University of Michigan Transplant Center: Standard Vessel Tracking Procedure and Supply Room Inventory Levels

Final Report

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Table of Contents

Executive Summary

Introduction

Goals and Objectives

Background

Project Approach

Key Issues

Project Scope

Report Organization

Methodology – Vessel Tracking

Interviewed Transplant Donation Specialists

Interviewed Surgical Nursing Staff

Researched Vessel Storage Options

Description of Current System – Vessel Tracking

Findings and Conclusions – Vessel Tracking

Cleveland Clinic

Nurse Interviews

Vessel Regulations

Recommendations – Vessel Tracking

Vessel Refrigeration Storage

Temperature Tracking

Vessel Security

Vessel Information Tracking

Action Plan – Vessel Tracking

Methodology – Supply Room

Interviewed Transplant Donation Specialists

Interviewed Materiel Services Personnel

Collected Current State Data from Supply Room

Obtained Protocols and Item Lists

Accessed Materiel Services Data

Defined Special Item Ordering

Predicted Inventory Levels

Description of Current System – Supply Room

Findings and Conclusions – Supply Room
List of Tables and Figures

Figure 1. Vessel Tracking Process Flowchart ................................................................. 12
Figure 2. Vessel Storage Schematic ............................................................................ 15
Table 1. Vessel Security Options ............................................................................... 16
Table 2. Vessel Tracking Options ............................................................................... 17
Figure 3. Supply Room Reorder Process Flowchart .................................................... 21
Table 3. Total Number of Procurements by Organ Type ............................................ 22
Table 4. Daily Frequencies by Procurement Type ....................................................... 23
Table 5. Project Summary ......................................................................................... 27
Executive Summary

At the University of Michigan Hospital, blood vessel tracking is an important process. Vessels are tracked from the time they reach the medical campus until they are used in a transplant surgery or discarded. The major tracking mechanism is a blood vessel log, containing important information about the vessels.

The Clinical Nurse Manager has reported that current vessel tracking procedures at the University of Michigan Transplant Center are leading to inconsistent entries in the blood vessel log. The inconsistent entries add unnecessary steps and wasted manpower to the vessel tracking process. In the past, standardizing the tracking procedures has been difficult because of the large number of people involved with the transplant process.

The Transplant Center’s supply room is also posing an inventory problem. The transplant staff reports that excessive inventory levels limit the working space in the supply room. The staff would like to ensure that they have sufficient stock to handle procurement demand, but still have an organized workspace.

The Clinical Nurse Manager asked the student team to evaluate the Transplant Center’s vessel tracking process and supply room to identify areas that could be improved and to recommend changes to implement these improvements.

Project Goals

To improve the vessel tracking process and reduce inventory levels, the team developed recommendations to:

- Create a standardized vessel tracking process in compliance with regulations of both the University of Michigan Hospital (UMH) and the United Network for Organ Sharing (UNOS)
- Meet the zero tolerance policy for lost or damaged vessels
- Determine Just-In-Time (JIT) stocking levels for the supply room
- Decrease waste and damaged stock in the supply room

Methodology – Blood Vessels

To gain a further understanding of the vessel tracking process, the team observed the current process with the Transplant Donation Specialists. The team also interviewed key personnel including the Clinical Care Coordinator of UMH Operating Rooms and the Clinical Manager. The interviews were conducted to gain a different perspective of the vessel tracking process.

To benchmark the vessel tracking process, the team contacted the Program Manager of Organ Transplant at Cleveland Clinic. The team also researched different vessel tracking options. The team sought to obtain information for vessel storage, security, and logging. Using all of this information, the team created a flowchart to clarify the steps of the vessel tracking process.
Findings and Conclusions – Blood Vessels

The Manager of Organ Transplant at Cleveland Clinic shared how they track and store vessels. Cleveland Clinic developed and continues to use Tissue Track Core, a software system that tracks vessels and tissues. Tissue Track Core also has capabilities to produce deliverables sent to UNOS and LifeBanc, Ohio’s version of Gift of Life. The team also learned from Cleveland Clinic that they do not currently use a locked refrigerator.

The team also interviewed key nursing staff members. Through these interviews, the team learned that the nurses are concerned about the lack of agreement between departments about vessel tracking procedures. The nurses asked that a flowchart of the Vessel Conduit Policy be made to help standardize the vessel tracking process.

After investigating the vessel tracking process, the team learned that the University of Michigan Transplant Center is not in compliance with two important UNOS policies:

- **Policy 5.7.6.3** The vessels must be stored in a secured refrigerator within a range of 2 to 8 °C.
- **Policy 5.7.6.7** There must be daily monitoring of the vessels with documented security and temperature checks by the transplant center.

The Transplant Center must alter their vessel tracking process to comply with all UNOS guidelines.

Recommendations – Blood Vessels

To improve the vessel tracking process, the team recommends that the vessel refrigerator be reorganized to achieve visual control. This involves storing blood and blood vessels in separate refrigerators, separating blood vessels first by serology and then by blood type within the refrigerator, and displaying visual aids on and around the refrigerator. The team also found it necessary to install a temperature tracking device on the refrigerator to record fluctuations in temperature according to UNOS standards.

The team has also developed several recommendations ranging from high to low levels regarding securing and tracking the blood vessels. In terms of vessel security, the team recommends that the Transplant Center install the Omni-Cell remote lock. Omni-Cell will ensure the vessels are secure and will track who accesses the vessel refrigerator. The team also recommends that the Transplant Center update their current vessel log to account for vessel re-entry. However, the team suggests the Transplant Center continue researching Tissue Track Core because of its many vessel tracking advantages.

Methodology - Supply Room

The team examined the current state of the inventory reorder process. The analysis included taking inventory of all items located in the transplant supply room. Pictures were also taken to document the current organization of the supply room, and can be found in Appendix A5.
team conducted multiple interviews to gain a better understanding of the reorder process. The Transplant Donation Specialists and Materiel Service Center (MSC) personnel were both interviewed to see how the inventory flowed through the room. The team then created a flowchart describing the inventory reorder process.

Protocols and item lists for all procurements and call log data were obtained from the Transplant Donation Specialists. The protocols and item lists were necessary to establish what supplies are needed for each type of procurement. The call log data was important in determining the volume of procurements the Transplant Center performed between July 1, 2006 and February 12, 2008. Data from MSC that documented all transplant supply room replenishments since July 1, 2006 was also acquired. The numbers were used to compare with levels predicted from the item lists and procurement volumes. The team predicted inventory levels by multiplying the volume of procurements by the supplies used in each procurement. The product of the multiplication represents the number of items used from the supply room in a given time period.

Findings and Conclusions – Supply Room

After observing the supply room and analyzing the inventory data, the team determined there was a lack of standardization in the reorder process. Items must sometimes be rushed to the supply room since orders are not always placed in the morning. Supplies ordered from different vendors do not have the same reorder process and orders are usually completed by one of the Transplant Donation Specialists.

The team also found that the Transplant Center carries an excessive amount of safety stock. This excess inventory does not match the procurement volume provided from the call logs.

