

2023 HEALTHTRUST UNIVERSITY CONFERENCE

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ALIGNED FOR SUCCESS
OPTIMIZING OUTCOMES

Pump It Up! Multidisciplinary Approach to Smart Pump Implementation & Audit

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Disclosures

- The presenters have no real or perceived conflicts of interest related to this presentation.
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Learning Objectives

At the end of this session, participants should be able to:

1. Recall features of smart infusion pumps commercially available in the United States
2. Identify examples of electronic health record and smart infusion pump guardrail library to establish standard IV concentration therapy profiles and minimum concentration for wild card entries
3. Recognize trends and use of continuous quality improvement (CQI) data from smart infusion pump

Polling Question 1:

What is Your Profession?

1. Nurse
2. Pharmacist
3. Physician
4. Supply Chain Professional
5. Other

Polling Question 2:

How Many Years of Experience Do You Have Managing IV Pumps?

1. 1-2 years
2. 3-5 years
3. 6-10 years
4. More than 10 years

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IV Pumps in the United States

Types of Pump Technology

- Gravity Infusion
 - First used in 1960s, using gravity to deliver medication, viscosity of fluid and precision are issues
- Volumetric
 - Medical device delivering continuous and specific amounts of fluids at very slow or very fast rates (0.1-999 mL/hr)
- Patient-Controlled Analgesia
 - Locking device, medication chamber, programming screen, and patient button to delivery initial loading dose, PCA dose, lockout interval, continuous infusion rate, and one/four-hour limits
- Syringe Pumps
 - Medication is held in the reservoir of a syringe, a movable piston controls fluid delivery

The Different Types of IV Infusion Pumps: <https://www.medonegroup.com/aboutus/blog/the-different-types-of-iv-infusion-pumps>. Accessed 6/6/2023

Large Volumetric Infusion Pumps Inventory Management and Usability: <https://www.ncbi.nlm.nih.gov/books/NBK361678>. Accessed 6/6/2023

What is an Infusion Pump: <https://www.fda.gov/medical-devices/infusion-pumps/what-infusion-pump>. Accessed 6/6/2023

B.Braun Infusomat Space

- Independent modularity: Single channel pump
- Lightweight and compact design, stackable
- Syringe, PCA and large volume infusion
- Non-numeric keypad with simple arrows
- Drug library: Up to 1,200 drugs, hard and soft limits, clinical advisories
- Wireless Integration
- MR compatible when used with SpaceStation MRI



Infusomat Space Large Volume Pump: <https://www.bbraunusa.com/en/products/b4/us-infusomat-space.html>. Accessed 6/6/2023

Perfusor PCA Syringe Pump: <https://www.bbraunusa.com/en/products/b4/perfusor-pcainfusionpumpsystem.html>. Accessed 6/6/2023

Integrated Automated Infusion Platform: <https://www.bbraunusa.com/en/products-and-therapies/infusion-therapy/integrated-automated-infusion-platform.html#>. Accessed 6/6/2023

BD Alaris

- Modular setup (up to 4 per PCU): primary pump, syringe, PCA, EtCO2, Auto-ID
- Alaris Guardrails Suite MX software: guardrail, drug library
- Wireless
- Integrated analytics: quarterly reports, Knowledge Portal



BD Alaris Infusion System: <https://www.bd.com/en-us/products-and-solutions/products/product-brands/alaris#infusionsystem> Accessed 6/6/2023
Alaris Syringe Module: <https://www.bd.com/en-us/products-and-solutions/products/product-families/bd-alaris-syringe-module> Accessed 6/6/2023

CE Credit Deadline: 8/25/23

Confidential: Not for distribution

Baxter Spectrum IQ Infusion System

- EMR Integration, onscreen barcode scan
- Wireless
- Drug library: FDB infusion knowledge (pre-populated, evidence-based drug library)
- Pump data management and CQI
- DeviceVue Asset Tracking Application: pump status and location data displayed
- Charge Capture: infusion start, stop and duration times on an infusion dashboard
- Novum IQ: syringe pump



Spectrum IQ Infusion System: <https://www.baxter.com/healthcare-professionals/hospital-care/spectrum-iq-infusion-system>. Accessed 6/6/2023

Novum IQ Syringe Infusion Pump: <https://www.baxter.com/healthcare-professionals/hospital-care/novum-iq-syringe-infusion-pump>. Accessed 6/6/2023

Baxter Hospital Care: <https://www.baxter.ca/healthcare-professionals/hospital-care>. Accessed 6/6/2023

CE Credit Deadline: 8/25/23

Confidential: Not for distribution

Fresenius Kabi Ivenix Infusion System

- Smartphone-like user interface, touchscreen
- Automatic drug library opt-in and real-time dose guidance during programming
- Auto-programming and auto-documentation with EMR/BCMA
- Ivenix Infusion Management System (IMS): admin tools, apps, analytics, and dashboards
- Infusion dashboard: multiple patients/infusions
- Each pump allows for one primary and one secondary



Meet The Ivenix Infusion System: <https://www.baxter.com/healthcare-professionals/hospital-care/novum-iq-syringe-infusion-pump> Accessed 6/6/2023

ICU Medical Plum 360

- Pump and syringe compatible
- Barcode identification on PCA module, proprietary glass vial
- Drug library software: IV-EHR Interoperability
- Unique cassette allows two medications at independent rates to infuse via single line. Deliver secondary medication without pausing primary.
- Real-time location services
- LifeCare PCA: separate PCA device using glass syringe
- Medfusion 4000 Wireless syringe infusion pump (Peds): not compatible



Plum 360 Infusion System: <https://www.icumed.com/products/infusion-therapy/iv-systems/large-volume-iv-pumps>. Accessed 6/6/2023

LifeCare PCA: <https://www.icumed.com/products/infusion-therapy/iv-systems/patient-controlled-analgesia>. Accessed 6/6/2023

Zyno/InfuTronix Nimbus

- Focused on oncology services, long term care, and outpatient clinics
- Requires proprietary cassettes, single channel, non-backlit display
- Nimbus II (3 models): PCA pump (PainPRO), Chemo (Flex), Amcare (Plus)
- Z-800WF - Cloud connected, wireless programming (non-wifi pump also available)
- ZynoFlow: integrated infusion system (electronic prescription ordering/dispensing, EMR integration with Flatiron Health's OncoEMR, billing integration)



InfuTronix The new generation of infusion devices, Meet Nimbus: <https://infutronix.com/>. Accessed 6/6/2023

Infusion Pumps and Supporting Platforms: <https://zynosolutions.com/Brochures.html>. Accessed 6/6/2023

Nimbus II Flex, an intelligent infusion therapy solution: <https://zynosolutions.com/assets/files/ZYS100-NF2-2-B.pdf>. Accessed 6/6/2023

Z-800WF IV Infusion Pump: <https://zynosolutions.com/assets/files/ZYS102-ZWF-1-Rev-A.pdf>. Accessed 6/6/2023

Summary of Smart Pumps Features

Infusion System	Setting	Profile	Drug Library	Wi-Fi	Integrated Syringe	Integrated PCA	Interoperability
B.Braun Infusomat Space	Acute Care	Yes	Yes	Yes	Yes	No	Yes
BD Alaris	Acute Care	Yes	Yes	Yes	Yes	Yes	Yes
Baxter Spectrum	Acute Care	Yes	Yes	Yes	No	No	Yes
Fresenius Kabi Ivenix	Acute Care	Yes	Yes	Yes	No	No	Yes
ICU Medical	Acute Care	Yes	Yes	Yes	Yes	No	Yes
Zyno	AmCare	N/A	Yes	Yes	N/A	N/A	Yes

Knowledge Check Question 1

Which of the following is not a feature on smart infusion pumps commercially available in the United States?

- A. Profile Setting
- B. Drug Library
- C. Wi-Fi Capability
- D. Gravity Infusion Technology
- E. Interoperability with Electronic Health Record (EHR)

Knowledge Check Question 1 | Answer...

Which of the following is not a feature on smart infusion pumps commercially available in the United States?

- A. Profile Setting
- B. Drug Library
- C. Wi-Fi Capability
- D. Gravity Infusion Technology**
- E. Interoperability with Electronic Health Record (EHR)

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Smart Infusion Pump Systems

Smart Infusion Pump Systems

- Purpose: Reduce errors and provide more accurate intravenous drug dose infusion to patients
- Dose Error Reduction Software (DERS):
 - Standard drug library with parameters, dosing limits and duration rate
 - Provides user support via alerts and pop ups to identify possible errors
 - Facility tailored drug library programming with different profiles, concentrations

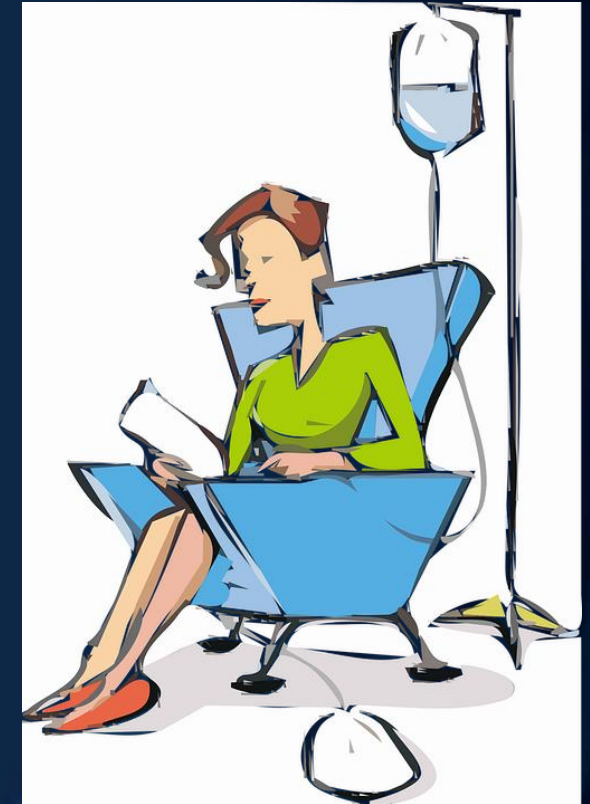


Figure 1. IV Pump Cartoon: https://cdn.pixabay.com/photo/2016/03/31/21/10/infusion-1296236_1280.png. Accessed 6/6/2023

