

# A Study Pre and Post Unit Dose Conversion in a Pediatric Hospital

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## ABSTRACT

Two pediatric medical wards were studied pre and post unit dose conversion using some of the methods described by Schnell et al.<sup>1,2</sup> The proportion of nurses' time spent on medication related activities decreased from 23.7% pre to 21.6% post unit dose conversion. Nurses' attitudes to the roles of pharmacists and nurses did not change overall and there were significant improvements in their perceptions of the drug distribution system. Observed medication incident rates decreased from 10.3% to 2.9% when wrong time errors were excluded. Medication room audits showed less opportunity for error post-conversion. Work sampling of pharmacists' activities showed no significant change in the amount of time spent on distribution activities. Medication costs decreased by 4% under unit dose drug distribution.

**Key Words:** drug distribution, unit dose, work sampling, medication errors, nurses' attitudes, pediatrics

## RÉSUMÉ

Deux unités pédiatriques ont été évaluées avant et après la conversion au système de distribution uni-dose en utilisant des méthodes décrites par Schnell et al.<sup>1,2</sup> Le pourcentage du temps des infirmier(e)s consacré aux activités liées aux médicaments a diminué de 23.7 pour cent avant la conversion à 21.6 pour cent après la conversion à l'uni-dose. Dans l'ensemble, l'attitude des infirmier(e)s envers les rôles des pharmaciens et des infirmier(e)s n'a pas changé et il y avait des améliorations significatives dans la façon dont ils(elles) percevaient le système de distribution des médicaments. Les taux d'incident observés, reliés aux médicaments ont diminué de 10.3 pour cent à 2.9 pour cent lorsque les erreurs d'horaire furent exclues. Les normes de ce mode de distribution des médicaments ont démontré qu'il y a moins de cause d'erreurs. Un échantillonnage des activités des pharmaciens n'a démontré aucun changement significatif du temps consacré aux activités de distribution. Le coût des médicaments a diminué de 4 pour cent avec la distribution de médicament uni-dose.

**Mots clés:** distribution de médicament, uni-dose, échantillonnage, erreurs de médicament, attitudes des infirmier(e)s

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## INTRODUCTION

The Hospital for Sick Children, a 548-bed pediatric hospital, has been in the process of converting from a traditional system of drug distribution to a unit dose system, including intravenous (IV) additives, since 1983. At the time this article was

written, approximately 65% of administered doses were covered by the unit dose system. In March 1988, two medical wards were scheduled for conversion. The pharmacy department took this opportunity to collect data to substantiate the per-

ceived benefits of the unit dose system in this institution.

An extensive study conducted for the Canadian Society of Hospital Pharmacists by Schnell et al and published in 1976 demonstrated a reduction in the amount of time spent

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on medication related activities by nursing staff, as well as cost savings with conversion to unit dose.<sup>1,2</sup> The study, conducted in four adult hospitals, also demonstrated that medication errors were significantly decreased post-conversion. In a pediatric facility where dosing is more variable, medication administration is more problematic, and wastage is significant, we felt that the advantages of unit dose might be more pronounced. Selected portions of the study by Schnell et al were duplicated in our facility as follows in order to compare our results to those published for adult hospitals.

1. The proportion of nurses' time directed to medication related activities under the traditional and unit dose systems;
2. Any changes in nurses' attitudes towards their role in administering medication, the drug distribution system and the pharmacist's role on the ward before and after conversion;
3. The effect of the drug distribution system on the percentage and type of medication errors made and the potential for error;
4. The proportion of pharmacists' time spent on various activities under the traditional and unit dose systems;
5. The medication cost per patient day before and after conversion.

## **METHODS**

The two units scheduled for conversion to the unit dose and IV additive system were pediatric medical wards with a total of 37 beds. These wards shared the same nursing station, but had separate medication rooms. The nurses practiced under the total patient care system which was a modification of primary care nursing; a nurse was responsible for all aspects of a patient's care during a given shift. Drug distribution was provided from a pharmacy satellite

situated on the same floor from 0800 to 2000 and from the central pharmacy from 2000 to 0800. Clinical pharmacy services were provided by two liaison pharmacists who spent approximately 50% of their time on the nursing units.

This study consisted of six components: work sampling of nurses' activities, a nurses' attitude survey, a medication error study, medication room audits, work sampling of pharmacists' activities and a medication cost analysis. An orientation to the study goals and objectives was conducted for the nursing staff on both wards by the liaison pharmacists over a one-week period. The true purpose of the medication error study was not revealed to the nurses as a disguised observer technique was used. Nurses were informed that this portion of the study was a more detailed timing study of their medication related activities.

