National Infusion Collaborative Clinical Meeting

Spring Clinical Meeting
March 26, 2026

Agenda

National Infusion Collaborative Infusion Trends

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

Becky Judge, PharmD
Pharmacy Clinical Specialist
Bainbridge Health

Pump IQ: The Smart Pump Navigator

Nat Sims, MD
Massachusetts General Hospital
Department of Anesthesia
Harvard Medical School Associate Professor
Newbower & Eitan MGH Endowed Chair in
Biomedical Technology Innovation

Isabelle Yang, MD
Massachusetts General Hospital
Chief Resident, Department of Anesthesia
Critical Care and Pain Medicine

Robert Butterfield, BSEE
Principal, RDB Consulting
PumpIQ Founder & Data Architect
AAMI Fellow 2020
Retired BD Research Engineer
Retired Health Technology Manager

Open Mic / Q&A

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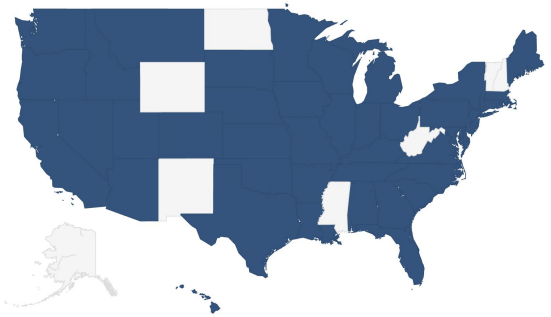
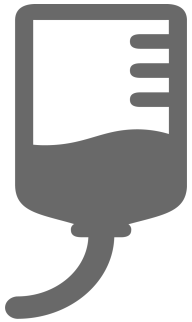
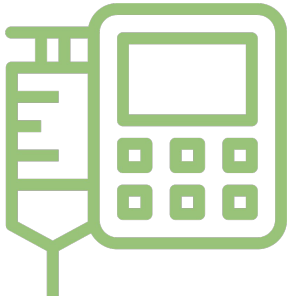
12/1/25 - 2/28/26



>800
Hospitals



>100,000
Infusion Pumps



>22 million
Infusion Records

> 1 million
Alerts

National Infusion Collaborative

Since last meeting, the NIC welcomed **Baxter** as its newest industry partner member.

National Infusion Collaborative

Key Performance Indicators

12/1/25 – 2/28/26	Compliance	Alert Rate	Override Rate
Pediatric Network	89.6%	7.7%	66%
Adult Network	90.3%	5.4%	70%
Interoperability Network	91.0%	5.1%	71%

Meeting Logistics and Introductions

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Retired Health Technology Manager (10 years)

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

PumpIQ: The Smart Pump Navigator

Isabelle Yang, M.D.
Bob Butterfield
Nat Sims, M.D.

March 26, 2026
National Infusion Collaborative

The Problem: Challenges in Intravenous Medication Management

- Correct prescribing of IV medications is essential.
- Coordination between healthcare professionals is crucial.
- Physicians must accurately order concentrations and dosing.
- Pharmacists need to understand pump library options.
- Bedside nurses face urgent medication delivery situations.

Provider

Provider orders drug with specified concentration and formulation

"EPINEPhrine 0.008mg/mL"

Pharmacist

Pharmacist verifies drug, concentration, formulation, confirms appropriate flow rate. Dispenses drug.

"EPINEPhrine 0.2mg in 50mL (0.008mg/mL) syringe"

Nurse

Nurse programs pump for drug.

Selects "Care Area", drug and indication, enters patient weight and dose rate, confirms final flow rate is correct

Patient

71 year old
female
47kg
with Heart Failure

Existing Challenges With Pumps and Drug Libraries

Why Today's Pump Drug Libraries Create Risk & Cognitive Burden

Large, fragmented drug library

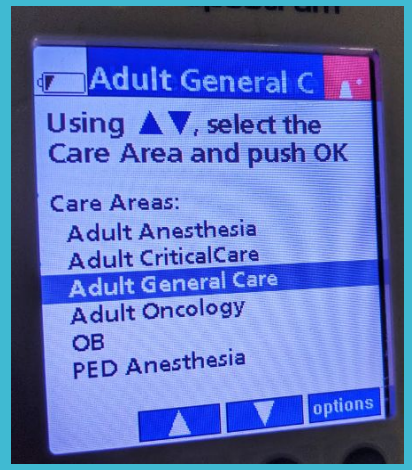
- 5,361 entries across 25 care areas in current Baxter Spectrum IQ drug library
- Near-duplicate names and formulations
- Providers must manually sift through long lists with similar names

5348	Vanco Periph 150mL
5349	Vanco Periph 250mL
5350	VancPeri 1251-1750mg
5351	VancPeri 1751-2500mg

Multiple steps before drug administration

Difficulty navigating each step creates risk of medication error, delays in patient care, and cognitive burden for staff

