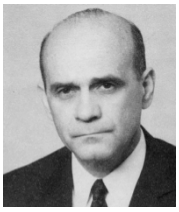
Marcia Ryder PhD MS RN
ryder1234@aol.com
RYDER SCIENCE
.....medical biofilm research

Father of Intravenous Infusion Therapy

Thomas Latta
1796-1833

1832 First IV procedure during the Cholera epidemic in London

Rivera AM. Acta Anaesth Belg. 2005;56:271-82

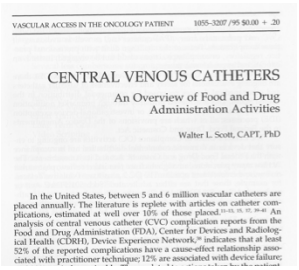


Robert Aubaniac 1952

Central Venous Catheterization

Sven-Ivar Seldinger 1953

FDA Central Venous Catheter Working Group



VASCULAR ACCESS IN THE ONCOLOGY PATIENT 1055-3207/95 $0.00 + .20

CENTRAL VENOUS CATHETERS

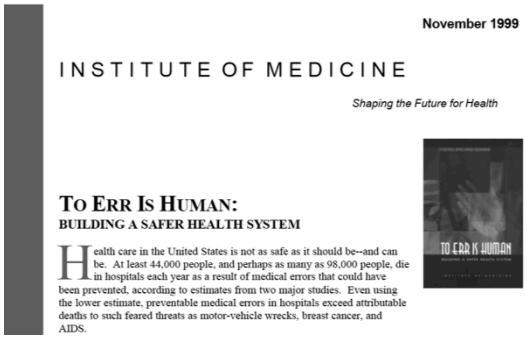
An Overview of Food and Drug Administration Activities

Walter L. Scott, CAPT, PhD

In the United States, between 5 and 6 million vascular catheters are placed annually. The literature is replete with articles on catheter complications, estimated at well over 10% of those placed. An analysis of central venous catheter (CVC) complication reports from the Food and Drug Administration (FDA), Center for Devices and Radiological Health (CDRH), Device Experience Network, indicates that at least 52% of the reported complications have a cause-effect relationship associated with practitioner technique; 12% are associated with device failure;

Catheter complication rate: 10%
Associated with practitioner technique: 52%
Associated with device failure: 12%
Undeterminable: 30%

Scott W. Surg Onc Clinics N Am.1995;4:390-4



November 1999

INSTITUTE OF MEDICINE

Shaping the Future for Health

TO ERR IS HUMAN:
BUILDING A SAFER HEALTH SYSTEM

Health care in the United States is not as safe as it should be--and can be. At least 44,000 people, and perhaps as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented, according to estimates from two major studies. Even using the lower estimate, preventable medical errors in hospitals exceed attributable deaths to such feared threats as motor-vehicle wrecks, breast cancer, and AIDS.

1999 Institute of Medicine "To Err is Human"

2002 National Quality Forum Patient Safety Indicators
"serious adverse events"
Pneumothorax
Arterial puncture
Selected infections
Mechanical adverse events

2005 Patient Safety Act

2005 Deficit Reduction Act → AHRQ PSOs Improve quality Collect data "Common Formats"

2008 National Quality Forum National Priority Partnership
↓hospital mortality
↓serious adverse events
National Healthcare Quality Report

2009 HHS National Action Plan to Prevent HAI: Roadmap to Elimination
5 yr action plan↓HAI 40%
2009-2013

2005-6 AHRQ Michigan Keystone Project

2010 Affordable Care Act

2008-12 CUSP

2014-15 HAC Reduction Program
Reduce payment when lack of quality

The Changing Healthcare Landscape
Affordable Care Act

The changing healthcare landscape

Regulatory requirements	*Reimbursement penalties / rewards*
Meaningful use / quality metrics	*Value based purchasing Reward / penalty*
Patient outcome measures	*Hospital readmissions Penalty*
Patient satisfaction reporting	*Healthcare acquired conditions reduction program Non-payment / penalty*
Use of evidence-based medicine	
Standards / guidelines / policies / procedures	

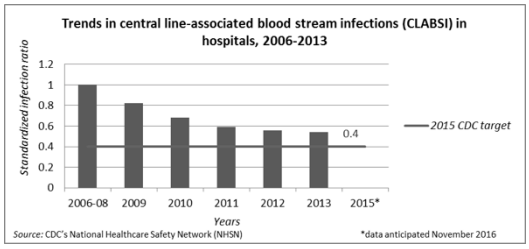
Hospital Acquired Condition Reduction Program...
how are we doing?

HAC Reduction Program Framework Finalized for FY 2015

Patient Safety Indicator Measure[1] (Combined into PSI-90 Composite Ratio)	Measure Weight in PSI-90 Composite
PSI 15 - Accidental Puncture or Laceration	42.89%
PSI 12 - Postop PE Or DVT	22.09%
PSI 3 - Decubitus Ulcer	13.57%
PSI 7 - Selected Infection Due to Medical Care	8.31%
PSI 6 - Iatrogenic Pneumothorax	6.14%
PSI 13 - Postop Sepsis	5.36%
PSI 14 - Postop Wound Dehiscence	1.59%
PSI 8 - Postop Hip Fracture	0.05%

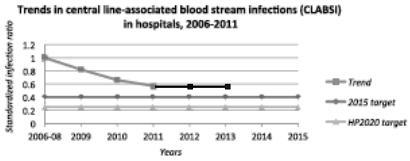
based *abstraction* AAMC

CDC Winnable Battles 2010-2015
Progress Report
2014

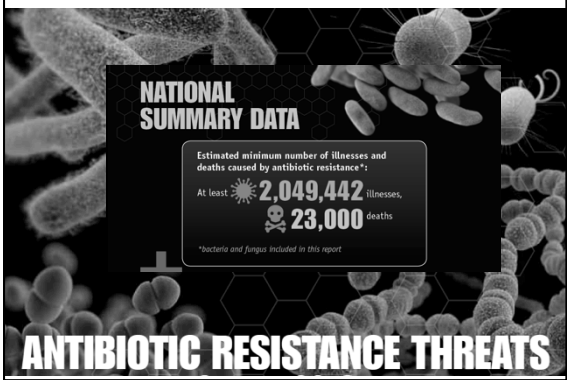


Winnable Battles
Healthcare-Associated Infections (HAI)
ensure safe healthcare for all Americans by reducing healthcare-associated infections

Indicator	Baseline	2015 Target
CLABSI SIR (in hospitals)	1.0 (2006-2008)	0.4 (60% reduction)
Healthcare-associated MRSA	27.08 infections per 100,000 persons (2007-2008)	10.83 infections per 100,000 persons (60% reduction)
SSI SIR (in hospitals)	1.0 (2006-2008)	0.70 (30% reduction)
CAUTI SIR (in hospitals)	1.0 (2009)	0.70 (30% reduction)

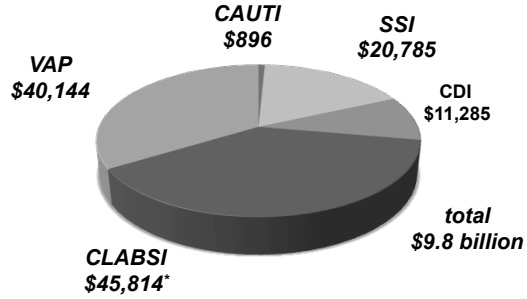


healthcare associated infection ……a global threat!



biofilms in healthcare-associated infections

….bacteria are in the business of medical device and chronic infections!



*cost per case

Zimlichman E., et al. JAMA Int Med. Sept 2013; doi:10.1001/jamainternmed.2013.9763

HealthLeaders Media

Medical Errors Third Leading Cause of Death, Senators Told

Cheryl Clark, for HealthLeaders Media , **July 18, 2014**

At a Senate subcommittee hearing, hospital quality experts urge lawmakers to establish measures to halt preventable medical errors in hospitals, which kill as many as 400,000 people each year.

Committee on Health, Education, Labor and Pensions
Subcommittee on Primary Health and Aging
United States Senate

Hearing on:
"More Than 1,000 Preventable Deaths a Day
Is Too Many:
The Need to Improve Patient Safety."

Lisa McGiffert, Consumer's Union

Consumers Union, the policy and advocacy division of Consumer Reports, appreciates the opportunity to speak to the Subcommittee on Primary Health and Aging about an urgent health care crisis – medical errors and health care-acquired infections that kill as many as 440,000 people[1] and harm an estimated 8.5 million[2] every year in this country.