### **Work Sampling of Nurses' Activities**

The work sampling technique described in numerous studies<sup>1-10</sup> was used to determine the proportion of nurses' time spent on medication related activities. Nursing activities were classified and the categories were reviewed by a representative sample of nurses (Appendix I). Observers were instructed in the technique of work sampling and a pilot study was carried out to test the observers' skills and determine the sample size required. It was determined that a total of 5,000 observations would be required to obtain a confidence level of 95% and a  $\pm 5\%$  degree of accuracy.<sup>11</sup>

Three pharmacy assistants acted as observers for the one-month study period prior to conversion and a pharmacy intern plus the same pharmacy assistants conducted the post study over a one-month period seven weeks after conversion. The seven

weeks between study periods gave the nursing staff time to become familiar with the new distribution system. An observation period covered four hours and there was a single observer for both wards. There were at least two observation periods each day and all nursing shifts were observed. Instantaneous observations of nurses were made at random intervals to determine which category of nursing activity was occurring at the time. On the day and evening shifts the observer required a minimum interval of 12 minutes between observations in order to locate and record the activities of all 12 nurses. The night shift had an average of seven nurses on duty, requiring a minimum of seven minutes between observations.

The proportion of time spent on the various activities was calculated as a percentage of the total number of observations. The absolute accuracy of the measurements was calculated according to the equation outlined by Barnes.<sup>11</sup> Statistical analyses were performed using a chi-square test. Additional data collection to determine the number of doses of medications administered per patient day on each unit for the entire pre and post study periods was undertaken through a retrospective chart review. Statistical analyses were performed using an unpaired t-test.

### **Nursing Attitude Survey**

A questionnaire, slightly modified from that used by Schnell et al,<sup>1</sup> was completed by registered nurses at the same time that the work sampling was being done. The anonymous questionnaire was designed to determine nurses' attitudes towards their role in medication administration, the drug distribution system and the pharmacist's role on the ward.

There were 18 questions with five

choices as responses: strongly agree, agree, undecided, disagree, and strongly disagree. The response scores increased from one to five as nurses' attitudes became less favourable. The scores were summed and an average calculated to give a mean score. An additional question was added to the post conversion survey asking nurses if the unit dose system had assisted them in daily patient care activities. Statistics were performed using an unpaired t-test. For the additional question on the post-conversion questionnaire, a t-test against a neutral response (3.0) was performed.

### Medication Error Study

A disguised observation technique was used similar to that described in previous studies of medication errors.<sup>1,2,6,7,12,13</sup> During their orientation to the study, nurses were informed that their activities were being timed from when they started to prepare the dose until it was administered. Four pharmacists, not directly connected with the units, acted as observers and carried a stop watch in order to appear to be timing. Senior nursing administration was informed of the true purpose of the study, but the nursing staff on the study wards were not aware of it. A trial was conducted for one week on a surgical ward unrelated to the study ward, to verify the method and to ensure that the observers were consistent. As well, during both study periods each observer was paired with the other observers for a period of one hour to ensure that their observation techniques were standardized.

The study was conducted over three weeks, commencing one week after the work sampling had begun, so that nursing staff would be somewhat accustomed to an observer's presence. There were approximately 100 hours of observation covering

all nursing shifts. Each observation period of two hours centered around major medication administration times. Observation times pre and post-conversion covered the same periods. The medication rooms on each ward were observed equally. The observer followed the first nurse to prepare and administer medication. The observer then returned to the medication room and followed the next nurse to prepare and administer medication. Nurses preparing IV bags with no additives or IV bags with a single potassium chloride additive were not observed. Additional information required to determine whether an error was made was obtained by the observer in the medication room between observations. The pharmacist did not attempt to draw any conclusions at the time of observations and did not intervene unless the error was obvious and judged to be clinically significant.

At the end of each observation period, the data from each observation was checked against the pharmacy's computer record for the medication order. Any discrepancies were referred to the liaison pharmacist to verify against the patient's chart or nurse's medication administration record. Only doses observed to be administered were included as opportunities for error. Medication left with the parent to give were considered successfully given, as this happened frequently and was permitted by hospital policies.

The medication errors were defined as: omitted dose, wrong dose, extra dose, unordered medication, wrong route, wrong time, expired medication, allergic to medication, other. Wrong time errors were defined as doses given greater than 30 minutes prior to or after the scheduled medication time as outlined in hospital policies. The error rate was calculated as a percentage

of total doses observed to be administered. Statistical analyses were performed using Fisher's Exact test.

### Medication Room Audits

At the same time as the error study, medication room audits were conducted daily on weekdays for three weeks to identify the potential for medication errors. At random times the liaison pharmacists observed the medication rooms for: improper storage of medications, caps left off bottles, opened bottles/vials with no expiry dates, patient's own medication on the ward with no doctor's order and expired medication. In addition, the medication administration records were reviewed to determine the number of scheduled doses not signed off as administered in the last 24 hours, starting 60 minutes prior to the audit time.

### Work Sampling of Pharmacists' Activities

There was an increase in pharmacy assistant staffing in the pharmacy satellite for the conversion of these two nursing units, but there were no plans to increase pharmacist staffing. Therefore, work sampling methods were used to determine if the proportion of time pharmacists spent on various activities changed after conversion. Pharmacists' activities were classified, defined and reviewed by a representative group of pharmacists within the department (Appendix II).