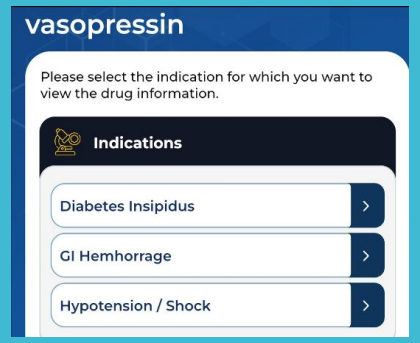
STEP 1:
"Know" the care area before searching for the drug name



STEP 2:
"Guess" the indication if not clearly indicated

For example, vasopressin

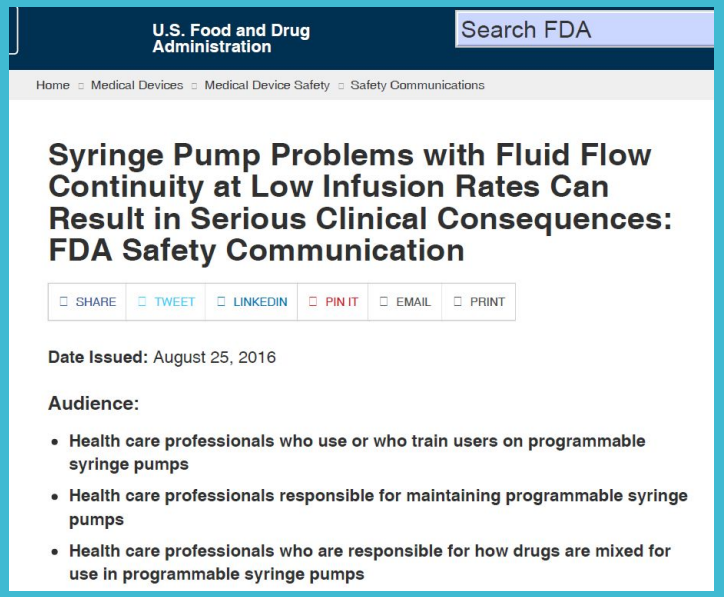
- DIABETES INSIPIDUS: mU/kg/h or mU/h
- SHOCK - mU/kg/min or U/min
- GI BLEED - U/kg/min or U/min



STEP 3:
Select the correct drug formulation concentration (among several options)

Large Volume Pump			
Drug	**Amount**	**Diluent**	**Concentration**
EPINEPhrine	4 mg	250 mL	0.016mg/mL
EPINEPhrine	1 mg	250 mL	0.004mg/mL
EPINEPhrine	2 mg	500 mL	0.004mg/mL
Syringe Pump			
Drug	**Amount**	**Diluent**	**Concentration**
EPINEPhrine	0.2mg	50 mL	0.008mg/mL

Challenges!!



U.S. Food and Drug Administration

Search FDA

Home □ Medical Devices □ Medical Device Safety □ Safety Communications

Syringe Pump Problems with Fluid Flow Continuity at Low Infusion Rates Can Result in Serious Clinical Consequences: FDA Safety Communication

□ SHARE □ TWEET □ LINKEDIN □ PIN IT □ EMAIL □ PRINT

Date Issued: August 25, 2016

Audience:

- **Health care professionals who use or who train users on programmable syringe pumps**
- **Health care professionals responsible for maintaining programmable syringe pumps**
- **Health care professionals who are responsible for how drugs are mixed for use in programmable syringe pumps**

- *Across US hospitals, despite a 77% adoption rate of "smart" pumps,[1] errors associated with continuous IV medications are still common, with up to 60% observed error rates in IV medication administration[2] and up to 4.95 adverse drug events per 1,000 hospital-days.[3]*

- FDA's 2016 Safety Communication: high-risk infusions at low-flow
  - Improper decision-making leads to serious clinical consequences.
  - Incorrect concentrations can cause preventable challenges.
- Infusion Pump Integration with Electronic Health Records
  - Impending workforce impact of automatic programming and documentation
  - Potential for reducing workload and errors, but an increased responsibility to ensure the automation is working properly

1. Pederson, C. A., P. J. Schneider, and D. J. Scheckelhoff. "ASHP national survey of pharmacy practice in hospital settings: monitoring and patient education—2012." Am J Health-Syst Pharm 70 (2013): 787-797.
2. Schnock, Kumiko O., et al. "The frequency of intravenous medication administration errors related to smart infusion pumps: a multihospital observational study." BMJ quality & safety 26.2 (2017): 131-140.
3. Nuckols, Teryl K., et al. "Programmable infusion pumps in ICUs: an analysis of corresponding adverse drug events." Journal of General Internal Medicine 23.Suppl 1 (2008): 41-45.