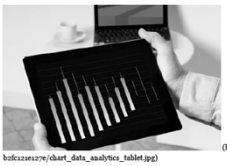
The impact on patients varies – from minor harm that is addressed quickly to permanent disability to years of recovery to death. People who are harmed lose their jobs, their homes, their health insurance. Many go bankrupt trying to pay the medical bills that they would not have had if they had not been harmed by a health care provider. These are the very real consequences of the failure to take action to address the problem of medical errors.

this is why you are here today!

News Feature | January 26, 2015

Hospital Infection Control Still Not Good Enough

By Christine Kern (/author/christine-kern)



(http://vertassets.blob.core.windows.net/image/745ebf93/745ebf93-5212-4723-9390-b2fc12281279/chart_data_analytics_tablet.jpg)

A CDC report shows hospitals are falling short on infection prevention goals.

this is why I am here today!

DISCLOSURES

HONORARIA:
- **Agion, Inc.**
- **Baxter Hea**
- **Care Fusio**
- **ICU Medi**
- **Johnson &**
- **Navilyst**
- **PFM Me**
- **Sage Prod**
- **Teleflex,**
- **3M**

RESEARCH GRANTS:
- **HRSA**
- **Sigma Theta Tau, SF chapter**

NT:
- **cular Access**
- **Inc**
- **edical, Inc.**
- **, Inc.**
- **al, Inc.**
- **cal**

Marcia PhD MS RN

Thanks to Jamie Santolucito and Oregon Health Sciences University

what more can we do?

"NEVER, EVER THINK OUTSIDE THE BOX!"

CDC

Device-associated Module
BSI

Central line-associated BSI (CLABSI): A laboratory-confirmed bloodstream infection (LCBI) where central line (CL) or umbilical catheter (UC) was in place for >2 calendar days on the date of event, with day of device placement being Day 1,

AND

a CL or UC was in place on the date of event or the day before. If a CL or UC was in place for >2 calendar days and then removed, the date of event of the LCBI must be the day of discontinuation or the next day. If the patient is admitted or transferred into a facility with an implanted central line (port) in place, and that is the patient's only central line, day of first access in an inpatient location is considered Day1. "Access" is defined as line placement, infusion or withdrawal through the line. Such lines continue to be eligible for CLABSI once they are accessed until they are either discontinued or the day after patient discharged (as per the Transfer Rule). Note that the "de-access" of a port does not result in the patient's removal from CLABSI surveillance.

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People.™

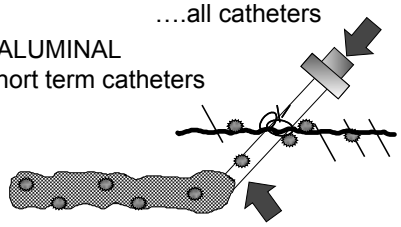
2011 Guidelines for the Prevention of Intravascular Catheter-Related Infections

CRBSI is a clinical definition, used when diagnosing and treating patients, that requires specific laboratory testing that more thoroughly identifies the catheter as the source of the BSI. It is not typically used for surveillance purposes. It is often problematic to precisely establish if a BSI is a CRBSI due to the clinical needs of the patient (the catheter is not always pulled), limited availability of microbiologic methods (many labs do not use quantitative blood cultures or differential time to positivity), and procedural compliance by direct care personnel (labeling must be accurate). Simpler definitions are often used for surveillance purposes. For example, CLABSI is

Surfaces for colonization on VADs

INTRALUMINAL
….all catheters

EXTRALUMINAL
….short term catheters



which source is most important ?

FOCUS ON INFECTION PREVENTION

Central-Line-Associated Bloodstream Infection: Comprehensive, Data-Driven Prevention

Davis J. Pa Patient Saf Advis. Sept 2011;8(3):100-4

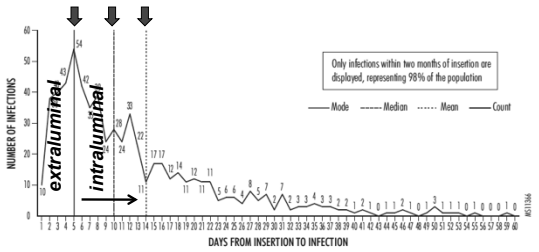
Purpose:
to determine whether an institution should focus resources on a specific phase of CVC life to prevent CRBSI (insertion vs maintenance)

Methods:
analysis of the NHSN database for the state of Pennsylvania for the year 2010 to determine the date of infection event from time of insertion

Sample size:
653 events

Results:
653 infections
468 (71%) occurred after day 5

Figure 1. Time Distribution of CLABSI: Pennsylvania NHSN Facilities 2010

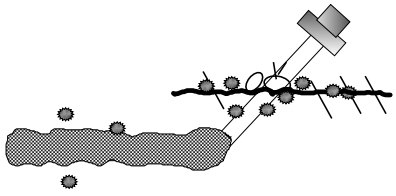


Conclusion: this data implicates maintenance as the phase in which CLABSI most likely is developed

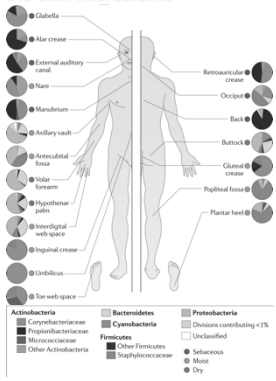
Davis J. Pa Patient Saf Advis. Sept 2011;8(3):100-4

THE SKIN……

What is important about the microbiology of the skin?



the skin microbiome

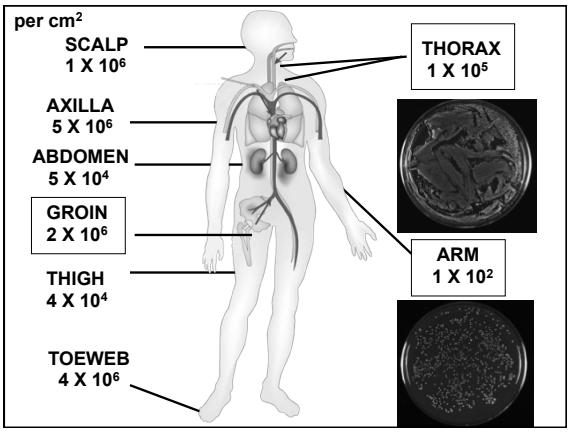


human body
10^{13} cells
23,000 genes

normal flora
10^{12} microbial cells
(1 trillion)
3.3 million genes

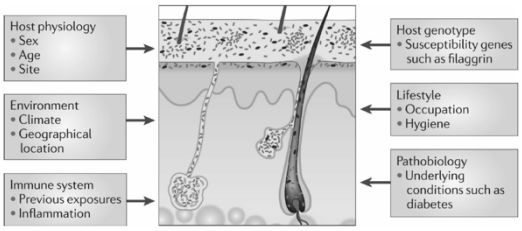
- about 5 lb. in weight
- enough bacteria to fill a half gallon jug
- the size of a large liver
- 1,000 species

Grice EA, Segre JA



80% RESIDENT BACTERIA IN FIRST 5 LAYERS OF STRATUM CORNEUM

20% RESIDENT BACTERIA IN HAIR FOLLICLES AND SEBACEOUS GLANDS

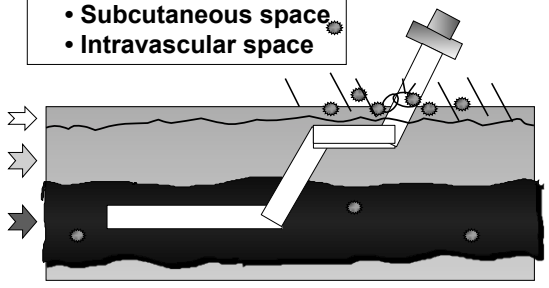


Factors contributing to variation in the skin microbiome

Grice EA, Segre JA. 2011;9(4):244-53

TISSUE SPACES

- Skin
- Subcutaneous space
- Intravascular space

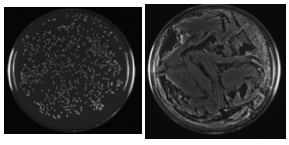


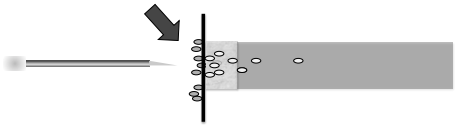
© MR

pathogenesis extraluminal colonization: insertion

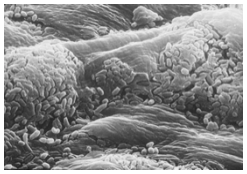
Venipuncture

insertion
ENTRY POINT 1

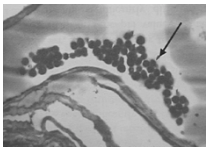




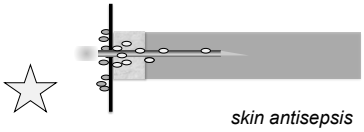
pathogenesis extraluminal colonization: insertion



