



Why We Should be "P/ccy: The Problem with Peripherally Inserted Central Catheters

Vineet Chopra MD, MSc Assistant Professor of Medicine

Conflicts of Interest

Grant Funding:

-Blue Cross Blue Shield Foundation of Michigan

- -Agency of Healthcare Research and Quality
- -National Institute of Aging
- -VA Center for Clinical Management Research

Overview

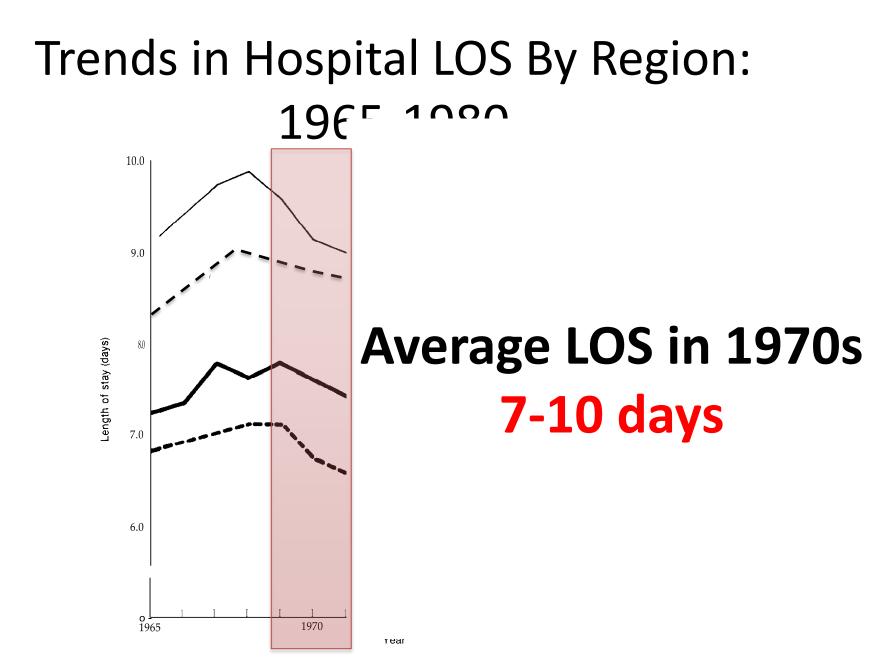
- Introduction and Background
- Why We Should Be "Piccy"
- Improving PICC Use in Michigan Hospitals
- Engineering Solutions to Improve PICC Use
- Conclusions



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SOURCE: Vital and Health Sfat/sties, series 13, Nos 2, 10, 14, 17, 19,23, 26,31, 41,46, 55,60,64 (Washington, D. C.' National Center for Health Statistics, 1967-82)

Osteomyelitis



Endocarditis

Pancreatitis

Non-functional GI Tract



Verne L. Hoshal MD

- UM trained surgeon (Class of 1964)
- Develop an "outpatient" catheter for total parenteral nutrition
- Key requirements:
 - Durable
 - Easy to insert
 - Self care compatible

"My goal was to shift patient care from the the hospital to the home..."

Verne L. Hoshal, MD (via telephone)



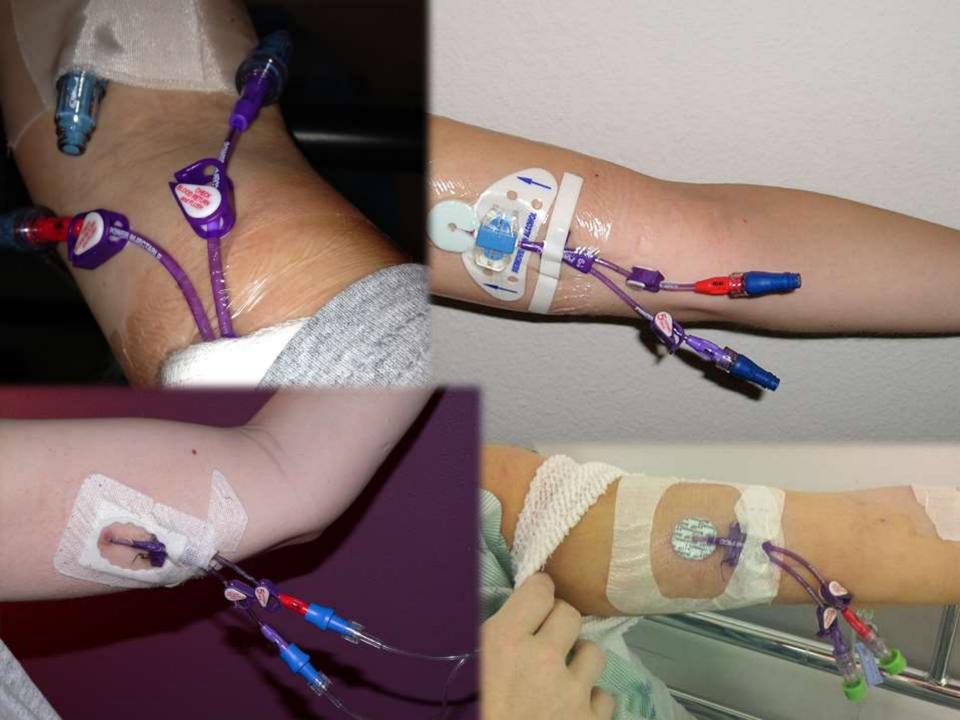
ARTICLE | May 1975

Total Intravenous Nutrition With Peripherally Inserted Silicone Elastomer Central Venous Catheters

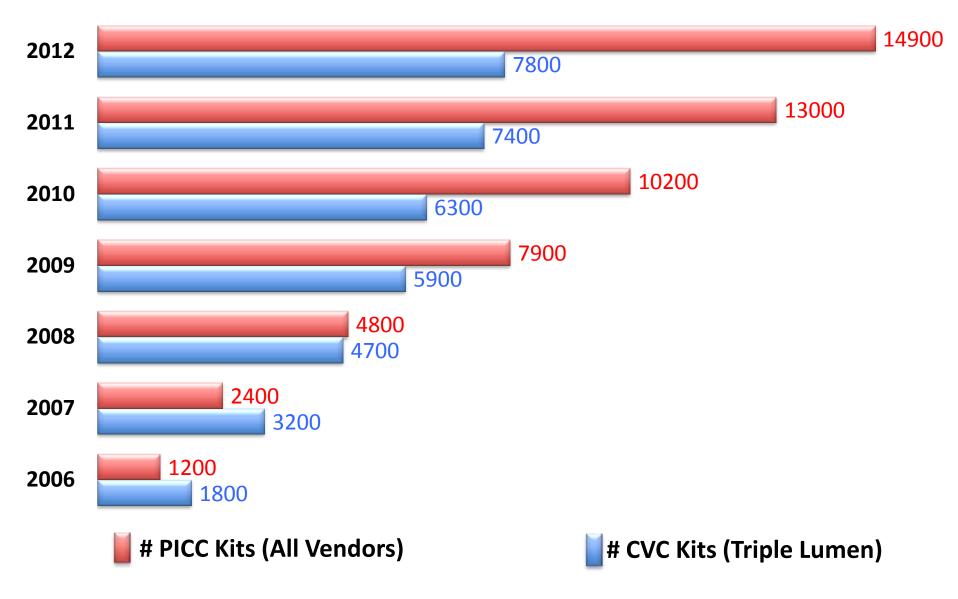
Verne L. Hoshal, MD

Inserted 36 catheters using this method
Mean dwell time: 20.4 days (4-36 days)
30 of 36 catheters lasted the entire duration
6 catheters developed infection and phlebitis



