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National Infusion Collaborative Clinical Meeting

Summer Clinical Meeting
June 25, 2025

Meeting Logistics and Introductions



Sara Mirzaei, PharmD, BCPS, BCPPS, CPHQ
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Children's Hospital Colorado



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Joanne Hatfield, PharmD, BCPS
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Navigating Zoom

Q&A Box and Chat Box: For any questions or comments throughout the presentation

Raise Hand: For the open mic discussion, please press "Raise Hand" if you wish to speak

Post-Meeting Survey: Following today's meeting, please let us know how we can improve going forward

National Infusion Collaborative Infusion Trends

Joanne Hatfield, PharmD, BCPS
Director - Clinical Solutions
Bainbridge Health

Enhancing Medication Safety: The Importance of Pharmacist-Nurse Collaboration in Pump Drug Library Builds

Sara Mirzaei, PharmD, BCPS, BCPPS, CPHQ
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Open Mic / Q&A

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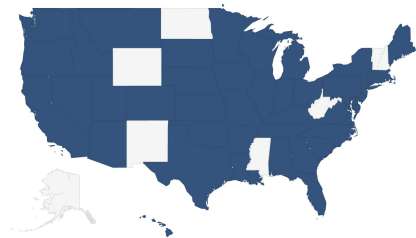
Infusion Metric Trends

Joanne Hatfield, PharmD, BCPS
Director - Clinical Solutions
Bainbridge Health

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3/1/25 - 5/31/25



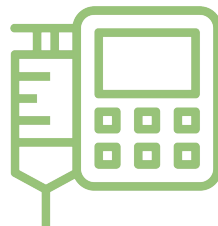
>500

Hospitals



>80,000

Infusion Pumps



>17 million

Infusion Records



> 900,000

Alerts

National Infusion Collaborative



Key Performance Indicators

3/1/25 – 5/31/25

Compliance

Alert Rate

Override Rate

Pediatric Network

86.8%

7.3%

66%

Adult Network

89.7%

6.2%

69%

Poll Questions

1) Who is involved in the governance of smart infusion pumps at your health system?

1. Pharmacy only
2. Pharmacy and Nursing
3. Pharmacy, Nursing, and additional disciplines (Physicians, Quality, Patient Safety, etc.)
4. Not sure

2) Do you utilize the bolus from continuous infusion feature in your smart pump drug library?

1. Yes
2. No
3. Considering
4. Not sure

Enhancing Medication Safety: The Importance of Pharmacist-Nurse Collaboration in Pump Drug Library Builds

Sara Mirzaei, PharmD, BCPS, BCPPS, CPHQ

Lani Ochoa, BSN, RN, CPN



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Children's Hospital Colorado

623

Licensed Beds

4

Hospitals

151,253

Emergency visits

19,448

Inpatient admissions

45,734

Urgent care visits

697,194

Outpatient visits

30,720

Total surgeries

140,574

Days of patient care



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Our Technology



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Our Team

Structure:

- Pharmacy Services
- Partner with Patient Safety

What we do:

- Retroactive and Proactive Safety Work
- Consulting/Mentoring/Education
- Policies and Procedures
- Committee Involvement
- Automation and Medication-use Technology

...and so much more!



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A Safety Story...



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Drug Library Evaluation

Initial Scope: Fentanyl, Morphine, Hydromorphone & Midazolam

1. Drug Information (Lexidrug, Clinical Pathways, etc)
2. Order Information (Epic SlicerDicer)
3. Library Dose Limits

Update Hydromorphone Bolus Dose Max: 0.3 mg/kg $\square$ 0.15 mg/kg

Cogito SlicerDicer

Ordered Dose Amount and Unit	Ordered Dose Amount and Unit	Ordered Dose Amount and Unit	Ordered Dose Amount and Unit	Ordered Dose Amount and Unit	Weight ...
HYDROmorphine (0.1 mg/mL) pump bolus 0.025-0.15 mg	0.0050 mg/kg/dose	0.01	mg/kg/dose	0.03	5
HYDROmorphine (0.5 mg/mL) pump bolus 0-0.37 mg	0.0000 mg/kg/dose	0.00	mg/kg/dose	0.02	19
HYDROmorphine (0.1 mg/mL) pump bolus 0.025-0.125 mg	0.0050 mg/kg/dose	0.01	mg/kg/dose	0.03	5
HYDROmorphine (0.5 mg/mL) pump bolus 0-0.11 mg	0.0000 mg/kg/dose	0.00	mg/kg/dose	0.01	19
HYDROmorphine (0.5 mg/mL) pump bolus 0.03-0.25 mg	0.0050 mg/kg/dose	0.01	mg/kg/dose	0.05	5
HYDROmorphine (0.5 mg/mL) pump bolus 0.23 mg	0.0050 mg/kg/dose	0.01	mg/kg/dose	—	45
HYDROmorphine (0.5 mg/mL) pump bolus 0.44 mg	0.0150 mg/kg/dose	0.01	mg/kg/dose	—	29



