



**The VAST Difference: Growing a Vascular Access Specialty Team (VAST) Using Data That Demonstrates Reduction in Waste and Variability**

Lee Steere, RN, CRNI, VA-BC

# Lee Steere, RN, CRNI, VA-BC



RN / 27 years

Hartford Hospital, Nurse Manager, IV Therapy Services and CB2 Infusion Room – 18+ years

- Member of the hospital's HAI committee since 2007 / Chair, 2 years
- Clinical Dyad for the systems Patient Care Clinical Value Team
- Past Co-chair of the hospital's Clinical Practice Council
- Member Purposeful Hourly Rounding Committee
- Local and national Speaker for INS and AVA meetings on LEAN IV Therapy, CLABSI prevention, and CVAD occlusion management
- Prior experience in Critical Care, hyperbaric medicine
- Two prior Nurse manager positions - inpatient Medical Units

Peer Review Publications:

1. *Lean Six Sigma for Intravenous Therapy Optimization: A Hospital Use of Lean Thinking to Improve Occlusion Management/ March 2017 JAVA*
2. *Reducing False Positive Blood Cultures: Using a Blood Diversion Device/February 2019 Connecticut Medicine*
3. *Reaching One Peripheral Intravenous Catheter (PIVC) Per Patient Visit With Lean Multimodal Strategy: the PIV5Rights™/September 2019 JAVA*
4. *CLE3AR Study5-Year Impact of LEAN Central Venous Catheter Occlusion Management & Quality Interventions*
5. *A New Force-Activated Separation Device for the Prevention of Peripheral Intravenous Restarts - March/April 2022 Journal of Infusion Nursing*

# Disclosures

Independent Consultant since 2011

Consulting Agreements with: Nexus Medical, Eloquest Healthcare, Lineus Medical

Speakers Bureau for: Nexus Medical, Eloquest Healthcare, Lineus Medical

Advisory Board for: AccuVein

Honorarium Received for Presenting Today: Eloquest Healthcare

# Learning Objectives

- ✓ Explain the goals of lean thinking.
- ✓ Describe lean thinking as it applies to vascular access
- ✓ Explore the benefits of a Vascular Access Specialty Team (VAST)
- ✓ Outline the the evidenced-based bundle that led the way for VAST expansion

ORIGINAL ARTICLE

## Reaching One Peripheral Intravenous Catheter (PIVC) Per Patient Visit With Lean Multimodal Strategy: the PIV5Rights™ Bundle

Lee Steere, RN, CRNI®, VA-BC™  
Cheryl Ficara, RN, MS, NEA-BC  
Michael Davis, RN, BSN, MBA, NE-BC  
Hartford Hospital, Hartford, CT  
Nancy Mourau, RN, PhD, CRNI®, CPUL, VA-BC™  
PICC Excellence, Inc., Hartwell, GA

**Highlights**

- Lean leadership for process improvement.
- Prospective comparator multimodal design study.
- Vascular access specialty team (VAST group 2) versus generalist nursing model (group 1).
- First stick success of 96%.
- Statistically significant improvement in dwell time with VAST versus generalist nursing model (89% versus 15% lasting until end of therapy).
- Projected 2.9 million in savings annually.
- Peripheral intravenous catheter team centralized proposal to Chief Nursing Officer (CNO) with acceptance based on outcomes.
- Reduction in cost per bed per year using a vascular access specialty team of \$3376.

**Abstract**

**Background:** Peripheral intravenous catheter (PIVC) sales per year exceed that of the number of people in the United States (US), 350 million. With only 37 million US hospital patient admissions per year, these data indicate an average usage of 10 PIVCs per patient admission, suggesting a very high failure, very low success rate, and excess cost associated with PIVC insertions. Patients often complain of multiple catheter insertion attempts, and published data reveal up to 53% of PIVCs fail before therapy ends.

**Methods:** Hartford Hospital (Hartford, CT) conducted a prospective comparator single-center clinical superiority design study to determine the impact of bundled practices including device insertions using vascular access specialty team (VAST) intravenous trained nurses versus current practice. The study used a 5 step multimodal best practice intervention strategy designated as the PIV5Rights Bundle with an aim to determine if the intervention outcomes and dwell time improved over current PIVC practices. The study group applied a Lean health care standard work process with a Six Sigma design, define, measure, analyze, improve, control approach that included VAST PIVC dwell time, complications, and economic impact compared with current state general nursing practice.

**Results:** Outcomes of the PIV5Rights Bundle in Group 2 (experimental) using a trained vascular access nursing team for insertion and management achieved a statistically significant result of 89% of catheters achieving end of therapy with a cost saving per bed of \$3376 (\$1405 versus \$4781) per year as compared to standard practice (Group 1: control). Results of Group 1 reflected PIVC dwell time to end of treatment in only 15% of catheters. Prestudy catheter consumption analysis was 4.4 catheters per patient hospital admissions, reflecting waste within labor and supply costs for PIVC insertion and usage. Peripheral intravenous catheter retrospective audits for

Correspondence concerning this article should be addressed to Lee.Steere@hhchealth.org  
<https://doi.org/10.2309/j.jvna.2019.003.004>  
Copyright © 2019 Association for Vascular Access. All rights reserved.

2019 | Vol 24 No 3 | JAVA | 31

January/February 2021  
ISSN 1533-1458

Volume 44 • Number 1  
[www.journalofinfusionnursing.com](http://www.journalofinfusionnursing.com)

## Journal of Infusion Nursing

The Official Publication of the Infusion Nurses Society

### Infusion Therapy Standards of Practice

**INS**  
INFUSION NURSES SOCIETY

Lippincott®

Wolters Kluwer

# Past and Present State. Future?

- 2015 – Past state
  - 7 RN's / 2 LPN's
  - 294 hours
  - 7.35 FTE's
- Present state
  - 30 RN's
    - 3 promoted to Clinical Nurse Leaders
  - 1026 hours
  - 25.65 FTE's
    - One open position – 40-hour Assistant Nurse Manager/Educator





# Hartford Hospital, Hartford CT

- Built in 1854 – Level 1 trauma center
- 867 licensed beds
  - 8 ICUs totaling 100 beds
- 6727 employees
- Air Ambulance Service - Lifestar
- ED visits : 96,419
- Transitions from Inpatient Care: 44,653



# Lean and Six Sigma Methodology in Healthcare

## Lean Process

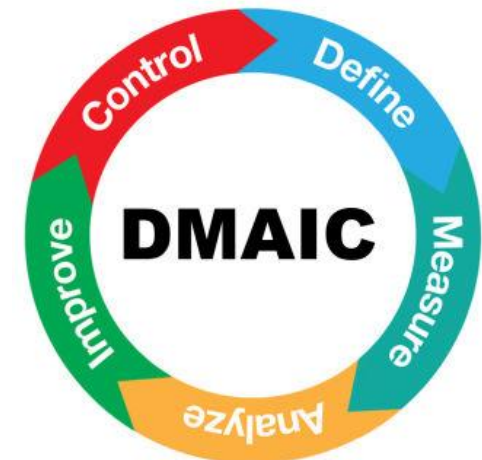
The main emphasis of Lean is on cutting out unnecessary and wasteful steps in the creation of a product so that only steps that directly add value to the product are taken.

In a lean organization, management empowers employees to define and then continuously refine processes

## Six Sigma Process

The essential goal of Six Sigma is to eliminate defects and waste, thereby improving quality and efficiency, by streamlining and improving all business processes.

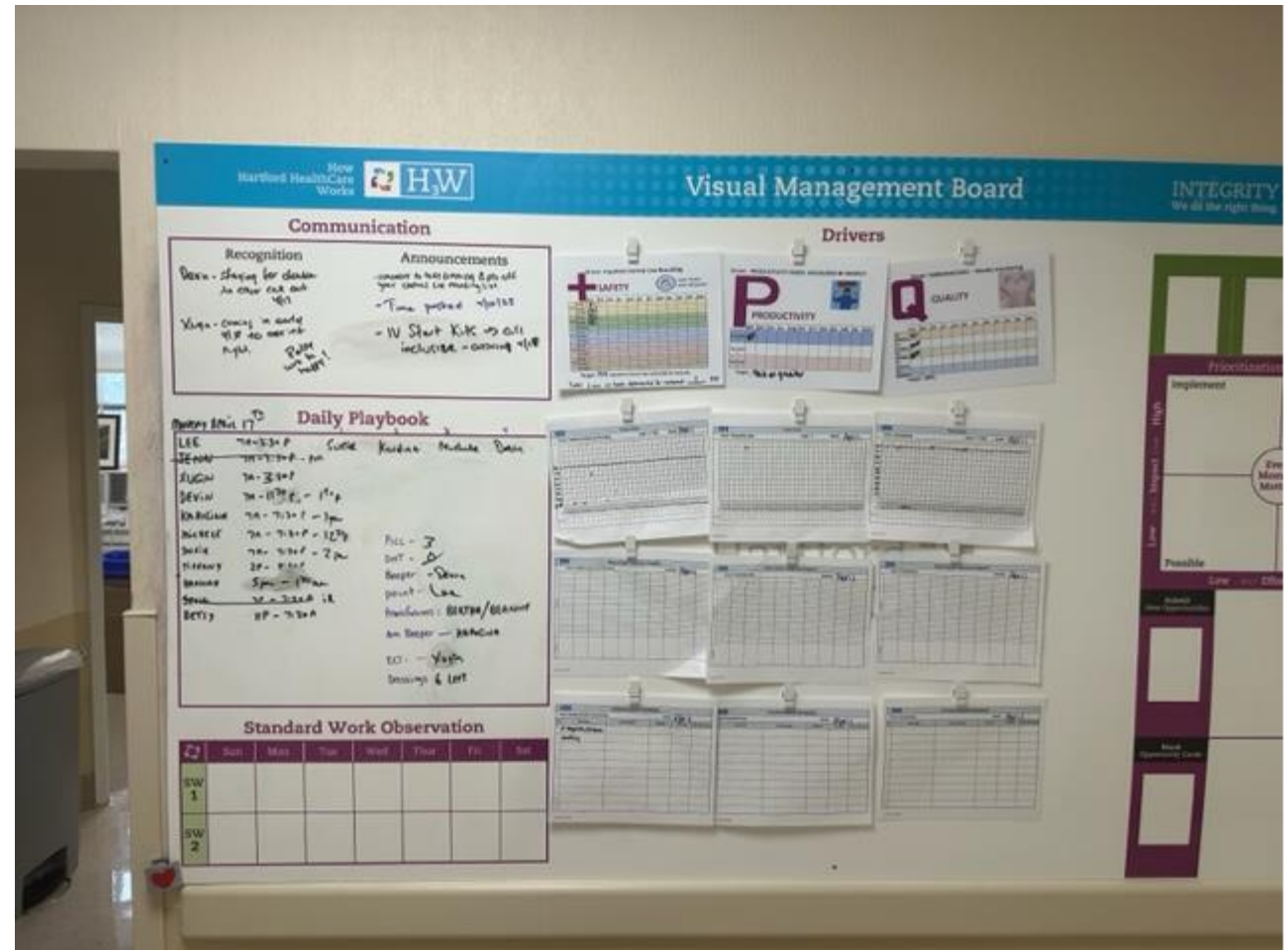
<https://www.villanovau.com/resources/six-sigma/six-sigma-vs-lean-six-sigma/>



# Visual Management Board

- Where we start our day
- Review Daily Playbook
- Recognition
- Important Hospital or Departmental Announcements
- Drivers
  - Central Line Rounding
  - Productivity
  - Hand Hygiene Compliance
- This is where we review new ideas
- Learning Moments
  - 52 repeating educational sessions

\*Hard getting Quality, Real-Time Data in EPIC.  
Would you agree?





