



Improving Safety, Efficiencies, and Reducing Waste with Ready-to-Administer IV Medications: A Roadmap to Success

Michele A Sheaffer, RPh,

Associate Director of Pharmacy Operations at Jefferson Abington Hospital

Satya Krishna Ramachandran, MD,

Director of Pharmacy, Associate Professor, Harvard Medical School,
Anesthesiologist, Beth Israel Deaconess Medical Center

Jointly provided by Partners for Advancing Clinical Education (PACE) and ISMP
Supported by an independent educational grant from **Fresenius Kabi**

©2023 ISMP | www.ismp.org | 1

1

ACCREDITATION



- Joint Accreditation Statement
- In support of improving patient care, this activity has been planned and implemented by Partners for Advancing Clinical Education (PACE) and Institute for Safe Medication Practices. PACE is jointly Accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.
- Pharmacy Continuing Education
PACE designates this continuing education activity for 1.0 contact hour(s) (0.10 CEUs) of the Accreditation Council for Pharmacy Education.
(Universal Activity Number - JA4008073-9999-24-009-L05-P/T)
Type of Activity: Knowledge



©2023 ISMP | www.ismp.org | 2

2

DISCLAIMERS

— Disclosure of Unlabeled Use

- This educational activity may contain discussion of published and/or investigational uses of agents that are not indicated by the FDA. The planners of this activity do not recommend the use of any agent outside of the labeled indications. The opinions expressed in the educational activity are those of the faculty and do not necessarily represent the views of the planners. Please refer to the official prescribing information for each product for discussion of approved indications, contraindications, and warnings.

— Disclaimer

- Participants have an implied responsibility to use the newly acquired information to enhance patient outcomes and their own professional development. The information presented in this activity is not meant to serve as a guideline for patient management. Any procedures, medications, or other courses of diagnosis or treatment discussed or suggested in this activity should not be used by clinicians without evaluation of their patient's conditions and possible contraindications and/or dangers in use, review of any applicable manufacturer's product information, and comparison with recommendations of other authorities.



©2023 ISMP | www.ismp.org | 3

3

ONLINE EVALUATION, SELF-ASSESSMENT AND CE/CME CREDIT

- Login at <https://paceducation.com/ISMP2062024> or Scan:
- Complete online evaluation
- Deadline: 4/5/2024
- Pharmacists/Technicians: Upon successfully completing the activity evaluation, your credit will be submitted to CPE Monitor. Please check your NABP account within thirty (30) days to make sure the credit has posted.



©2023 ISMP | www.ismp.org | 4

4

Learning Objectives

Following completion of this activity, participants will be able to:

1. Review the safety challenges and diversion risks associated with the preparation and administration of IV push medications doses that require product manipulation.
2. Outline the steps taken and data used to optimize automated dispensing cabinets (ADC) storage capacity in anticipation of the transition to RTA syringes.
3. Describe one organization's successful journey towards medication safety, waste reduction, and workflow efficiencies, when adopting RTA syringes.



©2023 ISMP | www.ismp.org | 5

5

FACULTY

- **Matthew Grissinger, RPh, FISMP**
Director, Education; Institute for Safe Medication Practices
- **Satya Krishna Ramachandran, MD**
Associate Professor, Anaesthesia, Harvard Medical School
Vice Chair of Quality, Safety, and Innovation
Beth Israel Deaconess Medical Center
Boston, MA
- **Michele Sheaffer, RPh**
Associate Director of Pharmacy Operations
Abington Hospital Jefferson Health
Abington, PA



©2023 ISMP | www.ismp.org | 6

6

DISCLOSURES

- PACE requires every individual in a position to control educational content to disclose all financial relationships with ineligible companies that have occurred within the past 24 months. Ineligible companies are organizations whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.
- All relevant financial relationships for anyone with the ability to control the content of this educational activity are listed below and have been mitigated according to PACE policies. Others involved in the planning of this activity have no relevant financial relationships.
- Matthew Grissinger, RPh, FISMP, activity director for this activity, has no relevant financial relationships.
- Satya Krishna Ramachandran, MD, faculty for this activity, consultant/advisor/speaker for Fresenius Kabi.
- Michele Sheaffer, RPh, faculty for this activity, consultant/advisor/speaker for Fresenius Kabi.



©2023 ISMP | www.ismp.org | 7

7

Improving Safety Efficiencies, and Reducing Waste with Ready-to-Administer IV Medications: A Roadmap to Success

Michele Sheaffer RPh
 Associate Director of Pharmacy Operations
 Jefferson Abington Hospital
 Michele.Sheaffer@Jefferson.edu

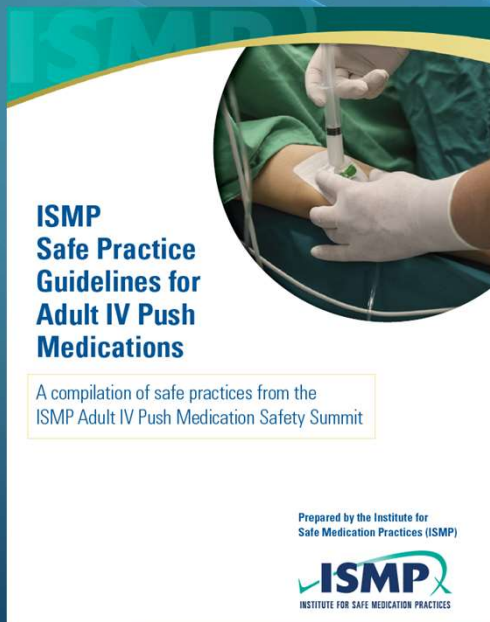
8

Disclosure

Michele Sheaffer discloses that she has participated in panel discussions for Fresenius Kabi.

9

Background



ISMP Outlined Risks Factors that can Increase Errors for IV push Medications in Adults

- Lack of Patient Information
- Lack of drug information
- Communication of Drug information
- **Drug labelling, Packaging and Nomenclature**
- **Drug storage, Stock, standardization and Distribution**
- **Device Use**
- Environments, Staffing and Workflow
- Staff Education and Competency
- Risk management and Quality Improvement Challenges

10

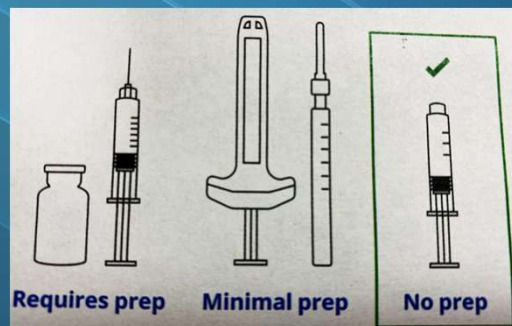
ISMP Suggested Safe Practice Guideline

- Acquisition and Distribution of Adult IV Push Medications
 - Ready to administer syringes
- Clinical Preparation
- Labelling
- Clinical Administration
- Drug Information Resources
- Competency Assessment
- Error Reporting

11

What is considered a Ready to Administer Product (RTA)?