The technique for sampling was similar to the self-reporting method described by Rascati et al.<sup>4</sup> Each pharmacist carried a pager and was paged at random times by an independent locator. The pharmacist recorded the time that was relayed on the pager and what activity she was involved in at the time the pager sounded. Any other pharmacist involved in the study that was in the

same location would also record their activity at the time the first pager was heard. Pharmacists were able to request no pages during rounds and other occasions where the constant interruption of a pager would be irritating. They were required to obtain the page times from the locator at the end of rounds and record their activity for those sampling times. A pilot study was conducted over three days to test the method, and determine the sample size. It was determined that a total of 3,000 observations would be required to obtain a confidence level of 95% and an accuracy of  $\pm 5\%$ .<sup>11</sup> The minimum interval between observations was five minutes.

Six staff pharmacists assigned to the pharmacy satellite providing service to the study wards were sampled on all weekday shifts for four weeks. The pre study was conducted just prior to conversion and the post study was done six months after conversion. The delay in performing the post study was necessary due to a pharmacist vacancy on the satellite from one month until four months after the conversion date.

The time spent on each activity was calculated as a percentage of the total number of observations. The absolute accuracy of these measurements was calculated according to the equation outlined by Barnes.<sup>11</sup> Statistical analyses were performed using a chi-square test.

### Medication Cost Analysis

Similar to the method of Stroup and Dinel<sup>14</sup> pharmacy computer reports of all transactions for the study wards were used to determine the cost of medication for the three-month period prior to and the three-month period after conversion. These two time periods went from January to June of the same year which meant that price increases were minimal. The data included all wastage associated with both the IV

additive service and the patient-specific oral unit dose packaging. Costs did not include bulk IV solutions, parenteral chemotherapy and total parenteral nutrition solutions, since the unit dose conversion did not alter the distribution system for these items.

The cost of pharmacy and nursing time for preparation of doses and the cost of supplies used to prepare doses were not included in the calculation since this data was available from other studies.<sup>1,2,5</sup> Our objective was simply to see if drug costs decreased because there was less waste with the pharmacy directed unit dose system. The drug costs per patient day were calculated using hospital statistics for the number of patient days on the two wards. Statistical analysis could not be performed since it was aggregate data.

## RESULTS AND DISCUSSION

### Work Sampling of Nurses' Activities

Work sampling of nurses' activities yielded 4,941 observations of registered nurses pre-conversion and 4,239 observations post-conversion. The percentage of nurses' time spent on medication-related activities on units A and B decreased 2.1% from  $23.7 \pm 0.3\%$  to  $21.6 \pm 0.3\%$ . This data is comparable to Schnell et al who demonstrated that nurses spent from 2.6% to 7.4% less time on medication related activities after unit dose conversion.<sup>1,2</sup>

The pre-conversion data was comparable to a study of the traditional system done at our hospital in 1982 which found that nurses spent 27.2% of their time on medication related activity on a pediatric medicine/cystic fibrosis nursing unit.<sup>15</sup> Also, Ziqubu et al<sup>10</sup> reported 25.4% of nurses' time was spent on medication related activities on a 26 bed pediatric ward under a traditional drug distribution system. Our post-conversion data was similar to the

study by Arrington et al<sup>5</sup> of a unit dose pediatric ward where nurses spent 22.2% of their time on medication-related activities.

However, in all pediatric studies the results are higher than the reported 9.6% to 20.6% of nurses' time spent on medication-related activities in adult hospitals with unit dose systems.<sup>1,2,3,5,8</sup> Since drug administration to a pediatric patient has been shown to be more time consuming,<sup>5</sup> this is not a surprising finding. The difference between results from adult and pediatric studies would be even more dramatic except that pediatric medicine patients receive fewer doses of medication per day (6.4 doses/day) than adult medicine patients (9.8 to 11.3 doses/day).<sup>3,5</sup>

The decrease in the percentage of nurses' time spent on medication-related activities was 2% on all shifts (Figure 1). This result differs from Schnell et al<sup>1,2</sup> who found a two to three-fold greater decrease on the night shift. Possible explanations for our results include the number of medications given around the clock on these wards, such as inhalation medications, intravenous antibiotics and acetaminophen. Prior to conversion 8.1% of patient days were for asthmatics and 26.2% for infections, and after conversion 8.5% were for asthmatics, and 21.5% were for infections.

The time spent on medication related activities and the average number of doses given per patient day were quite different on the two study wards (Table I). From previous statistics gathered at our hospital, the workload was expected to be about eight doses per patient day for both of these nursing units and this was true for the post-conversion study period. However, the number of doses of medication given during the pre-conversion period was significantly lower than the average for nursing unit B.

