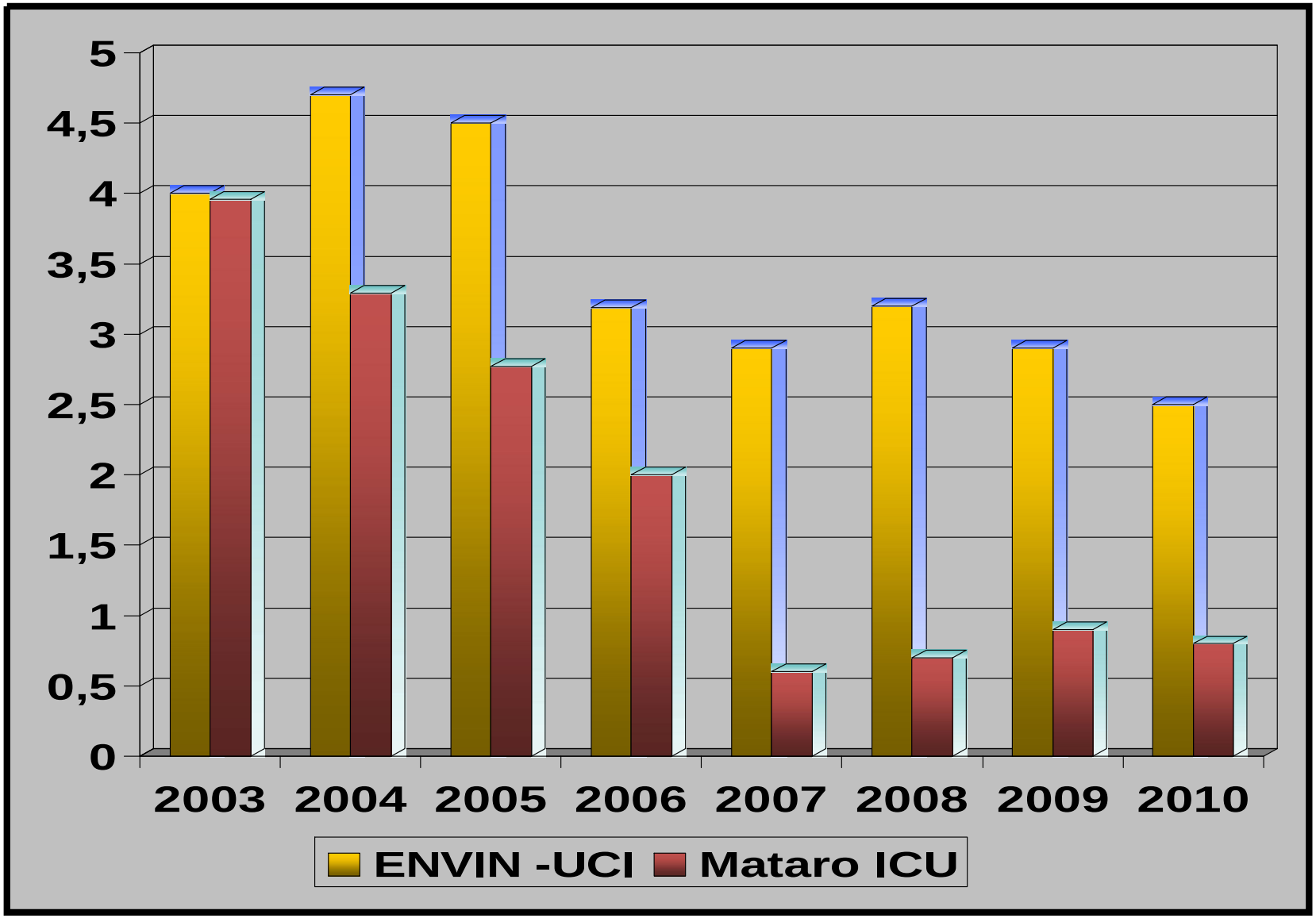
Table 1. Baseline characteristics of both groups

	Disinfectable, needle-free connector, N = 139	3-way stopcock, N = 139	*P* value
Patient characteristics			
Age (in years)*	55.3 ± 19.0	58.7 ± [illegible]	
Sex (% male)	75.5%	[illegible]	
Pathological group:			
Medical	[illegible]		
Surgical			
Trauma			
Sepsis on a[illegible]			NS
SAPS*		[illegible]	NS
TISS*		[illegible] ± 13.8	NS
Catheter charact[illegible]			
Insertion (% Subclavian/[illegible]	[illegible] / 18.8	84.8 / 15.2	NS
Number of lumen (% 3 lumen)	47.5%	45.3%	NS
Total parenteral nutrition	29.6%	28.5%	NS

Table 4. Risk factors for catheter-[illegible] [illegible]odstream infection (logistic regression)

Risk factor			*P*
Age (in y[illegible]			.005
TIS[illegible]		[illegible]	.134
[illegible]		[illegible]01-1.08	.018
[illegible]	[illegible]10	1.77-164.97	.014
[illegible]	11.98	1.26-113.51	.030

changed every 72 hours. There was a 2-month training period on the correct handling of the new connectors before the onset of the trial.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ENVIN -UCI
Mataro ICU

Annals of Internal Medicine

Central Venous Catheters Coated with Minocycline and Rifampin for the Prevention of Catheter-Related Colonization and Bloodstream Infections

A Randomized, Double-Blind Trial

Issam Raad, MD; Rabih Darouiche, MD; Jacques Dupuis, MD; Dima Abi-Said, PhD; Andrea Gabrielli, MD; Ray Hachem, MD; Matthew Wall, MD; Richard Harris, MD; James Jones, MD; Antonio Buzaid, MD; Claudia Robertson, MD; Salwa Shenaq, MD; Patrick Curling, MD; Thomas Burke, MD; and Charles Ericsson, MD

15 August 1997 | Volume 127 Issue 4 | Pages 267-274

Characteristic	Uncoated Catheter Group (n = 151)	Coated Catheter Group (n = 147)
Median age (range), *y*	56 (17–88)	58 (19–87)
Sex, *n (%)*		
Male	92 (61)	86 (58)
Female	59 (39)	61 (42)
Underlying disease or procedure, *n (%)*		
Cancer	34 (23)	35 (24)
Cardiopulmonary disease	37 (24)	40 (27)
Neurosurgery or head trauma	36 (24)	32 (22)
Abdominal surgery	36 (24)	30 (20)
Other	8 (5)	10 (7)
Neutropenia (<1000 polymorphonuclear cells/mm^3), *n (%)*	5 (3)	5 (3)
Thrombocytopenia (<100 000 platelets/mm^3), *n (%)*	10 (7)	12 (8)
Therapeutic interventions, *n (%)*		
Antibiotics	122 (81)	123 (84)
Blood products	15 (10)	21 (14)
Hyperalimentation	19 (13)	29 (20)
Interleukin-2	5 (3)	3 (2)
High-dose steroids	32 (21)	29 (20)
Other immunosuppressive drugs	11 (7)	11 (8)
Difficulty in catheter insertion, *n (%)*	6 (4)	7 (5)
Insertion site, *n (%)*		
Femoral vein	18 (12)	11 (8)
Jugular vein	46 (30)	46 (31)
Subclavian vein	87 (58)	90 (61)
Hospital site of insertion, *n (%)*		
Intensive care unit	98 (65)	91 (62)
Other	53 (35)	56 (38)
Median duration of catheterization (range), *d*	6 (1–21)	6 (1–28)
Reason for catheter removal, *n (%)*		
Catheter no longer needed	109 (72)	97 (66)
Suspected infection	18 (12)	24 (16)
Clotted catheter or thrombosis	1 (1)	3 (2)
Other	23 (15)	23 (16)

* No significant differences were seen between the two groups (P = 0.2).
† Unless otherwise indicated, values are the number (percentage) of patients.

Variable	Uncoated Cultured Catheters (n = 136)	Coated Cultured Catheters (n = 130)	P Value
Catheter colonization, *n (%)**	36 (26)	11 (8)	<0.001
S. aureus	1 (1)	0	>0.2
Polymicrobial	12 (9)	3 (2)	>0.02
Catheter-related bloodstream infections, *n (%)*†	7 (5)	0	<0.01
Infections confirmed by DNA typing, *n (%)*†	5 (4)	0	0.02
Infections/1000 catheter-days, *n*‡	7.34	0	<0.01
Infections confirmed by DNA typing/			

* Catheter colonization was defined as the isolation of at least 15 colony-forming units of any organism by the roll-plate method or at least 10^3 colony-forming units by the sonication method. The Fisher exact test was used to compare the two groups. Relative risk for colonization for uncoated catheters was 3.13 (95% CI, 1.66 to 5.88).
† Exact log-rank test was used; relative risks were undefined.
‡ Binomial exact test was used.