"MGH Blue Book"

MassGeneral Hospital *for* Children℠

MassGeneral Hospital for Children
NICU/PICU
Pediatric Medication Administration Process Manual
For Syringe Pumps

2005: Mandate Standardized Concentrations for Pediatrics

2006: Paper Manual to assist correct choice of concentration from among several standard MGH mixes

"Predicts Flow Rate as a function of Drug Concentration, Dose Rate, and Patient Weight, for Weight-Based Dosing"

Flow Rate as function of Drug Concentration, Dose Rate, Patient Weight

September-05

"DOPAMINE 0.8 MG/mL- PERIPHERAL OR CENTRAL LINE"

	Dose rate in mcg/kg/minute				
	Soft Min				Soft Max
Weight	2	3	10	15	20
0.5 kg	0.08	0.11	0.38	0.56	0.75
1.5 kg	0.23	0.34	1.13	1.69	2.25
3 kg	0.45	0.68	2.25	3.38	4.5
6 kg	0.9	1.35	4.5	6.75	9
20 kg	3	4.5	15	23	30
40 kg	6	9	30	45	60

Pump flow rate (mL/hr)

"DOPAMINE 1.6 MG/mL- CENTRAL LINE"

	Dose rate in mcg/kg/minute				
	Soft Min				Soft Max
Weight	2	3	10	15	20
0.5 kg	0.04	0.06	0.19	0.28	0.38
1.5 kg	0.11	0.17	0.56	0.84	1.13
3 kg	0.23	0.34	1.13	1.69	2.25
6 kg	0.45	0.68	2.25	3.38	4.5
20 kg	1.5	2.25	7.5	11.25	15
40 kg	3	4.5	15	22.5	30

Pump flow rate (mL/hr)

"DOPAMINE 3.2 MG/mL- CENTRAL LINE"

	Dose rate in mcg/kg/minute				
	Soft Min				Soft Max
Weight	2	3	10	15	20
0.5 kg	0.02	0.03	0.09	0.14	0.19
1.5 kg	0.06	0.08	0.28	0.42	0.56
3 kg	0.11	0.17	0.56	0.84	1.13
6 kg	0.23	0.34	1.13	1.69	2.25
20 kg	0.75	1.13	3.75	5.63	7.5
40 kg	1.5	2.25	7.5	11.25	15

Pump flow rate (mL/hr)

"DOPAMINE 8 MG/mL- CENTRAL LINE"

	Dose rate in mcg/kg/minute				
	Soft Min				Soft Max
Weight	2	3	10	15	20
0.5 kg	0.01	0.01	0.04	0.06	0.08
1.5 kg	0.02	0.03	0.11	0.17	0.23
3 kg	0.05	0.07	0.23	0.34	0.45
6 kg	0.09	0.14	0.45	0.68	0.9
20 kg	0.3	0.45	1.5	2.25	3
40 kg	0.6	0.9	3	4.5	6

Pump flow rate (mL/hr)

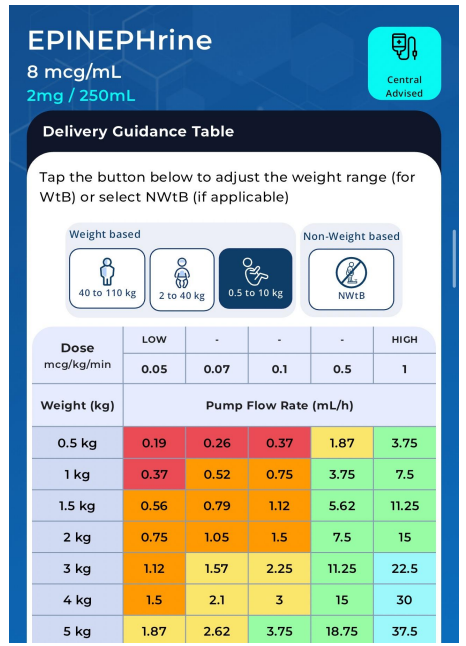
Flow rate <0.3 mL (at or near pump minumum) or >20 mL/hr (assess for fluid overload)
Flow rates 0.1-0.3mL may be initiated in an emergency, please page the pharmacist
Flow rate within recommended range

Key Milestones in PumpIQ Development

- 2005: Joint Commission requires pediatric hospitals abandon "Rule of 6" ad-hoc bedside compounding and convert to ***standardized concentrations,*** by 2008
- 2006: MGH "Blue Book" assist nurses to select correct one of multiple standard medication concentrations for life-critical drugs
- 2015: ASHP Standardize4Safety initiative launched under a Safe Use Initiative grant from FDA
- 2016: at MGB, Epic system implemented; Blue Book 'obsolete'
- 2016 - FDA alert for life critical infusions at low flow rates
- 2020: at MGH, Anesthesia innovation grant for PumpIQ development
- 2022: Ether Dome Challenge Grant to further enhance safety
- 2025: PumpIQ initial limited deployment at MGH on "clinical phones"

A Solution: PumpIQ

PumpIQ



Dose mcg/kg/min	LOW	-	-	-	HIGH
	0.05	0.07	0.1	0.5	1
Weight (kg)	Pump Flow Rate (mL/h)				
0.5 kg	0.19	0.26	0.37	1.87	3.75
1 kg	0.37	0.52	0.75	3.75	7.5
1.5 kg	0.56	0.79	1.12	5.62	11.25
2 kg	0.75	1.05	1.5	7.5	15
3 kg	1.12	1.57	2.25	11.25	22.5
4 kg	1.5	2.1	3	15	30
5 kg	1.87	2.62	3.75	18.75	37.5