Recommendations – Supply Room

A JIT Inventory Model was calculated using procurement protocols and procurement volumes, and the team recommends that the Transplant staff reduce inventory to the JIT levels. An analysis was performed using the number of procurements performed daily dating from July 1, 2006 to February 12, 2008 to determine the amount of stock used. Results can be found in Appendix A10. The model includes safety stock levels and optimal quantities for each item.

The team also recommends the Transplant Center introduce a standard reordering process that can be performed by any member of the perfusion staff. The new reorder process should be documented in a flowchart and all members of the perfusion staff should have a role in the new reorder process.

Changes also need to be made in the supply room to ensure optimal inventory flow in and out of the room. The recommended changes include updating labels on the shelves, replacing the wooden shelves with wire carts, removing obsolete stock, moving rarely used items to the ninth floor storage area, reorganizing the supply room using LEAN principles, and implementing First In, First Out (FIFO) as a means of managing inventory levels.
Introduction

At the University of Michigan Hospital, blood vessels are tracked from the time they reach the medical campus until they are used in a transplant surgery or discarded. The major tracking mechanism is a blood vessel log, containing important information about the vessels. The log is supposed to be updated every time vessels are received or discarded.

The Clinical Nurse Manager has reported that current vessel tracking procedures at the University of Michigan Transplant Center are leading to inconsistent entries in the blood vessel log. Due to these inconsistent entries, the possibility exists for Transplant Center personnel to misplace the blood vessels. In the past, standardizing the tracking procedures has been difficult because of the large number of people involved with the transplant process.

The Transplant Center’s supply room is also posing an inventory problem. The supply room has limited space to store all necessary supplies and equipment. As a result, the staff report reduced inventory levels would help to eliminate clutter in the room.

To address these inefficiencies, the Transplant Center’s Clinical Nurse Manager asked our team to analyze the current vessel tracking process and supply room inventory control process to identify areas where problems arise and improvements are possible. Based on this analysis, the team has recommended changes to address the Transplant Center’s concerns about the vessel tracking process and inventory levels in the supply room.

This final report presents the team’s methodology, findings, and recommendations.

Goals and Objectives

The team has developed recommendations to:

- Create a standardized vessel tracking process in compliance with regulations of both the University of Michigan Hospital (UMH) and the United Network for Organ Sharing (UNOS)
- Meet the zero tolerance policy for lost or damaged vessels
- Determine Just-In-Time (JIT) stocking levels for the supply room
- Decrease waste and damaged stock in the supply room
- Design a supply room organization in compliance with fire safety regulations
Background

The University of Michigan Transplant Center is devoted to providing patients with the best possible medical care. This objective is complicated because the field of organ transplantation is highly specialized and regulated. Therefore, the University of Michigan Transplant Center is dedicated to having the best practices in place for organ and vessel procurement and preservation.

An important part of the transplant process is the use of donor blood vessels. These vessels include the iliac veins and arteries, as well as segments of the aorta and vena cava. The donor vessels are used in the transplant operation to connect the transplanted organ with the recipient’s vessels.

Currently, blood vessels are stored in one of two ways. After being procured from the donor, the vessels are either placed in cooler storage to be used on an as-needed basis or are left with the organ to be utilized by the recipient’s surgeon and are kept in a cooler with the organ. Vessels taken for storage can be kept for 14 days after they are procured. When necessary, appointed Transplant Center personnel are in charge of the proper disposal.

Critical information, including donor blood type, serology, and vessel size must be tracked carefully to ensure compatibility between the vessel and the recipient. Currently, the Transplant Center has blood vessel logs that are intended to keep track of all vital information. However, because of the number of personnel that contribute to tracking the vessels, the logs are often left incomplete and the possibility exists for vessels to be misplaced. Sometimes the vessels are logged out, but then returned without proper documentation or disposal. Search and recovery of misplaced vessels is time consuming, and should be avoided. Strict regulation of vessel tracking and recording has not been enforced. This project strives to determine the sources of error in vessel tracking and provide recommendations to improve the inefficiencies.

In addition, the Transplant Center’s supply room is a concern. The room contains all the supplies necessary for the procurement of organs. Currently, the supplies are either special ordered or received from Materiel Services (MSC) based on periodic visual inspection of stock levels. Since procurement volume is sporadic, supply needs are difficult to predict. Hospital staff order and stock inventory to accommodate approximately ten procurement cases. This approach causes excessive inventory levels, which pose a problem because of the Transplant Center’s limited storage area. Procurements also call for specific medicinal supplies and equipment, not used by other areas of the hospital. Due to the dynamic environment of the procurement process, the Transplant Center personnel have difficulty determining the exact inventory needed without exceeding capacity. Limited room in the transplant supply area along with waste of supplies is a problem; therefore, this project also aims to improve inventory flow and reduce inventory levels.

Project Approach

The team examined two internal processes of the University of Michigan Transplant Center: the vessel tracking process and the inventory flow process of the transplant supply room. The
primary parties involved in this project included the Transplant Center Clinical Nurse Manager, Transplant Donation Specialists, transplant supply room stocker, registered nurses, and the team.

**Key Issues**

The following are key issues that drove the need for this project:

- UNOS and Gift of Life Protocols that address the growing importance of vessel tracking.
- Manpower wasted by tracking down missing or misplaced vessels when logs are incomplete.
- Procurements are sporadic and unpredictable, therefore forcing the special order items in the supply room to have a higher safety stock.
- Space limitations in transplant supply room for stocking items needed in procurement procedures.

**Project Scope**

The team received a clear description of the project scope from the Clinical Nurse Manager.

**Included**

This project examined the entire vessel tracking system for the University of Michigan Transplant Center. The project included kidney, liver, and pancreas procurements for the blood vessel tracking process. The process starts when the vessels are brought to the University of Michigan Hospital and is completed at the end of each month when an electronic version of the vessel logs is sent to UNOS.

For the inventory reorder process, the project only included the supply room of the Michigan Transplant Center, located in the University Hospital between operating rooms 16 and 17. Specifically, the project included research of the supplies needed for heart, lung, kidney, liver, and pancreas procurements. Finally, the project considered workspace organization for the supply room area. The stock room inventory process starts when items are reordered by supply room personnel and ends when the items are utilized.

**Excluded**

The project only studied processes inside the University of Michigan Transplant Center. Procurements at the Cardio Vascular Center, the Mott Children’s Hospital, or University of Michigan Hospital satellite sites were not considered. Also, the project did not include analysis of inventory scheduling, but did include the methodology used to efficiently reorder and stock inventory. The project only looked at the tracking system for blood vessels and not the tracking system for the organs themselves. The project did not include the reorder process for the Hospital’s main supply room; it focused only on the transplant supply room.
Report Organization

To achieve the goals outlined by the Clinical Nurse Manager, the team decided to spend equal time researching and analyzing the blood vessel tracking process and supply room inventory flow. The remainder of the report addresses the two main aspects of the project independently. The first part of the report addresses the vessel tracking methodology, findings and conclusions, and recommendations. The second part of the report addresses the supply room methodology, findings and conclusions, and recommendations. The last portion of the paper summarizes the project.