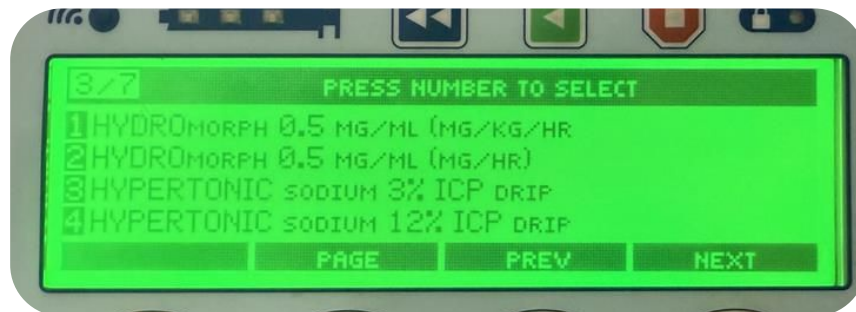
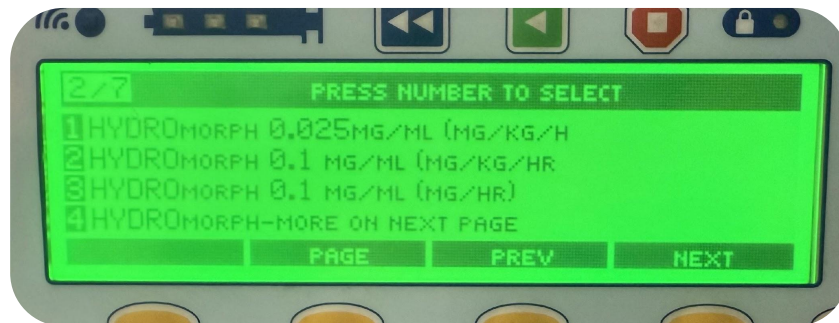
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Drug Program Properties - HYDROmorphine 0.1 mg/ml peds (mg/kg/hr)	
(Drug Name)	HYDROmorphine 0.1 mg/ml peds (mg/kg/h
Display Text	HYDROmorph 0.1 mg/ml (mg/kg/hr
Drug Classifications	Continuous
Infusion Type	dose/kg/hr
Syringe Model	(none)
Syringe Size	(none)
Drug Alert	Hydromorphone 0.1 mg/ml peds
ID	
Description	
▼ Infusion Units	
Concentration Units	milligrams (mg)
Delivery Units	milligrams (mg)
▼ Main	
Concentration Maximum	(none) mg/mL
Concentration High	(none) mg/mL
Concentration	0.1 mg/mL
Concentration Low	(none) mg/mL
Concentration Minimum	(none) mg/mL
Dose Maximum	0.3 mg/kg/hr
Dose High	0.05 mg/kg/hr
Dose	(none) mg/kg/hr
Dose Low	0.001 mg/kg/hr
Dose Minimum	(none) mg/kg/hr
Patient Weight	(none) kg
▼ Options	
Loading	Disabled
Loading Dose Maximum	(none) mg/kg
Loading Dose High	(none) mg/kg
Loading Dose	(none) mg/kg
Loading Dose Low	(none) mg/kg
Loading Dose Minimum	(none) mg/kg
Loading Time Units	MM:SS
Loading Time Maximum	(none) MM:SS
Loading Time High	(none) MM:SS
Loading Time	(none) MM:SS
Loading Time Low	(none) MM:SS
Loading Time Minimum	(none) MM:SS
Bolus	Enabled
Bolus Dose Maximum	0.3 mg/kg
Bolus Dose High	0.06 mg/kg
Bolus Dose	(none) mg/kg
Bolus Dose Low	0.001 mg/kg
Bolus Dose Minimum	(none) mg/kg
Bolus Time Units	MM:SS
Bolus Time Maximum	(none) MM:SS
Bolus Time High	(none) MM:SS
Bolus Time	(none) MM:SS
Bolus Time Low	02:00 MM:SS
Bolus Time Minimum	(none) MM:SS
Loading/Bolus Rate Maximum	(none) mg/kg/hr
Volume Limit	(none) mL
KVO Rate Maximum	(none) mL/hr