PumpIQ

iOS Demo

Alternate iOS Link Here

PumpIQ

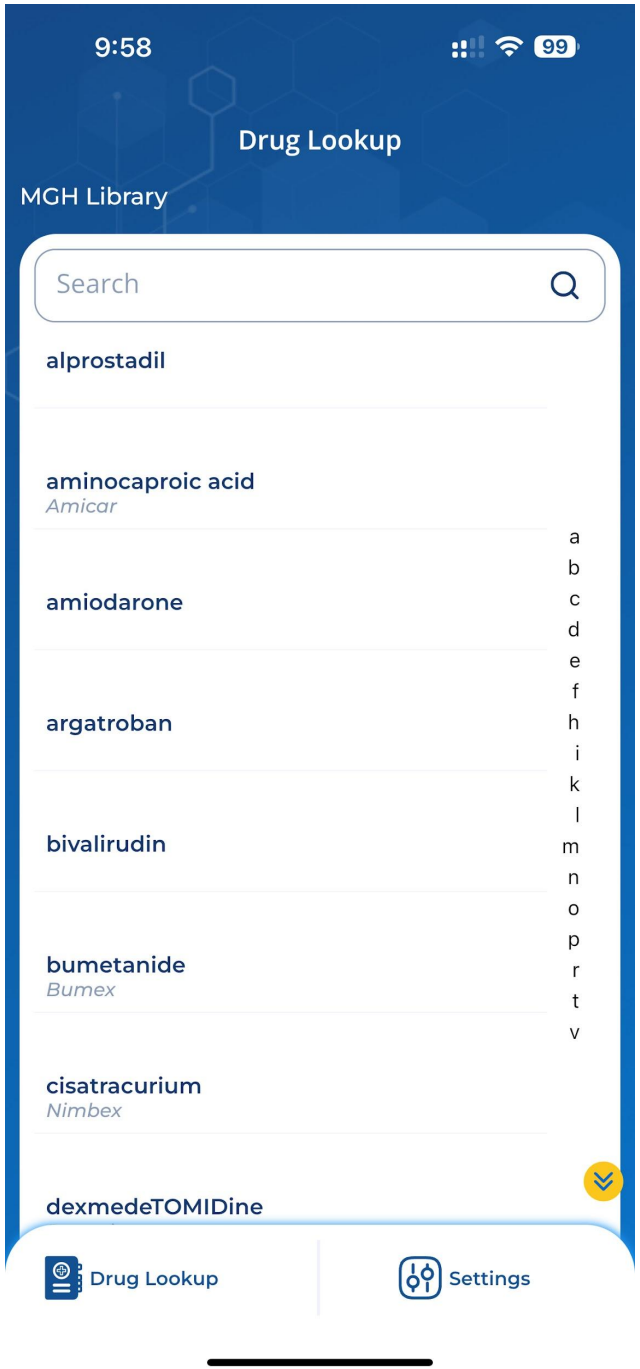
Web Demo

Alternate Web Link Here

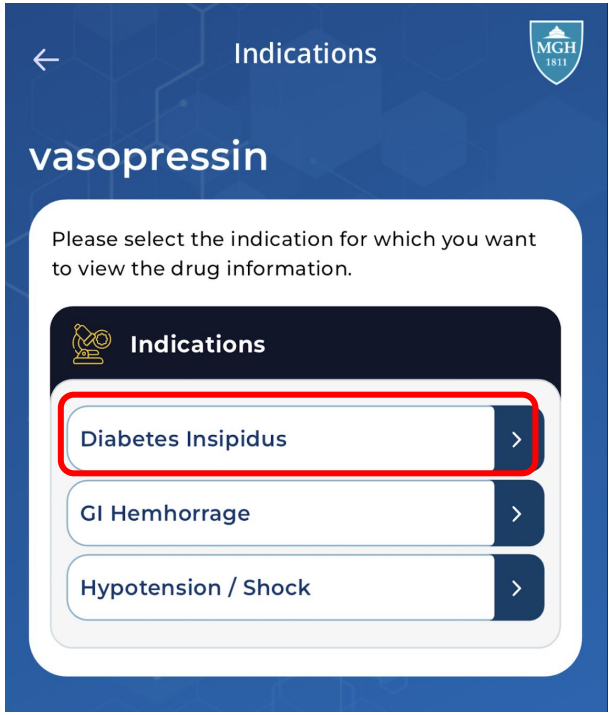
PumpIQ

Makes safe practice the easiest practice

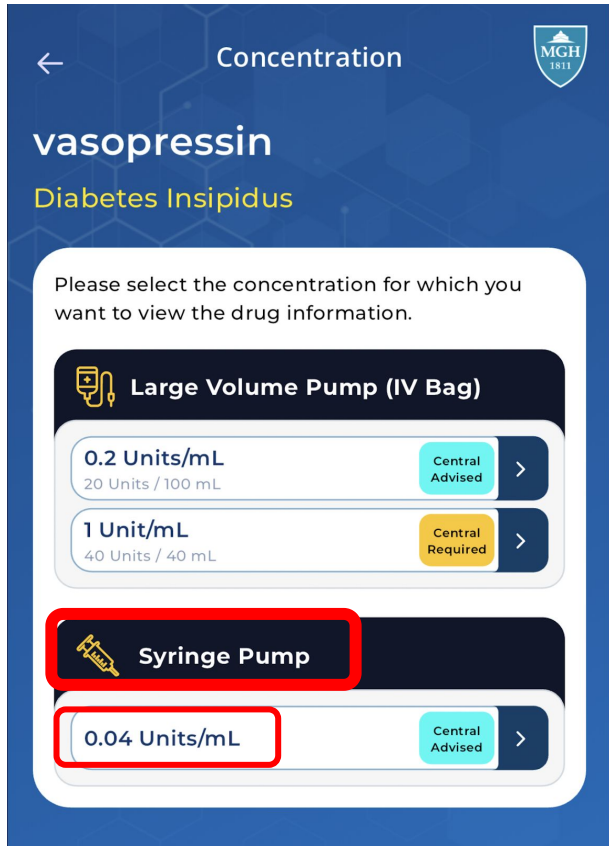
- ***Search*** for drugs and view options for indications, formulations & concentrations
  - Offers heatmap charts for verifying NWtB and patient-specific (WtB) dosage and flow rates.
  - Verify that the logic of decisions made by others, in provider order entry and in dispensing, is optimum for ***my patient***
- ***Verify*** medication infusion rate calculations
  - Helps identify pump programming errors by providing double-check mechanism