# Journal of Infusion Nursing

The Official Publication of the Infusion Nurses Society

## ***Infusion Therapy Standards of Practice***

# INS Position Regarding VAST

Organize a team of clinicians dedicated exclusively to infusion and vascular access practices to provide the optimum method for infusion delivery in acute care facilities.

---

PIVC insertion in adults by infusion/vascular access specialists produced greater first-attempt insertion success and lower rates of complications.

Establish the infusion team/VAT as a revenue and cost center in acute care hospitals, allowing the team to track and analyze services provided and document financial contributions to the organization, showing revenue to offset costs.<sup>18</sup> (V)

Teams reduce the health care-acquired complications associated with CVADs, including pneumothorax, arterial puncture, and catheter-associated infections.<sup>12,34-38</sup> (IV)

# IV Therapy Revenue Budget

- Fiscal Year 2020 Total Billable Service
  - \$16,312,685.65
- Fiscal Year 2022 Total Billable Services
  - Revenue Actual = \$25,007,485.00
  - Revenue Budget = \$23,570,152.00
  - Revenue Variance = \$1,437,333
- Fiscal Year 2023 Total Billable Services YTD
  - \$11,009,789.00
  - Annualized - \$26,423,494.00
- Hospitals receive \$1 out of every \$3 spent on health care in the United States



# Productivity Index

- Index calculated using Worked Hours Per Unit of Service (WHPUS)
- Looks at worked vs paid FTE's vs targets
  - Important to cost shift hours for orientation and education
- Breaks PI, worked and paid FTE's into 4 week averages
- Overtime % per pay period and 4 week average
- Important to stay **GREEN**
- Demonstrates the value we add and with a full compliment of staff, low OT
  - Less than 1%
- If **RED**, requests to get positions may be denied even if budgeted for the year
- Completion of certain orders
  - DHT, CVC Removal, CVC Dressing Changes, Ultrasound Guided IV Insertions

The screenshot displays the Oracle Analytics Productivity Analysis dashboard. The main section shows productivity metrics for Business Unit 10100 - Hartford Hospital, Department 301050 - IV Therapy, for the pay period ending 04/08/2023. The productivity index is 101.23, which is highlighted in green, indicating it is above the 98.00 threshold. The dashboard also includes a table for other utilization metrics, showing low overtime and contract FTE percentages.

	Pay Period	Actual	Target	Variance	4 PP Avg	Target 4 PP Avg	Var 4 PP Avg	Threshold
Paid FTEs	4/8/2023	24.52	24.82	0.30	25.25	24.95	(0.30)	25.32
Worked FTEs	4/8/2023	21.58	21.84	0.27	22.18	21.93	(0.26)	22.28
Productivity Index	4/8/2023	101.23	100.00	1.23	98.84	100.00	(1.16)	98.00

	Pay Period	Actual	Total Paid FTE	% of Paid FTEs	4 PP Avg FTEs	4 PP Avg Total Paid FTE	4 PP Avg % of Paid FTEs
Overtime FTEs	4/8/2023	0.36	24.52	1.47%	0.19	25.25	0.75%
Contract FTEs	4/8/2023	0.00	24.52	0.00%	0.00	25.25	0.00%
Non Productive FTEs	4/8/2023	2.95	24.52	12.02%	3.07	25.25	12.15%

Business Unit	Pay Period
10100 - Hartford Hospital	4/8/2023
10120 - Jefferson House	4/8/2023
10130 - Hartford Hosp dba Cedar Mtn Cm	4/8/2023
10200 - MidState Medical Center	4/8/2023
10300 - Hospital - Central Connecticut	4/8/2023
10400 - Windham Community Memorial Hos	4/8/2023
10500 - The William Backus Hospital	4/8/2023
10600 - Charlotte Hungerford Hospital	4/8/2023
10700 - St Vincent's Medical Center	4/8/2023
20100 - Natchaug Hospital	4/8/2023
20200 - Rushford Center, Inc.	4/8/2023
20300 - St Vincent's Special Needs Ctr	4/8/2023
30100 - Hartford HealthCare Corp.	4/8/2023
50300 - Hartford HealthCare at Home	4/8/2023
50310 - HHC Independence at Home	4/8/2023
50410 - Southington Care Center	4/8/2023
50420 - Mulberry Gardens	4/8/2023
50430 - Orchards at Southington	4/8/2023

Metric Name	Paid FTEs	Worked FTEs	Productivity Index
Green Circle	<= Target Paid FTE	<= Target Worked FTE	>= 100
Yellow Circle	>Target Paid FTE and <=Threshold	>Target Worked FTE and <=Threshold	98 to 99.99

# What led to the Growth of the VAST at Hartford Hospital

## Data, Data and More Data



**“In God we trust.  
All others must bring data.”**

*- Dr. W. Edwards Deming*

**“Without data you’re just  
another person with an  
opinion”**

Many ways to collect data – focus on reducing waste, variability, cost, adverse outcomes

**Link data to C-Suites Balanced Scorecard Initiatives**

**Decrease Length of Stay**

**Quality – less infections, adverse events**

**Cost reduction**

**Patient and Nurse Satisfaction**



# Institute for Healthcare Improvement – Call to Action

- Reduce Waste in the US Health Care System and Return the Cost Savings to Patients and the Economy
  - IHI Leadership Alliance
- “Waste is endemic in healthcare”
- “Health system leaders and all who work in healthcare need to heed this call”
  - Derek Foley, President and CEO of IHI
- Waste is defined as resources expended in services, money, time, and/or personnel that do not add value to the patient...
  - This non-value-added waste can cause harm (CLABSIs → \$1.4 billion 2018)



Institute *for*  
Healthcare  
Improvement



GDP → 6% 1970 to 19% 2020  
Largest increase than any other country



# Is Manufacturing 350 million PIVs LEAN?

- 350 million X \$1.50 (price of PIV only) = \$525,000,000.00
- Average cost of PIV insertion \$28.00 - \$35.00
  - 151 million X \$28.00 - \$35.00
    - \$4,228,000,000.00
    - \$5,285,000,000.00

Webster J , Clarke S , Paterson D , et al. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial . BMJ. 2008 ; 337 : 1-6

Rickard CM , Webster J , Wallis MC . Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomized controlled equivalence trial . Lancet. 2012 ; 380 ( 9847 ): 1066-1074

Helm, R.E., et al., Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing. 2016; 38(3): 189-203.6



## Eliminating Waste – Delivering Cost-effective Infusion Therapy

- The clinical literature shows peripheral IVs fail 46% of the time before their intended use is complete!
- Range in randomized clinical trials is 36-63%



1. Helm, R.E., et al., Accepted but Unacceptable: Peripheral IV Catheter Failure. *Journal of Infusion Nursing*. 2016; 38(3): 189-203.6

# Is Using 151 Million PIVs LEAN with 46% Failing Before Treatment Ends?

- 350 million X \$1.50 (price of PIV only) = \$525,000,000.00
- Average cost of PIV insertion \$28.00 - \$35.00
  - 46% of 151 million = \$69,460,000 X \$28.00 - \$35.00
    - \$1,994,880,000.00
    - \$2,431,100,000.00

Webster J , Clarke S , Paterson D , et al. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial . BMJ. 2008 ; 337 : 1-6

Rickard CM , Webster J , Wallis MC . Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomized controlled equivalence trial . Lancet. 2012 ; 380 ( 9847 ): 1066-1074

Helm, R.E., et al., Accepted but Unacceptable: Peripheral IV Catheter Failure. Journal of Infusion Nursing. 2016; 38(3): 189-203.6





Robert Helm, MD : *Accepted but Unacceptable: Peripheral IV Catheter Failure*  
May/June 2015, INS

“A failed IV catheter means pain, dissatisfaction, prolongation of care, and venous depletion, compounded by the need to treat minor and severe IV catheter failure related sequelae.”



“When a PIVC fails, caregivers and health care institutions traditionally have accepted it as necessary additional work to be performed.”





