IDENTIFYING CHANGES IN PERSONNEL REQUIREMENTS AND ACCURACY FROM IMPLEMENTATION OF A BAR CODE MEDICAL SUPPLIES INVENTORY SYSTEM

BY

LESLIE B. HANSON

A paper submitted in partial fulfillment

of the requirements for the degree of

MASTER OF SCIENCE

(Hospital Pharmacy)

at the

UNIVERSITY OF WISCONSIN-MADISON

1987

Pharmacy
AWH
H386

ACKNOWLEDGEMENTS

The assistance and encouragement of Donavan D. Klimpel, Robert G. Swendrzynski, Melvin H. Weinswig, James E. DeMuth, and David A. Zilz are gratefully acknowledged. Their guidance throughout this project helped to make it a success.

Chapter 1

OVERVIEW

Introduction

Bar codes are alternating dark lines and blank spaces, both of varying widths, arranged in a special sequence, which can be read by an electro-optical scanner. The first patent for a bar code was filed in 1949. However, it was not until 1971 that the first totally automatic bar code based production monitoring system was installed.[1] This occurred at a General Motors plant where the bar code system was used to count transmissions as they came off the assembly line to provide an accurate and timely measure of workload. Since then the automotive industry has greatly expanded the use of bar codes.[2] Another major application for bar codes began when the United States Supermarket Ad Hoc Committee adopted the Universal Product Code (UPC).[1] While implementation of this industry standard progressed slowly at first, it is now very widely used and recognized. Further impetus to the growth of bar codes was the adoption of the LOGMARS (Logistics Applications of Automated Marking and Reading Symbols) Program by the Department of Defense in 1982.[3] This program has been updated as progress has occurred in bar coding technology.

The first use of bar coding in the health care field appears to be in the medical laboratory environment where it is used as a specimen identification mechanism.[4] Standardization of bar coding in health care came with the adoption of the Health Industry Bar Code Standard for use throughout the health care industry.[5] Since that time the use of bar coding has grown. There are reports of substantial savings in inventory costs as well as increased capture of revenue with the use of bar codes.[6]

Objectives

Based on the apparent value of using bar code technology in an inventory system a study was undertaken at the University Hospital and Clinics, University of Wisconsin, Madison, Wisconsin. The objectives of this study were:

1. To determine any significant difference in the personnel time required to issue medical supplies to nursing units using a bar code system *vs.* a manual system.
2. To determine any significant difference in the accuracy of the perpetual inventory using a bar code system *vs.* a manual system.

References

1. Anderson, EP. A historical perspective of bar code technology. ScanJournal. 1984; 1:22-6.

2. Coe, ES. Bar code standards in the automotive industry. ScanJournal. 1984; 1:39-42.

3. Crouse, SN. LOGMARS revision to military standard MIL-STD-1189. ScanJournal. 1984; 1:27-33.

4. Rappaport, AE. Machine readable identification systems. If bar code works in supermarkets, it should be great for medicine. Pathologist. 1985 Feb:39(2):39-40.

5. Palmer, R, Williams, TC. Bar code standardization in the health care industry. ScanJournal. 1985; 1:34-7.

6. Walker, B. Bar code proves good samaritan. Bar Code News. 1986 Feb:34-40.

Chapter 2

LITERATURE REVIEW

In 1983, the nation spent $147 billion for hospital care versus $39 billion in 1973--a gain of nearly 277 percent.[1] In this same ten year period, per capita outlays for hospital care jumped from $179 to $604 and the proportion of gross national product devoted to this service rose from 2.9 to 4.5 percent. The health care delivery industry had more than 7.2 million employees in 1983 making it the second largest industry in the United States in terms of employment.[2]

One method of reducing expenses is the implementation of new technologies. This is especially effective in reducing personnel expenses usually without decreasing the quality of service provided to the patient. This will become more important since, under DRGs, hospitals will continue to look for efficient ways to track costs.[3]

It would appear that bar coding offers the health care industry the opportunity to both decrease personnel time (and therefore costs), as well as increase the accuracy of the data generated and used by automated systems.

Bar code systems have been used in the blood banking industry for several years. A uniform standard was put in place in 1977 and is primarily used in processing patient samples and in administering blood to proper recipients.[4] This system has reduced the hand transcription required for the recording of blood product group, type and expiration date of the blood product.

