Four Essential Elements for Chain-of-Custody Solutions In Health Care

How chain of custody helps hospital administrators improve patient outcomes, cut costs and reduce narcotics theft and diversion.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Summary</td>
<td>1</td>
</tr>
<tr>
<td>Chain of Custody Defined</td>
<td>2</td>
</tr>
<tr>
<td>Chain of Custody in the Hospital</td>
<td>3</td>
</tr>
<tr>
<td>Why is Chain of Custody So Important in Healthcare Settings?</td>
<td>4</td>
</tr>
<tr>
<td>Chain of Custody Challenges for Hospital Chain of Care Departments</td>
<td>6</td>
</tr>
<tr>
<td>Narcotics Chain-of-Custody Tracking</td>
<td>6</td>
</tr>
<tr>
<td>Lab/Specimen Chain-of-Custody Tracking</td>
<td>8</td>
</tr>
<tr>
<td>Blood Bank Chain-of-Custody Tracking</td>
<td>9</td>
</tr>
<tr>
<td>The Four Essential Elements of a Robust Chain-of-Custody Solution</td>
<td>10</td>
</tr>
<tr>
<td>Essential Element #1: The Chain-Of-Custody Solution Establishes an Audit Trail</td>
<td>11</td>
</tr>
<tr>
<td>Essential Element #2: The Chain-of-Custody Solution is Secure and Safe</td>
<td>11</td>
</tr>
<tr>
<td>Essential Element #3: The Chain-of-Custody Solution Promotes the Timely Handling of Transactions</td>
<td>13</td>
</tr>
<tr>
<td>Essential Element #4: The Chain-of-Custody Solution is Efficient and Easy To Use</td>
<td>14</td>
</tr>
<tr>
<td>Summary</td>
<td>15</td>
</tr>
<tr>
<td>Next Steps</td>
<td>16</td>
</tr>
</tbody>
</table>
Executive Summary

Pneumatic tube systems have evolved to become critical to hospital logistics. Their essential duty is to efficiently move materials to and from patient care and service locations within the hospital —either for delivery or further processing. Success for these systems is measured when a carrier payload securely reaches its intended recipient free of mishandling, tampering, theft or diversion. In order to achieve this standard consistently, hospital administrators must exercise control over their automated transport systems. And the means to do that is through a chain-of-custody solution.

For pneumatic tube systems, a chain-of-custody solution gives you control over carrier payloads by combining technology with best practice processes. As a result, you gain granular, real-time visibility into transaction data. That visibility empowers your staff to improve the quality of patient care. Knowing where an individual carrier is at any time—at motion and at rest—means that you ensure delivery of the tools for patient care—stat doses, lab samples, etc. Moreover, by identifying, tracking and monitoring carrier transactions, you can improve pharmacy, lab and blood bank turnaround times. Transaction visibility further enables you to track down lost payloads. It also gives you an effective weapon against narcotics theft and diversion. At the operational level, chain-of-custody gives you the means to establish an impeccable virtual or paper trail; one you can use to improve processes efficiency as well as employee performance.

This technical paper provides a clear understanding of what chain-of-custody means for pneumatic tube systems, and how it impacts your hospital’s process of care. You’ll also learn how a well-conceived chain-of-custody solution can increase the quality and value of the patient care you deliver. This includes understanding how an ideal solution works for pneumatic tube systems, along with a discussion of the four essential elements your solution should have.
Chain-of-Custody, Defined

If you've ever watched a television episode of Crime Scene Investigations (CSI), you've no doubt come across the concept of chain of custody in criminal investigations. In this regard, chain of custody may be defined as:

"...the chronological documentation or paper trail, showing the seizure, custody, control, transfer, analysis, and disposition of physical or electronic evidence." ¹

In real life, your community CSI investigators collect and bag evidence at a crime scene. They then label it with descriptive data including the name of the person(s) who harvested the evidence. From that point—until the time the evidence is presented in a court of law—any transfer or change of possession of the evidence is logged.