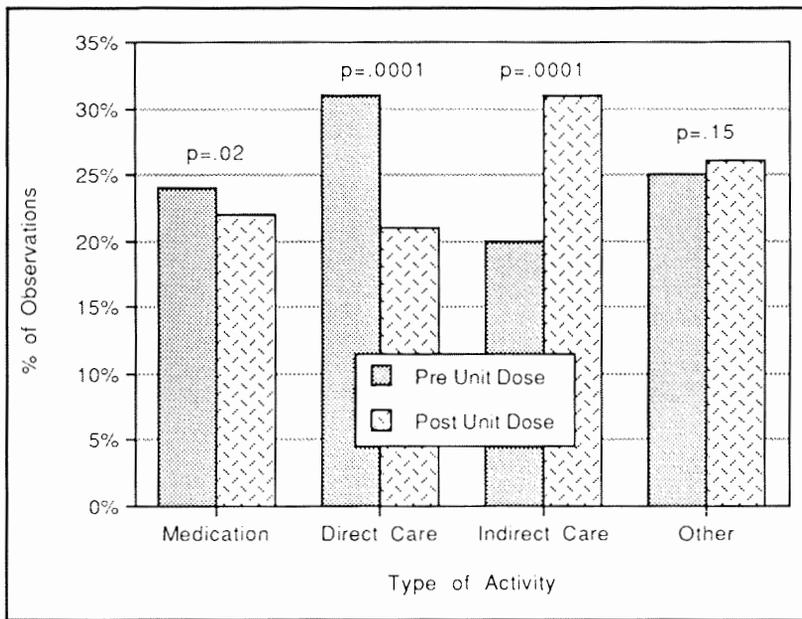


Figure 1: Nursing time spent on medication related activities by shift (Units A and B combined)

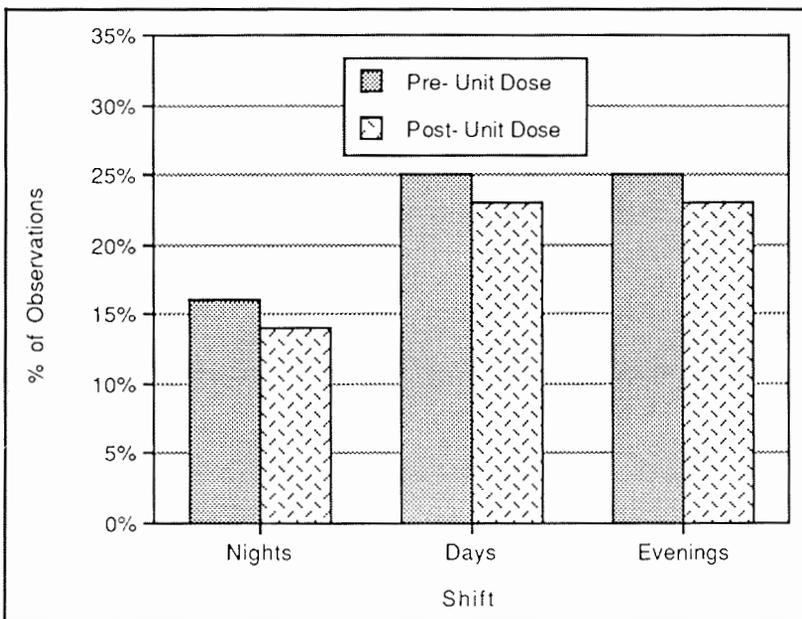


Figure 2: Work sampling of nurses' activities (Units A and B combined)

Table I: The proportion of nurses' time spent on medication related activities and the doses of medication given per patient day on Units A and B when data was analyzed separately

	Traditional System	Unit Dose System	Significance
<b>Unit A</b>			
% Time Medication Activities	26.8%	21.7%	p = .0001
Doses/Patient Day	7.7	8.1	p = .45
<b>Unit B</b>			
% Time Medication Activities	21.2%	21.5%	p = .79
Doses/Patient Day	6.1	8.6	p = .0001

A change in the number of doses administered per patient day from one study period to the next was also observed by Schnell et al<sup>1</sup> and varied from a 22% decrease up to a 30% increase. However, he concluded that medication workload was not an important variable in the study. Unlike Schnell et al, Knoppert et al<sup>3</sup> showed a statistically significant difference in the amount of nursing time spent on medication related activities, 12.52% vs 10.25%, when the number of doses per patient day were 9.85 and 8.13 respectively. Since nursing staffing levels are based on the number of patient days and not on the number of medications administered, we felt that the significant increase in doses per patient day on unit B explained the observation that the percentage of time spent on medication related activities did not change significantly post-conversion.

Another interesting observation was the 10% decrease in direct patient care and the 11% increase in time spent on indirect patient care (Figure 2). The post-conversion figures match most closely the 20.8% for direct patient care and 33.8% for indirect patient care found in our previous study<sup>15</sup> and in data published by Knoppert et al.<sup>3</sup> On consulting with the nursing unit administrators, this change was felt to be due to an increased expectation for documentation of nursing activities due to changes in the nursing department as a whole.

### Nurses' Attitudes Survey

The questionnaire was completed by 36 registered nurses prior to conversion and 39 registered nurses post-conversion. The mean score pre-conversion was 47.3 where a score of 18 indicated strong satisfaction, 36 mild satisfaction, 54 neutral response, 72 mild dissatisfaction and 90 strong dissatisfaction. The mean score, with one additional question

post-conversion, was 46.5 where a score of 19 indicated strong satisfaction, 38 mild satisfaction, 57 neutral response, 76 mild dissatisfaction and 95 strong dissatisfaction.

