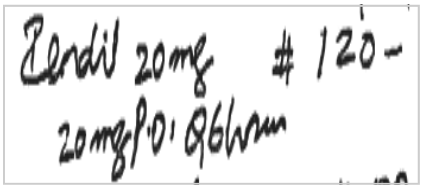
September 2005

PRHI Executive Summary

Pittsburgh Regional Healthcare Initiative

Region improving medication safety



Pens can kill. When 42-year-old Ramon Vasquez received Plendil, a calcium-channel blocker, instead of Isordil, a longer-lasting version of nitroglycerin, the error was fatal. Hospitals in the Pittsburgh region are using high-tech and low-tech improvements to prevent such errors.

Example reprinted by permission of Robert Wachter, M.D., co-author of *Internal Bleeding*.

Nationally

- Medication errors cause over 7,000 deaths each year.
- Each adverse drug event costs about $2,595.
- 25% of prescriptions reaching a pharmacy are illegible or incomplete.

In Southwestern Pennsylvania

- About 1.7 million medication errors and 15,300 adverse drug events occur annually.
- Adverse drug events add about $39,703,500 in costs.
- Two local studies confirm that illegible and incomplete orders occur at about the national rate: 25%.

Improving the accuracy and timeliness of medication administration has become a patient safety imperative in many local hospitals. Some have been able to implement advanced, computerized systems of order entry and medication delivery. Others are relying more on low-tech innovations.

Regardless of approach, the experience of our hospital partners emphasizes one common element: the ability of the organization to solve problems. Even the most advanced systems have "bugs" that require problem-solving.

This edition of *PRHI Executive Summary* describes the experiences of three hospital systems in improving medication delivery, and increasing problem-solving capacity.

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New publications place SWPA in national healthcare spotlight

Publication of a healthcare improvement book and three national journal articles have placed PRHI's partner organizations squarely in the national spotlight.

Book:

Chalice, Robert W., *Stop Rising Healthcare Costs Using Toyota Lean Production Methods: 38 Steps for Improvement*. ASQ Press, ISBN 0-87389-657-2. http://qualitypress.asq.org, or call 800-248-1946.

Articles:

Spear, Steven J.:

The Health Factory, New York Times Editorial, August 29, 2005.

Fixing Health Care from the Inside, Today. Harvard Business Review, September 2005.

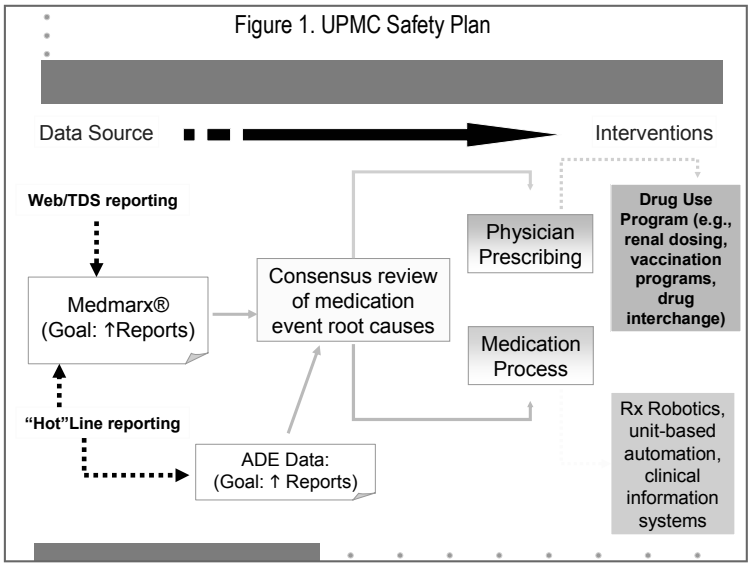
Buntin, John, *Plague of Errors: Hospital infection rates are rising and killing 90,000 patients a year. Can the states put a stop to it?* Governing Magazine, August 2005, (www.governing.com).