Methodology – Vessel Tracking

To analyze the current state of the vessel tracking process, the team observed the current process, interviewed key personnel, and researched UNOS regulations. Using all of this information, the team made a flowchart to clarify the steps of the vessel tracking process.

Interviewed Transplant Donation Specialists

The team used interviews with the Transplant Donation Specialists and observations of the vessel tracking logs to develop an understanding of the current state of the blood vessel tracking process. At the beginning of February, the team observed a Transplant Donation Specialist entering the vessel log data into an Excel file, which was later sent to Gift of Life. The Excel file included vessel activity for the month of January 2008.

Interviewed Surgical Nursing Staff

The nurses that record all vessel transplants gave the team an accurate picture of the current state of the tracking process. The team gained information from these interviews regarding the training that the nurses receive before they can record information in the vessel tracking log, favorable aspects of the current process, and the obstacles observed in the current process. The team also asked for the nursing staff’s input regarding the future state of the vessel tracking process.

Researched Vessel Storage Options

In the initial stages of the project, the team and Clinical Nurse Manager discussed the use of Omni-Cell as a potential solution to the vessel tracking process. However, the team has contacted a member of the University of Michigan Hospital Pharmacy Department to talk about Omni-Cell refrigeration storage for the vessels. The team was informed by Health Care Administrative Manager of UMH Inpatient Pharmacy Services that if the refrigerator does not contain any medications, justification for purchasing an Omni-Cell refrigerator cannot be made. Since the storage and handling of medications is beyond the scope of this project, the team also considered other refrigeration solutions. These solutions included purchasing a new refrigeration system and recommending two independent systems; one for vessel tracking and logging and
The team contacted several people to see if UMH is using any tissue tracking system that could be easily modified to store the necessary blood vessel information. These contacts included Good Tissue Manufacturing Personnel, the Laboratory Practices Coordinator, and the Manager of Organ Transplant for Cleveland Clinic. To make recommendations for vessel security, the team researched possible refrigeration security devices including a refrigerator keypad, an Omni-Cell remote lock system, and an RFID system. The RFID system is currently used at UMH to track tissues. The team obtained information about the RFID system late in the project, therefore this option could not be fully investigated.

The team has researched several refrigerators that would satisfy the requirements of the Clinical Nurse Manager and meet UNOS guidelines. However, during the course of the project, the Transplant Center has entered into the purchasing phase for two new vessel refrigerators; one for the Main OR room and one for Mott. The team relied on input from the nursing staff and Transplant Donation Specialists because they are the parties most affected by the vessel tracking recommendations.

**Description of Current System – Vessel Tracking**

Based on the observations and interviews, the team created a vessel tracking flowchart to understand the current state of the vessel tracking process. The flowchart, shown in Figure 1, documents all major steps and decisions in the current process, as well as, the starting and ending points of the process. The team has confirmed with the Transplant Donation Specialists that all steps and decisions depicted in the vessel tracking process flowchart are correct.
Figure 1. Vessel Tracking Process Flowchart

Findings and Conclusions - Vessel Tracking

The team used interviews with nurses and a contact at Cleveland Clinic to research vessel tracking options and assess the feasibility of each option. The team also researched the regulations associated with vessel storage to ensure UMHS compliance.
Cleveland Clinic

The team contacted the Program Manager of Organ Transplant at Cleveland Clinic to gain a better understanding of the process they use to track and store vessels. To track both vessels and tissues, Cleveland Clinic developed and continues to use, software called Tissue Track Core. Personnel at Cleveland Clinic log both vessels and tissues directly into the computer system. Barcodes are generated for each vessel, and the vessels are scanned into or out of the log when needed. Vessels are also scanned to the operating room in which they will be used. Deliverables that must be sent to UNOS and LifeBanc (Ohio’s version of Gift of Life) once a month are generated by Tissue Track Core, eliminating the need to convert vessel logs into access reports.

The team also learned that the vessels are stored in a separate, temperature-controlled refrigerator at Cleveland Clinic. The vessels are organized by blood type, size, and serology within the refrigerator. The refrigerator is not locked, but is stored behind a control desk in the operating room. The hospital administration is looking into a card swipe system that would allow them to properly secure the refrigerator and further limit who has access to it. The Cleveland Clinic personnel concluded that a card swipe system is not currently feasible because of its high price.

Nurse Interviews

Based on interviews with the UMH Operating Room Clinical Manager and the UMH Operating Room Clinical Care Coordinator, the team found that the RN’s main concern with the vessel tracking process was the lack of standardization. Specifically, the transplant staff debate about whether the blood vessels that have been opened in the operating room should be discarded. To promote a standard process, the nurses asked the team to create visual flowcharts to better communicate the surgeons’ policy to the RN’s. One flowchart shows how to check the vessels out of the vessel refrigerator and how to handle vessels once they enter the Operating Room. A second flowchart describes how to check the vessels into the vessel refrigerator and how to properly track them. The team has reviewed the flowcharts with the Director of Transplant Surgery and made the necessary changes based on his feedback. A hardcopy of this flowchart can be found in Appendix A1. The team then reviewed this flowchart with the UMH Operating Room Clinical Manager who made additional revisions. This version of the flowchart can be found in Appendix A2. The differences between these two versions of the flowchart must be worked out between the Surgical Team, RN’s and the Transplant Donation Specialists. The current working Microsoft Visio Files will be e-mailed to the Clinical Nurse Manager.

The team also asked the UMH Operating Room Clinical Manager for her opinion on securing the blood vessels by installing a card swipe. She believes that securing the blood vessels with a card swipe would be an expensive addition to the transplant supply room and would only provide information as to who accessed the refrigerator. The card swipe system would not be able to capture data describing which vessels have been taken.
Vessel Regulations

After observing the supply room and the vessel tracking process with the Transplant Donation Specialists, the team found that two important Organ Procurement and Transplantation Network (OPTN) policies require some changes to the current vessel tracking process. The OPTN polices are synonymous with the UNOS guidelines and they are:

- **5.7.6.3** The vessels must be stored in a secured refrigerator within a range of 2 to 8 °C.
- **5.7.6.7** There must be daily monitoring of the vessels with documented security and temperature checks by the transplant center.

Recommendations – Vessel Tracking

The team again used the information from interviews and internet research to compose a list of options to improve vessel refrigeration storage, temperature tracking, security, and information tracking.

Vessel Refrigeration Storage

To improve the vessel tracking procedure, the team recommends that the vessel refrigerator be reorganized to achieve visual control. The recommendations include:

- Store blood vessels and medications in separate refrigerators.
- Separate blood vessels with different blood types and serology status within the refrigerator.
  - Use individual refrigerator shelves to store blood vessels of one blood type.
  - Store positive serology vessels in a separate colored bag with a label clearly indicating that the vessels contained within have a positive serology.
- Display visual aids on and around the refrigerator.
  - Place the vessel log on the side of the refrigerator, near the door handle.
  - Post the flowcharts for vessel tracking on the refrigerator.
  - Place a copy of each flowchart inside the vessel log.
A summary of the recommended refrigerator organization is shown in Figure 3.

