



**(Management Case Study)**  
**Implementation and Evaluation of a Sterile  
Compounding Robot in a Cancer Center Pharmacy**

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# Disclosure

All planners, presenters, and reviewers of this session report no financial relationships relevant to this activity.

# Learning Objectives

- Explain the fundamental safety features of automated robotic compounding technology (ARCT) in chemotherapy compounding.
- Describe important features related to the implementation of IV automation into pharmacy workflow.
- Identify potential benefits of utilizing ARCT in chemotherapy compounding.

# Self-Assessment Question 1

ARCT offers many safety features to enhance patient safety, which of the following is NOT a feature utilized with this technology?

- A. Gravimetric weight checking to ensure accurate dosage and volume transfer
- B. Photovalidation of components such as syringes and vials
- C. Barcoding capabilities on drug vials and IV bags
- D. Proxy verification methods such as syringe pull back or writing volumes on the IV label

# Self-Assessment Question 2

(True or False) Key aspects of an IV automation implementation plan involves a multi-disciplinary effort, change management, training, and education.

# Self-Assessment Question 3

Which of the following is a benefit of ARCT when used for hazardous drug compounding?

- A. Guaranteed return on investment in 3 to 5 years
- B. Advanced safety features such as barcoding, gravimetrics, interfacing, containment, and photovalidation to ensure patient and staff safety
- C. Improved efficiency in preparation and turnaround time by at least 10 minutes
- D. Increased patient satisfaction scores

# Houston Methodist



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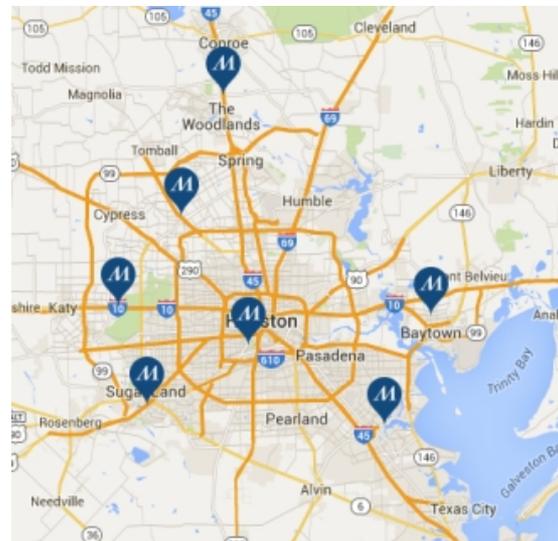
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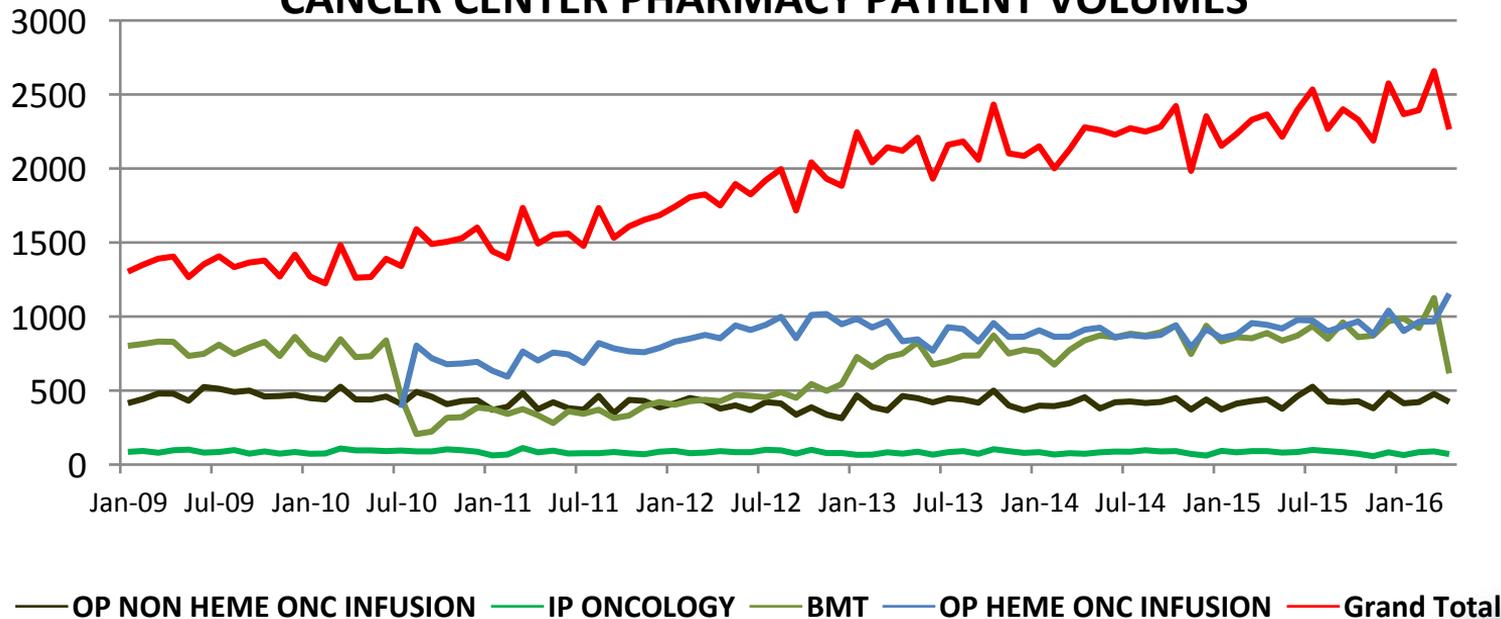


