Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

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Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

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Target Audience & Learning Objectives

The target audience for this activity is pharmacists and pharmacy technicians.

Upon completion of this activity, participants should be able to:

1. Describe the risks associated with the preparation and administration of IV medications that are manipulated at the bedside.
2. Compare studies evaluating the cost and safety comparisons between manufacturer-prepared prefilled ready-to-administer (RTA) products versus traditional vial-and-syringe products.
3. Describe an organization's perspective of the financial savings and improved safety from transitioning from traditional vial-and-syringe medications to manufacturer-prepared prefilled ready-to-administer (RTA) products.

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Intravenous Injections

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ISMP Survey: Compounding Outside the Pharmacy

Most frequently prepared sterile injectables

- Intravenous push medications
  - **Mostly medications transferred from vials to syringes (e.g., opioids, antiemetics, antibiotics, proton pump inhibitors)**
- Intermittent infusions
  - **Mostly using vial and bag adapter systems**
- Intramuscular injections
  - **Mostly vaccines, antipsychotic and, antibiotics**

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ISMP Survey Provides Insights into Preparation and Admixture Practices OUTSIDE the Pharmacy
https://www.ismp.org/node/21184

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Compounding Outside the Pharmacy

Frequency of preparation

Intravenous push medications	Intermittent infusions	Intramuscular injections
Always or often 58%	Always or often 53%	Always or often 39%

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Compounding Risks

Risk for medication errors

- 31% aware of or personally experienced errors when preparing or admixing injectable medications
  - *The practitioner preparing the medication or solution is often the one administering it*
- Top errors
  - **Wrong drug, dose, concentration, diluent or diluent volume (82%)**
  - **No label or labelling error (81%)**

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Compounding Risks

Sterility risks

- Microbial contamination of parenteral medications: clinical versus pharmacy environment
- Literature review
  - **PubMed and EMBASE search; publication dates: 2000-2018**
- Significantly higher contamination rates for preparation of parenteral medication in the clinical environment
- Clinical area prepared products: Contamination rate = 1.09 – 20.7%
- Many potential contributing factors: environment, staff, training, frequency, aseptic technique

Larmene-Beld KHM, Frijlink HW, Taxis, K A systematic review and meta-analysis of microbial contamination of parenteral medication prepared in a clinical versus pharmacy environment. *Eur J Clin Pharmacol.* 2019 May;75(5)609-617.

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Bringing Medication Safety into Focus

- Eliminate the need for compounding and potential risk of hospital-acquired infections by capitalizing on the purchase of commercially-manufactured products
- Remove the need for compounding outside the pharmacy environment by dispensing intravenous push medications in ready-to-administer dosage forms
- Reduce the steps required for wasting controlled substances by providing patient-specific doses of intravenous push controlled substances in ready-to-administer dosage forms

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Comparing Costs and Safety Implications Between Ready-to-Administer (RTA) Products Versus Traditional Vial-and-Syringe Products

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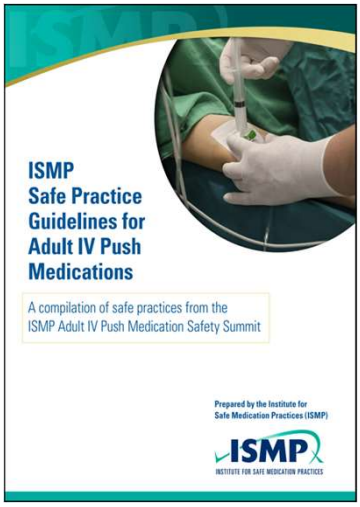

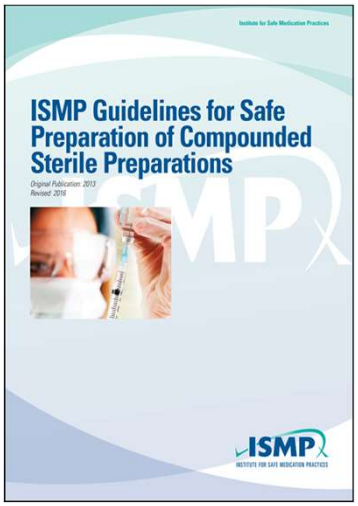

ISMP Safe Practice Guidelines for Adult IV Push Medications. 2015.
ISMP Guidelines for Safe Preparation of Compounded Sterile Preparations. 2016.

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First Consensus Development Conference - 1999

- Evaluated the relative safety of (non-electronic) drug delivery systems available at that time
- Decision-analysis method ranked 6 systems
  - Safety, cost, simplicity-of-use, and training required
- Highest scored: **manufacturer-prepared**, point-of-care activated, and pharmacy-based admixture systems
- The requirement for a combination of systems was discussed
  - Lack of availability of highly-rated systems

Schneider PJ. *Hosp Pharm*. 1999; 34(9):1044-56.