Study or subcategory	Treated n/N	Standard n/N	Peto OR (95% CI)	Weight (%)	Peto OR (95% CI)
01 Femoral					
Chatzinikolaou, 2003[15]	0/66	7/64		100.00	0.12 (0.03 to 0.54)
Subtotal (95% CI)	66	64		100.00	0.12 (0.03 to 0.54)
Total events: 0 (treatment), 7 (standard)					
Test for heterogeneity: NA					
Test for overall effect: $Z = 2.75$ ($p = 0.006$)					
02 Subclavian					
Babycos, 1993[72]	0/17	1/16		1.88	0.13 (0.00 to 6.42)
Logghe, 1997[57]	17/338	15/342		57.49	1.15 (0.57 to 2.35)
Collin, 1999[62]	1/98	4/139		8.98	0.41 (0.07 to 2.46)
Bong, 2003[16]	7/128	11/142		31.66	0.69 (0.27 to 1.81)
Subtotal (95% CI)	581	639		100.00	0.86 (0.50 to 1.47)
Total events: 25 (treatment), 31 (standard)					
Test for heterogeneity: $\chi^2 = 2.43$, df = 3 ($p = 0.49$), $I^2 = 0\%$					
Test for overall effect: $Z = 0.55$ ($p = 0.58$)					
03 Jugular					
Bach, 1996[53]	0/116	3/117		11.18	0.13 (0.01 to 1.30)
Boswald, 1999[66]	4/86	13/79		57.59	0.28 (0.10 to 0.76)
Jaeger, 2005[8]	1/51	8/55		31.22	0.20 (0.05 to 0.78)
Subtotal (95% CI)	253	251		100.00	0.23 (0.11 to 0.50)
Total events: 5 (treatment), 24 (standard)					
Test for heterogeneity: $\chi^2 = 0.41$, df = 2 ($p = 0.82$), $I^2 = 0\%$					
Test for overall effect: $Z = 3.76$ ($p = 0.0002$)					
04 Mixed					
Pemberton, 1996[54]	2/32	3/40		4.71	0.83 (0.13 to 5.08)
Maki, 1997[58]	2/72	7/86		8.57	0.37 (0.10 to 1.43)
Raad, 1997[38]	0/130	5/136		4.98	0.14 (0.02 to 0.80)
Tennenberg, 1997[59]	5/137	9/145		13.50	0.58 (0.20 to 1.70)
Hannan, 1999[63]	1/174	3/177		4.01	0.37 (0.05 to 2.66)
Marik A, 1999[71]	1/36	1/20		1.82	0.53 (0.03 to 9.83)
Marik B, 1999[71]	0/38	1/19		0.90	0.05 (0.00 to 3.18)
Sheng, 2000[64]	1/113	2/122		3.00	0.55 (0.06 to 5.36)
Jaeger, 2001[68]	1/25	1/25		1.98	1.00 (0.06 to 16.45)
Stoiser, 2002[69]	3/50	3/47		5.75	0.94 (0.18 to 4.85)
Corral, 2003[14]	1/103	4/103		4.96	0.29 (0.05 to 1.73)
Brun-Buisson, 2004[13]	3/188	5/175		7.93	0.56 (0.14 to 2.26)
Hanna, 2004[11]	3/182	14/174		16.41	0.25 (0.09 to 0.65)
Leon, 2004[10]	6/187	11/180		16.44	0.52 (0.20 to 1.37)
Yücel, 2004[9]	0/118	1/105		1.01	0.12 (0.00 to 6.07)
Rupp, 2005[18]	1/345	3/362		4.03	0.38 (0.05 to 2.74)
Subtotal (95% CI)	1930	1916		100.00	0.42 (0.28 to 0.62)
Total events: 30 (treatment), 73 (standard)					
Test for heterogeneity: $\chi^2 = 6.91$, df = 15 ($p = 0.96$), $I^2 = 0\%$					
Test for overall effect: $Z = 4.33$ ($p < 0.0001$)					

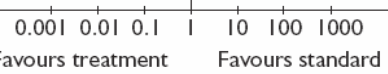

FIGURE 14 *CRBSI rates, subgrouped by insertion site*

The Use of Rifampicin-Miconazole–Impregnated Catheters Reduces the Incidence of Femoral and Jugular Catheter-Related Bacteremia

Leonardo Lorente,[1] María Lecuona,[2] María José Ramos,[2] Alejandro Jiménez,[3] María L. Mora,[1] and Antonio Sierra[2]

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Table 1. Characteristics of patients with either rifampicin-miconazole–impregnated catheters (RMC group) or standard catheters (SC group) placed at either the femoral or central jugular venous sites.

	Femoral placement			Central jugular placement		
Variable	RMC group (n = 73)	SC group (n = 111)	P	RMC group (n = 114)	SC group (n = 127)	P
No. of catheter-days	634	927		1107	1217	
Age, mean years ± SD	59.77 ± 17.71	58.05 ± 16.48	.24	64.10 ± 14.57	65.04 ± 14.23	.65
Male sex	47 (64.4)	78 (70.3)	.42	75 (65.8)	80 (63.0)	.69
APACHE II score, mean value ± SD	17.51 ± 5.49	17.35 ± 6.20	.77	16.55 ± 5.87	16.72 ± 7.18	.65
Diagnosis group			.97			.84
Cardiac surgery	11 (15.1)	21 (18.9)		18 (15.8)	16 (12.6)	
Cardiology	9 (12.3)	17 (15.3)		13 (11.4)	18 (14.2)	
Respiratory	17 (23.3)	22 (19.8)		27 (23.7)	37 (29.1)	
Digestive	12 (16.4)	18 (16.2)		33 (28.9)	34 (26.8)	
Neurological	10 (13.7)	15 (13.5)		15 (13.2)	16 (12.6)	
Traumatology	13 (17.8)	16 (14.4)		8 (7.0)	6 (4.7)	
Intoxication	1 (1.4)	2 (1.8)		0 (0)	0 (0)	
Order of catheter insertion			.41			.45
First	40 (54.8)	66 (59.5)		71 (62.3)	85 (66.9)	
Second	18 (24.7)	29 (26.1)		34 (29.8)	34 (26.8)	
Third	15 (20.5)	16 (14.4)		9 (7.9)	8 (6.3)	
Use of tracheostomy	25 (34.2)	36 (32.4)	.87	27 (23.7)	27 (21.3)	.76
Reintubation	9 (12.3)	10 (9.0)	.62	14 (12.3)	13 (10.2)	.68
Use of mechanical ventilation	68 (93.2)	101 (91.0)	.78	99 (86.8)	106 (83.5)	.48
Use of antimicrobial drugs	56 (76.7)	90 (81.1)	.58	92 (80.7)	98 (77.2)	.53
Use of total parenteral nutrition	7 (9.6)	12 (10.8)	.81	19 (16.7)	16 (12.6)	.46
Use of paralitic agents	9 (12.3)	13 (11.7)	.99	10 (8.8)	11 (8.7)	.99
Use of urinary catheter	71 (97.3)	106 (95.5)	.70	113 (99.1)	122 (96.1)	.22
Use of vasoactive agents	24 (32.9)	35 (31.5)	.87	41 (36.0)	41 (32.3)	.59
Use of propofol	23 (31.5)	31 (27.9)	.62	27 (23.7)	33 (26.0)	.77
Reason for catheter removal			.71			.85
Death	11 (15.1)	18 (16.2)		16 (14.0)	20 (15.7)	
Suspicion of catheter-related infection	28 (38.4)	45 (40.5)		31 (27.2)	32 (25.2)	
Catheter no longer needed	30 (41.1)	38 (34.2)		59 (51.8)	69 (54.3)	
Accidental removal	4 (5.5)	10 (9.0)		8 (7.0)	6 (4.7)	
Duration of catheter use, mean days ± SD	8.68 ± 4.90	8.35 ± 4.49	.77	9.71 ± 5.11	9.58 ± 4.55	.89
CVCRB	0 (0)	8 (7.2)	.02	0 (0)	6 (4.7)	.02
No. of CVCRB cases per 1000 catheter-days	0	8.62	.03	0	4.93	.04
Death	11 (15.1)	21 (18.9)	.56	16 (14.0)	21 (16.5)	.60

NOTE. Data are no. (%) of patients, unless otherwise indicated. APACHE, Acute Physiology and Chronic Health Evaluation; CVCRB, central venous catheter–related bacteremia.