ISMP definition: an injectable product containing the active drug in solution at the required concentration and volume, presented in the final container (syringe, infusion bag, or elastomeric device) and ready to be administered to the patient."¹⁴



12

Reasons to Transition to RTA and Product Optimization



13

Reasons to Transition to RTA and Product Optimization

Patient Safety

- Ready to Administer(RTA)- no manipulation/ assembly
- Single patient use prefilled syringe
 - Exact dose to be administered
- Properly labelled- (ISMP guidelines)
 - Clear, readable
 - Easy to read graduations- vertical preferred
- Barcode available to scan
- Integrity of medication
 - Manufacturer Prepared
- Accurate/ Proper documentation



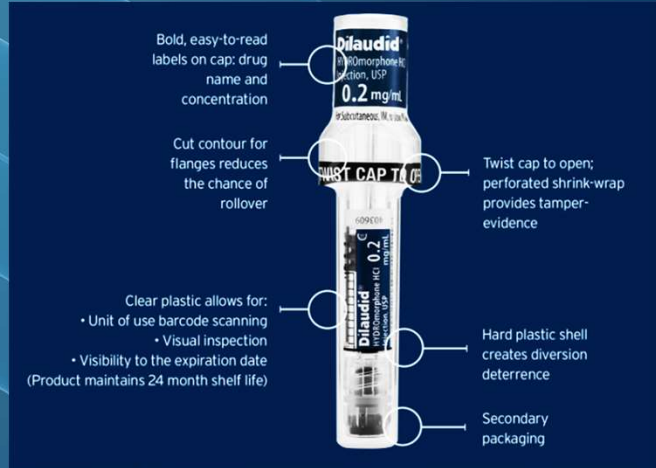
14

Reasons to Transition to RTA and Product Optimization



Diversion

- Optimized dosing to limit waste
 - No remaining medication waste
- Reduced use of waste disposal systems
- Tamper Evident Packaging
 - Deters opportunity
 - Medication can be returned
- Diversion monitoring software
 - Less transactions



15

Iowa Nurse Pleads Guilty to Diverting Fentanyl at Waterloo Hospital

Instead of wasting the controlled substances, he diverted them for personal use.

Former Nurse Sentenced for Tampering with Fentanyl Vials Intended for Patients at Fertility Clinic

Tuesday, May 25, 2021

Share >

For Immediate Release
U.S. Attorney's Office

Houston Methodist nurse accused of stealing drugs including Fentanyl, swapping vials and syringes with saline

Former Missoula nurse sentenced for felony diversion of drugs

she had been taking waste amounts of hydromorphone and morphine two to three times a week by exchanging the drugs for saline before disposing of them.

16

Reasons to Transition to RTA and Product Optimization

Workflow

- **Nursing / Anesthesia Benefits**
 - No additional supplies to gather
 - No relabeling
 - Barcode available
 - No waste to dispose
 - No waste witness
 - Less interruptions
 - Simplify stressful emergent administrations
 - More time to dedicate to patient care
- **Nurse Manager/ Pharmacy Benefits**
 - Less time needed to follow up on outstanding waste documentation

17

Product Optimization Timeline – Jefferson Abington

HYDROmorphone & FentaNYL Injections

5/17/22
HCP
Conference
- Hertig
report



18

Original Article

A Continuous Observation Workflow Time Study to Assess Intravenous Push Waste

John Hertig¹, Kaitlyn Jarrell², Prachi Arora¹, Jonell Nwabueze¹, Charlotte Mournaud¹, Daniel D. Dugman¹, and Tate Trujillo¹

Abstract

Background: There are significant costs associated with proper controlled substance disposal, management, and regulatory compliance. Given the high abuse potential of fentanyl, hydromorphone, and morphine it is imperative that (1) product waste is minimized and (2) waste procedures are followed to ensure safe disposal. Research is needed to better understand the financial and workforce impacts of drug waste on inpatient hospital units. The primary objective of this study was to quantify the waste associated with administering fentanyl, hydromorphone, and morphine via the intravenous push route. Two categories of waste were evaluated: (1) the quantity (mg/kg) of drug disposed and (2) workforce time associated with the waste disposal process. **Methods:** A workflow time study design, a sub-set of continuous direct observation time-motion studies, was employed to achieve the research objectives. A data collection tool was developed to capture medication type, waste amount, activity time status, total time, and number of interruptions at two separate study sites. Descriptive statistics were conducted on all the data measures. The number of assessments, total volume, and mass values were reported for each drug (fentanyl, hydromorphone, and morphine) separately as well as grouped data. **Results:** A total of 467 distinct waste observations meeting inclusion criteria were collected during a study period of 15 days. In total, 327 mg of hydromorphone and 1762.50 mg of fentanyl were wasted during this study. Nursing staff time associated with the wasting process totaled 50799 seconds (912.32 minutes or 15.20 hours). A combined waste level of approximately \$165.39 was associated with controlled substance wasting. The cost per dose wasted in this study was found to be \$2.40 for all medications. When a yearly extrapolation model was applied to the four study units, the total combined product and workforce waste cost was \$1451. **Conclusions:** There are financially significant costs associated with wasting both the product and the valuable time of a skilled workforce. Optimizing product size, taking special care to match product availability with common practice use, would reduce the associated financial burden on our health-systems nationwide.

Keywords: intravenous therapy, cost effectiveness, medication process, paralyzing

Introduction

Background


Health-system policies and procedures for handling and disposing of controlled substances vary. Proper disposal is an essential best practice, as controlled substances including fentanyl, hydromorphone, and morphine are associated with particularly high abuse and diversion risk. The Drug Enforcement Administration (DEA) estimates that prescription drug diversion in the United States is a \$20-billion-a-year industry.¹ Current federal statute dictates the appropriate disposal of controlled substance medications must occur immediately with documentation, and be witnessed by two licensed health-care professionals.² Depending on the patient care unit, the quantity, and variety of controlled substances administered can create an administrative and regulatory burden on health-care professionals. Policies requiring thorough documentation, check-and-balance, and positive audits necessitate an institutional investment of time and resources.

¹Drug Enforcement Administration, DC, USA
²Indian University, Indianapolis, IN, USA
³Indian University Health, Indianapolis, IN, USA
⁴Indian University, West Alabama, IN, USA

Corresponding Author:
 John Hertig, Butler University, 400 Sunset Ave, Indianapolis, IN 46208-3443, USA.
 Email: jhertig@butler.edu

Outcomes & Identified opportunities

- Significant financial costs associated with waste:
 - Nursing workforce time
 - Cost of interruptions
 - Cost of Medication waste
- Other:
 - Patient care/ safety
 - Cost waste disposal
 - Pharmacy time
 - Staff satisfaction



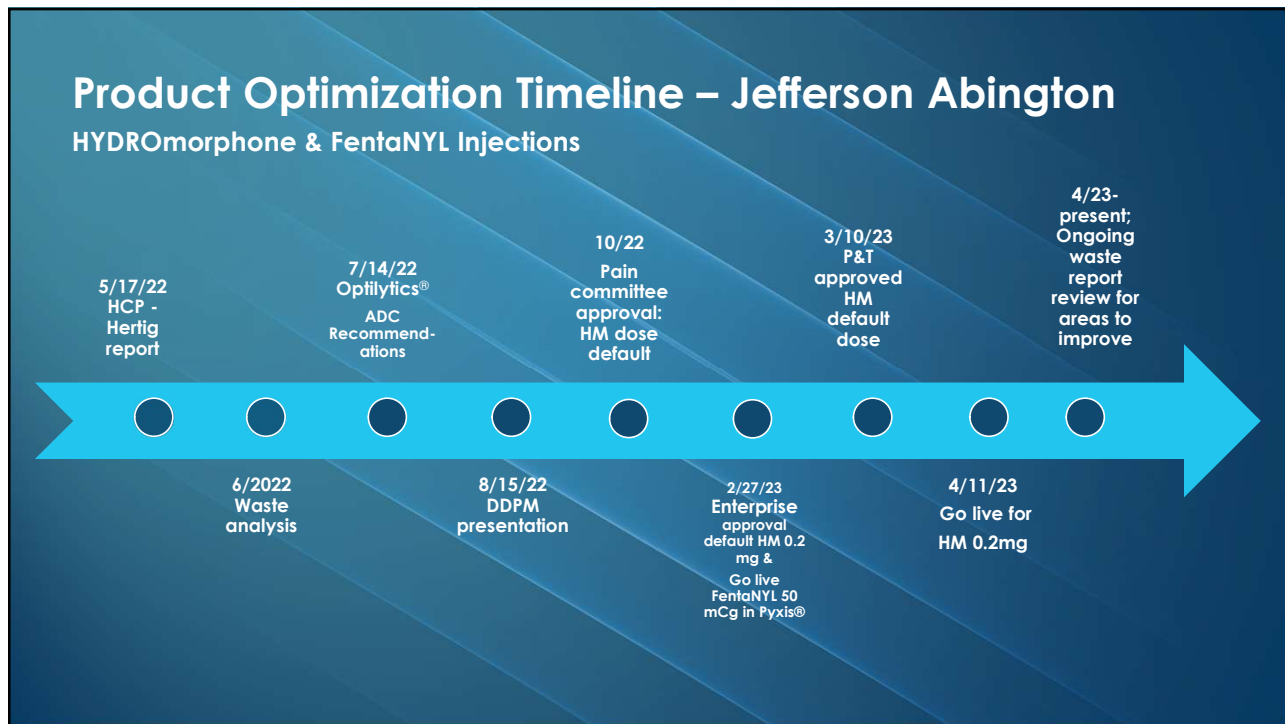
19

Estimated Waste Calculator

How much is narcotic waste costing you?