Guidelines From Safety and Professional Organizations

- ISMP Targeted Medication Safety Best Practices for Hospitals 2022-2023
- ISMP Guidelines for Safe Medication Use in Perioperative and Procedural Settings 2022
- ISMP Guidelines for Optimizing Safe Implementation and Use of Smart Infusion Pumps 2020
- ASHP Guidance Document for Improved Smart Pump Usage and Governance



2022-2023 Targeted Medication Safety Best Practices for Hospitals: <https://www.ismp.org/guidelines/best-practices-hospitals>. Accessed 6/6/2023

2022 Guidelines for Safe Medication Use in Perioperative and Procedural Settings: <https://www.ismp.org/resources/guidelines-safe-medication-use-perioperative-and-procedural-settings>. Accessed 6/6/2023

2020 Guidelines for Optimizing Safe Implementation and Use of Smart Infusion Pumps: <https://www.ismp.org/guidelines/safe-implementation-and-use-smart-pumps>. Accessed 6/6/2023

ASHP. Guidance Document for Improved Smart Pump Usage and Governance. https://www.ashp.org/-/media/assets/pharmacy-practice/resource-centers/patient-safety/Guidance-Document-for-Improved-Smart-Pump-Usage-and-Governance_final.pdf. Accessed 6/6/2023

2022-2023 ISMP Targeted Medication Safety Best Practices for Hospitals:

Best Practice 8

- Administer medication infusions via a programmable infusion pump utilizing dose error-reduction systems (DERS)
- Maintain a compliance rate of greater than 95% for the use of dose error-reduction systems
- Monitor compliance with use of smart pump dose error-reduction software on a monthly basis
- For bolus or a loading dose from a continuous medication infusion, use a smart pump that allows programming of the bolus (or loading dose) and continuous infusion rate with separate limits for each.

2022-2023 Targeted Medication Safety Best Practices for Hospitals: <https://www.ismp.org/guidelines/best-practices-hospitals>. Accessed 6/6/2023

Smart Pump Practice Recommendations

- Utilize smart pump technology *all the time!*
- Limit multiple indication-based options
- Test prior to distributing new updates house wide
- Engage end users and evaluate clinical workflow
- Plan for bi-directional interoperability
- Dedicate resources and tracking of pumps for ongoing maintenance and timely update
- Review continuous quality improvement (CQI) data. Update library at least quarterly and have a standard communication of changes implemented
- Align dose limits with hospital protocols, references, literature and clinical practice



Institute for Safe Medication Practices (ISMP). Safety considerations for challenges when using smart infusion pumps. *ISMP Medication Safety Alert! Acute Care*. 2022;27(21):1-5.
Figure 1. Human writing recommendation: <https://foto.wuestenigel.com/wp-content/uploads/api/human-hand-writing-recommendation-on-whiteboard.jpeg>. Accessed 6/6/2023

Communication Methods

- Update library at least quarterly and have a standard communication of changes implemented
- Email announcement
- Facilitywide broadcast
- Direct communication with staff during medication safety walkabouts and pump audits
- Themed Day: Pump it up Fridays

ALARIS INFUSION PUMP DRUG DICTIONARY UPDATE - Version: LRHMC V43 23-05-23

Additions

Location	Drug	Notes
Adult Profiles	Cefiderocol	Added to adult profiles
Adult Profiles	Aminophylline	Added to adult profiles
Critical Care/PCU-Tele	Dextrose 20%	Added to adult profiles as guardrail fluid
Peds/Peds-IMC	NS + Additives	Added to pediatric profiles
Peds/Peds-IMC	D10w + Additives	Added to pediatric profiles
Peds/Peds-IMC	Daptomycin	Added to pediatric profiles

Modifications

Location	Drug	Notes
Adult Profiles	Valproic Acid	Changed soft min from 250 mg to 50 mg
Adult Profiles	Heparin	Removed non-weight-based dosing from Standard and High therapies, added Units/hr Dosing as separate therapy
Adult Profiles	Potassium Phosphate	Changed clinical advisory to denote peripheral and central line max dose/concentration. Changed soft min to hard min concentration.
Critical Care	Norepinephrine	Removed 4 mg/500 mL and 8 mg/250 mL
Critical Care	Propofol (Anesthesia)	Decreased bolus dose limit to 0.25 mg/kg
Critical Care	Fentanyl	Changed max dose limit to 300 mcg/hr
Critical Care/PCU-Tele	Amiodarone	Decreased dose limit to 0.5 mg/min for 1 st therapy
Critical Care/PCU-Tele/Medsurg	Octreotide	Changed therapies to "octreotide drip" and "octreotide bolus"
Pediatric	Magnesium sulfate	Changed default infusion rate to 1 hour
Peds/Peds-IMC	Cefoxitin	Changed max dose to 50 mg/kg/dose

The new release is downloaded into every pump on/after: May 23, 2023

To activate the new Dictionary, the nurse should:

1. Find and power-on all Alaris PC units in your patient care area. Any device in use may remain in use during data set transfer using the wireless system.
2. Alaris PC units should be left on for at least 24 hours so that the device may receive the new data set.
3. After 24 hours, devices should be cycle powered OFF. Turn back ON and select "New Patient" when prompted. If in use, cycle Power OFF then ON only if there is no risk to the patient.
4. Look for the New Guardrails data set Name (LRHMC V43 23-05-23) on the top line of the Alaris PC Unit LCD screen.
 - a. If the new data set name is displayed, you may turn the device off, if not in use.
 - b. If the device did not receive the Guardrails data set, it should be left on for another 24 hours. Then repeat steps 2 through 5.

Drug Library Recommendations

- Use therapy options to distinguish medications with multiple indications or treatment dosing options.
 - Morphine PCA (Opioid naïve vs. tolerant)
 - Heparin

PCA Drugs - CRITICAL CARE						
Drug Name Therapy	Concentrations:					
morphine 1 mg/mL Opioid Naïve	30 mg / 30 mL (1 mg / mL) 50 mg / 50 mL (1 mg / mL)					
Concentration Limits	Conc. Units			Hard Min	Soft Min	Soft Max
	n/a					
Limits	Hard Min	Soft Min	Soft Max	Hard Max	Initial Value	PCA Pause Protocol: No
PCA Dose	n/a	0.1	2.5	5		Dosing Units
Continuous Dose / h	n/a					mg
Bolus Dose	n/a				n/a	Max Accum. Includes Bolus?
Loading Dose	n/a	0.1	2.5	5	n/a	No
Lockout Interval (minutes)	4	5	30	n/a		Clinical Advisory Name
Max Acc. Dose Range / 1 h	n/a	0.1	15	25		High Risk

PCA Drugs - CRITICAL CARE						
Drug Name Therapy	Concentrations:					
morphine 1 mg/mL Opioid Tolerant	30 mg / 30 mL (1 mg / mL) 50 mg / 50 mL (1 mg / mL)					
Concentration Limits	Conc. Units			Hard Min	Soft Min	Soft Max
	n/a					
Limits	Hard Min	Soft Min	Soft Max	Hard Max	Initial Value	PCA Pause Protocol: No
PCA Dose	n/a	0.1	4	10		Dosing Units
Continuous Dose / h	n/a					mg
Bolus Dose	n/a				n/a	Max Accum. Includes Bolus?
Loading Dose	n/a	0.1	4	10	n/a	No
Lockout Interval (minutes)	4	5	30	n/a		Clinical Advisory Name
Max Acc. Dose Range / 1 h	n/a	0.1	15	50		High Risk

Continuous/Bolus - Non-Anesthesia Drugs - CRITICAL CARE																	
Drug Name Therapy Concentrations	Module		Conc. Limits	Dosing Units	Continuous				Bolus			Bolus Dose Administration Rate				Clinical Ads. Name	
	P	S			Soft Min	Soft Max	Hard Max	Initial Value	Soft Min	Soft Max	Hard Max	Initial Value	Soft Min	Soft Max	Hard Max		Initial Value
	glucagon 5 mg / 50 mL (0.1 mg / mL) 10 mg / 100 mL (0.1 mg / mL) 20 mg / 200 mL (0.1 mg / mL)	X				N/A	Continuous mg/h	0.1	6								
heparin Heparin High Dose 25,000 unit / 500 mL (50 unit / mL)	X		N/A	Continuous unit/kg/h	1	35		18								Weight-Based Dosing	
heparin Heparin .Standrd Dos 25,000 unit / 500 mL (50 unit / mL)	X		N/A	Continuous unit/kg/h	1	35		12								Weight-Based Dosing	
heparin Heparin .Stroke Dose 25,000 unit / 500 mL (50 unit / mL)	X		N/A	Continuous unit/kg/h	1	35		12								Weight-Based Dosing	
heparin Heparin Impella Dose 25,000 unit / 500 mL (50 unit / mL)	X		N/A	Continuous unit/kg/h	1	35		12								Weight-Based Dosing	
heparin Heparin Unit/hr Dose 25,000 unit / 500 mL (50 unit / mL)	X		N/A	Continuous unit/h	200	3,500										Non-Wt Based Dosing	

Los Robles Regional Medical Center. (2023). Data Set Report (LRHMC V43 23-05-23).