Alternative Approaches to Narrow Dose Limits

- Weight-banding
- Palliative Care Entries



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Deep Dive: Dose Alerts

Drug: Hydromorphone gtt (all concentrations)

Date Range: 2 years

Pump Bolus Dose Alert Rate: 11.36%

Weight/BSA	Parameter	Previous Value	Entered Value	Hard Min	Soft Min	Soft Max	Hard Max	Final Value
35.7 kg	Bolus Dose mg/kg	0.01	0.321	0.0008	0.001	0.06	0.3	0.009
Total Dose Entered ☐ Hard Limit Exceeded ☐ Corrected								
8.89 kg	Bolus Dose mg/kg	0	8.89	0.0006	0.001	0.06	0.3	0.004
Pt. Weight Entered ☐ Hard Limit Exceeded ☐ Corrected								
6.8 kg	Bolus Dose mg/kg	0	0.068	0.0008	0.001	0.06	0.3	0.068
Total Dose Entered ☐ Soft Limit Exceeded ☐ Overridden								
17.4 kg	Bolus Dose mg/kg	0.073	0.072	0.0025	0.0025	0.06	0.3	0.072
Total Dose Entered ☐ Soft Limit Exceeded ☐ Overridden								

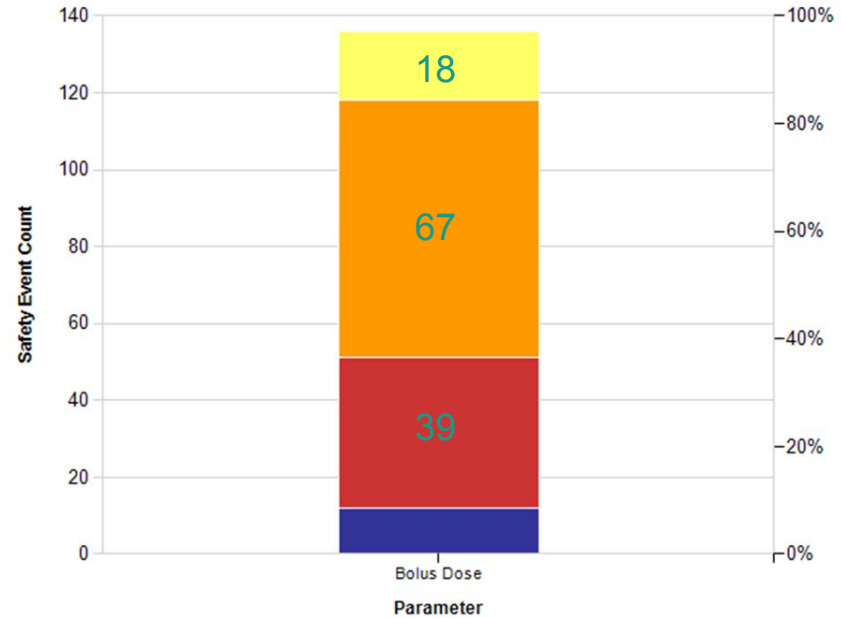
Common Error Modes:

- Inputting patient weight as dose
- Inputting total dose vs. weight-based dose

Most alerts were being overridden...



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- Soft Limit Reprograms
- % Infusions w/Soft Limit Reprograms
- Soft Limit Overrides
- % Infusions w/Soft Limit Overrides
- Hard Limit Alerts
- % Infusions w/Hard Limit Alerts
- Abandons
- % Infusions w/Abandons

Soft Limit Reprograms: A value is entered outside a soft limit range then reentered in range.