biofilm on epithelial surface



biofilm in epithelial layers

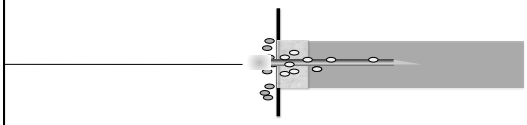


Venipuncture

skin antisepsis

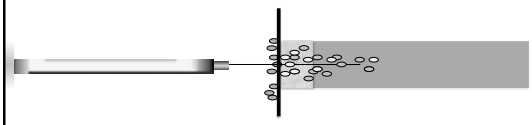
pathogenesis extraluminal colonization: insertion

guidewire insertion



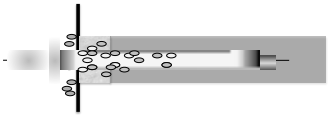
pathogenesis extraluminal colonization: insertion

dilator and tear-away sheath insertion



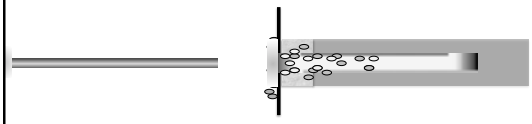
pathogenesis extraluminal colonization: insertion

dilator and tear-away sheath insertion

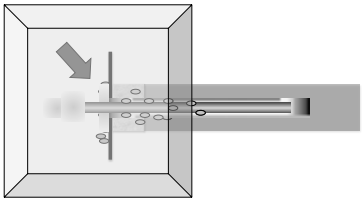


pathogenesis extraluminal colonization: insertion

catheter insertion



pathogenesis extraluminal colonization: insertion



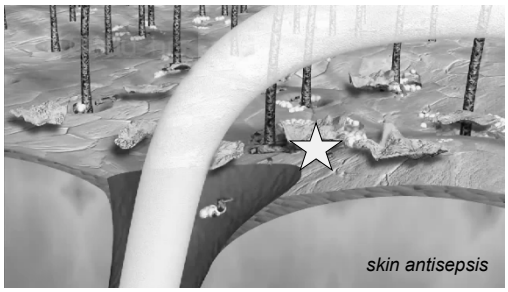
Post-insertion ENTRY POINT 2

SUBCUTANEOUS SPACE

- WITHIN HOURS EDEMA/DRAINAGE OCCUPY THE SKIN TRACT DUE TO "INFLAMMATORY PROCESS"

post-insertion ENTRY POINT 3 **SKIN**

- **COMPLETE RECOLONIZATION OF SURFACE BACTERIA OCCURS WITHIN 18 HOURS OF ANTISEPTIC APPLICATION**



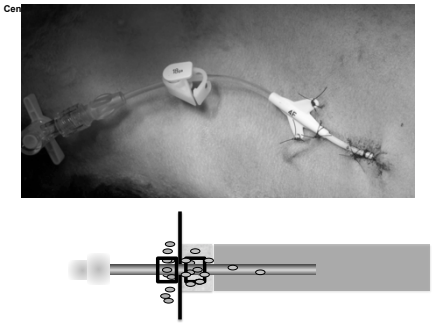
skin antisepsis

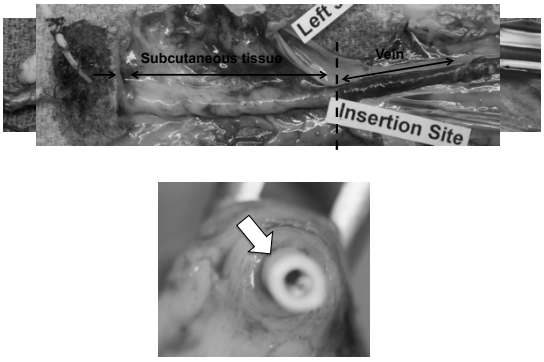
post-insertion ENTRY POINT 4

- **OPEN WOUND POST INSERTION**

skin antisepsis

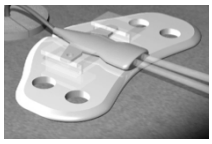
migration of cutaneous bacteria to subcutaneous tissue

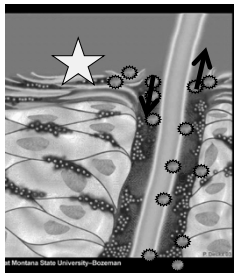




Post-insertion ENTRY POINT 5

- **CATHETER MIGRATION TRANSPORTS BACTERIA INTO THE SKIN TRACT AND BLOODSTREAM**

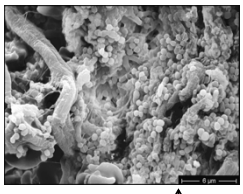


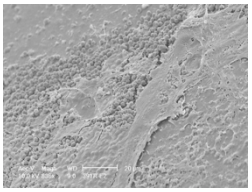


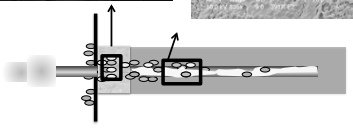
catheter stabilization

what happens to the microorganisms?

subcutaneous tissue **intravascular catheter surface**

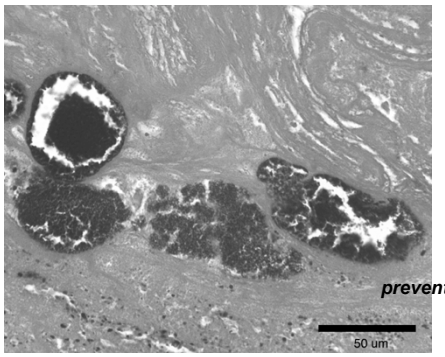






what happens to the microorganisms?

subcutaneous tissue



prevention?

prevention: what does the evidence tell us?

The Joint Commission

Accreditation Program: Hospital
National Patient Safety Goals

"As of Jan. 1, 2010, the hospital implements policies and practices aimed at reducing the risk of central-line associated bloodstream infections that meet regulatory requirements and are aligned with evidence-based standards (for example, the CDC and/or professional organization guidelines."

CDC

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

Naomi P. O'Grady, M.D.[1], Mary Alexander, R.N.[2], Lillian A. Burns, M.T., M.P.H., C.I.C.[3], E. Patchen Dellinger, M.D.[4], Jeffrey Garland, M.D., S.M.[5], Stephen O. Heard, M.D.[6], Pamela A. Lipsett, M.D.[7], Henry Masur, M.D.[8], Leonard A. Mermel, D.O., Sc.M.[9], Michele L. Pearson, M.D.[10], Issam I. Raad, M.D.[11], Adrienne Randolph, M.D., M.Sc.[12], Mark E. Rupp, M.D.[13], Sanjay Saint, M.D., M.P.H.[14] and the Healthcare Infection Control Practices Advisory Committee (HICPAC)[15]

CDC. MMWR 2002;51(No. RR-10).

CDC

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

Use hospital-specific or collaborative-based performance improvement initiatives in which multifaceted strategies are "bundled" together to improve compliance with evidence-based recommended practices

SHEA/IDSA PRACTICE RECOMMENDATION

Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update

Jonas Marschall, MD[1,2,a] Leonard A. Mermel, DO, ScM[3,a] Mohamad Fakih, MD, MPH[4] Lynn Hadaway, MEd, RN, BC, CRNI[5] Alexander Kallen, MD, MPH[6] Naomi P. O'Grady, MD[7] Ann Marie Pettis, RN, BSN, CIC[8] Mark E. Rupp, MD[9] Thomas Sandora, MD, MPH[10] Lisa L. Maragakis, MD, MPH[11] Deborah S. Yokoe, MD, MPH[12]

Marshall J, et al. ICHE, July 2014;35(7):753-96

.....pathogenesis-based interventions

maximum antisepsis / disinfection

#1 Daily CHG bathing, select populations
#2 Pre-op / pre-procedural skin cleansing
#3 Surgical site disinfection
#4 Antimicrobial catheter
#5 Catheter insertion site protection
#6 Low bacteria transfer rate connector
#7 Access site / hub disinfection

protecting the gateway to CRBSI !

CDC

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

Skin Preparation

- **Prepare *clean* skin with a *>0.5% chlorhexidine preparation with alcohol* before central venous catheter and peripheral arterial catheter insertion and *during dressing changes***

SHEA/IDSA PRACTICE RECOMMENDATION

- **Before catheter insertion, apply an *alcoholic chlorhexidine solution containing more than >0.5% CHG to the insertion site***

protecting the gateway to CRBSI !

purpose of insertion site dressing:

- **protect from contamination / infection**
- **prevent catheter dislodgement / loss of access**

how do we do that?

protecting the gateway to CRBSI !