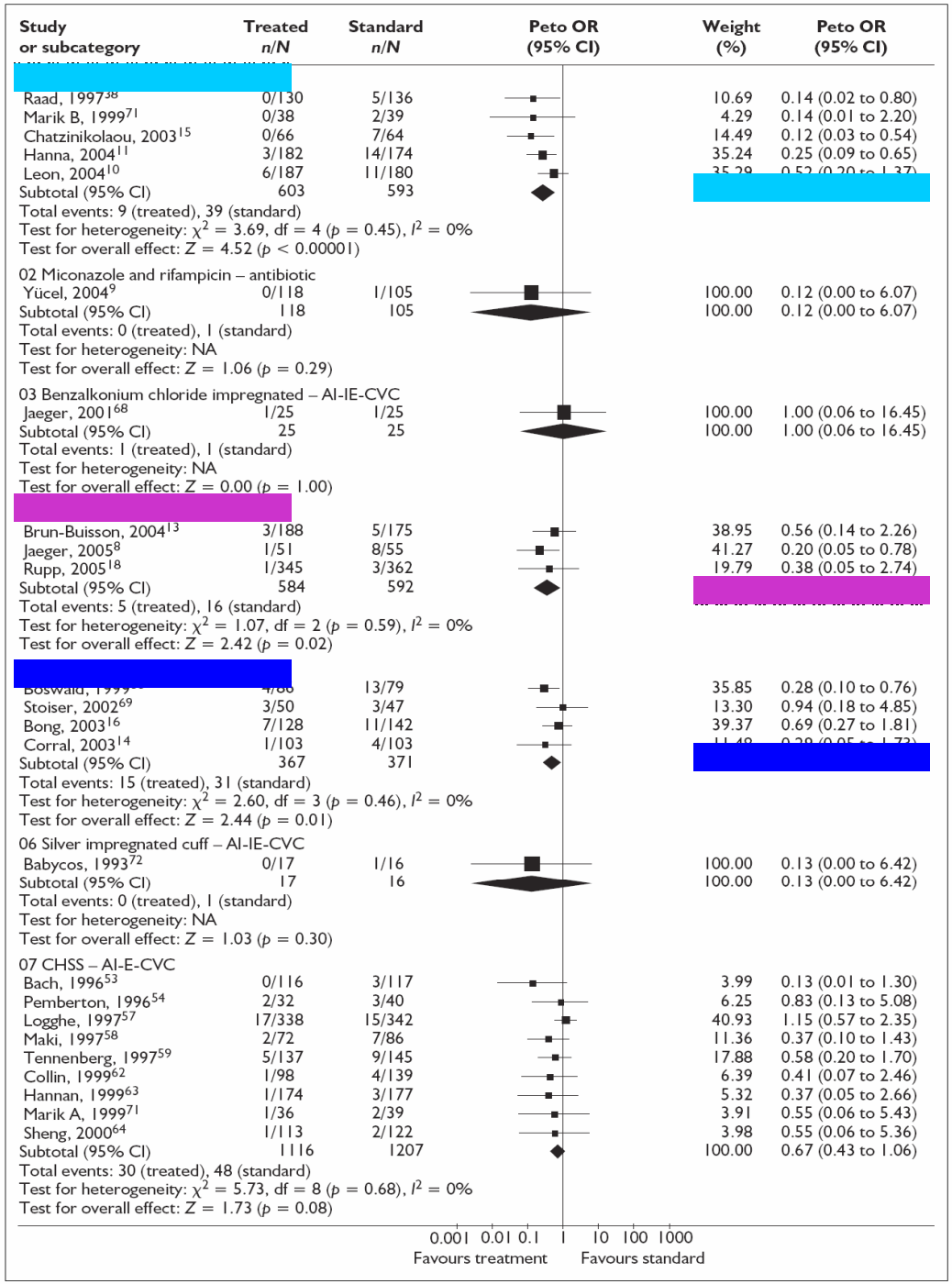

FIGURE 8 *CRBSI rates, subgrouped by different CVCs*

Intensive Care Med (2004) 30:1891–1899
DOI 10.1007/s00134-004-2378-2

ORIGINAL

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Benefits of minocycline and rifampin-impregnated central venous catheters

A prospective, randomized, double-blind, controlled, multicenter trial

Table 2 Differences of central venous catheter colonization and catheter-related bloodstream infection (CRBSI) according to catheter type and culture Method

Data	Minocycline and rifampin-impregnated catheters (*n*=187)		Non-impregnated catheters (*n*=180)		Relative risk (95% CI)
	No. (%)	Episodes per 1000 catheter days	No. (%)	Episodes per 1000 catheter days	
Catheter colonization					
Semi-quantitative culture (roll-plate method)					
Hub	28 (15)	14.5	42 (23.3)	22.4	0.65 (0.4–1.05)
Subcutaneous segment	20 (10.7)	10.4	47 (26.1)	25.1	0.41 (0.25–0.7)
Tip	20 (10.7)	10.4	45 (25)	24	0.43 (0.26–0.73)
All sections (tip and/or subcutaneous segment and/or hub)					
Coagulase-negative staphylococci	13 (7)	6.8	52 (28.9)	27.8	0.24 (0.13–0.45)
Candida spp.	12 (6.4)	6.2	2 (1.1)	1.1	5.84 (1.31–26.1)
Quantitative culture (sonication method)					
Subcutaneous segment	26 (13.9)	13.5	40 (22.2)	21.4	0.63 (0.39–1.04)
Tip	17 (9.1)	8.8	34 (18.9)	18.2	0.49 (0.27–0.87)
All sections (tip and/or subcutaneous segment and/or hub)					
	7 (3.7)	3.6	33 (18.3)	17.6	0.21 (0.09–0.47)
	10 (5.3)	5.2	2 (1.1)	1.1	4.87 (1.07–22.2)
	6 (3.2)	3.1	11 (6.1)	5.9	0.53 (0.2–1.44)
Catheter-related clinical infectious complications	11 (5.9)	5.7	16 (8.9)	8.6	0.67 (0.31–1.44)
	1 (1.6)	0.5	10 (13.9)	5.3	0.1 (0.01–0.76)
	2 (2.1)	1	13 (12.4)	6.9	0.15 (0.03–0.66)
	9 (9.9)	4.7	3 (4)	1.6	2.92 (0.79–10.78)

[a] Minocycline and rifampin catheters, *n*=63; non-impregnated catheters, *n*=72
[b] Minocycline and rifampin catheters (including lipid-based parenteral nutrition), *n*=94; non-impregnated catheters, *n*=105
[c] Minocycline and rifampin catheters, *n*=91; non-impregnated catheters, *n*=75

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Improved Antibiotic-Impregnated Catheters with Extended-Spectrum Activity against Resistant Bacteria and Fungi

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February 2012 Volume 56 Number 2

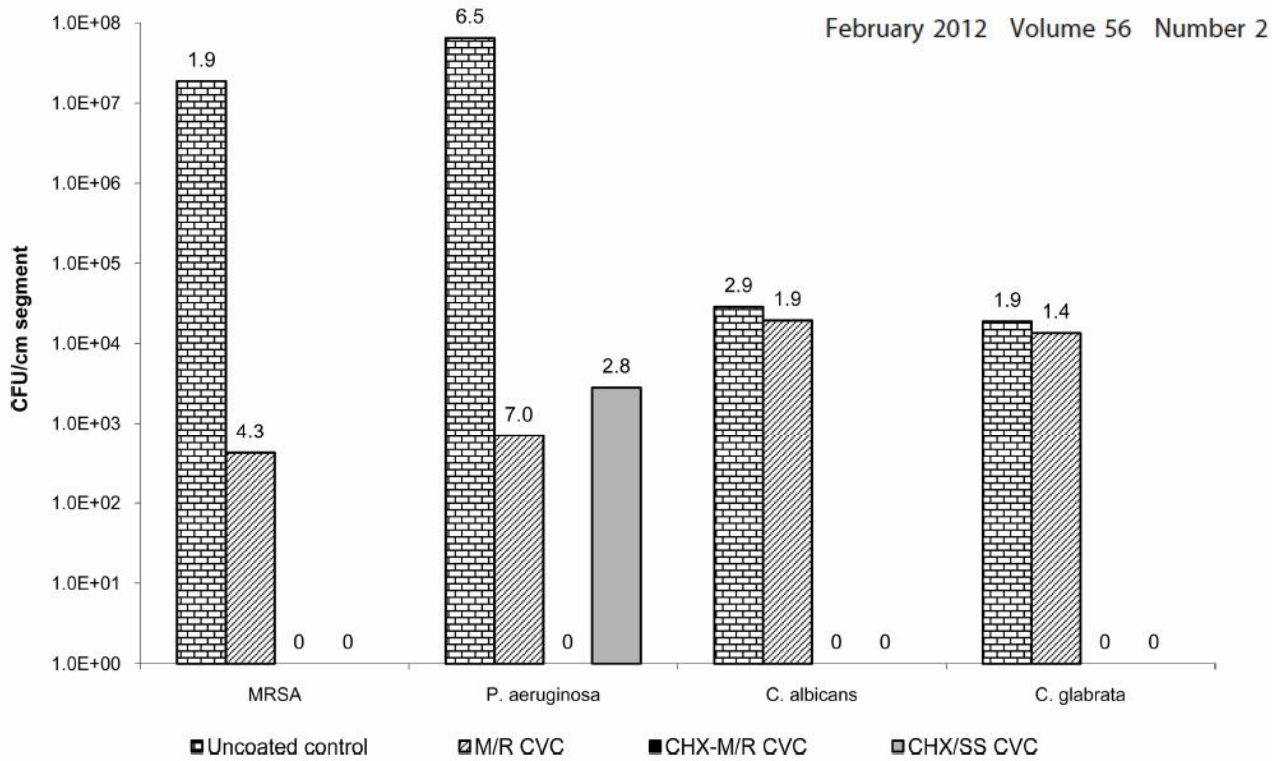

FIG 1 *In vitro* biofilm adherence of various microorganisms to different antimicrobials coating CVC surfaces after 24 h of biofilm formation. M/R, minocycline and rifampin; CHX, chlorhexidine; SS, silver sulfadiazine; NS, not statistically significant. *P* values for MRSA and *P. aeruginosa* were as follows: control versus M/R CVC, $P = 0.005$; control versus CHX-M/R CVC, $P = 0.003$; control versus CHX/SS CVC, $P = 0.004$; CHX-M/R CVC versus M/R CVC, $P = 0.03$; and CHX-M/R CVC versus CHX/SS CVC, $P =$ NS. *P* values for *C. albicans* and *C. glabrata* were as follows: control versus M/R CVC, $P =$ NS; control versus CHX-M/R CVC, $P = 0.003$; control versus CHX/SS CVC, $P = 0.003$; CHX-M/R CVC versus M/R CVC, $P = 0.003$; and CHX-M/R CVC versus CHX/SS CVC, $P = 0.003$.