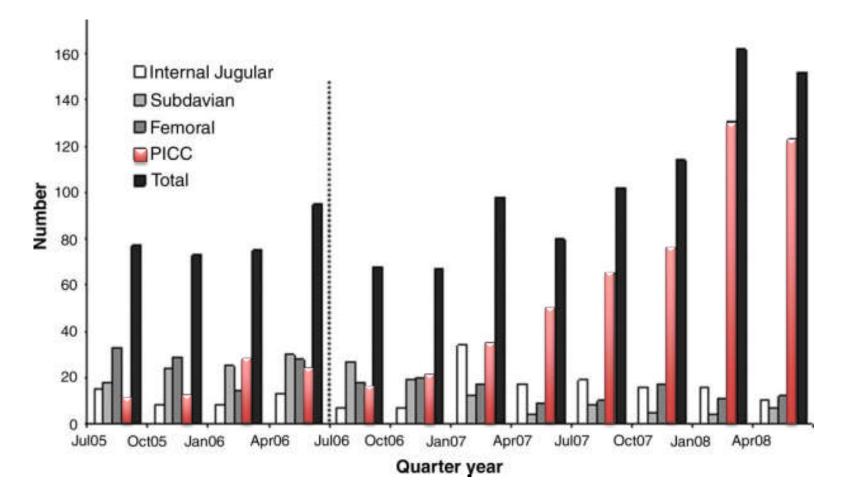


PICC Orders at UMHS: 2006-2012



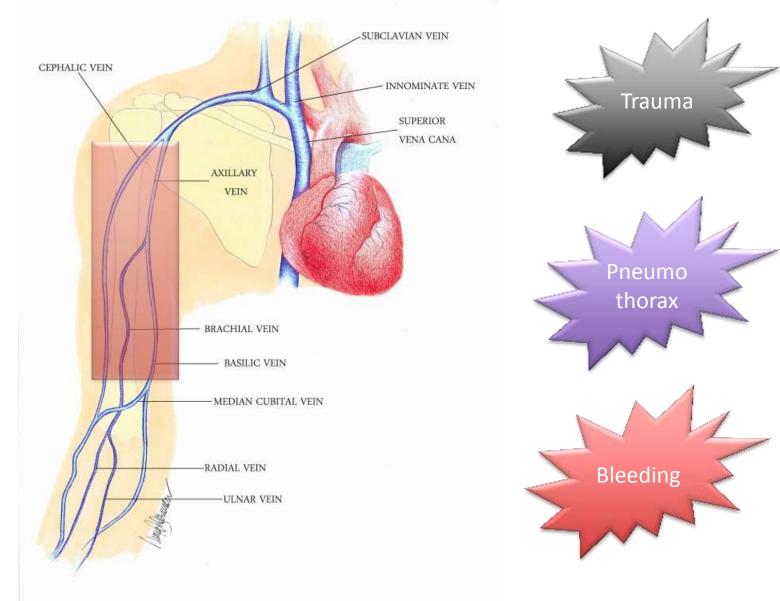
Data Courtesy Kristine Komives, Central Sterile Supply

Utilization of PICCs vs. other devices



Lobo et al, J Hosp Med 2011

Safer To Insert



PICCs Are **Economically** Attractive



- Enable early discharges
- Transitions of care
- No physician time for insertion of device

Pikwer M, et al. Anesthesia 2011 Evans RS, et al. Chest 2013 Umscheid CA, Anesthesia 2013

Patients **love** them...



Convenient Venous Access

So Why Be PICCy?



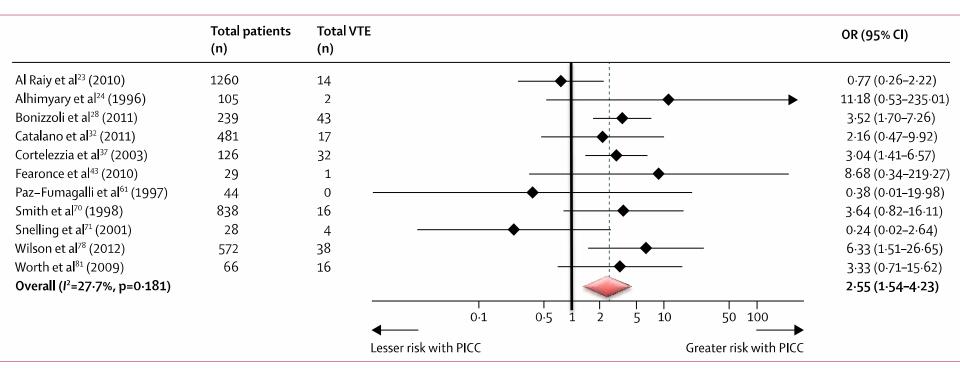


Venous Thromboembolis

Bloodstream Infection

m

PICC DVT Risk Versus CVCs



Pooled meta-analyses of 12 studies revealed that PICCs were associated with **2.55x** greater risk of Upper Extremity DVT compared to CVCs The Risk of Bloodstream Infection Associated with Peripherally Inserted Central Catheters Compared with Central Venous Catheters in Adults: A Systematic Review and Meta-Analysis

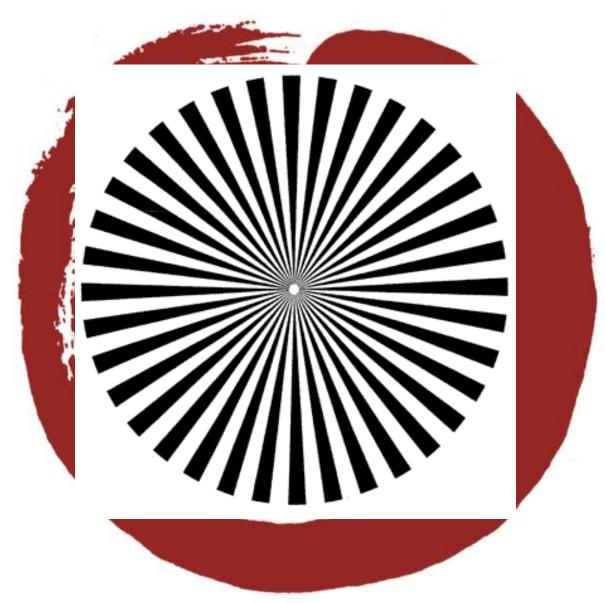
> Vineet Chopra, MD, MSc;¹ John C. O'Horo, MD;² Mary A. M. Rogers, PhD;¹ Dennis G. Maki, MD, MS;³ Nasia Safdar, MD, PhD³

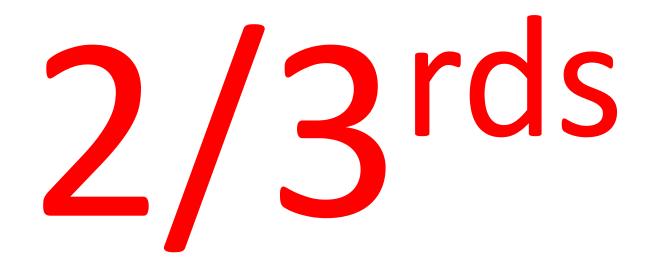
- N=23 studies (57,250 patients)
- 20 of the 23 studies compared PICCs to other devices
- No difference between the rate of infection in patients who got PICCs vs. those that got other devices

Chopra V, et al. Inf Control Hosp Epidemiol 2013.



Current Systems Concentrate On ICUs

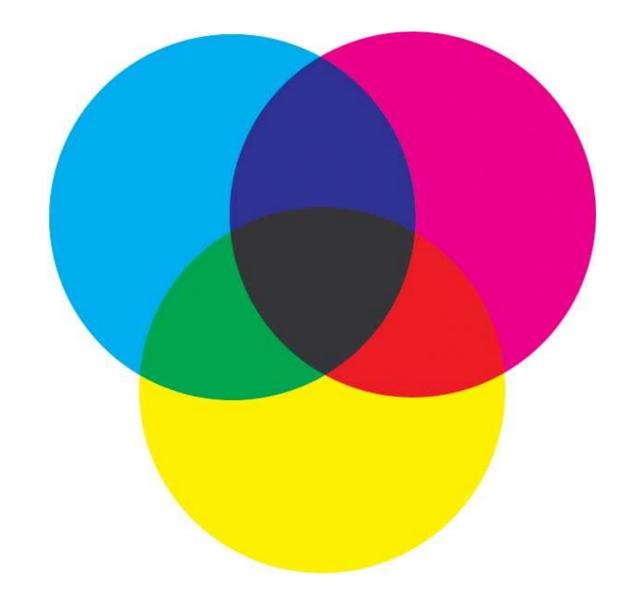




of CVCs are now in non-ICU patients

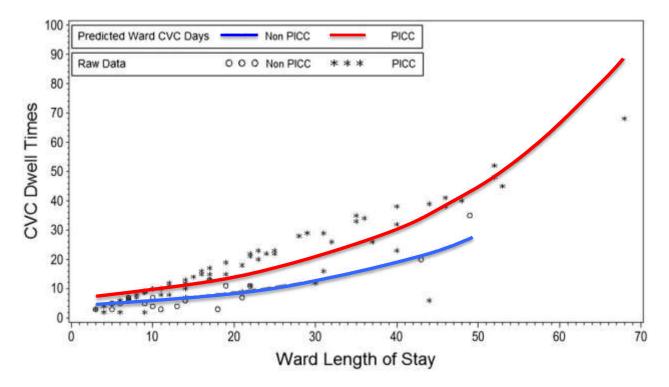
Climo M, et al. ICHE 2003, Zingg W, et al. J Hosp Infection 2011, Ajenjo MC, et al. ICHE 2011, Tejedor SC, et al. ICHE 2012