![Figure 2. Vessel Storage Schematic.](image-url)

The refrigerator organization shown in Figure 3 will help eliminate the flaws associated with the current system. Separating the vessels by blood type will eliminate the risk for errors in identifying blood vessels that are compatible with the patient. Placing positive serology blood vessels in a separate bag will force those retrieving the vessels to perform another step before removing the vessels from the refrigerator. Also, the new location of the vessel binder will make the vessel log more visible for the RNs and Transplant Donation Specialists.

**Temperature Tracking**

The team recommends that the new vessel refrigerator complies with all UNOS/OPTN guidelines. The guidelines stipulate that the Transplant Center must maintain daily monitoring of the refrigerator temperature. To follow the guidelines, the team recommends one of the following options:

- New refrigerator with a built in temperature recording device
- Adding a temperature recording device as an accessory to an existing refrigerator. An example of one such device can be found in Appendix A3.
**Vessel Security**

All vessel security options need to restrict access from unauthorized personnel. However, some options differ in the scope of their functionality and financial feasibility. Table 1 shows the advantages, disadvantages, and cost associated with each option. The options include:

- **Keypad Lock**: To gain access to the vessel refrigerator, the users must enter the keypad code.
- **Omni-Cell Remote Lock**: To gain access to the vessel refrigerator, users must enter their personal code on the Omni-Cell tower. The Omni-Cell tower will remotely unlock the vessel refrigerator for the user.
- **Card Swipe Reader**: To gain access to the vessel refrigerator, users must slide their card through the reader.

<table>
<thead>
<tr>
<th></th>
<th>Keypad Lock</th>
<th>Omni-Cell with Remote Lock</th>
<th>Card Swipe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>- Easily implemented</td>
<td>- Already in use in the hospital</td>
<td>- Records who has entered the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Records who has entered the refrigerator</td>
<td>refrigerator</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Located on the refrigerator</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>- Limited number of access codes</td>
<td>- Only used for Medication storage</td>
<td>- Question of who manages the</td>
</tr>
<tr>
<td></td>
<td>- Lacks the ability to record who has entered the refrigerator</td>
<td>- Question of who manages the access records.</td>
<td>access records.</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$200 - $600</td>
<td>$30,000 - $35,000</td>
<td>$9,000</td>
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The team has identified the Omni-Cell remote lock as the best option for vessel security because it secures the vessels and is already in use within the University of Michigan Hospital System. With Omni-Cell, there also exists the potential to track more information about vessel history. This option also allows for the generation of access records.

**Vessel Information Tracking**

The team has researched several options that address the need to accurately and completely record vessel information. The team has found two possible solutions that address this issue and the advantages and disadvantages for these options can be seen in Table 2. The two options are:

- **An updated Vessel Tracking Log currently being used by the Transplant Center staff to track and monitor vessels.**
- **Tissue Track Core Software**: Custom designed software to help hospitals track donor tissue and comply with federal regulations.
Table 2. Vessel Tracking Options

<table>
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<tr>
<th></th>
<th>Updated Paper Log</th>
<th>Tissue Track Core System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>-Easy to customize and allows for custom notes.</td>
<td>-Works with hospitals to comply with federal regulations.</td>
</tr>
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<td></td>
<td>-The staff is familiar with the vessel log.</td>
<td>-Simplifies end of the month reporting to UNOS and GOL.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Allows the use of barcodes to track vessels.</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>-The paper log can become lost or damaged.</td>
<td>-Long implementation process. Purchase of substantial hardware.</td>
</tr>
<tr>
<td></td>
<td>-Staff may forget to enter all information into the log.</td>
<td>-The transplant supply room would need to have the capabilities necessary to support the system.</td>
</tr>
<tr>
<td></td>
<td>-Time consuming to generate reports to send to UNOS and GOL.</td>
<td></td>
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</table>

The team recommends updating the current vessel logs in the short term to allow for a second vessel disposition, while further investigating the financial feasibility of the Tissue Track Core system. The advantages of the Tissue Track Core software may prove to be worth the additional cost.

**Action Plan for Vessel Tracking**

The team has developed an action plan to help the transplant staff implement the recommendations made regarding the vessel tracking process. The most important aspects of our recommendations deal with the need to comply with UNOS and OPTN regulations.

- The team recommends that once the new vessel refrigerator is chosen, the Transplant Center outfit it with a temperature recording device in order to and comply with OPTN Policy 5.7.6.7
- The team recommends that the Transplant Center secure the blood vessels in order to restrict unauthorized personnel from accessing the vessels and to comply with OPTN Policy 5.7.6.3 and OPTN Policy 5.7.6.7. We recommend that the transplant center achieve this by implementing the Omni-Cell remote lock.

The team also recognizes the importance of making improvements in the vessel tracking process even when these changes may not be required by UNOS or OPTN regulations. Therefore, the team recommends that the new refrigerator be organized similar to Figure 3, immediately upon the arrival of the new vessel refrigerator.

**Methodology - Supply Room**

To analyze the current state of the supply room, the team spent one morning taking inventory of every item in the transplant supply room. The team also interviewed key personnel to gain a
better understanding of the reorder process. Using the information from these interviews, the team created a flowchart to represent the inventory reorder process.

**Interviewed Transplant Donation Specialists**

The team interviewed the Transplant Donation Specialists to gain a hands-on perspective of the reorder process. The Transplant Donation Specialists described how par stock and special order items were replenished. The Specialists also showed the team the ninth floor storage area, so the team could see the backup storage area for the Transplant Center.

**Interviewed Materiel Services Personnel**

The Materiel Services Personnel provided the team with information pertaining to the supply room, including: how the current inventory levels were established, what supplies move fastest through the room, how often stock-outs occur, and how often stock is damaged. The team also asked for the Materiel Services Personnel’s input regarding the future state of the supply room’s inventory control.

**Collected Current State Data from Supply Room**

A study of the inventory levels in the supply room was completed on February 14, 2008 to determine how much of each supply was on hand in the current state. The team took pictures of the supply room to reflect the current state organization of the room and facilitate comparisons after the recommended changes have been implemented. The pictures can be found in Appendix A5. The information from the inventory study will help the team determine the proper inventory levels for each item in the supply room. The information will also be useful in explaining the current state and identifying problem areas.

**Obtained Protocols and Item Lists**

The protocols and item lists, created by the perfusion team, listed the supplies from the Transplant supply room used in adult organ procurements. Protocols or item lists were provided for lung, heart, pancreas, liver, and kidney procurements. There are two protocols for pancreas procurements: one describes the procedure if livers are procured simultaneously and one describes the procedure for individual procurements. Living and non-living kidney procurements also require slightly different supplies. A table including all protocol items can be found in Appendix A6.