The results of the questionnaire on nurses' attitudes toward the drug distribution system and pharmacy and nursing roles were very similar to results found by Schnell et al.<sup>1,2</sup> The average response score remained on the positive side of neutral suggesting that nurses' attitudes neither improved nor deteriorated with the implementation of unit dose. There were however, significant decreases in three average response scores. The nurses perceived that the amount of time spent on medication related activities was more appropriate post-conversion (Figure 3). They also felt that the number of opportunities for error were less with the unit dose system (Figure 3).

It was anticipated that nurses might feel that the implementation of unit dose would cause a delay in receiving stat doses. Prior to conversion, most stat doses were available as ward stock and post-conversion there was minimal ward stock. However, the questionnaire showed an improvement in response to stat doses (Figure 3). The proximity of these wards to the satellite pharmacy, the fact that stat doses were ready to administer from pharmacy and the good rapport with the nursing staff probably explains this result.

One average response score increased significantly. Nurses felt more strongly prior to conversion that there was a need for all medication to be provided in a form ready to administer to the patient (Figure 3). They may have become more realistic in their expectations post-conversion since some products (e.g. topical medications, parenterals other than antibiotics, and inhalation

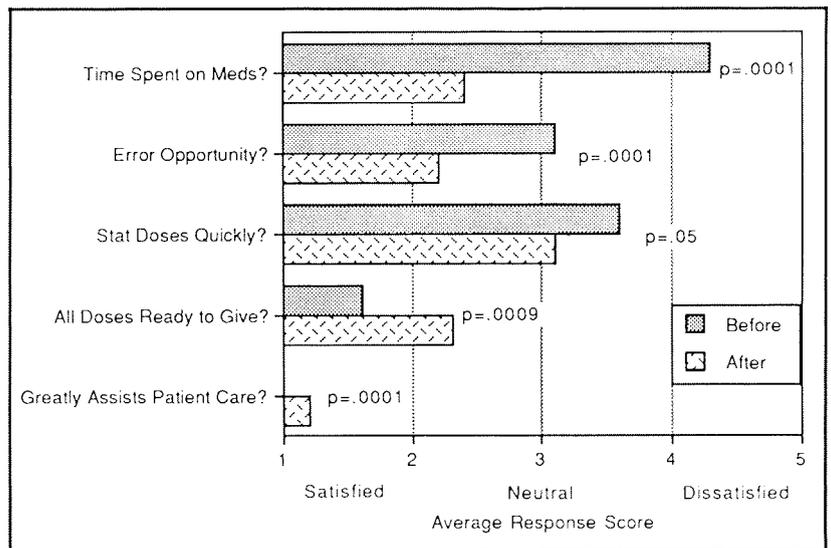


Figure 3: Nurses' attitudes to unit dose and traditional drug distribution systems

medications) were still provided in "bulk" formats.

The addendum to the post implementation questionnaire asking the nurses if they felt the unit dose system greatly assisted them with daily nursing care received an overwhelming positive response (Figure 3). This response was a positive endorsement for unit dose and was also reported by Schnell et al.<sup>1,2</sup> In a time of extreme nursing shortages it is important that nurses are positive about their working conditions and the support provided by service departments such as pharmacy.

No questionnaire was administered to patients or parents, however we had a positive anecdotal report from a parent who was on the ward during the conversion period and who preferred the fact that all doses were labelled up to the time of administration and were in sealed packages. Schnell et al did administer a questionnaire to patients and found similar responses.<sup>1,2</sup>

#### Medication Error Study

There were two times during the medication error study when a pharmacist judged intervention to be

necessary, both occurring prior to conversion. The medications involved had narrow therapeutic ranges and significant harm could have resulted for the patient. However, it was felt that the intent of the medication error study was not revealed at these times.

The direct observation of registered nurses for medication errors, yielded 282 observations prior to conversion and 241 observations post-conversion. A total error rate of 37.2% was calculated prior to conversion and 21.2% post-conversion. Because the definition of wrong time errors varies significantly between institutions and because they are usually considered less serious than other errors, the error rate was recalculated excluding all wrong time errors. The resulting error rate was 10.3% prior to conversion and 2.9% after conversion. The distribution according to type of error is shown in Figure 4. The error categories of omitted dose, wrong route and allergic to medication were not included in the graph as no instances of this type of error were observed.