# Empathy Project

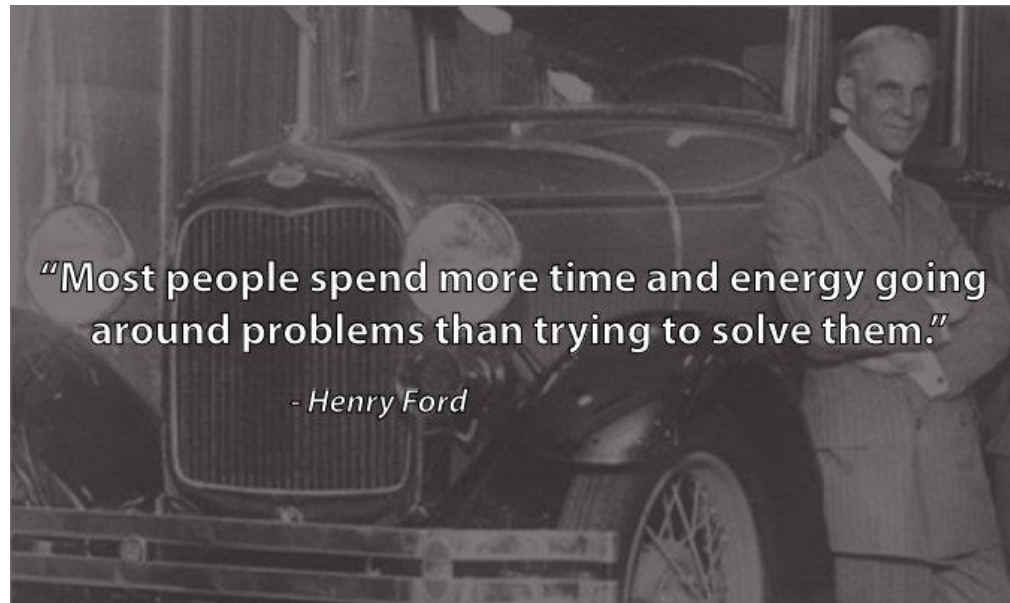


## Top 10 fears of patients being hospitalized:

1. Infection
2. Incompetence
3. Death
4. Cost
5. Medical mix-up
- 6. Needles**
7. Rude doctors and nurses
8. Germs
9. Diagnosis, prognosis
10. Communication issues



Colleen Sweeney, RN, a national expert in the customer/patient experience



*"Most people spend more time and energy going around problems than trying to solve them."*

*- Henry Ford*

### **WE KNOW WHY PIVCs FAIL**

"First, the underlying cause of SPC failure has not changed. It is the interaction of 2 basic forces applied over time: trauma and contamination. These 2 forces interact in varying degrees to cause the 5 general modes of SPC failure described in the literature and delineated in our article: infiltration, occlusion/mechanical failure, dislodgement, phlebitis, and infection."

Helm, Robert E. MD Accepted but Unacceptable: Peripheral IV Catheter Failure, Journal of Infusion Nursing: May/June 2019

***PIVC Complicaton's – Infiltration, Infection, Phlebitis, Inadvertent Removal Underreported and lack of documentation as to why they are being replaced***

All PIVs are Important to Preserve, but...  
can we all agree *that some just feel more important*



## How Important Is This PIV?





# Cost-effective if we are Overly Sticking Patients?

- Since 2012, HCAPHPS patient satisfaction score – impact hospital reimbursement
- Value-Based Purchasing Program
  - Payed for the quality of care, not quantity
- Higher the score, better reimbursement
- Low HCAPHPS scores impact bottom line – two ways
  - Reputation among consumers
  - Limiting amount of funds received from Medicare
- Billions of dollars in value-based incentive payments available yearly





I will deny I ever said  
this, but...



# There are Those PIVs you Hope Fail

Past State: Waste, Variability, Defects





# Priceless PIVs Worth Protecting

Current State: Standard Work (PIV5R's), EVB-Best Practice



# How much are you Paying to Deliver Infusion Therapy

**IV Costs: \$4.1M or \$4781/bed**

CURRENT STATE CATHETERS				
<b>33,486 ADMITS</b> <small>75% of 44,648 admits have an IV catheter placed</small>	CATHETER USAGE (Admits Only)		CATHETERS PER PT VISIT	
	<b>148,200 Catheters</b>		<b>4.4</b> <small>148,200 ÷ 33,486</small>	
<b>CATHETER USAGE</b>	Nurse Hours		FTE Equivalent	
	<b>49,400</b> <small>148,200 * 20 minutes ÷ 60</small>		<b>23.75</b> <small>2,080 hours per year per FTE</small>	
<b>IV Costs</b>	Labor	Supplies	Cost per IV	Total
	<b>\$16.17</b> <small>RN @ \$48.50/hr</small>	<b>\$11.80</b> <small>Catheter, Tubing, Connectors/Caps, Kit</small>	<b>\$27.97</b> <small>\$16.17 + \$11.80</small>	<b>\$4,145,154</b> <small>148,200 * 27.97</small>
	<b>PER BED</b>			<b>\$4,781</b> <small>\$4.1M/867 beds</small>



## TIME TO PLACE IV: 20 Minutes, 10 Steps



- Hartford Hospital 2018 Annual Report and Internal Data Sources, including GPO data report.
- Definitive Health Care Data. 2017
- Rickard, et al. Reported data on time to successfully place a PIVC including all steps.
- Glassdoor.com (Hartford, CT; Avg RN) + HH Benefits



# Case Study

Male in his 60's – admitted to a cardiology unit after a syncopal episode at home. Large bore PIV placed in wrist by EMS. In ED, BP soft. Labs drawn with some concerns, although cardiac enzymes were not elevated. After 2<sup>nd</sup> night and many tests, determined too not be cardiac. MD opts to keep patient for 3<sup>rd</sup> night, repeat labs in a.m. If ok, patient to be transitioned home.

Next morning, PCA goes in and takes VS. Temperature is 102.1. RN goes in and assesses patient and notices erythema around IV site. Removed, blood cultures drawn. Blood cultures grow MRSA. Patient requires 4 weeks of IV abx. Due to patient's insurance, patient required a PICC line for transition to SNF for IV Therapy. Insurance would not cover his infusions at home.

We failed to follow our policy – removal of EMS lines within 24 hours







# How much are you Paying to Deliver Infusion Therapy

**IV Team Costs:  
\$1.2M or  
\$1405/bed**

Savings do not include other added benefits such as reduced PIV-CLABSI, Patient Satisfaction, etc which may also contribute to avoided costs, savings or reimbursement.



FUTURE STATE PIV5R CATHETERS				
<b>33,486 ADMITS</b> <small>75% of 44,648 admits have an IV catheter placed</small>	CATHETER USAGE (Admits Only)		CATHETERS PER PT VISIT	
	<b>36,835 Catheters</b> <small>89% Success Rate Catheter/Visit Admits 33,486 * 1.1</small>		<b>1.1</b>	
<b>CATHETER USAGE</b>	Nurse Hours		FTE Equivalent	
	<b>12,278</b> <small>36,835 * 20 minutes ÷ 60</small>		<b>5.9</b> <small>2,080h/yr. per FTE</small>	
<b>TIME TO PLACE IV</b>	Labor	Supplies	Cost per IV	Total
	<b>\$18.68</b> <small>IV-Trained RN @ \$48.50/hr</small>	<b>\$14.40</b> <small>Adds better technology</small>	<b>\$33.08</b> <small>\$18.68 + \$14.40</small>	<b>\$1,218,502</b> <small>36,835 catheters * 33.08</small>
<b>IV Costs</b>				<b>\$1,405</b> <small>\$1.2M/867 beds</small>
<b>PER BED</b>				

# How much are you Paying to Deliver Infusion Therapy

How much money are we actually saving Hartford Hospital? Can we put a dollar figure to this initiative?

How could 1 catheter per patient visit impact LOS? Patient Satisfaction? Costs?



## Direct Cost

- Fewer restarts = cost savings
- No more time training bedside RNs

## Indirect Cost

- CLABSI Prevention
- Treating fewer IV adverse related events
- Patient Satisfaction Scores
  - Needlesticks #6 Top Fears of Patients Being Hospitalized
- LOS impact – less delays in treatment interruptions



# Data that Supported VAST Expansion

ORIGINAL ARTICLE

## Reaching One Peripheral Intravenous Catheter (PIVC) Per Patient Visit With Lean Multimodal Strategy: the PIV5Rights™ Bundle

Lee Steere, RN, CRNI®, VA-BC™  
 Cheryl Ficarra, RN, MS, NEA-BC  
 Michael Davis, RN, BSN, MBA, NE-BC  
 Hartford Hospital, Hartford, CT  
 Nancy Moreau, RN, PhD, CRNI®, CPUI, VA-BC™  
 PICC Excellence, Inc., Hartwell, GA

**Highlights**

- Lean leadership for process improvement.
- Prospective comparator multimodal design study.
- Vascular access specialty team (VAST group 2) versus generalist nursing model (group 1).
- First stick success of 96%.
- Statistically significant improvement in dwell time with VAST versus generalist nursing model (89% versus 15% lasting until end of therapy).
- Projected 2.9 million in savings annually.
- Peripheral intravenous catheter team centralized proposal to Chief Nursing Officer (CNO) with acceptance based on outcomes.
- Reduction in cost per bed per year using a vascular access specialty team of \$3376.

**Abstract**

**Background:** Peripheral intravenous catheter (PIVC) sales per year exceed that of the number of people in the United States (US), 350 million. With only 37 million US hospital patient admissions per year, these data indicate an average usage of 10 PIVCs per patient admission, suggesting a very high failure, very low success rate, and excess cost associated with PIVC insertions. Patients often complain of multiple catheter insertion attempts, and published data reveal up to 53% of PIVCs fail before therapy ends.

**Methods:** Hartford Hospital (Hartford, CT) conducted a prospective comparator single-center clinical superiority design study to determine the impact of bundled practices including device insertions using vascular access specialty team (VAST) intravenous trained nurses versus current practice. The study used a 5 step multimodal best practice intervention strategy designated as the PIV5Rights Bundle with an aim to determine if the intervention outcomes and dwell time improved over current PIVC practices. The study group applied a Lean health care standard work process with a Six Sigma design, define, measure, analyze, improve, control approach that included VAST PIVC dwell time, complications, and economic impact compared with current state general nursing practice.

**Results:** Outcomes of the PIV5Rights Bundle in Group 2 (experimental) using a trained vascular access nursing team for insertion and management achieved a statistically significant result of 89% of catheters achieving end of therapy with a cost saving per bed of \$3376 (\$1405 versus \$4781) per year as compared to standard practice (Group 1; control). Results of Group 1 reflected PIVC dwell time to end of treatment in only 15% of catheters. Prestudy catheter consumption analysis was 4.4 catheters per patient hospital admissions, reflecting waste within labor and supply costs for PIVC insertion and usage. Peripheral intravenous catheter retrospective audits for

Downloaded from https://www.jco.org/ at National Cancer Institute on May 10, 2019

Correspondence concerning this article should be addressed to Lee Steere at [hchealth.org](mailto:hchealth.org)  
<https://doi.org/10.2399/jco.2019.003.004>  
 Copyright © 2019 Association for Vascular Access. All rights reserved.