**1,119 licensed beds**  
**67 operating rooms**

**265 pharmacy staff**

# Institutional Growth

## CANCER CENTER PHARMACY PATIENT VOLUMES



OP NON HEME ONC: Outpatient Non-Hematology/Oncology Infusion

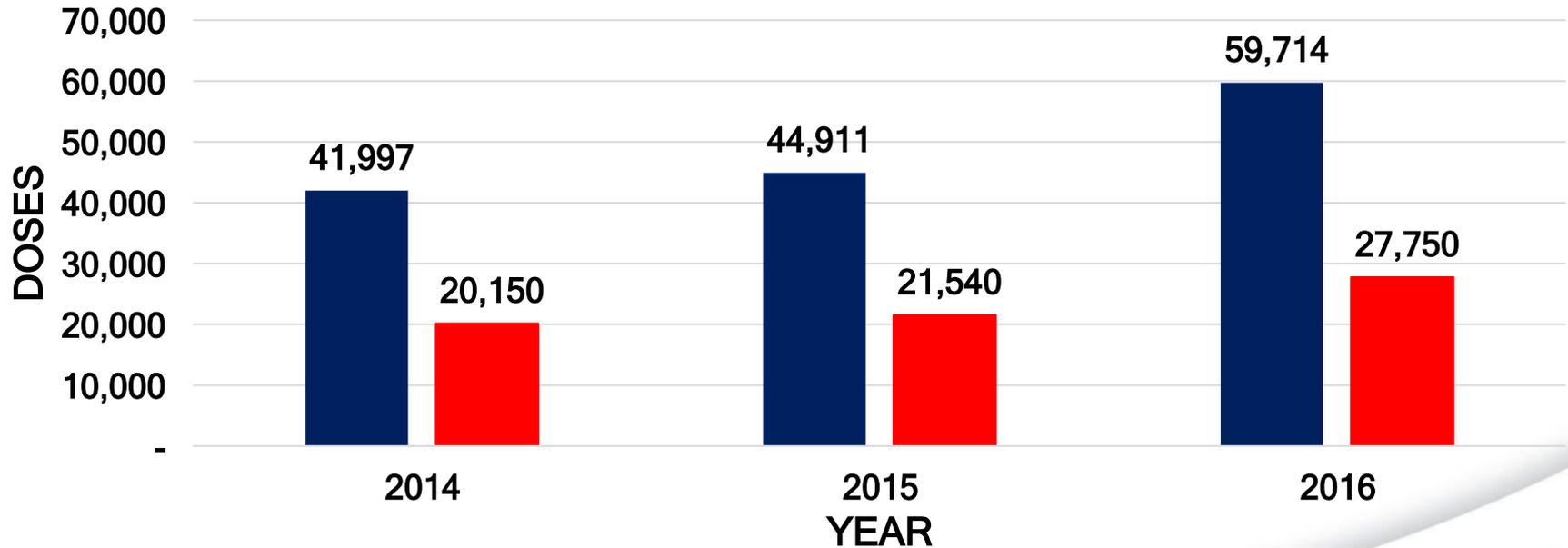
IP ONCOLOGY: Inpatient Oncology

BMT: Bone Marrow Transplant

OP HEME ONC: Outpatient Hematology/Oncology Infusion

# Institutional Growth

## CANCER CENTER PHARMACY DISPENSE VOLUMES



■ Dispense Volume ■ Hazardous Preparations

# Focus on Quality and Safety

***“For hospitals and other IV admixture locations that regularly provide parenteral cancer chemotherapy, or ideally, where pediatric patients are treated, gravimetrics should be used when information about specific gravity of ordered medication is available.”***