**Accessed Materiel Services Data**

To obtain a better understanding of what quantity of each item was used during procurement procedures, the team contacted the Materiel Services Warehouse Manager. The Warehouse Manager was able to provide the student team with data describing replenishments to the transplant supply room between July 1, 2006 and February 25, 2008. The data included information regarding all par stock and special order replenishments handled by Material
Services, but it did not include any information regarding special order items coming from outside vendors.

The Materiel Services data allowed the team to develop a better understanding of how items moved through the transplant supply room. The replenishment data also helped the team to ensure that the optimum quantities and safety stock calculated each item were accurate.

**Defined Special Item Ordering**

For the transplant supply room, par stock items are defined as items that are replenished by Materiel Services without the use of a Custom Requisition Form. Therefore, special order items are supplies that are ordered from outside vendors, the instrument room, Gift of Life, or Custom Requisition Forms. The replenishment process differs for each special order item depending on where it is ordered from.

**Outside Vendors**

The Transplant Donation Specialists keep track of the inventory levels of all special order items from outside vendors. When the quantity of a special order item from an outside vendor reaches a certain point, the Transplant Donation Specialists contact the Transplant Center Accountant Associate with the replenishment quantity desired. The Transplant Center Accountant Associate then places the order with the outside vendor.

The item is delivered within a time period of one to seven days. When the special order item arrives at the University of Michigan Hospital, the Transplant Donation Specialists are notified. The Transplant Donation Specialists retrieve the items and make sure that items requiring refrigeration are handled accordingly.

The team also used the special order data from outside vendors to verify inventory calculations for the special order items. The team examined the quantity of each item that was ordered over the past year and compared it to the projected usage quantities calculated from the protocols and call logs.

**Instrument Room**

The Transplant Donation Specialists walk to the Instrument Room and request supplies when necessary. The Specialists then bring the supplies back to the transplant supply room and place them in the proper location shortly after the request.

**Gift of Life**

Several supplies used in procurement procedures are ordered through the Gift of Life. When these supplies are needed, one of the Transplant Donation Specialists contacts the Gift of Life. When the supplies arrive on the University of Michigan medical campus, the Transplant Donation Specialists are notified, so they can transport the items to the transplant supply room.
Custom Requisition Forms
When special order items replenished by Materiel Services are required, the Transplant Donation Specialists fill out a Custom Order Requisition Form. This form is then faxed to the Materiel Services department. Materiel Services personnel pick the items and bring them to the transplant supply room within one day of the request.

Predicted Inventory Levels

The team determined that the information necessary to predict JIT inventory levels in the supply room was the volume of organ procurements and the supplies used in each type of organ procurement. The volume of procurements multiplied by the supplies used in each procurement indicates the number of items used from the supply room in a given time period.

When researching procurement volume, the team initially assumed that the Organ Transplantation Information System (OTIS) database provided the number of procured organs, but later determined that OTIS records only represent transplant volumes and kidney procurements. To fill the gaps in information, the transplant staff made call logs (from June 6, 2006 to February 12, 2008) documenting procurement volumes available to the student team. The logs indicate when a transplant team was sent from UMH to procure a donated organ. The call logs were used to generate tables showing the daily frequency of each type of organ procurement.

Using procurement protocols and procurement volume, the team was able to predict the number of supplies that have moved through the supply room. After validating the protocols, the predicted supply usage numbers were used to determine safety stock and optimum quantities necessary to meet JIT inventory levels for each item in the supply room.

The JIT model assumes that inventory in the supply room is only used for lung, heart, pancreas (simultaneous with liver), pancreas (not simultaneous with liver), non-living donor kidney and living donor kidney procurements.

Safety stock was determined based on the number of cases performed historically between reorder periods. Since stock is not replenished during the weekend, the longest reorder period is Friday through Monday. Optimum quantities were determined by adding the safety stock to the amount of inventory used during each item’s lead time. Optimum quantity is the ideal inventory level, and whenever inventory falls below this level it should be replenished back to the optimum level.

Description of Current System – Supply Room

The team created a flowchart to document the current supply room reorder process based on discussions with the Transplant Donation Specialists and Materiel Services Personnel. The flowchart, shown in Figure 2, documents all major steps and decisions in the current process along with the starting and ending points. The team has confirmed with the Transplant Donation Specialists that all steps and decisions depicted in the supply room reorder process flowchart are correct.
Use Items

Is item special order?

Transplantation Donation Specialist check the inventory levels. (Daily)

Yes

Transplant Donation Specialist place special item orders via requisition form.

No

Materiel Services personnel note what is needed for the supply room. (Once a day)

Materiel Services personnel bring items to supply room.

Same Day

Materiel Services personnel stock items to specific level.

Use items

Items arrive to UMHS 3800 office complex

Transplant Donation Specialist is paged

Transplant Donation Specialist stock items in supply room.

Use items

Figure 3. Supply Room Reorder Process Flowchart
Findings and Conclusions - Supply Room

The team analyzed inventory data from MSC and outside vendors to formulate conclusions regarding the accuracy of the predicted inventory levels. The team also developed reorder process and supply room organization conclusions based on observations.

Reorder Process

Based on the quantitative data analyzed and qualitative observations, the team developed conclusions regarding the reorder process. First, items are not always ordered in the morning or early in the week, so MSC personnel are sometimes rushed to deliver supplies in a short period of time. Next, there is a lack of standardization in the ordering process. Par stock is ordered and replenished using a different process than special order items. Furthermore, not all special order items have the same reorder process. For example, special order items from outside vendors follow a different process than special order items from Gift of Life. Finally, the transplant supply room maintains inventory levels large enough to satisfy procurement demand for months. For example, the supply room is stocked for 128 pancreas procurements even though they only performed 20 pancreas procurements since July 1, 2006.

Just-In-Time Inventory Model

The team found the total number of each type of procurement performed since July 1, 2006. These totals can be found in Table 3.

<table>
<thead>
<tr>
<th>Number of Procurements</th>
<th>Liver</th>
<th>Heart</th>
<th>Pancreas with Liver</th>
<th>Pancreas without Liver</th>
<th>Living Donor Kidney</th>
<th>Lung</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>134</td>
<td>48</td>
<td>12</td>
<td>8</td>
<td>163</td>
<td>38</td>
<td></td>
<td>397</td>
</tr>
</tbody>
</table>

As shown in Table 3, the Transplant Center has performed a total of 397 procurements since July 1, 2006. The table also shows that the most supplies are needed for liver and living donor kidney procurements.

The team also determined how often multiple procurements of the same organ type were performed in a day. The results are shown in Table 4.
Table 4. Daily Frequencies by Procurement Type.