## Study involved

- Right Proficiency
- Right Inserter
- Right Vein and Catheter
- Right Supplies and Technology
- Right Assessment

This included antireflux  
 needleless connector  
 CHX bordered antimicrobial  
 dressing

Demonstrated a 29%  
 reduction in  
 complications

## Overall Results

Variable	Group 1 (n=94)	Group 2 (n=113)
1st Time Success Rate	33%*	96%
Success Rate (therapy completed)	15%	89%
Dwell Time, Hours (mean ± SD, P<0.001)	29.6 ± 18.0	71.4 ± 58.8
Dwell Time, Hours (Upper End)	110.98	333.21
Complication Rate (%; P<0.001)	40%	11%
Cost/Bed/Year (2018 USD)	\$4,781	\$1,405
Saving/Bed/Year (2018 USD)	-	\$3,376

Study failed to capture number of attempts or percentage of success associated with Group 1; 33% is from the

# Hartford Hospital PIV Failure Rate

- VAST Team Failure Rate
  - Peripheral IV line failure rate today:

26.5%

- Hartford Hospital has clearly bought into the idea of investing in their vascular access team and in quality vascular access devices, which is shown by the hospital's world class results.
  - Better results, lower costs.



## The D.I.P.P.E.R. Study

(Dislodgement Infiltration Phlebitis Prevention Eliminating IV Restarts)

A prospective, randomized controlled trial comparing SafeBreak® Vascular with the standard of care for adult peripheral IV catheters

**Principal Investigator:** Lee Steere, RN, CRNI, VA-BC - Hartford Hospital, Hartford, Connecticut  
**Study Sponsor:** Lineus Medical - Fayetteville, Arkansas

### Background

While over 90% of inpatient admits in the US have a peripheral intravenous catheter (PIV) inserted, the rate of failure has been reported between 36% and 63%<sup>1</sup>, which can lead to significant delays in therapy and more importantly, costly IV restarts. These PIV failures are largely the result of mechanical complications: dislodgement, infiltration, phlebitis, and occlusion. Previous bench tests indicated that forces above 4 lbs were harmful to a peripheral IV and might lead to failure. Large and small animal studies and one human study showed that a break-away device that separates at 4 lbs to off-load the damaging force could be of clinical benefit.<sup>2,3</sup>

The primary objective of the study was to compare mechanical IV complication rates requiring a PIV restart between a device group receiving SafeBreak Vascular, a break-away device, and a control group

receiving the standard of peripheral IV care. The secondary endpoints were to evaluate the total delay in therapy times and adverse events between the two groups.

SafeBreak Vascular is a new medical device designed to separate when excessive tension is exerted across a peripheral IV line. When SafeBreak separates, the harmful force placed on the IV line is removed and the patient's IV catheter remains intact. It is the first in a new class of infusion management devices known as Force-Activated Separation Devices.

Figure 1 shows the SafeBreak Vascular device. The device is placed between the long IV tubing to the IV pump and the needleless connector/extension tubing set that is attached to the patient's peripheral IV. The device separates when a force greater than 4lbs is placed on the IV line, but leaves the patient's IV catheter intact. Upon separation, valves on each side of the device close to prevent the loss of medication from the IV pump and



Figure 1. SafeBreak Vascular

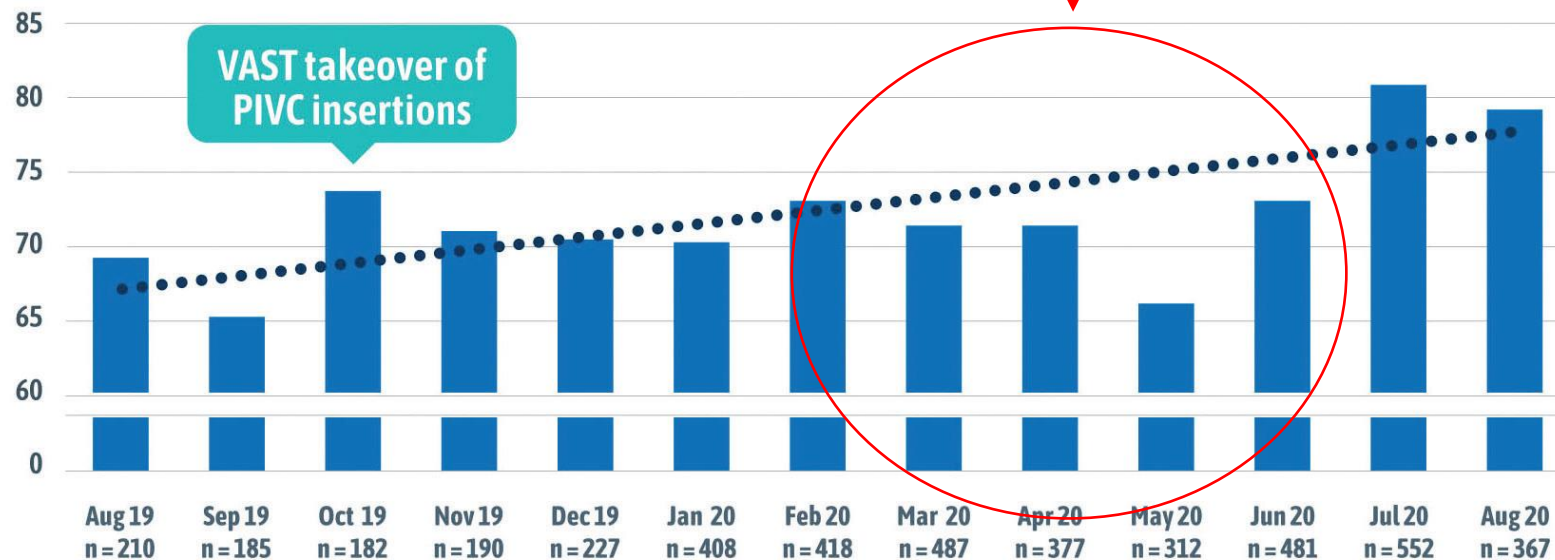
# Improving the Patient Experience

**IHI Triple Aim**

1. Improve patient experience of care
2. Improve health of populations.
3. Reduce per capita cost of healthcare.

**COURTESY OF PERSON WHO STARTED IV**

COVID 19



Unfortunately, we are no longer asking patients this question on our patient satisfaction surveys







# How Do You Demonstrate Value to Your Organization

ORIGINAL ARTICLE

## Lean Six Sigma for Intravenous Therapy Optimization: A Hospital Use of Lean Thinking to Improve Occlusion Management

Lee Steere, RN, CRNI, VA-BC  
 Marc Rousseau, MBA, RPH  
 Lisa Durland, MS, RPH  
 Hartford Hospital, Hartford, CT

**Abstract**  
**Background:** Continual improvement is a necessary part of hospital culture. This occurs by identifying opportunities for improvement that influence efficiency while saving money.  
**Methodology:** An investigation of intravenous device-related practices was performed by the nurses of the intravenous access team, pharmacy, and hospital operations at Hartford Hospital using Lean Six Sigma methodology. Central venous access device occlusion and tissue plasminogen activator variability was identified. Using observation, measurement of performance, and root cause analysis, the hospital's practices, policies, and equipment were evaluated for the process of occlusion management. The team utilized a Six Sigma strategy employing the elements define, measure, analyze, improve, and control, which is a disciplined, data-driven methodology that focuses on eliminating defects (waste). Interventions initiated based on the assessment performed by the team using the define, measure, analyze, improve, and control approach included replacement of negative displacement needleless connectors with antireflux needleless connectors and specialty team assessment before tissue plasminogen activator use.  
**Results:** Over the course of the 26-month study, Hartford Hospital experienced a 69% total reduction in tissue plasminogen activator use representing a total 26-month savings of \$107,315. Other cost savings were reflected in areas of flushing, flushing disposables, and in a decrease in needleless connector consumption. Central line-associated bloodstream rates fell 36% following the intervention as an unexpected secondary gain, resulting in further savings related to treating this nonreimbursable hospital-acquired condition.  
**Conclusions:** This study examined the influence of using Lean Thinking and Six Sigma methodology as a tool in saving hospital money, resulting in better patient outcomes.  
**Keywords:** central venous catheter, cost savings, lean six sigma

**Introduction**  
 Among the most frequent complications associated with central venous access devices (CVADs) is catheter occlusion, ranging from 3%-79%.<sup>1,4</sup> Thrombotic formations on a CVAD are a natural physiological process in response to the insertion of foreign material into the body. Immediately upon insertion of an intravenous (IV) catheter, cells attach to the surface forming a fibrin coating.<sup>5,6</sup> This body response occurs soon after insertion and may develop around and within a catheter at any

time during the IV treatment processes.<sup>7,8</sup> Intraluminal thrombotic catheter occlusion, a common noninfectious complication, is associated with negative outcomes of loss of patency (43%), device replacement (29%), device removal (14%), and hospital visits (15%) that all delay or disrupt the treatment process, slow a patient's progress toward therapeutic goals, and increase length of hospital stay and cost of care.<sup>12,9,10</sup> Peripherally inserted central catheters (PICCs), a type of CVAD, have a higher incidence of occlusion than other chest-inserted central catheters potentially due to factors such as insertion into smaller peripheral veins, larger surface area, use of 3F-6F sizes with multiple lumens, and small catheter diameter.<sup>2,11,16</sup> Activities associated with PICCs for administration of IV medications and solutions require flushing, aspiration of blood, and connection and disconnection of needleless connectors (NCs) causing pressure changes within the catheter that result in venous blood cell deposits within the lumen of the

Correspondence concerning this article should be addressed to Lee.Steere@hhchealth.org.  
<https://doi.org/10.1016/j.java.2018.01.002>  
 Copyright © 2018 Association for Vascular Access. Published by Elsevier Inc. All rights reserved.