In a criminal case, the defendant's freedom or life is at stake. So it's no surprise that law-enforcement agencies advocate strict adherence to chain-of-custody policies in the handling of evidence. In so doing, the integrity and authenticity of evidence is maintained. This effectively squelches claims of evidence tampering or mistreatment by defense attorneys. And it goes to the very core of the American legal system because judgments and verdicts that "...are based on tainted, unreliable, or compromised evidence would undermine the integrity of the entire legal system..."²

Chain-of-custody is a critical component of maintaining the veracity and integrity of evidence in the criminal justice system. Likewise, chain-of-custody has a crucial role to play in hospitals. And that's the subject of the next section.

Figure 1: Chain-of-custody process in the legal system.
The application of chain of custody concepts to hospital pneumatic tube systems is more complex. Its implementation combines both personnel processes (who collected what sample when and sent it to whom and when) with technologies (software applications, pneumatic tube systems etc.), as well as transactions among many process of care departments. Moreover, instead of evidence, caregivers collect and transport specimens (e.g., tissue, blood, spinal, urine, stool) consumables (drugs, blood etc.) and other materials (paperwork etc.) associated with patient care.

NOTE: for the purposes of this paper, "consumables" is defined as materials used in the course of patient care such as medications, IV fluids, blood and other non-renewable inventory.
Why is Chain of Custody So Important in Healthcare Settings?

While hospitals have gone to great lengths to incorporate chain of custody concepts into their patient-care areas (ER, pharmacy, lab, blood bank etc.), pneumatic tube systems represent a potential “blind spot.” Meaning that the stringent chain of custody that carrier payloads experience prior to their tube system transport vanishes at the send station. In effect, the carrier “disappears” into a pneumatic tube system “cloud” to arrive at its destination with varying degrees of security. Then the chain of custody trail is picked up again.

The problem here is that lax policies around pneumatic tube system dispatch and receipt can result in a “broken” chain of custody. Control over a carrier and its contents may be “lost,” meaning unintended personnel may access it or it may go to an unintended destination to languish. “Broken” also means that hospital personnel don’t know where the carrier and contents are, nor are able to show a trail for their end-to-end tube system transport.

This can have dire consequences to patients and hospitals alike. For example:

- Patient care may suffer:
  - Delayed or lost payloads slow the delivery of patient care, which can be especially critical for stat transactions and pain medications.
  - The absence of transaction notification features, e.g., “your carrier has arrived,” slows turnaround times.
- A weak chain-of-custody solution can be exploited by employees, patients or visitors to steal/divert narcotics.
- Without historical transaction records:
  - Administrators can’t make informed business decisions to improve processes
  - Errors and bad practices can’t be linked to specific individuals for coaching and/or training
  - Narcotics theft investigators lack valuable data to help them identify thieves/diverters
Fortunately, the application of viable chain-of-custody technologies and processes can counter such vulnerabilities. A chain-of-custody solution for pneumatic tube systems:

- **Promotes positive patient outcomes**
  - Puts the right payload in the hands of the right people at the right time to perform the right task(s)
  - Establishes the origin and authenticity of a carrier (audit trail) to maintain the integrity of its payload
  - Supports the matching of the right patient to the right specimen/consumable/medication
  - Fosters the timely handling of narcotics blood and specimens
  - Lowers the incidence of lost specimens
  - Avoids unacceptable loss of “only-one-available” specimens
  - Counters concerns regarding the “planting” of or tampering with specimens/consumables/medications

- **Fosters the trust of patients and the community**
  - By leveraging chain-of-custody solutions to run a tight operation, fewer errors occur; thus, it helps protect your hospital’s reputation and demonstrates your commitment to quality care

- **Combats the theft/diversion of narcotics**
  - Increases awareness and permits individual accountability
  - Reduces exposure to federal/state fines associated with lax countermeasures and reporting