Variable **Practices** in non-ICU settings



Over 75% of PICCs multiple "idle days" of non use That in the source of the source of

Sheri Chernetsky Tejedor, MD, SFHM;^{1,2} David Tong, MD, MPH;¹ Jason Stein, MD, SFHM;^{1,2} Christina Payne, MD;¹ Daniel Dressler, MD, MSc, SFHM;¹ Wenqiong Xue, MS;³ James P. Steinberg, MD⁴



Tejedor SC, et al. ICHE 2012



Chopra V et al., J Hosp Med 2013

"As of yesterday afternoon, did your patient have a urinary catheter?"



Providers were unaware 28% of the time Attendings were most likely to be unaware (38%)

Saint S, et al. Am J Med 2000

Do physicians know which of their patients have PICCs?



PICC Awareness Study

"As of this morning, does your patient have a PICC or a CVC in place?"

- Directly examined patients in the AM
- Queried providers (interns, residents, and attendings) the same day <u>after rounds</u>
- Interviewed 990 patients and over 2000 medical providers over 1 year at three academic medical centers

Awareness by Providers

- Interns: not aware **15%** of the time
- Senior residents: not aware **10%** of the time

General Medicine Attendings and Hospitalists Not aware of PICC presence: 20% of the time

PICCs were most likely to be associated with lack of awareness (OR 4.8, 3.2-6.9)

Original Research

Annals of Internal Medicine

Do Clinicians Know Which of Their Patients Have Central Venous Catheters?

A Multicenter Observational Study

Vineet Chopra, MD, MSc; Sushant Govindan, MD; Latoya Kuhn, MPH; David Ratz, MS; Randy F. Sweis, MD; Natalie Melin, BA; Rachel Thompson, MD; Aaron Tolan, MD; James Barron, MD; and Sanjay Saint, MD, MPH

· ..

Background: Complications associated with central venous catheters (CVCs) increase over time. Although early removal of unnecessary CVCs is important to prevent complications, the extent to which clinicians are aware that their patients have a CVC is unknown.

209), of which 60.3% (126 of 209) were PICCs. A total of 21.2% (90 of 425) of clinicians interviewed were unaware of the presence of a CVC. Unawareness was greatest among patients with PICCs, where 25.1% (60 of 239) of clinicians were unaware of PICC presence. Teaching attendings and hospitalists were more frequently unaware of the presence of CVCs than interns and resi-

Annals of Internal Medicine

Editorial

Whose Line Is It Anyway?

"The show where everything is made up, and the points don't matter." That is how Drew Carey used to introduce the improvisational comedy television show *Whose Line Is It Anyway?* Players made everything up as they went along, and no one really kept score. If only medicine could be that way, but it is not.

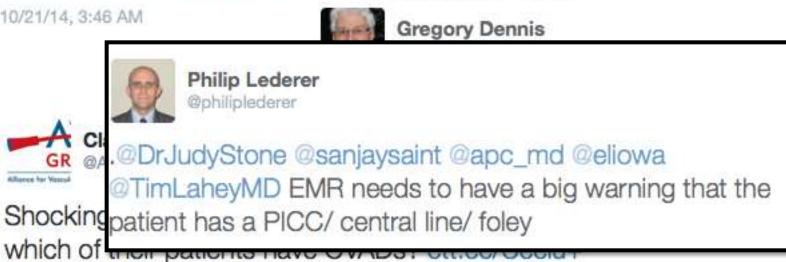
Our notes are scripted, our actions increasingly regimented according to clinical protocols and evidence-based guidelines, and you bet that everyone is keeping score: payers, administrators, patients, and physicians. That medical practice is less the "art" it used to be has been commine whether the CVCs were still indicated, and did not survey nurses, at face value the rate of unawareness is troubling.

Perhaps nothing is wrong here, as the most important limitation of this study is the lack of data on outcomes: Did patients whose clinicians were unaware of their CVCs have more complications? However, because we know that reducing indwelling time by removing CVCs is one of the most effective means of reducing their complications (6, 8), I suspect that the unawareness identified by Chopra and coworkers does matter.



Out of sight - out of mind. True for urinary #catheters over a decade ago. Also now true for #PICCs. #patientsafety annals.org/mobile/article... Vineet Chopra retweeted

10/21/14, 3:46 AM



@ivteam #ivteam



@MaryDixonWoods @sanjaysaint @vineet_chopra Great stuff...presumably the nurses knew? Docs can't do it all distributed cognition essential

erful finding.

10/20/14, 10:03 PM





The Problem With Peripherally Inserted Central Catheters

Vineet Chopra, MD, MSc

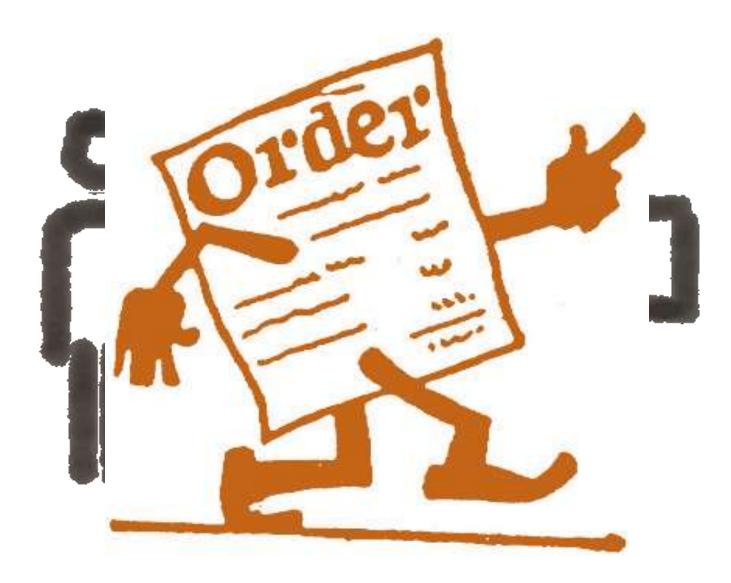
Scott A. Flanders, MD

Sanjay Saint, MD, MPH

Rapid growth in non-ICU settings Substantial Variation in Use Risk of important complications Important Patient Safety Problem