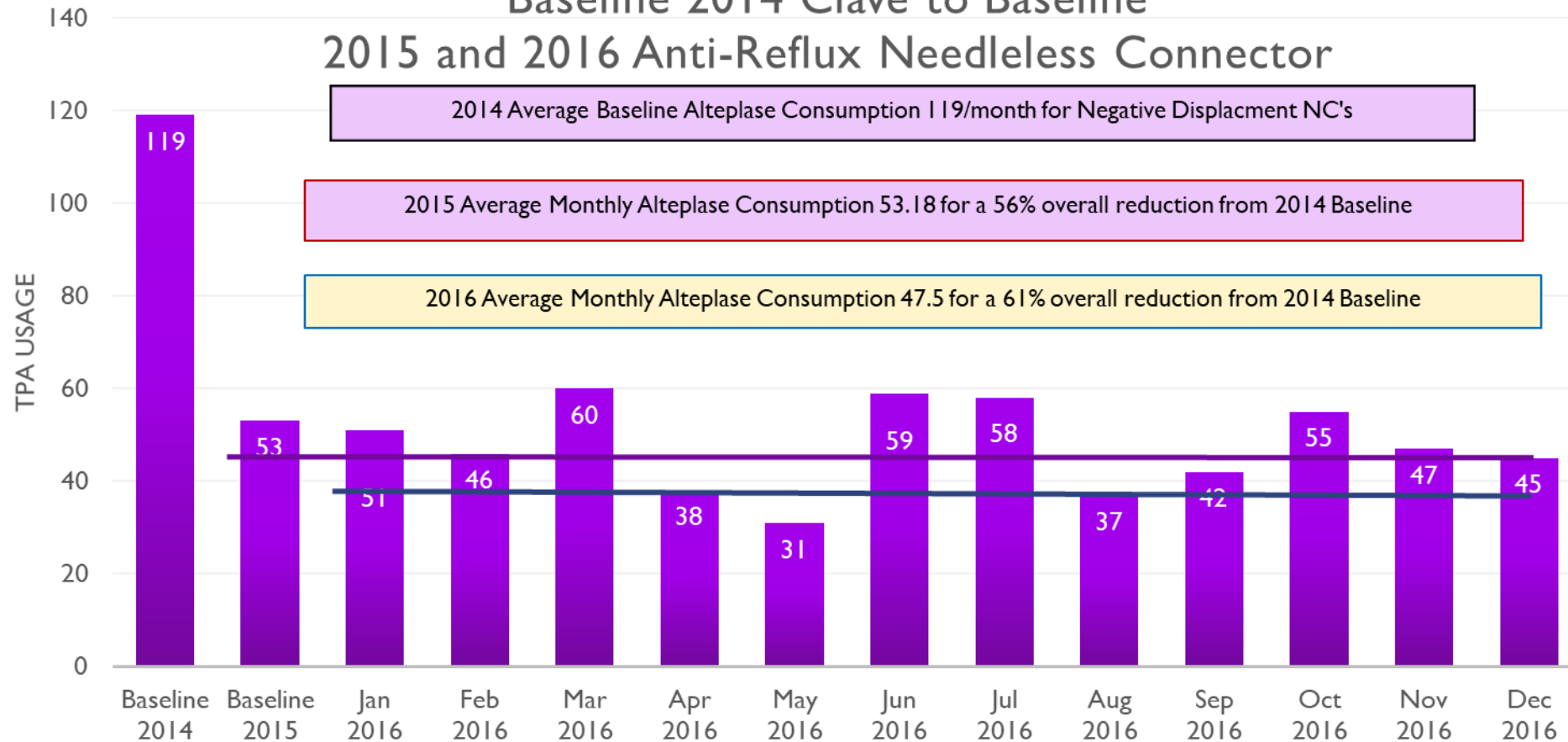
- Find waste that is driving up infusion therapy costs and implement process improvements to drive down costs
  - And PUBLISH!!
- Alteplase reduction for declotting central lines
  - Anti-reflux needleless connector
  - Algorithm to troubleshoot central lines
  - VAST orders Alteplase



# Eliminating Waste – Delivering Cost-effective Infusion Therapy



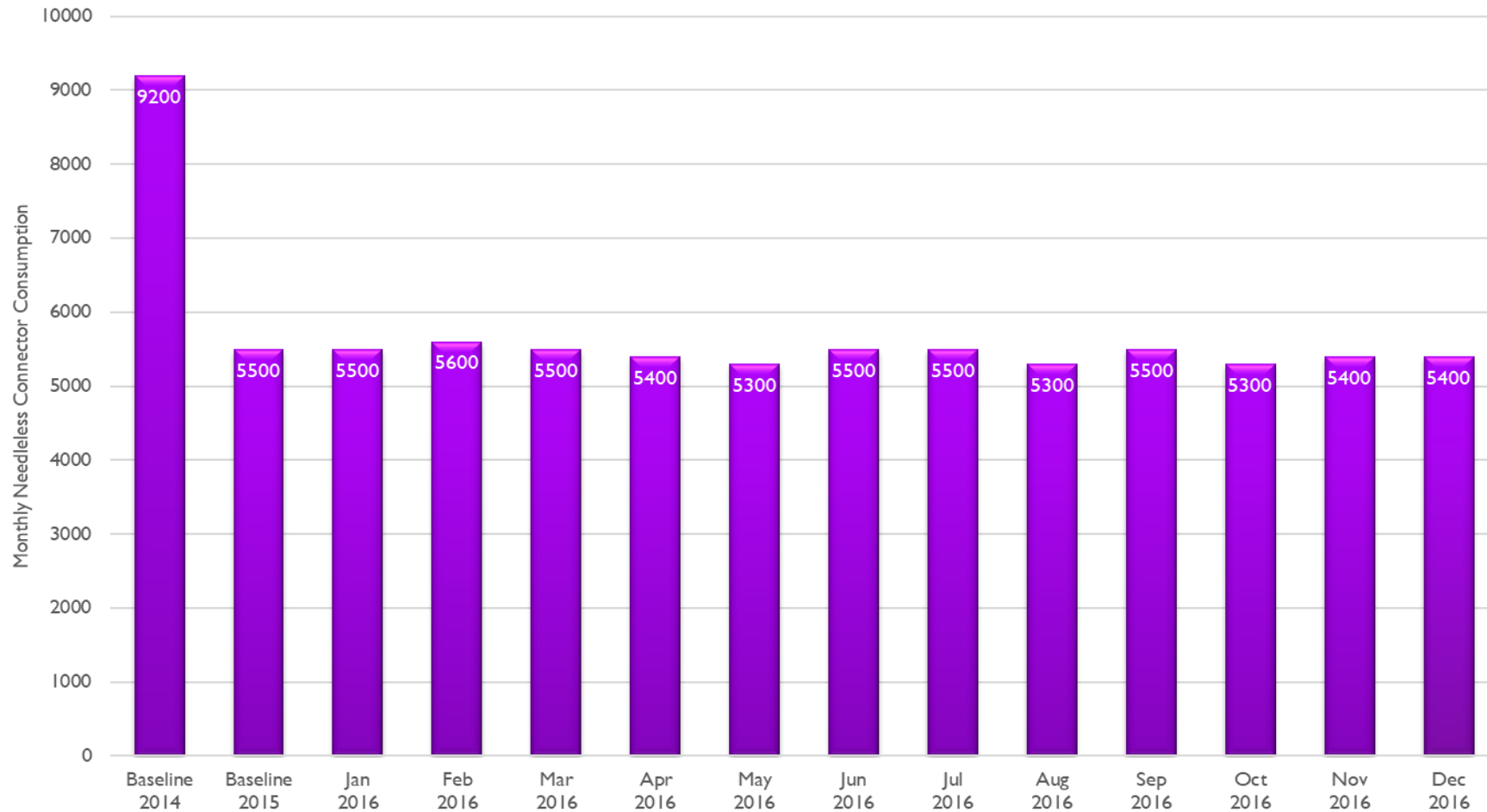
## Alteplase Consumption Reduction: Baseline 2014 Clave to Baseline 2015 and 2016 Anti-Reflux Needleless Connector



# Eliminating Waste – Delivering Cost-effective Infusion Therapy

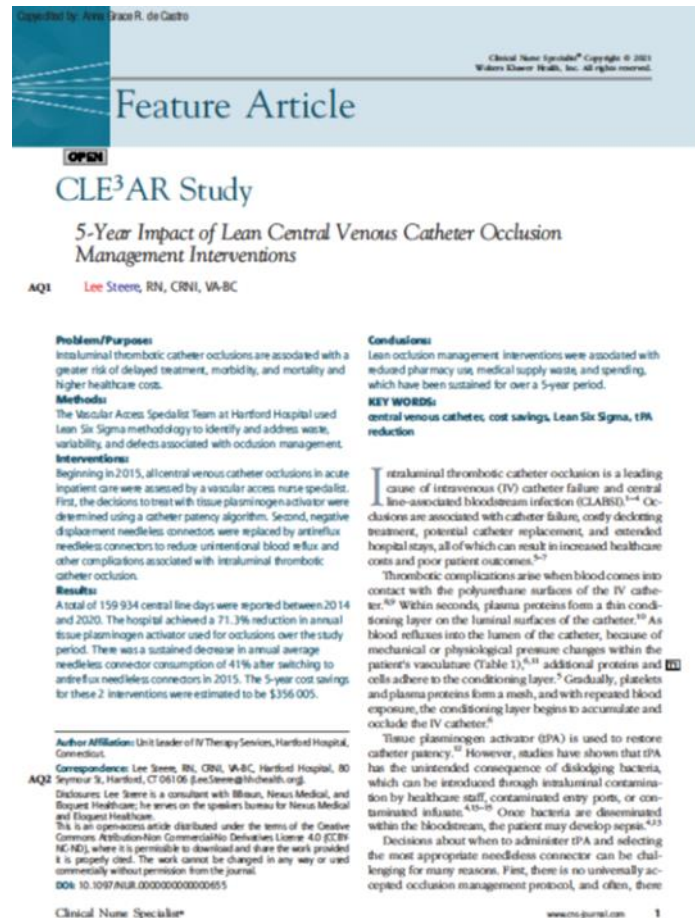


## Critical Care Needleless Connector Consumption Reduction: Negative Displacement to Pressure Activated Anti-Reflex Connectors





# Eliminating Waste – Delivering Cost-effective Infusion Therapy



The study name has a duality: it refers to Central Line patency (“CLEAR”) as well as the “3 E’s” of LSS methodology (efficiency, effectiveness, and economics) and the use of antireflux technology.