- **Reduces the incidence of “lost” narcotics**
  - Lowers the time and cost of pharmacy reissues and restocks

- **Boosts organizational efficiency**
  - Can identify issues at the individual level and solve them
  - Can establish performance thresholds (response/payload pick-up time; carrier load errors etc.) and link them to individuals for coaching
  - Can identify recurring systemic/process issues and revise processes/systems to correct them

To understand how your hospital can enjoy these benefits, it is first necessary to discuss the specific challenges that your process of care departments face.
Chain-of-Custody Challenges for Chain of Care Departments

For most hospitals, pneumatic tube systems service departments throughout the facility, such as: central laboratory, pharmacy, intensive care, emergency department, operating rooms, nursing units and radiology. However, rather than approaching the discussion from a location perspective, it’s more useful to speak in terms of the functions or objectives hospital administrators want to achieve with chain-of-custody solutions. Specifically, these are:

1. Effectively track narcotics to ensure timely delivery and reduce theft, diversion, reissue and restock
2. Effectively track lab specimen containers to ensure the integrity and timely handling and processing of contents, to support fast turnaround on results
3. Effectively track blood bank transactions to meet state requirements and prevent expiration

Narcotics Chain-of-Custody Tracking

Hospital executives and pharmacists alike are no strangers to the importance of safeguarding their narcotics supplies. The possibility of loss, theft or diversion is real and can threaten the delivery of the right medication, in the right dose to the right patient at the right time. In fact, the failure to implement adequate delivery safeguards can lead to:

- **Significant hard-cost losses from:**
  - Stolen drugs. Following an internal investigation, Parkland Health and Hospital System in Dallas, TX discovered that approximately 370,000 pills were stolen in a one-year period, totaling a street value of about $1,000,000.
  - Pharmacy labor hours devoted to identifying, tracking down and reporting drug losses.²
- **Greater federal and state agency scrutiny that distracts the pharmacy from its patient-care mission.**
- **Potential harm or death to patients whose narcotics were diverted.** In 2010 a surgery technician in Colorado was sentenced to 30 years after infecting 36 patients with hepatitis C.⁴ She diverted Fentanyl intended for patients, replacing it with saline solutions in syringes she had used on herself.
- **Exposure to fines related to lax theft/diversion countermeasures.** Parkland Health and Hospital System in Dallas was fined $20,000 by the Texas State Board of Pharmacy for failing to adequately stop drug thieves.⁵
- **A loss of confidence among patients and members of your community.**

### Chain-of-Custody for Narcotics Tracking:

- Adhere to rights of medication administration
- Prevent theft and diversion.
- Reduce drug-loss and associated costs.

### Challenges:

- Wrong medication, time or recipient is hazardous.
- Theft/diversion can result in negative health outcomes, including death
  - Increases drug costs and the labor hours devoted to reconciling and reporting losses.
  - Increases scrutiny from federal, state and local law enforcement.
- Increases actionable accountability: can identify who received what and when.
  - Fosters culture of narcotics accountability to lower loss.
  - Tracking thwarts thieves to lower incidence of theft.
- Reduces expenses related to theft/diversion/loss
- Supports mandatory tracking, reconciliation and reporting
- Reduces expense to re-send/re-stock “temporarily lost” meds.
- Cuts labor hours formerly spent on reconciling and reporting losses
This reality has driven significant spending to develop and implement exacting chain-of-custody procedures and powerful systems for narcotics that cover their lifecycle from acquisition to order fulfillment.

It is prudent, therefore, to maintain this level of control, by extending chain-of-custody oversight to your pneumatic tube system. This is of particular concern for older systems that were installed years ago before much more stringent security requirements became the norm.  

With regards to your pneumatic tube system, a robust chain-of-custody solution will significantly bolster the traceability of your pharmacy’s narcotics, including high-cost medications and/or patient-specific doses. And it links the “where is the medication” with “who received it last, where and when.”