Grunden, Naida, *Industrial Techniques Help Reduce Hospital-Acquired Infection*. Biomedical *Instrumentation* and Technology, September/October 2005. (www.aami.org/publications/BIT)

Guest columnist, Robert J. Weber, MS, FASHP

Bar code medication administration enhances patient safety

The goal of the University of Pittsburgh Medical Center (UPMC) in medication patient safety is to eliminate medication errors through the systematic reporting, analysis, and sharing of medication error information and problem solving strategies within and across health-system hospitals. Through the support of senior leadership and the efforts of our staff and industry partners, UPMC Presbyterian implemented bar code medication administration in May 2005. Bar code medication administration promotes safety by intercepting and preventing medication administration errors; improves medication administration processes by preventing duplicate work; and allows for an electronic medication administration record (eMAR).



Point of care systems and UPMC's safety plan

Implementing a bar code medication administration system is part of UPMC's patient safety plan (Figure 1), which includes automation as a way to improve safety. Currently, UPMC uses Robot-Rx® and AcuDose-Rx® dispensing systems to reduce errors and improve pharmacy efficiency. But bar code medication scanning systems, recommended by the Institute of Medicine (IOM), reduce the chance of error at the point of care, before the wrong medicine can reach the patient. The Food and Drug Administration (FDA) also requires all manufacturers to supply universal readable bar codes on their products by early 2006.

Safety Potential Using Bar Code Medication Administration in Relation to National Medication Error Trends and UPMC Presbyterian Errors

We demonstrated just how bar code medication administration can improve safety by analyzing errors reported through the national MEDMARX database and predicting which of these errors could be prevented by using the system. Since error reporting is voluntary, it is difficult to determine the true safety value of bar code medication administration. However, we used national MEDMARX data to establish a range of prevented errors, then validated the information with our system experts to determine a potential impact of bar code medication administration.

MEDMARX reports medication errors for each level of the NCC MERP* Category Index. This index indicates both severity and outcome of reported medication errors, from the "near miss" to the "sentinel event."

Category "A" and "B": Did not reach a patient and/or are circumstances or events that have the capacity to cause errors.

Category "C" and "D": Reached a patient but did not result in harm.

Category "E" and "F": Resulted in harm that was resolved after treatment.

Category "G" through "I": Resulted in permanent harm and even death.

Examining Category "E" through "I" Errors reveals the safety benefit of bar code medication administration

We chose to review Category "E" through "I" errors reported to the National MEDMARX Database and the Pittsburgh Regional Healthcare Initiative (PRHI) from June 1, 2002 through February 28, 2003, since these errors most likely serve as a threat to patient safety. Figure 2 represents the drug classes involved in serious errors for both the region and the nation. These trends are consistent with the reports throughout the medication error literature as well as those identified by the Institute for Safe Medication Practices.

MEDMARX data also showed us where in the medication process the serious errors occurred, (Figure 3). Administration errors can include an omitted dose, wrong timing of administration, or administration of a wrong dose or drug to a patient.

We further identified those drugs associated with administration errors where using a bar code medication administration system would have prevented the error both across the nation and the region (Figure 4).

Positive patient identification (PPID) improves medication safety

PPID makes medication ordering more efficient and safer.

Bar code medication administration has made our medication processes at UPMC more efficient by eliminating duplicate work and reducing the risk of errors. For example, UPMC Presbyterian staff were using hand-written medication administration records on the medical-surgical units; Emtek® electronic medication orders in the ICU; and the Electronic Health Record's PharmNet® system in the pharmacy. Nurses, health unit coordinators (HUCs) and pharmacists had to enter the same order for a single patient. UPMC's bar code medication administration system eliminates this duplication of work and attendant opportunity for error, and provides for an electronic MAR for the medical-surgical units.

Bar code medication administration has reduced medication errors by making sure the right medication gets to the right patient. Double-checking of patient identification every time medication is administered, or "Positive Patient Identification (PPID)", is an important feature of the bar code medication administration system. Figure 5 describes the "before and after" effects of PPID.

Sharing what we learned

We have learned lessons that may be of value to others interested in using this technology. We found this system to be valuable in standardizing medication administration processes that improve medication safety. To implement such a system, organizations should focus on the following:

1. Establishing support from leadership and at all levels of the organization for bar code medication administration to incorporate bar coding systems as part of the organization's safety plan;
2. Designing a multidisciplinary process for selecting a bar code system;
3. Installing the computing infrastructure to support bar coding;
4. Establishing an inventory control system that assures for nearly 100% bar coding of medications;
5. Revising pharmacy and nursing medication processes to enhance functionality and
6. Developing quality indicators for bar coding systems.

