Optimization of Supply Inventory to Support Medical Space Planning
A Classical Engineering Approach to Hospital Space Programming
with emphasis on Optimizing the Deployment of Supply Inventory in Acute Care Units
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Introduction
Core Industrial Engineering principles teach us the value of inventory strategy, storage density and operational efficiency as design tools during facility design. It's a classic financial trade-off between how much space should be built (storage density and inventory) versus how much staff is required to operate the facility (operational efficiency). These principles and analysis techniques are typically deployed during Manufacturing Plant and Distribution Center design planning projects.

St. Onge Company (an independent global design consulting firm assigned as design, facility and Supply Chain consultants for Johns Hopkins Medicine) has asked these same classical Industrial Engineering questions during the planning of two new clinical buildings for Johns Hopkins Medicine. Currently under construction is a new Cardiac Critical Care Hospital and Children’s and Maternal Hospital on the campus of Johns Hopkins in Baltimore, Maryland.

Johns Hopkins Medicine was intrigued by the classic and unique approach St. Onge Company proposed for design consulting services as they prepared for the design and construction of the two new state-of-the-art Hospital Towers. As a result, St. Onge Company and Johns Hopkins Medicine have formed a unique partnership that has blended classical Industrial Engineering techniques with current Medical Space Programming and Design techniques for nearly 4 years.

This relationship has matured into a successful design and operating strategy that will maximize nurse and patient interaction (“nurse touch time”), save on construction cost, maximize materials management delivery efficiency and response time and optimize inventory control. This article will outline the fundamental techniques used to assist the Architectural Teams in defining space requirements for storage and handling of the supplies used throughout the Hospitals. Although the St. Onge Company project scope has covered all aspects of the supply chain from off-site warehousing, dock design, automated delivery and supply storage and deployment, this article focuses on the delivery, storage and deployment of Supplies (inventory) in Acute Care Units.

Cross-Over Correlation
The starting point was to draw parallels between the typical distribution center design SKU pareto (an ABC velocity analysis) and the Hospital infrastructure (both current and planned strategies).

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<th>Distribution Center Design Component</th>
<th>Hospital Infrastructure Equivalent</th>
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<tr>
<td>Distribution Center</td>
<td>Hospital</td>
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<td>Warehouse Section</td>
<td>Hospital Unit (ex. Pediatric Oncology)</td>
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<td>Reserve Storage for Slow Moving Product (D Movers)</td>
<td>Central Utility Room (CURe)</td>
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<td>Higher Volume Pick Line (B and C Movers)</td>
<td>Satellite Supply Stations (S³)</td>
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<td>Highest Volume (A-Movers)</td>
<td>Servers (Bedside, Mobile, Shared)</td>
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Existing Approach

The existing approach used at Johns Hopkins is to deliver Supplies to a Clean Utility Room typically located central to each Hospital Unit. Supplies are delivered by Materials Management staff based on usage, re-order point and inventory level. The Clean Utility Room has traditionally used open bin storage and has lacked optimal inventory control processes. All items, including small cube items, large cube items, chargeable and non-chargeable items would be stored using the same technique.

The migration in storage has led to more secured storage cabinets that accurately track inventory usage, identify the user (via fingerprint or password) and allow for supply usage to patient accounting. Even though these new cabinets help track supply usage and provide inventory security and control, these do not establish proper inventory deployment on the unit (although they provide a data collection mechanism to enable further analysis).

Current Configurations

Clean Utility Room, Central Utility Rooms, Supply Room

The two pictures below show an existing Clean Utility Room with open bin shelving and a modified Clean Utility Room with controlled and secure inventory storage. The focus of this article is not a benefit analysis of the storage medium itself. Although there are inherent benefits in the security, inventory control (automated replenishment) and Accounting (chargeable patient) characteristics of the storage mechanism, this study will focus on the location of supplies on the Unit and the benefits associated with less travel on the Unit for Nurses, increasing Nurse to patient interaction.