<table>
<thead>
<tr>
<th>Procurements per Day</th>
<th>Liver</th>
<th>Heart</th>
<th>Pancreas with liver</th>
<th>Pancreas without liver</th>
<th>Lung</th>
<th>Living Donor Kidney</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>479</td>
<td>544</td>
<td>583</td>
<td>584</td>
<td>555</td>
<td>463</td>
</tr>
<tr>
<td>1</td>
<td>95</td>
<td>48</td>
<td>7</td>
<td>8</td>
<td>36</td>
<td>95</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximum per Day</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Using the Table 4, the team found that the Transplant Center rarely performs more than two heart, lung, or pancreas procurements in a day. However, liver and living kidney donor procurements were more likely to occur twice in a day. The tables displaying the frequencies for Friday through Monday, Friday through Tuesday, two day, seven day, and ten day reorder periods can be found in Appendix A7.

Materiel Services Data

During the analysis of the MSC data, the team encountered several obstacles to developing recommendations. First, some of the items that were replenished by MSC in the past year and a half had been replaced with new items or had grown obsolete. Next, the MSC replenishment data did not include any special order items from outside vendors or Gift of Life. Finally, the MSC data did not give a completely accurate picture of all items that had been used in the past year and a half because the data did not account for items that were already in the room. Even though the team encountered these obstacles, they were able to use a portion of the MSC data to verify the recommended inventory levels.

Special Order Data – Outside Vendors

After reviewing the special order data, the team found that most of the calculated quantities supported conclusions from the procurement protocols and call logs. The special order data also showed that lead times for special order items are longer than the lead times for par stock items.

Supply Room Organization

The team used qualitative techniques to analyze the transplant supply room. The first issue that the team noticed in the supply room was that many of the shelves are incorrectly labeled. Next, the team found that there are thirteen items in the supply room that are obsolete or rarely used. These items take up valuable space that could be used for important procurement supplies. Finally, the team concluded that the wooden shelves in the transplant supply room are an inefficient use of space.
Recommendations – Supply Room

The team developed recommendations for inventory levels, reorder process improvements, and supply room organization. Based on these recommendations, the team formulated an action plan.

Recommended Inventory Levels

The recommended safety stock and optimum quantities for each item used in organ procurements can be found in Appendices A10 and A11. JIT inventory levels were determined based on lead time for each item.

**Par stock items from MSC**

- **Lead Time:** Same day (Items can be reordered every weekday)
- **Safety Stock:** Friday-Monday (This accounts for any procurements that could take place after stock was reordered Friday morning)
- **Optimum Quantity:** Safety stock plus the supplies to perform one of each type of procurement

**Specialty Order items**

- **Lead Time:** Two day (Items can be reordered every weekday)
- **Safety Stock:** Friday-Wednesday (This accounts for any procurements that could take place after stock was reordered Friday)
- **Optimum Quantity:** Safety stock plus supplies to perform two of each type of procurement

- **Lead Time:** Seven day (Items can be reordered every weekday)
- **Safety Stock:** Friday-Second Monday (This 10 day period accounts for any procurements that take place after stock was reordered Friday morning)
- **Optimum Quantity:** Safety stock plus supplies to perform seven of each type of procurement

Recommended Changes to Reorder Process

The Transplant Center should introduce a standard reordering process that can be performed by any member of the perfusion staff.

- New reorder process flowchart applicable to every reordering process. The same steps should be performed regardless of the location the stock is ordered.
• Negotiate contracts with suppliers. Contracts will ensure shortest delivery times and
decrease the possibility of backorders.
• Each member of the profusion team should understand and participate in the reordering
process. The entire team must be knowledgeable in reordering stock in order to meet JIT
inventory levels.

Recommended Changes to Transplant Center Supply Room

The following are recommended changes to the Transplant Center Supply Room necessary to
achieve JIT inventory:

• Update labels on shelves to identify item name and location. Items having a set location
will improve organization and assist staff in reordering inventory at the correct time.
• Replace wooden shelves with wire mesh carts wherever possible. The wooden shelves
that are currently in use are an inefficient use of wall space in comparison to carts.
• Remove obsolete stock and move rarely used items to the ninth floor storage room. The
obsolete and rarely used stock occupies valuable storage space.
  o All obsolete items that can be sold back to MSC should be exchanged for credit
    and the remainder should be discarded.
  o Items that provide value to the transplant staff, but are not regularly used should
    be moved from the supply room to the ninth floor storage area.
  o Items that should be removed from the supply room include:
    ▪ Old Procurement Bags
    ▪ Old Coolers
    ▪ Wire Carts
    ▪ Old Water Box
    ▪ Suture (cardiovascular) 7-0 Prolene (24”)
    ▪ Suture, O Coated Vicryl Violet Braided (27”)
    ▪ Pulmonary Adapter Tube ¼”
    ▪ Arzol Silver Nitrate Applicators
    ▪ 4 Towel PK (FF)
    ▪ 8 Towel PK (FF)
    ▪ Short Potts (Medical Action Industries)
    ▪ Perfusion Adapter ¼”
    ▪ Training Supplies
• Reorganize stock in the supply room using Lean principles. The team recommends using
5-S methodology and Kanban pull cards for stock reordering.
  o 5S methodology is used to identify and eliminate waste.
    ▪ Sort: Go through all the supplies in the room and keep only essential
      items. Everything else is stored or discarded to eliminate hazards and
      clutter.
    ▪ Straighten: Organize items to allow for FIFO wherever possible. Update
      labels on shelves to accurately identify designated item name and location.
    ▪ Sweep: Keep the room clean and neat. Maintaining cleanliness should
      become part of the daily work - not an occasional activity initiated when
      things get too messy.
- Standardize: Develop a standard work practice for organizing the stock room and reordering supplies. The standard procedure will ensure each member knows his or her responsibility for supply room organization and reordering stock.
- Sustain: Maintain the standards agreed upon by all members. Do not allow a gradual decline back to the old ways of operating.
  - Kanban cards are used to signal when an item falls below its optimal quantity and needs to be replenished. An example of a Kanban card can be found in Appendix A12.
    - A Kanban card needs to be created for each item labeled with the item name, location in the supply room, reorder location.
    - Whenever an employee uses the last item before the Kanban card, the card needs to be placed in a reorder basket located by the door.
    - At the beginning of each day the perfusion staff will remove the Kanban cards from the reorder basket and follow the standardized process for reordering stock.

- Launch First In, First Out (FIFO) restocking practice. FIFO is a restocking practice that uses the oldest stock. The item that has been on the shelf the longest is always the first item used.

**Action Plan for Just-in-Time Inventory Model**

In order to reach JIT Inventory in the supply room the following recommendations must be implemented:

- Reduce inventory to recommended JIT Levels. No items should be replenished until the current stock levels reach the reorder point.
- Hold a “5S day” including MSC staff and Transplant Donation Specialists. Designate a day for the perfusion staff and MSC staff to organize the stock room.
- Introduce Kanban cards for inventory management.

**Summary**

Table 5 summarizes the methodology, findings and conclusions, and recommendations for the vessel tracking and supply room portions of the project.
Table 5. Project Summary.