Ibbotson, et al. described a bar code system that was developed to handle the workload at a transfusion center which is responsible for controlling multiple blood fractions from several hundred thousand donations per year.[5] This system was designed to accept data as soon as it became available, such as at the time of testing, point of production and point of issue. The system captured data from several bar code labels. The most important ones are the donor identification number, blood grouping label, blood product label and center identification. The authors indicated that the system improved safety, reduced transcription errors, and produced useful information for management of blood stocks. Further, this benefit will extend to hospital blood banks which will be able to use the bar coded identification information to help with blood bank registers and the tracing of individual donations to patients.

Evidence that bar code systems do reduce costs and increase accuracy comes from both the automobile industry and the health care industry. The General Motors system installed in the Oldsmobile plant in Flint, Michigan in 1967 cost $25,000 but replaced a manual record keeping system that cost $75,000 in yearly salaries.[6] At Henry Ford Hospital the bar code system for the pharmacy department cost $37,440 but has a payback period of only 1.4 years due to the system replacing $26,000 for 1.5 full-time employees for manual keyboard entry of inventory data.[7] There was a time saving since manual keypunching entry of data at approximately 3 key punch strokes per second was replaced by bar code reader entry at 20 to 30 characters per second.[8] Further, the accuracy of this data entry would be greatly increased since a Defense Department study showed that one error occurs once in 300 manual entries into a data system.[6] In contrast, in a bar code system, an error occurs only once in 3 million scannings.

In the pharmaceutical industry bar coding has been used for materials handling, including the manufacturing process, tracking specimens through test procedures in order to eliminate multiple entries of data, and as a product designed for sale to other institutions for increasing efficiency and productivity.[9]

Hokanson, _et al_. examined the impact bar coding would have on the quality assurance of prescription dispensing in the outpatient setting. In the first study, bar code technology was used to attempt to automatically verify the dispensing of the correct medication.[10] A decentralized dispensing unit was chosen and two bar code labels were used. One was affixed to the stock bottle while the second was attached to the back of the prescription form upon presentation for filling. After the prescription was filled both labels were scanned and a match indicated that the correct medication had been dispensed. There were no dispensing errors made during this small study. However, the authors state that this was only a feasibility study with limitations in time, money, equipment and sample size. This makes extrapolation to a larger dispensing setting difficult. The authors concluded by indicating that bar coding may very well be cost effective since the technology could increase accuracy while at the same time increasing productivity by improving the utilization of the pharmacist.

In a second, expanded study Hokanson et al. then examined the use of bar codes for quality assurance for both correct drug and expiration dating.[11] Two bar code labels were again used. These labels contained product identification and expiration date information. One was placed on a pre-packaged container while the second was kept at the label typing station. When a prescription was filled both labels were placed on the back of the prescription form. The labels were then scanned to detect errors. This study used a pre-study of 25 randomly sequenced precontrived medication errors and 25 outdated products. All errors were detected by the bar code system. The second phase was on-line. In this phase no errors were detected as well. Again, this study was short (one week) and involved a small number of prescriptions (121). Further, the authors reveal that the pharmacists were curious about the system which could have very well affected the outcome. They conclude that this was also a small scale prototype system study. However, further evidence has been presented for the beneficial use of bar codes for quality assurance.

References

1. Grimaldi, PL, Micheletti, JA. Prospective Payment. The definitive guide to reimbursement. Chicago, IL: Pluribus Press; 1985.

2. Nold, EF, Williams, TC. Bar codes and their potential applications in hospital pharmacy. Am J Hosp Pharm. 1985; 42:2722-32.

3. Anon. Bar codes increase efficiency, cut costs. Hospitals. 1984; 58:80-82.

4. Anon. Standardized bar code in blood banking removes dangers of manual clerical errors. Hospitals. 1984; 58:80.

5. Ibbotson, RN, Jackson, RE. Data capture by the use of bar coding in a blood transfusion centre. Med Lab Sci. 1980; 37:237-42.

6. Anon. From supermarket to hospital: Bar coding to streamline hospital functions. Cost Containment. 1985; 26:3-6.

7. Anon. Scanning the possibilities. Connections. 1986; 2:2-4.

8. Anon. Bar coding may revolutionize management of formularies. Convention Reporter. 1986; 16:1-3.

9. Doyle, PC. Travenol laboratories: A leader in HIBC. Bar Code News. 1986:Sept/Oct:40-45.

10. Hokanson, JA, Guernsey, BG, Bryant, SG, et al. The feasibility of bar code based dispensing quality assurance programs. Drug Intel Clin Pharm. 1984; 18:76-8.