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

- **Use either sterile gauze, transparent, semipermeable dressing to cover the catheter site**

prevents exogenous contamination

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

Catheter Site Dressing Regimens

protecting the gateway to CRBSI !

- **Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than 2 months of age if the CLABSI rate is not decreasing despite adherence to basic prevention measures….**

SHEA/IDSA PRACTICE RECOMMENDATION

- **Use chlorhexidine-containing dressings for CVCs in patients older than 2 months**

prevents endogenous contamination

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

Catheter Site Dressing Regimens

protecting the gateway to CRBSI !

- **Replace dressings used on short-term CVC sites *at least* every 7 days for transparent dressings**
- **Replace dressings used on short-term CVC sites every 2 days for gauze dressings.**
- **Replace catheter site dressing if the dressing becomes *damp, loosened, or visibly soiled***

SHEA/IDSA PRACTICE RECOMMENDATION

protecting the gateway to CRBSI !

C. After insertion

For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic every 5-7 days or *immediately* if the dressing is *soiled, loose, or damp*;

Change gauze dressings every 2 days or earlier if the dressing is *soiled, loose, or damp*.

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

peripheral IV dressing change .....what?

Replacement of Peripheral and Midline Catheters

- There is no need to replace peripheral catheters more frequently than every 72-96 hours to reduce risk of infection and phlebitis in adults Category 1B
- No recommendation is made regarding replacement of peripheral catheters in adults only when clinically indicated Unresolved issue
- Replace peripheral catheters in children only when clinically indicated [32, 33]. Category **IB**

protecting the gateway to CRBSI !

Journal of Infusion Nursing

Infusion Nursing Standards of Practice

Vascular Access Device Removal

- The nurse should consider replacement of the short peripheral catheter when clinically indicated and when infusion treatment does not include peripheral parenteral nutrition.
- The nurse should not routinely replace short peripheral catheters in children

FOCUS ON INFECTION PREVENTION

Peripheral Vascular Catheter–Related Infection: Dwelling on Dwell Time

James Davis, MSN, RN, CCRN, CIC
Senior Infection Prevention Analyst
Pennsylvania Patient Safety Authority

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) guidelines for prevention of peripheral vascular catheter–related infection (PVCRI) state the following:[1]

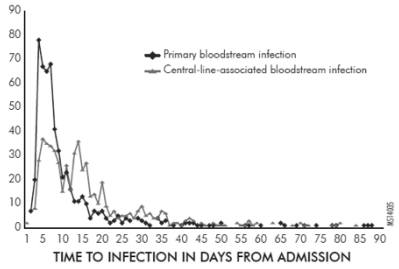
Purpose:
to determine the primary bloodstream infection rate in the Pennsylvania NHSN database for the years of 2011 and 2012

Methods:
analysis of the PA NHSN database for 2011-2012 to determine the date of primary BSI event from time of admission

Sample size:
1,890 events

Davis J. Pa Patient Saf Advis. March 2014;11(1):30-5

Figure. Time to Infection: *Staphylococcus aureus* Primary Bloodstream Infections and Central-Line-Associated Bloodstream Infections in Pennsylvania Acute Care Facilities, 2011 to 2012



Davis J. Pa Patient Saf Advis. March 2014;11(1):30-5

CENTRAL-LINE-ASSOCIATED BLOODSTREAM INFECTION (CLABSI)

PATHOGEN	NO. OF INFECTIONS	PERCENTAGE
Staphylococcus aureus	598	19.9
Klebsiella pneumoniae	250	8.3
Enterococcus faecalis	247	8.2
Coagulase-negative staphylococci	197	6.5
Candida albicans	193	6.4
Staphylococcus epidermidis	159	5.3
Enterococcus faecium	152	5.1
Pseudomonas aeruginosa	147	4.9
Escherichia coli	125	4.2
Enterobacter cloacae		

Note: Data as identified from the Centers for Dis Safety Network.

Table. Top 10 Pathogens Causing Primary BSI and CLABSI in Pennsylvania, 2011 to 2012

PRIMARY BLOODSTREAM INFECTION (BSI)

PATHOGEN	NO. OF INFECTIONS	PERCENTAGE
Staphylococcus aureus	584	30.9
Escherichia coli	197	10.4
Klebsiella pneumoniae	140	7.4
Enterococcus faecalis	130	6.9
Enterococcus faecium	81	4.3
Pseudomonas aeruginosa	72	3.8
Candida albicans	63	3.3
Coagulase-negative staphylococci	46	2.4
Enterobacter cloacae	45	2.4
Serratia marcescens	43	2.3

Davis J. Pa Patient Saf Advis. March 2014;11(1):30-5

Results: herein, when the epidemiologic links of time to infection and the pathogen profile are combined with the definition of primary BSI, and when the sheer prevalence of the PVC is considered, it is likely that the majority of acute care adult primary BSIs in Pennsylvania are due to PVCRI.

Conclusion: Events reported by Pennsylvania healthcare facilities suggests that *facilities may want to conduct focused surveillance for PVCRI* in order to consider the practice of re-siting peripheral catheters in adult patients every 72 hours, as opposed to re-siting when clinically indicated. The

Davis J. Pa Patient Saf Advis. March 2014;11(1):30-5

Arterial Catheters as a Source of Bloodstream Infection: A Systematic Review and Meta-Analysis*

John C. O'Horo, MD[1]; Dennis G. Maki, MD, MS[2]; Anna E. Krupp, RN[3]; Nasia Safdar, MD, PhD[2,3,4]

Conclusions: Arterial catheters are an underrecognized cause of catheter-related bloodstream infection. Pooled incidence when catheters were systematically cultured and correlated to blood culture results indicated a substantial burden of arterial catheter-related bloodstream infection.

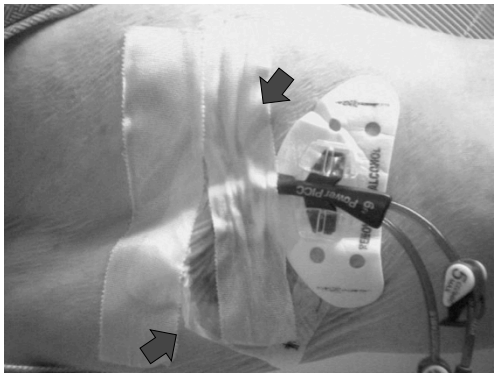
In conclusion, arterial catheters are a significant source for CRBSI with infection rates similar to what is seen in short-term CVCs. Consideration should be given to application of novel technologies, such as chlorhexidine-impregnated sponge, especially in the high-risk group of patients with femoral arterial catheters. In patients with cryptogenic BSI, arterial catheters should be examined as a potential source.

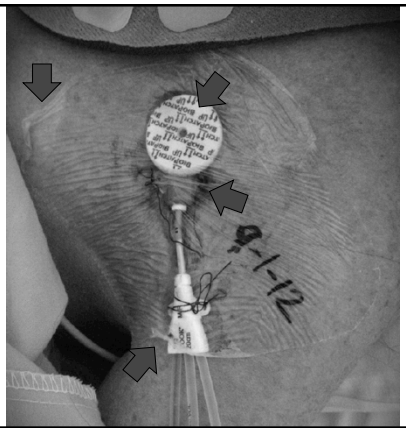
O'Horo C, et al. Cri Care Med. June 2014;42(6):1334-9

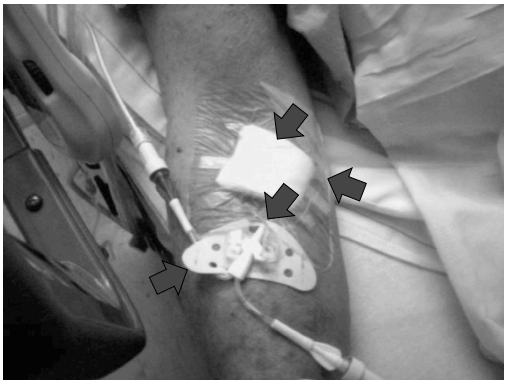
purpose of insertion site dressing:

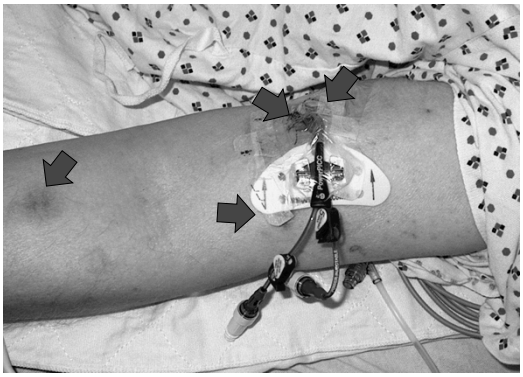
- **protect from contamination / infection**
- **prevent catheter dislodgement / loss of access**

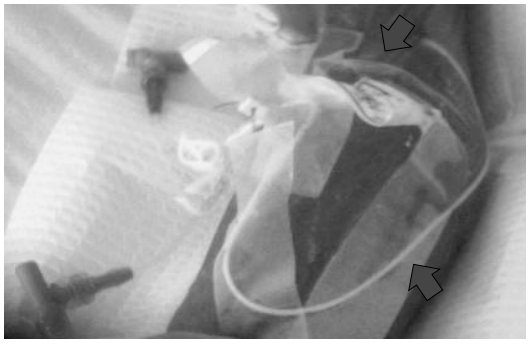
is there a problem?