  - Flow rate (mL/h) on pump screen and in PumpIQ should ***match***
- User-friendly way to ***locate*** drugs in new drug library, on current and new pumps
  - Available on personal and hospital-owned devices



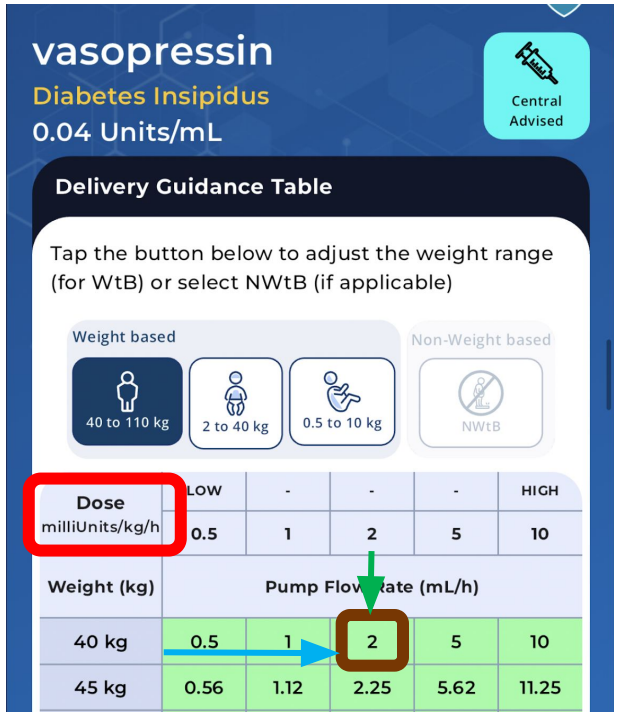
De-fragmenting the workflow!!



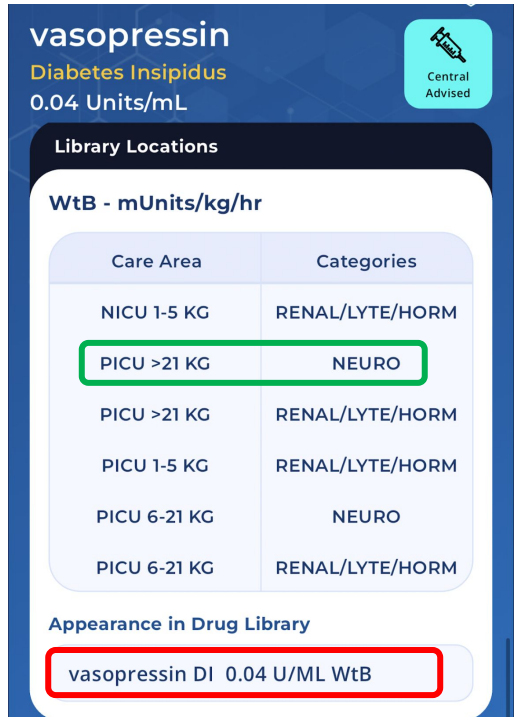
Which ***indication*** was ordered?



Which available ***concentration*** & ***pump type*** were dispensed?



With WB dosing, what ***flow rate*** will result from the mandatory ***dose rate units*** and the ordered ***dose rate*** for the ***40kg*** patient?



In the pump, how can I ***navigate*** to the correct ***care area*** & ***drug library entry*** in our SP, & what will the ***pump display name*** say ?