11. Hokanson, JA, Keith, MR, Guernsey, BG, et al. Potential use of bar codes to implement automated dispensing quality assurance programs. Hosp Pharm. 1985; 20:327-37.

Chapter 3

METHODOLOGY

Background

The University of Wisconsin Hospital and Clinics is a 480 bed tertiary care teaching institution. Inpatient services include five intensive care units while outpatient services include over seventy clinics. Data for the fiscal year 1985-1986 indicate that University Hospital is following the current nationwide trends for hospitals. That is, admissions at University Hospital fell 1.8% to a total of 15,618 while outpatient visits rose 10.2% to a total of 299,084.[1]

The Central Supply department stocks eighteen nursing unit supply carts and five intensive care unit exchange system supply carts. Each cart is stocked or exchanged daily in the morning and restocked in the early to mid-afternoon. The Central Supply inventory currently consists of approximately 1700 different items with an average inventory value of $425,000. Supply items include medical and surgical supplies, IV's and IV sets, sutures, dialysis supplies and special order items. The Central Supply department includes reprocessing and soiled materials handling personnel. Staffing of Central Supply is accomplished by 80 individuals covering 24 hours of service. The supply distribution portion of the department is staffed by 35 hospital supply clerks.

Nursing Units--Time Study

The nursing units chosen for the timing portion of this study were picked for high usage of medical supplies. All units were to be on one floor to reduce the number of decentralized Central Supply personnel involved in the study. The patient care units chosen for study were B4/5 (plastic surgery, peripheral vascular surgery, ENT), D4/5 (cardiovascular, thoracic surgery), and D6/5 (cardiovascular medicine, pulmonary medicine, dermatology).

Perpetual Inventory--Accuracy

Fifteen medical supply items were chosen for the accuracy portion of this study. Since the carts each have 150 to 160 items, this represents about 10% of that total. The study items were determined by first generating a Customer Standard Contents Report to discover exactly which medical supplies were stocked on each nursing unit. Once this list had been generated a monthly Central Supply Issue Report by Item by Department was generated. This lists all issues to all departments of all items stocked by Central Supply. The items on the nursing unit list were then checked against the issue report to find medical supplies whose total issue was 85% or more to the nursing carts alone. Any item used in many departments other than the nursing units was excluded.

The next step was the generation of a Report for ABC Code Assignment for Central Supply. This listing shows which medical supplies are in the A category (10% of items comprising 70% of total usage), B category (20% of items comprising 20% of total usage) and C category (70% of items comprising 10% of total usage). Five items were chosen in each category in order to cover all types of issues. Of the fifteen items chosen seven were patient charge items.

Data Collection

The data collection for each phase of the study was divided into three different time frames. Each time frame consisted of eight days of data collection over two calendar weeks so that both weekday and weekend activity was observed. The two week period also allowed the capture of any fluctuations in census or workload due to changes in patient acuity.

The first time frame was April 1 to April 14, 1986 before the bar code system was implemented. This data collection examined the time required for all activities necessary to issue stock to the nursing units using five order forms consisting of twenty-eight pages for manual entry. These activities were broken down along clearly defined steps in the issue process. Included were all travel times between units, to and from Central Supply. The steps in the process were travel time to the unit, recording the order on the form, travel time to Central Supply, picking the order, delivery time to the unit and stocking time once on the unit. Finally, the amount of time required to enter the order into the Central Supply computer was recorded. All interruptions encountered by the personnel performing the ordering process were excluded so that only relevant times were recorded.

The second data collection was August 5 to August 18, 1986 which was one month after implementation of the bar code system. As before, all travel times were recorded but now the ordering steps were done by a bar code system rather than the manual forms. A complete listing and definition of each timed step appears in Appendixes 1 and 2.

The third data collection was November 4 to November 16, 1986. This collection examined the experienced use (four months after implementation) of the bar code system.