As discussed, the storage mechanism is only part of the challenge. To truly optimize the efficiency of the Unit, the deployment of inventory outside these Clean Utility Rooms is critical.
**In Room Servers**

The two pictures below are examples of in-room servers. In-room servers can be large cabinets of supplies (often found in ER rooms) or simple table top cabinets for non-chargeable everyday use items in inpatient rooms.

**Hallway Servers**

The two pictures below are examples of Hallway Servers. These can be dedicated to one patient room, shared between two patient rooms or several patient rooms. This type of server is the baseline opportunity that triggered the potential benefits of optimizing supply deployment that will be outlined in later sections of this article. The study at Johns Hopkins Medicine (specifically in an inpatient Oncology Unit) identified the potential to reconfigure the hallway servers with a different set of items that would significantly decrease the time spent, by nurse, to retrieve and administer supplies to patients.

**Mobile Servers**

Mobile servers can have two distinct purposes. A multi-use supplies-on-wheels methodology that can support a variety of patient needs (ER’s, ICU’s, etc) or an exchange cart delivered by Materials Management staff that is used to resupply all supply deployment past the Central Utility Room.
Opportunities – Statistical Review

As mentioned earlier, the first glimpse of opportunity came when we evaluated the effectiveness of the supplies that were kept in existing bedside servers.

**Understanding the Pareto (Which Items Represent the Majority of Daily Usage?)**

The chart below shows a steep pareto. This indicates that a relatively low number of items equate to a relatively high percentage of daily volume. It is a very clear indicator that an opportunity exists to optimize which items we store in closer proximity to the end-user (patient). In Distribution (keeping in step with the Core Engineering analogy outlined in the introduction), these items (SKU’s) would be the “A” movers and be faced up in a forward pick area.

The next chart shows a method for deciding which supplies belong in each of the storage levels. (Clean Utility Room, Intermediate supply location and server (various types). The intermediate storage location (somewhere between a Clean Utility Room central to the unit and the actual server level) is the focus of later sections of this article.
Are The Correct Supplies in the Hallway Servers?

The chart below is an example of a server optimization analysis. The existing server had seventy-eight (78) distinct items or SKU’s. After a volume/velocity analysis of the daily usage of these items, we concluded that the seventy-eight items in the existing servers represented 49% of the daily supply usage. Our analysis concluded that if we put a different seventy-eight (78) items in the servers (no more, no less), it would represent 85% of the supply usage on the Unit. In other words, if we put the right supplies in the servers, we could significantly decrease the time spent travelling to and from the Clean Utility Rooms, increase Nurse to patient touch time and care.

Cost Model

The chart below is a high-level summary of the detailed cost analysis. This is where the typical warehouse business case and Hospital correlation starts to differentiate itself. In a typical warehouse optimization effort, a business case would be developed that used the reduction in staff (operational efficiency) to justify the capital spend for equipment or automation.

In this study, the goal of optimizing daily nurse activity was not to eliminate nurses, but to quantify and highlight the amount of time saved that could be applied directly to increased patient care or increased “nurse touch time”. The chart below simply shows the overall cost model is significantly impacted by Nurse Cost (daily efficiency) when compared to the cost of equipment, materials management staff or additional inventory carrying costs.
Results – Unit Programming
A large amount of statistical analysis was completed to support and document the total activity on a typical unit. Metrics such as the number of trips each nurse makes to each supply location, the number of trips by patient and the number of items retrieved per trip are just an example of the breadth of information resulting from a study of this type.

Daily Volume
The charts below show a migration from existing condition to future intermediate deployment of supplies.

Hospital Unit Delivery Supply Chain
Current Configuration and Nurse Travel Radius

Hospital Unit Delivery Supply Chain
De-Centralized PYXIS and Optimized Server
Unit Reconfiguration

The illustrations below show a sample Unit with Clean Utility Room and no further deployment of supplies and a Unit with Satellite Supply Stations.

Conclusion

Although the idea of moving supplies closer to the patient seems obvious, a strong and detailed analysis must be completed to insure that the correct supplies are deployed out and the adjustment is not over-corrected which could over-inflate the Materials management cost.