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Supply Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Interviewed Transplant Donation Specialists</td>
<td>- Interviewed Transplant Donation Specialists</td>
</tr>
<tr>
<td>- Interviewed surgical nursing staff</td>
<td>- Interviewed MSC Personnel</td>
</tr>
<tr>
<td>- Researched vessel storage options</td>
<td>- Collected current state data from suppliers</td>
</tr>
<tr>
<td></td>
<td>- Obtained protocols and item lists</td>
</tr>
<tr>
<td></td>
<td>- Accessed MSC data</td>
</tr>
<tr>
<td></td>
<td>- Defined special item ordering</td>
</tr>
<tr>
<td></td>
<td>- Predicted inventory levels</td>
</tr>
<tr>
<td>Findings and Conclusions</td>
<td>Findings and Conclusions</td>
</tr>
<tr>
<td>- Cleveland Clinic uses Tissue Track Core software</td>
<td>- Lack of standardization in reorder process</td>
</tr>
<tr>
<td>- Recognized need for a vessel policy flowchart</td>
<td>- Stock levels do not match procurement volume</td>
</tr>
<tr>
<td>- Transplant Center is not in compliance with two OPTN policies</td>
<td>- Several obsolete or rarely used items found in the supply room</td>
</tr>
<tr>
<td>Recommendations</td>
<td>Recommendations</td>
</tr>
<tr>
<td>- Separate blood vessels with different blood types and serology status within the refrigerator</td>
<td>- Reduce inventory to JIT levels</td>
</tr>
<tr>
<td>- Install temperature recording device in new refrigerator</td>
<td>- Create a standardized reordering process</td>
</tr>
<tr>
<td>- Use Omni-Cell remote lock to secure vessels</td>
<td>- Reorganize stock in the supply room using Lean principles</td>
</tr>
<tr>
<td>- Update vessel tracking log and research Tissue Track Core</td>
<td></td>
</tr>
</tbody>
</table>

Upon implementation, these recommendations will help the Transplant Center develop a standardized vessel tracking process that follows all UNOS and OPTN guidelines. The recommendations will also help the Transplant Center improve supply room organization and decrease inventory levels.
Appendix A1: Vessel Flowchart Draft 1

DONOR VESSEL CONDUIT
FLOW CHART

Organ accepted

Vessel labeled by Perfusion Specialist

YES

Perfusion Specialist places vessels in refrigerator between OR 16 and 17

Perfusion Specialist enters Vessels into Log

YES

Perfusion Specialist notes expired vessels in log

Is organ procured by UM team?

NO

Surgeon responsible for verifying label is fixed

*Verify label is fixed to outside with date of recovery, UNOS ID#, blood type, and any positive serologies

*Vessel labeling protocol: label at the point of recovery with date of recovery, UNOS ID#, blood type, and any positive serologies

Surgeon (or designee) removes vessels from non-sterile ice

Circulating Nurse places vessels in refrigerator between OR 16 and 17

Circulating Nurse enters vessels into log

Is procurement date >14 days ago?

YES

Vessels discarded

NO

Vessels remain in refrigerator
Circulating nurse verifies UNOS ID, ABO compatibility, confirms procurement date<14 days, notifies surgeon of Hepatitis C status.

Circulating Nurse places vessels on sterile back table. Keep vessels on non-sterile ice in cooler with organ.

Surgeon documents UNOS ID in operative note.

Vessels requested by surgeon

Is organ transplanted?

YES → Are vessels used?

YES → Surgeon documents UNOS ID in operative note

NO → Have the vessels been opened?

YES → Has there been crossover between recipient and back table?

YES → Circulating Nurse notes discarded vessels and initials in log → Vessels discarded

NO → Are the vessels in the refrigerator?

YES → Vessels discarded

NO → Are vessels with the organ?

YES → Circulating Nurse logs vessels out as reallocated

NO → Vessels repackaged

* Repackaging Protocol: Package in Preservation Solution, Three Sterile Barriers, and label with date of Recovery, Donor Name, UNOS ID#, Blood Type, and Donor CMV Status. Place with Organ in Non-Sterile Ice.
Appendix A2: Vessel Flowchart Draft 2 (Nurse Revisions)

DONOR VESSEL CONDUIT FLOW CHART

Organ accepted

YES NO

* Vessel labeling protocol: Label at the point of recovery with date of recovery, UNOS ID#, blood type, and any positive serologies

Vessel labeled by Perfusion Specialist

Perfusion Specialist enters vessels into log

Perfusion Specialist places vessels in refrigerator between OR 16 and 17

Surgeon (or designee) removes vessels from non-sterile ice

Circulating Nurse places vessels in refrigerator between OR 16 and 17

Circulating Nurse enters vessels into log

Surgeon responsible for verifying label is fixed

* Verify label is fixed to outside with date of recovery, UNOS ID#, blood type, and any positive serologies

Is organ procured by UM team?

YES

Surgeon places vessels in refrigerator between OR 16 and 17

Perfusion Specialist enters vessels into log

Vessel Expiration Regulation
(Performed Every Weekday)

Is procurement date >14 days ago?

YES

Perfusion Specialist notes expired vessels in log

Vessels discarded

NO

Vessels remain in refrigerator

RESPONSIBILITIES

SURGEON

PERFUSIONIST

CIRCULATING NURSE
Surgeon requests vessels by UNOS ID, ABO, Hep C and HIV status. Indicates if vessels are original to the procurement.

Circulating Nurse retrieves vessels from refrigerator and verifies UNOS ID, ABO compatibility, confirms procurement date=14 days. Logs vessels out.

Are vessels ABO Compatible? YES

Circulating Nurse notifies surgeon of Hep C and HIV status.

Circulating Nurse prepares sterile back table and keeps vessels in cooler with organ until surgeon is ready to work with vessels.

Were vessels opened? NO

Were both Artery and Vein vessels used? YES

Was organ transplanted? YES

Surgeon documents UNOS ID in operative note.

*Definition of Crossover:*

Circulating Nurse notes discarded vessels and initials in log.

Vessels discarded.

Circulating Nurse notes remaining vessels in log.

Vessels repackaged and returned to refrigerator. WHO IS RESPONSIBLE FOR REPACKAGING?

* Repackaging Protocol: Package in ___ and label with date of Recovery: Donor Name, UNOS ID, Blood Type, and Donor CMV Status. Place with Organ in Non-Sterile Ice.

Are vessels still in the refrigerator? NO

Remove vessels from refrigerator.

Are vessels with the organ? YES

Circulating Nurse logs vessels out as reallocated and puts the vessel and notifies Perfusionist.

Is Perfusionist available? YES

Perfusionist repackages organ to be reallocated.

NO

repackages organ to be reallocated.

RESPONSIBILITIES

SURGEON
PERFUSIONIST
CIRCULATING NURSE
Appendix A3: Keypad and Temperature Tracking Accessories

Accessories for REF & FZR series undercounter refrigerators and freezers

Keypad Locking System
Factory-installed keypad lock provides more product security and ease of use than standard cylinder lock. Allows multiple users while providing greater control over access. Available factory-installed for new REF orders; as a retrofit kit for existing REFs. Not available for FZR series.