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Second Consensus Development Conference – 2008

- Ranked 5 systems, noting few major developments in availability of systems
  - Applicability, ease-of-use, regulatory compliance, cost, safety, and resources required
- **Manufacturer-prepared** ranked highest again
- Panel noted the complexity of IV medication delivery had increased
  - No single system meets all needs and situations

Sanborn MD, Moody ML, Harder KA et al. Am J Health Syst Pharm. 2009; 66: 185-92.

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IV Drug Delivery Since 2008…

- Regulatory and standards changes
  - Continued revisions to USP chapters <797> and <800>
  - Updates to National Patient Safety Goals
  - Passage of the 2013 Drug Quality and Security Act
  - Standardize 4 Safety
- Development and expansion of technology
  - IV workflow, interoperability, and automation
  - Robotics
- Clinical challenges
  - Drug shortages
  - Pricing and access
  - Pandemic-related (e.g., staffing)

Rodriguez R. *Hosp Pharm*. 2018; 53:408-14.

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Third Consensus Development Conference - 2018

SPECIAL FEATURE

Third Consensus Development Conference on the Safety of Intravenous Drug Delivery Systems—2018

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Maureen Burger, M.S.N., RN, CPHQ, FACHE, Visante, Inc., St. Paul, MN.

Angela Yaniv, Pharm.D., Sterile Products, Cleveland Clinic, Cleveland, OH.

Maureen McLaughlin, M.S., RN, ACNS-BC, CPAN, CAPA, Division of Anesthesiology, Lahey Hospital and Medical Center, Acton, MA.

Mary Lynn Moody, B.S.Pharm., University of Illinois at Chicago College of Pharmacy, Chicago, IL.

Purpose. The Third Consensus Conference on the Safety of Intravenous Drug Delivery Systems was convened to evaluate the benefits and risks of available systems and assess ongoing threats to the safety of intravenous drug delivery.

Summary. The Third Consensus Conference on the Safety of Intravenous Drug Delivery Systems convened in Chicago, Illinois in November 2018. An expert panel of healthcare providers with experience in medication quality and safety, pharmacy and nursing operations, information technology, and/or sterile compounding led the conference. An experienced audience of approximately 30 healthcare leaders provided feedback to the panel via preconference survey and during the conference. Additionally, expert speakers presented on a range of issues, including the effects of drug shortages, the impact of standards and guidelines, and patient and administrator perspectives on the importance of intravenous drug delivery safety.

Conclusion. At the end of the conference, the expert panel concluded that manufacturer ready-to-use products remain the safest intravenous drug delivery system due to their many benefits and low overall risk profile. The panel identified various ongoing threats to the safety of intravenous drug delivery, with major concerns including the impact of drug shortages and lack of intravenous product standardization. Finally, the panel agreed upon a series of statements designed to advance the safety of intravenous drug delivery in healthcare institutions.

Keywords: drug administration, drug compounding, drug safety, intravenous infusion, pharmacy administration

Am J Health-Syst Pharm. 2020; 77:215-221

Gabay M, Hertig JB, Degnan D, Burger M, Yaniv A, Mclaughlin M, Lynn Moody M. *Am J Health Syst Pharm*. 2020; 77:215-20. https://pubmed.ncbi.nlm.nih.gov/31811297/.

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Comparing Practices Over Time

Table 2. Results from Preconference Survey Statements Specific to the 2018 Conference

Statement	No. (%) Who Agree in 2018 (*n* = 31)
My hospital has experienced a disruption of supply from manufacturers or outsourced (503B) compounding entities.	30 (97)
My hospital has a proactive system in place to identify and mitigate diversion of i.v. products.	11 (35)
My hospital uses an automated i.v. workflow management system to improve the safety and efficiency of the medication use process.	11 (35)
My institution consistently uses electronic health record operability to interface between the i.v. pump and the electronic health record.	6 (19)
The majority of US hospitals have a complete understanding of the various factors that contribute to the cost-effectiveness of delivering safe i.v. admixtures to patients (i.e., product and staffing waste).	0 (0)

Gabay M, Hertig JB, Degnan D, Burger M, Yaniv A, Mclaughlin M, Lynn Moody M. *Am J Health Syst Pharm*. 2020; 77:215-20. https://pubmed.ncbi.nlm.nih.gov/31811297/.