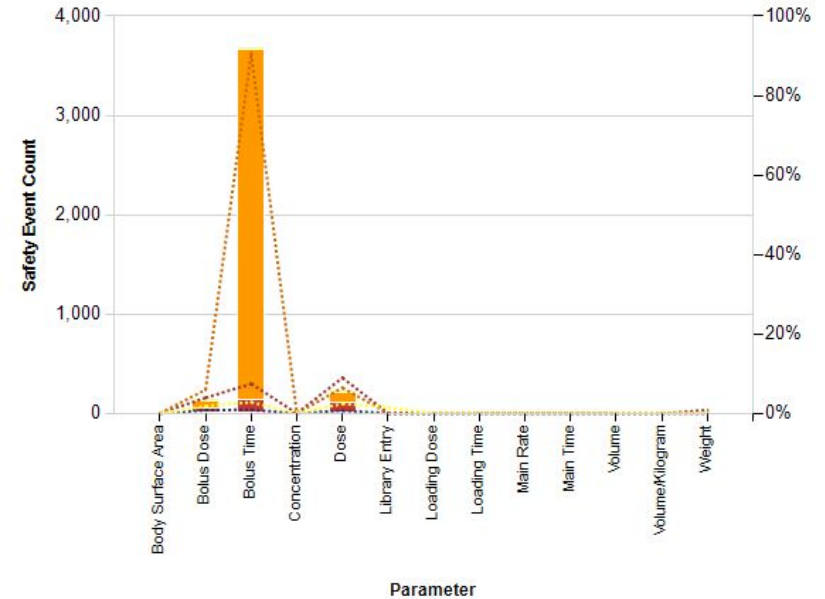
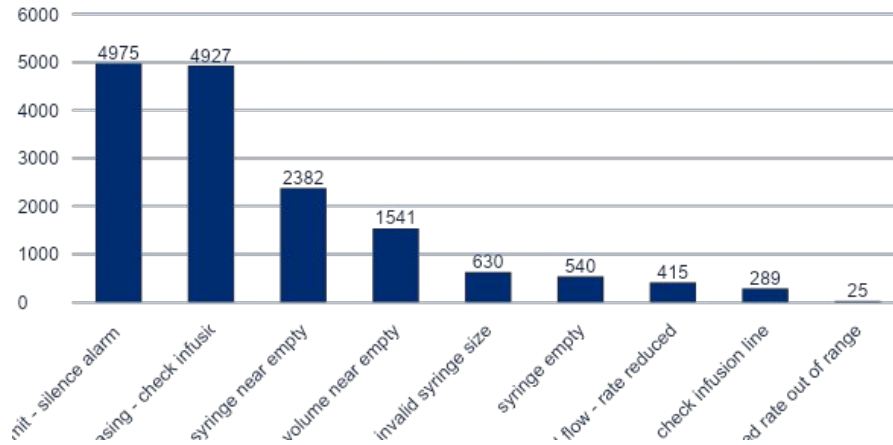
Soft Limit Overrides: A value is entered outside a max/min range (safety limit boundary).

Hard Limit Alerts: A value is entered outside a max/min range (safety limit boundary).

Abandons: A value is entered outside a range & the pump is powered off at the confirmation screen.

Zooming Out: Impact of All Clinical Alerts

Count of Clinical Alerts by Type Over 2 Years
Hydromorphone Continuous Infusions



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- Soft Limit Reprograms
- % Infusions w/Soft Limit Reprograms
- Soft Limit Overrides
- % Infusions w/Soft Limit Overrides
- Hard Limit Alerts
- % Infusions w/Hard Limit Alerts
- Abandons
- % Infusions w/Abandons

System Cause: Alert fatigue from bolus *Time* alerts is contributing to missed bolus *Dose* alerts during pump bolus programming

Alert: Pump Bolus Time

Medications: Midazolam, Morphine, Hydromorphone, Fentanyl

Date Range: 2 Years

Row Labels	fentaNYL	HYDROmorphon e	midazola m	morphin e	Grand Total
Abandon	6	10	3	3	22
Hard Limit Alert	166	112	61	24	363
Soft Limit Override	4914	3519	1613	1367	11413
Soft Limit Reprogram	62	23	18	48	151
Grand Total	5148	3664	1695	1442	11949

95.5%
override
rate



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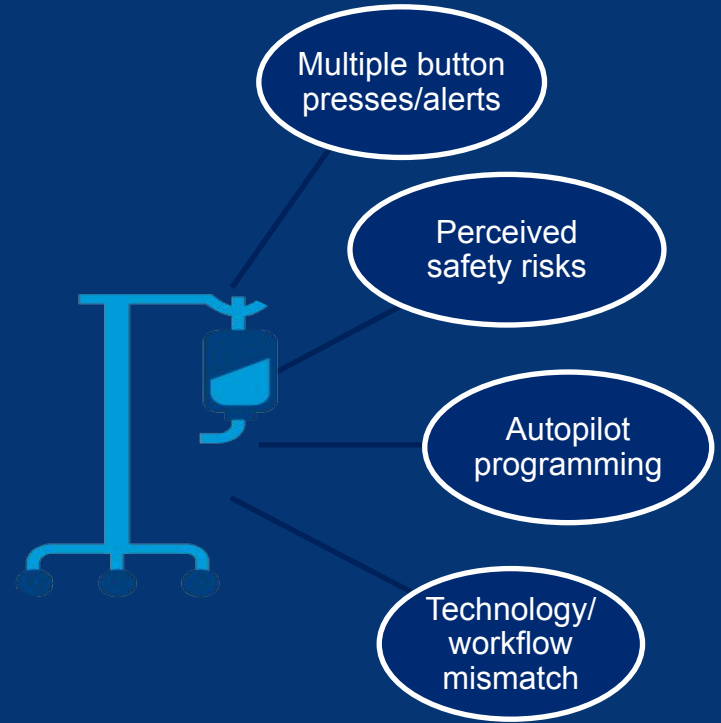
Finding the Missing Pieces



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ICU Rounding



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Current State: Epic Documentation

HYDROmorphine pump bolus 0.054-0.108 mg Ordered Dose: 0.003-0.006 mg/kg/dose × 18 kg : Admin Dose: 0.054-0.108 mg : Intravenous : Every 15 minutes as needed : BREAKTHROUGH PAIN, if ineffective response contact provider , interventions or to maintain COMFORT score within target range Target COMFORT score range: 17-26.