Figure 2. Drug Classes Involved in "E" – "I" Errors

National MEDMARX Reporting		PRHI MEDMARX Reporting	
Drug Class	% E-I errors	Drug Class	% E-I errors
Opioids	13.4%	Opioids	20.5%
Anticoagulants	10%	Glycemic agents	11%
Glycemic agents	8.1%	Antibiotics	7.8%
Electrolytes	3.0%	Anticoagulants	5.7%

Figure 3. Steps in Medication Process Where Errors Occurred

Process Step	PRHI Reports	National Reports
Prescribing	4.5%	16.7%
Dispensing	10.1%	20.7%
Administering	50.6%	35.7%
Documentation	13.8%	24.6%
Monitoring Medication Effects	4.4%	2.3%

Figure 4. Selected Drug Products (Incidence) Associated with Serious Administration Errors Nationally, June 2002 – Feb 2003

Morphine (76)	Diltiazem (14)
Warfarin (52)	Glipizide (10)
Oxycodone (20)	Glyburide, glemipiride, metformin (20)
Metoprolol (20)	Clonazepam (6)
Digoxin (16)	Clopidogrel (9)
Ciprofloxacin, levofloxacin (20)	Trazodone, zolpidem (8)
Citalopram (5)	Enalapril, captopril, lisinopril (14)

Figure 5. Impact of PPID feature of Bar Code Medication Administration

Metric	Before PPID	After PPID
Nurse satisfaction with the safety of the medication system	42%	78%
Unauthorized drug errors	5 per 1000 doses administered	2 per 1000 doses administered
Compliance with patient identification process	27%	100%
Intercepted medication errors	0 per day	1-2 per day

Robert J. Weber is the Associate Professor of Pharmacy and Therapeutics and Executive Director and Department Chair, Pharmacy at UPMC Presbyterian Hospital. He can be reached at weberrj@upmc.edu.

Five years in: Bar code medication administration at the VAPHS

The secret of deploying new machines: *People First*

It may sound amusing now, but full deployment of the bar code medication administration (BCMA) system at the VA Pittsburgh Healthcare System required the services of a plumber. Now that 99 percent of patients on the 4 West post-surgical unit are receiving their medications on time, the team there believes they have some crucial information to share about BCMA implementation: *even the most promising, sophisticated electronic systems must be run by real people.*

Chances are, hospital and Board leaders would be pleased to learn of a unit where 90% of medications were delivered on time. This was the starting point on the 4 West post-surgical unit at the VAPHS.

But what did 90% really mean? *Of the 400 to 600 doses dispensed on the unit each day, 40 to 60 were late.*

"It's hard get to the bottom of 40 or 50 individual problems," says Nurse Manager Sharon Parson.

With 99% of medications on time, as they are on most days now, the 3 or 4 problems can be solved to root cause every day.

The VA health system won acclaim when, five years ago, they made a massive investment in patient safety by converting to electronic medical records, computerized physician order entry, and BCMA nationwide. The state-of-the-art electronic system, properly and fully deployed, ensures a dramatic improvement in the "five rights" of medication delivery: right patient, right medication, right dose, right time, and right route (oral, IV, etc.). The system automatically tracks every step of the process without adding to the work load of the healthcare professional. Automatic collection of these data quickly makes problems visible, which is the first step toward fixing them.

This sophisticated electronic equipment, however, must be operated by frontline healthcare workers with varying degrees of interest and aptitude. Therein lies the opportunity for designing the way work is done.

Infection project leads to BCMA

Shortly after beginning a project to eliminate antibiotic-resistant infection in the post-surgical unit on 4 West, staff identified the BCMA system as the leading opportunity to eliminate wasted time. Using the Perfecting Patient Care technique of asking "Why" five times, the team learned that the system broke down every shift because the batteries would run down. Training had not addressed the machine's routine requirements. Troubleshooting began.

The first order of business was to place cue cards on the machine, to make sure that both the computer and scanner batteries were swapped through the charger on a regular schedule. Brief instructions were posted regarding the simple steps nurses should take to recover from a breakdown. If these instructions were still not successful, then the directions clearly stated how and who to call for help. Gone were the days of a nurse puzzling over a malfunctioning machine for 45 minutes.