Medication	Acquisition Cost	Total Waste	Waste Events	Waste % of Waste Events	Results
Fentanyl Citrate Injection, USP CII (50 mcg/mL) 2 mL	\$ 5.30	117063.5 mcg	1966	60%	<div style="background-color: #007bff; color: white; padding: 10px; text-align: center;"> Viols Wasted Annually 16,267 <small>Cost: \$55,360.88</small> </div>
Fentanyl Citrate Injection, USP CII (50 mcg/mL) 5 mL	\$ 3.60	3425 mcg	27	51%	
Hydromorphone HCl Injection, USP CII (0.5 mg/0.5 mL) 0.5 mL	\$ 1.53	496.77 mg	1917	52%	<div style="background-color: #007bff; color: white; padding: 10px; text-align: center;"> Hours Wasted Annually 628.63 <small>Cost: \$22,162.76</small> </div>
Hydromorphone HCl Injection, USP CII (1 mg/mL) 1 mL	\$ 3.07	1160.7 mg	2151	54%	
Hydromorphone HCl Injection, USP CII (2 mg/mL) 1 mL	\$ 3.60	0 mg	0	0%	<div style="background-color: #007bff; color: white; padding: 10px; text-align: center;"> Dollars Wasted Annually \$77,513.64 </div>
Morphine Sulfate Injection, USP CII (2 mg/mL) 1 mL	\$ 3.44	865.24 mg	820	53%	
Morphine Sulfate Injection, USP CII (4 mg/mL) 1 mL	\$ 3.44	959.61 mg	442	54%	
Workforce Hourly Wage	\$ 35.24	Workforce Time Wasted per Event	76.2 Seconds	Total Days Observed	90

20



21

Our Steps to Transition

1. Identify opportunity

- Waste analysis: morphine, fentaNYL and HYDROmorphone Inj.
- Addition of fentaNYL 50 mcg (removal of 100 mCg in areas)
- Optimize current HYDROmorphone 0.5 mg inj
- Addition of HYDROmorphone 0.2 mg inj
- Change Epic® default dosing HYDROmorphone 0.25 mg-> 0.2 mg

Jefferson Abington Hospital (data observed over 90 days)		
Opportunities to reduce waste transactions with Fentanyl 50 mcg per 1 mL		
Drug	Waste Amount	Number of Waste Events
Fentanyl 100 mcg per 2 mL	50 mcg	1,012
Estimated Annualized Total Waste Events		4,104
Opportunities to reduce waste transactions with Hydromorphone 0.5 mg per 0.5 mL		
Drug	Waste Amount	Number of Waste Events
Hydromorphone 1 mg per 1 mL	0.5 mg	1,688
Hydromorphone 2 mg per 1 mL	1.5 mg	5
Estimated Annualized Total Waste Events		6,866
Opportunities to reduce waste transactions with Hydromorphone 0.2 mg per 1 mL		
Drug	Waste Amount	Number of Waste Events
Hydromorphone 0.5 mg per 0.5 mL	0.25* mg	1,844
Hydromorphone 1 mg per 1 mL	0.75* mg	319
Hydromorphone 2 mg per 1 mL	1.75* mg	1
Estimated Annualized Total Waste Events		8,776

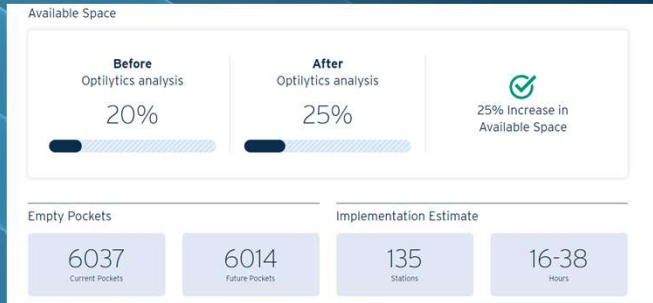
22

Our Steps to Transition, continued

2. Approvals (Diversion, Pain & P&T committees)

3. ADC Preparation

- Unload medications
- Consolidate pockets
- Appropriate pockets
- Optilytics® ADC assessment
 - Where? Par levels?



MOVE THIS	carbidopa 12.5 mg/levodopa 50 mg (SINEMET)	drawer 6.1	pocket E4 [HHC:1x3]	20	Preview
TO HERE	carbidopa 12.5 mg/levodopa 50 mg (SINEMET)	drawer 6.2	pocket A2 [HHC:1x1]	15	
Note: The suggested fill quantity of 15 is 6 less than the pocket capacity of 21 Note: Change par from 20 to 15					
ADD THIS	Simplist® Fentanyl MV 50 MCG	drawer 6.1	pocket E4 [HHC:1x3]	10	Preview

23

Our Steps to Transition, continued

4. Staff Notification & Education

- Proper use of tamper evident package/ RTA syringe
- SBAR

Topic: **HYDROMORPHONE Injection Optimization**
 Effective date: 4/11/2023
 Distribute to: Clinical staff

Situation:	A new product size is available for HYDROMORPHONE 0.2 mg/ mL injection which will not require waste for doses of 0.2 mg.				
Background:	For controlled medications, if the dose ordered is less than what is commercially available and dispensed, two licensed practitioners are required to participate in the wasting process.				
Assessment:	An evaluation from an external vendor of HYDROMORPHONE injection usage and dosing data was recently conducted for Abington. It was determined that adjusting the standard doses available to select and order in Epic in conjunction with adding a HYDROMORPHONE 0.2 mg/ mL product for dispensing will support organizational dosing practices by: <ul style="list-style-type: none"> • Minimizing the number of wasted doses • Reducing the need for a witness to complete waste transactions • Decreasing nursing time away from patient bedside • Limiting the number of Bluesight events requiring follow up by nursing & pharmacy 				
Recommendation:	<p>Beginning 4/11/2023,</p> <ul style="list-style-type: none"> • Epic will be updated with HYDROMORPHONE injection order options of 0.2 mg instead of 0.25 mg – shown below <p>Dose: <input type="text" value="0.2"/> mg 0.2 mg 0.5 mg 1 mg</p> <ul style="list-style-type: none"> • For all new orders of HYDROMORPHONE 0.2 mg inj. the preferred product will be HYDROMORPHONE 0.2 mg/ mL syringes. • HYDROMORPHONE 0.2 mg/ mL syringes will be stocked in Pyxis <table border="1"> <thead> <tr> <th>Current HYDROMORPHONE supply</th> <th>Addition of HYDROMORPHONE supply</th> </tr> </thead> <tbody> <tr> <td>0.5 mg/ 0.5 mL</td> <td>0.2mg/ 1 mL</td> </tr> </tbody> </table>	Current HYDROMORPHONE supply	Addition of HYDROMORPHONE supply	0.5 mg/ 0.5 mL	0.2mg/ 1 mL
Current HYDROMORPHONE supply	Addition of HYDROMORPHONE supply				
0.5 mg/ 0.5 mL	0.2mg/ 1 mL				