The reduction in medication

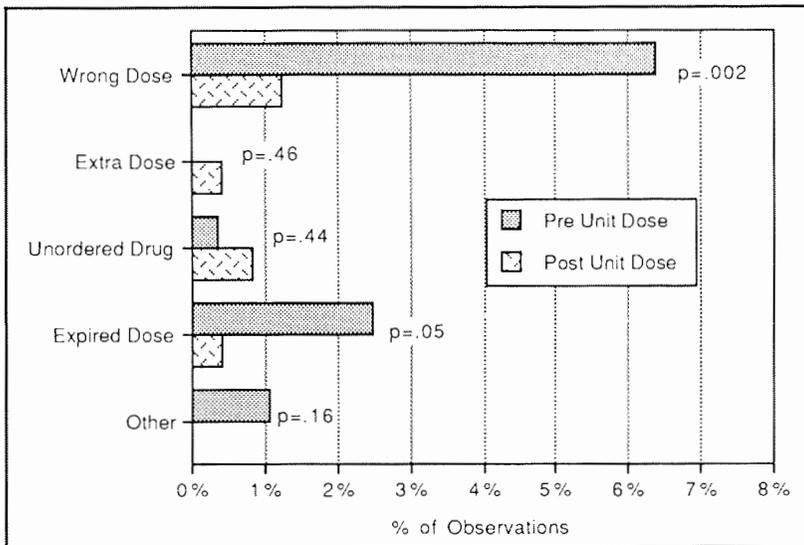


Figure 4: Observed medication errors (Units A and B combined)

errors, exclusive of wrong time errors, with the implementation of unit dose compares favorably with other studies.<sup>1,2,6,7,12,13</sup> Schnell et al.<sup>1,2</sup> showed an average reduction in error rates from 10.3% to 5.9% in four hospitals. Our pre-conversion error rate of 10.3% is similar to results shown in other studies of traditional drug distribution systems. Tisdale<sup>13</sup> reported an 8.8% error rate for two pediatric units and error rates of 8.53% to 15% have been reported in adult settings.<sup>1,2,6,12</sup> The post-conversion error rate of 2.9% is also similar to the 0.97% to 5.9% reported in some adult unit dose studies.<sup>1,2,6</sup> The fact that pediatric dosing is more variable does not seem to influence the overall error rate compared to adult studies.

The significant reduction in wrong doses from 6.4% to 1.2% (Figure 4) was not demonstrated by Schnell et al.<sup>1</sup> Because many doses are administered as oral liquids in a pediatric institution, more calculation is required by the nurse to administer the ordered dose. Post-conversion, calculations were performed and double-checked by Pharmacy staff and the nurse also had an opportunity to verify the calculation prior to

administration, giving a total of three checks. Also, not shaking liquid suspensions prior to dose measurement accounted for 44% of the wrong doses given prior to conversion. Since doses were prepared by Pharmacy in oral syringes post-conversion, nurses did not have the opportunity to make this error.

The significant reduction in administration of expired medication from 2.4% pre to 0.4% post-conversion (Figure 4) was also not shown by Schnell et al.<sup>1</sup> The expired doses primarily consisted of expired reconstituted injectables and oral suspensions manufactured within the hospital. In a pediatric institution suspensions of medications which are not commercially available are manufactured to administer doses to children and these products have a short expiry date. This problem would not arise as often in an adult institution. The use of parenteral medication and the number of different antibiotics available has increased since 1973 possibly explaining the increase in incidence of the use of expired injectables. As well, in pediatrics more part vials of injectables remain to be stored for future doses. Post conver-

sion only a 24-hour supply of injectables and suspensions packaged in syringes were dispensed in the unit dose bins and any remaining doses were removed after that time, virtually eliminating the incidence of administration of expired medication.

The elimination of "other" medication errors post-conversion was not statistically significant (Figure 4). However under the traditional system, three errors were observed that involved incorrect dilution of IV drugs for infusion. Post-conversion, individualized instructions for the further dilution of IV additive doses were included on the label of each dose prepared by Pharmacy and no instances of these errors were observed.

Wrong time errors  $\pm 30$  minutes from the scheduled time, decreased from 27% to 18% ( $p = 0.01$ ), but still remained high. Prior to conversion, medications were often late because of the time nurses needed to prepare doses. Post-conversion, the prepackaged medication decreased preparation time allowing more medication to be administered with 30 minutes of the scheduled time. This was also verified by the fact that 41 fewer observations were collected post-conversion even though there were five extra hours of observation and more doses were given per patient day as outlined in the work sampling study of nurses. While the observing pharmacist was following one nurse, other nurses could obtain and administer their medications more quickly, decreasing the opportunities for observation. For the busiest medication times, it may have been more efficient to have two observers in the medication room at the same time but space limitations precluded this solution.

Wrong time errors were also analyzed using the criteria of  $\pm 60$

minutes. Prior to conversion 6% of doses were given outside this range and 7% post-conversion. Doses given  $\pm 60$  minutes from a scheduled time tended to be due to problem situations, eg. new admissions that had to be done first, and the incidence would not change with unit dose conversion.

It is interesting to note that none of the errors observed were reported as medication incidents. This finding was also reported by Tisdale.<sup>13</sup> It may be that on all occasions where errors occurred, the nurse did not realize that she had committed an error.