Smart Pump Drug Library

Why Smart Pump Drug Library?

- Provides a guardrail to ensure safe dosing and administration of IV medications

What is a guardrail?

- A strong fence/barrier at the side of a road or in the middle of an highway, intended to reduce the risk of serious accidents



Figure 1. Adobe Stock. (n.d.). 5 Financial Guardrails That Can Help Protect You From Disaster. <https://images02.military.com/sites/default/files/styles/full/public/2022-07/stock-road-guardrails-1800.jpg?itok=gqqGJkhJ>

Components of the Smart Pump Drug Library

Software Editor

- Drugs
- Fluids
- Therapies
- Clinical Advisories
- Profiles

Standard
Concentration/
Wild Card Entries

Reports

- Quarterly Reports
- Realtime Reports

Drug Library Fluid

Fluids - CRITICAL CARE							
Fluid Name <i>Therapy</i>	Supports Secondary	Module		Rate Limits (mL/h)			Clinical Ads. Name
		P	S	Soft Min	Soft Max	Hard Max	
..Maint IVF	Yes	X		1	999		
.IVF + BICARB	Yes	X		15	200	300	
.IVF + KCL 10 mEq/L	Yes	X		1	999		
.IVF + KCL 20 mEq/L	Yes	X		1	500		
.IVF + KCL 30 mEq/L	Yes	X		1	333	350	
.IVF + KCL 40 mEq/L	Yes	X		1	250	275	
.IVF +Elyte Additive	Yes	X		1	250		
.IVF Bolus	Yes	X		1	999		
1.5% SodiumChloride	Yes	X		1	60		Sod Chlor Hypertonic
3% Sodium Chloride	Yes	X		1	60		Sod Chlor Hypertonic
6% SodiumChloride	Yes	X		1	30		Sod Chlor Hypertonic

Los Robles Regional Medical Center. (2023). *Data Set Report* (LRHMC V43 23-05-23).

Drug Library Therapies

- Therapies are used to alert the end user of different indications or criteria for use
- Insulin
 - Critical Care (units/hr) vs DKA (units/kg/hr)
- Heparin
 - AMI/Afib dosing (12 units/kg/hr) vs DVT/PE dosing (18 units/kg/hr)
- Potassium Phosphate
 - Peripheral (max 0.7 mM/mL) vs Central (max 0.12 mM/mL)

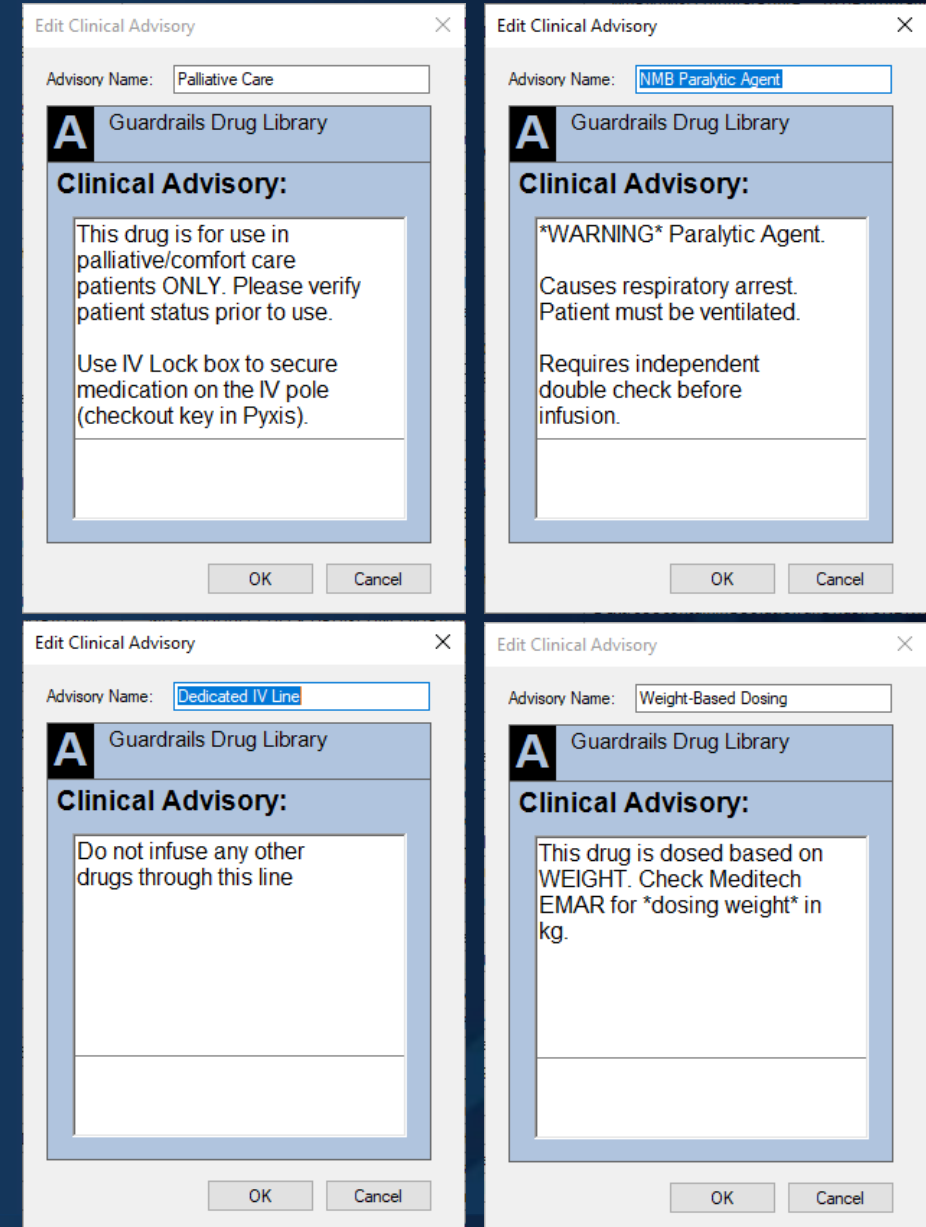
Continuous/Bolus - Non-Anesthesia Drugs - CRITICAL CARE																	
Drug Name Therapy Concentrations	Module		Conc. Limits	Dosing Units	Continuous				Bolus				Bolus Dose Administration Rate				Clinical Ads. Name
	P	S			Soft Min	Soft Max	Hard Max	Initial Value	Soft Min	Soft Max	Hard Max	Initial Value	Soft Min	Soft Max	Hard Max	Initial Value	
insulin Regular Critical Care Infusn 100 unit / 100 mL (1 unit / mL)	X		N/A	Continuous unit/h	0.1	30	40									2nd RN to verify	
insulin Regular DKA 100 unit / 100 mL (1 unit / mL)	X		N/A	Continuous unit/kg/h Bolus Dose unit/kg Bolus Admin Rate unit/kg/min	0.01	0.49		0.14	0.01	0.15		0.1	0.01	0.15		DKA	

Los Robles Regional Medical Center. (2023). *Data Set Report* (LRHMC V43 23-05-23).

Drug Library Clinical Advisories

Clinical advisories can provide variety of safety alerts for the end user

- Infusion restrictions based on level of care
- Independent double check
- Weight-based dosing (use kg)
- Tubing requirements (non-DEHP, filters)
- IV compatibility (D5W only)
- Max dose
- Central vs peripheral line
- Medication security (controlled substance)



Los Robles Regional Medical Center. (2023). *Data Set Report* (LRHMC V43 23-05-23).

Drug Library Report

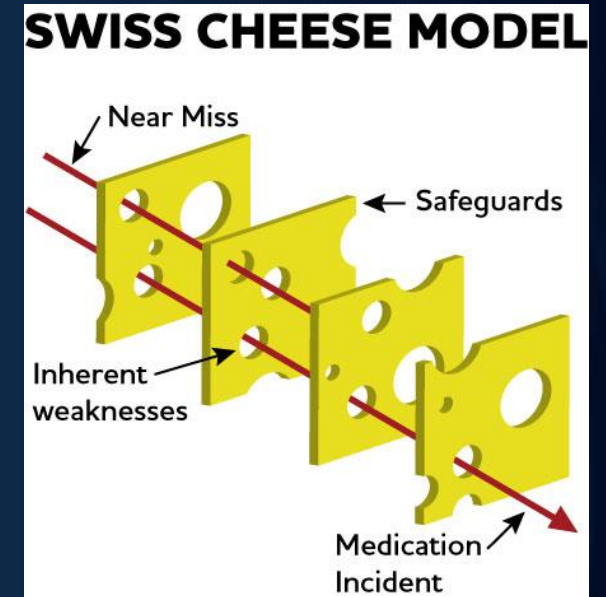
- Functions as a reference of the most current guardrail library
 - Includes standard concentration, module availability, guardrail parameters for troubleshooting
- Version numbers and date help users to identify if pump is on most current drug library
- Available on the hospital intranet page
- PDF format
- CTRL+F to easily find the drug within the profile

Three parallel, slanted orange lines of varying lengths on the left side of the slide.