Enter the plumber

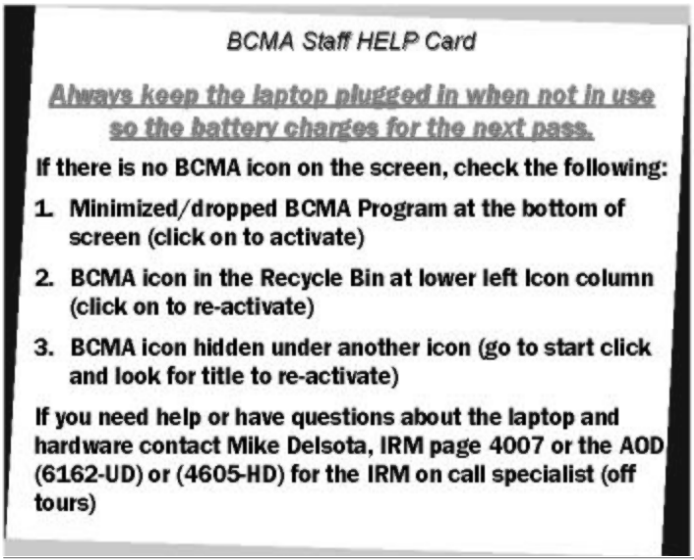
When that was fixed, one mystery still remained: batteries did not always charge in the charger. Again, the team observed the comings and goings around the machine and discovered the problem. The BCMA battery charger was located next to a sink. When workers washed their hands at the sink, the high water pressure caused water to splash on the electrical outlet, which triggering the ground fault interrupter, a safety device that shuts off the outlet in the presence of moisture. A dead outlet meant dead batteries.

Enter the plumber. The water pressure was reduced to keep the water from splashing, an adjustment ultimately made in all patient rooms as well.

Targeting the training

Once these initial problems were observed and addressed, the team looked at the training gap. Nurses began keeping a log of the problems they encountered, and the team leader tracked calls to the help desk. The training was targeted specifically to the needs expressed.

"Getting used to a whole new way of dispensing medications was a big culture change," says Sharon Parson, R.N., the Nurse Manager on 4 West. "Not every user had the same ability to use this system."