5. Go Live:

- ADC Stocked
- IS System Build
- Order sets
- Preferred lists

6. Post Go Live :

- Routine review
- Optimize Par levels

24

Results:**Product Optimization Results**

Data evaluated from April 1, 2022 through October 15, 2023

80.6%

Reduction in overall Fentanyl waste transactions

Before 4/1-6/28/22 (89 days) 19.39 waste transactions per day**After** 8/1-10/15/23 (76 days) 3.72 waste transactions per day**83.33%**

Reduction in overall Hydromorphone waste transactions

Before 4/1-6/28/22 (89 days) 44.99 waste transactions per day**After** 8/1-10/15/23 (76 days) 7.5 waste transactions per day

25

Challenges VS Benefits

Challenges	Benefits
ADC Storage limitations	Safer Practices
Pharmacy Resources	Diversion Deterrent
Alignment	Streamlined Workflow
EHR system	Cost savings
Cost	Staff Satisfaction

26

Key Takeaways

- Weigh benefits vs challenges
- Identify opportunities & target
- Develop a plan
- Buy-in!!!
 - Stakeholders
- Resources
 - Pharmacy staff
 - HIS (Epic®, Pyxis®)
- Support
 - Metrics
- Ongoing Review & Education

27

Provider Feedback:

"Wish we could make all meds like that!"

"So much easier and faster"

"Love them, don't have to take the time to find a syringe and needle and draw up"

"Not having to waste all the time is fantastic"

"Has there ever been a nurse who said no to eliminate a step to something?" (haha)

"So much easier, we cut ourselves on ampules, have to take the time to find a filter needle, risk of glass when we can't find them emergently"

28

References:

1. ISMP Best Practice Guidelines for Adult IV push medications Available at: [ISMP97-Guidelines-071415-3_FINAL.pdf](#)
2. [Simplist® Prefilled Syringes by Fresenius Kabi \(simplist-us.com\)](#)
3. ISMP Safe Guidelines for Adult IV Push Medications, An Abridged Reference Tool
4. Hertig,J., Jarrell,K.,Arora,P., Nawabueze,J.,Moureaud ,C. ,Degnan, D.D., & Trujillo,T.(2020) A Continuous Observation Workflow Time Study to Assess Intravenous Push Waste. Hospital Pharmacy
5. [Former Missoula nurse sentenced to 3 years probation for diverting opiates | KECI \(nbcmontana.com\)](#)
6. [District of Connecticut | Former Nurse Sentenced for Tampering with Fentanyl Vials Intended for Patients at Fertility Clinic | United States Department of Justice](#)
7. [Houston Methodist nurse accused of stealing drugs including Fentanyl, swapping vials and syringes with saline \(click2houston.com\)](#)
8. [Northern District of Iowa | Iowa Nurse Pleads Guilty to Diverting Fentanyl at Waterloo Hospital | United States Department of Justice](#)
9. Institute for Safe Medication Practices. ISMP safe practice guidelines for adult IV push medications: a compilation of safe practices from the ISMP Adult IV Push Medication Safety Summit. Published 2015. Accessed June 9th, 2020. www.ismp.org/Tools/guidelines/ivsummitpush/ivpushmedguidelines.pdf

29

Beth Israel Deaconess
Medical Center



HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

The Effect of Opioid Vial Sizes on Patient Outcomes

Krish Ramachandran MD

Associate Professor of Anaesthesia, Harvard Medical School
Beth Israel Deaconess Medical Center, Boston MA

30

Scope

Recognize new evidence demonstrating improved patient outcomes when providers are presented with RTA products

Opioid “Overdosing”

- Scope of problem
- Dosing behaviors
- Outcome relationships

Waste

- Risks & Outcomes
- ### Overcoming barriers to change
- Beliefs/Practices

Beth Israel Deaconess
Medical Center



31

“Overdose”

Beth Israel Deaconess
Medical Center



32

Postoperative Opioid-induced Respiratory Depression

A Closed Claims Analysis

Lorri A. Lee, M.D., Robert A. Caplan, M.D., Linda S. Stephens, Ph.D., Karen L. Posner, Ph.D., Gregory W. Terman, M.D., Ph.D., Terri Voepel-Lewis, Ph.D., R.N., Karen B. Domino, M.D., M.P.H.

- 9799 claims reviewed
 - 357 acute pain claims
 - 92 had respiratory depression (RD)
- 88% within 24 hours of surgery
- 97% deemed preventable
- Somnolence in 62% of cases

ABSTRACT

Background: Postoperative opioid-induced respiratory depression (RD) is a significant cause of death and brain damage in the perioperative period. The authors examined anesthesia closed malpractice claims associated with RD to determine whether patterns of injuries could guide preventative strategies.

Methods: From the Anesthesia Closed Claims Project database of 9,799 claims, three authors reviewed 357 acute pain claims that occurred between 1990 and 2009 for the likelihood of RD using literature-based criteria. Previously cited patient risk factors for RD, clinical management, nursing assessments, and timing of events were abstracted from claim narratives to identify recurrent patterns.

Results: RD was judged as possible, probable, or definite in 92 claims ($\kappa = 0.690$) of which 77% resulted in severe brain damage or death. The vast majority of RD events (88%) occurred within 24 h of surgery, and 97% were judged as preventable with better monitoring and response. Contributing and potentially actionable factors included multiple prescribers (33%), concurrent administration of nonopioid sedating medications (34%), and inadequate nursing assessments or response (31%). The time between the last nursing check and the discovery of a patient with RD was within 2 h in 42% and within 15 min in 16% of claims. Somnolence was noted in 62% of patients before the event.

Conclusions: This claims review supports a growing consensus that opioid-related adverse events are multifactorial and potentially preventable with improvements in assessment of sedation level, monitoring of oxygenation and ventilation, and early response and intervention, particularly within the first 24 h postoperatively. (*ANESTHESIOLOGY* 2015; 122:659-665)

Beth Israel Deaconess
Medical Center



Lee LA, et al. *Anesthesiology* 2015; 122:659-665

33

Cost of Postoperative RD from Opioids

Khanna et al. *BMC Anesthesiology* 2021;21:88
<https://doi.org/10.1186/s12871-021-01307-8>

BMC Anesthesiology

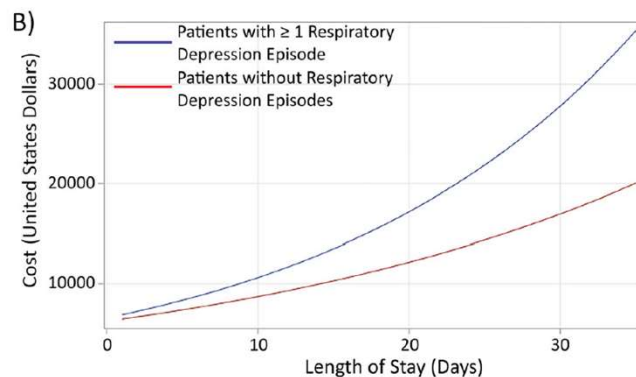
RESEARCH ARTICLE

Open Access

Opioid-induced respiratory depression increases hospital costs and length of stay in patients recovering on the general care floor

Ashish K. Khanna^{1*}, Lief Saager², Sergio D. Bergese³, Carla R. Jungquist³, Hiroshi Morimatsu⁴, Shoichi Uezono⁵, Lian Kah Ti⁶, Roy Soto⁷, Wei Jiang¹⁰ and Wolfgang Buhre¹¹

- PRODIGY secondary analysis
- Cost data from 420 U.S. patients
- Patients with ≥ 1 RD episode had
 - Longer length of stay (6.4 ± 7.8 days vs. 5.0 ± 4.3 days, $p = 0.009$)
 - Higher hospital cost ($\$21,892 \pm \$11,540$ vs. $\$18,206 \pm \$10,864$, $p = 0.002$)



Beth Israel Deaconess
Medical Center



Khanna AK, et al. *BMC Anesthesiology*. 2021;21:88.