Standard Concentration/ Wild Card Entries

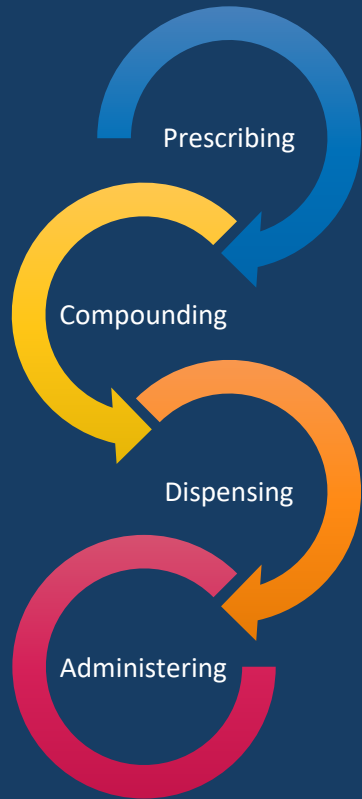
Standard Concentration

- Facilitywide standard concentration reduces med errors during:
 - Prescribing – minimizes ordering of unusual/custom concentration
 - Compounding – standardizes compounding recipe
 - Dispensing – only approved products are loaded in ADC
 - Administration – streamline pump setup to display standard concentration and prevent higher dose than prescribed to be administered



How Swiss Cheese Can Help Visualize Medication Safety Risks: <https://pharmacyconnection.ca/how-swiss-cheese-can-help-visualize-medication-safety-risks/>. Accessed 6/6/2023

Standard Concentration Integration



niCARDipine Inj (Cardene Inj) 25 MG IV *Per Bag* Remove Favorite
 in ~0.9% NaCL 50 ML (PYXIS) (MB+) (~NS 50 ML (PYXIS) ...Tot Vol 60 ML Monograph
 <see Admin Crit> ASDIR TITRATE Show All Locations

Rate/Dose	Directions	PRN	Start	Stop
25 MG	ASDIR	N	05/29 2338	

Inst Admin Criteria Taper Additives Fluid Alt IV Pending
 25 MG ASDIR ~0.9% NaCL 50 ML (PYXIS) (MB+) 50 ML
 **** MINI-BAG PLUS **** FOR HYPERTENSION ** FOR INPATIENT USE ONLY ****

EHR

Name: niCARDipine 25 mg/50mL in 0.9% NS - 50mL - ADDEASE STOCK
 Type: Drug
 Recon Vol: 0
 Total Vol: 50

Pharmacy

Name	Brand Name	Med ID
niCARDipine/Sodium Choride 0.9% (0.5mg/mL) 25 mg (50 mL) Bag	Cardene Drip	NICARD25AD

ADC

Continuous/Bolus Drug Setup Group - CRITICAL CARE

Drug Concentration Therapy Advisory
 Drug Name: niCARDipine

Non-Weight Based Weight Based

Setup: niCARDipine / Non-weight based

Concentrations:

Concentration	Pump	Syringe	Anesthesia Only
20 mg / 200 mL (0.1 mg / mL)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25 mg / 50 mL (0.5 mg / mL)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Smart Pump

Standard Concentration and Infusion Guidelines

Check for organization published guidance document (Pharmacy and Therapeutics)

ASHP provides a template to use and modify for individual facility needs

Drug	First concentration	Second concentration	Third conc	Dosing units	Commercially available	Comments
Alteplase	1 mg/mL			mg/hour	Yes, comes in a kit with diluent	This concentration is for treatment doses only and does not apply to interventional radiology needs and/or catheter treatments. Available in drug kits of 50 mg or 100 mg vials with diluent included
Amiodarone	1.5 mg/mL	3.6 mg/mL		mg/min	Yes	Two concentrations needed, 1.5 mg/mL for peripheral, 3.6 mg/mL for central. Some institutions were using 1.8 mg/mL but still seeing phlebitis.
Argatroban	1 mg/mL			mcg/kg/min	Yes	
Bumetanide	0.25 mg/mL			mg/hour	Administer undiluted	
Cisatracurium	2 mg/mL ^{1,2}			mcg/kg/min	Administer undiluted	The package insert (PI) has infusion information using 0.4 mg/mL
Dexmedetomidine	4 mcg/mL			mcg/kg/hour	Yes	Only concentration recommended in package insert also commercially available product
Diltiazem	1 mg/mL			mg/hour	No	Hospira has advantage 100 mg/100 mL (may be similar products)- using the manufacturer vial of 125mg the admixture would be 125 mg in 125 mL unless not accounting for any overflow of the bag
DOBUTamine	4000 mcg/mL			mcg/kg/min	Yes	Premix bag -considerations may be needed for areas performing diagnostic tests - in addition to what is needed in home care setting. No evidence to dispute 4000 mcg/mL cannot be given via peripheral route
DOPamine	1600 mcg/mL	3200 mcg/mL		mcg/kg/min	Yes	Premix bags, consider limiting to one bag size of each (250 vs. 500 mL, could reduce inventory needs and errors)
EPINEPHrine	20 mcg/mL	40 mcg/mL		mcg/kg/min	No	vial size 1 mg/mL or 30 mg/30 mL. The group intentionally made these concentrations different from those for norepinephrine in order to avoid confusion between the two agents.
Esmolol	10 mg/mL	20 mg/mL		mcg/kg/min	Yes	10 mg/mL for peripheral, 20 mg/mL for central. Most institutions use the 10 mg/mL premix but dosing ranges indicate the 20 mg/mL is more appropriate based upon fluid volumes.
FentaNYL ⁴	10 mcg/mL	50 mcg/mL		mcg/hour	No	Ease of prep, can make 2500 mcg (50 mL) in 250mL to make 10 mcg/mL (need to remove volume of drug and overflow) or use straight drug of 50 mcg/mL
Furosemide	2 mg/mL	10 mg/mL		mg/hour	No, and the 10 mg/mL is administered undiluted	This is highly dependent upon using low dose continuous infusions (doses less than 10 mg/hour) or using high doses (20 mg/hour or more)

ASHP Standardize 4 Safety: <https://www.ashp.org/-/media/assets/pharmacy-practice/s4s/docs/s4s-iv-adult-continuous-infusion-guiding-principles.ashx>. Accessed 6/6/2023

Wild Card Concentrations

- Fill-in-the-blank custom concentrations
- Examples: ___ mg/___ mL; ___ units/___ mL; ___ gm/___ mL
- The pump needs the wild card concentration input to calculate the volume needed to deliver the prescribed dose
- Programmed concentration lower than actual – delivers an **overdose**
- Programmed concentration higher than actual – delivers an **underdose**



Smart Pump Custom Concentrations Without Hard “Low Concentration” Alerts: <https://www.medscape.com/viewarticle/759920>. Accessed 6/6/2023

Figure 1. Wild Card: https://2.bp.blogspot.com/_jiA6ct7emSA/TMTtnR_x74I/AAAAAAAAA_M/H7BcKaRT-nQ/s1600/wildcard.png. Accessed 6/6/2023

Case Example 1 – HYDRORmorphone

- Physician prescribed HYDRORmorphone 20 mg/100 mL (0.2 mg/mL) to infuse at 2.5 mg/hour
 - Standard concentration in the hospital was 0.1 mg/mL
- Wild card concentration entered by the nurse, but mistakenly inputted as 2.5 mg/100 mL (0.025 mg/mL) instead of 20 mg/100 mL
- Soft guardrail warning of low concentration alert was bypassed, mistakenly believing the warning was inconsequential
- Drug was infused at a rate of 100 mL/hr, intended rate is 12.5 mL/hr
- Patient received entire bag of HYDRORmorphone 20 mg in one hour
- Outcome of the patient was not reported



Figure 1. Error Sign: <https://2.bp.blogspot.com/-JCpfeMWoPlc/U6YNrqzmSEI/AAAAAAAAA5k/M3VMXr8fSWI/s1600/Error.png>. Accessed 6/6/2023

Case Example 2 – Insulin

- Physician prescribed IV insulin at 12.5 units/hr for a patient with hyperglycemia
- Standard insulin bag 100 units/100 mL (1 unit/mL) was dispensed from pharmacy
- Nurse failed to select the standard concentration and entered wild card concentration of 5 units/100 mL (0.05 units/mL)
- The smart pump infused the drug at a rate of 250 mL/hr
- Entire bag of 100 units of insulin was infused in approximately 20 minutes
- Patient outcome was not reported



Figure 1. Error Sign: <https://2.bp.blogspot.com/-JCpfeMWoPlc/U6YNrqzmSEI/AAAAAAAAA5k/M3VMXr8fSWI/s1600/Error.png>. Accessed 6/6/2023

Wild Card Concentration – Mental Mix-Ups

- Per mL concentration paired with total infusion volume
 - HYDROmorphine 1 mg/mL in a 50 mg/50 mL bag ends up as 1 mg/50 mL concentration
- Soft low concentration guardrail is provided on the pump, but the significance of the alert may not be fully appreciated
- Low concentration soft alert may be misinterpreted as being similar to low dose alerts
- Low concentration hard stop will stop the user from continuing to program the pump and check the wild card input

Wild Card Concentration – Recommendations

- Assess vulnerability to serious errors
- Use standardize concentrations
- Set **hard minimum** concentration limits if wild card used
- Educate staff
- Distinguish custom concentrations
- Require doses to be expressed in drug's metric weight
 - mg/hr, mcg/kg/hr instead of mL/hr
- Match MAR and labels to pump settings
- Verify pump programming; independent double check for high-alert meds
- Analyze Data



Figure 1. Human writing recommendation: <https://foto.wuestenigel.com/wp-content/uploads/api/human-hand-writing-recommendation-on-whiteboard.jpeg>. Accessed 6/6/2023

Knowledge Check Question 2

Which of the following is true?

- A. Standard concentration in guardrail allows for wild card programming in smart pumps
- B. Standard concentration provides options for variability between electronic health record and smart pump guardrail library
- C. Wild card concentration require the use of hard minimum concentration to avoid overdose
- D. Wild card concentration is necessary for non-weight based dosing

Knowledge Check Question 2 | Answer...

Which of the following is true?