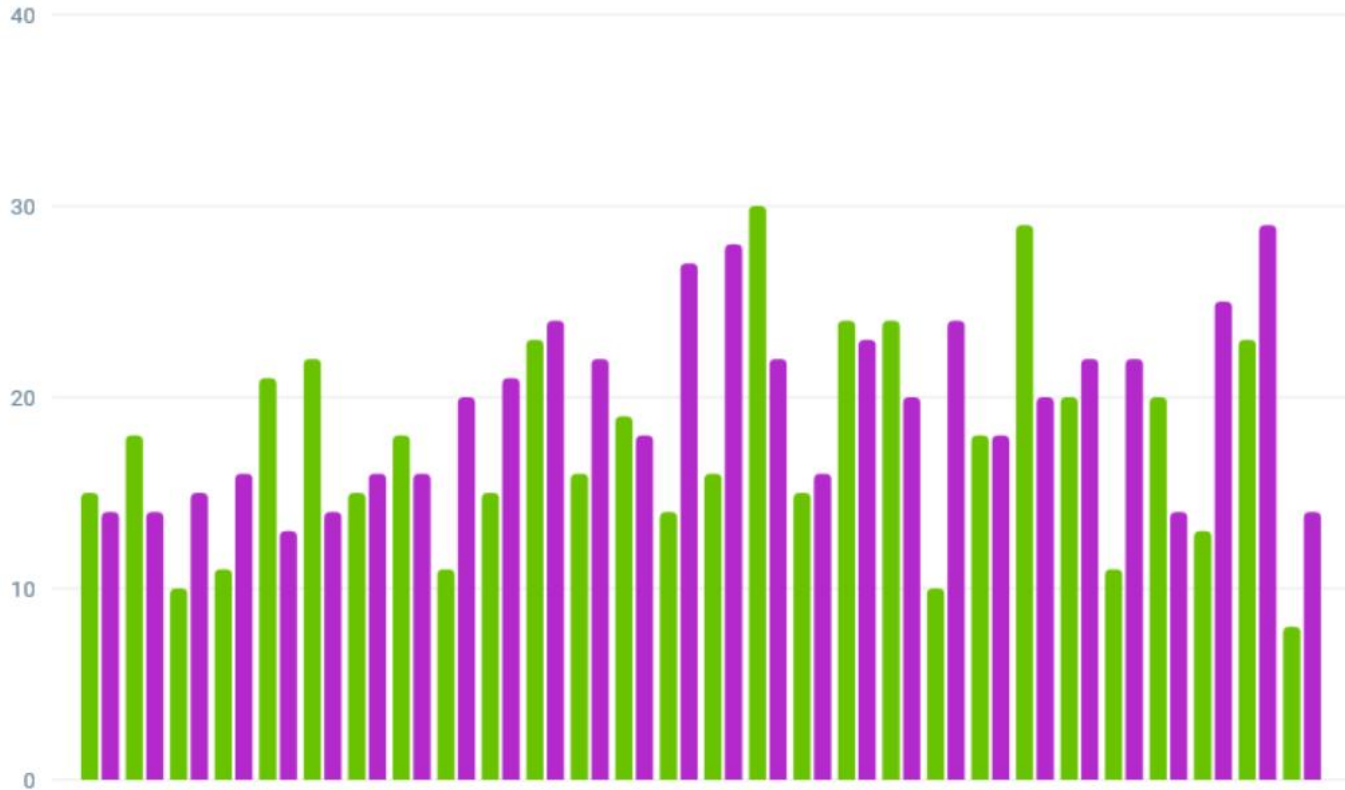
- A total of 159,934 central line days were reported between 2014 and 2020.
- The hospital achieved a 71.3% reduction in annual tissue plasminogen activator used for occlusions over the study period.
- There was a sustained decrease in annual average needleless connector consumption of 41% after switching to anti-reflux needleless connectors in 2015.
- The 5-year cost savings for these 2 interventions were estimated to be \$356,005.

Despite a nearly 3-fold increase in central line days, fewer patients were administered Alteplase representing a nearly 71% reduction in Alteplase use since 2014.

# tPA Usage 1-2 mg Jan 2021 – April 2023

## Number of Medication Administrations by Ordered Dose...

Between 1/1/2021 and 4/19/2023 by month



### Population

Base: All Medication Administrations  
All of:  
• Order Medication: ALTEPLASE 1 MG/1 ML SYRINGE  
• Hospital Location: HHC HH Hartford Hospital  
• Component Simple Generic Name: Alteplase

### Slices

2 Slices by Ordered Dose Amount

### Measures

Number of Medication Administrations

### Dates

Start Date: Jan 1, 2021  
End Date: Apr 19, 2023  
Slice By: Month  
Based On: Administration Date

### Visual Options

Bar Color: 2 Slices by Ordered Do...  
Y-Axis Range: Automatic

### Slice by Ordered Dose Amount



+ Add Stop

Keep ranges even

- Less than 1.00
- 1.00 or more and less than 2.00
- 2.00 or more and less than 2.50
- 2.50 or more
- No value

# How Do We Control the Order for tPA?

The screenshot displays a medical software interface for order management. At the top, a navigation bar includes tabs for 'Flowsheets', 'Notes', 'Chart Review', 'Results Review', 'Orders', 'Work List', 'IV Therapy', 'Therapy Plans', and 'Clinical References'. The 'Orders' tab is active, showing a 'Manage Orders' section with a search bar and a '+ New' button. Below this, a 'New Orders' section is highlighted in green, displaying the details of a new order: 'Alteplase Catheter Clearance - IV Therapy Panel'. The order details include 'IV Cath check by IV Team' (checked), 'Once, today at 1743, For 1 occurrence', 'Reason for Check: Suspected malfunction', and 'Alteplase evaluation for catheter occlusion.' Below this, there is an unchecked checkbox for 'alteplase (CATHFLO) injection'. A blue banner at the bottom of the order panel reads 'Next Required' with a warning icon and an 'Accept' button. The main order list shows '100 un' and 'Alteplase Catheter Clearance - IV Therapy Panel' with an 'Accept' button. A 'Dismiss' button is visible in the background. At the bottom of the screen, there is a section for '1 mg, Intramuscular, Daily PRN, low blood sugar, for Blood Glucose LESS than 70 mg/dL, Starting on Tue 4/18/23 at 1503' with 'Modify', 'Hold', and 'Discontinue' buttons.

# Central Line Care and Maintenance

## First Step – Identify if Line Clinically Indicated

Jan	Rounding Date	Total Lines	Lines Seen By IV Therapy	IV Therapy advocated and removed	Acute HD IJ	Femline	PICC	Other	TPN	NO TPN sticker	
	1/1/2023	62	48	2				2	10	2	
	1/3/2023	62	45	3				2	1	9	1
	1/7/2023	61	1	0						0	0
	1/8/2023	65	22	1				1		16	0
	1/10/2023	64	37	0							
	1/12/2023	83	39	2					2	1	1
	1/15/2023	70	56	2				2		2	1
	1/17/2023	73	37	0						3	0
	1/19/2023	68	48	4				3	1	6	1
	1/22/2023	70	43	4				1	3	4	1
	1/24/2023	60	33	1					1	2	0
	1/26/2023	66	56	3		1			2	3	1
	1/29/2023	65	12	0						1	0
	1/31/2023	70	63	0						3	1
	TOTALS	939	540	22	0	1	0	11	10	60	9

Feb	Rounding Date	Total Lines	Lines Seen By IV Therapy	IV Therapy advocated and removed	Acute HD IJ	Femline	PICC	Other	TPN	NO TPN sticker	
	2/2/2023	71	49	3					1	8	2
	2/5/2023	74	11	1					1	2	2
	2/7/2023	74	38	0						3	1
	2/9/2023	88	49	6		2		4		2	0
	2/12/2023	71	45	0						3	1
	2/14/2023	81	62	3		1			2	3	1
	2/16/2023	84	40	1				1		6	1
	2/19/2023	77	42	2		1		1		1	0
	2/21/2023	71	29	0						1	0
	2/23/2023	61	36	4		2		2		2	0
	2/26/2023	74	50	2				2		3	1
	2/28/2023	79	76	1				1		6	4
	TOTALS	905	527	23	0	8	0	11	4	40	13

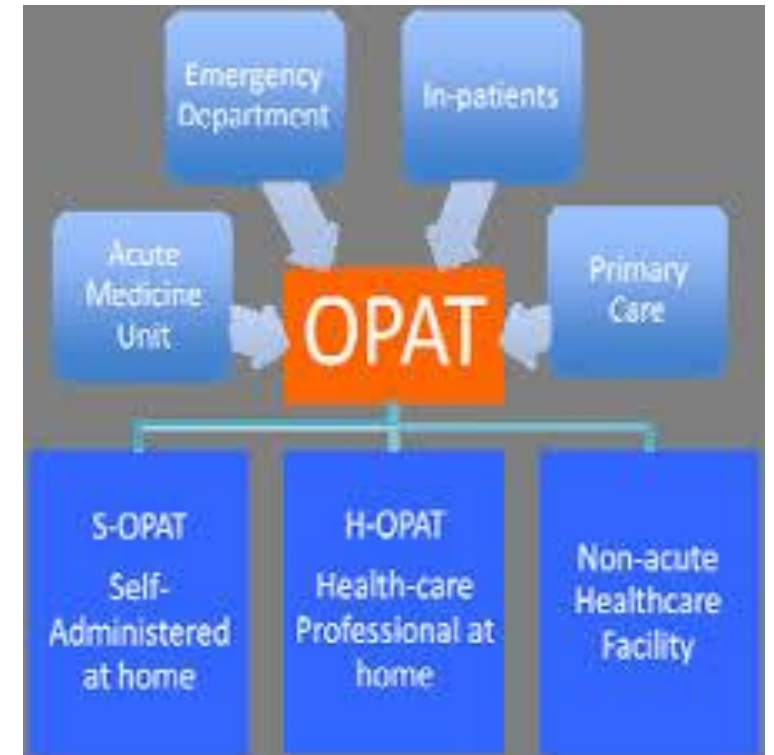
Having the VAST the do all CVC Care and Maintenance, have we shown a reduction in our SUR and CLABSI's?