Benefits with PumpIQ

- Routine use of PumpIQ streamlines the "ordering-dispensing-administration" process for IV infusions to prevent errors
  - Single, centralized resource for providers, pharmacists, and nurses
- Improving IV medication safety and reducing pump-related medication errors
  - Double-check all infusions
  - Avoid use of pumps in "manual mode"
- Vital tool for staff onboarding and education
  - Reduce cognitive burden and decision-fatigue
  - Increase awareness of pump safety for critical continuous infusions titration
- Support the transition to new drug library or new pumps for front-line staff

PumpIQ: Next Steps

"Best Practices Drug Library"

- List of life-critical continuous intravenous medications with standardized concentrations and delivery guidance tables for generic syringe and large volume pump
- Generalizable across systems and practice settings, not specific to institution
- Make ASHP S4S concentration list available to public (soon!)

Customization and Dissemination

- Customize hospital-specific drug library to PumpIQ
- Publish delivery guidance tables based on pump technical specifications
- Outline care areas / drug directory for each medication
- Incorporate hospital-specific pump capabilities customizable to institutions

New Features

- Syringe size settings
  - Dynamic syringe-size settings
  - Hard limits
  - Start-up time
  - "Time-to-occlusion" is dependent on syringe size
- Incorporation of pharmacokinetics into pump limits, dose rates
- Provide context/continuous feedback to providers
- Remote interface to program pumps

Nursing Leadership Driving Enterprise Innovation and Growth

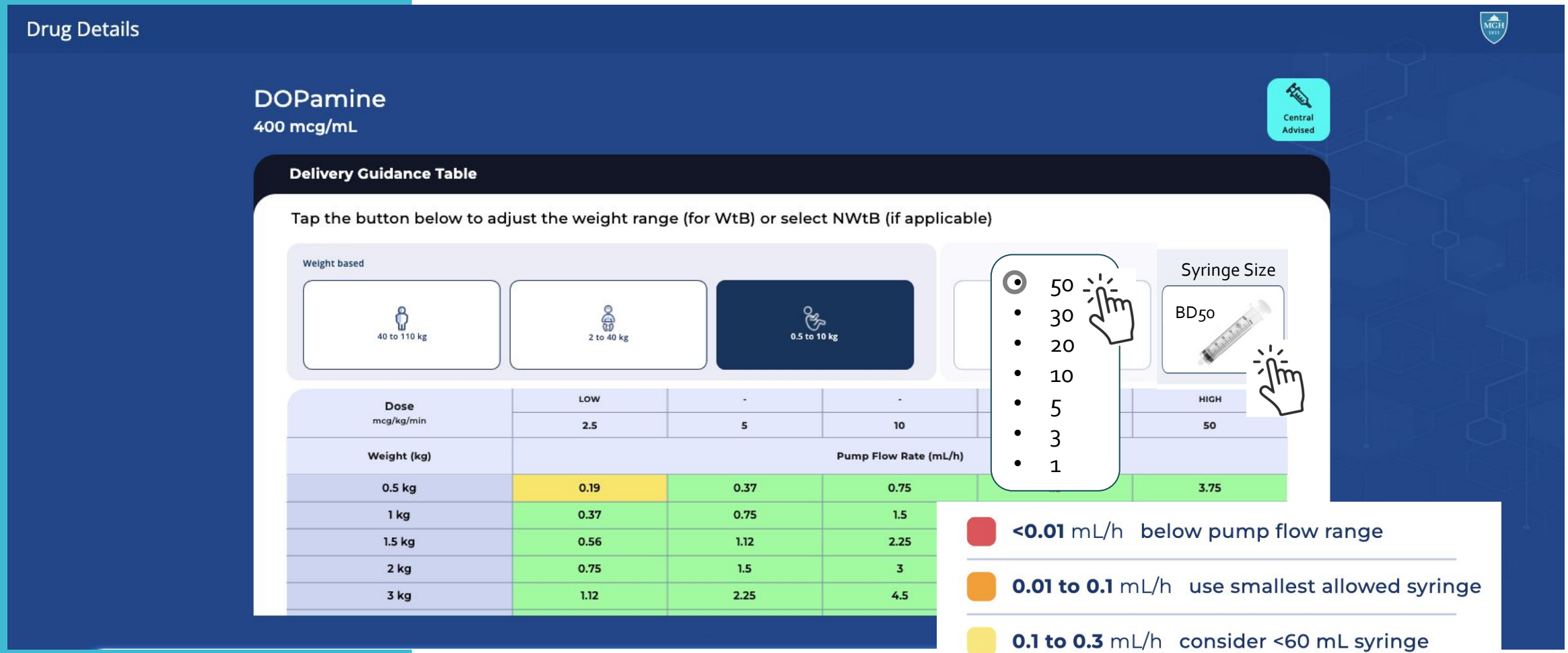
Mass General Brigham is uniquely positioned to showcase nursing innovation at scale by endorsing PumpIQ as a nurse-led technology that elevates medication safety and operational reliability across the system.

Nursing leadership can set the standard by advocating for enterprise adoption, aligning training and education, and coordinating with Pharmacy, Anesthesia, Biomedical Engineering, and IT to ensure a seamless and sustainable rollout.