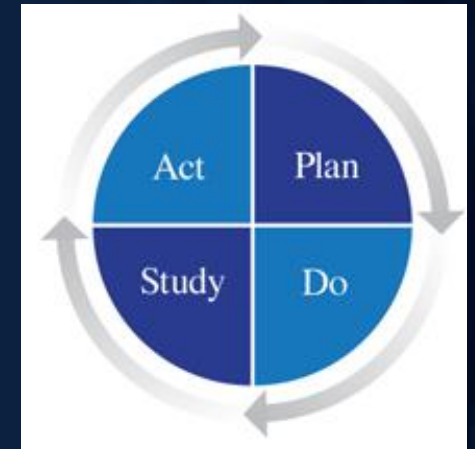
- A. Standard concentration in guardrail allows for wild card programming in smart pumps
- B. Standard concentration provides options for variability between electronic health record and smart pump guardrail library
- C. Wild card concentration require the use of hard minimum concentration to avoid overdose**
- D. Wild card concentration are necessary for non-weight based dosing

Three parallel orange diagonal lines of varying lengths on the left side of the slide.

Continuous Quality Improvement (CQI)

Continuous Quality Improvement (CQI)

- Definition: Progressive incremental improvement of processes, safety, and patient care
- Goals: Improvement of operations, outcomes, systems processes, improved work environment or regulatory compliance
- Process improvement: gradual or breakthrough
- Methodology examples: Lean, Six Sigma, Plan-Do-Study-Act (PDSA), Baldrige Criteria



Continuous Quality Improvement: <https://www.ncbi.nlm.nih.gov/books/NBK559239/>. Accessed 6/6/2023

Figure 1. Plan Do Study Act Diagram: <https://teachonline.ca/sites/default/files/tools-trends/stories/allaboutdesign3.jpg>. Accessed 6/6/2023

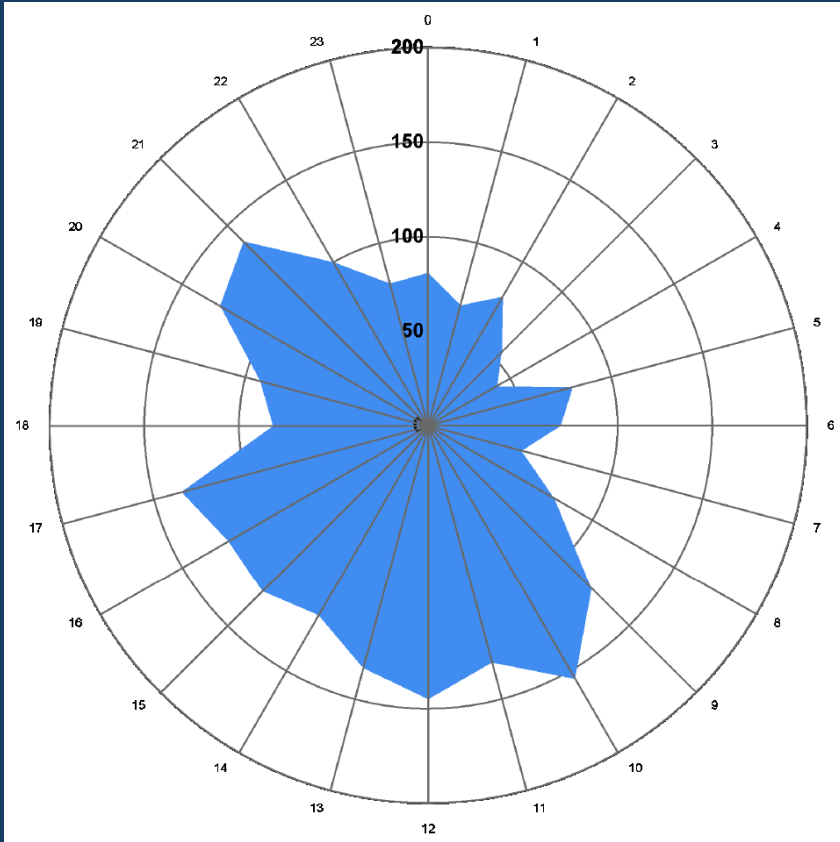
CQI in Smart Pump Systems

- Goals:
 - Minimize basic infusion
 - Minimize override of guardrails
- CQI data should be available in real-time online and customizable for daily, monthly and quarterly comparisons
- Key Performance Indicators with drill-down functionality
 - Chronogram
 - Severe Harm Averted
 - Top 5 overrides

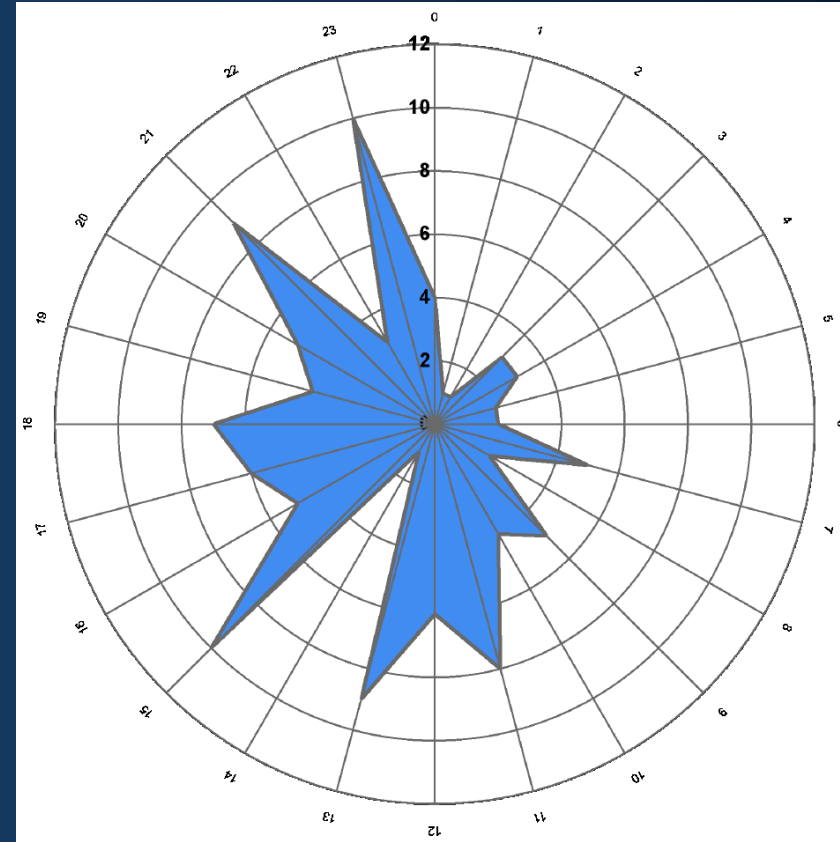


Figure 1. Man Walking Up Continuous Improvement Ladder: <https://www.duperrin.com/english/wp-content/uploads/2021/03/continuous-improvement-scaled.jpeg>. Accessed 6/6/2023

CQI Data: Chronogram



Override 2023 Q1



Harm Index – All Harms Averted 2023 Q1

BD Carefusion. (2023). *Infusion Analytics Service for Alaris Products (01/01/2023-03/31/2023)*.

CQI Data: Severe Harm Averted – Mag Infusion L&D



- 38F brought in by ambulance due to intrapartum hemorrhage during elective termination at outside facility with pregnancy
- Patient underwent emergent c-section with post-op preeclampsia complicated by possible undiagnosed HTN
- On 3/4/2023, measured BP was 175/92 and post-partum preeclampsia with severe features was diagnosed; magnesium drip initiated at 2gm/hour (50 mL/hr)

MAGN0.32 - MAGNESIUM SULF 20 GM/500 ML (MAGNESIUM SULFATE 20 GM/500 ML) 20 G - 500 ML

ROUTE: IV
 SITE: ORDERED RATE:
 TOTAL VOLUME: 500 MLS RATE: 50 MLS/HR DURATION: 10 HR
 ORDERED VOLUME: 500 MLS
 SIG: ASDIR (SCH)

Profile	Device Number	Drug Name and Therapy	Log Time	Patient ID	Clinician ID	Concentration	Guardrails® Alert Type	Alert Value	Alert Limit	Reprogrammed Value	Alert Unit	Inf. Rate
L & D / OB		mag sulfate infusion, Unknown	3/4/2023 12:12		Unknown	0.0400 gram/mL	Continuous Dose	20	8	2	gram/h	500.0000 mL/h

BD Carefusion. (2023). *Infusion Analytics Service for Alaris Products (01/01/2023-03/31/2023)*.

Figure 1. Warning Sign: https://cdn.pixabay.com/photo/2013/07/12/14/33/attention-148478_960_720.png. Accessed 6/6/2023

CQI Data: Severe Harm Averted – Sedation in ICU



Profile	Device Number	Drug Name and Therapy	Log Time	Patient ID	Clinician ID	Concentration	Guardrails® Alert Type	Alert Value	Alert Limit	Reprogrammed Value	Alert Unit	Inf. Rate
Critical Care		dexMEDETOmidine, Unknown	2/14/2023 23:06		Unknown	4.0000 mcg/mL	Continuous Dose	10	2.5	1	mcg/kg/h	294.2500 mL/h

- 52M brought in by ambulance after motorcycle crash, thrown 20-25 feet off his motorcycle
- Code green tier 1 activated; patient had abdominal pain, went to OR for exploratory laparotomy.
- On 2/13 intubated/sedated to reduce stress on abdominal closure
- On 2/14 dexmedetomidine was running at 1 mcg/kg/hr to manage sedation

```

IV drip 5: DEXMEDETOMIDINE HCL
IV drip 5 status: Start

IV drip 5: DEXMEDETOMIDINE HCL
IV drip 5 concentration: 1000 MCG/250 ML
IV drip 5 new dosage: 1
IV drip 5 dose units: mcg/kg/hr
IV drip 5 dosage in ml/hr:
IV drip 5 titrate parameter: RASS -2
IV drip 5 parameter value:
RASS -2
IV drip 5 actual parameter value:
IV DRIP RUNNING AT 1 MCG/KG/MIN WHEN SHIFT STARTED
    
```

BD Carefusion. (2023). *Infusion Analytics Service for Alaris Products (01/01/2023-03/31/2023)*.