Order Information

Controlled Substance: Waste Witness required for partial dose/not given

Admin Instructions:
Bolus dose should equal current hourly rate.

Product Instructions:
This is a HIGH ALERT medication.

Extravasation Risk = GREEN
Ordered Admin Dose: 0.054-0.108 mg
Dispense Location: Central Pharmacy
Frequency: Every 15 minutes as needed
Route: Intravenous
Indications of Use: Analgesic
Linked Line: [Not Linked](#) (as of Today 02/17/25 at 0956)
Order Start Time: Today 02/17/25 at 0953
PRN Reasons: BREAKTHROUGH PAIN, if ineffective response contact provider
PRN Comment: interventions or to maintain COMFORT score within target range Target COMFORT score range: 17-26.
References: [CHCO Formulary](#)
[Extravasation](#)

Administration Details

Action	Date	Time	Comment
Pump Bolus	02/17/2025	0956	
Route	Site		
Intravenous			
Dose	0.054-... mg		

Cannot be a range
Ordered: 0.003-0.006 mg/kg/dose
Enter correct dose.

Associated Flowsheet Rows

Time taken: Responsible Restore ☐ Show Details

If no new assessment is needed, check the box to link flowsheet rows to the previous assessment. ☐ Use All Previous Values

PRN Medication Given Reason

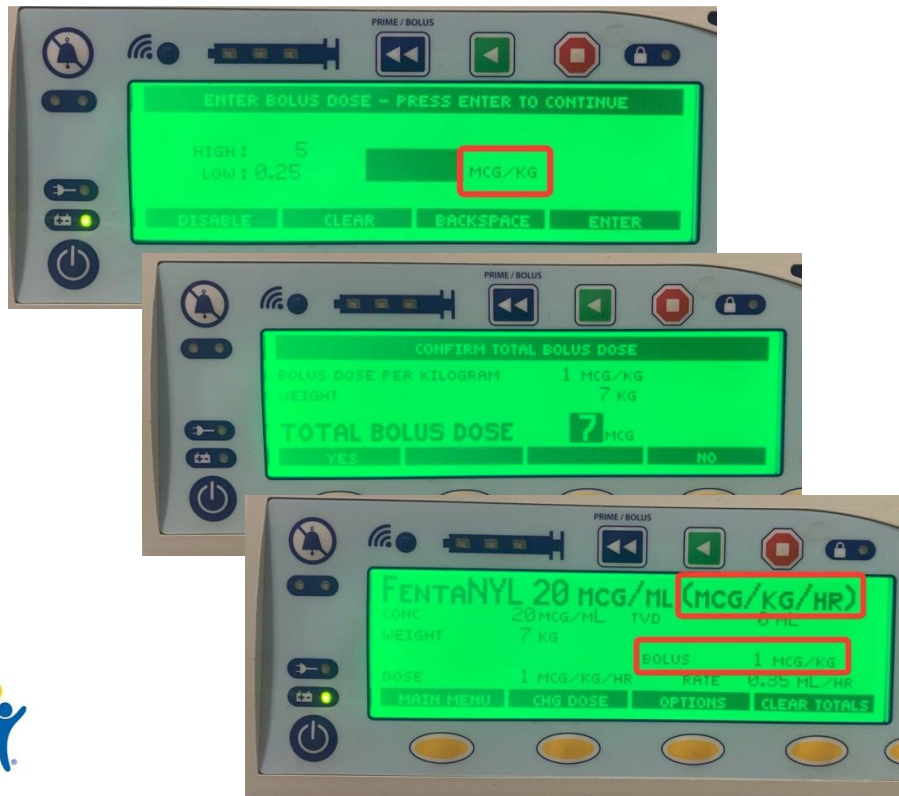
PRN Medication Given Reason

Pump bolus dose **MUST** be documented as “simple” units (mg, mcg, units)