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Third Consensus Development Conference

- Participants/Process
- Statements:

(1) Healthcare institutions should promote a culture of IV drug delivery safety across all sites of care that is patient-centric and proactive

(2) Organizational leadership is accountable for ensuring the highest level of safety regarding IV drug delivery systems

(3) **Manufacturer-prepared products are the safest IV drug delivery system, and manufacturer-prepared, ready-to-administer products are preferred for patient use whenever possible**

(4) Compounding sterile preparations is a high-risk practice, and incorporating established standards, such as USP chapter <797>, is essential to ensure benefit while reducing risks to the patient

(5) All non-pharmacy compounding should be restricted to only immediate-use, urgent situations

Gabay M, Hertig JB, Degnan D, Burger M, Yaniv A, Mclaughlin M, Lynn Moody M. *Am J Health Syst Pharm*. 2020; 77:215-20. https://pubmed.ncbi.nlm.nih.gov/31811297/.

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Third Consensus Development Conference

6) Specialized education, training, certification, and competency with regard to compounding of sterile preparations should be required for pharmacists, pharmacy technicians, and other involved healthcare providers

(7) Automation and technology that have been validated to improve the safety of CSPs should be implemented

(8) The profession of pharmacy must take the lead in interdisciplinary efforts for the safety of IV drug delivery systems

(9) A legislative and regulatory framework that supports and encourages IV medication safety in all settings should be developed

(10) the organizational costs of inaction, or of pursuing the minimum action necessary with regard to the safety of IV drug delivery, far exceed an institutional financial investment in the safest systems for the patient and staff

- **Better understanding of the "costs of inaction" and "holistic costs" is vital**

Gabay M, Hertig JB, Degnan D, Burger M, Yaniv A, Mclaughlin M, Lynn Moody M. *Am J Health Syst Pharm*. 2020; 77:215-20. https://pubmed.ncbi.nlm.nih.gov/31811297/.

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Factors Contributing to Cost-Effectiveness

- Safety
  - Relative error and/or harm reduction
- Costs
  - Product and administration
  - Workforce
  - Waste
- Compliance
  - Legal and regulatory
  - Diversion
- External
  - Practice changes
  - Satisfaction (patient AND staff)
  - Shortages

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Safety

ORIGINAL ARTICLE

OPEN

A Comparison of Error Rates Between Intravenous Push Methods: A Prospective, Multisite, Observational Study

John B. Hertig, PharmD, MS, CPPS, Daniel D. Degnan, PharmD, MS, CPPS, CPHQ,* Catherine R. Scott, CPHQ,* Janelle R. Lenz, PharmD,* Xiaochun Li, PhD, MSc,† and Chelsea M. Anderson, PharmD, MBA, BCPS**

Objectives: Current literature estimates the error rate associated with the preparation and administration of all intravenous (IV) medications to be 9.4% to 97.7% worldwide. This study aims to compare the number of observed medication preparation and administration errors between the only commercially available ready-to-administer product (Simplist) and IV push traditional practice, including a cartridge-based syringe system (Carpuject) and vials and syringes.

Methods: A prospective, multisite, observational study was conducted in 3 health systems in various states within the United States between December 2015 and March 2016 to observe IV push medication preparation and administration. Researchers observed a ready-to-administer product and IV push traditional practice using a validated observational method and a modified data collection sheet. All observations were reconciled to the original medication order to determine if any errors occurred.

Results: Researchers collected 329 observations (ready to administer = 102; traditional practice = 227) and observed 260 errors (ready to administer = 25; traditional practice = 235). The overall observed error rate for ready-to-administer products was 2.5%, and the observed error rate for IV push traditional practice was 10.4%.

Conclusions: The ready-to-administer group demonstrated a statistically significant lower observed error rate, suggesting that use of this product is associated with fewer observed preparation and administration errors in the clinical setting. Future studies should be completed to determine the potential for patient harm associated with these errors and improve clinical practice because it relates to the safe administration of IV push medications.

Key Words: IV push medication administration, direct observation, medication errors, safety, error rates, ready-to-administer IV push medication, nurse administration

(*J Patient Saf* 2018;14: 60–65)

and challenges with reversing pharmacologic effects of drugs administered by this route.[2] This risk is recognized by the medical community, and 99% of nurses agree that errors related to IV medication use pose a serious risk to patients.[3] In addition, many IV medications were identified as having a serious risk for patient harm on the high-alert medication list for acute care settings.[2]

A study in 2012 by Lahue et al[4] estimated that 1.2 million hospitalizations each year are impacted by preventable adverse drug events associated with injectable medications. Almost half (48%) of the errors that occur with all IV medications happen during preparation or administration,[1] but error rates related to these practices vary significantly in the literature. Studies worldwide estimate the error rate with all IV medications to be between 9.4% and 97.7%, with IV push administrations demonstrating higher error rates than IV infusions.[5–12] Common IV medication errors included failure to maintain aseptic technique during drug preparation, use of the wrong diluent, and incorrect labeling of an IV product.[5–12]