<https://doi.org/10.1186/s12871-021-01307-8>

34

Long-term Impact of Intraoperative Opioid Dose

BJA

British Journal of Anaesthesia, 120 (5): 1090–1102 (2018)
doi: 10.1093/bja/2017-12-294
Advance Access Publication Date: 9 March 2018
Quality and patient safety

Association between intraoperative opioid administration and 30-day readmission: a pre-specified analysis of registry data from a healthcare network in New England

D. R. Long¹, A. L. Lihn^{1,2}, S. Friedrich¹, F. T. Scheffenbichler¹, K. C. Safavi¹, S. M. Burns¹, J. C. Schneider³, S. D. Grabitz¹, T. T. Houle¹ and M. Eikermann^{4,5,*}

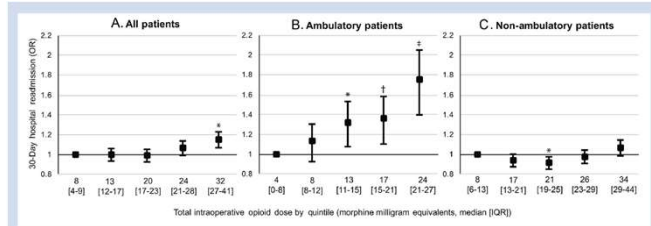


Fig 2. Association between intraoperative opioid dose and 30-day postoperative hospital readmission amongst (A) 153 902 patients of all admission classes; P<0.001; (B) 40 060 ambulatory patients; P<0.001, P<0.001, P<0.001; and (C) 113 842 non-ambulatory (admitted) patients; P=0.013. Total opioid doses (including morphine, hydromorphone, methadone, meperidine, fentanyl, sufentanil, and alfentanil) were calculated using standard equianalgesic conversion ratios^{18,19} with adjustment for lean body weight²¹ and are reported in quintiles of i.v. morphine milligram equivalents. Logistic regression was performed using the model described in Supplementary eTable 1, which included adjustment for remifentanyl exposure. IQR, inter-quartile range; OR, odds ratio.

- Retrospective registry analysis of 153,902 surgical cases
- Clear dose-response curve for readmission risk
- Highest impact on ambulatory patients

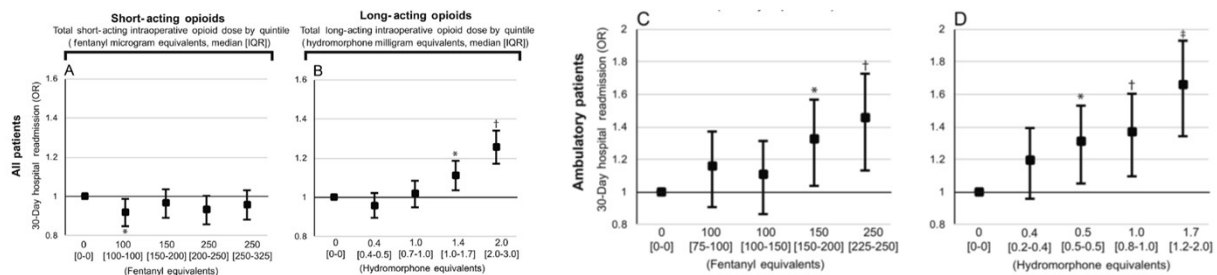
Beth Israel Deaconess Medical Center

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Long DR, et al. *Br J Anaesth.* 2018;120(5):1090-1102.

35

Outcomes with Opioid & Admission Type



- Readmission association most pronounced with hydromorphone
- Dose response for ambulatory surgery shows important opportunities for improvement

Beth Israel Deaconess Medical Center

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

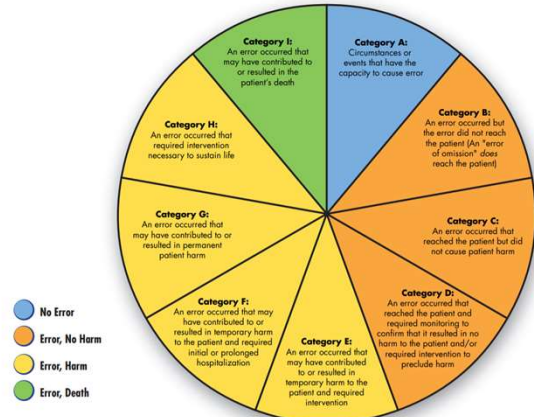
Long DR, et al. *Br J Anaesth.* 2018;120(5):1090-1102.

36

Intraoperative Opioid Dose - Early Postoperative Outcomes

Aim: To evaluate the relationship between incremental unit dosage and clinically relevant outcomes

Focused on “Harm Outcomes”

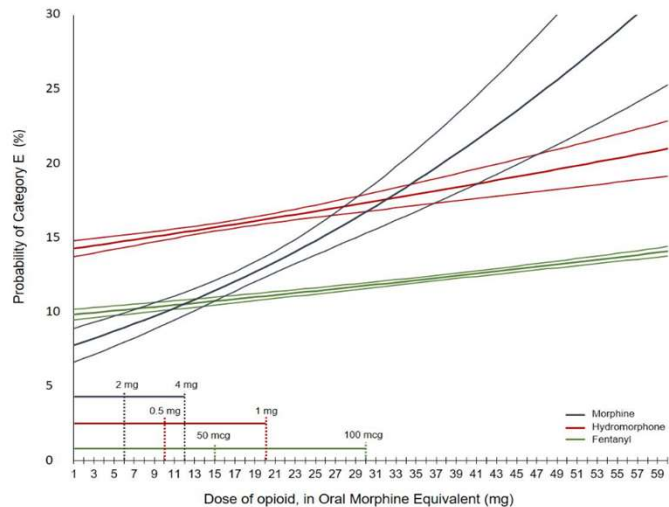
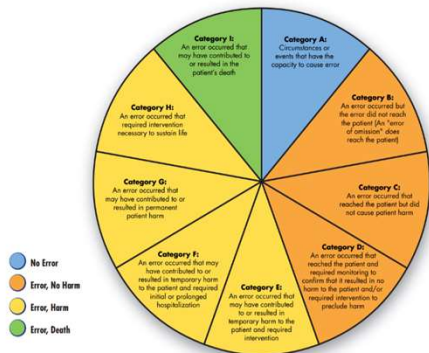


Since the causality of opioid dosing in these complications is difficult to quantify, we do not assess higher dose administration as "medication errors" necessarily, but use this as a framework for classifying safety outcomes

Beth Israel Deaconess Medical Center
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

37

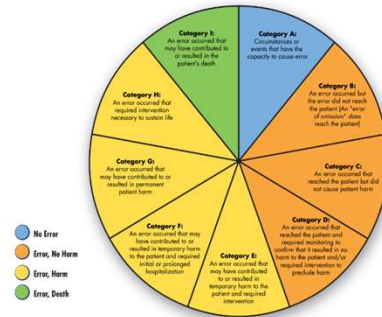
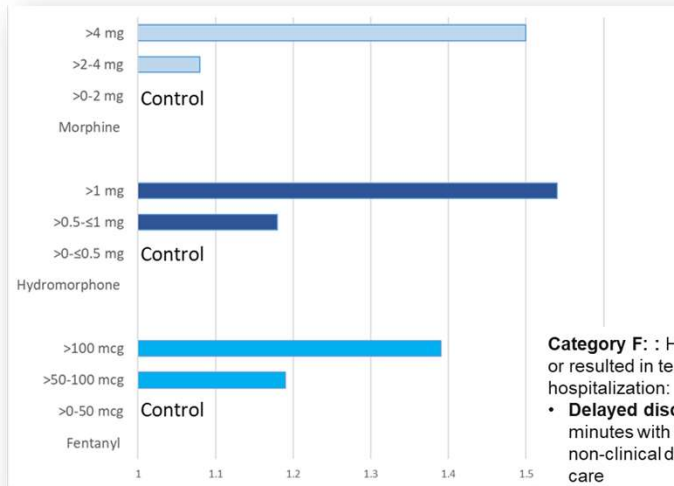
Category E Harm