On each of the days that time data was collected the accuracy of the Central Supply perpetual inventory was monitored as well. Once the computer data entry for all issues to all units was complete for the day an Open Customer Order Report was printed. This report contains a listing of all the issues to any unit. The source document for each non-nursing unit was checked to determine if any of the fifteen study items was issued to that unit that day. If so, then the Open Order Report was checked to ensure that the data entry was correct. The physical inventory was then counted independently by two persons. Any discrepancies in the count were resolved before the physical inventory and computer perpetual inventory were compared. The comparison was done through the use of the Cycle Count Book-to-Actual Variance Report which is printed after the physical count is entered into the computer system. The final step was then to update the perpetual inventory using the double checked physical inventory figures in preparation of the next day's inventory data collection.

Statistical Analysis

Due to the small sample size the first step in the analysis was to look at the 24 times collected for an individual step (e.g., time for order entry) for all three carts for one data collection period. This was done in an attempt to determine if there were significant differences between the carts themselves. To do this the Kruskal-Wallis test was applied. This test is a nonparametric test which can be used to examine differences between more than two groups.[2] If no significant differences were shown then the times for that step were combined for analysis for differences between the manual and bar code inventory system. If significant differences were shown then times for that step were examined for obvious outliers. If any values were suspected to be outliers the Dixon Criterion for Outliers was applied to determine if they could be rejected within a 95% confidence level.[3]

Once the Kruskal-Wallis test was completed the grand mean time for each step was calculated for each data collection. Since this research deals with three data collections a one-way analysis of variance was then used to find the presence of any significant differences between the two inventory systems.

Since the outcome of an analysis of variance does not show where a significant difference is between the three data collections one more step was required. The post hoc procedure chosen to determine where the differences actually occurred is the Scheffe's Procedure. This procedure was chosen because complex comparisons can be made between groups.[2] The Type I error rate remains the same as the error rate used in the original ANOVA.

Chi Square was then used to examine the effect of the bar code process on the accuracy of the perpetual inventory system. A variance was calculated for each inventory item for each of the eight days of a data collection. This was done by the following formula

$$\text{Variance} = \frac{\text{Actual Inventory} - \text{Computer Inventory}}{\text{Computer Inventory}}$$

The absolute values for the variances were then used for further analysis.

Chi Square was calculated using the following formula:

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Where: O = observed variance

E = expected variance

The expected value was calculated by arranging the manual data and bar code data into a three row (one row per data collection) and four column (four variance ranges) table. The value for each cell in a corresponding table of expected values was then calculated by multiplying the sum of the row by the sum of the column and dividing this product by the grand sum of the rows and columns. The Chi Square statistic for significance for $p = 0.05$ and six degrees of freedom is 12.59.

Limitations

This study is limited to two components of the inventory system, i.e., accuracy of the perpetual inventory and personnel time required for the two methods of medical supply issue. Changes in the capture of costs or patient revenue were not considered. However, it may be possible to extrapolate any increases in accuracy of the system to improved cost control.

Also, bias from the involvement of humans cannot be totally eliminated. This effect was minimized by observing the same personnel on each nursing unit for all data collections. In addition, the study was carefully and completely explained to these individuals to allay fears that the study was really to monitor their performance rather than the system they were using.

References

1. University of Wisconsin Hospital and Clinics, Fiscal Affairs 1986.

2. Hayes, W. Statistics. New York: Holt, Rinehart and Winston; 1981.

3. Natrella, MG. Experimental Statistics. National Bureau of Standards Handbook 91. U.S. Government Printing Office. 1963 (Aug).

Chapter 4

RESULTS

The Kruskal-Wallis Test showed a significant difference between the three carts only on one step of one data collection. This occurred in the order taking step for the bar code system one month post implementation. Upon examination it appeared that two outliers might be present. These were the shortest and longest times of the 24 observed times. The Dixon Criterion for Outliers was applied to these two times. The result was that these two times could be rejected within a 95% confidence level. Therefore, these times were excluded from further consideration. The remaining values for each step were combined to triple the sample size.

It was also determined that the various travel times were totally unaffected by the type of system used since the same units were studied and did not move or change over the study period. Travel time was therefore not included in further analysis.

The major steps that remained were 1) order taking, 2) order entry time, 3) order picking time and 4) stocking time. Of these steps the ANOVA showed a significant difference for only the time required for order entry into the computer system (Table 1).

Since the personnel followed during this study were all experienced in the medical supplies system it is reasonable that there was no significant difference shown in the order taking step. That is, these individuals were very adept at using a multipage manual form.