One of the factors associated with an increased potential for error with IV medications is the number of complex manipulations required when preparing and administering these drugs.[5–13] Drug manufacturers have begun to develop and market ready-to-administer IV push products with the aim of reducing this complexity of drug preparation and administration, while minimizing the potential for errors and patient harm. Ready-to-administer products are viewed as the IV drug delivery systems of choice, particularly because of their low risk for contamination and ease of use.[14,15] They are recommended for use in procedural areas and for dispensing anesthetic products to help reduce errors while maintaining efficiency.[15–18] Although there is support for the use

Hertig JB, Degnan DD, Scott CR, Lenz JR, Li X, Anderson CM. A comparison of error rates between intravenous push methods: a prospective, multisite, observational study. J Patient Saf. 2018;14(1):60–5.

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Safety Study Summary

- Prospective, multisite, observational study conducted in 3 health systems in various states within the United States
- Researchers observed a ready-to-administer product and IV push traditional practice using validated observational methods
  - Observations reconciled to the original medication order to determine if any errors occurred
- Collected 329 observations total
  - Observed 260 errors
- Overall observed error rate for ready-to-administer products was 2.5%, and observed error rate for IV push traditional practice was 10.4%
- Ready-to-administer group demonstrated a statistically significant lower observed error rate
  - Associated with fewer observed preparation and administration errors in the clinical setting

Hertig JB, Degnan DD, Scott CR, Lenz JR, Li X, Anderson CM. A comparison of error rates between intravenous push methods: a prospective, multisite, observational study. J Patient Saf. 2018;14(1):60–5.

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Costs and Waste

Original Article

A Continuous Observation Workflow Time Study to Assess Intravenous Push Waste

John Hertig[1], Kaitlyn Jarrell[2], Prachi Arora[1], Jonell Nwabueze[1], Charlotte Moureaud[1], Daniel D. Degnan[2], and Tate Trujillo[3]

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/µg) 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 stamps, 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 values, and mean values were reported for each drug (fentanyl, hydromorphone, and morphine) separately as well as grouped data. **Results:** A total of 669 distinct waste observations meeting inclusion criteria were collected during a study period of 15 days. In total, 207 mg of hydromorphone and 17962.50 µg of fentanyl were wasted during this study. Nursing staff time associated with the wasting process totaled 50990 seconds (849.83 minutes or 14.16 hours). A combined waste (loss) of approximately $1405.39 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 $35 425. **Conclusion:** There are financially significant costs associated with wasting both the product and the valuable time of a skilled workforce. Optimizing product size, taking special note 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, purchasing

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 $25 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, checks-and-balances, and possible audits necessitate an institutional investment of time and resources.

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Hertig JB, Jarrell K, Arora P, Nwabueze J, Moureaud C, Degnan D, Trujillo T. *Hosp Pharm.* 2020. https://journals.sagepub.com/doi/10.1177/0018578720931754.

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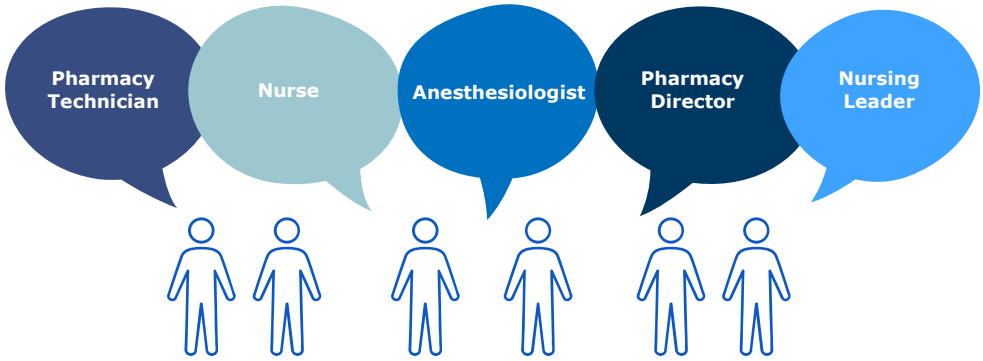
The Medication Waste Problem



Waste decreases staff productivity, increases overall labor expense and adversely impacts patient care

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Medication Use in OR/Procedural Areas

- Medication errors that occur in the OR are especially problematic
  - Anesthesia provider is often the only person involved in the entire process (e.g. prescribing, formulating, dispensing, and administering), removing the protection of double checks that exist in other hospital areas
  - One Comprehensive expert review paper evaluated 138 recommendations
  - Highest ranked included: standardization of concentrations, written policies for medication safety, and the "use prefilled whenever possible."
- One study collected data on 13,078 prepared drug syringes
  - Drug wastage varied from 7.8% (Urapidil, an alpha-1 antagonist antihypertensive) to 85.7% (epinephrine) of prepared syringes
  - Mean waste was 38% with an estimated yearly waste of 139,531 syringes
  - "The overall extent of drug wastage in ORs and ICUs is concerning"

Anesthesia & Analgesia: May 2021 - Volume 132 - Issue 5 - p 1450-1456.doi: 10.1213/ANE.0000000000005457. British Journal of Anesthesia, 118 (1): 32–43 (2017).