The primary outcome, Category E, included
Post-extubation desaturation
Postoperative nausea and vomiting needing rescue treatment in post-anesthesia care unit, or
Postoperative somnolence or sedation needing nursing observation or administration of naloxone

38

Category F Harm



Category F: Higher opioid dose, independent of other factors, which contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization:

- **Delayed discharge from PACU**, defined as length of stay (LOS) greater than 120 minutes with defined clinical cause. This measure is primarily for out-patient, since non-clinical delays are common in patients admitted to hospital for postoperative care
- **Unplanned admission:** booked outpatients who required unplanned admission
- **Delayed discharge from hospital**, defined as length of stay >75th centile of
- **Readmission** within 30 days after hospital discharge (all-cause)

39

Summary

Lower opioid doses are associated with
 Measurable, reproducible **value** through

Reduced early postoperative complication rates
Reduced healthcare utilization
Cost-savings

40

OPIOID WASTE: HIDDEN RISKS AND COSTS

Beth Israel Deaconess Medical Center
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

41

Why Eliminating Waste is Important

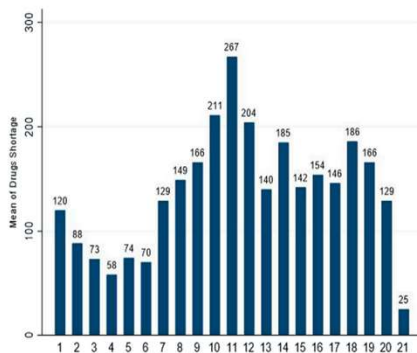


FIGURE 1 | Number of drugs in shortage per year reported by University of Utah Drug Information Services (UUDIS) (American Society of Health System Pharmacists, 2020, June 30).

REUTERS World Business Markets Breakingviews Video More

HEALTHCARE & PHARMA JUNE 9, 2020 17:41 AM / UPDATED 3 YEARS AGO

Special Report: COVID deepens the other opioid crisis - a shortage of hospital painkillers

HOSPITALS

Hospitals are confronting a new opioid crisis: an alarming shortage of pain meds

By Casey Boss March 16, 2018



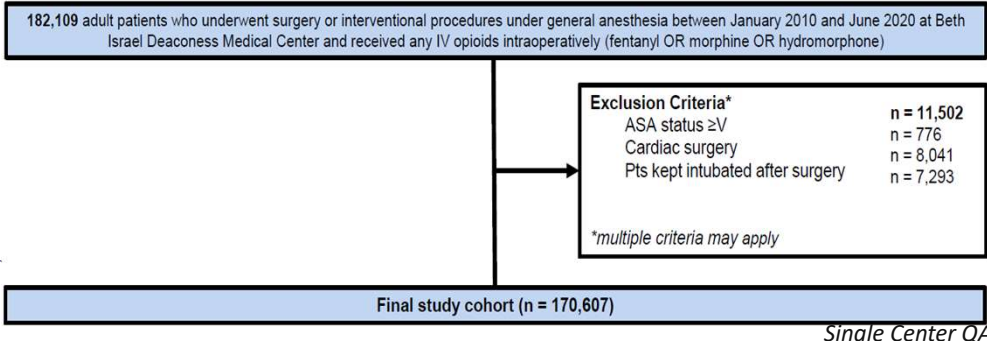
Beth Israel Deaconess Medical Center
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

42

Projected Waste Analysis

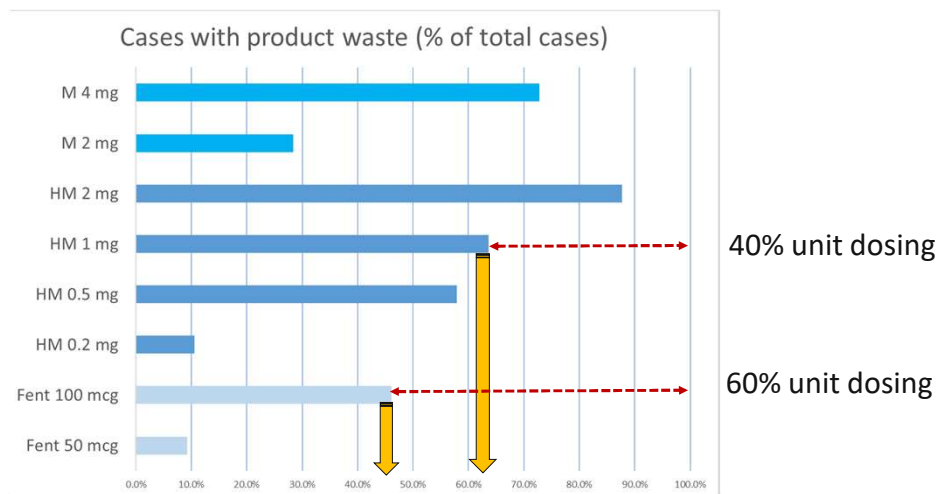
Cost data:

- All projected waste data converted to cost (USD) using average wholesale price (AWP)
- Loss of provider time to accomplish waste was assessed using an estimated average of CRNA hourly wages



43

Projected RTA Product Size and Waste



Beth Israel Deaconess Medical Center
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Single Center QA Data

44

Projected RTA Product Size & Cost

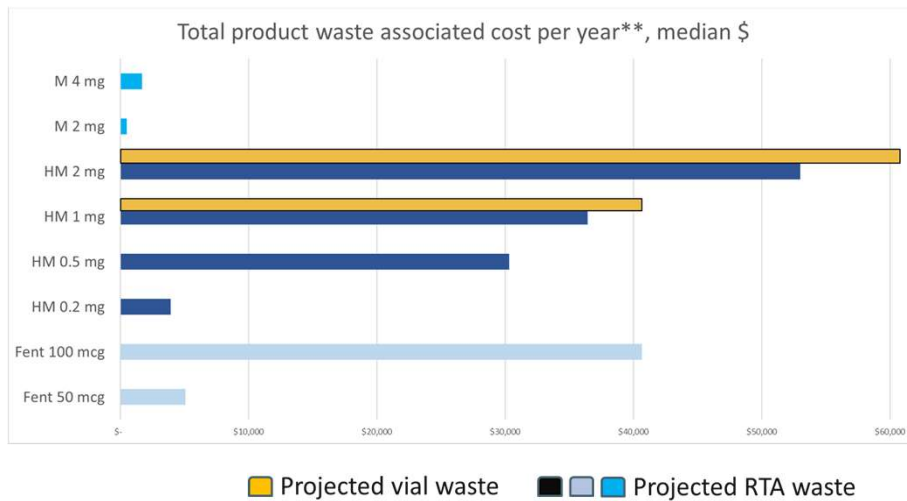


Beth Israel Deaconess Medical Center
 HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Single Center QA Data

45

Product Waste is Greater with Vials



Beth Israel Deaconess Medical Center
 HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