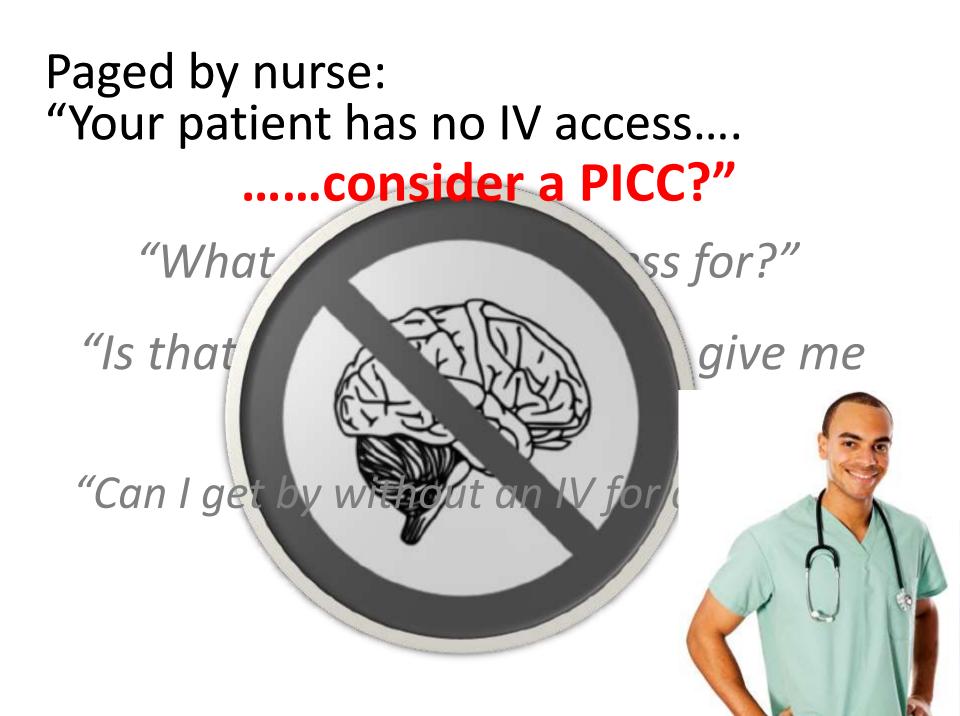


PICCs Facilitate Lack of Decision Making



Patient Needs 3 More Days of IV Antibiotics Before Discharge







Not Only True For PICCs

CT Scans PCI Medical Devices Stress Tests



PICCs teach us how technology diffuses in healthcare

Gartner Hype Cycle

Cardiac Stress Tests

Cardiac Stents

Imaging

PICCs

VISIBILITY





"Iatrogenesis" Hospital Culture Patient Safety





Don't place peripherally inserted central catheters (PICC) in stage III-V CKD patients without consulting nephrology.

Venous preservation is critical for stage III–V CKD patients. Arteriovenous fistulas (AVF) are the best hemodialysis access, with fewer complications and lower patient mortality, versus grafts or catheters. Excessive venous puncture damages veins, destroying potential AVF sites. PICC lines and subclavian vein puncture can cause venous thrombosis and central vein stenosis. Early nephrology consultation increases AVF use at hemodialysis initiation and may avoid unnecessary PICC lines or central/peripheral vein puncture.

American Society of Nephrology

1. Don't recommend daity nome imper glucose testing in patients with type 2 diabetes metitics not using insutin.

- 2. Don't perform routine general health checks for asymptomatic adults.
- 3. Don't perform routine pre-operative testing before low-risk surgical procedures.
- 4 Don't recommend cancer screening in adults with life expectancy of less than 10 years
- 5. Don't place, or leave in place, peripherally inserted central catheters for patient or provider convenience.

"Physicians in General Internal Medicine have a special long-term relationship with their patients. Our goal is to maintain our patients' health and function, to treat their acute and chronic diseases, and to coordinate care with other specialties on behalf of our patients. The *Choosing Wisely* topics seek to identify areas where we can engage our patients in conversations designed to enhance their health across this spectrum of practice. We are proud to engage in this specialty-defined *Choosing Wisely* effort to enhance care

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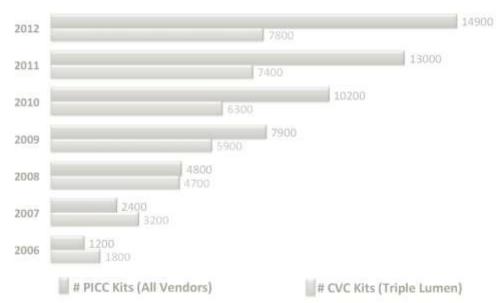


Overview

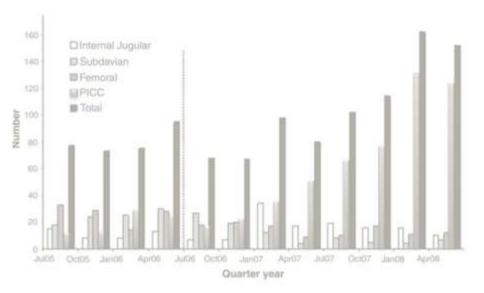
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PICC Orders at UMHS: 2006-2012



Utilization of PICCs vs. other devices



Lobo et al, J Hosp Med 2011

No Data

Available

PICCs placed in hospitalized patients = "buried within DRG"

- Most are placed by nurses (so like urinary catheters), no charge codes are generated
- Only physician placed PICCs are tracked
- National datasets do not contain PICC data

You can't improve what you can't measure













Blue Cross Blue Shield Blue Care Network of Michigan



Clinical "Laboratory"

- 48-hospital, Blue Cross Blue Shield of Michigan/Blue Care Network-funded quality initiative
- 10 Pilot Hospitals Focusing on PICCs:
 - Appropriateness
 - Predictors of Harm
 - Interventions



Robust Data Collection

- Trained abstractors at each hospital; EMR data
- Defined data collection protocol and template
- Operations Manual
- Auditing of Data Quality from a central coordinating center
- Real-time feedback nurse coordinators assigned to hospitals and available to respond to questions and issues as they arise