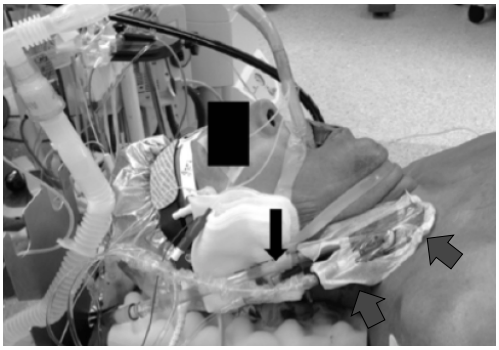


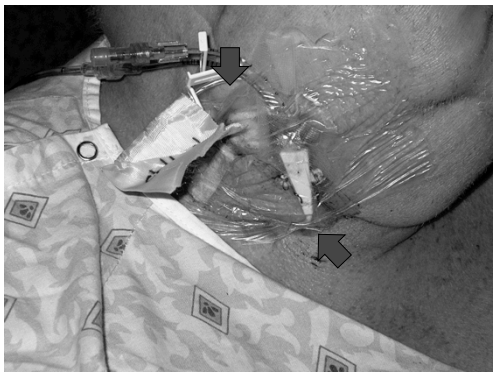






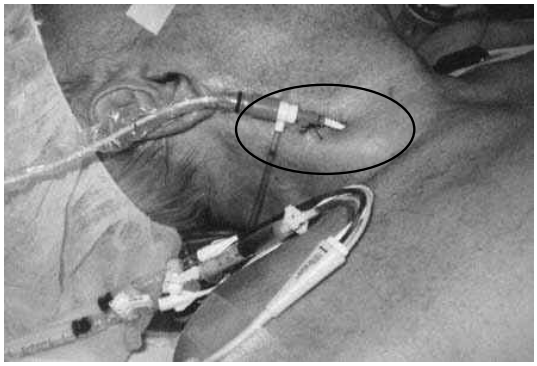






Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011

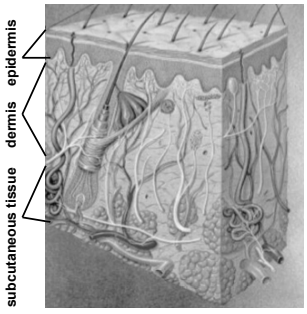
- **If the patient is diaphoretic or if the site is bleeding or oozing, use a gauze dressing until this is resolved**



what about the skin?

skin function and structure

- **physical barrier to irritants and pathogens**
- **fluid / temperature regulation**
- **immune surveillance**



Thayer D. *JIN*. 2012;35(6):390-401.

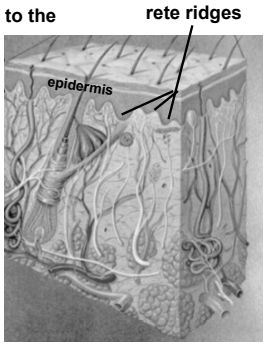
dermis

- **2.0 mm thickness**
- **blood vessels, hair follicles, eccrine glands, sebaceous glands**
- **fibroblasts: collagen and elastin proteins**

Thayer D. *JIN*. 2012;35(6):390-401.

epidermis

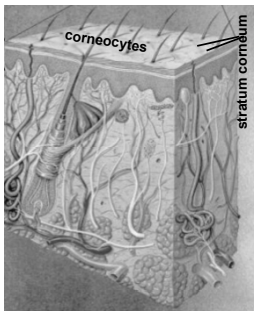
- **rete ridge attaches the dermis to the epidermis**
- **rete pegs project downward and interlock with upward projections of the dermis**
- **prevents shear forces from separating the two layers**
- **thinning: age related changes make more vulnerable to skin tears**



Thayer D. *JIN*. 2012;35(6):390-401.

stratum corneum

- **protective matrix**
  15 – 20 layers flat, stacked cells, water, intercellular lipids
- **alteration of lipids disrupt cell cohesion**
- **resident and transient microorganisms**

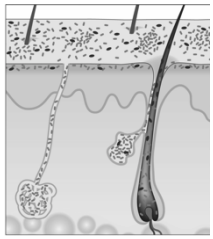


Thayer D. *JIN*. 2012;35(6):390-401.

biofilms in the human body

benefits of the normal flora

- **prevents colonization by pathogens**
- **antagonize other bacteria**
- **stimulate the development of certain tissues**
- **stimulate the production of cross-reactive antibodies**
- **synthesize and excrete vitamins (B-vitamins, *Lactobacilli* and *Streptococci)***



…….applying a dressing changes all that!

materials used in insertion site

- **antiseptics**
- **adhesives on dressing stabilization devices**
- **suture material**

The Art and Science of Infusion Nursing

Debra Thayer, MS, RN, CWOCN

Skin Damage Associated With Intravenous Therapy

Common Problems and Strategies for Prevention

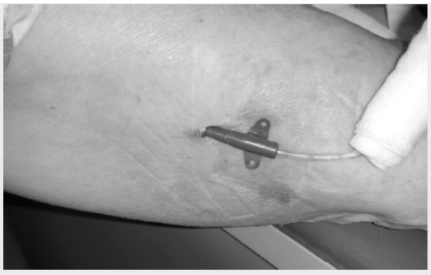
types of skin damage with VAD dressings:

- **contact dermatitis / allergy**
- **mechanical trauma induced by adhesives**
- **moisture associated skin damage**

Thayer D. *JIN*. 2012;35(6):390-401.

- **contact dermatitis**

- **mechanical trauma**



Note. This photo shows resolution following the elimination of chlorhexidine gluconate and the securement device. Silicone-faced tape is used underneath the securement device to prevent exposure to the securement adhesive and to maintain PICC line stabilization.

Kutzscher L. Clin J Onc Nurs. 2012;16(2):E48-E55

Photos courtesy of Royal Victoria Regional Health Centre

- **skin diseases**

How well are we protecting the gateway to CRBSI?

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

Jean-François Timsit, MD, PhD — **Context** Use of a chlorhexidine gluconate–impregnated sponge (CHGIS) in intra-

Purpose: to assess superiority of CHGIS dressings regarding rate of major CRIs (sepsis, no BSI) and non-inferiority (< 3% increase colonization) of 7-day vs 3-day dressing changes

Design: randomized, controlled trial

JAMA. Mar 2009;301(12):1231-41

results

Table 5. Relationship Between Semiquantitative Skin Culture and Study Groups[a]

Culture	All Catheters (n = 2903)	Dressing		Dressing Change Interval	
		Control (n = 1358)	CHGIS (n = 1545)	3 d (n = 1386)	7 d (n = 1517)
Sterile	1887 (65.0)	786 (57.8)	1101 (71.3)	935 (67.5)	952 (62.7)
1-9 CFUs/plate	326 (11.2)	148 (10.9)	178 (11.5)	168 (12.1)	158 (10.4)
10-99 CFUs/plate	462 (15.9)	261 (19.2)	201 (13)	183 (13.2)	279 (18.4)
≥100 CFUs/plate	228 (7.90)	163 (12)	65 (4.2)	100 (7.2)	128 (8.4)

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate–impregnated sponge.
[a]Missing data: all catheters, 875; control dressings, 467; CHGIS dressings, 418; 3-day dressing change interval, 429; 7-day dressing change interval, 446. $P < .01$ for comparisons between CHGIS and control dressings (χ^2 for trends); $P < .01$ for comparisons between 3-day and 7-day dressing changes (χ^2 for trends).