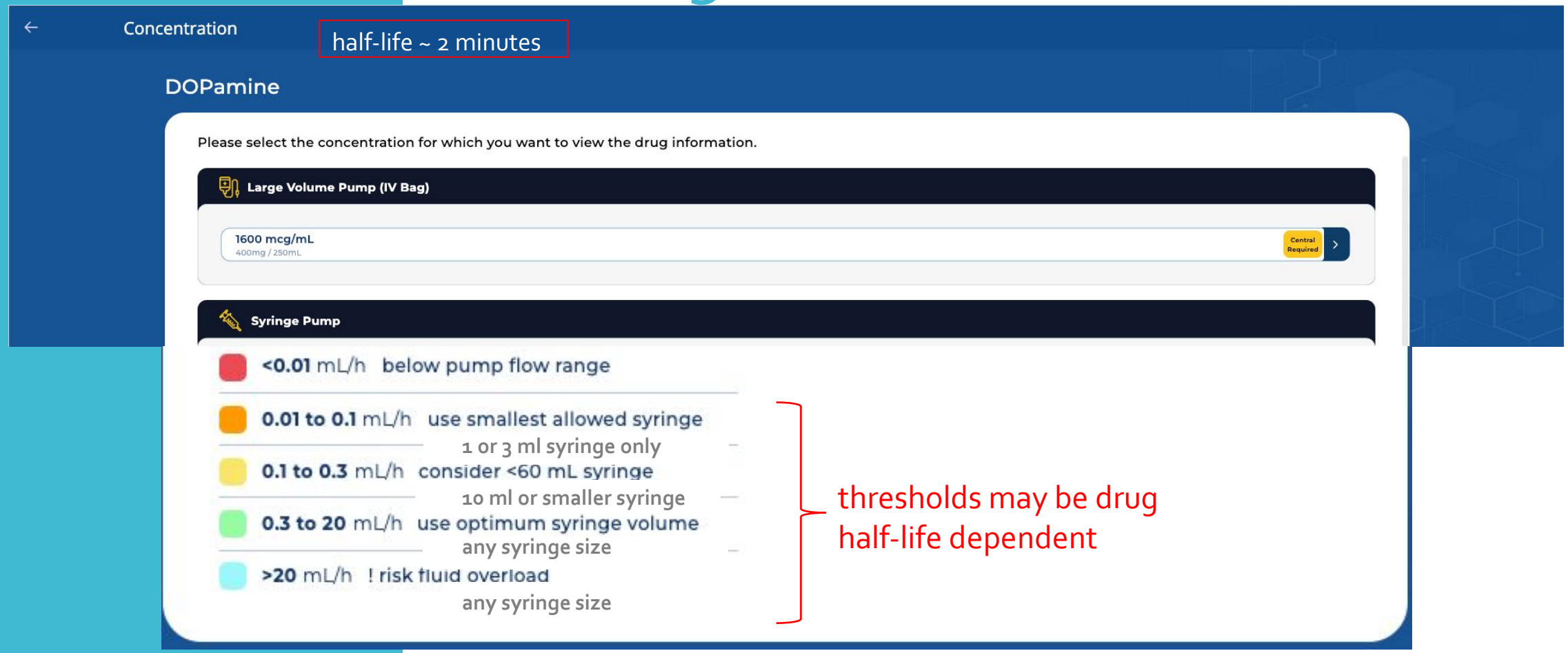
By taking the lead on this initiative, nursing not only strengthens clinical safety and workflow efficiency—it highlights nursing's role as a driver of technological advancement.

PumpIQ becomes a strategic asset with the potential to expand beyond MGB, generating new revenue streams for MGB while reinforcing the organization's commitment to innovation, safety, and excellence in patient care.