Figure 1. Warning Sign: https://cdn.pixabay.com/photo/2013/07/12/14/33/attention-148478_960_720.png. Accessed 6/6/2023

CE Credit Deadline: 8/25/23

Confidential: Not for distribution

CQI Data: Top 5 Overrides

- Displays observations of override alerts and current settings
- Gives opportunities to update pumps if warranted to minimize overrides
- Identify trends in dosing and prescribing patterns

Top 5 Overrides					
Drug Name	Guardrails® Alert Type	Guardrails® Limit	Below Above Limit	# of Alerts	Observations
AMIODArone	Continuous Dose	0.9000 mg/min	Below	336	93% of Alerts had a value of 0.5000 mg/min
propofol	Bolus Dose	0.5000 mg/kg	Below	60	30% of Alerts had a value of 0.3000 mg/kg
FENTanyl	Continuous Dose	250.0000 mcg/h	Above	58	84% of Alerts had a value of 300.0000 mcg/h
potassium PHOSPHATE	Primary Intermittent Concentration	0.0700 mmol/mL	Above	51	24% of Alerts had a value of 0.0720 mmol/mL
albumin 25 %	Fluid Rate	400.0000 mL/h	Above	40	45% of Alerts had a value of 500.0000 mL/h

BD Carefusion. (2023). *Infusion Analytics Service for Alaris Products (01/01/2023-03/31/2023)*.

Knowledge Check Question 3

Which of the following is *not true* regarding continuous quality improvement (CQI)?

- A. CQI is a progressive incremental improvement of processes, safety and patient care
- B. CQI is used in smart pump technology to minimize basic infusion
- C. CQI data is used to evaluate how physician orders are carried out and implement best practice and compliance improvements
- D. CQI is used in smart pump technology to maximize the number of guardrail overrides

Knowledge Check Question 3 | Answer...

Which of the following is *not true* regarding continuous quality improvement (CQI)?

- A. CQI is a progressive incremental improvement of processes, safety, and patient care
- B. CQI is used in smart pump technology to minimize basic infusion
- C. CQI data is used to evaluate how physician orders are carried out and implement best practice and compliance improvements
- D. CQI is used in smart pump technology to maximize the number of guardrail overrides**

Three parallel orange diagonal lines on the left side of the slide.

Multi-Disciplinary Approach to Continuous Quality Improvement

Smart Pump Challenges

- Facility drug library use goal is greater than 95%
- No max recommended dose or wide dosing parameters based on patient response or different indications
- Large dosing differences (opioid naïve vs. tolerant or end of life)
- Lack of facility resources for maintaining and timely updating of drug library
- Interoperability: pump not integrated with CPOE, EHR and BCMA
- Transition process to a facility specific pump when a patient transfers from another facility with meds infusion



Institute for Safe Medication Practices (ISMP). Safety considerations for challenges when using smart infusion pumps. *ISMP Medication Safety Alert! Acute Care*. 2022;27(21):1-5.

Figure 1. Challenges on Desert Road: <https://depositphotos.com/84025640/stock-photo-challenges-on-desert-road.html>. Accessed 6/6/2023

CPOE = computerized prescriber order entry; EHR = electronic health record; BCMA = barcode medication administration

Alaris Pump Guardrail Utilization Trend

2021

Guardrails Utilization														Total Infusions Administered using Guardrails divided by the total infusions administered
TARGET	PY AVERAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2021 Average
≥ 95%	92.3%	92.8%	91.9%	92.0%	91.7%	91.8%	91.7%	91.5%	91.7%	93.9%	94.4%	95.0%	94.6%	92.8%

2022

Guardrails Utilization														Total Infusions Administered using Guardrails divided by the total infusions administered
TARGET	PY AVERAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2022 Average
≥ 95%	92.8%	94.6%	92.6%	94.8%	95.5%	95.6%	95.7%	95.3%	96.2%	95.8%	95.4%	95.5%	95.6%	95.2%

2023

Infusion Pump Guardrails Utilization														
Total Infusions Administered using Guardrails divided by the total infusions administered														
2023														
PY AVERAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2023 Average	
95.2%	96.1%	96.9%	96.6%	96.4%										96.5%

Journey to Promote and Improve Pump Safety



Pharmacist Resource for Pump Management

- Dedicated clinical pharmacist with knowledge of pump technology and maintenance of drug library
- Provides guidance for standard concentrations recommendations to Pharmacy and Therapeutics committee approval
- Acts as subject matter expert for drug dosing, administration rate, IV compatibility
- Review CQI data for trends and recommend changes
- Review drug library transfer data report to ensure all pumps are on the current version

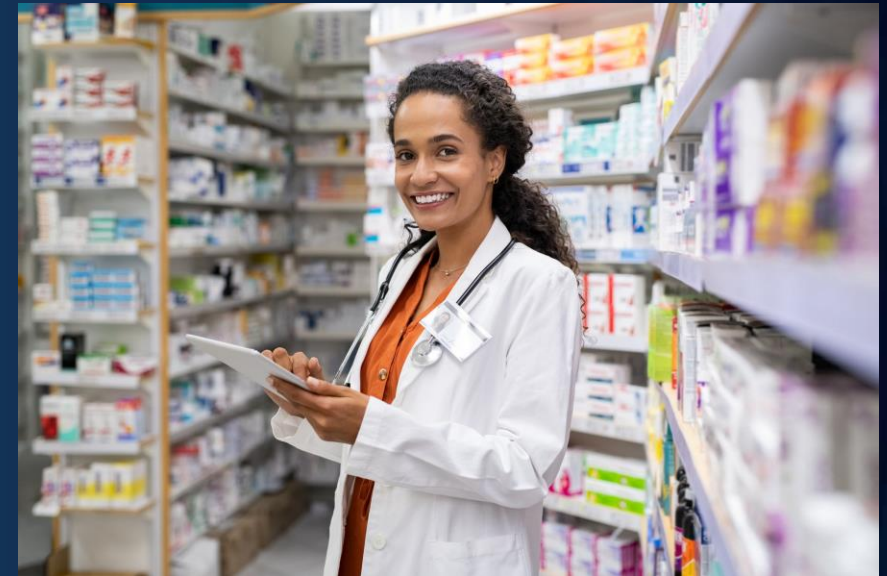


Figure 1. Pharmacist's Role in Patient Care: https://www.amnhealthcare.com/siteassets/amn-insights/news-and-features/pharmacists_role.jpg. Accessed 6/6/2023

Medication Safety and Medical Staff Committees

- Non-punitive approach to medication safety
- Review, track, trend errors related to pump use and propose potential system changes
- Evaluate smart pump guardrail utilization, identify trends, and update settings based on evidence-based best practices
- Review overall CQI data
 - Review pump library utilization and specific profile percentile
 - Conduct subgroup focused meeting to recommend changes for next library release
- Med Safety Committee recommends changes to Smart Pump Library to various med staff committees for approval (Medicine, Critical Care, Cardiology)



Figure 1. Collaboration Cartoon: https://scope.bccampus.ca/pluginfile.php/59301/mod_label/intro/BCCampus-FLOGuide-FacilitationTeams-Colour.png. Accessed 6/6/2023

Med Safety Committee Subgroup Discussion and Result

Quarter 4 2022

Top 5 Overrides					
Drug Name	Guardrails® Alert Type	Guardrails® Limit	Below Above Limit	# of Alerts	Observations
AMIODArone	Continuous Dose	0.9000 mg/min	Below	282	89% of Alerts had a value of 0.5000 mg/min
cisATRAcurium	Continuous Dose	5.0000 mcg/kg/min	Above	87	47 mcg/kg
insulin REGULAR	Continuous Dose	0.4900 unit/kg/h	Above	73	15 units/kg/h
albumin 25 %	Fluid Rate	400.0000 mL/h	Above	72	65 mL/h
morphine Pall Care	Continuous Dose	30.0000 mg/h	Above	68	22 mcg/h

Quarter 1 2023

Top 5 Overrides					
Drug Name	Guardrails® Alert Type	Guardrails® Limit	Below Above Limit	# of Alerts	Observations
AMIODArone	Continuous Dose	0.9000 mg/min	Below	336	93% of Alerts had a value of 0.5000 mg/min
propofol	Bolus Dose	0.5000 mg/kg	Below	60	30% of Alerts had a value of 0.3000 mg/kg
FENTanyl	Continuous Dose	250.0000 mcg/h	Above	58	84% of Alerts had a value of 300.0000 mcg/h
potassium PHOSPHATE	Primary Intermittent Concentration	0.0700 mmol/mL	Above	51	24% of Alerts had a value of 0.0720 mmol/mL
albumin 25 %	Fluid Rate	400.0000 mL/h	Above	40	45% of Alerts had a value of 500.0000 mL/h

Drug Name Therapy Concentrations	Module		Conc. Limits	Dosing Units	Continuous			
	P	S			Soft Min	Soft Max	Hard Max	Initial Value
AMIODArone 1st Inf 1mg/min 6hr 360 mg / 200 mL (1.8 mg / mL) 450 mg / 250 mL (1.8 mg / mL)			N/A	Continuous mg/min	0.4		1.1	1
AMIODArone 2nd Inf 0.5mg/min 18hr 360 mg / 200 mL (1.8 mg / mL) 450 mg / 250 mL (1.8 mg / mL)			N/A	Continuous mg/min	0.4	0.6	1.1	0.5

BD Carefusion. (2023). *Infusion Analytics Service for Alaris Products (01/01/2023-03/31/2023)*.