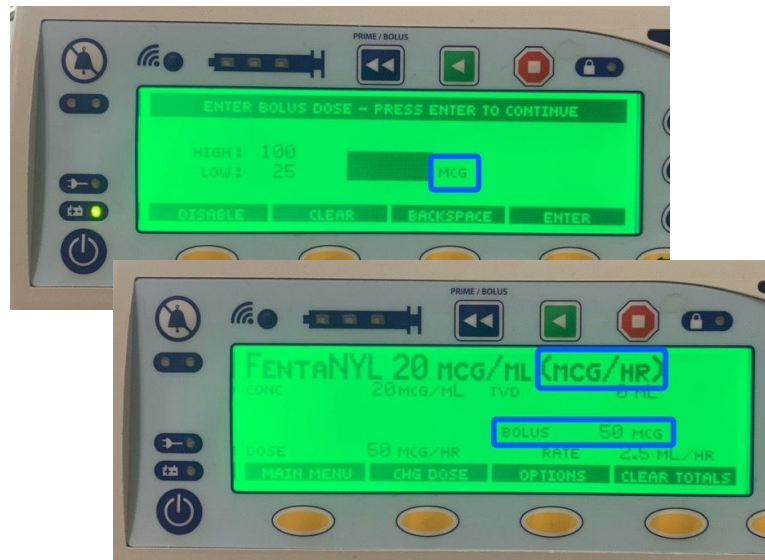


Pump Programming:

Weight-Based Infusions



Non-Weight Based Infusions



Pump bolus dose units **MUST** match continuous dose units



System Cause: Technology limitations force unit mismatch across pump programming & documentation for weight-based infusions

Syringe Pump Library

- Pump bolus dose units **MUST** match continuous dose units (mg/kg, mcg/kg, units/kg, etc)

Epic

- Pump bolus doses **MUST** be documented as “simple units” (mg, mcg, units, etc)



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Solution: MAR Visual Reminder

morphine pump bolus 0.02-0.04 mg Ordered Dose: 0.003-0.006 mg/kg/dose x 6.1 kg : Admin Dose: 0.02-0.04 mg :

Intravenous : Every 2 hours as needed : BREAKTHROUGH PAIN, if ineffective response contact provider :

Product Instructions:
This is a HIGH ALERT medication.

Extravasation Risk = YELLOW
Ordered Admin Dose: 0.02-0.04 mg

morphine pump bolus 0.02-0.04 mg Ordered Dose: 0.003-0.006 mg/kg/dose x 6.1 kg : Admin Dose: 0.02-0.04 mg :

Intravenous : Every 2 hours as needed : BREAKTHROUGH PAIN, if ineffective response contact provider

Order Information

Product Instructions:
This is a HIGH ALERT medication.

Extravasation Risk = YELLOW
Ordered Admin Dose: 0.02-0.04 mg
Dispense Location: Central Pharmacy
Frequency: Every 2 hours as needed
Route: Intravenous
Indications of Use: Deep Sedation
Linked Line: [Not Linked](#) (as of Today 02/24/25 at 1503)
Order Start Time: 02/17/25 at 1449
PRN Reasons: BREAKTHROUGH PAIN, if ineffective response contact provider
References: [Drug Information](#)
[Extravasation](#)

Administration Details

Action	Date	Time	Comment
Pump Bolus	02/24/2025	1503	

Route: Intravenous

Site:

Dose: mg
 Expected Dose: 0.02-0.04 mg

Associated Flowsheet Rows

Time taken: 2/24/2025 1503 Responsible Restore ☐ Show Details

If no new assessment is needed, check the box to link flowsheet rows to the previous assessment. ☐ Use All Previous Values

PRN Medication Given Reason

PRN Medication Given Reason



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Solution: MAR Dose Calculator

norphine pump bolus 0.02-0.04 mg ¹⁹ Ordered Dose: 0.003-0.006 mg/kg/dose × 6.1 kg - Admin Dose: 0.02-0.04 mg :
intravenous - Every 2 hours as needed - BREAKTHROUGH PAIN, if ineffective response contact provider

Order Information

Program pump bolus dose as mg/kg (weight-based)

Product Instructions:
This is a HIGH ALERT medication.