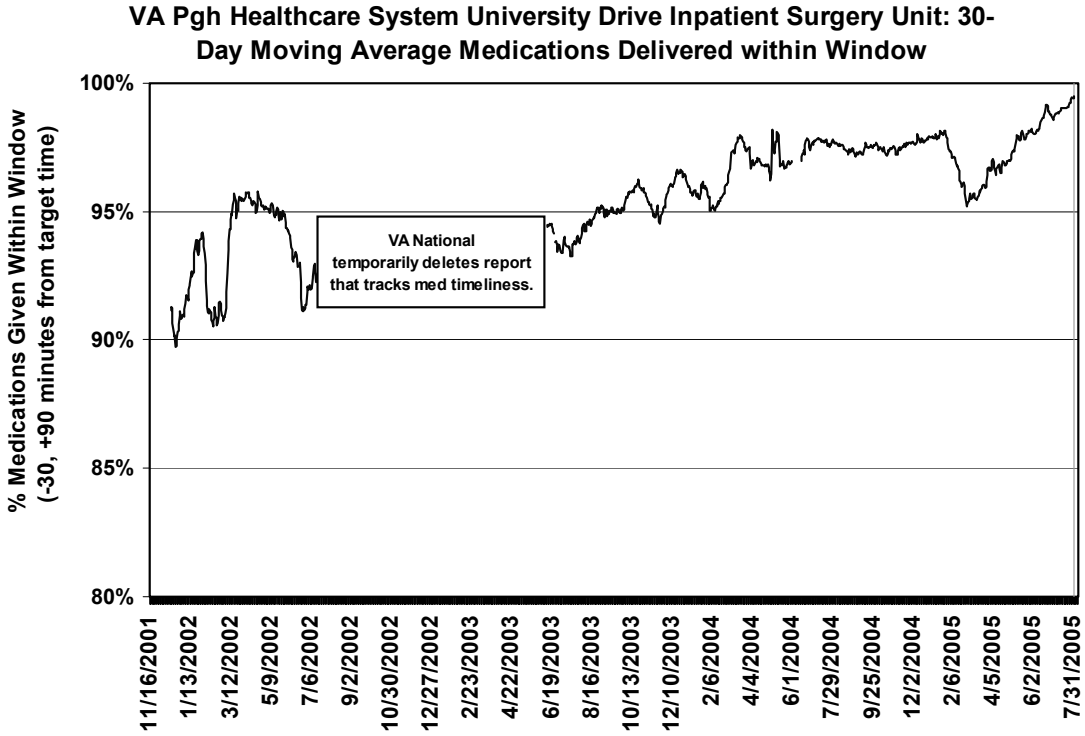
BCMA Staff HELP Card

Always keep the laptop plugged in when not in use so the battery charges for the next pass.

If there is no BCMA icon on the screen, check the following:

1. **Minimized/dropped BCMA Program at the bottom of screen (click on to activate)**
2. **BCMA icon in the Recycle Bin at lower left Icon column (click on to re-activate)**
3. **BCMA icon hidden under another icon (go to start click and look for title to re-activate)**

If you need help or have questions about the laptop and hardware contact Mike Delsota, IRM page 4007 or the AOD (6162-UD) or (4605-HD) for the IRM on call specialist (off tours)



Process improvements on 4 West following the introduction of BCMA increased medication timeliness from 90% to almost 99%. Days in a row reach 100%. Now every problem can be investigated, and "missing meds" are largely a thing of the past.

The team identified the stronger users, those with higher than average interest and capability for using the system. They encouraged any user with a BCMA question or problem to find help through a charge nurse. They also mounted cards on the machine, to let users know whom to call for help (see illustration).

90% is good: 99% is better

Initially, the unit achieved an impressive 90 percent rate of medication timeliness on 4 West. That is, 90 percent of the time, the right patient received the right medication in the right dose within the agreed-upon window of time. "Missing meds," the bane of existence for nurse and pharmacist, were already fairly rare.

But what did 90 percent mean, exactly? Staff deliver between 400 to 600 medications per day to the unit's 30 patients. With 10 percent of the medications delivered outside the time window, it meant that the nurse leaders would need to follow up on between 40 and 60 doses.

"It's hard get to the bottom of 40 or 50 individual problems," said Parson. The group began weekly meetings with the pharmacy troubleshooting things that had gone wrong, patient by patient, one by one. They discovered that, in fixing the root cause of one individual error, they usually solved whole strings of problems that had been plaguing the system.

Improvements have continued over time (see chart), with the rate of medication timeliness on 4 West rising to 99 percent for the last three months.

"Today we might only have 2 or 3 medications per day falling outside the window," says Parson. "Now we can really drill down to root cause. Usually we find the problem is due to something like the patient's being off the floor for a procedure. Missing medications are extremely rare, thanks to our communication with the pharmacy."

And the staff knows how they are doing. Parson sends the latest updated on-time medication administration chart with a change-of-shift report, along with other measures of improvement, and posts them on a wall. But nurses do not need to wait: they can get a print-out at the end of each medication pass that shows whether all of their medications were delivered on time. If they have a problem, they can call for help and continue to care for patients.

Sophisticated electronic machinery can indeed make patients much safer. However, using the machinery to its fullest requires the creativity, commitment and discipline of the people who do the work.

On the trail of missing meds

Ellesha McCray, RN, Team Leader on 4 West from 2001-04. Ellesha worked with Sharon Parson, RN, who is now the Nurse Manager on 4 West, assuming many Team Leader duties. They were aided on-site with a PRHI Coach, Peter Perreiah, who is now also PRHI's Managing Director.

Pharmacy improvements at LifeCare Hospitals of Pittsburgh

Big improvements the low-tech way

Not every hospital can afford sophisticated pharmacy tracking software. For smaller and community hospitals, advanced-but-expensive tools like computerized physician order entry or bar code medication administration may be years off. And while implementing these state-of-the-art programs can eliminate a whole host of problems, it can introduce others that can tax the problem-solving capabilities of their organizations. (See story, page 4.)

What low-cost, low-tech steps can a hospital take to begin to make medication administration safer? LifeCare Hospitals of Pittsburgh is working on some innovations.