Timsit et al. *JAMA*. 2009;301:1231-1241

results

Table 3. Hazard Ratios in the Intention-To-Treat and Per-Protocol Analyses

	Dressing						Dressing Change Interval					
	Incidence, No./1000 Catheter-Days		ITT Analysis		Per-Protocol Analysis[a]		Incidence, No./1000 Catheter-Days		ITT Analysis		Per-Protocol Analysis[a]	
Variable	Control (n = 1925)	CHGIS (n = 1953)	HR (95% CI)	P Value	HR (95% CI)	P Value	3 d (n = 1815)	7 d (n = 1963)	HR (95% CI)	P Value	HR (95% CI)	P Value
Catheter colonization >10 CFUs/plate	15.8	6.3	0.36 (0.28-0.46)	<.001	0.35 (0.27-0.45)	<.001	10.4	11.0	0.99 (0.77-1.28)	.95	0.99 (0.77-1.28)	.95
Catheter-related bloodstream infection	1.3	0.4	0.24 (0.09-0.65)	.005	0.24 (0.09-0.63)	.004	0.7	0.9	1.26 (0.47-3.34)	.65	1.26 (0.48-3.40)	.62
Major catheter-related infection	1.4	0.6	0.39 (0.16-0.93)	.03	0.38 (0.16-0.92)	.03	0.9	1.1	1.16 (0.50-2.69)	.74	1.18 (0.51-2.73)	.70

Abbreviations: CFU, colony-forming unit; CHGIS, chlorhexidine gluconate–impregnated sponge; CI, confidence interval; HR, hazard ratio; ITT, intention-to-treat.
[a] Analysis adjusted on imbalanced parameters (ie, presence of ≥1 chronic disease for comparison of control and CHGIS groups).

Timsit et al. *JAMA*. 2009;301:1231-1241.

2. Is there a difference in catheter colonization when changing dressings every 3 days compared to every 7 days?

RESULTS

- **45% of dressing changes were performed before the planned date because of soiling or leaking.**
- **40% were unplanned in 3-day group**
- **50% were unplanned in the 7-day group 10% in place at 7 days**
- **both CHG foam disc and transparent dressings in each group**

Timsit et al. JAMA. 2009;301:1231-1241

Dressing disruption is a major risk factor for catheter-related infections*

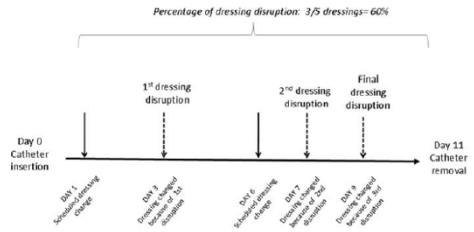
Jean-François Timsit, MD, PhD; Lila Bouadma, MD, PhD; Stéphane Ruckly, MSc; Carole Schwebel, MD, PhD; Maïté Garrouste-Orgeas, MD; Régis Bronchard, MD; Silvia Calvino-Gunther, RN; Kevin Laupland, MD; Christophe Adrie, MD, PhD; Marie Thuong, MD; Marie-Christine Herault, MD; Sebastian Pease, MD; Xavier Arrault, PharmD; Jean-Christophe Lucet, MD, PhD

Purpose: to determine the importance of dressing disruption on the risk for development of catheter-related bloodstream infection

Design: secondary analysis of a randomized controlled trial

Measures and Results: observations on 151 CVCs in 106 patients (total 721 catheter days)

Timsit J-F, et al. Crit Care Med, 2012;40:1707-14



Timsit J-F, et al. Crit Care Med, 2012;40:1707-14

Results:

- **catheter dressing disruption was a common event in ICU patients with central venous and arterial catheters**
- **more than 2 dressing changes for disruption were associated with higher than 3-fold increase in sepsis and CRBSI**
- **when final dressing is disrupted, the risk of catheter colonization or infection is increased by more than 12-fold**

Timsit J-F, et al. Crit Care Med, 2012;40:1707-14

This study adds major arguments to include dressing integrity in catheter bundles. Further investigation is warranted in order to better understand the particularities of different types of dressings and to optimize their uses to improve adhesiveness (34). A new area/field in catheter-related infection prevention should also be opened for the development, validation, and use of more adherent dressings.

Timsit J-F, et al. Crit Care Med, 2012;40:1707-14

Randomized Controlled Trial of Chlorhexidine Dressing and Highly Adhesive Dressing for Preventing Catheter-related Infections in Critically Ill Adults

Jean-François Timsit[1,2], Olivier Mimoz[3], Bruno Mourvillier[4], Bertrand Souweine[5], Maité Garrouste-Orgeas[6], Serge Alfandari[7], Gaëtan Plantefeve[8], Régis Bronchard[9], Gilles Troche[10], Remy Gauzit[11], Marion Antona[12], Emmanuel Canet[13], Julien Bohe[14], Alain Lepape[14], Aurélien Vesin[1], Xavier Arrault[15], Carole Schwebel[2], Christophe Adrie[16], Jean-Ralph Zahar[17], Stéphane Ruckly[1], Caroline Tournegros[2], and Jean-Christophe Lucet[18]

Purpose: to determine if chlorhexidine-impregnated and strongly adherent dressings decrease catheter colonization and CRI rates

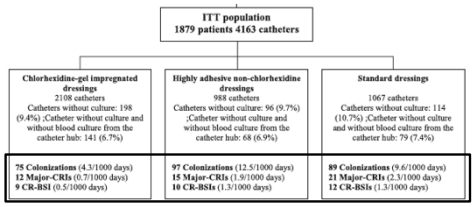
Design: 2:1:1 blinded randomized trial

Measures: comparison
CHG dressing Highly adhesive Standard dressing

Subjects: patients with CVCs in 12 ICUs

Timsit J-F, et al. Am J Respir Crit Care Med. 2012;186:1272-78

Results



Detachment: 14,019 dressing changes
- **30.7% intact**
- **29.9% detached**
- **27% soiled**
- **12.5% detached and soiled**

Timsit J-F, et al. Am J Respir Crit Care Med , 2012;186(12):1272-78

Central venous catheter-related bloodstream infections: improving post-insertion catheter care.

Shapey IM, Foster MA, Whitehouse T, Jumaa P, Bion JF.

Purpose: to assess practice and staff knowledge of CVC post-insertion care and identify aspects of CVC care with potential for improvement

Design: observational

Methods: observations on 151 CVCs in 106 pts.

Results:
- **significant differences between ICUs and non-ICU wards**
- **dressings (non-intact): 22% failure rate**

J Hosp Infect. 2009;71(2):117-22.

Contents lists available at ScienceDirect
American Journal of Infection Control
journal homepage: www.ajicjournal.org

Brief report

Hospital-wide assessment of compliance with central venous catheter dressing recommendations

Mark E. Rupp MD[a,b,*], Kyle Cassling BA[a], Hayley Faber BS[a], Elizabeth Lyden MS[c], Kate Tyner RN[b], Nedra Marion RN[b], Trevor Van Schooneveld MD[a,b]

Purpose: to assess hospital-wide compliance with CVC site care recommendations and to correlate compliance with unit specific CLABSI rates

Design: observational

Sample: 420 CVC sites

Rupp ME, et al. AJIC , 2012;186(12):1-3

Results:

- **suboptimal: 31%**
  jugular more likely p = .001
- **blood under dressing 69%**
- **edge lift or exposed site 25%**
- **moisture 5%**

Rupp ME, et al. AJIC , 2012;186(12):1-3

Conclusion

In conclusion, we have found substantial room for improvement in CVC site maintenance procedures….

Technological improvements in catheter and dressing design should be pursued to enable easier and more effective CVC securement and insertion site protection.

is there a solution?

Rupp ME, et al. AJIC , 2012;186(12):1-3

protecting the gateway to CRBSI !

use of a

- gum mastic liquid adhesive
- liquid adhesive remover

what about compatibility with chlorhexidine skin prep?

EVALUATION OF THE COMPATIBILITY OF A LIQUID ADHESIVE AND LIQUID ADHESIVE REMOVER WITH A CHLORHEXIDINE GLUCONATE SKIN PREPARATION OVER A 7-DAY PERIOD ON HEALTHY VOLUNTEERS

Ryder M, Duley C, Paulson DS

Purpose: to evaluate the compatibility of a gum mastic liquid adhesive (GMLA) and liquid adhesive remover (LAR) with a chlorhexidine gluconate/alcohol skin preparation.

Study design: randomized control trial

Setting: BioScience, Inc., Bozeman, MT

IRB approval: study protocol was approved by the Gallatin Institutional Review Board.