Increased security
- Door opens only when authorized code is entered
- Door relocks automatically when closed
- Each keypad provides one master code and up to eight individual codes
- Lock-out feature prevents opening through repeated random code entry
- Secure and reliable motor-driven bolt operation

Ease of use
- One-step operation—enter authorized code and door unlocks
- No turning of keypad to unlock or relock door
- Easy addition and deletion of user codes
- Two 9-volt alkaline batteries provide approximately 8000 openings
- Low battery alert signals for battery replacement
- Batteries accessed from front without tools
- All codes retained during battery replacement

Temperature Alarm
Solid-state temperature alarm provides audible and visual alarm, visual verification of product temperature, and high/low temperature display.

Protection for medications and patient supplies
- Audible and/or visual alarm alerts staff to temperatures above or below set points
- Product simulation bottle mimics product temperature for more accurate readings
- Digital product temperature display in °F or °C
- Dry contacts can be wired to central alarm system
- 9-volt backup battery (included) ensures protection during power outages
- Supports JCAHO standards for medications, local and state codes for food and beverages
- Records highest and lowest temperature since last time reset button was pressed

Easy installation
- Compact module (3.125"W x 1.875"D x 4.75"H (80mm x 48mm x 121mm)) mounts in desired location with screws (not provided)
- 8' (2.4m) probe wire provides location flexibility

Temperature Surveillance Module
All-in-one temperature surveillance module provides extra security for critical product storage.

Monitor product temperatures with confidence
- Audible and/or visual alarm with user-selectable high and low setpoints
- Compact chart recorder with easy-to-read 6" (150mm) 7-day chart
- Digital product temperature read-out
- LED power status indicator
- Remote contacts for connecting to central alarm system
- 9-volt backup battery ensures protection during power outages
- Includes product simulating bottle and box of (80) 7-day charts

Easy installation
- 15' (4.6m) probe leads with immersible stainless tip
- 6' (1.8m) power cord and AC adapter
- Surface or wall mount ready

Replacement charts and pens
- Replacement charts (box of 80, 7-day) (item# 00182009)
- Replacement pens (box of 6, red) (item# 00182091)

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Appendix A4: OPTN/UNOS Policy 5 (as 21/2008)

5.7 Vessel Recovery, Storage, and Transplant

5.7.1 The practice of vessel recovery and immediate use in a solid organ transplant (for example either a current liver or pancreas transplant) should not be disrupted.

5.7.2 The sanction for vessel recovery and storage for use in a subsequent solid organ transplant from a different donor must be sustained: (for example, when the vessels and the liver or pancreas allograft are being transplanted from different donors with different numbers). The vessels cannot be used other than for the implantation or modification of a solid organ transplant.

5.7.3 Vessels can be shared amongst transplant programs. If sharing occurs between transplant programs, the implanting program must write a detailed explanation justifying the sharing and that justification will be reviewed by the Membership and Professional Standards Committee (MPSC). It is the responsibility of the implanting transplant program to notify the OPO and the OPTN of subsequent disposition of the vessels.

5.7.4 If the vessels are stored and subsequently used for the intended recipient or another transplant recipient, the OPO and the OPTN must be notified.

5.7.5 The consent forms used by the recovering OPO must include language that indicates that vessels will be used for transplant.

5.7.6 If the vessels are being stored, the procedure of packaging, labeling, storage, the medium and temperature, the location, and the duration of storage must be addressed by the organ transplant community using the following standards.

5.7.6.1 The vessels must be stored in a Food and Drug Administration (FDA) approved preservation solution (ex. UW, Custodial HTK).

5.7.6.2 The vessels must be stored in a sealed container labeled with the recovery date, ABO, serology, container contents, and the Donor ID Number for tracking. The appropriate packaging of the vessel should be completed in the donor operating room. Label should clearly state for use in organ transplantation only.

5.7.6.3 The vessels must be stored in a secured refrigerator within a range of 2 to 8 °C.

5.7.6.4 The vessels can be stored up to a maximum of 14 days from the original recovery date.

5.7.6.5 The Transplant Center must designate a person to monitor and maintain records, destroy, and notify the OPO and OPTN of outcome and/or use of vessels. This designated person would maintain information on all donor vessels including monitoring and maintaining all records relating to the use and management of donor vessels (i.e. subsequent positive serology testing, monitor inventory of stored vascular conduits, monitor the refrigerator, ensure records are up to date and available with the conduits, destroy the vessel when expired, and notify the OPO of its use or disposal).

5.7.6.6 The transplant surgeon must be provided around the clock access to the donor information for his/her review prior to using the donor vessel in a recipient other than the intended recipient.

5.7.6.7 There must be daily monitoring of the vessels with documented security and temperature checks by the transplant center.

5.7.6.8 A log of stored vessels must be maintained by the transplant center at the point of storage.

5.7.7 If vascular conduits from donors with positive serology for hepatitis are subsequently used in other than the intended recipient, the implanting transplant center must provide a detailed explanation for the use of this conduit for review by the MPSC.
Appendix A5: Supply Room Pictures

Figure A5.1 Suture Cabinet

Figure A5.2 Syringe Shelf

Figure A5.3 Solution Cart
Figure A5.4 Left Wall Shelving

Figure A5.5 Kidney Machines and Shelf

Figure A5.6 Left Wall Wooden Shelving
## Appendix A6: Procurement Protocols

<table>
<thead>
<tr>
<th>Item #</th>
<th>Description</th>
<th>Liver</th>
<th>Non-Living Kidney</th>
<th>Living Kidney</th>
<th>Pancreas (w/o/wi)</th>
<th>Pancreas (w/o liver)</th>
<th>Heart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Custom Kidney pack- Gift of Life Michigan</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Normal saline (bottle)</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Alcohol (bottles)</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>HTR- (Liters)</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Catheter Adapter: 1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Kidney (p/s, bag- 500ml)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Heparin-1 vial</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3cc Syringe w/ hypo</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Sterile Saline Baggad- (liters)</td>
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Appendix A7: Procurement Volume - 1 Day Reorder Period

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<th>Pancreas (w/o liver)</th>
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<th>Total</th>
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Table A7.1: Daily Procurement Volume

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Table A7.2: One Day Reorder Period Procurement Volume
### Appendix A8: Procurement Volume - 2 Day Reorder Period

#### Table A8.1: Two Day Procurement Volume

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<th>2 day liver</th>
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<th>2 day panc w/ L</th>
<th>2 day panc w/o L</th>
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<th>Living Kidney total</th>
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#### Table A8.2: Two Day Reorder Period Procurement Volume

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<th>Lung Fri-Tues</th>
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Table A8.2: Two Day Reorder Period Procurement Volume
## Appendix A9: Procurement Volume - 7 Day Reorder Period

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Table A9.1: Seven Day Procurement Volume

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Table A9.2: Seven Day Reorder Period Procurement Volume
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</table>
Appendix A12: Kanban

Figure A13: Kanban Card

- Set at the optimum quantity
- When inventory falls to Optimum level card is placed in bin to indicate how much to reorder
- Includes:
  - When to reorder
  - Quantity to reorder
  - Location of item in supply room