The tracking of narcotics through your pneumatic tube system also addresses the challenge of “misplaced” medications. Properly employed, a chain-of-custody solution captures granular narcotics transaction data and facilitates the tracking down of lost/misplaced prescriptions. This capability has a positive impact, not only on patient care, but on your operational efficiency and costs. Consequently, the incidence of narcotics re-issues and re-stocks—all with their accompanying time/incident costs—both decrease.
Lab/Specimen Chain-of-Custody Tracking

The timely handling and accounting of patient specimens is tied directly to patient care and outcomes. And while all specimens are important in this regard, properly maintaining chain of custody across a specimen’s lifecycle is particularly significant in two scenarios. These are stat transactions and occasions where a “replacement” sample is either not possible or highly undesirable. In both these potential scenarios, when healthcare providers view tube system chain of custody as weak, they may choose to courier specimens to the lab rather than sending them via the pneumatic tube system.

This of course, defeats the purpose of a pneumatic tube system, which is deployed in part to significantly improve specimen-handling turnaround times. For pressured ED teams, neither the increased turnaround time associated with manual sample delivery, nor the potential loss, misplacement or lack of validation of a sent sample, are acceptable options.

That holds true as well for samples taken from infirm/weak or neonatal/infant patients. Such specimens tend to be “one-of-a kind,” where, for medical reasons, they can’t be replaced. In the case of spinal tap or preemie specimens, the taking of a second specimen is highly undesirable.

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<tr>
<th>Challenges:</th>
<th>Consequences:</th>
<th>Benefits:</th>
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<tr>
<td>Prevent unauthorized access or tampering</td>
<td>Lost/delayed/tampered specimen delivery jeopardizes material integrity</td>
<td>Authorizations puts right specimen in right hands to match right test results to right donor</td>
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<td>Match sample/tissue test results with correct donor</td>
<td>Presents hazard of right test result matched to wrong donor</td>
<td>Notifications promote prompt specimen handling</td>
</tr>
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<td>Transport specimens to correct destination fast</td>
<td>Inconveniences donors (sometimes painfully) by taking a replacement sample.</td>
<td>- Upon sample arrival</td>
</tr>
<tr>
<td>Reduce incidence of lost/misplaced samples</td>
<td>Risks unrecoverable loss, in case of frail donors where you can’t take second sample</td>
<td>- If sample is delayed/lost</td>
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<tr>
<td></td>
<td></td>
<td>Reduces incidence of retaking samples to replace lost/expired ones</td>
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<td></td>
<td></td>
<td>Lowers potential loss of irreparable tissue samples</td>
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Chain-of-custody tracking of pneumatic tube system transactions overcomes these issues in the same ways that it does for narcotics tracking. An audit trail serves as verification of where a specimen was sent, when and to whom. For stat transactions, notifications may be configured to alert recipients. Notifications also may be created to alert employees of lost or delayed carriers too. This capability gives you the ability to track down specimens to be processed in a timely manner. The tracking of carriers also increases tube system user confidence, and reduces the number of time-wasting courier runs. Additionally, for non-stat transactions, users may reduce the incidence of specimen batching dramatically, choosing instead to send specimens via the tube system for immediate processing as they are collected.

“Adding additional tracking features [chain of custody] to the [tube] system will decrease the number of missing doses, plus the available system data will allow you to chart potential cost savings...”

Source: David J. Klinger, RPh, Dale Palmer, Pharmacy Purchasing & Products
Blood Bank Chain-of-Custody Tracking

The perishable nature of blood means that it is time-, temperature- and tamper-sensitive. Add to that, the potential hazard of a patient-blood mismatch. As a result, blood requires a signature when it is transferred. This in turn, requires the establishment of a trustworthy chain-of-custody "paper trail" including blood payloads that enter the tube system. And just as stat transactions require time-window thresholds that trigger alerts, so too do blood transactions to guard against expiration.