Last 12 months Feb 2022 to Jan 2023  
 5 months, zero ICU CLABSI's  
 1 months, zero Medical-Surgical CLABSI's  
 SUR 0.727



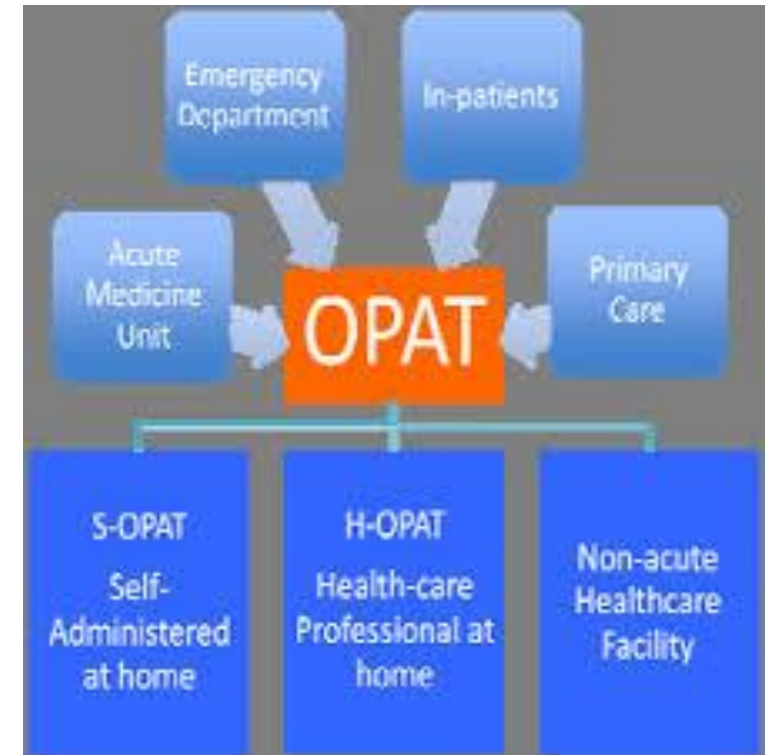
# OPAT Program - 819 Visits

- 7 OPATs - 0.9% - mean number of visits per OPAT → 23.71 Days
  - 283 RBCs - 34.6%
  - 276 Iron Infusions - 33.8%
  - 111 Platelets - 13.6%
  - 126 IVF Infusions - 15.4%
  - 2 IV Push Meds - 0.2%
  - 3 Thyrogen Injections for Nuclear Medicine Patients 0.4%
  - 4 PICC Insertions - 0.5%
  - 24 Dressing Changes on Central Venous Catheters 2.9%
  - 23 Lab Draws - 2.8%
  - 41 Other - 5%
- 
- Annualized Volume without Growth = Approximately 1640 visits



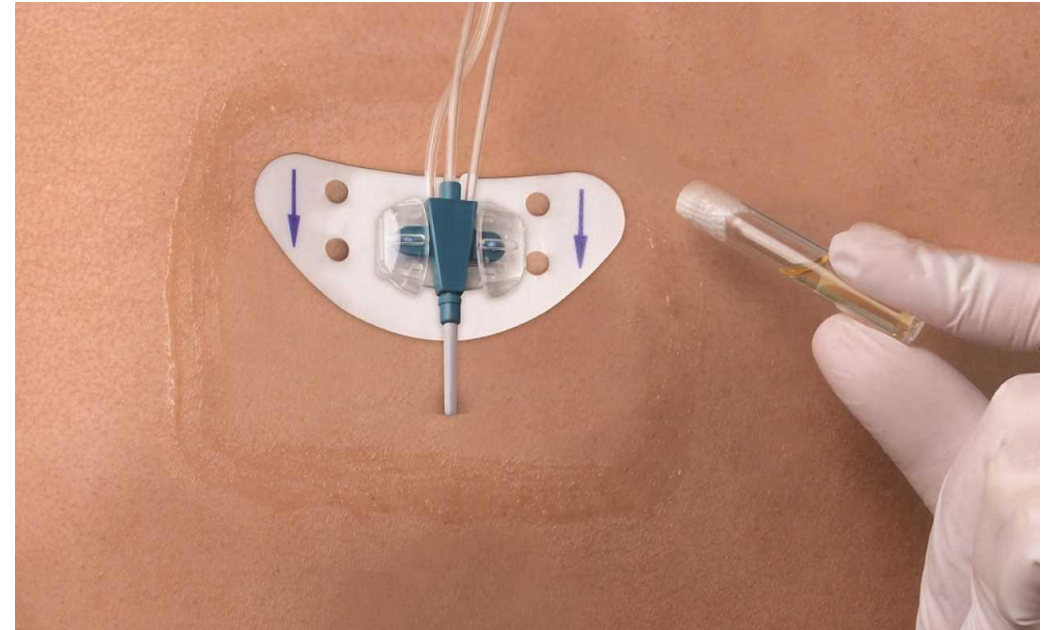
# OPAT Revenue Projections for FY 2023

- Fiscal Year 2023 OP Revenue Projections → \$4,757,289.00
- October 2022 – February 2023
  - Outpatient Revenue = \$2,476,020.86
  - Annualized Revenue = \$5,943,677.66
    - Above projections do not include:
      - Days saved transitioning inpatient to OPAT
        - » Total 166 days based off mean of 23.71 days per OPAT
      - Days saved transitioning patient from home to OPAT avoiding ED visit and potential admission
      - Days saved caring for blood and blood product patients vs. admitting to CB2 for the day
- Current FTE's – 1.65 RNs and 0.9 PCA



# LEAN – Using Adhesive to Eliminate Waste with Unplanned Dressing Changes

- Problem being addressed
  - Dressing adherence
  - Inadvertent removal
  - Phlebitis from micro-pistoning
- Standard of care on all CVCs
  - Add to CVC Dressing change kits – compliance
    - As we standardize insertion trays, gum mastic being added
- PIV's – added PRN
  - Plan to add to PIV Bundle



# Results of Adhesive trial on CVC's

- Tried in B10I – cardiac ICU
  - Patients with Swan-Ganz
- Before trial → Avg % of non-intact dressings
  - 77%
- After trial → 36% average non-intact
  - 0% completely detached
  - 0% partially detached
  - 36% edges lifting compared to 61% pre trial
- Cost savings in nursing time, supplies, CLABSIs
- “We love this product... we used to have to change IJ dressings daily”

	Before Trial	Intact	Edges Lifting	Partially Detached	Totally Detached
Before	11/12/2019	8%	59%	25%	8%
Before	11/13/2019	31%	44%	25%	0%
Before	11/14/2019	35%	60%	5%	0%
Before	11/15/2019	20%	80%	0%	0%
	AVERAGE	24%	61%	14%	2%
				<b>Average Non-Intact Dressings</b>	<b>77%</b>
	After Trial	Intact	Edges Lifting	Partially Detached	Totally Detached
After	12/2/2019	75%	25%	0%	0%
After	12/3/2019	62%	38%	0%	0%
After	12/4/2019	70%	30%	0%	0%
After	12/6/2019	50%	50%	0%	0%
	AVERAGE	64%	36%	0%	0%
				<b>Average Non-Intact Dressings</b>	<b>36%</b>
				<b>% Change in Non-Intact Dressings</b>	<b>-53%</b>



## Vascular Access Dressing Adherence Point Prevalence: Hartford Hospital

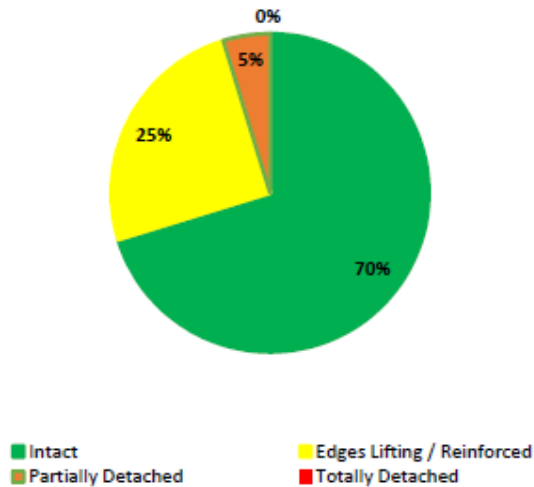
Date Completed: 12/27/2021 Total VADs Assessed: 84  
Unit(s): Hartford Hospital

### Summary of Infection Risk, Nurse Efficiency & Financial Analysis:

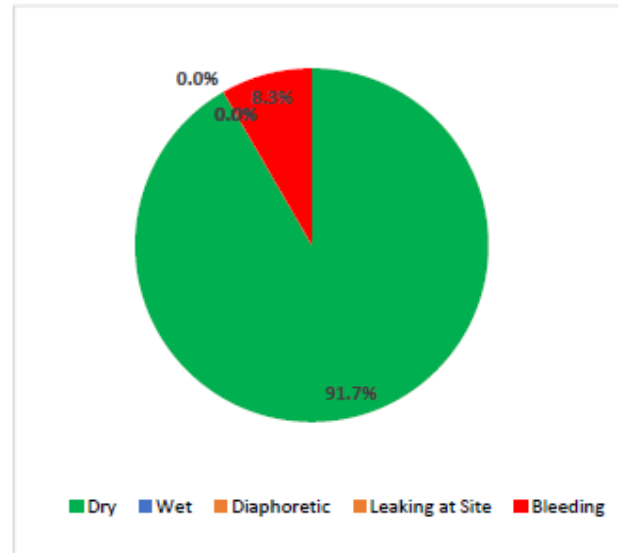
- 5% of observed dressings were Non-Adherent (Partially or Totally Detached) and are a risk factor for infection. *(Timsit)*
- 30% of dressings were Non-Intact and therefore should be prematurely changed resulting in material product waste. *(CDC, Infusion Therapy Standards)*
- 337.5 Minutes of lost productivity spent changing dressings prematurely. *(Richardson; 13.5 min per average dressing change)*

### Assessment Results:

Dressing Adherence



Moisture Presence



### Methodology:

Catheter-related bloodstream infections (CRBSIs) are a serious complication related to vascular access and are associated with increased hospital length of stay, mortality, and costs. Recent data suggests that dressing disruptions are a major risk factor for catheter-related infections. Prevalence of dressing disruptions at the facility was unknown. As such, a Vascular Access Dressing Adherence Point Prevalence Assessment was conducted. Two key assessments were made:

- Dressing Adherence: Dressing was assessed to ensure insertion site is protected. Dressings are considered "Non-Adherent" if the dressing is missing or partially detached and the insertion site is exposed.
- Dressings Compromised by Moisture Presence: The dressing and insertion site is compromised if there is any moisture under the dressing. Strain at which skin breaks is 4X weaker with excess moisture than with dry skin.