The medication incidents identified by the voluntary hospital reporting system showed a 58% increase from the 12 months prior to conversion (88 incidents) to the 12 months after conversion (139 incidents). The increased reporting after unit dose conversion was mainly due to the

follow-up by Pharmacy of doses left at bin exchange. Lepinski et al<sup>6</sup> also reported a two-fold increase in voluntary reporting with unit dose implementation. If the observer study had not been done, the conclusion might be that medication incidents increase with unit dose implementation. The error rate of 2.9% observed post-conversion represents 0.2 medication incidents/patient day for these units and even with the increased voluntary reporting seen post-conversion, it is estimated that only 10% of errors are recognized and officially documented, as the reported errors averaged approximately 0.02 incidents per patient day (Figure 5). This finding is consistent, but less dramatic than that reported in 1962 by Barker and McConnell<sup>12</sup> who estimated a 712-fold difference between actual and reported medication incidents. One explanation for our improved

reporting could be the increased emphasis on quality assurance in the 1980's.

Limitations of the error portion of the study included the fact that we were unable to look at the distribution of errors by time of day. Even though all times were studied, the morning medication time was weighted most heavily as this was when most scheduled medication times fell. Omitted doses could not be determined by our method of observation, but this limitation was also identified by Schnell et al.<sup>1</sup> No attempt was made to weight the severity of medication errors by classification of the medication involved. It was felt that we did not have enough information about the patient to make this judgement. In addition, Schnell et al.<sup>1,2</sup> found that while the number of medication errors decreased with the unit dose system, the potential clinical significance of

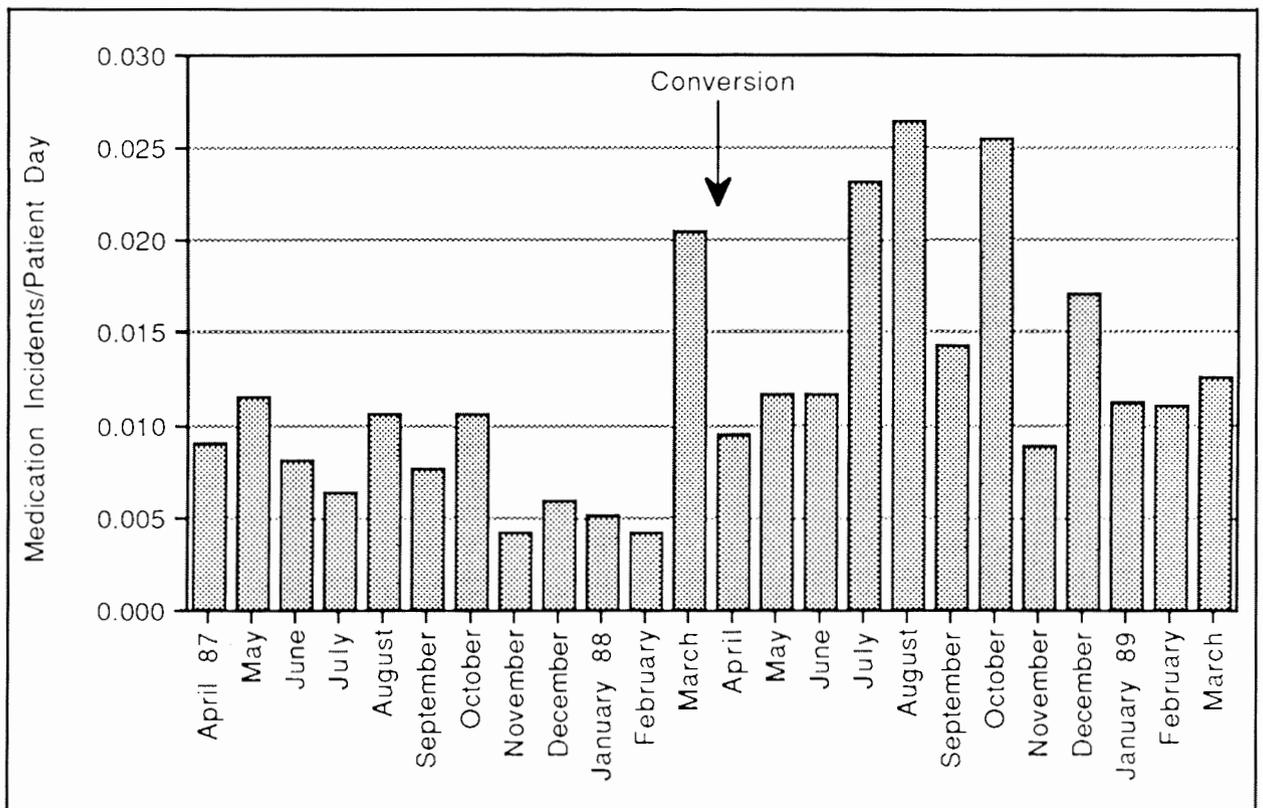


Figure 5: Reported medication incidents (Units A and B combined)

each error remained the same.