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Drug Diversion in Healthcare

"If you haven't caught [illegible], you may not be looking hard enough."

- K Harper

Limit waste in our health-systems!

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Controlled Substance Waste

- Due to high abuse and diversion risks, laws and best practices dictate the appropriate disposal (waste) of controlled substance medications
  - Must occur immediately with documentation by two health professional witnesses
  - Compliance requires investments of time and resources
- Modelling published in previous research found significant costs were associated with proper disposal and management of controlled substances
- Research was needed to better understand the financial and workforce costs of controlled substance waste on inpatient hospital units
  - Limited direct-observation studies in peer-reviewed literature

Hertig JB, Jarrell K, Arora P, Nwabueze J, Moureaud C, Degnan D, Trujillo T. *Hosp Pharm.* 2020. https://journals.sagepub.com/doi/10.1177/0018578720931754.

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Waste Study Results

- 669 distinct waste observations met inclusion criteria
- Collected during 15 days across four units – 80 beds (two hospitals)
- In total, 207 mg of hydromorphone and 17,962.50 µg of fentanyl were wasted
- Nursing staff time associated with the wasting process totaled 50,990 seconds (849.83 minutes or 14.16 hours)

Table 2. Most Frequently Observed Waste Amounts for Fentanyl and Hydromorphone.

Drug	N	Waste amount	Percentage of total wastes (%)
Fentanyl (50 µg/mL) 2 mL vial	143	50 µg	49.83
Fentanyl (50 µg/mL) 2 mL vial	132	75 µg	45.99
Hydromorphone (1 mg/mL) 1 mL vial	239	0.5 mg	62.89
Hydromorphone (1 mg/mL) 1 mL vial	68	0.8 mg	17.89

Hertig JB, Jarrell K, Arora P, Nwabueze J, Moureaud C, Degnan D, Trujillo T. *Hosp Pharm.* 2020. https://journals.sagepub.com/doi/10.1177/0018578720931754.

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Waste Study Results

- The average total cost per dose wasted was $2.40 for all medications
- When a yearly extrapolation model was applied, the total waste was $35,425
- 86 of the 669 PWs observed were interrupted
- Average time to chart PW was 2 hours, 4 minutes, 52 seconds
  - 31 PWs documented more than 8 hours after removed to be administered

Table 3. Observed Total Cost of Waste.

Drug	N	Product waste (PW)	Workforce waste (WTW)	Total waste	Total waste per dose
Fentanyl (50 µg/mL) 2 mL vial	287	$226.33	$217.58	$443.91	$1.55
Hydromorphone (1 mg/mL) 1 mL vial	380	$886.89	$270.23	$1157.12	$3.05
Morphine (2 mg/mL) 1 mL vial	2	$2.66	$1.70	$4.36	$2.18
Total	669	$1115.88	$489.51	$1605.39	

Hertig JB, Jarrell K, Arora P, Nwabueze J, Moureaud C, Degnan D, Trujillo T. *Hosp Pharm.* 2020. https://journals.sagepub.com/doi/10.1177/0018578720931754.

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Factors Contributing to Cost-Effectiveness

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Cost-Effectiveness Analysis Study

ORIGINAL RESEARCH

A Cost-Effectiveness Study Comparing Ready-to-Administer and Traditional Vial-and-Syringe Method for Opioids

Prachi Arora · Maria Muehrcke · John Hertig

Received: April 8, 2022 / Accepted: May 26, 2022

ABSTRACT

Objective: The purpose of this study was to develop a cost-effectiveness model for manufacturer-prepared prefilled ready-to-administer (RTA) syringe products versus the traditional vial-and-syringe administration of intravenous (IV) opioids.

Methods: Cost parameters included cost of manufacturer-prepared prefilled RTA syringe product, traditional vial and syringe, drug preparation, drug administration, drug waste, and severity of error. Effectiveness endpoint included number of preparation and administration errors in each comparator arm. Simple decision tree was used, and incremental cost-effectiveness ratio (ICER) was calculated as the reduction in the incremental errors per observation with RTA compared with traditional vial-and-syringe method. One-way sensitivity analysis (OWSA) and probabilistic sensitivity analysis (PSA) were conducted to test the robustness of the model. TreeAge Pro software was used to create and analyze the decision model. All the cost parameters were converted to USD 2021.