# Point Prevalence Study on Dressing Adherence

VAD Type	Adherent		Non-Adherent		TOTAL	% Non-Adherent (Partially & Totally Detached)	% Impaired (Edges Lifting, Partially & Totally Detached)
	Intact	Edges Lifting/ Reinforced	Partially Detached	Totally Detached			
CVC	22	11	3	0	36	8.3%	38.9%
<i>CVC-SCV</i>	5	0	0	0	5	0.0%	0.0%
<i>CVC-IJ</i>	16	10	3	0	29	10.3%	44.8%
<i>CVC-Fem</i>	1	1	0	0	2	0.0%	50.0%
CVC-Tun	0	0	0	0	0	0.0%	0.0%
PORT	4	1	0	0	5	0.0%	20.0%
PICC	21	3	0	0	24	0.0%	12.5%
MID	0	0	0	0	0	0.0%	0.0%
HD	2	4	1	0	7	14.3%	71.4%
PA	0	0	0	0	0	0.0%	0.0%
PAC	10	2	0	0	12	0.0%	16.7%
PIV	0	0	0	0	0	0.0%	0.0%
Total Dressings	59	21	4	0	84	4.8%	29.8%
% VAD Dressings	70.2%	25.0%	4.8%	0.0%	100.0%		

# ECT – 3 Days a Week – 0.6 FTE

Executive Summary Observations show that the ECT Department is **70 minutes behind** on an average day when seeing 15 patients. The delay is primarily due to variance associated with the IV placement and patient transition. Externalizing the IV placement and segments of the patient transition will allow for the treatment of 15 patients in **3 hours and 45 minutes versus the current time of 5 hours**, in turn **reducing the daily expense by \$321.48.**



## Speak C-Suite Language

- You demonstrate you are saving time, you are showing them you are saving money





# My Team's Next Study - Journey for the Perfect PIV Insertion Bundle

Sleere et al., ... PIVC insertions. ... 3/23/2023

## The PIV5Rights® Safety and Quality Bundle

Principal Investigator: Lee Steere, RN, CRNI, VA-BC

### Literature Review

#### Peripheral IV Catheter Failure Rate

It has been reported in numerous journal publications, PIVC access is the most common invasive procedure with over 80% of hospital admits receiving at least two successful PIVC insertions per patient stay (Hadjaway 2012). Today our US hospitals purchase more than 340 million peripheral IV catheters (PIVC) each year (GHX 2013). The American Hospital Association reported from 2018 to 2021 on average annual hospital admissions were 34.95 million per year (AHA 2019).

While placement of a PIVC is one of the most frequently performed invasive health care procedures, it may also be one of the greatest sources of patient dissatisfaction, patient discomfort as well as patient and nurse anxiety (Jones 2018). The number of actual PIVC-sticks per patient continues to be unreported in electronic medical records and continues to be an unresolved clinical issue. However, each year the PIVC manufacturers continue to report the very same PIVC consumption data and the large disproportionate ratio to hospital admission continues.

When PIVCs are placed improperly and not cared for or maintained, PIVCs can be a significant source of morbidity and hospital expense (Rickard Lancet 2012). Unreported PIVC stick and the risks they pose may often be overshadowed by more expensive and complex technologies (capital budget items, such as magnetic resonance imaging) and higher-risk procedures (such as the placement of interventional cardiac devices) in which the stringent application of quality metrics by health care payers or outside credentialing agencies may demand quality programs and compliance (Jones, Joint Commission 2018).

The medical literature is filled with PIVC reports that focus on the various types of IV complications related to the use of PIVCs and their associated range of IV complication occurrence rates (Rickard 2012). The risk factors for various PIVC complications are also well known and published, (Rickard, Tamura, Helm) but healthcare providers have largely ignored the various types of complications related to the use of PIVCs and their associated range of occurrence rates. Providers remain largely unaware of the PIVC consumption data for their health system and are unaware of the unreported root cause of PIVC failure such as occlusions, infiltrations, phlebitis and dislodgement (Helm 2015, Dychter 2012).

Few if any health systems have active programs which specifically assess and measure the safety, quality and performance of their current state regarding PIVC insertion, and catheter dwell time success rates. Today there is no unified, standard system which is or can be used in all hospitals that specifically addresses the safety quality and performance of PIVC care.

There is a need for a PIVC focused Safety and Quality systems which can be proven to provide "First-Stick Success with each PIVC insertion lasting for the length of stay". It seems apparent that the yardstick by which PIVC safety and quality is to be measured must encompass all of the potential complications that may occur from PIVC insertion to PIVC care and maintenance and to the completion of the patient's infusion therapy. It seems appropriate for a new PIVC standard of best practice to

Adding Gum  
Mastic  
and catheter  
inserted using a  
seldinger  
technique

RCT 106 patients

Hope to see you  
at AVA this fall



## Informed Consent for Research



6816

Principal Investigator: Lee Steere, RN, CRNI, VA-BC  
IV Therapy Services  
(860) 972-7708

You have been asked to participate in the research study, "The PIV5Rights Safety and Quality Bundle", because you have been admitted to a medical/surgical unit in the hospital and will require a peripheral intravenous catheter (PIVC), which is a small plastic tube inserted into a vein in your arm with a needle, that delivers medication and fluids. This research study is expected to last one year at Hartford Hospital.

This research is funded by Vygon Corporation. Vygon Corporation is paying Hartford HealthCare to conduct this research.

If you agree to take part in this study after reading the information below and asking questions you may have, you will be one of about 112 people taking part in the study at Hartford Hospital.

The Hartford HealthCare Institutional Review Board (IRB) has reviewed the information in this consent document and has given approval for the study. An IRB is an independent committee established to help protect the rights of research subjects. This does not mean the IRB has approved your participation in the study. You must think about the information in this consent document for yourself. You must then decide if you want to be in the study.

The person in charge of this study is Lee Steere, RN, CRNI, VA-BC, from the Hartford HealthCare Department of IV Therapy. If you have questions, suggestions, or concerns regarding this study or you want to withdraw from the study, his contact information is: (860) 972-7708.

### A. The Purpose and procedures of this research

#### A.1. What is the purpose of this research?

You will be receiving a PIVC in your arm, as ordered by your doctor. The purpose of this study is to see a PIVC will last longer if inserted by a Registered Nurse who specializes in inserting PIVCs. Many of these PIVCs will be placed by this specialty RN using a machine (ultrasound) that displays your vein on a monitor. Ultrasound is a painless and common procedure and does not have risks involved. These PIVCs will also use the best in class medical technology (a connector that does not allow blood to flow in and out of the PIVC when not being used; dressing that contains medicine to kill bacteria on our skin; a sticky substance that will act as glue so the dressing will stay on for as long as the PIVC is in use or until the PIVC is no longer needed and is removed).

We believe that the use of the ultrasound, an RN who specializes in PIVC placement and use of the best of class medical technology, may improve first stick success with PIVC insertion and the length of time the PIVC stays in place without showing any related complications.

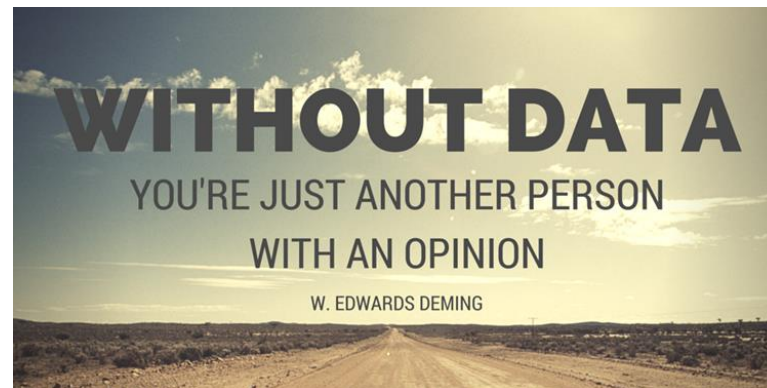
Page:	1 of 6	IRB Use Only.
PI:	Steere	
IRB #:	HHC-2022-0276	
Version:	01/20/2023	

# With Growth of Team – What Else Are We Able to do to Show Value?

- Care and maintenance of all CVC's outside of the ICU settings
- Placement of DHT's using Real-Time tracing technology
  - Avoids inadvertent lung cannulation that could result in a pneumothorax
- Prompt CVC removals – prior was done by MD's or Advanced Practitioners
- Education at competency day
- Monoclonal Antibody Infusions for COVID + patients (no longer occurring)
- Outpatient infusions – IVF, Blood and Blood Products, Abx
  - Very profitable for the hospital

# Summary

- We know what the problem is... and we can fix it!
  - Our patients need and want us
- Change in healthcare is constant
  - IV therapy effects nearly every patient, we should be collecting data as more changes are coming
    - Need to be proactive vs reactive before big changes come
- Using Lean and Six Sigma is a pathway to achieving goals
- Focus on data that speaks the language of your CEO, CNO, CFO



# References

- Andrea M. Sisko and others, “National Health Expenditure Projections, 2018–27: Economic and Demographic Trends Drive Spending and Enrollment Growth,” *Health Affairs* 38 (3) (2019)
- Helm, R.E., et al., Accepted but Unacceptable: Peripheral IV Catheter Failure. *Journal of Infusion Nursing*. 2016; 38(3): 189-203.6
- Rickard CM , Webster J , Wallis MC . Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomized controlled equivalence trial . *Lancet*. 2012 ; 380 ( 9847 ): 1066-1074
- Webster J , Clarke S , Paterson D , et al. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomised controlled trial . *BMJ*. 2008 ; 337 : 1-6
- [www.ERCI.org](http://www.ERCI.org)
- [www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries-2](http://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries-2)
- [www.ihl.org/Engage/collaboratives/LeadershipAlliance/Documents/IHLLeadershipAlliance\\_CallToAction\\_ReduceWasteUSHealthCareSystem.pdf](http://www.ihl.org/Engage/collaboratives/LeadershipAlliance/Documents/IHLLeadershipAlliance_CallToAction_ReduceWasteUSHealthCareSystem.pdf)
- [www.phca.org/wp-content/uploads/2019/03/PHCA-ppt-March-2019-Colleen-Sweeney.pdf](http://www.phca.org/wp-content/uploads/2019/03/PHCA-ppt-March-2019-Colleen-Sweeney.pdf)
- [www.villanovau.com/resources/six-sigma/six-sigma-vs-lean-six-sigma](http://www.villanovau.com/resources/six-sigma/six-sigma-vs-lean-six-sigma)



# Thank you

Questions?

[Lee.Steere@hhchealth.org](mailto:Lee.Steere@hhchealth.org)

860-614-8254