Extravasation Risk = YELLOW

Ordered Admin Dose: 0.02-0.04 mg
Dispense Location: Central Pharmacy
Frequency: Every 2 hours as needed
Route: Intravenous
Indications of Use: Deep Sedation
Linked Line: Not Linked (as of Today 02/25/25 at 0940)
Order Start Time: 02/17/25 at 1449
PRN Reasons: BREAKTHROUGH PAIN, if ineffective response contact provider
References: Drug Information
Extravasation

Administration Details

Action	Date	Time	Comment
Pump Bolus	02/25/2025	0940	
Route			
Intravenous			
Dose			
mg			
Expected Dose:			
mg			

Associated Flowsheet Rows

Time taken: 2/25/2025 0940 Responsible: Restgtr ☐ Show Details

If no new assessment is needed, check the box to link flowsheet rows to the previous assessment. ☐ Use All Previous Values

PRN Medication Given Reason

PRN Medication:

Pump Bolus Calculator

Pump Programming (mg/kg/dose): 0.004

MAR Documentation Dose (mg): 0.024

Pump Bolus Calculator

Pump Programming (mg/kg/dose): 0.004

MAR Documentation Dose (mg): 0.024

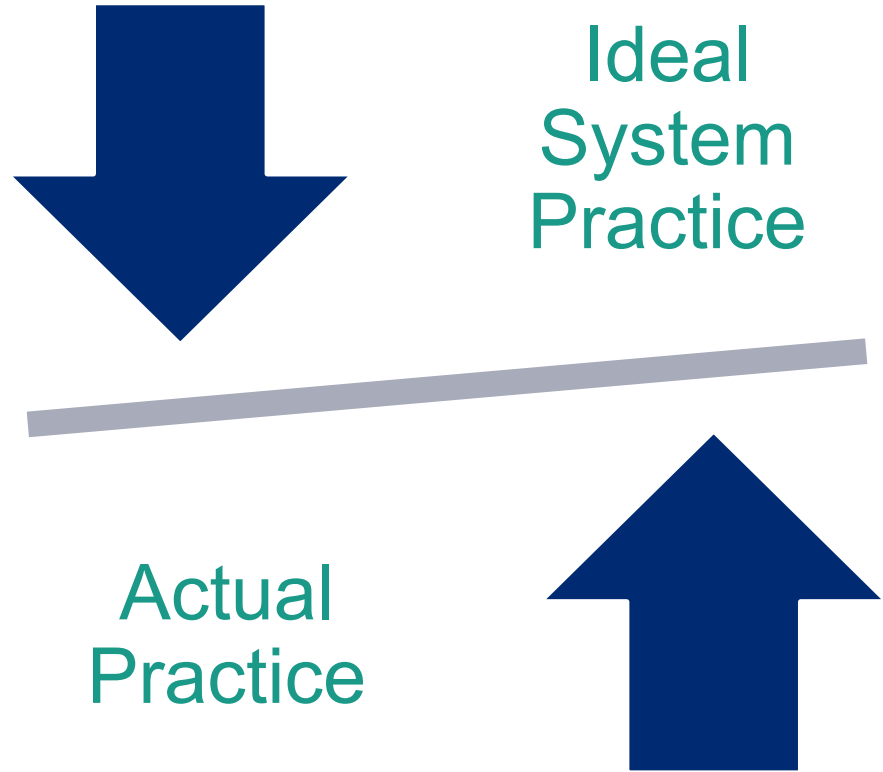
After entering dose as mg/kg/dose, the calculator will provide the total dose to be administered & documented above.



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What We Know

- Improved safety with bolus administration with drug library guardrails
- RN's are experiencing alert fatigue
- Conflict between recommended bolus admin time & perceived patient safety risks



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Expected Practice:

Current Lexidrug: Administration Pediatric

IV:

Neonates: Administer as a continuous infusion via an infusion pump or by **slow IV push over 3 to 5 minutes**. **Larger bolus doses (>5 mcg/kg) should be administered over 5 to 10 minutes**; may also administer intermittent doses via syringe pump **over 15 to 30 minutes** (^{Ref}). Risk of chest wall rigidity is minimized when doses are administered over **at least 1 to 2 minutes** (^{Ref}).

Infants, Children, and Adolescents: Administer by **slow IV push over 3 to 5 minutes** or by continuous infusion via an infusion pump. **Larger bolus doses (>5 mcg/kg) should be given by slow IV push over 5 to 10 minutes**.

Current Syringe Pump Time Limits:

Intermittent Doses:

Fentanyl 50 mcg/mL

- Min (hard stop): None
- Time Low (overridable): 1 min

Fentanyl 10 mcg/mL (NICU only)

- Min (hard stop): 1 min
- Time Low (overridable): 3 min

Pump Bolus Doses

(These doses programmed from actively running continuous infusion)

- Time Min (hard stop): None
- Time Low (overridable): 1 min



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Actual Practice (Pump Boluses Only):

Alert: Pump Bolus Time

Medications: fentanyl infusions (all continuous concentrations/dose modes)

Date Range: 2 years

Fentanyl Pump Bolus Time Alerts

Abandon	6
Hard Limit Alert	166
Soft Limit Override	4914
Soft Limit Reprogram	62
Total Alerts	5148