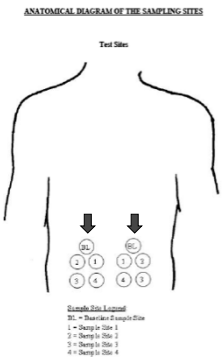
June 26 – July 31, 2014

methods

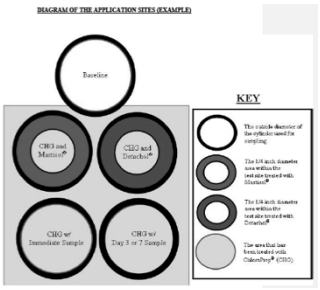
Subjects: 20 adult volunteer subjects
10 females / 10 males

Sampling:

- Five test sites were marked on the skin on each side of the umbilicus on the abdomen.
- A baseline microbial sample was collected on one site from the skin on each side of the abdomen.

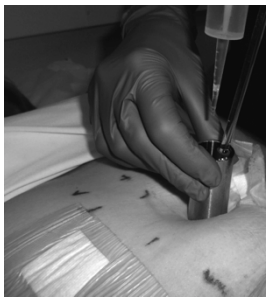


- On each side, GMLA was applied around the perimeter of one site and a LAR applied around the perimeter of another site and allowed to dry.
- The remaining four sites on each side were prepped with CHG/ IPA antiseptic and cultured



- the treated test sites and prepped-only control sites were covered with sterile polyester-blend gauze sponges covered by semi-occlusive catheter dressings for three or seven days.

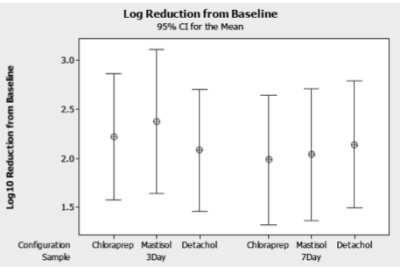
- subjects returned to the study facility on day 3 and 7
- bacterial samples were taken from
  one GMLA- treated site,
  one LAR - treated site,
  one prepped-only control site.



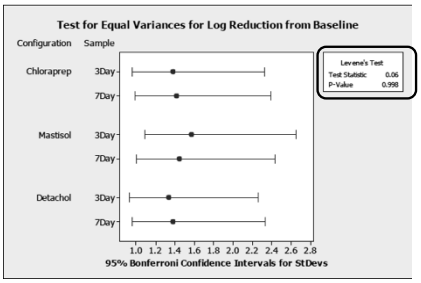
outcome measures

- The compatibility of the tested GMLA and LAR with CHG/IPA was based on the comparison of counts from CHG/IPA prepped skin to the skin prepped with CHG/ IPA: GMLA and CHG/ IPA: LAR

p = 0.998



conclusion



- the GMLA and LAR tested are compatible with chlorhexidine gluconate/IPA.

what about "real patients" with VADs?

…..”VAD data from the bedside”!

Quality improvement pilot project: the use of a liquid adhesive and liquid adhesive remover for the reduction of non-adherent PICC dressings

Lee Medical, Inc.: Vascular Access Service Organization

combined

- **evidence based service model**
- **innovative mobile iOS electronic medical record and data aquisition system (VAST™ Vascular Access Surveillance and Tracking)**
- **Vascular Access Specialty team**

LEE MEDICAL, INC.

- **Study question: will the use of a gum mastic liquid adhesive (GMLA) and a liquid adhesive remover (LAR) reduce the incidence of dressing detachment?**
- **Study design: Observational Pre / post intervention**
- **Subjects: 25 facilities Tennessee**

Acute Care Hospitals
Long Term Acute Care Hospitals
Rehabilitation Hospital
Skilled Nursing Facility
Correctional Facility

LEE MEDICAL, INC.

methods

- **Catheters: PICC**
  IJ, EJ
- **Dressing change frequency: weekly**
- **Project duration: Jan – April, 2013**
  Pre-intervention period 45 days
  Post-intervention period 45 days

LEE MEDICAL, INC.

results

	Dressings	Catheters	Patients
Pre	592	301	276
Post	564	289	271
Total	1156	561	499
% reduction	69%	74%	75%

Overall: 90% reduction in incidence of non-adherent PICC dressings

LEE MEDICAL, INC.

conclusion

- the GMLA and LAR tested was highly effective in reducing the incidence of non-adherent PICC dressings and the improvement of quality care

what is the incidence of non-adherent dressings in your unit / facility?

LEE MEDICAL, INC.

QUALITY IMPROVEMENT INITIATIVE: VAD DRESSING ADHERENCE

Catheter-related bloodstream infection (CRBSI) is a preventable complication of vascular access. These infections occur due to microbial ingress from the skin to the extraluminal catheter surface and/or the intraluminal surface from access site contamination. It has been well established that the prevention of these infections require a set of interventions or a "bundle" approach to minimize microbial invasion during both the insertion procedure and the maintenance phase of catheterization.

The extraluminal prevention strategies focus on skin antisepsis, sterility, and catheter site protection. Continuous post-insertion skin antisepsis is accomplished by the application of chlorhexidine/alcohol antiseptic, chlorhexidine discs and *intact* semi-occlusive dressings. The sterile dressing is applied to prevent insertion site contamination/colonization and securement of the catheter. The loss of dressing adherence exposing the insertion site, an often overlooked and unattended occurrence[1], increases the risk of CRBSI[2]. The rate of loss of dressing adherence is reported to be 22 – 67%[3,4]. Loss of skin integrity due to dressing adhesives, antiseptics, and moisture is an additional risk for CRBSI as well as discomfort and pain for the patient[5].

Do you know the rate of loss of dressing adherence in your institution? If not, you may want to conduct a survey in your facility or patient care unit to determine if dressing disruption is a potential quality issue. Page two of this document is a tool that can be used for assessment and calculation of your facility/unit non-adherent dressing rate. The assessment tool is designed to use as a one-time/one day survey for your facility or an individual patient care unit(s) as typically done in point prevalence studies (a one-time snapshot of the occurrence of a particular point of interest). If you find the rate to be a risk factor for CRBSI in your patient population, you might consider a quality improvement initiative evaluating the use of a liquid adhesive and adhesive remover as part of your "maintenance bundle". The assessment tool may be used in the post-intervention phase of the quality improvement project to determine improvement in patient outcomes.

Instruction for the assessment:

1. Select the facility or unit(s) to be surveyed.
2. Select one day for the survey.
3. On the chosen day, observe each central venous catheter, arterial and/or peripheral IV catheter dressing and the condition of the skin under the dressing for each patient.
4. Use one line per dressing on the data sheet. Complete each section [Dressings Observed, Dressing Assessment, and Skin Condition) as indicated in the columns. Check only the observations in each column that apply. Suggested abbreviations and numeric key are provided on page 2 for the VAD type, insertion site and skin conditions.
5. Dressings are considered **adherent** if dry and intact and the insertion site is not exposed. The dressing may be at risk for detachment if the edges are lifting or has been taped down.
6. Dressings are considered **non-adherent** if the dressing is missing or partially detached and the ***insertion site is exposed.***
7. The dressing and insertion site is **compromised** if there is any moisture under the dressing.
8. The skin under the dressing is evaluated as dry and intact or with a condition as indicated in the numeric key on page 2.
9. When the survey is completed, calculate the total number of dressings observed.
10. Calculate the total number of non-adherent dressing, compromised dressing and skin condition incidence rate (%) for each unit, or facility by dividing the total number of non-adherent dressing, etc by the total number of dressings and then multiply by 100.

    total number of non-adherent dressings (compromised dressing or skin condition)
    total number catheters/dressings observed x 100 = % non-adherent dressings

11. The rate of non-adherence, etc for VAD type, insertion site or compromised dressing can also be calculated using the same formula as in number 9 but substituting the total number in the denominator example:

    total number of non-adherent PICC dressings
    total number of PICC catheters/dressings observed x 100 = % non-adherent PICC dressings

12. The assessment can be repeated at a later date for comparison or used as a quality improvement measure to assess effect of planned interventions.