Los Robles Regional Medical Center. (2023). *Data Set Report (LRHMC V43 23-05-23)*.

CE Credit Deadline: 8/25/23

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Med Safety Walkabouts

- Walkabouts on different units conducted by pharmacists, nursing leaders and student pharmacists.
- Purpose is to ask end users for basic knowledge about pump safety and query on feedback on other medication safety issues.
- Example Questions:
 - Is the smart pump library standardized for pediatric and adult dosing?
 - How often do you receive questions about mismatch concentrations from the EHR and smart pump?
 - If you are using a smart infusion pump to administer a medication and the concentration of the product is different than what is in the smart pump, what would you do?
 - Describe the process for double checking the pump setting of a high-risk drug? Do you have concerns with this process?

Med Safety Walkabout Success Examples

Added 2 different peds IV fluids
DKA patients

Added new antibiotics for peds
patients

Added Dextrose 20% on critical
Care and PCU/Tele profiles

Fluids - PEDS							
Fluid Name Therapy	Supports Secondary	Module		Rate Limits (mL/h)			Clinical Ads. Name
		P	S	Soft Min	Soft Max	Hard Max	
DKA- D10%+ Additives	Yes	X	X	0.1	255		
DKA- NS + Additives	Yes	X	X	0.1	255		
FLUSH	Yes	X	X	0.1	150		

Fluids - CRITICAL CARE							
Fluid Name Therapy	Supports Secondary	Module		Rate Limits (mL/h)			Clinical Ads. Name
		P	S	Soft Min	Soft Max	Hard Max	
Cryoprecipitate	No	X	X	1	999		
Dextrose 10%	Yes	X		1	250		
Dextrose 20%	Yes	X		1	250		Central Line Only
Fresh Frozen Plasma	No	X		1	999		Indicate Volume

Pharmacy Student Program

- Started pharmacy student precepting program in May 2020
- IPPE students on 2-4 weeks of rotation
- APPE students on 6-week rotation
- Medication Safety Component
 - Review components of the Alaris pump
 - Hands on training on how to use the pump
 - Daily hospital wide audits
- Recorded video demonstration to embed into learner curriculum



Figure 1. Pharmacy Sign: <https://www.picpedia.org/highway-signs/images/pharmacy.jpg>. Accessed 6/6/2023

Student Pharmacist Videos



Syringe module training for respiratory technicians for continuous albuterol administration



Basic smart pump tutorial, including programming of drug infusion and promoting to guardrail therapy from basic infusion

Liou, D. (2022). *Alaris Syringe Module Aerogen Respiratory Training*. Retrieved June 6, 2023, from <https://mediaconnect.app.medicity.net/#/videos/c77b0acd-6111-46ff-bc80-427a80dcca74>
Trigueiro, K. (2021). *Alaris functions: Patient ID, Guardrails, and Promote*. Retrieved June 6, 2023, from <https://mediaconnect.app.medicity.net/#/videos/7d1d7092-45b6-4772-a78f-519e5859ce39>

Daily Smart Pump Audits and Biomed Involvement

- Direct observation to measure compliance and identify areas of opportunity
- Allow students to interact and develop communication skills with patients (AIDET)
- Allow students an opportunity to be part of the multidisciplinary team
- Allow student learners to perform direct observations of smart pump utilization and provide just-in-time education to improve compliance
- Remove and quarantine defective pumps (e.g., low battery, no wifi) to BioMed Department for maintenance



Figure 1. Audit Cartoon: <https://2.bp.blogspot.com/-WgKAL26xcfU/Wbbt86W1t7I/AAAAAAAAABaw/tQVJbC1k0wl6qJu-IXHG5P0VvXaC75QGQCLcBGAs/s320/Contoh%2B121%2BSkripsi%2BAkuntansi%2BAudit%2BLengkap%2BBAB%2B1-5%2BBisa%2BCOPAS.jpg>. Accessed 6/6/2023

RN Education Provided by Students



Los Robles Hospital and Medical Center
Department of Pharmacy Services

Alaris Pump Audit Tip Sheet

Question:

What should we audit when looking at the pump?

Answer:

- ✓ Check to see if pump is plugged in, turned on, and wifi light is lit.
- ✓ Check the pump is on the correct version of Guardrail Library
- ✓ Check Patient ID is filled in as Patient room number.
- ✓ Check to see if the pump is on the correct profile for the unit.
- ✓ Check active pump modules to ensure marquee is scrolling with the medication info.

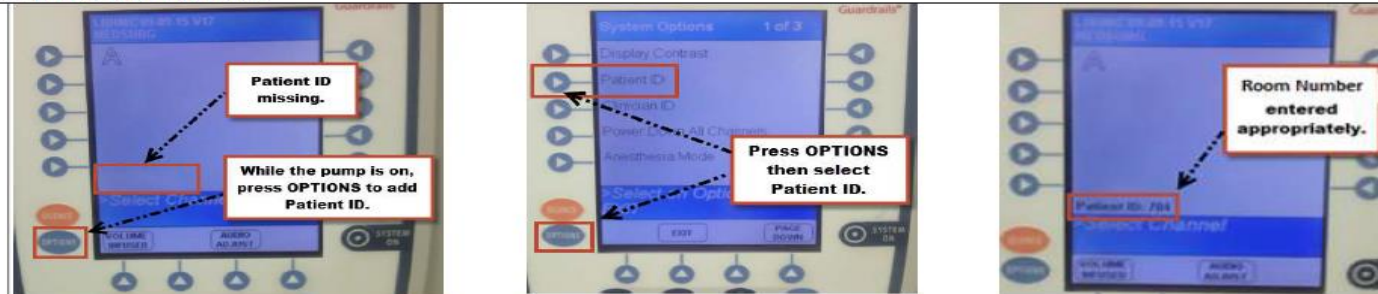
Question:

How to add Patient ID to a pump during infusion without turning the pump off?

Answer:

While the pump is running, press OPTIONS, then select Patient ID. Enter the patient room number.

DO NOT TURN PUMP OFF!



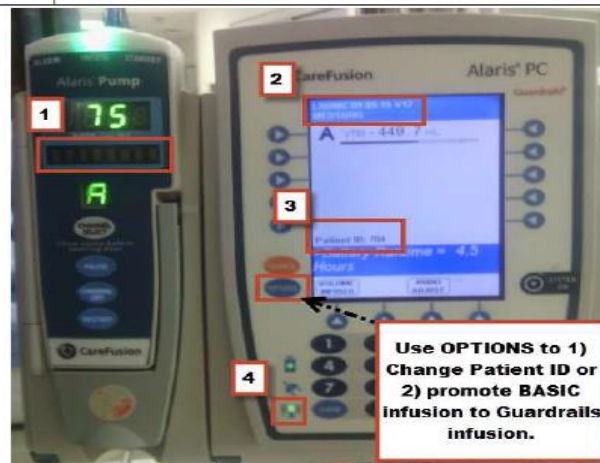
Question:

How to promote a pump from BASIC infusion to GUARDRAIL drug/fluid without turning the pump off?

Answer:

While the pump is running, press CHANNEL SELECT, then press OPTIONS. Select Guardrail Drugs or Guardrail IV Fluids and program the pump accordingly.

DO NOT TURN PUMP OFF!



Question:

What are the elements on the pump that I should audit for?

Answer (see left):

- 1) Look to see if any module is running basic infusion (the marquee is not scrolling).
- 2) Check that the pump has the updated drug library AND in the correct care profile (e.g. Critical Care, MedSurg, etc.).
- 3) Check to see if Patient Room Number is entered in the Patient ID field.
- 4) Check to see if the WIFI light is lit (should be green). If not, report to Biomedical at *74446

Question:

How to change the care profile (e.g., from Critical Care to MedSurg)?

Answer:

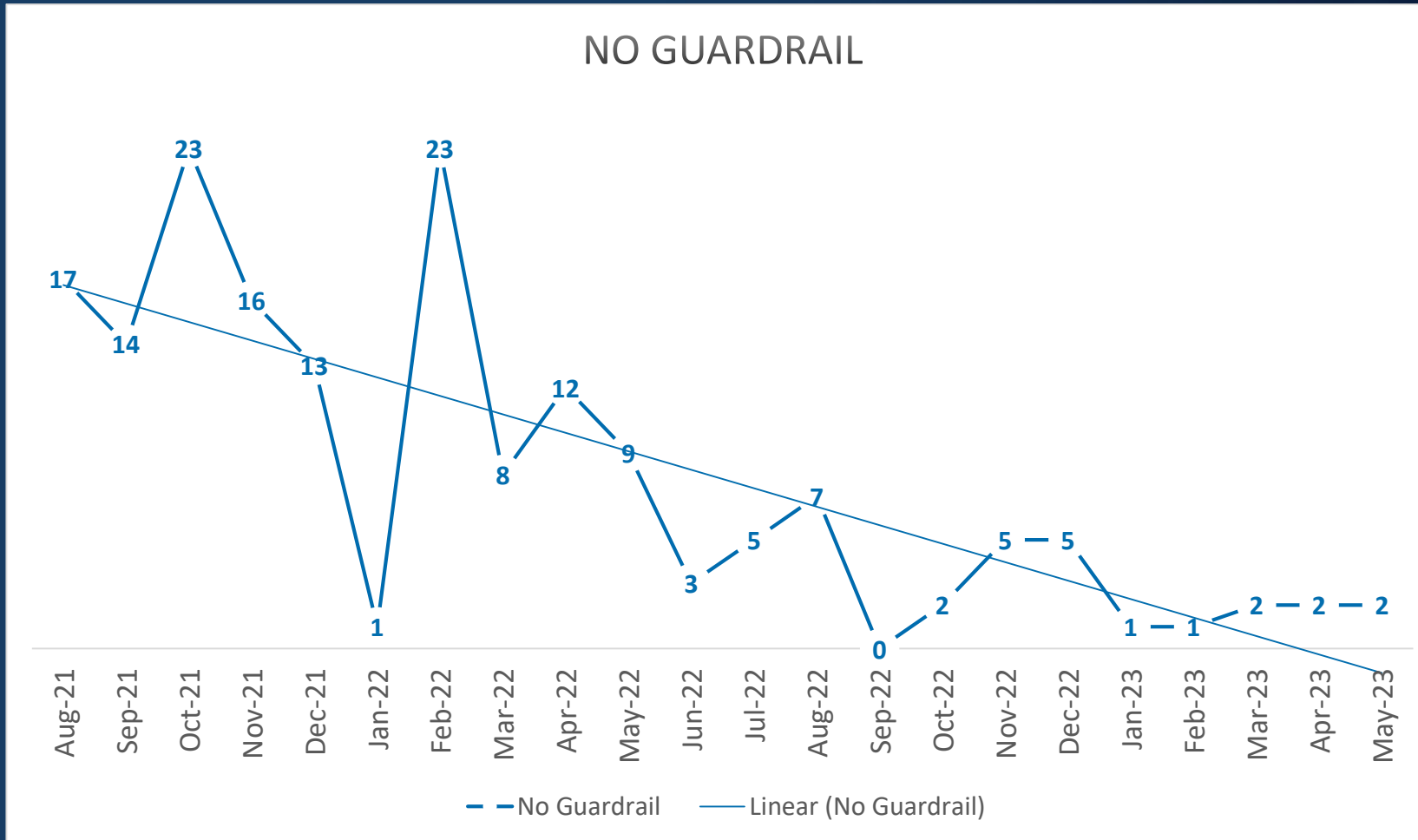
The only way to change the care profile is by turning the pump OFF. **Be sure to select YES for "New Patient" prompt.**

Student Audit Template and Results from 2021-2023

Date	Room	Plugged In	Version 43	Correct Profile	Pt Identifier	Battery	Wifi	Running on Guardrails	Med Stickers Present	Additional Notes	BioMed Needed	RN	I-trace (ICU)	IV Line Labels (top/ bottom/ both)
------	------	------------	------------	-----------------	---------------	---------	------	-----------------------	----------------------	------------------	---------------	----	---------------	------------------------------------

Running In Guardrails 2021= 90%		Running in Guardrails 2022 = 97%		Running in Guardrails 2023 = 99%	
No	83	No	74	No	8
August	17	January	1	January	1
September	14	February	23	February	1
October	23	March	8	March	2
November	16	April	12	April	2
December	13	May	9	May	2
		June	3		
Yes	760	July	5	Yes	856
August	120	August	7	January	275
September	127	September	0	February	165
October	198	October	2	March	139
November	216	November	5	April	171
December	99	December	5	May	106
		Yes	2639		
		January	62		
		February	332		
		March	289		
		April	397		
		May	242		
		June	233		
		July	235		
		August	189		
		September	218		
		October	120		
		November	154		
		December	169		

Monthly Guardrail Audit Trend



End User Feedback

- Online form available to request changes or report issues
- Provide feedback to student pharmacists during daily audits or unit-based pharmacists
- Managers/Directors bring up concerns from staff regarding pump issues and report during daily safety huddles
- Report medication errors and close calls related to pump in facility incident reporting system



Figure 1. Feedback Chalkboard handwriting: <https://sarahnollwilson.com/wp-content/uploads/2017/03/pexels-photo-247708.jpeg>. Accessed 6/6/2023

Pump It Up! Summary

- Smart pumps can assist the end user to administer medication accurately and safely to the patient
- Standard concentrations reduce programming and dosing errors by minimizing wild card concentrations
- If wild card concentration needs to be used, hard minimum concentration should be established
- Continuous quality improvement is a progressive incremental process to analyze basic infusions, guardrail overrides, and smart pump updates as needed to improve safe delivery of medications
- Pump safety involves multi-disciplinary team approach which can bring added value, satisfaction and enhanced patient safety

References

- The Different Types of IV Infusion Pumps: <https://www.medonegroup.com/aboutus/blog/the-different-types-of-iv-infusion-pumps>. Accessed 6/6/2023
- Large Volumetric Infusion Pumps Inventory Management and Usability: <https://www.ncbi.nlm.nih.gov/books/NBK361678>. Accessed 6/6/2023
- What is an Infusion Pump: <https://www.fda.gov/medical-devices/infusion-pumps/what-infusion-pump>. Accessed 6/6/2023
- Infusomat Space Large Volume Pump: <https://www.bbraunusa.com/en/products/b4/us-infusomat-space.html>. Accessed 6/6/2023
- Perfusor PCA Syringe Pump: <https://www.bbraunusa.com/en/products/b4/perfusor-pcainfusionpumpsystem.html>. Accessed 6/6/2023
- BD Alaris Infusion System: <https://www.bd.com/en-us/products-and-solutions/products/product-brands/alaris#infusionsystem>. Accessed 6/6/2023
- Spectrum IQ Infusion System: <https://www.baxter.com/healthcare-professionals/hospital-care/spectrum-iq-infusion-system>. Accessed 6/6/2023
- Novum IQ Syringe Infusion Pump: <https://www.baxter.com/healthcare-professionals/hospital-care/novum-iq-syringe-infusion-pump>. Accessed 6/6/2023
- Meet The Ivenix Infusion System: <https://www.ivenix.com/our-system/>. Accessed 6/6/2023
- Plum 360 Infusion System: <https://www.icumed.com/products/infusion-therapy/iv-systems/large-volume-iv-pumps>. Accessed 6/6/2023
- LifeCare PCA: <https://www.icumed.com/products/infusion-therapy/iv-systems/patient-controlled-analgesia>. Accessed 6/6/2023
- InfuTronix The new generation of infusion devices, Meet Nimbus: <https://infutronix.com/>. Accessed 6/6/2023
- Infusion Pumps and Supporting Platforms: <https://zynosolutions.com/Brochures.html>. Accessed 6/6/2023
- 2022-2023 Targeted Medication Safety Best Practices for Hospitals: <https://www.ismp.org/guidelines/best-practices-hospitals>. Accessed 6/6/2023

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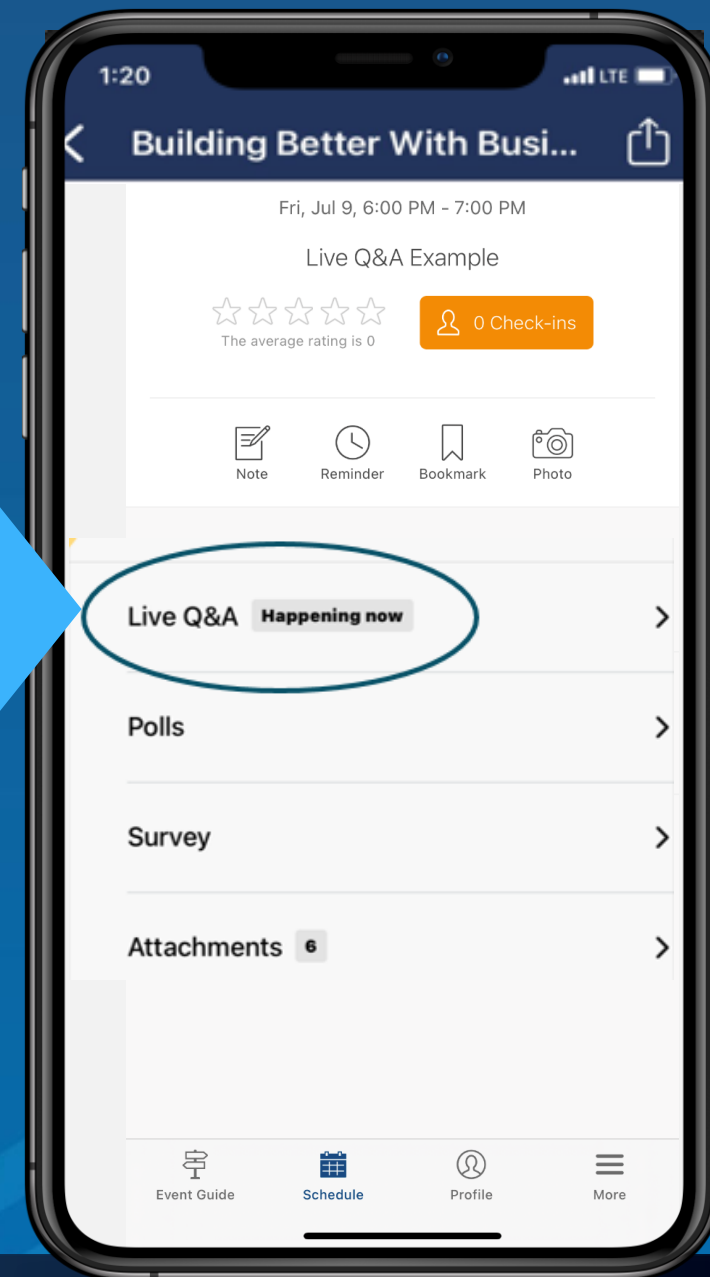
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