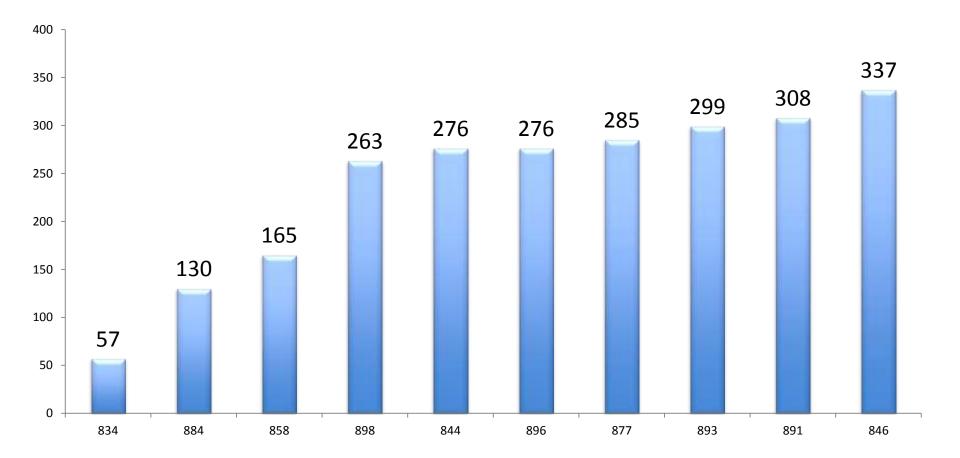
for the knowledge is new

Early data from this collaborative

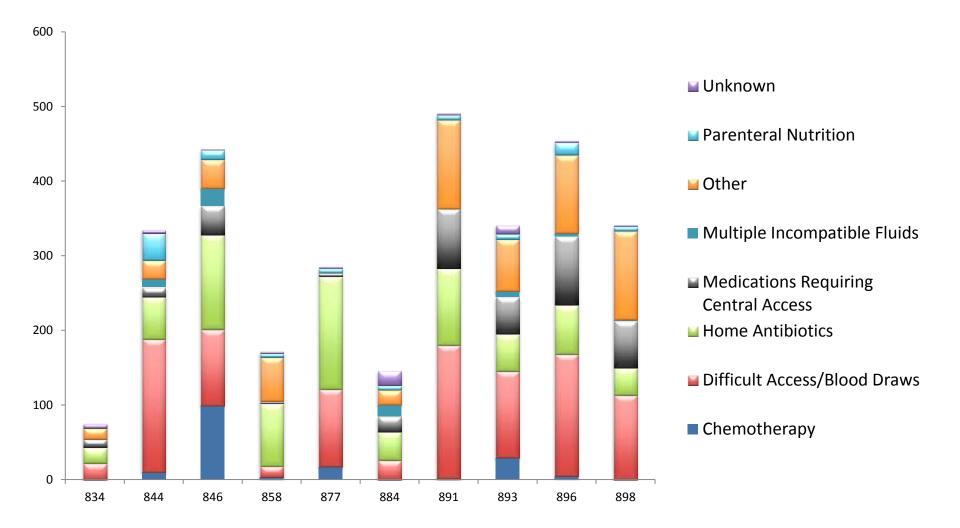


Volume of PICC Data Collected

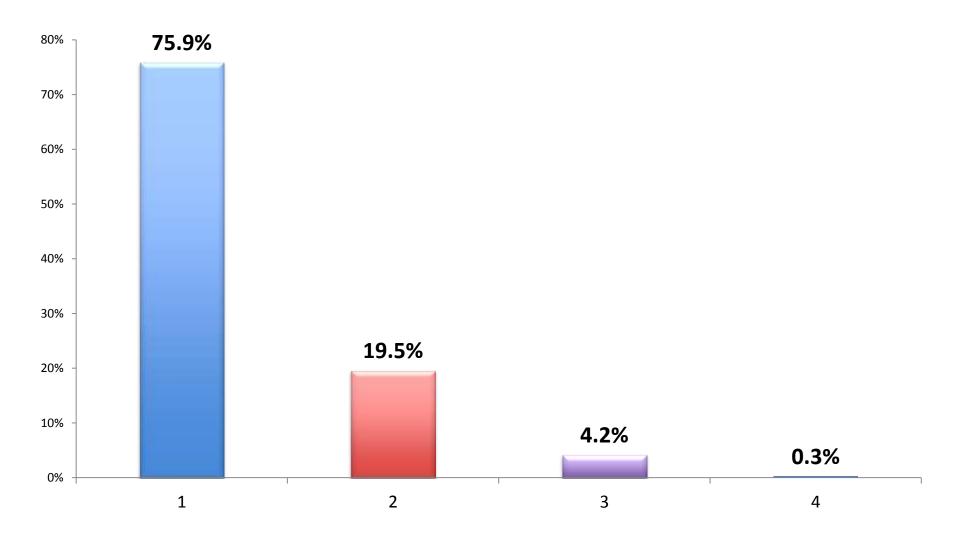
2,396 completed cases as of Sept 30th 2014



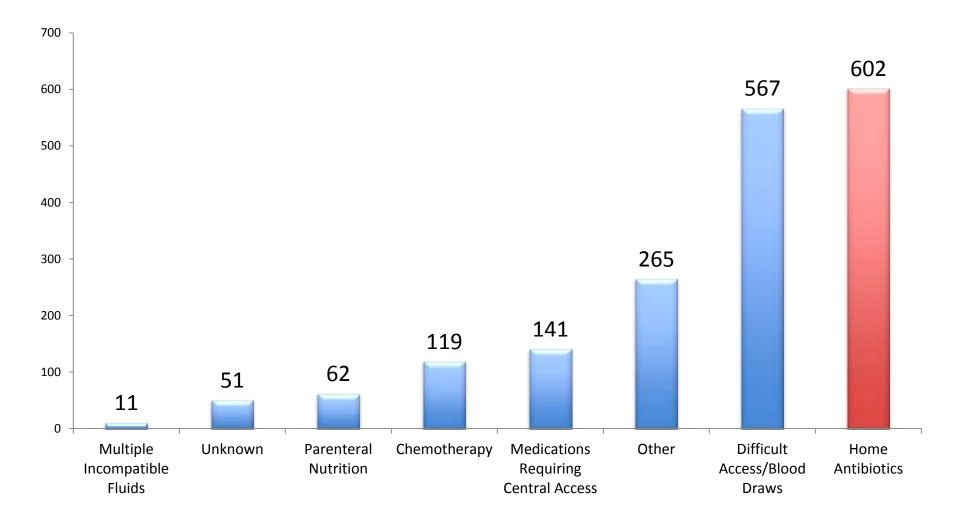
Placement Indication – All (Sites)