TABLE 1

Step Time Grand Means
(Minutes)

	Manual System	One Month Post Bar Code Implementation	Four Months Post Bar Code Implementation		
	Mean±S.D. N = 24	Mean±S.D. N = 24	Mean±S.D. N = 24	F	p Value
Take Order	4.14±1.48	4.38±0.58	4.48±1.04	0.59	N.S.
Order Entry	1.36±0.45	7.10±2.60[a]	7.10±2.09	69.73	p<0.01
Order Picking	9.37±4.00	8.72±3.02	10.01±3.90	0.74	N.S.
Shelf Stocking	3.10±1.71	3.92±1.41	4.07±1.71	0.07	N.S.

[a]N = 22 due to the elimination of two outliers.

This would reduce the time savings possible by the use of bar coding to replace the manual form.

Some time savings were expected from the order picking step since the manual forms are arranged in the order of the nursing unit shelves while the bar code generated pick lists are arranged in the order of the shelves in Central Supply. Theoretically, the pick list should be faster to use since the pickers can pick all items on one pass through the shelves. The manual form should require the picker to go from point to point in Central Supply as he goes through the form. This could require the return to one aisle or shelf several times which is not time efficient.

However, there was no significant difference shown between the systems in the picking step. Again, the experience of the workers could be the major factor. When using the manual form they could remember most of the stock items needed. They would then be able to pick most or all of the items from one aisle or shelf. This would bypass the multiple trips to a shelf as dictated by a line-by-line following of the form. The time required would then be closer to the bar code pick list time.

No significant difference was expected or shown for the stock time step. After the order is picked it is delivered and placed in the nursing unit stock area. This is really not affected by what order system is in use. Therefore, there should be no differences between systems.

When the ANOVA showed a significant difference in the computer entry step, Scheffe's Post Hoc Procedure was applied. The manual order entry time was compared to both bar code times since the two bar code times were very close to each other. The result was a confidence interval that did not contain zero (-7.29 to -4.19). Since zero lies outside of this interval the differences in time between the two systems cannot be due to chance alone.

The longer time required for bar code entry of data can be attributed to the computer system presently in use in Central Supply. This minicomputer currently has 53 devices attached and is a shared service between Purchasing, Warehouse, Central Supply, Fiscal Affairs, Food Service, Pharmacy and the Receiving Dock.

Manual entry of order data from the manual form is a standard keypunching operation. The process for entry of bar code information is more complex. It begins by transferring the order into the computer from the bar code reader. The system must then search files to find inventory, determine if there is stock on hand, generate a pick list and deduct from inventory. Several reports are generated and printed including the pick list and packing slips. Finally, this process requires four prompts by the user who must therefore remain at the terminal until the final form is printed. Therefore, this is a much slower process than keypunch order entry.

Chi Square analysis showed a significant improvement in the accuracy of the perpetual inventory system (Table 2). This can be seen in the two fold increase in the number of items that had a zero variance as well as the approximately 50% increase in items with an absolute variance of less than 10.

TABLE 2

Inventory Variances
(Absolute Values)

Variance	0.00	0.01-10.00	10.01-30.00	>30.01
Manual System	9	44	38	29
Bar Code System (One month post implementation)	22	59	18	21
Bar Code System (Four months post implementation)	18	65	17	20

$\chi^2 = 23.23$; $dF = 6$; $p < 0.001$.

There are several reasons for this result. First, any errors in the perpetual inventory due to keying errors were eliminated by the bar code reader system. There is also a reduced chance for lost charge documents which would introduce error into the perpetual inventory.

Finally, the bar code generated pick list reduced actual picking errors. There are several reasons for this. The pick list eliminated picking errors due to picking an item listed on a line above or below the actual item needed on a manual form. The pick list also has location codes for each item. This code indicates the exact position of the item on a specific spot on a shelf on a specific aisle. This directs the picker to the item which reduces the chance of picking an adjacent item on the shelf. The pick list also has unit of issue information. This will reduce the possibility of error due to picking the wrong quantity of an item. For example, the unit of issue could be one item but one box of 50 could be picked.

Chapter 5

SUMMARY

Conclusion

The bar code system currently in use at University Hospital for issuing medical supplies to the nursing units takes longer than the manual system it replaced. The majority of this additional time was in the order entry step. This is due to the requirements of the Central Supply computer system.