Fentanyl Pump Bolus Admin Time

0-30 seconds	93%
0-1 minute	99%
Total Admins	4976

- 85% (1,728/2,030) of fentanyl infusions programmed and administered fired at least 1 pump bolus time alert
- 95.5% (4,926/5,148) of alerts were overridden; only 62 reprogramming events
- 93% (4,627/4,976) of doses firing a bolus time alert were given over 30 sec or less
- Nursing Feedback: Rapid administration preferred to prevent patient self-harm (e.g., UEs)



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Summary of Literature Review

- Many case reports of pediatric patients demonstrating chest wall rigidity with fentanyl bolus dose administration
- One prospective cohort study describing risk of chest wall rigidity with low dose fentanyl (2.2-6.5 mcg/kg/dose) administered **over 2-3 minutes** in premature and term neonates:
 - 8 of 89 patients (9%) experienced chest wall rigidity that resolved w/ naloxone
 - 204 total doses administered (4% incidence)
 - 1 patient had continuous infusion (developed 9 hrs after discontinuation)
- Very limited information about patients getting boluses with a continuous infusion:
 - No incidence in 20 newborn & premature babies receiving continuous fentanyl (Avg time of infusion was 86 +/- 47 h with a mean dose of 0.68 +/- 0.24 mcg/kg/hr)
 - No incidence in 23 children (Age: 1 wk-22 mo) receiving continuous fentanyl >24 hrs



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External Practice: National Infusion Collaborative

NIC Pediatric Collective Pump Data: Fentanyl Pump Boluses							
Bolus Feature Enabled in Drug Library	Drug Libraries w/ HARD limit ONLY for min time/max rate	Drug Libraries w/ <u>SOFT limit ONLY</u> for min time/max rate	<u>Derived</u> Allowable Pump Bolus Time	February 2024-January 2025			
				Total Programmed Fentanyl Continuous Infusions	Total Fentanyl Pump Bolus Admin Rate/Duration Alerts (% of Total Admins)	Bolus Administration Rate/Duration Alert Override Rate	Total Fentanyl Pump Bolus Dose Admins
88%	15%	46%	1-10 minutes	26,383	3,144 (12.5%)	92%	25,008

- Note: Different pumps have different limit options (rate vs. duration) □ time range is derived
- 46% of included hospitals do NOT have a hard limit set for fentanyl pump bolus time/rate
- Key Difference: only 12.5% of administered bolus doses fired a pump bolus time/rate alert



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NIC Pediatric Collective Pump Programming Data:

National Infusion Collaborative Pediatric Network Cohort								
	Bolus Feature Enabled in Drug Library	Drug Libraries with No Soft Limit for Minimum Duration for Administration of Bolus Dose (only use Hard Limit)	Drug Libraries with No Hard Limit for Minimum Duration for Administration of Bolus Dose (only use Soft Limit)	Drug Library Limits for Bolus Administration Duration	February 2024-January 2025			
					Continuous Infusions	Count of Bolus Administration Rate/Duration Alerts (% of total Admins)	Bolus Administration Rate/Duration Alert Override Rate	Total Bolus Dose Admins
Fentanyl	88%	15%	46%	1-10 minutes	26,383	3,144 (12.5%)	92%	25,008
Morphine	81%	17%	44%	1-10 minutes	25,977	1,117 (4.6%)	97%	24,040
Hydromorphone	84%	19%	43%	1-10 minutes	21,820	2,798 (17.5%)	94%	15,986
Midazolam	80%	11%	43%	2-10 minutes	40,286	1,584 (7.5%)	92%	21,014



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Next Steps:

1. Update Lexidrug CHCO Specific Administration to clearly state one minute minimum duration for fentanyl pump bolus doses.
2. Update pump drug library files with HARD minimum time limit of 1 minute for intermittent doses and pump bolus doses.
3. Implement MAR optimization for pump bolus dose programming.
4. Monitor closely for patient harm events related to above changes.
5. Evaluate remaining medications for pump bolus duration limit changes.



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Key Takeaways

- Consider EHR limitations beyond drug file design when building pump libraries
- Collaboration is crucial!
 - Engage multidisciplinary groups in review of and response to pump programming errors
 - Routinely review pump server data with multidisciplinary groups to identify optimizations



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A short horizontal bar with a blue segment on the left and a green segment on the right.

Questions?

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Navigating Zoom

Q&A Box and Chat Box: For any questions or comments throughout the presentation

Raise Hand: For the open mic discussion, please press “Raise Hand” if you wish to speak

Post-Meeting Survey: Following today’s meeting, please let us know how we can improve going forward