EFFECT OF NURSE STAFFING AND ANTIMICROBIAL-IMPREGNATED CENTRAL VENOUS CATHETERS ON THE RISK FOR BLOODSTREAM INFECTIONS IN INTENSIVE CARE UNITS

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TABLE 2
CHARACTERISTICS OF THE CENTRAL VENOUS CATHETERS, NATIONAL NOSOCOMIAL INFECTIONS SURVEILLANCE SYSTEM–DETAILED ICU SURVEILLANCE COMPONENT STUDY, 1997 TO 1999

Variable	No.	
Total CVC-days	56,627	-
Mean CVC-days (± SD)	6.6 (± 5)	-
Type of CVC		
Nontunneled	5,185	60
Swan-Ganz	2,203	26
PICC	637	7
Central hemodialysis	498	6
Other*	70	1
Insertion site		
Internal jugular vein	3,751	44
Subclavian vein	3,204	37
Femoral vein	932	11
Arm	697	8
CVC characteristics		
Multiple lumens	7,542	88
Needleless access system	5,314	62
First CVC in the patient	3,696	43
Overlapping CVC†	2,384	28
CVC in place 48 hours after ICU discharge	319	4
TPN	2,365	28
Insertion in OR or SPR	2,129	25
Antimicrobial impregnated‡	1,774	21
Inserted by guidewire exchange	1,578	18
No antibiotic given for 48 hours after insertion	1,088	13

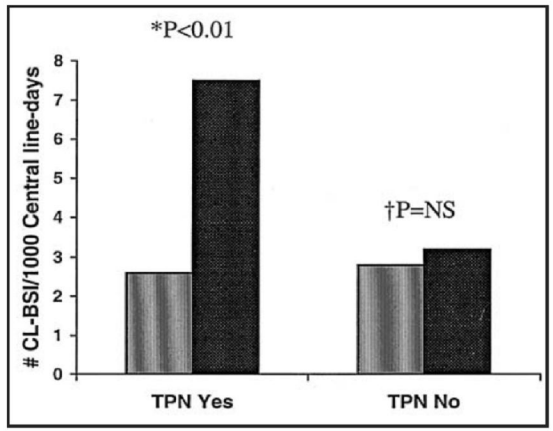


FIGURE 1. Effect of the use of total parenteral nutrition (TPN) on the protective role of antimicrobial-impregnated central venous catheters (CVCs), National Nosocomial Infections Surveillance System–Detailed ICU Surveillance Component Study, 1997 to 1999. The lighter bars represent bloodstream infection (BSI) rates per 1,000 CVC-days for non–antimicrobial-impregnated CVCs. The darker bars represent BSI rates per 1,000 CVC-days for antimicrobial-impregnated CVCs. *Relative risk, 0.41; 95 confidence interval, 0.22 to 0.75. †Relative risk, 0.95; 95 confidence interval, 0.61 to 1.48. CL-BSI = central venous catheter–associated bloodstream infection; NS = not significant.

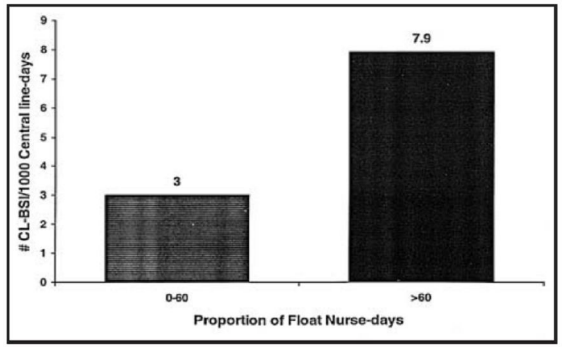


FIGURE 2. Effect of float nurses on the risk for central venous catheter–associated bloodstream infections, National Nosocomial Infections Surveillance System–Detailed ICU Surveillance Component Study, 1997 to 1999. Rate ratio, 2.61; 95 confidence interval, 1.21 to 5.59. CL-BSI = central venous catheter–associated bloodstream infection.

Annals of Internal Medicine | ARTICLE

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

A Randomized, Controlled Trial

Mark E. Rupp, MD; Steven J. Lisco, MD; Pamela A. Lipsett, MD; Trish M. Perl, MD, MSc; Kevin Keating, MD; Joseph M. Civetta, MD; Leonard A. Mermel, DO, ScM; David Lee, MD; E. Patchen Dellinger, MD; Michael Donahoe, MD; David Giles, MD; Michael A. Pfaller, MD; Dennis G. Maki, MD; and Robert Sherertz, MD

Variable	Control Catheter Group	Antiseptic Catheter Group
Definite and possible catheter colonization, *n (%)*†	59 (16.3)	32 (9.3)
Colonization/1000 catheter-days	24.1	13.3
De novo insertion, *n (%); rate/1000 d*	42 (17.3); 23.8	17 (7.4); 10.4
Guidewire exchange, *n (%); rate/1000 d*	17 (14.3); 24.9	15 (13); 19.1
Microbiological characteristics, *n*		
[illegible]		
Other	1	2
Polymicrobic	19	9
Definite CVC-associated BSI, *n (%)*	3 (0.8)	1 (0.3)
BSI/1000 catheter-days	1.24	0.42
De novo insertion, *n (%); rate/1000 d*	3 (1.25); 1.7	1 (0.4); 0.6
Guidewire exchange, *n (%); rate/1000 d*	0	0
Microbiological characteristics, *n*		
S. aureus	2	0
Enterococcus sp.	0	1
Gram-negative bacilli	1	0
Candida sp.	0	1
Polymicrobic	0	1
Definite and possible CVC-associated BSI, *n (%)*‡	8 (2.2)	6 (1.7)
BSI/1000 catheter-days	3.27	2.48
De novo insertion, *n (%); rate/1000 d*	6 (2.5); 3.4	2 (0.9); 1.2
Guidewire exchange, *n (%); rate/1000 d*	2 (1.7); 2.9	4 (3.5); 5.1
Microbiological characteristics, *n*		
[illegible]		
Other	1	0
Polymicrobic	1	2

What are the implications of this study?

Because bacterial colonization of catheters usually precedes bloodstream infection, antibiotic-coated catheters are potentially useful in preventing such infections. Also, the rate of infection in the control group (without the antiseptic-coated catheters) was lower than expected, most likely because of the careful attention paid to aseptic technique during insertion and dressing changes. This implies that serious infections in our hospitals could be avoided with simple preventive measures.

SUPPLEMENT ARTICLE: SHEA/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals

Jonas Marschall, MD; Leonard A. Mermel, DO, ScM; David Classen, MD, MS; Kathleen M. Arias, MS, CIC; Kelly Podgorny, RN, MS, CPHQ; Deverick J. Anderson, MD, MPH; Helen Burstin, MD; David P. Calfee, MD, MS; Susan E. Coffin, MD, MPH; Erik R. Dubberke, MD; Victoria Fraser, MD; Dale N. Gerding, MD; Frances A. Griffin, RRT, MPA; Peter Gross, MD; Keith S. Kaye, MD; Michael Klompas, MD; Evelyn Lo, MD; Lindsay Nicolle, MD; David A. Pegues, MD; Trish M. Perl, MD; Sanjay Saint, MD; Cassandra D. Salgado, MD, MS; Robert A. Weinstein, MD; Robert Wise, MD; Deborah S. Yokoe, MD, MPH

2. Use antiseptic- or antimicrobial-impregnated CVCs for adult patients (A-I).[64-70]

a. The risk of CLABSI is reduced with some currently marketed catheters impregnated with antiseptics (eg, chlorhexidine-silver sulfadiazine) or antimicrobials (eg, minocycline-rifampin). Consider the use of such catheters in the following circumstances:

i. Hospital units or patient populations have a CLABSI rate higher than the institutional goal, despite compliance with basic CLABSI prevention practices.

ii. Patients have limited venous access and a history of recurrent CLABSI.

iii. Patients are at heightened risk for severe sequelae from a CLABSI (eg, patients with recently implanted intravascular devices, such as a prosthetic heart valve or aortic graft).

b. These catheters are not approved by the US Food and Drug Administration for use in children.

i. Preliminary data suggest that antimicrobial-impregnated catheters appear to be safe and may hold promise for pediatric ICU patients.[71,72]

From: **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. doi:10.1001/jama.2009.376

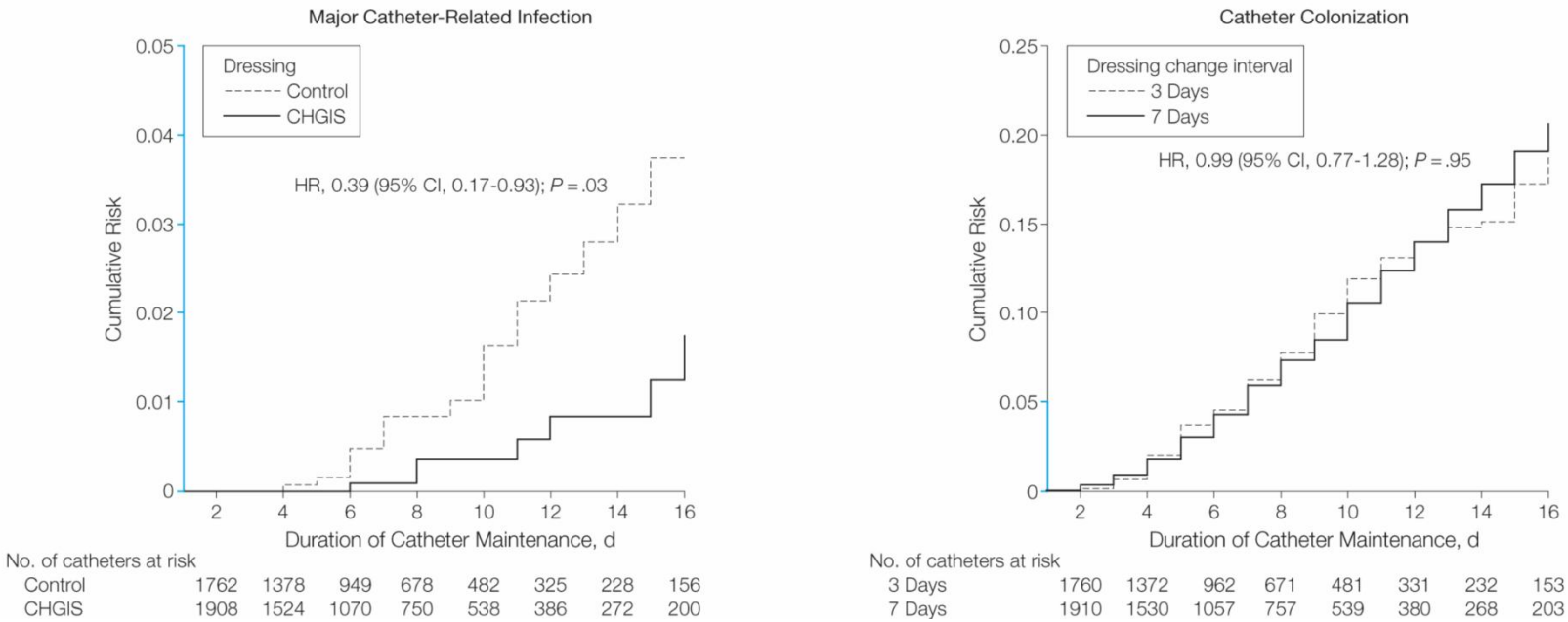


Figure Legend:

Median duration of catheterization was 6 days (interquartile range, 4-10 days) for all curves. y-Axis in blue indicates values in the range of 0-0.05. CHGIS indicates chlorhexidine gluconate–impregnated sponge; CI, confidence interval; HR, hazard ratio.

