

# **MAHRMM Fall Conference**

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**Managing Inventories of Physician Preferred and General Medical  
Supplies: An examination of in-stock vs. consignment stock policies**

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# Problem Motivation

- Many different supplies
- Supplies management – significant costs involved 30-40% of the average hospital's budget (Neil, 2005)
- Cost of supplies represents second largest cost category in hospitals after labor expenses (Goodbaum, 2015)
- Focus on patient care
- Not all supplies are created equal!

# Problem Motivation

- Medical supplies can be categorized as
  - General supplies (GEN) or Physician preferred items (PPI)
- GEN supplies include:
  - Gloves
  - IV solutions
  - Etc.
- Most items purchased tend to be GEN



# Problem Motivation

- PPI supplies include
  - Orthopedic implants
  - Pacemakers
  - Etc.
- Most expensive tend to be PPI
  - Costs of hip and knee implants - \$11 billion for hospitals in 2004
  - Projections \$50 billion for Medicare by 2030 (Wilson et al., 2008)



# Problem Motivation

## Options to Reduce Supplies Costs:

- GPO agreements
  - GEN items ✓
  - PPI items ✗
- Consolidating suppliers
  - GEN items ✓
  - PPI items ✗
- Find alternative more competitive supplier
  - GEN items ✓
  - PPI items ✗
- **Use consignment**
  - GEN and PPI ✓

# Consignment Inventory – Controlling Supply Chain Costs

- Under consignment inventory
  - Vendor keeps ownership of inventory until used
  - Delays payment of used items
  - Increase inventory levels for consignment stock
- Economic benefits for Hospital:
  - Reduction of capital invested in supplies
  - No impact in quality of care
  - Delayed billing
  - No need to involve physicians in negotiations
  - Higher cost or higher volume items typically provide greatest benefits

# Purchasing Contract– Controlling Supply Chain Costs

- Effect of consignment on vendor
  - Stronger relationship with hospital system
  - Delayed payment
  - Vendor absorbs capital holding costs
- Vendor typically agrees to supply under consignment if:
  - Minimum purchase amount
  - Increased unit cost

# Saving Under Consignment?

- How much are hospitals saving due to use of consignment?
- Partnered with hospital system in Midwest
  - Several hospitals - over 3,000 beds
- Spending data was collected for 4 hospitals – detailing inventory/purchasing costs for 6 years
- Data includes:
  - monthly spending for items used at the hospital
  - Item price
  - Categorized
    - PP/GEN
    - Consignment/Inventory

# Empirical Results

- From hospital data we found...
  - GEN Items managed under consignment
    - result in lower hospital spending \*
  - PPI items managed under consignment
    - do not result in lower hospital spending \*
    - As price of the item increases, consignment becomes more cost attractive for PPI items

Why is consignment not providing benefits for PPI?

\* Models control for item price and other important variables

# Literature

- Few studies focused on consignment in healthcare
- Some healthcare literature support the use of consignment in hospitals (Ballard 1991, Williams 2000, Bendavid et al. 2012, etc)
- Other articles point to potential drawbacks (Green 1985, Costa and Nobre 2015, etc.)
  - Limited control of consignment stock
  - Shrinkage rates higher for consignment stock
  - Hospitals unaware of potential increase in inventory costs for consignment items

# Solution Approach

## Analytical Insights

- Mathematical model for hospital using consignment inventory
- We study the two types of contracts typically used
  - Higher per unit price
  - Higher purchase volume
- We analyze which type of item (GEN or PPI) is more susceptible to unforeseen shrinkage or other inventory cost increase due to consignment

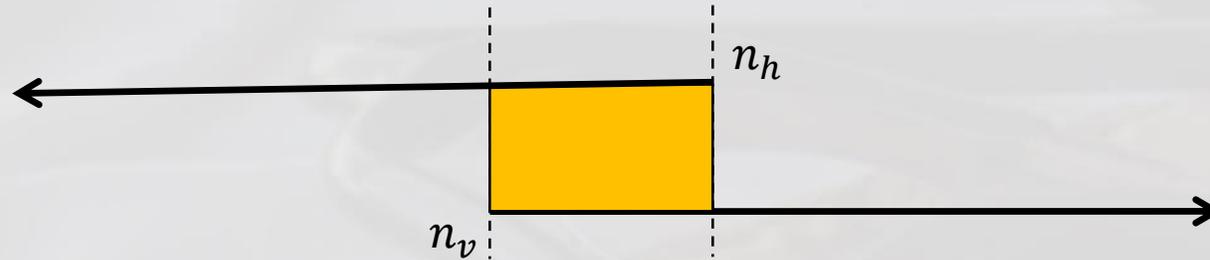
# Difference Between GEN and PPI

- GEN items
  - High volume
  - Low price items
  - Relative low demand variability
- PPI items
  - Low volume
  - High price items
  - Higher demand variability