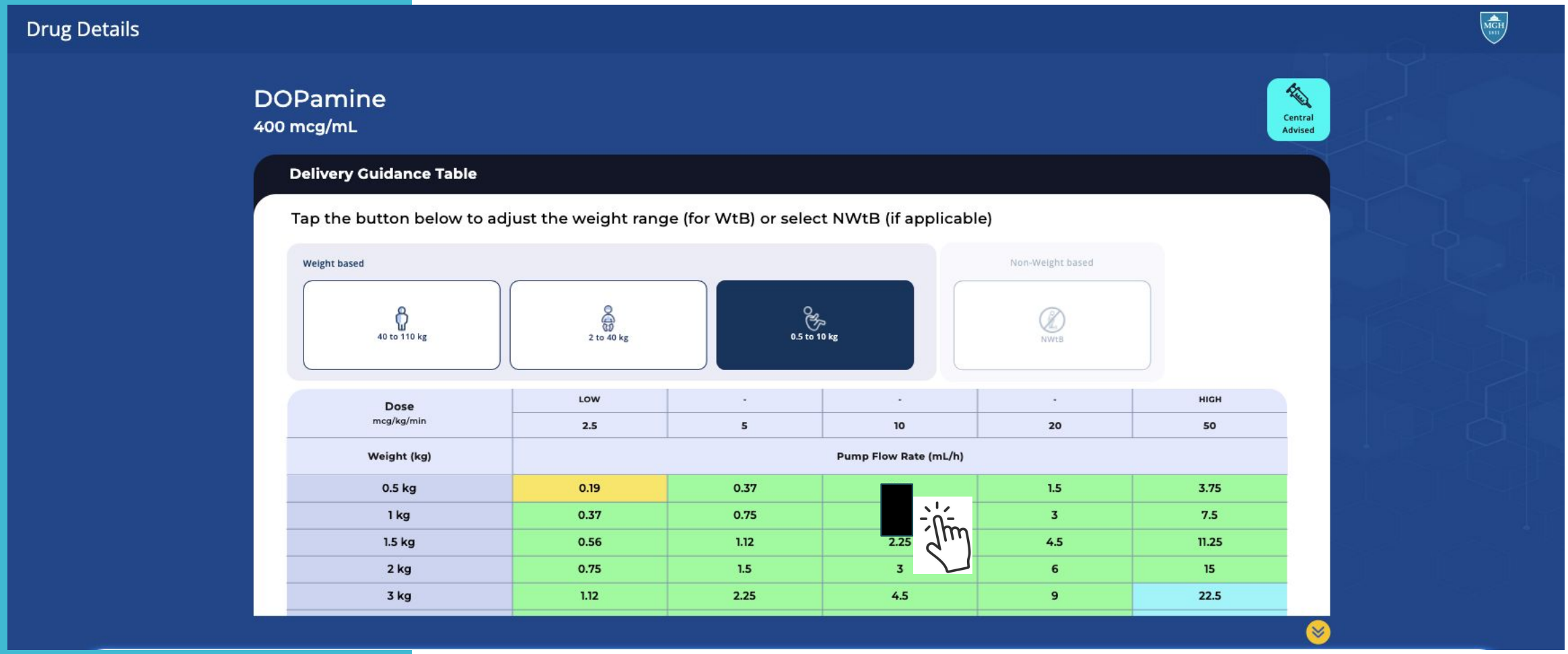
Syringe Selection



Drug Half-Life



Context



Dose mcg/kg/min	LOW	-	-	-	HIGH
	2.5	5	10	20	50
Weight (kg)	Pump Flow Rate (mL/h)				
0.5 kg	0.19	0.37	[redacted]	1.5	3.75
1 kg	0.37	0.75		3	7.5
1.5 kg	0.56	1.12	2.25	4.5	11.25
2 kg	0.75	1.5	3	6	15
3 kg	1.12	2.25	4.5	9	22.5

pressing dose value presents color histogram of usage

Aviation, EFBs, Healthcare, and PumpIQ

- Aviation transitioned from an ***analog*** experience managed "ad hoc" by pilots, to the modern state of ***digital aviation***

- Aircraft have ***flight management systems (FMS)*** to fully control navigation, altitudes, speed, and autopilot modes, from pre-flight to landing, but ***pilots must stay actively engaged***!

- Workforce empowerment in aviation includes ***electronic flight bag (EFB) apps*** to plan, predict risks, stay informed, troubleshoot, and check performance vs peers!

*PumpIQ was inspired by and **emulates EFB's**, with similar motivation for frontline workforce empowerment (but in **healthcare**), in an era of sophisticated automation.*

1. FlightPulse, Made by Pilots for Pilots – GE Aerospace – 2025 - https://youtu.be/JJko9muzkVg?si=HCYyz8PGFOlmI3id
2. Flight Pulse Quick Reference Guide: https://www.geaerospace.com/sites/default/files/flightpulse-quick-reference-guide.pdf

Summary and High-Level Vision

- PumpIQ is an ***antidote*** to the *paradox of automation*, which is:
  - Improvements in patient safety and efficiency, by digital integration of electronic health records with drug delivery devices
  - Risk of de-skilling / job simplification
- PumpIQ ***sustains*** structured engagement of providers, pharmacists, and nurses
  - as vigilant and mindful managers
  - during life-critical, dynamic, event-driven care
- PumpIQ ***reinforces*** the principles of *High-Reliability Organizations*:
  - Preoccupation with failure
  - Reluctance to simplify
  - Sensitivity to operations
  - Commitment to resilience
  - Deference to expertise
- SUGGEST:
  - Provider organizations ***adopt and sustain*** customized versions of PumpIQ
  - Policy: Use of PumpIQ by relevant workforce as '*digital second check*'

Thank You

- MGH
  - Kimberly Whalen (Nurse Director Pediatric ICU)
  - Hiyam Nadel (Nurse Director for Innovation)
  - Sylvia Okrzesik (Pharmacist, Pediatric ICU)
  - Russel Roberts (Pharmacy Manager, ICU and EM)
  - Seth Klapman, MD (Found)
  - Chris Colvin (Human Factors and User Interface Expert)
  - Bob Butterfield (Association for the Advancement of Medical Instrumentation Fellow)
  - Nat Sims (Endowed Chair in Biomedical Innovation)
- Bainbridge Health
  - Sean O'Neill, Joanne Hatfield
- American Society of Health-System Pharmacists
  - Mary Ann Kliethermes
- Zco Corporation

Questions?

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Becky Judge
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Navigating Zoom

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