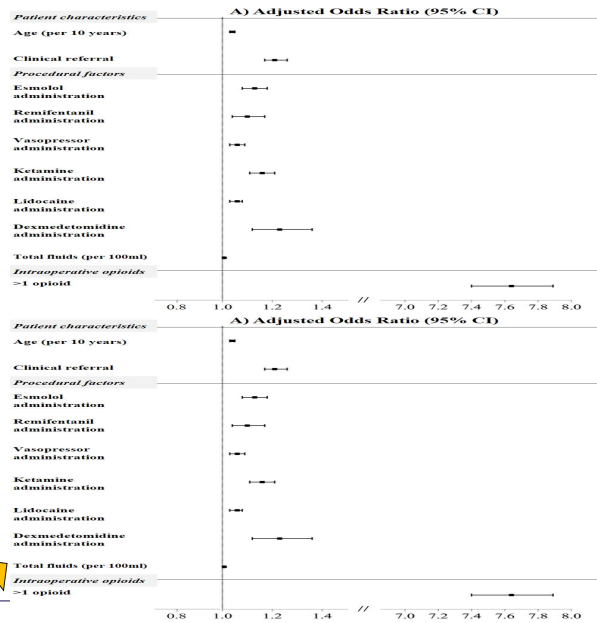
Single Center QA Data

46

Predictors of Intraoperative Opioid Waste

- The **generalizability** of this single center's predictors is expected to be **high**
- Only 10% of the observed variance in intraoperative opioid dosing may be explained by individual hospital (25% of model R^2 of 0.426)

Naik BI, et al. Anesth Analg. 2022;134(1):8-17



Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

47

Summary

- Unit dosing: ~50% of intraoperative opioid doses
- Waste 8 times more likely when >1 opioid used
- Estimated cost of waste
 - \$75,000 per year at one center
 - Waste and cost are higher with vials

Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

48

BARRIERS TO CHANGE

Beth Israel Deaconess
Medical Center

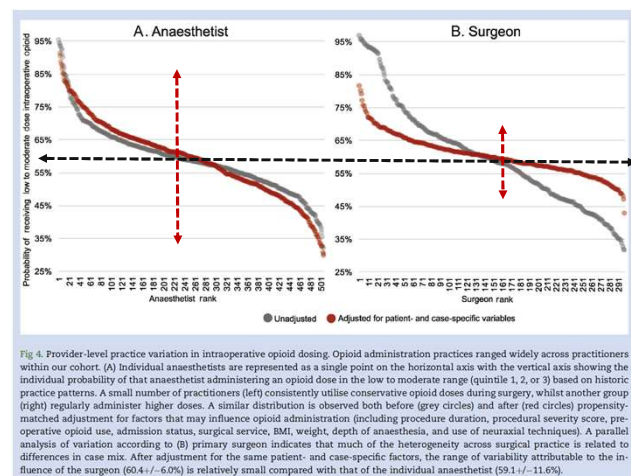
HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

49

Prescribing & Dosing Behaviors

Probability of a patient receiving **low-to-moderate dose opioid** intraoperatively

- Depends on the individual provider's historical dosing patterns
- Wide variation in dosing patterns among practitioners
- Anesthetists are 2-times more influential on opioid dose selection than surgeons



Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Long DR, et al. *Br J Anaesth.* 2018;120(5):1090-1102.

50

UNIT DOSING

- Is reproducible
- Has roots in human factors
- Impacts cost, waste, and complications

Beth Israel Deaconess
Medical Center



51

What if we could ...

influence clinician prescribing/dosing behavior

So that ...

we improved the quality of care &
reduced complications?

For example ...

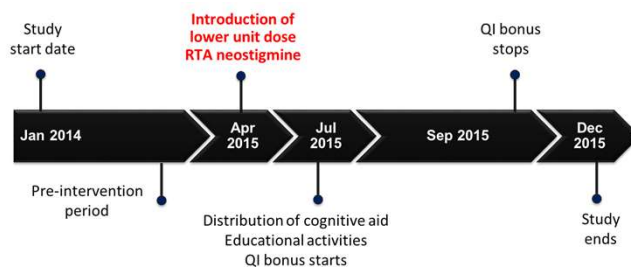
Beth Israel Deaconess
Medical Center



52

EXAMPLE 1

Changing Anesthesia Clinician Behaviors

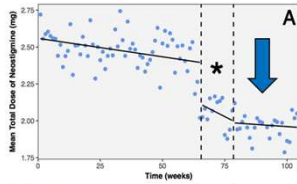


Type of Monitoring		Neostigmine Dose	
Qualitative	Quantitative	Weight-Based	70-kg patient
No twitch	No twitch	WAIT	WAIT
1 twitch	1 twitch	WAIT	WAIT
2-3 twitches	2-3 twitches	~50 mcg/kg	3-4 mg
4 twitches with fade	TOF ratio <0.4	~40 mcg/kg	2-3 mg
4 twitches without fade	TOF ratio 0.4-0.9	15-30 mcg/kg	1-2 mg
	TOF ratio >0.9	NONE	NONE
Risk factors for Residual Weakness			
High total dose of NMBA >1.5 mcg/kg rocuronium or >0.4 mg/kg cisatracurium			
High dose neostigmine reversal >60 mcg/kg			
ALWAYS DOSE NMBA AND REVERSAL ACCORDING TO MONITORING AND CLINICAL CONDITION			

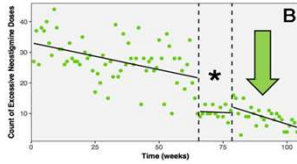
TOF: train of four; NMBA: neuromuscular blocking agent

Rudolph MI, et al. *Anaesthesia*. 2018;73:1067-1078.

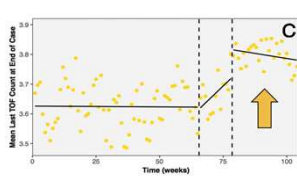
Process Measures



Mean Neostigmine Dose



Excessive Neostigmine Dosing



TOF Count at the End of the Case

Outcome Measures

- PPC reduced by 25%
- HLOS reduced by 10%
- Costs reduced by 5%

TOF: train of four; PPC postoperative pulmonary complications; HLOS hospital length of stay

Beth Israel Deaconess Medical Center



Rudolph MI, et al. *Anaesthesia*. 2018;73:1067-1078.

EXAMPLE 2

Beth Israel Deaconess Medical Center



Does Use of RTA Syringes vs. Vials Impact Dose?

Three study periods (17,695 cases)

- 2-mL fentanyl syringes (14 weeks)
- 5-mL fentanyl vials (12 weeks)
- 2-mL fentanyl syringes (10 weeks)

Mean fentanyl dose/case

- 110 μg -->> 164 μg -->> 120 μg

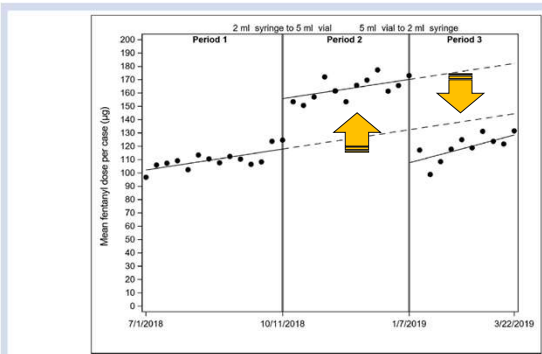


Fig 1. Change in mean fentanyl dose administered per case associated with change in vial size. Circles represent the mean fentanyl dose administered per case per week. Solid lines show the observed temporal trends in mean fentanyl dose administered per case per week within each study period, estimated from a weighted segmented linear regression model. The vertical distance between adjacent trend lines represents the difference in mean fentanyl dose per case associated with the corresponding change in vial size. Dashed lines show the projected temporal trend in mean dose of fentanyl administered per case, predicted based on data from prior periods using weighted linear regression models.

Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

Stone A, et al. *Br J Anaesth.* 2020;124(6):e219-e231.