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Vascular Access Dressing Adherence Point Prevalence Assessment

Date:______________ Unit:______________

Dressings Observed				Dressing Assessment									Skin Condition	
No.	VAD Type	Insertion Site	# Lumens	Adherent (Cath. site Not exposed)		Non-adherent (Cath. site exposed)		Compromised					Enter Value(s) for one column only. Non-intact column may have multiples values. See page 2 for numeric key.	
Use one line for each dressing observed. Use appropriate abbreviations as indicated on reverse side. See page 2 for abbreviation tables				Check Only One		Check Only One		Check All That Apply					Dry, Intact	Non-intact (Enter all that apply)
				Dry/ Intact	Edges Lifting	Partially Detached	Totally Detached	Intact	Wet	Diaphoretic	Leaking at Site	Bleeding	1	2, 3a, 3b, 3c, 4, 5
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
Subtotals														
Totals														

 Page 1 *Collection Tool Developed by* RYDER SCIENCE, Inc. ....medical biofilm research VAST® Research Services

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Vascular Access Dressing Adherence Point Prevalence Assessment

VAD Type Abbreviation Table	
VAD Type	Abbreviation
Non-tunneled CVC	CVC
Tunneled CVC	CVC-Tun
Subcutaneous Implanted Port	Port
Peripherally Inserted Central Catheter	PICC
Midline	MID
Hemodialysis	HD
Pulmonary Artery Catheter	PA
Peripheral Arterial Catheter	PAC
Peripheral IV Catheter	PIV

Insertion Site Abbreviation Table	
Insertion Site	Abbreviation
Subclavian Vein	SCV
Jugular Vein	IJ/EJ
Femoral	Fem
Upper Extremity	UE
Radial/Ulnar	RA/UA
Hand	H
Wrist	W
Forearm	F

Skin Condition Numeric Key	
Skin Condition	Key Code
Dry, Intact	1
Moist	2
Skin stripping	3a
Blister	3b
Skin Tear	3c
Irritation (redness, swelling, pruritus, vesicles)	4
Skin maceration	5

Use this formula to calculate your unit's percentage of non-adherent dressings:

Percentage of Non-adherent Dressings = (Total Non-adherent Dressings/Total Dressings Observed) x 100

 Page 2 RYDER SCIENCE, Inc. ....medical biofilm research VAST® Research Services

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VASCULAR ACCESS DRESSING ADHERENCE POINT PREVALENCE ASSESSMENT

Institution: [redacted] Date: Oct 6, 7, 2014

Unit(s) floor	11th	10th	9th	8th	7th	5th	4th	CVU	ICU	total: 9 units
Catheters	15	12	16	7	16	23	18	26	21	total: 154 VADs
Total patients	19	11	17	19	18	20	20	27	18	total: 169 patients
Patients with VAD	15	11	15	7	15	20	17	25	16	total: 141 patients with VAD - 83%

VAD TYPE

VAD	subclavian	jugular	femoral	hand/wrist	forearm	antecubital	upper arm	right	left	SUBTOTAL	% dressings /VAD type (154)	% patients with VAD type (141)
CVC	2	11						9	4	13	8.4%	9.2%
CVC-TUN												
PORT	8							4	4	8	5.2%	5.7%
HD	2							1	1	2	1.3%	1.4%
PA												
PICC							12	6	6	12	7.8%	8.5%
PIV				11 22	44	36	3 1EJ	50	67	117	76%	83%
PAC				2				1	1	2	1%	1%
subtotal	12	11		11 22	44	36	3 1EJ			TOTAL 154		
Percent/site	52%	48%		9% 19%	38%	31%	3% 1%					

Central: 35 (28%) peripheral: 117 (76%) arterial: 2 (1%)

DRESSING CONDITION: ADHERENT

EDGES LIFTING or REINFORCED 20%

VAD	subclavian	jugular	femoral	Hand/wrist	forearm	antecubital	Upper arm	right	left	SUBTOTAL	% dressings edges lifting	% patients with VAD type
CVC		4						3	1	4	3%	3%
CVC-TUN												
PORT	1								1	1	1%	1%
HD	1								1	1	1%	1%
PA												
PICC												
PIV				3 3	12	6		10	14	24	16%	17%
PAC												
subtotal										TOTAL		
Per cent/site										30	20%	

DRESSING CONDITION: NON-ADHERENT

PARTIALLY DETACHED

VAD	subclavian	jugular	femoral	hand/wrist	forearm	antecubital	upper arm	right	left	SUBTOTAL	% non-adherent dressings	% patients with VAD
CVC												
CVC-TUN												
PORT												
HD												
PA												
PICC												
PIV												
PAC												
subtotal										TOTAL		
Per cent/site												

TOTALLY DETACHED

VAD	subclavian	jugular	femoral	hand/wrist	forearm	antecubital	upper arm	right	left	SUBTOTAL	% dressings	% patients with VAD
CVC												
CVC-TUN												
PORT												
HD												
PA												
PICC												
PIV												
PAC												
subtotal										TOTAL		
Per cent/site												

Total dressings partially detached	
Total dressings detached	
TOTAL NON-ADHERENT	
PER CENT NON_ADHERENT	

DRESSING CONDITION: COMPROMISED

VAD	INTACT	WET	DIAPHORETIC	LEAKING AT SITE	BLEEDING				SUBTOTAL	% dressings/ dressings	% patients with VAD
CVC											
CVC-TUN											
PORT											
HD											
PA											
PICC											
PIV											
PAC											
subtotal									TOTAL		
Per cent/site											

TOTAL COMPROMISED	
PER CENT COMPROMISED	

SKIN CONDITION

VAD TYPE	DRY/ INTACT	MOIST	SKIN STRIPPING	BLISTER	SKIN TEAR	IRRITATION	MACERATION	SUBTOTAL	% dressings	% patients with VAD
CVC										
CVC-TUN										
PORT										
HD										
PA										
PICC										
PIV										
PAC										
subtotal								TOTAL		
Percent/site										

TOTAL COMPROMISED	
PER CENT COMPROMISED	

SUMMARY

VAD TYPE	Number of VAD (%)	EDGES LIFTING (%)	NON-ADHERENT (%)	COMPROMISED (%)	SKIN CONDITION (%)		SUBTOTAL	% dressings/ VAD type	% patients with VAD type
CVC									
CVC-TUN									
PORT									
HD									
PA									
PICC									
PIV									
PAC									
subtotal									
							TOTAL		
% dressings									
% patients with a VAD									

VAD type	% VAD	% patients	% VAD ICU	% central VAD ICU	% PIV ICU	other	other
CVC							
PIV							
ART							

SUMMARY

VAD TYPE	Number of VAD type (%)	EDGES LIFTING (%)	NON-ADHERENT (%)	COMPROMISED (%)	SKIN CONDITION (%)	Pain/ Tenderness	SUBTOTAL	% dressings/ VAD type	% patients with VAD type
CVC	13 (8%)	4 (3%)	2 (1%)	8 (23%)	3 (9%)		17	130%	
CVC-TUN									
PORT	8 (5%)	1 (1%)		5 (63%)			6	75%	
HD	2 (7%)	1 (1%)					1	50%	
PA									
PICC	12 (8%)			5 (42%)			5	42%	
PIV	117 (76%)	24 (16%)	3 (3%)	21 (18%)	8 (1%)	12 (10%)	66	56%	
PAC	2 (1%)								
subtotal	154	30	5	39	11	10	95		
							TOTAL 95		
% dressings		20%	3%	25%	7%		62%		
% patients with a VAD	83%	21%	4%	28%	8%		67%		

VAD type	% VAD	% patients	% VAD ICU	% central VAD ICU	% PIV ICU	other	other
CVC	23%	25%	30%	20%	28%		
PIV	76%	83%					
ART	1%	2%					

Hospital	Units	VADs	VAD pts	PTS	central	PICC	PIV	PAC	VAD ICU	Edges lifting / reinforced dressings (%)					Partially detached dressings (%)					Comp	Skin cond
										CVC	PICC	PIV	PAC	%	CVC	PICC	PIV	PAC	%		
	4	51	43		9	4	41	1	8	2	1	9	0	24%			2		5	7 (16%)	4 (8%)
	2	14	14		1	13			----	1	8			37%		4			29	10 (71%)	7 (50%)
		18		53	6	7	5		----	12	5	5		67%					0	4 (22%)	3 (17%)
		22			6	22			----	5	14			68%					0	6 (21%)	4 (14%)
	9	154	141 88%	169	23	12	117	2	42(30%)	6		24		20%	0		3		3	39 25%	21 (14%)
	7	130	108 84%	128	19(15%)	14(11%)	94(72%)	3(2%)	30(30%)	3		3	1	3%	9				9	39 (25%)	21 (14%)
	4	45	40 83%	69	5(7%)	12(27%)	25(56%)	1(2%)	16(36%)	1	3	14		40%		2	1	1	9	1 1%	0
	5	74	67 72%	93	4(5%)	11(15%)	59(80%)		16(22%)	3	4	14		28%	0	4	14		31	4 (5%)	5 (7%)
	3	93	80 86%	91	7(100%)		86			1		26		29%	0		2		4	5 5%	3 (3%)

.....pathogenesis-based interventions

maximum antisepsis / disinfection

#1 Daily CHG bathing, select populations
#2 Pre-op / pre-procedural skin cleansing
#3 Surgical site disinfection
#4 Antimicrobial catheter
#5 Catheter insertion site protection
#6 Low bacteria transfer rate connector
#7 Access site / hub disinfection

protecting the gateway to CRBSI !