# Contract 1 – Higher per unit price

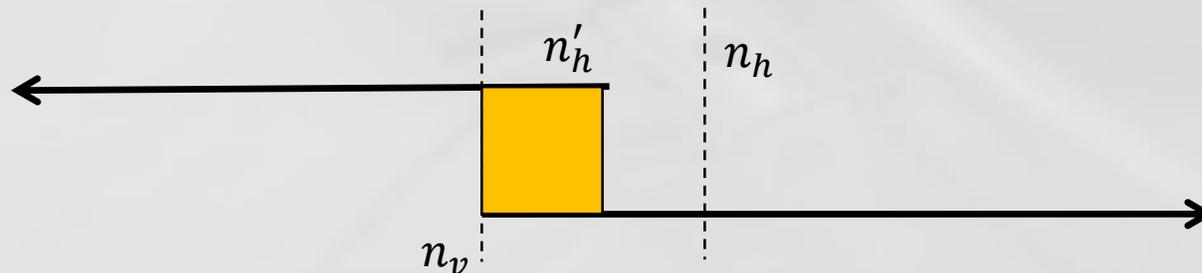
- Contract conditions will impact overall benefits of the use of consignment
- Considering a higher per-unit price in a contract
  - Hospital will negotiate the lowest possible price increase
  - Vendor seeks the highest possible price increase
- Consignment will be used only if increased price is believed to provide benefits for both parties
- Hospital needs accurate information to estimate maximum price increase

# Contract 1 – Higher per unit price



But what if shrinkage costs increase under consignment?

The hospital's real maximum price increase is  $n'_h < n_h$



Potential to negotiate unfavorable contract conditions as gap increases

# Contract 1 – Higher per unit price

The gap between  $n_h$  and  $n'_h$  increases as demand variability increases

PPI items have higher demand variability - higher chances to negotiate unfavorable contract conditions

The gap between  $n_h$  and  $n'_h$  decreases as average demand increases

GEN items have higher average demand – lower chances to negotiate unfavorable contract conditions

The gap between  $n_h$  and  $n'_h$  decreases as average price increases

As the price of PPI items increase - lower chances to negotiate unfavorable contract conditions

# Contract 2 – Higher Purchase Volume

Makes sense only when hospital sources an item from more than one vendor

Becomes interesting when hospital considers consignment with most expensive vendor

Limited by physician's willingness to switch vendor

# Contract 2 – Higher Purchase Volume

Using a similar analysis

– Hospital determines a maximum volume allocation to vendor  $x_h^{max}$

- Hospital and vendor contract only if conditions are right for both
- If shrinkage costs increase with consignment, maximum demand allocation should be  $x_h^{max'}$

$$x_h^{max'} < x_h^{max}$$

- Potential to negotiate unfavorable contract conditions as gap increases

# Contract 2 – Higher Purchase Volume

The gap between  $x_h^{max}$  and  $x_h^{max'}$  increases as demand variability increases

PPI items have higher demand variability - higher chances to negotiate unfavorable contract conditions

The gap between  $x_h^{max}$  and  $x_h^{max'}$  can increase or decrease with increases in mean demand and price.

Under this type of contract even under increased shrinkage costs, the difference between  $x_h^{max}$  and  $x_h^{max'}$  may be insignificant

# Conclusions

- Empirical data supports the fact that hospitals may not receive financial benefits from using consignment, particularly for PPI.
- If the impact of consignment stock on shrinkage or other inventory costs is not well understood, unfavorable contract conditions may be inadvertently negotiated.
- If estimating the impact of consignment stock on shrinkage cost is not easy, committing to a higher volume contract vs. higher per-unit price may be the best option.

Questions?