Beyond the usual, "who sent/received what and when," a chain-of-custody audit trail gives administrators valuable information.

Consider the case of an improperly-packed blood product that breaks in transit. Pneumatic tube systems operating under high (air) pressure suffer a messy outcome, requiring a multi-hour decontamination process. Not only is this disruptive to tube system operations, this avoidable circumstance drives up operating costs.

Whether a first instance, or a repeat offender, it is in administrators’ best interests to identify personnel who improperly pack containers for tube system transport. This allows managers to take appropriate actions—perhaps to revise packing procedures or to counsel an offender.

While each hospital process of care department faces different challenges, a comprehensive chain-of-custody solution can overcome them all. The next section describes the core features that a successful solution must have in order to achieve this end.

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<th>Challenges:</th>
<th>Secure and verify blood transport between authorized personnel</th>
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<tr>
<td></td>
<td>Promptly deliver right blood to right person at right time for right patient</td>
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<td></td>
<td>Maintain blood integrity:</td>
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<tr>
<td></td>
<td>- Temperature sensitive</td>
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<td></td>
<td>- Time sensitive</td>
</tr>
<tr>
<td></td>
<td>- Prevent tampering</td>
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| Consequences: | Lost/delayed/tampered blood can result in negative patient care outcomes, or compromised material integrity |
|               | Blood-donor/recipient mismatches can lead to unacceptable outcomes |

| Benefits:     | Chain-of-custody authorizations put right blood in hands of right provider to match right donor/recipient at the right time |
|               | Notifications promote prompt handling |
|               | - Upon blood arrival |
|               | - If blood is delayed/lost |
|               | Lowers incidence of loss for bags with rare blood types |
The Four Essential Elements of a Robust Chain-of-Custody Solution

The following checklist will guide you in evaluating an effective chain-of-custody solution for pneumatic tube systems.

- Establishes an impeccable audit trail
  - Identifies individual carriers, tracks, reconciles, validates and logs transaction data (who sent what container where and when; and who picked up what container where and when) and stores it electronically for later reference

- Is secure and safe
  - Only allows authorized users to access PTS stations to send/receive carriers
  - Has a means to physically protect sensitive payloads (narcotics, specimens, blood) via a "vault" feature that prevents unauthorized access
  - Allows the segregation of carriers into user "groups" (nursing, pharmacy, lab etc.); protects against cross-contamination

- Promotes patient care with the timely handling of transactions
  - Notifies recipients upon the arrival of a carrier
  - Incorporates easily configurable "business rules" to establish actions/notifications to be taken when a carrier arrives or is delayed, misdirected or not picked up within a given time window
  - Automatically returns wrong-destination and "not picked up in time" carriers to sender

- Is efficient and easy to use
  - Leverages existing tools (employee swipe cards, PINs etc.) and processes to minimize the operational impact on busy employees
  - Fosters fast adoption and routine use of the chain-of-custody solution
  - Utilizes an intuitive station user panel
  - Interfaces with software
  - Supports user compliance

- Easily configures settings (time thresholds, authorized users, notifications etc.)

- Reporting features allow granular visibility into transaction data
  - Automates processes where possible to liberate employee labor hours for use in direct patient care
Essential Element #1: The Chain-of-Custody Solution Establishes an Audit Trail

In order to meet the requirements listed above, your tube system’s chain-of-custody solution must be able to identify individual carriers both at rest and in motion. Simply using color-coded or barcoded carriers for the pharmacy, for example, doesn’t help locate a lost or wrong-route transaction as dozens of deliveries can be made per hour.

Both bar coding and radio-frequency identification (RFID) technologies adequately identify carriers at an individual level—at rest. However, the use of wireless technologies (RFID tags) excels at tracking carriers in motion.