Comparison of Oligon catheters and chlorhexidine-impregnated sponges with standard multilumen central venous catheters for prevention of associated colonization and infections in intensive care unit patients: A multicenter, randomized, controlled study*

Kostoula Arvaniti, MD; Dimitrios Lathyris, MD; Phyllis Clouva-Molyvdas, MD; Anna-Bettina Haidich, PhD;

Crit Care Med 2012 Vol. 40, No. 2

Table 3. Catheter colonization/infection and catheter-related bloodstream infections[a]

	Group A (Standard Central Venous Catheter) (n = 156)	Group B (Chlorhexidine–Gluconate-Impregnated Sponge) (n = 150)	Group C (Oligon Central Venous Catheter) (n = 159)	Chlorhexidine–Gluconate-Impregnated Sponge vs. Standard Central Venous Catheter Unadjusted Hazard Ratio (95% Confidence Interval)	*p*	Oligon vs. Standard Central Venous Catheter Unadjusted Hazard Ratio (95% Confidence Interval)	*p*
No. of catheter-days	1148	1054	1147				
Catheter colonization							
No. of catheters (%)	24 (15.38)	21 (14)	25 (15.72)	1.21 (0.56–2.61)	.64	1.0 (0.46–2.21)	.98
Incidence, per 1000 catheter-days	20.9	19.92	21.79				
Catheter-related infection, nonbacteremic							
No. of catheters (%)	9 (5.76)	6 (4)	7 (4.40)	0.65 (0.23–1.85)	.42	0.72 (0.27–1.95)	.52
Incidence, per 1000 catheter-days	7.83	5.69	6.10				
Catheter-related bloodstream infection							
No. of catheters (%)	2 (1.28)	3 (2)	2 (1.25)	1.65 (0.27–10.01)	.59	0.75 (0.11–5.38)	.78
Incidence, per 1000 catheter-days	1.4	2.84	1.74				

Table 4. Cox proportional hazards model for catheter colonization and stratified for center[a]

Variables	Adjusted Hazard Ratio	(95% Confidence Interval)	*p*
Type of CVC			
Chlorhexidine–gluconate-impregnated sponge vs. standard CVC	1.19	(0.63–2.25)	.59
Oligon CVC vs. standard CVC	1.21	(0.67–2.18)	.53
Insertion site			
Internal jugular vein vs. subclavian vein	3.29	(1.26–8.61)	.01
Femoral vein vs. subclavian vein	3.36	(1.17–9.65)	.02
Cancer	2.29	(1.06–4.94)	.03
Age	1.01	(0.99–1.02)	.46
Blood infusion	1.06	(0.49–2.28)	.88
McCabe score (none or non fatal underlying disease)	3.12	(0.88–11.1)	.08

Triptychs used for the non-attendance education

Check-list manteniment

1. He fet higiene de mans abans i després de manipular el catèter o les seves connexions

2. He netejat els connectors amb antisèptic abans d'administrar un bolus o connectar un equip d'infusió.

3. He manipulat la nutrició parenteral amb tècnica estèril.

4. He recanviat els connectors amb tècnica estèril.

5. He retirat aquells catèters que ja no calen o que presenten signes locals d'infecció.

TABLE 1. Review of methods for diagnosing catheter-related infection

First author and year	Material employed	Technique	Criterion for positive result	Catheter in situ	Rapid
Druskin (28) 1963	Catheter segment	**Qualitative culture** in broth	Any growth	No	No
Seligman (81) 1974	Catheter segment	**Quantitative culture**		No	No
		Flushing with needle (81)	$\geq 10^3$ CFU per segment		
		Vigorous agitation (7)	$\geq 10^3$ CFU per segment		
		Sonicating (6)	$\geq 10^2$ CFU per segment		
		Vortexing (11)	$\geq 10^3$ CFU per segment		
		Sonicating and vortexing (84)	$\geq 10^2$ CFU per segment		
		Dilutions onto agar, Ultrasonicating (46), and mixing with mole	$\geq 10^2$ CFU per segment		
Maki (53) 1977	Catheter segment	**Semiquantitative** culture on roll plate	≥15 CFU per segment (53)	No	No
			≥5 CFU per segment (21)		
Wing (98) 1979	Blood from catheter	**Paired quantitative** pour plate **blood** cultures from catheter and peripheral vein	Catheter counts > vein counts (98)	Yes	No
			Catheter counts > vein counts by 30 (62)	Yes	
			Catheter:vein = 7:1 (29)	No	
			Catheter:vein = 4:1 (13)	Yes	
Powell-Tuck (65) 1979	Skin swab insertion site	**Nonquantitative culture** on agar (with every dressing change)	Any growth	Yes	No
Powell-Tuck (65) 1979	Skin swab insertion site	**Gram stain** (if purulent)	Not stated (65)	Yes	Yes
Bjornson (7) 1982	Skin swab at entry site	**Quantitative culture** by dilution plate count after vigorous agitation on blood agar (75)	$\geq 10^3$ CFU per swab (9)	No	No
			≥5 CFU per swab (75)		
Snydman (89) 1982	Blood from catheter	**Quantitative culture** on pour plate	Any growth (89)	Yes	No
			≥25 CFU per ml (58)	No	
			≥15 CFU per ml (91)	Yes	
			$\geq 10^3$ CFU per ml (1)	Yes	
		On solid agar (72)	Any growth (72)	Yes	
Grabe (34) 1983	Inner surface of cannula	**Semiquantitative** roll plate **culture** of steel stiletto inserted into lumen and drawn back and forth	Counts given; no cutoff mentioned	No	No
		Plastic obturator (41)	As above	Yes	No
Grabe (34) 1983	Washing fluid of cannula	**Semiquantitative culture** of centrifuged deposit from washings through sideport and infusion port	As above	No	No
Jakobsen (40) 1983	Inner surface of sideport	**Nonquantitative culture** of a stick rubbed into the inside of the sideport and spread on agar	Any growth	No	No
Bozzetti (8) 1984	Blood from catheter	**Nonquantitative culture** in broth	Any growth	No	No
Sitges-Serra (86) 1984	Catheter hub	**Quantitative culture** flushing with a needle dilution onto agar	$\geq 10^3$ CFU per segment	No	No
Cooper (22) 1985	Catheter segment	**Direct staining**		No	Yes
		Gram stain of catheter segment (23)	≥1 organism per 20 oil immersion fields (22)		
		Gram stain of impression smear of catheter segment (21)	Results given for various levels of counting (21)		
		Acridine orange stain of catheter (99)	Presence of bacteria or fungi (99)		
Rushforth (78) 1993	Blood from catheter	**Acridine orange staining** of monolayered leukocytes from pellet examining with UV microscope	Presence of bacteria	Yes	Yes
Khardori (45) 1993	Catheter segment	**Culture** of tiny sections of catheter embedded into agar	Probably any growth	No	No

Infecciones relacionadas con catéteres intravasculares en el paciente crítico. Estudio multicéntrico

M. A. LEÓN REGIDOR*, C. LEÓN GIL**, A. MATEU SOLA***, P. OLAECHEA ASTIGARRA****, J. M. INSAUSTI ORDEÑANA+, A. MARTÍNEZ PELLÚS++, V. GONZÁLEZ SANZ+++, V. LÓPEZ CAMPS++++, B. ÁLVAREZ SÁNCHEZ+++++, Y GRUPO PARA EL ESTUDIO DE LAS INFECCIONES RELACIONADAS CON CATÉTERES INTRAVASCULARES EN UCI (GEIRCI) [1]

*Hospital General de Catalunya, Barcelona. **Hospital Universitario Valme, Sevilla. ***Hospital de Bellvitge, Barcelona. ****Hospital de Galdákano, Vizcaya. +Hospital General de Navarra, Pamplona. ++Hospital Virgen de la Arrixaca, Murcia. +++Hospital Miguel Servet, Zaragoza. ++++Hospital Puerto de Sagunto, Sagunto. +++++Hospital, Alicante.

Fundamento. Conocer las características de las infecciones relacionadas con el uso de catéteres intravasculares en el paciente crítico, en nuestro medio, valorando la prevalencia/incidencia, tipo de microorganismo(s) involucrado(s) y la vía de entrada utilizada, aspectos clínicos y complicaciones.

Métodos. Estudio prospectivo llevado a cabo por 18 UCI de nuestro país. En todo paciente con

de BRC de 40 casos (8,1%). En estos casos de BRC la vía de entrada utilizada por los diferentes microorganismos fue la piel en once casos (27,5%), la conexión en trece casos (32,5%) y ambos en dieciseis casos (40%).