1. Throwing down the gauntlet on incomplete orders

In early May, LifeCare CEO Cliff Orme threw down the gauntlet on illegible and incomplete pharmacy orders, setting the expectation that staff would work together to eliminate them. An improvement team of front-line doctors, nurses and pharmacists began by addressing the basics: a clear order form. The existing form allowed for mostly free text. Hasty handwriting and incompleteness were continual sources of confusion once the order reached the pharmacy.

The key to making the form easier lay in the "visual cue." With columns of information asking for drug-dose-route-frequency, missing information was immediately obvious. The first revision was introduced in mid-May, followed quickly by several revisions.

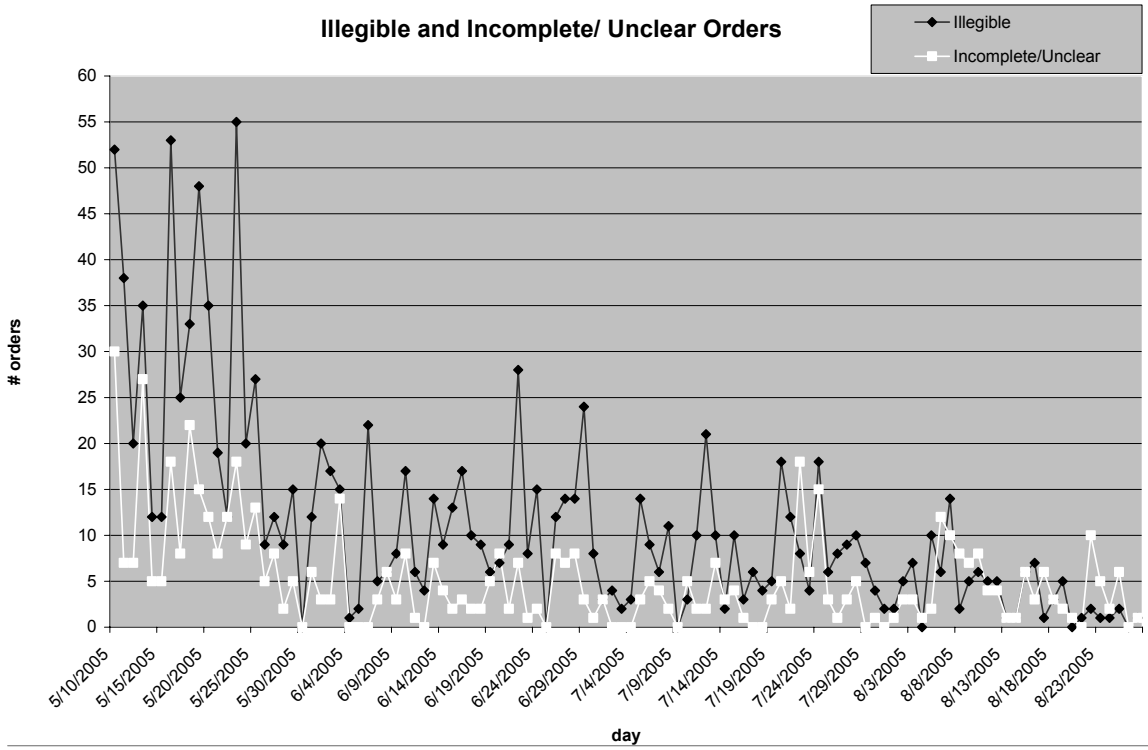
"It was the first time changes were made spontaneously, without seeking approval from a committee. It was also the first time that changes were made by the people doing the work rather than a group of leaders in a conference room," said Pharmacy Manager Darlene Schreiber. "The form dramatically improved completeness of orders. Although it wasn't designed to eliminate illegible orders, we actually saw improvement in that area as well." (see chart).

2. Home-grown automation

The next step may be to eliminate hand-written orders. A home-grown computer program for order entry, created a few years earlier, had never really taken off. The information includes up-to-date lists of physician staff members, patients, and the formulary.

The improvement team believed this system could be useful, and two physicians agreed to try it. Coming to the program with differing degrees of computer expertise, the physicians needed varying degrees of one-on-one coaching to become conversant with the ordering system. As they have learned to use it, they have called for help as needed, and the team has responded with real-time problem-solving.

Orme hopes that within the next few months, the automated system will be rolled out throughout LifeCare Pittsburgh. Troubleshooting techniques taught by PRHI and paid consultants* will help the staff quickly identify and remedy the initial problems or "growing pains," and further reduction in illegible and incomplete orders is anticipated.