*– 2016 ISMP Guidelines for Safe Preparation of Compounded Sterile Preparations*

# Key Safety Features of ARCT

## Barcoding

- During loading
- Vials
- Bags
- Lot/Expiration Information loaded on web interface

## Gravimetrics

- High sensitivity balance
- Dose thresholds ( $\pm 5\%$ )
- Bag and vial weight thresholds

## Photovalidation

- Vials against validation library
- Provides tertiary check
- Syringe and needle type

## Containment

- Dual chamber positive pressure
- Internal negative pressure
- Vented externally
- CACI equivalent

# Key Considerations for Robotics

- Business case
- Plans for efficiency measurement and optimization
- IT costs, interface testing
- Cleanroom footprint
- Training and education
- Return on capital expenditure

Improve patient safety  
Improve production capacity and decrease  
disposables  
Decrease risk of repetitive motion injury  
Minimal space requirement  
Network of hospitals maintain drug library  
Reporting features

Cost of ARCT  
Build of drugs not in drug library  
Requires a technician to operate and  
maintain machine  
Can only prepare products in the form of a  
syringe or bag

## SWOT

Absorb increase in order volume  
Ability to prepare batches  
Minimization of waste  
Improve turn-around time of medications  
Expand pharmacist clinical responsibilities  
due to decreased time to verify dose

ARCT malfunctions  
ARCT becomes obsolete  
Employee resistance to change  
Employees worried about taking his or her  
position

# Previous Operations State

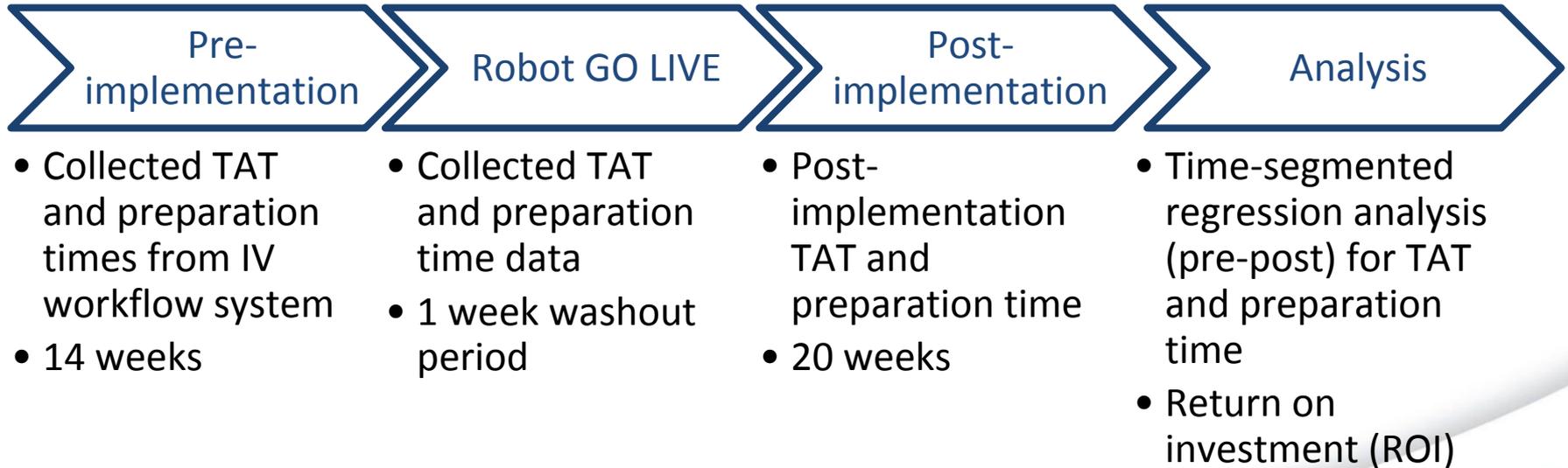
**Extensive growth due to addition of new service lines, requiring increased resources to meet the outpatient treatment needs**