La bacteriemia se consideró una siembra hematógena en el catéter con otro foco de origen os y, en cinco casos, la bacteriemia con líquidos de infusión que estaados.

más frecuentemente involucrado fue coccus epidermidis en 17 casos uido por *Staphylococcus aureus* (12,5%), *Streptococcus faecalis* 12,5%), y *Candida parapsilosis* tam-

TABLA 5. **Sintomatología clínica en el momento de la retirada y procesamiento de los catéteres**

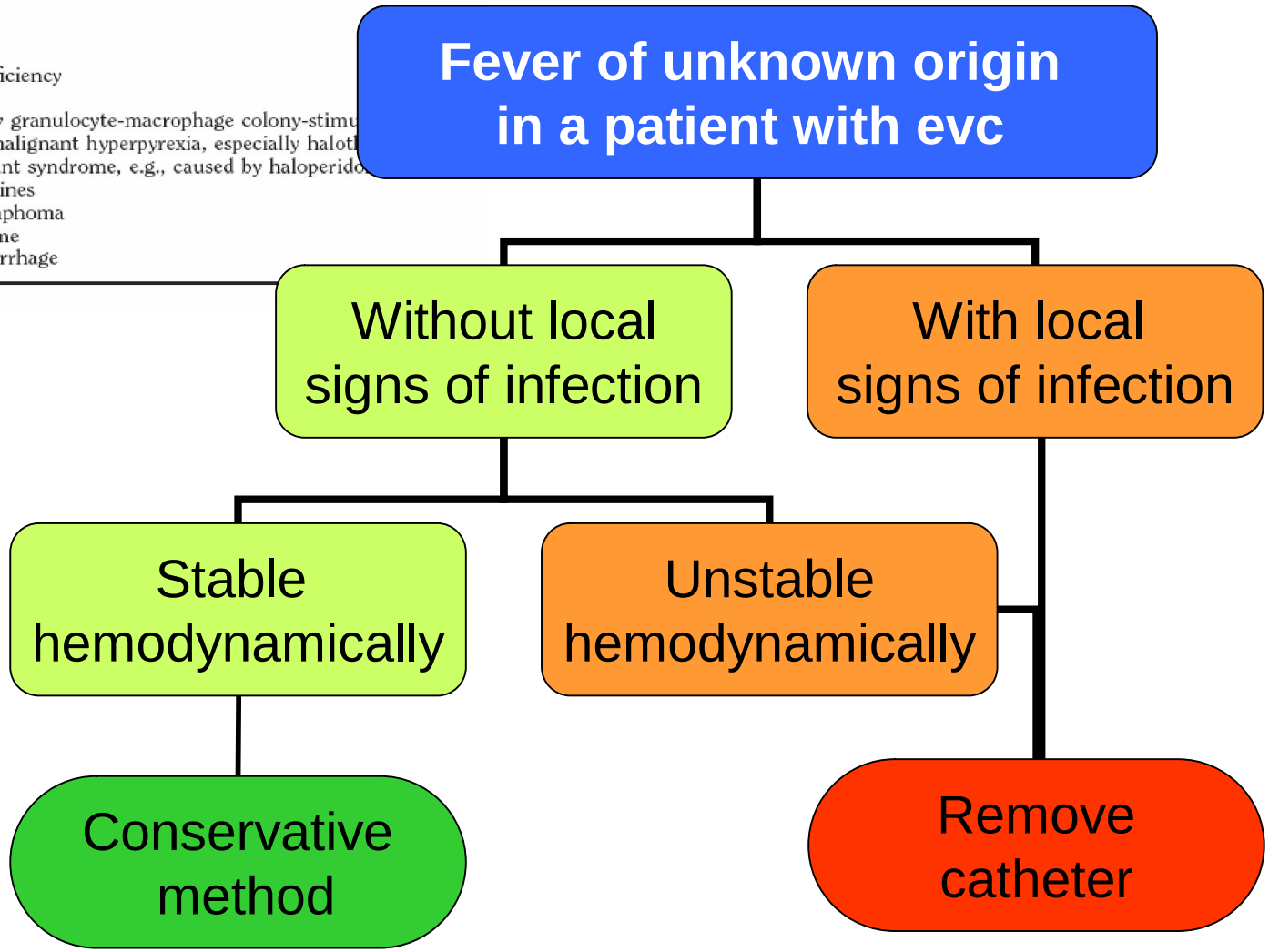
	Casos	(%)
Síntomas locales		
Ninguna	273	55,5
Orificio entrada rojo	174	35,4
Flebitis	45	9,1
Síntomas generales		
Ninguna	84	17,1
Aguja febril	123	25,0
Síndrome febril mantenido	285	57,9

TABLA 12. **Evaluación definitiva del catéter**

Estéril	323	(65,7%)
Colonizado	41	(8,3%)
Infectado	74	(15,0%)
Bacteriemia relacionada infusión	5	(1,0%)
Siembra hematógena	9	(1,8%)
Bacteriemia relacionada catéter	40	(8,1%)
Origen de piel	11	(27,5%)
Origen de conexión(es)		13
(32,5%)		

Table 1. Noninfective causes of systemic inflammatory response syndrome

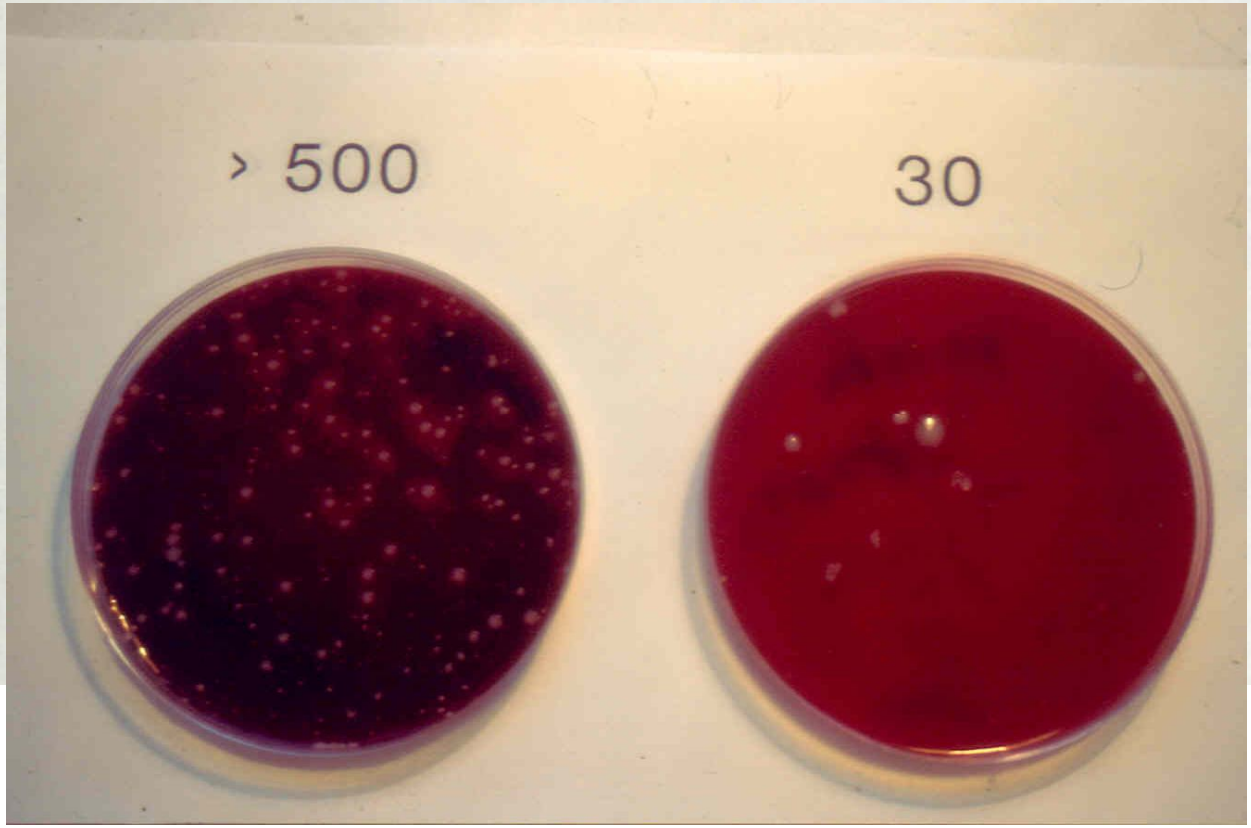
Tissue injury	Surgery/trauma
	Hematoma/venous thrombosis
	Myocardial/pulmonary infarction
	Transplant rejection
	Pancreatitis
	Erythroderma
Metabolic	Thyroid storm
	Acute adrenal insufficiency
Therapy related	Blood products
	Cytokines, especially granulocyte-macrophage colony-stimu
	Anesthetic-related malignant hyperpyrexia, especially halot
	Neuroleptic malignant syndrome, e.g., caused by haloperido
	Opiates/benzodiazepines
Malignancy	Hypernephroma/lymphoma
	Tumor lysis syndrome
Neurologic	Subarachnoid hemorrhage



Eur. J. Clin. Microbiol. Infect. Dis., May 1992, p. 403–407
0934-9723/92/05 0403-05 $ 3.00/0

Value of Differential Quantitative Blood Cultures in the Diagnosis of Catheter-Related Sepsis

J.A. Capdevila[1]*, A.M. Planes[2], M. Palomar[3], I. Gasser[2], B. Almirante[1], A. Pahissa[1], E. Crespo[2], J.M. Martínez-Vázquez[1]



A Randomized and Prospective Study of 3 Procedures for the Diagnosis of Catheter-Related Bloodstream Infection without Catheter Withdrawal

Emilio Bouza,[1] Neisa Alvarado,[1] Luis Alcalá,[1] Maria Jesús Pérez,[2] Cristina Rincón,[2] and Patricia Muñoz[1]

Clinical Infectious Diseases 2007; 44:820–6

Table 3. Comparison of the validity values (95% CI) of 3 techniques for the detection of catheter-related bloodstream infection.