The accuracy of the perpetual inventory was improved with the implementation of the bar code system. While not providing 100% accuracy the improvement was significant for the sample studied. This is vital since any increase in control over an expense that averages $425,000 is critical in this day of shrinking revenue and increasing need for cost containment.

Recommendations

The bar code system should continue to be expanded throughout Central Supply. Consideration is currently being given to upgrading both the hardware and the software of the present computer system. This will be expensive. However, it should be given a high priority since the utilization of the system will continue to grow.

An examination of the time of day that the bar code system is used should be done. Presently, the order process is done in the morning which is the peak user time for all users who share the system. It may be possible to change the time to the evening or night hours. This will allow the bar code system to be used when there are few or no large reports being run by other users. These reports are a major reason for the slowness of the system at times. An increase in speed for the bar code system should result.

As the system grows it will also be an aid to new personnel since the pick lists have exact item location codes. As new items are added to the inventory this location code will help all Central Supply employees to locate these new items. In both cases an increase in efficiency should result.

As the system expands and becomes increasingly "live" with fewer after the fact manual data entries, further efficiencies should result from the availability of accurate, instantaneous information provided by bar code technology.

APPENDIX 1

STEPS IN THE TRADITIONAL METHOD OF STOCK ISSUE

I. ORDER TAKING

1. Travel Time--Begins when the order form is picked up in the Acco and ends at the arrival at the stock area at the nursing unit.

2. Take The Order--Starts when the first bin is counted and ends when the last bin is counted.

3. Travel Time To Second Cart--Done if one person is counting two carts. Begins immediately after last item is counted on the first cart and ends at arrival at the stock area at the second nursing unit.

4. Take Order--Same as number 2 above.

II. PICKING ORDER

5. Travel Time To Central Supply--Starts immediately after the last bin is counted and terminates when person arrives at the cart filling area in Central Supply. This step includes a stop at the Acco to obtain a bin for the transport of the order.

6. Pick Order For The First Cart--Measured from the picking of the first item to last item on the order. This step includes the placing of patient charge stickers on any item requiring one.

7. Pick Order For The Second Cart--Same as number 6 above.

III. ORDER DELIVERY

8. Delivery Time To The Nursing Unit Via Cart--Begins when the order filler leaves Central Supply and ends just before the first item is placed into stock on the nursing unit.

9. Stock Time--Counted from the time the first item is put into stock to the time the last item is placed.

10. Delivery Time To Second Cart--Starts when leaving the first nursing unit and ends upon arrival at the floor stock area at the second nursing unit.

11. Stock Time At Second Unit--Same as number 9 above.

12. Order Entry Into Computer--Begins when the first item on the order is entered and ends with the entry of the last item.

APPENDIX 2

STEPS IN THE BAR CODE METHOD OF STOCK ISSUE

I. ORDER TAKING

1. Travel Time--Begins when the bar code scanner is picked up in Central Supply and ends at the arrival at the stock area at the nursing unit.

2. Take The Order--Starts when the customer number is scanned and ends when the last bar code is scanned for the quantity remaining for the last item needed.

3. Travel Time To Second Cart--Done if one person is counting two carts. Begins immediately after last item is counted on the first cart and ends at arrival at the stock area at the second nursing unit.

4. Take Order--Same as number 2 above.

5. Travel Time To Acco To Allow Order Entry--Starts immediately after last item is entered in step 4 above and ends upon arrival in the Acco area.

6. Time For Order Entry--Counts all time required to prepare equipment and send the order to the computer.

II. PICKING ORDER

7. Travel Time To Central Supply--Starts immediately after the order is entered and ends at arrival at the cart filling area in Central Supply.

8. Obtain Pick List--Starts upon arrival at the cart filling area in Central Supply and ends when the pick list is obtained. This will include any waiting time for the computer generation of the pick list.

9. Pick Order For The First Cart--Measured from the picking of the first item to last item on the order. This step includes the placing of patient charge stickers on any item requiring one.

10. Pick Order For The Second Cart--Same as number 9 above.

III. ORDER DELIVERY

11. Delivery Time To The Nursing Unit Via Cart--Begins when the order filler leaves Central Supply and ends just before the first item is placed into stock on the nursing unit.

12. Stock Time--Counted from the time the first item is put into stock to the time the last item is placed.

13. Delivery Time To Second Cart--Starts when leaving the first nursing unit and ends upon arrival at the floor stock area at the second nursing unit.

14. Stock Time At Second Unit--Same as number 12 above.