**Lack of technology in high alert drug compounding (chemotherapy)**

**Infusions nearly doubled from 2013 to 2014 (35/day → 70/day) and subsequent 41% increase in dispense volume from 2014 to ~60,000 in 2016**

**11 FTEs; 5 Pharmacists and 6 Technicians**

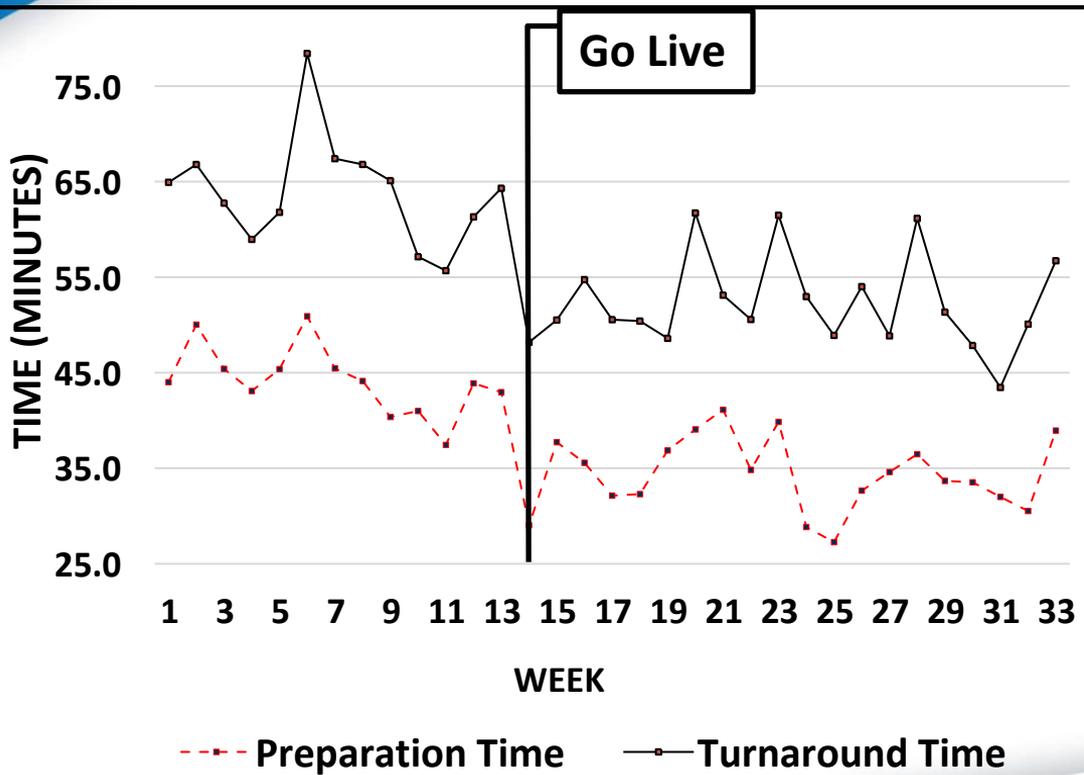
# Robotics Implementation Analysis



# Efficiency Monitoring Plan

- Quantify the impact on preparation time and turnaround time compared to i.v. workflow management system (IVWFM) alone
- Statistical approach: interrupted time series for initial four oncologic agents
- Supply cost savings: closed-system transfer device utilization reduction
- Monitor deviation trends, robot preparation failures, downtimes

# Evaluation of Efficiency



## Initial Four Oncologic Agents:

- Cyclophosphamide
- Cisplatin
- Carboplatin
- Oxaliplatin

Endpoint	Slope Pre-robot (min)	Difference (min)	Slope Post-robot (min)
TAT, mean ± std	-0.5 <sup>a</sup>	-9.2 ± 3.7 <sup>b</sup>	0.5 <sup>a</sup>
Prep time, mean ± std	-0.4 <sup>a</sup>	-6.3 ± 2.6 <sup>b</sup>	0.4 <sup>a</sup>