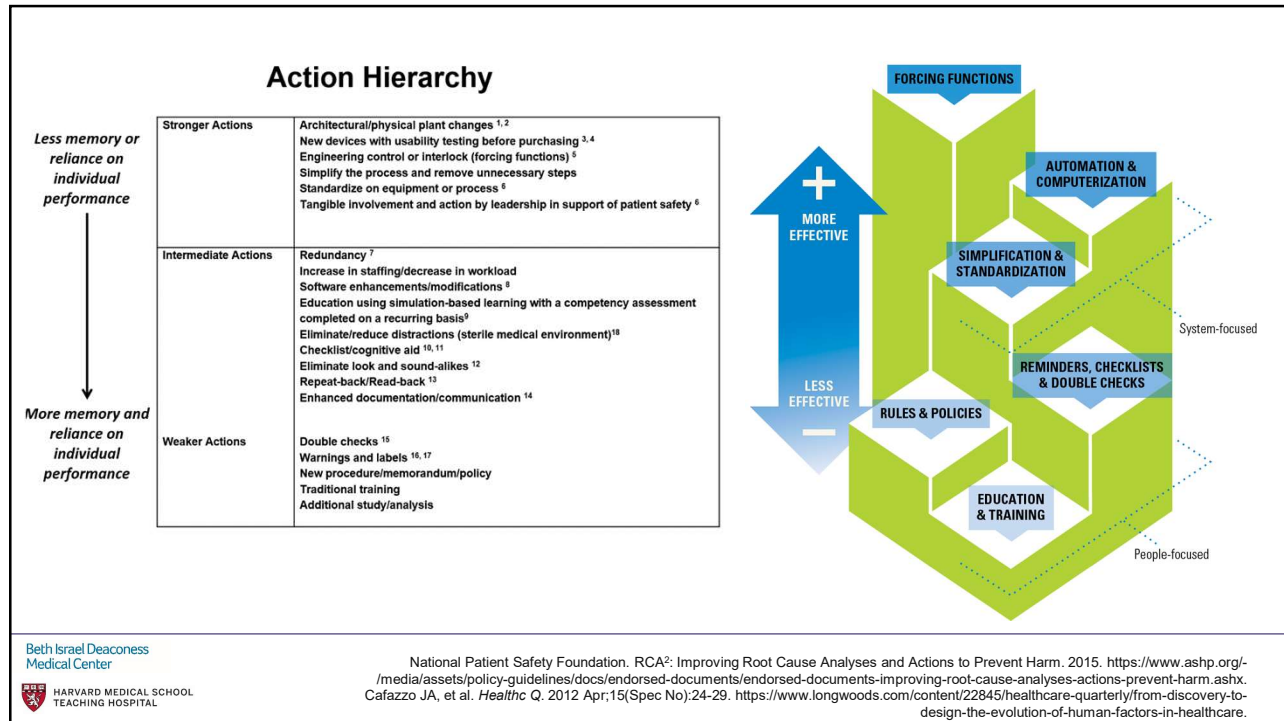
57

FOCUS ON HIGH-IMPACT INTERVENTIONS

Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

58



59

Potential High-Impact Solutions

Forcing Functions

- 1. Choose RTA products over vials**
 - Improved safety: reduced mislabeling/medication error
 - Reduced waste: cost, environmental impact
- 2. Consider patient outcomes and cost of waste**
 - Optimal fentanyl syringe size 50 µg for outpatient surgery
 - Optimal hydromorphone syringe size 0.5 mg

Beth Israel Deaconess Medical Center
 Harvard Medical School Teaching Hospital

60

Potential Lower Impact Actions

Discretionary Actions

3. Educate clinicians to choose RTA syringe size optimized for meaningful outcomes

- Fentanyl dose-response shows harm for >50 µg doses
- Hydromorphone dose-response shows harm >0.5 mg doses

4. Educate clinicians to choose one opioid

- Associated with reduced product waste
- Fentanyl better than hydromorphone for PACU outcomes in outpatients

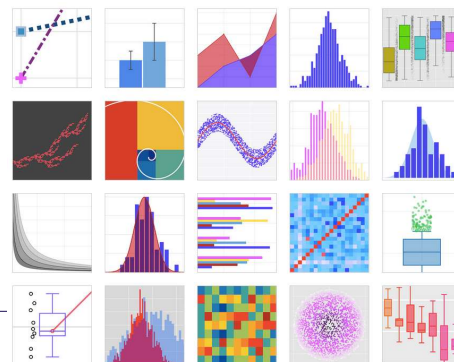
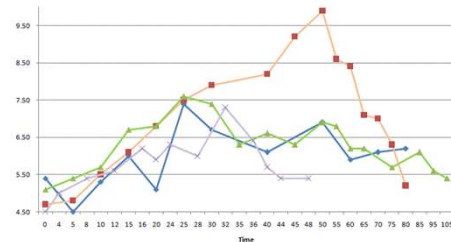
Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

61

Measure Intended and Unintended Effects

- PROMs: Pain outcomes
 - Patient Reported Outcome Measures
- Healthcare utilization
 - PACU delays
 - Unplanned admissions
 - ICU utilization
- Drug costs

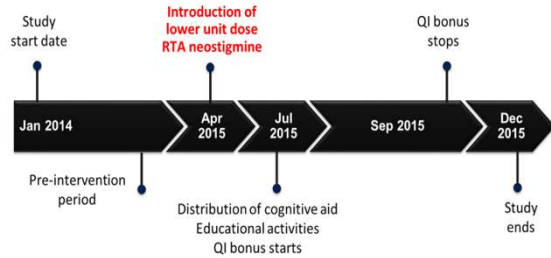


Beth Israel Deaconess
Medical Center

HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

62

Why Was This Intervention Successful?



Type of Monitoring		Neostigmine Dose	
Qualitative	Quantitative	Weight-Based	70-kg patient
No twitch	No twitch	WAIT	WAIT
1 twitch	1 twitch	WAIT	WAIT
2-3 twitches	2-3 twitches	~50 mcg/kg	3-4 mg
4 twitches with fade	TOF ratio <0.4	~40 mcg/kg	2-3 mg
4 twitches without fade	TOF ratio 0.4-0.9	15-30 mcg/kg	1-2 mg
	TOF ratio >0.9	NONE	NONE
Risk factors for Residual Weakness			
High total dose of NMBA >1.5 mcg/kg rocuronium or >0.4 mg/kg cisatracurium			
High dose neostigmine reversal >60 mcg/kg			
ALWAYS DOSE NMBA AND REVERSAL ACCORDING TO MONITORING AND CLINICAL CONDITION			

I. INTERVENTION CHARACTERISTICS	
Evidence Strength and Quality	X
Intervention Source	X
I. INNER SETTING	
Networks and Communications	?
Implementation Climate	
Tension for change	X
Relative priority	X
Goals and Feedback	X
Learning climate	
Readiness for Implementation	
Leadership Engagement	X
V. PROCESS	
Planning	X
Reflecting and Evaluating	X

Beth Israel Deaconess Medical Center
 HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Rudolph MI, et al. *Anaesthesia*. 2018;73:1067-1078.

63

Key Takeaways

- Intraoperative opioid dose restriction has clinical outcome implications
- Evidence supports the use of standardized opioid RTA sizes as an effective strategy to influence administered dose and opioid waste/cost
- Consider the strength of intervention and other tactics of implementation science

Beth Israel Deaconess Medical Center
 HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

64

Selected Resources

- Lee LA, Caplan RA, Stephens LS, et al. Postoperative opioid-induced respiratory depression: a closed claims analysis. *Anesthesiology*. 2015;122(3):659-665.
- Khanna AK, Saager L, Bergese SD, et al. Opioid-induced respiratory depression increases hospital costs and length of stay in patients recovering on the general care floor. *BMC Anesthesiol*. 2021;21:88.
- Long DR, Lihn AL, Friedrich S, et al. Association between intraoperative opioid administration and 30-day readmission: a pre-specified analysis of registry data from a healthcare network in New England. *Br J Anaesth*. 2018;120(5):1090-1102.
- Stone A, Fields K, Rathmell J, et al. Association between fentanyl vial size and dose given: an interrupted time series analysis of intraoperative opioid administration. *Br J Anaesth*. 2020;124(6):e219-e221.

Beth Israel Deaconess
Medical Center

 HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

65



Questions?

This activity is supported by **Fresenius Kabi**.

©2023 ISMP | www.ismp.org | 66

66