Measure	Semiquantitative superficial cultures[a,b]	Differential quantitative blood cultures[a,c]	Differential time to positivity[b,c]
Sensitivity	78.6 (59.0–91.7)	71.4 (51.3–86.8)	96.4 (81.7–99.9)
Specificity	92.0 (87.0–95.6)	97.7 (94.3–99.4)	90.3 (85.0–94.3)
Positive predictive value	61.1 (43.5–76.9)	83.3 (62.6–95.3)	61.4 (45.5–75.6)
Negative predictive value	96.4 (92.4–98.7)	95.6 (91.4–98.1)	99.4 (96.6–99.9)
Accuracy	90.2 (85.3–93.9)	94.1 (90.0–96.9)	91.2 (86.4–94.7)

JOURNAL OF CLINICAL MICROBIOLOGY, Mar. 1997, p. 641–646 Vol. 35, No. 3
0095-1137/97/$04.00+0

Diagnosis of Triple-Lumen Catheter Infection: Comparison of Roll Plate, Sonication, and Flushing Methodologies

ROBERT J. SHERERTZ,[1]* STEPHEN O. HEARD,[2] AND ISSAM I. RAAD[3]

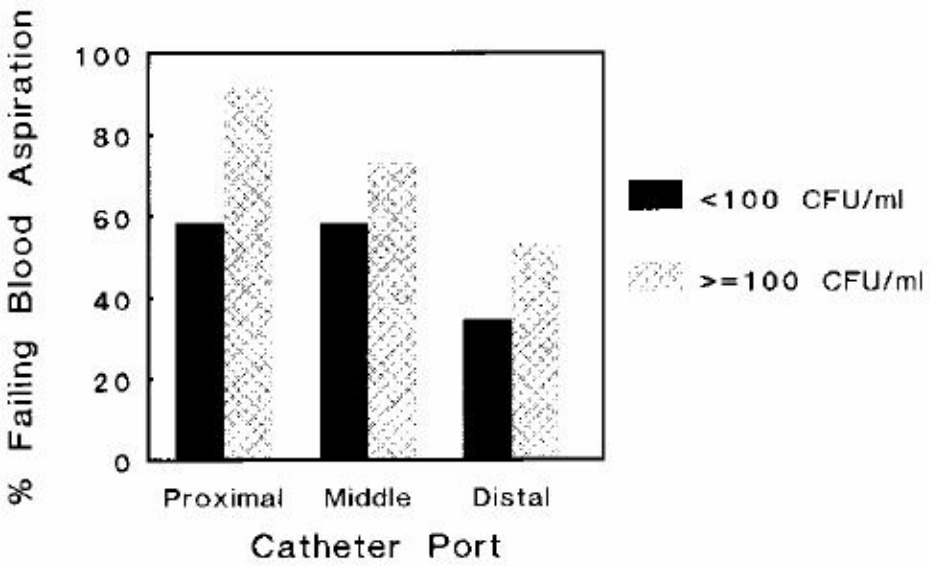


FIG. 2. Frequency with which failure of blood aspiration through each catheter lumen occurred with or without the presence of significant colonization of the lumen with microorganisms. The statistical differences between the two groups (<100 and ≥100 CFU) by catheter port were as follows: proximal, P = 0.001 (one-tailed Fisher's exact test); middle, P = 0.1; distal, P = 0.09.

How Many Lumens Should Be Cultured in the Conservative Diagnosis of Catheter-Related Bloodstream Infections?

María Guembe,[1] Marta Rodríguez-Créixems,[1,2] Carlos Sánchez-Carrillo,[1] Alfonso Pérez-Parra,[1] Pablo Martín-Rabadán,[1,2,3] and Emilio Bouza[1,2,3]

Clinical Infectious Diseases 2010;50(12):1575–1579

Table 3. Baseline Data for Episodes of Catheter-Related Bloodstream Infection Detected by Culture of Blood Samples Obtained via Double-Lumen and Triple-Lumen Catheters

Variable	Double-lumen catheters (n = 112)	Triple-lumen catheters (n = 59)
With 1 lumen causing infection		
No. (%) of episodes	61 (54.5)	28 (47.5)
95% CI, %	44.8–64.1	33.9–61.1
With 2 lumens causing infection		
No. (%) of episodes	51 (45.5)	10 (17.0)
95% CI, %	35.9–55.2	6.5–27.4
With 3 lumens causing infection		
No. (%) of episodes	…	21 (35.6)
95% CI, %	…	22.5–48.7

NOTE. CI, confidence interval.

Table 4. Number and Percentage of Missed Episodes

Variable	Double-lumen catheters (n = 112)	Triple-lumen catheters (n = 59)
When eliminating 1 lumen		
No. (%) of episodes	81.4 (72.8)	49.7 (84.2)
95% CI, %	65.2–81.3	74.6–93.2
P	<.001	.001
When eliminating 2 lumens		
No. (%) of episodes	…	37 (62.7)
95% CI, %		49.2–74.6
P		<.001

NOTE. CI, confidence interval.

A Prospective, Randomized, and Comparative Study of 3 Different Methods for the Diagnosis of Intravascular Catheter Colonization

Emilio Bouza,[1] Neisa Alvarado,[1] Luis Alcalá,[1] Matilde Sánchez-Conde,[1] María Jesús Pérez,[2] Patricia Muñoz,[1] Pablo Martín-Rabadán,[1] and Marta Rodríguez-Créixems[1]

Clinical Infectious Diseases 2005; 40:1096–100

Table 3. Diagnostic yield of the different techniques used for the detection of colonization in patients with catheter-related bloodstream infection (with breakpoints of ⩾15 cfu, for Maki's technique, and ⩾100 cfu/catheter segment, for quantitative techniques) by duration of catheterization.

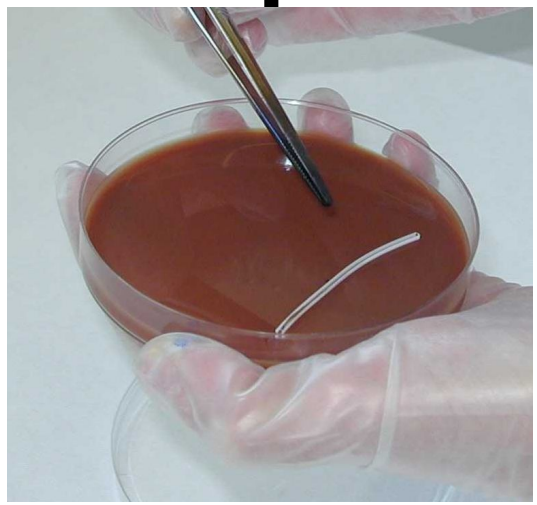
Procedure order	Short-term catheters (n = 142)			Long-term catheters (n = 227)		
	Maki's technique	Sonication	Vortexing	Maki's technique	Sonication	Vortexing
Sensitivity[a]	90.0 (55.5–99.7)	90.0 (55.5–99.7)	90.0 (55.5–99.7)	87.5 (77.6–94.1)	91.7 (82.7–96.9)	83.3 (72.7–91.1)
Specificity[b]	81.8 (74.2–88.0)	81.8 (74.2–88.0)	87.1 (80.2–92.3)	77.4 (70.0–83.7)	78.7 (71.4–84.9)	80.0 (72.8–86.0)
Positive PV[c]	27.3 (13.3–45.5)	27.3 (13.3–45.5)	34.6 (17.2–55.7)	63.6 (53.4–73.1)	65.3 (55.2–74.5)	63.2 (52.6–72.8)
Negative PV[d]	99.1 (95.0–100)	99.1 (95.0–100)	99.1 (95.2–100)	93.8 (88.1–97.3)	96.8 (92.1–99.1)	93.9 (88.4–97.3)
Positive LR (95% CI)	5.0 (1.8–13.5)	5.0 (1.8–13.5)	7.0 (2.5–19.6)	3.9 (2.4–6.4)	4.3 (2.6–7.1)	4.2 (2.5–7.0)
Negative LR (95% CI)	0.12 (0.02–0.97)	0.12 (0.02–0.97)	0.11 (0.01–0.91)	0.16 (0.08–0.34)	0.11 (0.04–0.25)	0.21 (0.11–0.40)

Table 1. Noninfective causes of systemic inflammatory response syndrome

Tissue injury	Surgery/trauma
	Hematoma/venous thrombosis
	Myocardial/pulmonary infarction
	Transplant rejection
	Pancreatitis
	Erythroderma
Metabolic	Thyroid storm
	Acute adrenal insufficiency
Therapy related	Blood products
	Cytokines, especially granulocyte-macrophage colony-stimu
	Anesthetic-related malignant hyperpyrexia, especially halot
	Neuroleptic malignant syndrome, e.g., caused by haloperido
	Opiates/benzodiazepines
Malignancy	Hypernephroma/lymphoma
	Tumor lysis syndrome
Neurologic	Subarachnoid hemorrhage

Fever of unknown origin in a patient with evc

- Without local signs of infection
  - Stable hemodynamically
  - Unstable hemodynamically
- With local signs of infection



Intensive Care Med (2008) 34:2185–2193
DOI 10.1007/s00134-008-1204-7

ORIGINAL

Jose Garnacho-Montero
Teresa Aldabó-Pallás
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Risk factors and prognosis of catheter-related bloodstream infection in critically ill patients: a multicenter study

Table 4 Univariate and multivariate analyses of factors associated with in-hospital mortality in patients with CR-BSI