3. Improving the pharmacy

The pharmacy itself has been the focus of a three-month improvement effort with the goal of reducing waste and inefficiency

Advances in Cardiovascular Medicine
September 30-October 1
Westin Hotel & Convention Center
National forum with courses valuable to healthcare professionals with an interest in cardiovascular medicine.
Note: PRHI Cardiac Working Group members invited to attend!
Information and registration online at:
http://ccehs.upmc.edu/formalCourses.jsp
Presented by UPMC Health System
2005

and freeing up time for the pharmacy technicians. At first, two technicians needed one 8-hour shift apiece per week to order pharmaceuticals from outside suppliers. The ordering method was cumbersome and inefficient, the drug list incomplete, the restocking amounts poorly understood.

Starting in 2002, Schreiber led an effort to understand the inventory needed and reduce unnecessary supply. The result was a reduction in pharmacy inventory of about one-third between 2002 and 2004.

Yet inventory excesses and stock-outs continued.

Convinced that "reducing inventory" was not the ultimate goal, Schreiber worked with consultants to understand the current need. They purchased a customized report on actual usage and used the information to calculate (1) how much of each drug was needed to avoid stock-outs, (2) which vendor to order from, and (3) when and how much to reorder. Pharmacy Technicians Debbie Reichbaum and Sherry Miller and took charge of the project.

The result is a *kanban* system, based on the principles of the Toyota Production System. *Kanban* cards contain all necessary information for reorder: vendor, contact information, amount to order and so forth. These cards are placed at a "trigger" point in the inventory, when enough product remains for a specified number of days—more than enough time for the stock to be replenished. When the trigger point is reached, the worker removes the *kanban* and places it in the specified bin. Within 24 hours, the *kanbans* are collected and orders are placed.

As they went from item to item in the pharmacy creating *kanbans*, Reichbaum and Miller discovered some items long-unused, and some of insufficient quantity. Adjusting the amounts required research and intuition.

"Many customizations were required," said Schreiber. "But now, the technicians order every day as part of their regular work. Having the entire pharmacy on a *kanban* system has freed up 16 hours of technician time. My happy dilemma is going to be choosing what to do with that 16 hours, and in this case, we will be expanding our problem-solving capacity."

The number of stockouts and other problems have been so greatly reduced that now, each problem that comes up can be examined and solved quickly, in real time.

The pathway for orders—from the physician's pen to the patient's bedside—is being continuously examined at LifeCare for improvements. Clear and complete orders, a reliable supply of medications, and a way to solve problems in real time every day are key to the work at LifeCare.

Pharmacy Techs Sherry Miller (above) and Debbie Reichbaum helped implement the *kanban* system of stocking in the LifeCare pharmacy. Strategically placed cards show exactly when and how much to order, eliminating guesswork, making ordering part of everyday work, and restoring 16 hours of technician time per week—time that can be used to make more

Kanban cards: Low-cost, low-tech, high impact

**The improvements at LifeCare have been guided by PRHI, a community resource, and by paid consultants from Value Capture, a for-profit healthcare improvement consulting firm.*

Pittsburgh Regional Healthcare Initiative

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Calendar, Fall 2005

Day	Date	Time	Event	Place	Contact
Tues	Oct 6	4-7 p	Perfecting Patient Care Introductory Session	PRHI Learning Center PRHI Offices Centre City Tower 24th floor 650 Smithfield Street Pittsburgh	***CME credits offered*** ***Registration required*** Barbe Jennion 412-586-6711 *bjennion@prhi.org*
Tues	Nov 8				
Weds	Oct 12	8a-5p	PPC 101		
Weds	Nov 9				
Mon-Fri	Nov 14-18	8a-5p	Perfecting Patient Care™ University		
Tues	Sept 20	5:30-9p	Excellence in Chronic Care: *Successes in the primary care setting*	UPMC St. Margaret 815 Freeport Road	Tania Lyon, Ph.D. 412-586-6709 *tlyon@prhi.org*

PRHI Executive Summary is also posted monthly at www.prhi.org
Please direct newsletter inquiries to: Naida Grunden, Director of Communications, 412-586-6706, ngrunden@prhi.org