Results: Base-case analysis showed that the cost of the RTA arm was lower by $182.61 and the number of errors in the RTA arm was lower by 94%, compared with the traditional vial-and-syringe arm. The manufacturer-prepared prefilled RTA syringe product was found to be cost-effective with an incremental savings of $22,554 per additional error avoided. Sensitivity

Arora A, Muehrcke M, Hertig JB. Pain Ther. https://doi.org/10.1007/s40122-022-00402-z

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Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

Background: What is Cost-Effectiveness?

- Cost-effectiveness analysis (CEA) is a way to evaluate costs and health outcomes of one or more interventions
- Compares an intervention to another intervention or to the status quo
  - Estimates much it costs to gain a unit of a health outcome (e.g., death prevented)
  - Because CEA is comparative, an intervention can only be considered cost effective compared to something else
- Inputs
  - Net cost is the intervention costs minus averted medical and productivity costs
  - Multiple inputs are often used
- CEA can be useful in comparing the health and cost impacts of different interventions affecting the same health outcome (e.g., decreased errors/harm; or improvement in heart disease)

www.cdc.gov/policy/polaris/economics/cost-effectiveness/index.html

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CEA Study - Aims

- Development of a cost-effectiveness model for manufacturer prepared RTA products vs. the traditional VAS administration of intravenous opioids (fentanyl, hydromorphone, and morphine)

Arora A, Muehrcke M, Hertig JB. Pain Ther. https://doi.org/10.1007/s40122-022-00402-z

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CEA Study - Methods

- The analysis was conducted focusing on inpatient units with a total of 15,727 observations over a period of one year
- Various parameters used from peer-reviewed literature

Effectiveness	Cost	Probability
I. **Medication preparation and administration errors**	I. AWP cost of the drug II. Cost associated with the preparation of drugs III. Cost associated with the administration of drugs IV. Cost of the drug waste V. Cost associated with errors (medication preparation and administration)	I. Probability of medication preparation and administration errors per observation II. Probability of errors leading to harm (or Adverse Drug Event) III. Probability of errors categorized by severity: significant, serious, life-threatening

Arora A, Muehrcke M, Hertig JB. Pain Ther. https://doi.org/10.1007/s40122-022-00402-z

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CEA Study - Results

- Monte Carlo probability distribution diagram for the probabilistic sensitivity analysis
- Depicts incremental cost-effectiveness ratios (ICERs) ranged from $19,012 to –$28,907

Arora A, Muehrcke M, Hertig JB. Pain Ther. https://doi.org/10.1007/s40122-022-00402-z

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CEA Study - Results

- RTA arm associated with a **94% reduction in errors** and saved $2,871,889 in costs annually, compared with the traditional VAS
  - Incremental savings of $22,554 per additional error avoided
- RTA was the least costly option compared to traditional vial and syringe by $182.61
  - Relative savings of $182.61 per administration
- Due to a decrease in medication errors that lead to adverse events, the use of **RTA can estimate to save $2.9 million per year** based on 15,727 administrations

Arora A, Muehrcke M, Hertig JB. Pain Ther. https://doi.org/10.1007/s40122-022-00402-z

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Practice Changes

- Products must be safe and cost-effective
- Our research provides a robust CEA model
  - Repeated 10,000 randomly generated scenarios
- Conduct pilot studies in your own health-system
  - Use your own data to optimize IV product use
- Tell a story
  - Compelling narrative that includes holistic data elements
- Better patient care!

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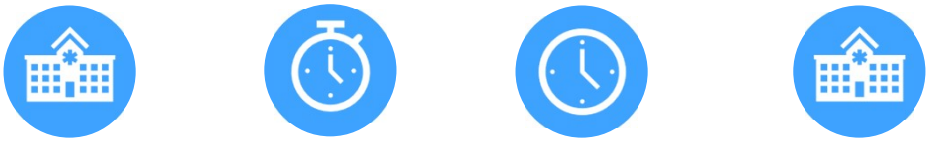
Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

Key Takeaways: Optimizing Care Delivery

- Providing safe IV therapy is complex
  - Manufacturer-prepared, ready-to-administer products are preferred whenever possible
- Various factors (inputs) contribute to the safe and effective use of sterile products
  - Understanding the total cost (effectiveness) of delivering safe IV therapy is needed!
- Integrating and adopting ready-to-administer could play an important role in improving care, building efficiency, increasing patient safety, and saving money



Improved health-system | Prioritizing workforce time | Ensuring patient safety | Establishing a compliant practice