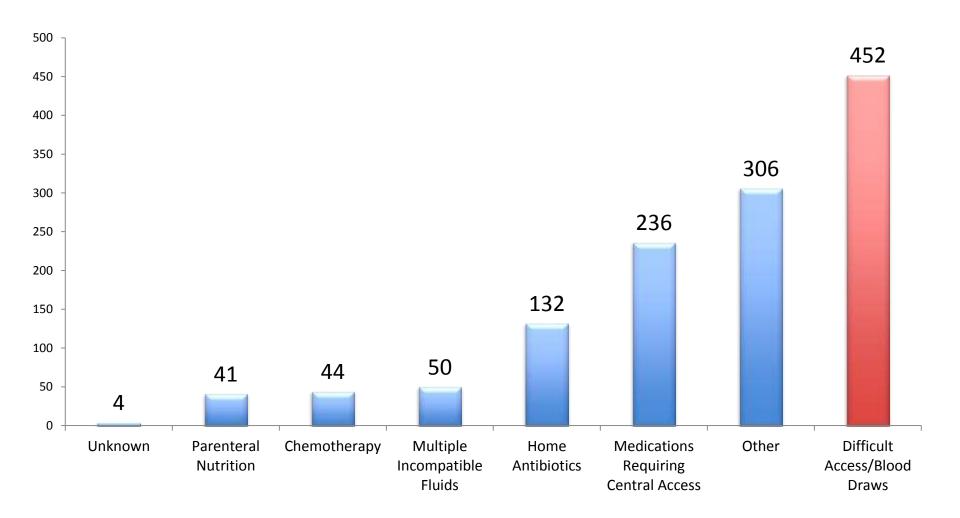
Number of PICC Indications Selected



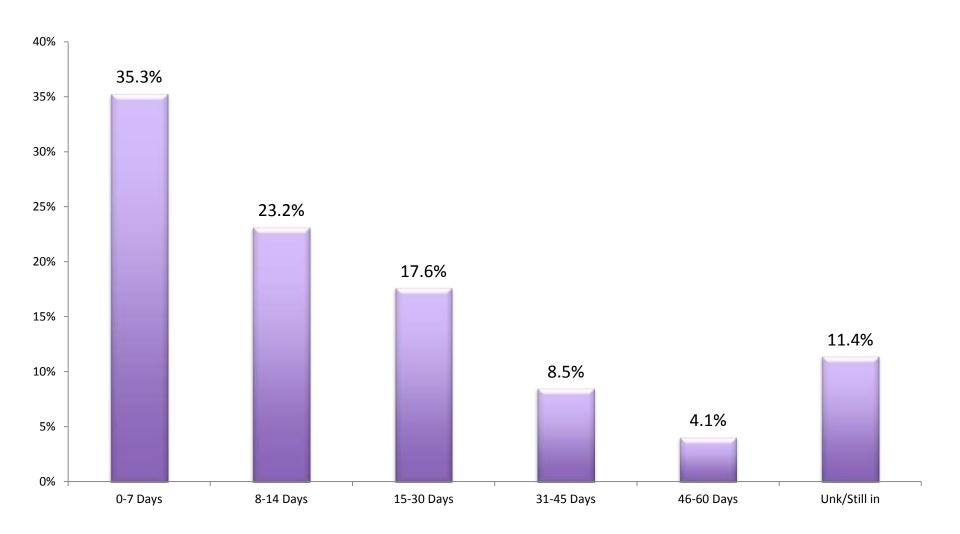
Placement Indication – 1 selection



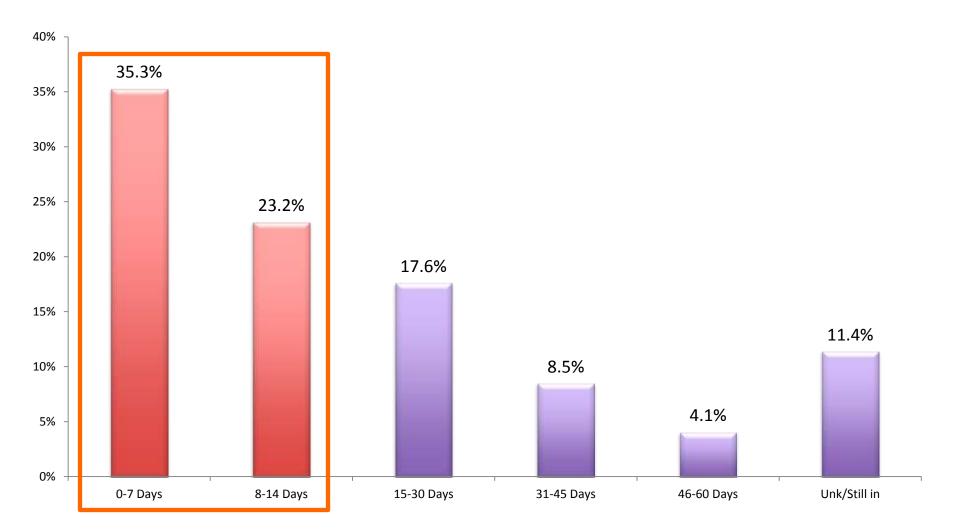
Placement Indication – 2+ selections



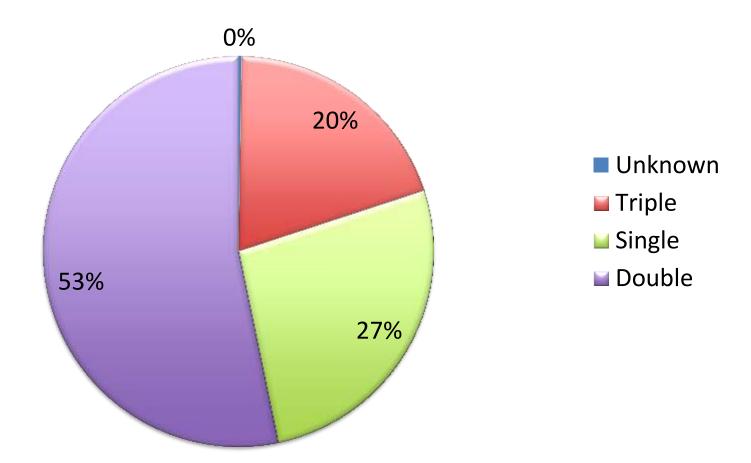
PICC Dwell Times



PICC Dwell Times

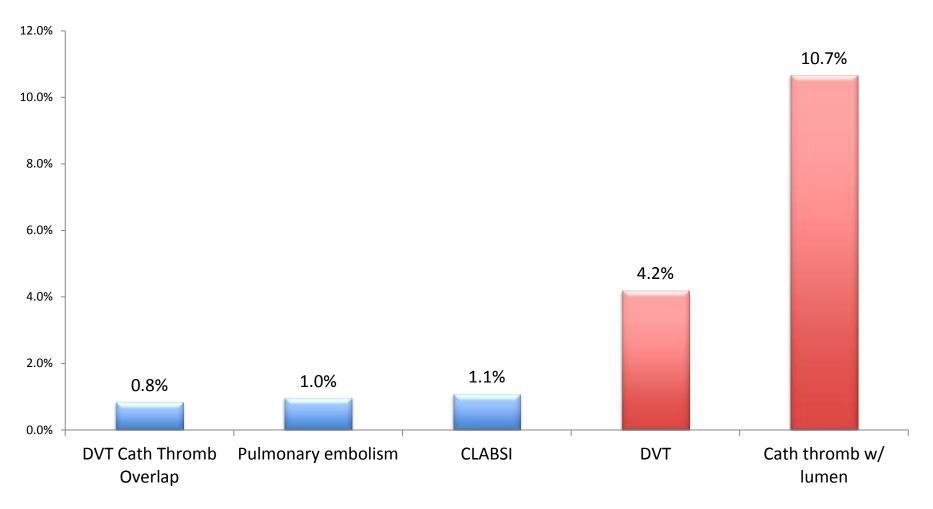


Number of PICC Lumens



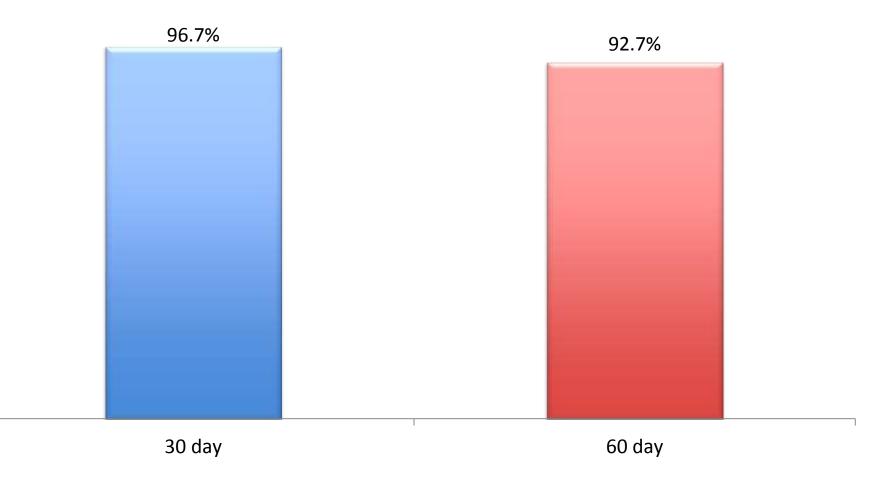
Statistically significant variation across hospitals for Double and triple lumen PICCs

Major Complications



Catheter thrombosis: Increased use of t-PA and prolongation of hospitalization (p<0.001)

Follow Up – EMR Success Rate



*Of patients that coordinating center believes should have information at time-point



Moving Forwards...

- Expansion to other sites across the CQI
 April 2015 (over 50 hospitals)
- Reduce variation in use (under- and over-use)
- Design interventions to reduce PICC-related complications and promote appropriate use
- Reduce cost, morbidity and mortality in patients who receive these devices



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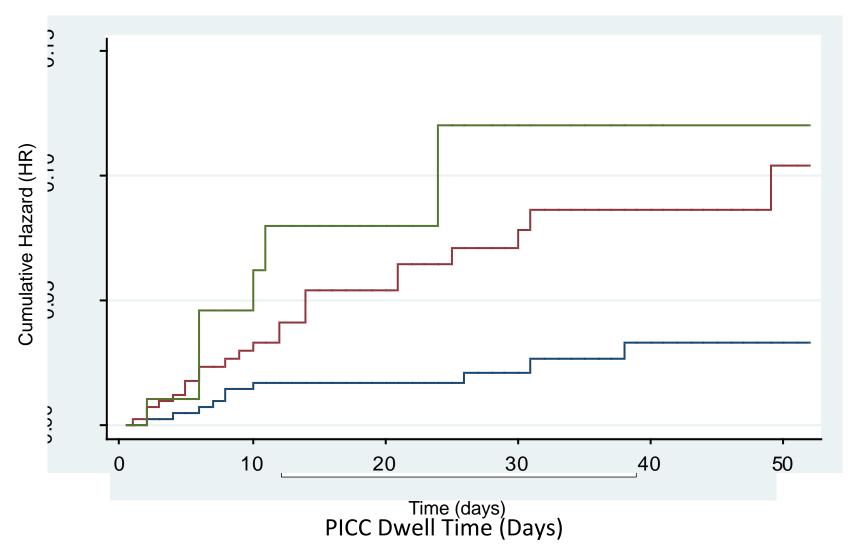
Reminders of PICC Presence

- Up to 50% of providers at least once "forgotten" their patient has a PICC
- Many providers do not remove PICCs when therapy completed in hospital settings
- Providers may often be unaware that their patients have a PICC in place!

Chopra V, et al. J Hosp Med 2013 Chopra V, et al. Ann Intern Med 2014

Why does awareness matter?

Each day with a PICC: **A**Risk of Complications



Early Removal of CVCs

A Cornerstone To Prevention Contingent on Awareness of Complications

How may providers forget?





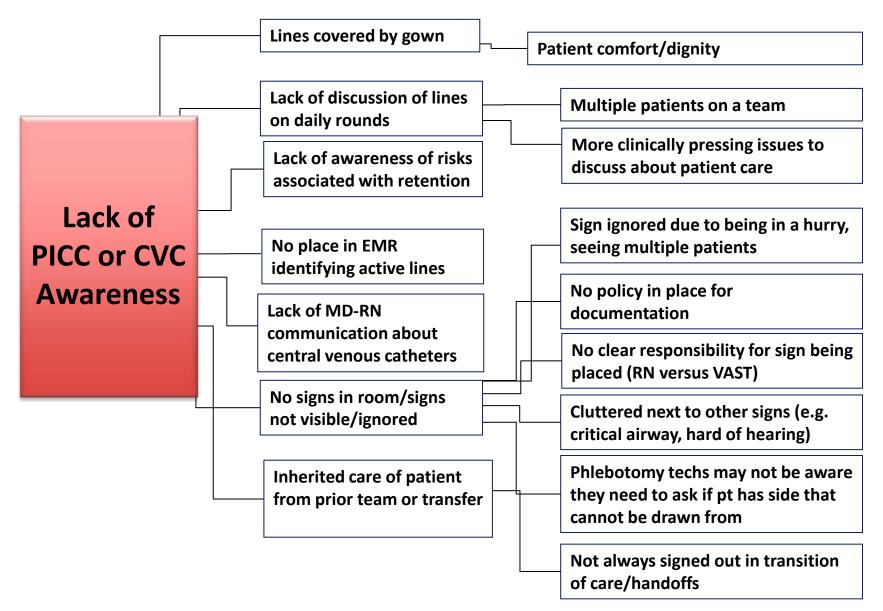
Which of these patients has a PICC?