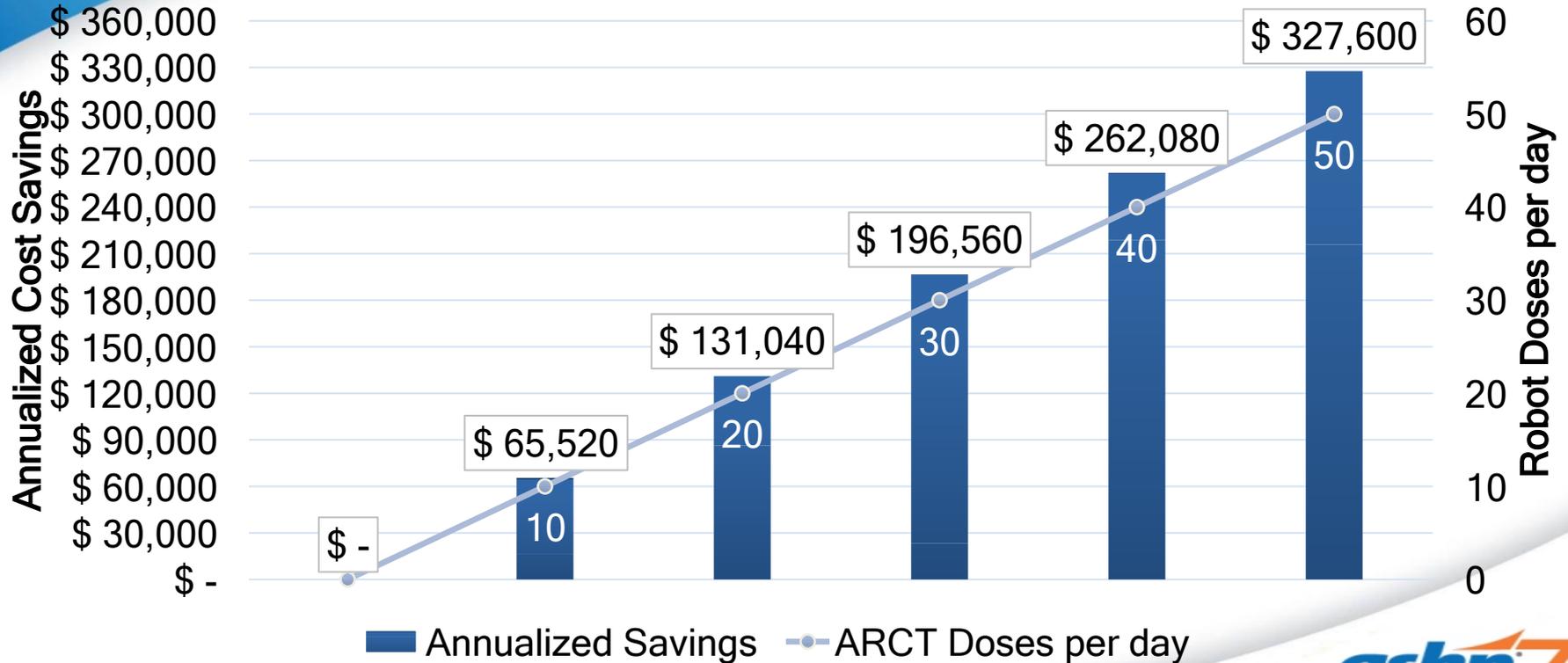
<sup>a</sup>p>0.05

<sup>b</sup>p=0.01

# IT Considerations

- Interface testing
- Product mapping: many to many relationship table created
  - HL7 standards for interface messaging with EHR
- New product addition and configuration
  - Specific gravities, NDC for product mapping
- EHR default dispensing to ARCT during operational times
  - ARCT as a dispense location

# Supply Cost Savings



# Realized (current) State

- Additional production stream in OPC
- Addition of compounding barcode scanning standards, gravimetric dose validation, and photovalidation compounding accuracy and safety
- Automated in-process validation
- A reduction in pharmacy compounding supply costs
- Operational efficiencies gained in both TAT and preparation times
- FTE Neutral
- Robot went live in September 2016
- 10 drugs configured in robot

# Lessons Learned

- Change management
- Robotic downtime: cleaning, maintenance, spills, ventilation errors
- Preparation rejections: alignment issues, bag withdrawal system issues, partial vials
- Spill management: policy and procedures
- IT possibilities: many to many relationships via HL7 interface

# Key Takeaways

- Key Takeaway #1
  - Create a business case that incorporates implementation timelines, and estimated impacts on safety, costs, and efficiency
- Key Takeaway #2
  - Robotic implementations must identify key operational metrics and conduct effective technology assessments utilizing appropriate statistical techniques
- Key Takeaway #3
  - Engage IT stakeholders early to optimize interfacing with EHR and assistance with troubleshooting



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