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Mass General Brigham

An Organization's Perspective on Transitioning From Traditional Vial-and-Syringe Medications to Ready-to-Administer (RTA) Products

Christopher Fortier, PharmD, FASHP, CPEL
Chief Pharmacy Officer
Massachusetts General Hospital
Boston, MA

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Raise your hand when you know HOW MANY results are out of range

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Species : Adult Canine
Patient : SYDNEY
Client : SUE B

Test		Results		Reference Range
ALKP	=	85	U/L	23 - 212
ALT	=	23	U/L	10 - 100
BUN	=	16.6	mg/dl	7.0 - 27.0
CREA	=	0.77	mg/dl	0.50 - 1.80
GLU	=	130.6	mg/dl	77.0 - 125.0
TP	=	6.21	g/dl	5.20 - 8.20
Na	=	149.9	mmol/l	144.0 - 160.0
K	=	4.44	mmol/l	3.50 - 5.80
Cl	=	116.9	mmol/l	109.0 - 122.0

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Let's Try Again

Raise your hand when you know HOW MANY results are out of range

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Test	Results	Reference Range	Indicator (LOW / NORMAL / HIGH)
ALKP	= 85 U/L	23 - 212	
ALT	= 23 U/L	10 - 100	
BUN	= 16.6 mg/dl	7.0 - 27.0	
CREA	= 0.77 mg/dl	0.50 - 1.80	
GLU	= 130.6 mg/dl	77.0 - 125.0	
TP	= 6.21 g/dl	5.20 - 8.20	
Na	= 149.9 mmol/l	144.0 - 160.0	
K	= 4.44 mmol/l	3.50 - 5.80	
Cl	= 116.9 mmol/l	109.0 - 122.0	

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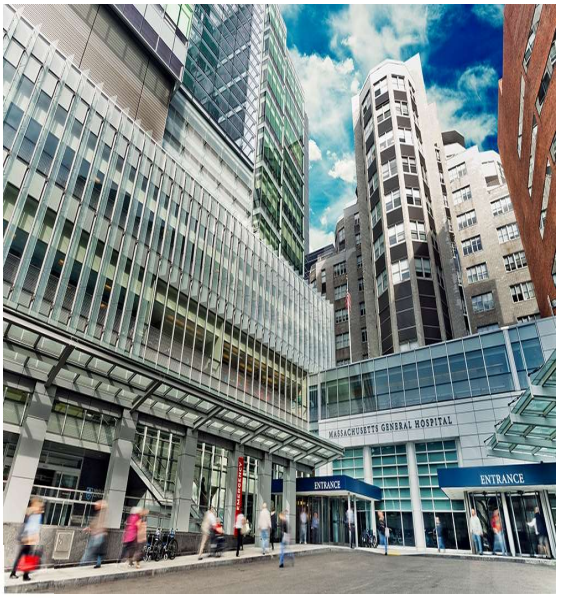
Current State

- 1,035 bed academic medical center
- Level 1 adult and pediatric trauma and burn care
- 5 multidisciplinary care centers
  - Cancer, digestive disorders, heart disease, transplantation, and vascular medicine
- Mass General Hospital for Children
- In 2022 ranked #8 in the nation on the U.S. News & World Report Best Hospitals List
- Conducts the largest hospital-based *research program in the country*

Mass General Brigham



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Medication error or ADE occurring 1 in every 25 medication administrations in the perioperative setting

Lack of pharmacy oversight, production pressure, and lack of technology

Anesthesia errors: 37% incorrect dose; 23% substitution, 19% omission

89% of anesthesiologists admitted to a drug error

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Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

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Results

	SELF-FILLED SYRINGES	PRE-FILLED SYRINGES
Number of cases	8	9
Process steps	21	19
System vulnerabilities	21	8
Medications administered per case	9.6	10.3

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Yang Y, Rivera J, Fortier CR, Abernathy J. A Human Factors Study to Examine the Anesthesia Medication Flow in the Operating Room Settings: Self-Filled Syringe vs. Pre-Filled Syringe. *Anesthesiology*. 2016 Apr; 124:795-803