Did you guess right?



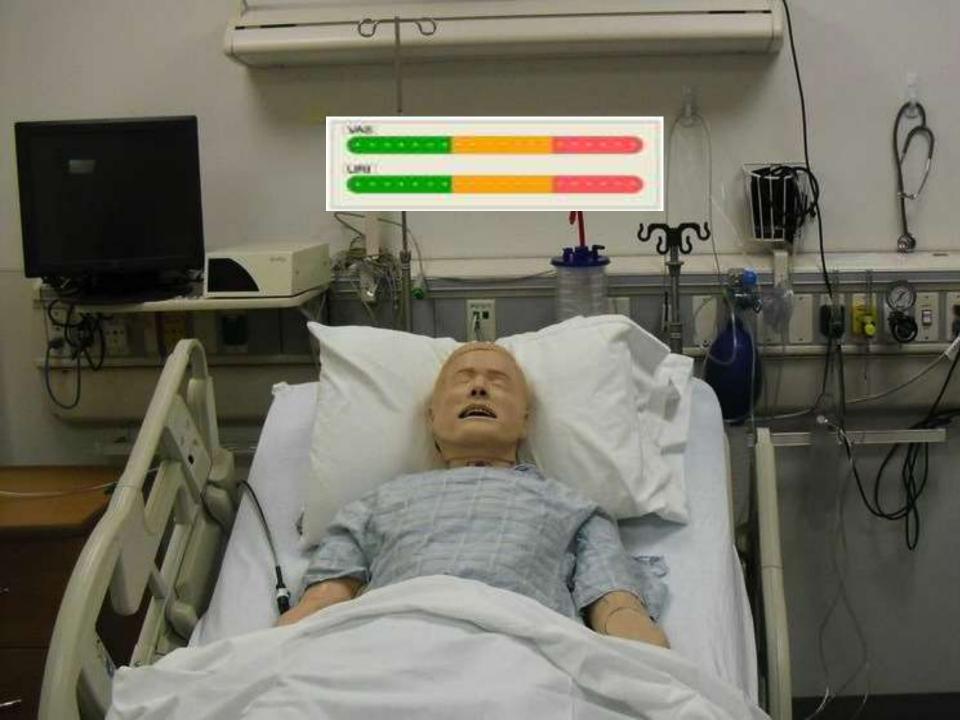


It's NOT Hard To Forget....



What we need is a system...







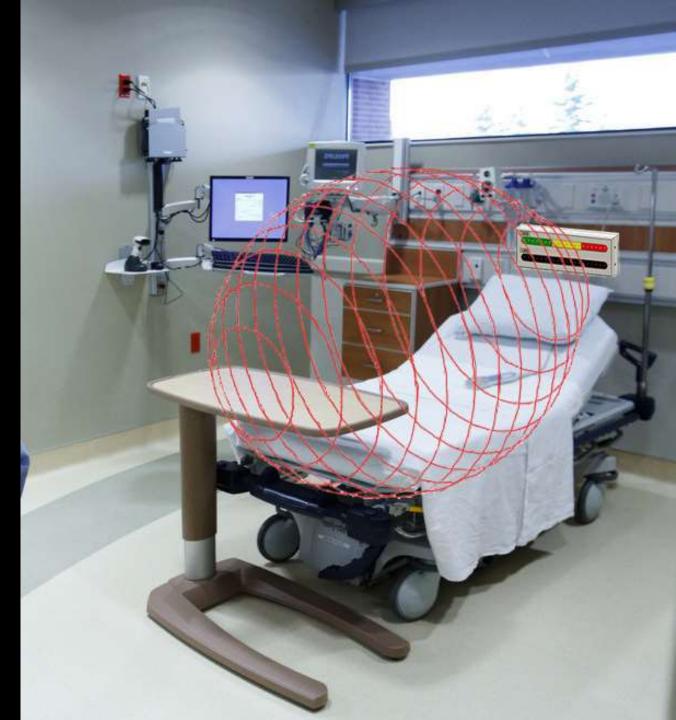


- Catheter Detection and Reminder System
- Activated when device (e.g., PICC or urinary catheter) inserted by nurse
- Sends signal to light panel above bed
- Colors change to reflect duration of catheter
- Ultimately integrate into the electronic medical record, auto-populate progress notes

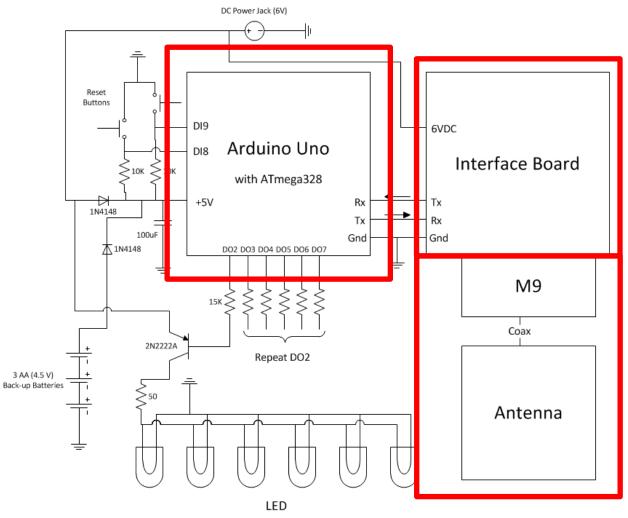
$$r = \frac{\lambda}{4\pi} \sqrt{\frac{P_t G_t G_r \tau}{2P_{th}}}$$

Read range equation where is the read range in meters, λ is the wavelength, P_t is the power into the transmitting antenna, G_r is the gain of the transmitting antenna, G_t is the gain of the tag antenna, P_{th} is minimum threshold power to operate the tag, and τ is a factor describing how well the tag's chip and antenna are impedance matched.

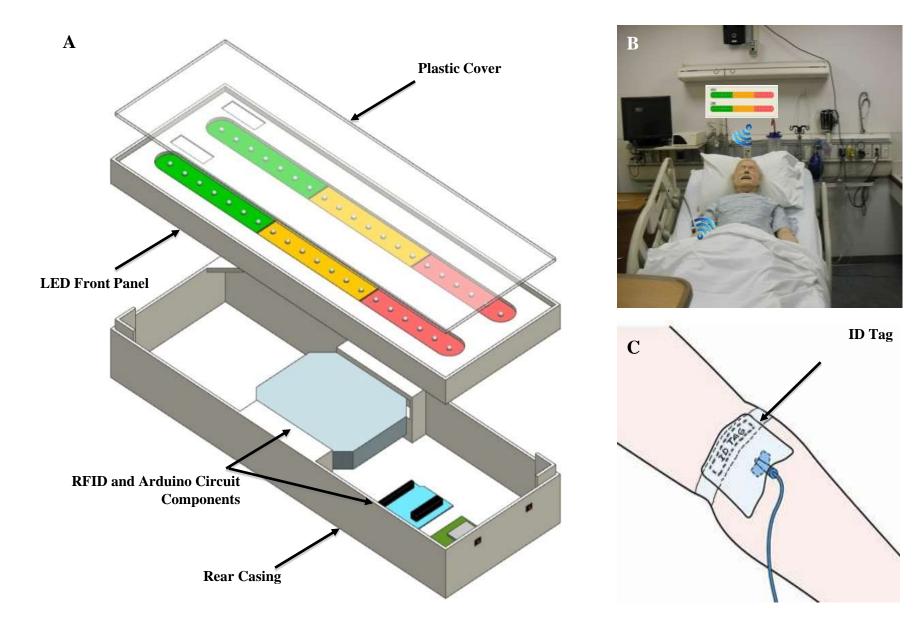
The values inputted were: λ =0.328 m*00 mW*, *Gt*=3.55,*Gr*=1.41, *Pth*=100 μ W, τ = 0.7.