Real-Time Carrier Tracking

Sensors at tube system send/receive access points, as well as along the tube pathways allow hospitals to track individual RFID carriers in real time. Each "leg" of the carrier’s journey is logged to provide a verified audit trail including when it was sent, by whom, who picked it up, where and when. In this way, senders can validate the demarcation point of their payloads and move on to their next task without worrying if “it got there.” Furthermore, RFID technology provides an automatic delivery confirmation, identifying whether the carrier that arrived was indeed the correct one.

Another advantage to RFID carrier identification is that it enables the automation of a time-consuming manual, carrier-inventory process. Rather than assigning someone to spend hours per week (times 52 weeks per year) manually counting pneumatic tube system carriers, RFID tags automatically report carrier locations in real time. That data is then updated and available to be used in a carrier inventory report. Some chain-of-custody systems go one step further by reconciling the number of carriers assigned to a pneumatic tube station and automatically redeploy carriers that may have been manually moved by an employee. Thus, tube system users always have carriers at hand to complete their transactions.

Essential Element #2: The Chain-of-Custody Solution is Secure and Safe

To process secure transactions, a chain-of-custody solution must have a means to identify and validate authorized users before granting access to a tube system station (a carrier send/receive access point.) “Safe,” in this context, is defined as:

a) The application of operational systems to prevent the cross-contamination of carrier contents among departmental points-of-care (POC)
b) The blocking of inappropriate/unnecessary transactions between POC tube system stations
A pharmacy technician fills a narcotic prescription due for a patient in the vicinity of Nursing Station 12. After loading the narcotic payload into a carrier, he goes to a tube system station (carrier send/receive access point) and "shows identification."

Some systems use personal identification numbers to grant users access to the station. More secure methods utilize card readers that require employees to swipe their hospital-issued ID badges. Either way, the station captures user authorization data and compares it to a predefined database. With verified ID, the pharmacy tech has access to the tube station and chooses Nursing Station 12 as the carrier’s destination.

Depending upon the chain of custody solution’s features, the next steps may vary.

Upon arrival at Nursing Station 12:

- The carrier may drop into a station bin to be retrieved. This is the least secure method because any number of people could gain access to the contents.
- The carrier may be held within the tube station until an authorized person retrieves it (using the same identification method described above.) While secure, the carrier does occupy one Nursing Station 12 port until it is retrieved, possibly delaying the receipt of other carriers.
- The carrier may be routed to a nearby "vault," which serves as a secure repository until an authorized person presents a valid ID to retrieve it. The carrier then travels the final few feet to be picked up by that party. The advantage of a vault is that a station is free to conduct other transactions while the narcotics-filled carrier safely stored. This is the most secure carrier destination solution.

By integrating authorization-of-use with each PTS station, administrators can be assured that only pre-approved personnel access the system for secure transactions. This is of particular concern for high-traffic areas open to visitors and the public.
How a chain of custody solution ensures safe transactions

Figure 3 below shows how segregating carriers by points of care reduces the risk of cross-contamination. Operationally, there is no reason for pharmacy payloads to go to the lab. That prohibition is reinforced by disallowing pneumatic tube system transport of pharmacy-specific carriers to the lab’s tube station, and vice-versa. Consequently, the risk of cross-contamination is significantly reduced. So too is the risk that a narcotics payload would inadvertently make its way to an invalid station where it may be subject to theft/diversion.

Carrier color coding also fosters transactions in line with their intended use. In this example, the use of blue carriers by nurses reinforces the idea that “these are for the lab.”

Essential Element #3: The Chain-of-Custody Solution Promotes the Timely Handling of Transactions

With respect to pneumatic tube system chain-of-custody solutions, “timely” is defined as facilitating the rapid handling of carrier payloads to:

- Promote prompt delivery of patient care, particularly for stat transactions (ED, ICU, OR etc.)
- Prevent spoilage (specimens/samples) or expiration (e.g., blood, chemotherapies with short half lives) of carrier payloads
- Quickly identify, locate and rectify misdirected/lost carriers to their final destinations

Chain-of-custody notification features improve turnaround times

When evaluating a potential chain-of-custody solution, you’ll want to study its messaging and notification features.