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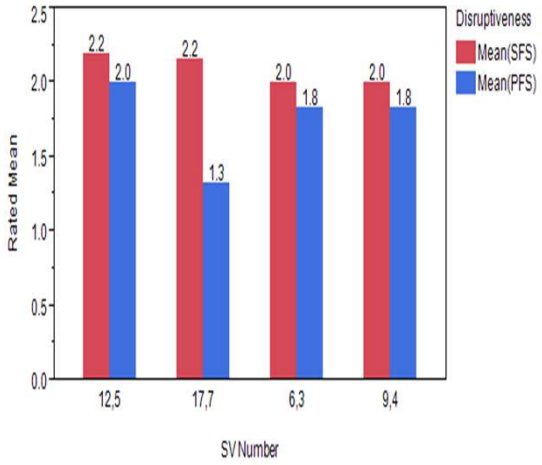
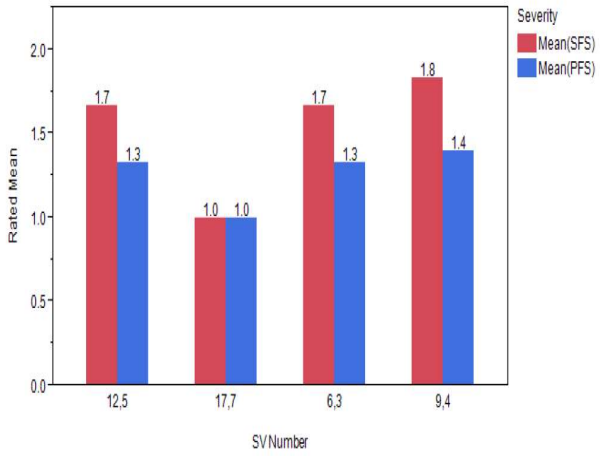
Disruptiveness & Severity





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Waste Reduction Data

	Phase I (baseline)	Phase II (PFS)
Days	10	10
Cases	154	171
Case w/ waste	110 (71%)	66 (38%)
Drug waste (mL)	3284.2 mL	1266.3 mL

61%

TOTAL WASTE REDUCTION WITH THE USE OF PFS

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Clinician Satisfaction Survey

% of Respondents (n=24)	Survey Question
79.3 %	Clinicians felt that less drug was wasted when they used PFS
91%	Clinicians felt that using PFS saved them time in preparing syringe for procedure
74%	Clinicians felt that using PFS increased their confidence in integrity of the preparations

Time saved with the use of PFS	
Estimated time saved	**% of respondents (n=24)**
5 to 6 minutes	42%
3 to 4 minutes	29%
7 to 9 minutes	8%
1 to 2 minutes	4%

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Can we do this better internally?

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Why can't we do this internally?

- **Cost**
  - Material, labor, overhead, compliance
- **Testing**
  - Real-time stability, sterility
  - 2023 USP Guidelines
- **Dedicated labor** – labor shortage
- **Extended beyond use dating**
- **Drug shortages**
- **Labeling**
  - Bar code, color coding, expanded content, tall man lettering
- **Proper facilities and equipment**
- **Robots and technology**

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Considerations

Do you use RTA medications at your institution?

What are some reasons you do not use RTA medications?

What RTA medications would you select?

What is your reasoning for choosing the RTA(s) you did?

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Transitioning to Ready-to-Administer IV Medications: Can it be Both Safe and Affordable?

Considerations

- Pharmacy lead and/or provider interest and collaboration
- Production selection/availability
  - Different RTA syringe volumes
- Dispense locations
- Availability
- Drug shortages
- Workflow
  - Medication distribution
  - Space/storage model (cabinet/OR trays)
  - Inventory control/monitoring of expiration
  - Ability to reuse

Most beneficial features
1. Labeling
2. Reduced risk of contamination
3. No need for reconstitution
4. Tamper evident
5. Diluted
6. Expiration based upon real-time stability
7. Sterility testing

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Considerations

- Partner with vendor
- Ongoing assessment of utilization
- Associated cost
- Shifting labor
- Narcotics, OR, procedure areas, surgery centers, ambulatory
- Work with vendor to develop more RTA

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Antibiotics	Cefazolin
Anticholinergics	Atropine Glycopyrrolate
Beta Blockers	Esmolol
Blockade agents	Succinylcholine Vecuronium
Local anesthetics	Lidocaine
Vasopressors	Ephedrine Phenylephrine

Beta Blockers	Labetalol
Blockade agents	Rocuronium Cisatricurium
Induction agents	Propofol Ketamine
Local anesthetics	Bupivacaine Ropivacaine
Narcotics	Fentanyl Ketamine Morphine Hydromorphone Sufentanil
Reversal agents	Neostigmine
Sedatives	Propofol Midazolam

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Key Takeaways

- RTA medications have shown significant reductions in system vulnerability and drug waste
- Clinician satisfaction increased with the use of RTA products due to safety, prep time saved, enhanced labeling, and product integrity
- Hospital pharmacies will have difficulty preparing RTA medications internally
- RTA product selection, product volume/sizes, locations, and cost must be considered

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Online Evaluation, Self-Assessment and CE/CME Credit

- Login at www.ProCE.com
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- Enter the attendance code
- Complete online post-test & evaluation
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Questions?

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