Variable	Univariate analysis			Multivariate analysis	
	Survivors ($n = 44$) [N (%)]	Non-survivors ($n = 22$)	P value	P value	OR (95% CI)
Age[a]	53.1 (17.6)	65.1 (13.3)	0.008	0.074	
APACHE II[a]	11.7 (6)	16.2 (4.9)	0.006	0.015	1.17 (1.03–1.33)
Gender (male)	34 (77.3)	16 (72.2)	0.764	–	
Diabetes mellitus	6 (13.6)	7 (31.8)	0.105	–	
COPD	3 (6.8)	2 (9.1)	0.999	–	
Cirrhosis	5 (11.4)	1 (4.5)	0.655	–	
ESRD	1 (2.3)	0 (0)	0.999	–	
CHF	7 (15.9)	2 (9.1)	0.706	–	
Immunosuppression	0 (0)	2 (9.1)	0.108	–	
Cancer	6 (10.6)	1 (4.5)	0.409	–	
SOFA score (day of CR-BSI)[a]	5.94 (5.1)	5.4 (3.96)	0.662	–	
Adequate empirical therapy	22 (50)	10 (45.5)	0.797	–	
Early removal (<24 h)	35 (79.5)	13 (59.1)	0.089	0.030	0.22 (0.1–0.86)

[a] Mean (SD) COPD denotes chronic obstructive pulmonary disease
ESRD end-stage renal disease, *CHF* chronic heart failure, *CR-BS* catheter-related bloodstream infection

E) GRUPOS DE GÉRMENES

GRUPO	n	%
BGN	136	35,60
Gram +	208	54,45
Hongos	35	9,16
Otros	3	0,79
TOTAL	**382**	

MICROORGANISMO	TOTAL		Primarias		Catéter		≤ 4 días		> 4 días	
	n	%	n	%	n	%	n	%	n	%
Staphylococcus epidermidis	85	22,25	26	22,61	59	22,10	12	23,08	73	22,12
Staphylococcus coagulasa negativo	37	9,69	15	13,04	22	8,24	5	9,62	32	9,70
Enterococcus faecalis	30	7,85	7	6,09	23	8,61	3	5,77	27	8,18
Klebsiella pneumoniae	22	5,76	6	5,22	16	5,99	2	3,85	20	6,06
Pseudomonas aeruginosa	22	5,76	4	3,48	18	6,74	2	3,85	20	6,06
Staphylococcus otros	18	4,71	11	9,57	7	2,62	7	13,46	11	3,33
Acinetobacter baumannii	16	4,19	2	1,74	14	5,24	1	1,92	15	4,55
Escherichia coli	16	4,19	7	6,09	9	3,37	6	11,54	10	3,03
Candida albicans	15	3,93	2	1,74	13	4,87	1	1,92	14	4,24
Enterococcus faecium	15	3,93	10	8,70	5	1,87	1	1,92	14	4,24
Candida parapsilopsis	12	3,14	3	2,61	9	3,37	1	1,92	11	3,33
Enterobacter cloacae	10	2,62	1	0,87	9	3,37	0	0,00	10	3,03
Klebsiella oxytoca	10	2,62	0	0,00	10	3,75	0	0,00	10	3,03
Staphylococcus aureus	10	2,62	6	5,22	4	1,50	4	7,69	6	1,82
Serratia marcescens	9	2,36	4	3,48	5	1,87	2	3,85	7	2,12
Stenotrophomonas maltophilia	9	2,36	3	2,61	6	2,25	0	0,00	9	2,73
Staphylococcus aureus meticilín resistente	7	1,83	1	0,87	6	2,25	1	1,92	6	1,82
Proteus mirabilis	6	1,57	1	0,87	5	1,87	0	0,00	6	1,82
Candida tropicalis	4	1,05	0	0,00	4	1,50	0	0,00	4	1,21
Enterobacter aerogenes	4	1,05	3	2,61	1	0,37	2	3,85	2	0,61
Morganella morganii	4	1,05	0	0,00	4	1,50	0	0,00	4	1,21

Preventing *Staphylococcus aureus* Bacteremia and Sepsis in Patients With *Staphylococcus aureus* Colonization of Intravascular Catheters

A Retrospective Multicenter Study and Meta-Analysis

TABLE 3. Risk Factors for Subsequent *S. aureus* Bacteremia in Patients With *S. aureus* Colonization of IV Catheters, Combined Analysis*

	Patients Without Subsequent SAB	Patients With Subsequent SAB After 48 h	Univariate Analysis		Multivariate Analysis	
Variable	No. (%) (n = 259)	No. (%) (n = 32)	P	OR (95% CI)	P	OR (95% CI)
No antibiotic therapy within 24 h	140 (54)	27 (84)	0.001	4.59 (1.71–12.35)	0.001	5.4 (2.0–15.1)
Documented exit-site infection	85 (33)	17 (53)	0.023	2.32 (1.11–4.87)	0.003	3.31 (1.5–7.4)
Corticosteroid therapy	46 (18)	12 (37)	0.007	2.87 (1.30–6.32)	0.013	2.9 (1.3–6.6)
Immunosuppressive therapy (all)	63 (24)	15 (47)	0.007	2.74 (1.30–5.81)	0.61	1.4 (0.3–5.6)

*Combining results from present report and results of the study by Ekkelenkamp et al.[1]

Hetem DJ, Medicine (Baltimore) 2011 Jul;90(4):284-8.

878 *Clinical Microbiology and Infection*, Volume 18 Number 9, September 2012 CMI

Central venous catheter colonization with *Staphylococcus aureus* is not always an indication for antimicrobial therapy

P. Muñoz[1,2,3], A. Fernández Cruz[1], R. Usubillaga[1], A. Zorzano[1], M. Rodríguez-Créixems[1,2,3], M. Guembe[1] and E. Bouza[1,2,3]

Clinical Practice Guidelines for the Diagnosis and Management of Intravascular Catheter-Related Infection: 2009 Update by the Infectious Diseases Society of America

Leonard A. Mermel,[1] Michael Allon,[2] Emilio Bouza,[9] Donald E. Craven,[3] Patricia Flynn,[4] Naomi P. O'Grady,[5] Issam I. Raad,[6] Bart J. A. Rijnders,[10] Robert J. Sherertz,[7] and David K. Warren[8]

Clinical Infectious Diseases 2009; 49:1–45

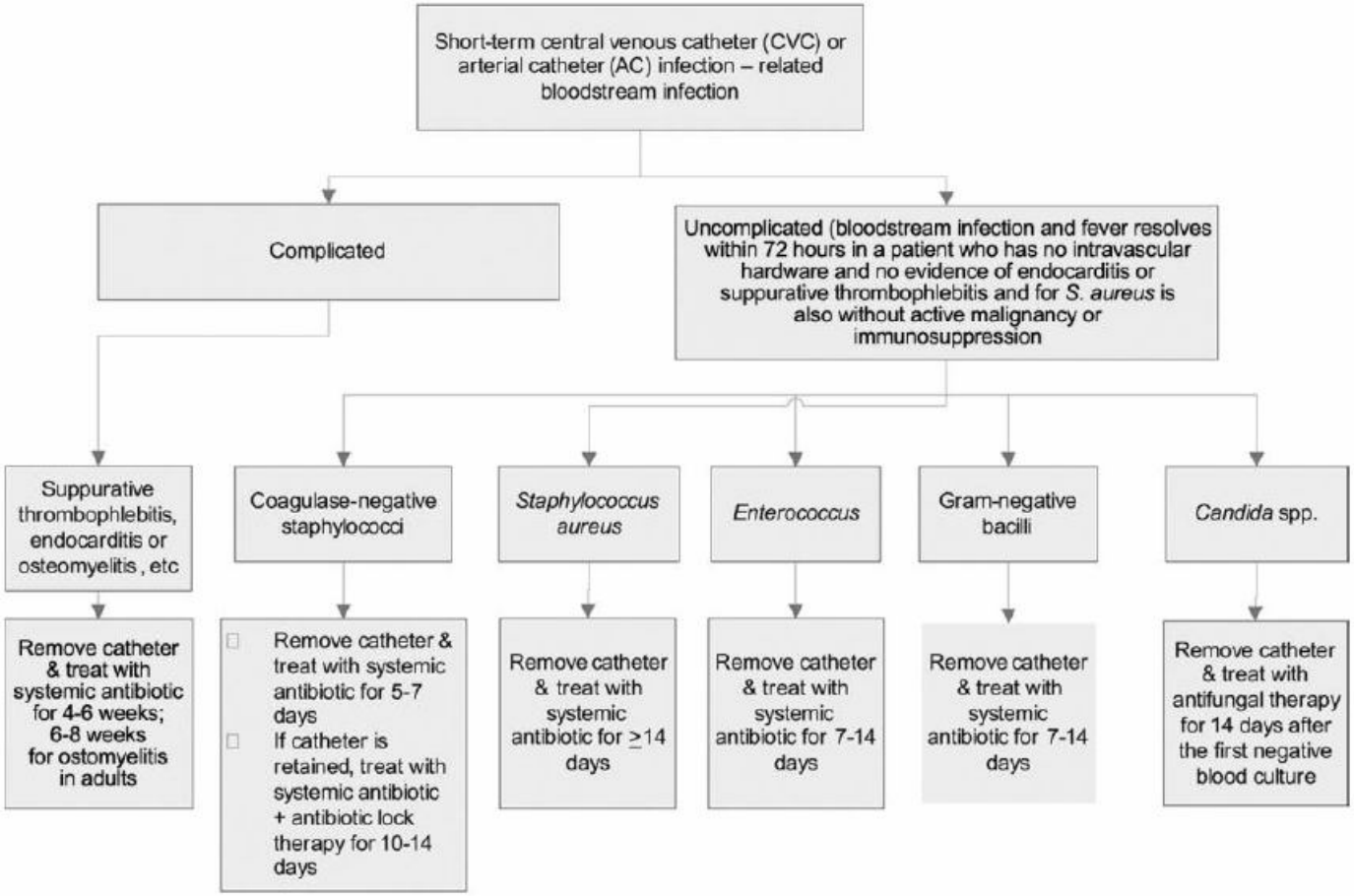

Figure 2. Approach to the management of patients with short-term central venous catheter–related or arterial catheter–related bloodstream infection. CFU, colony-forming units; *S. aureus, Staphylococcus aureus.*