It’s good to track a transaction’s point-to-point data. However, the purpose of the transaction is to advance the payload along in the patient’s process of care. This is achieved when the carrier’s identifying label is read at the receiving station and compared against “business rules” or hospital governance for handling at that moment. Typically, this takes the form of a “carrier-arrival” notification (via email, text, pager etc.) to the recipient’s preferred device.

The automation of transaction notifications serves to forward patient care by calling immediate attention to the “hand-off” from the sender. Should the carrier not be picked up within a pre-configured time window, it may be processed according to pre-determined business rules (e.g., return to sender, notify sender, etc.) Should a transaction arrive at a wrong station, that too triggers a notification to the sender who can immediately take corrective action. Consequently, the utilization of proactive messaging and notification features prevents transactions from becoming lost between the PTS’s cracks.
Essential Element #4: The Chain-of-Custody Solution is Efficient and Easy to Use

Your employees are more likely to adopt your chain-of-custody solution if it’s easy to use. In practice, that means deploying a solution that makes your users’ lives easier rather than adding more process steps to their busy workloads.

A few things to consider in your evaluation are:

- Is the secure use of the pneumatic tube system transparent to the user?
  - Can an employee complete transactions using familiar tools (e.g., employee badge swipe) and without adding steps to their workflow?
- Is the station user interface easy to read, well laid out and does it leverage intuitive menus?
  - Does the solution include forced compliance or can employees “skip” important process steps?

The efficiency of a chain-of-custody solution comes indirectly from its software application reporting capabilities. Things to look for here are:

- Ability to create historical transaction reports with sufficient granular detail to develop actionable business intelligence
- Ability to identify specific users who are improperly using the tube system so that remedial action may be taken
- Ability to tabulate user-specific data to supplement your hospital security team’s narcotics theft/diversion investigations

Now that you understand the four essential elements of a robust pneumatic tube system chain-of-custody solution, you can use this criteria in evaluating your hospitals needs in the context of current available technology and suppliers.
To assure that control, chain of custody for pneumatic tube systems must have four essential elements.

Essential Element #1 is the foundational building block because allows you to establish an impeccable paper trail for your secure tube system transactions. It includes the ability to identify individual carriers at rest and in motion as well as to record and report transaction data to improve your operational efficiency.

Essential Element #2 allows you to secure your transactions by leveraging card-reader technology to read employee ID badges. It protects your sensitive carrier payloads (narcotics, perishable consumables and specimens) and limits access to them by authorized employees only.

To promote the strongest security of your narcotic and perishable contents, use a dedicated secure storage module. This component serves not only as a secure vault, but also liberates your pneumatic tube system stations for continued use irrespective of when the carrier is retrieved.

Essential Element #3 is the timely handling of transactions. Sound pneumatic tube system chain-of-custody solutions incorporate software that provides the means to configure business rules or governance to issue notifications and alerts to promote the prompt delivery of patient care.

However, the best chain-of-custody solution in the world does your hospital no good if employees choose not to use it. So, Essential Element #4 requires that it be easy to use. This means leveraging tools that your employees already have (ID badges, swipe cards etc.) as well as technologies (the reading of carrier RFIDs, for example) that make process steps transparent to users.
Next Steps

Swisslog chain-of-custody modules provide all four of the Essential Elements outlined. With experience in more than 3,000 hospitals worldwide, Swisslog systems are the world’s leading pneumatic tube systems for health care. Dozens of patents for pneumatic tube systems, software and performance are evidence of Swisslog technology leadership and innovation.
Resources and Footnotes

2. Farlex Legal Dictionary citation for Chain of Custody.
Contact Swisslog to learn more about how our proven pneumatic tube systems and chain-of-custody solutions can help your hospital:

- Improve patient outcomes
- Reduce expenses
- Lower the incidence of stolen/diverted narcotics
- Protect your hospital’s reputation

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