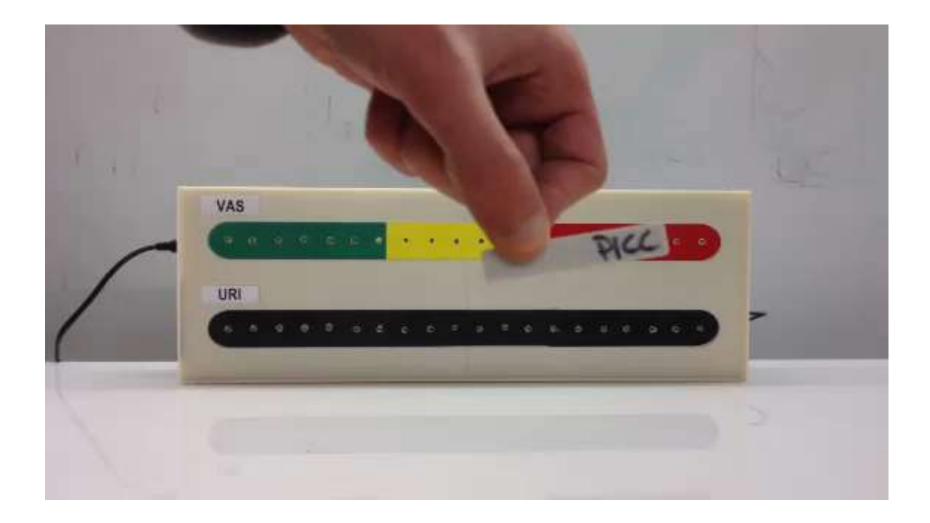
"Heart" of the Technology



array



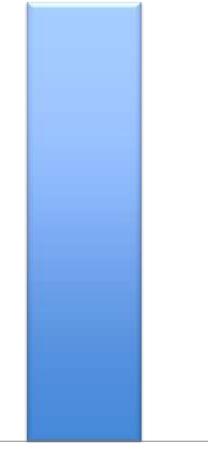
A: Design assembly contains the covered alarm light scheme front piece that attaches to the RFID technology and Arduino casing. B: Placement of the device above the bed permits communication with the RFID tag on the patient. C: The flexible RFID tag will be placed in between the dressing by a nurse for a PICC and attached to the bag of a urinary catheter. Tegaderm will be used as the adhesive for the RFID tag to it respective location based on the catheter type.



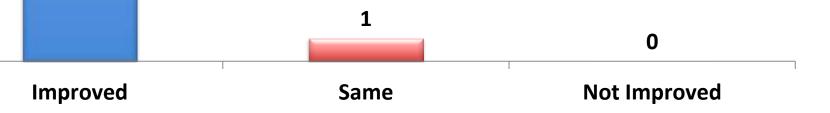
Field Testing Results

(20 UMHS ICU and Floor Nurses)

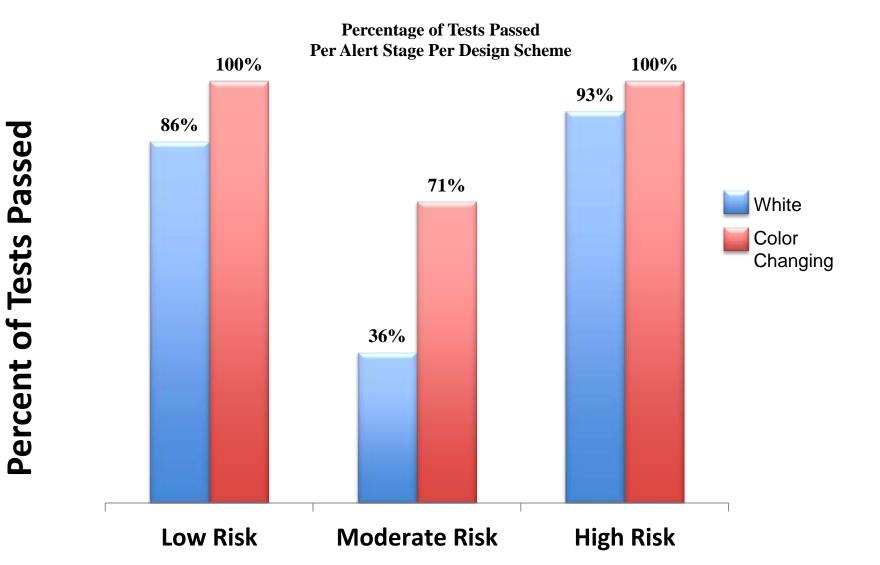




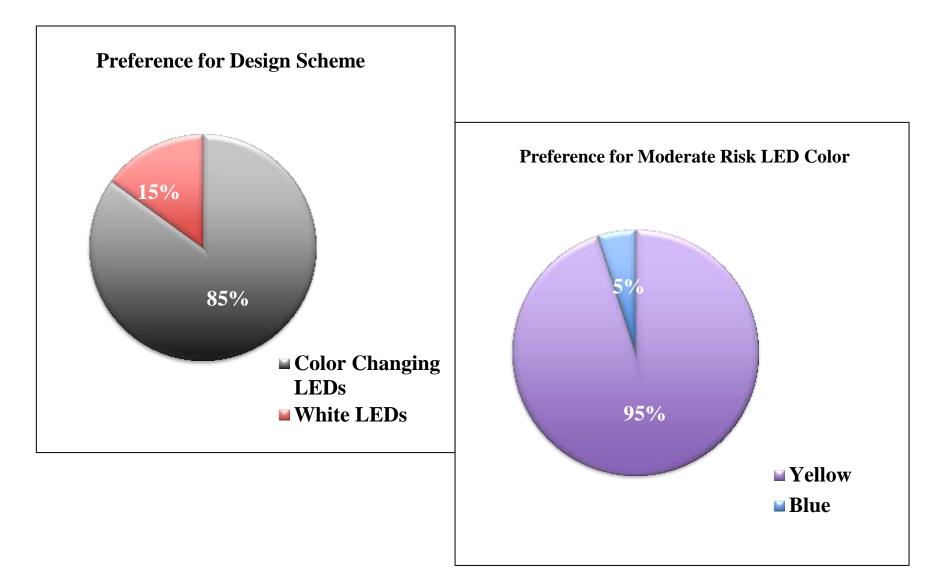
"Compared to your current workflow, does this system improve your recognition of the presence and duration of catheters?"



Field Testing Results



Field Testing: User Preferences



PICC

ART-LINE

URINARY

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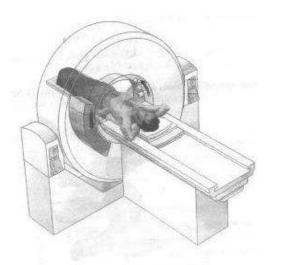


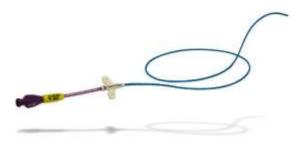
"It may seem a strange principle to enunciate as the very first requirement in a hospital to do the sick no harm."

Florence Nightingale



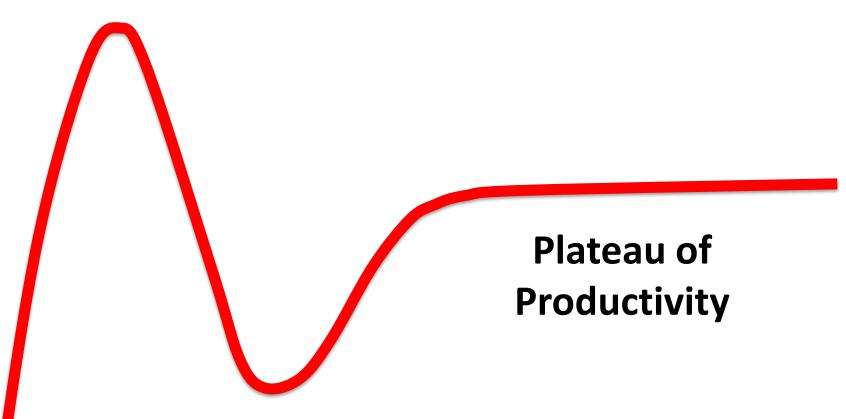








Peripherally Inserted Central Catheters







vineetc@umich.edu @vineet_chopra