**Medication Room Audits**

The results of the medication room audits pre and post-conversion are illustrated in Figure 6. The medication room audits showed an improvement in all criteria that were identified as sources of potential error and this was attributed to better pharmacy controls with unit dose. The number of doses given during the audit periods were estimated at 2,969 doses pre-conversion and 3,127 doses post-conversion. The audit of the medication administration records showed that 3.8% of scheduled doses pre and 3% of scheduled doses post-conversion were not signed as having been administered within 60 minutes of the time of audit. We were unable to determine whether the doses not signed for were actually omitted, if the doses were given late, or if the nurse had forgotten to sign at the time of administration and then signed the MAR by the end of the

shift. The latter two explanations are most probable since post-conversion it was observed that nearly all of the doses not signed for were not left in the patient's bin at exchange time. Also, our medication error study found that 6% of medications before and 7% after conversion were given  $\pm 60$  minutes from the scheduled time.

**Work Sampling of Pharmacists' Activities**

Work sampling for pharmacists activities yielded 2,222 observations of pharmacists prior to conversion and 2,411 observations post-conversion. It was not possible to obtain 3,000 observations since the date for conversion of the study wards was reached and no additional pre-conversion measurements could be made.

The percentage of time spent on drug distribution increased from  $33 \pm 0.7\%$  to  $35 \pm 0.7\%$  (Figure 7). This increase in distributive time post-conversion was due to the

checking of patients' unit dose bins which was a pharmacists' responsibility in our department. The increase was small and was similar to that reported by Schnell et al for three of the four hospitals studied.<sup>1,2</sup> It was concluded that the conversion to unit dose of two wards serviced by this pharmacy satellite had no significant effect on the profile of pharmacists' activities.

Clinical activities increased 8% and there was a 9% reduction in the amount of time spent on administrative activities (Figure 7). The work samplings prior to conversion were done at the same time as the medication error and medication room audit portions of this study. Four of the pharmacists were involved in the study which took time directly away from their clinical commitment. During the post-conversion work sampling none of the pharmacists were involved in the study so that the time devoted to clinical activities returned to normal. The increase in

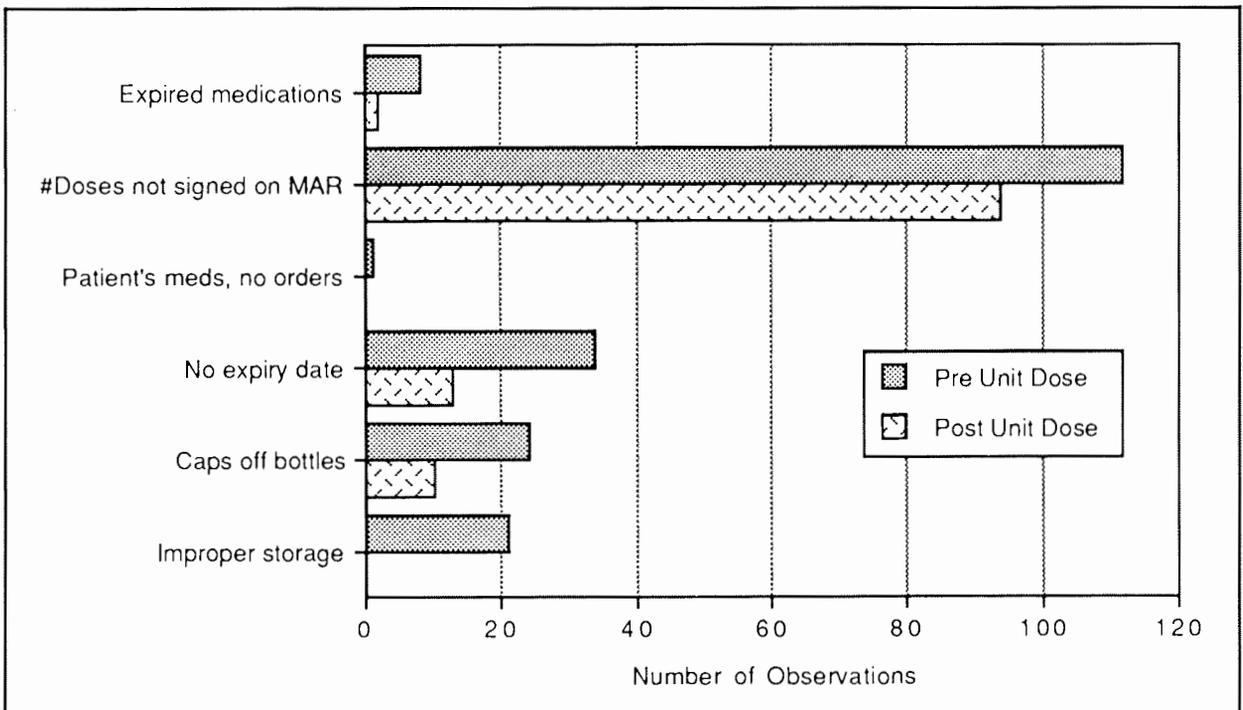


Figure 6: Medication room audits, Units A and B studied for 15 days pre and post conversion

informational activities reported in other studies<sup>1,2,14</sup> was not seen because the two wards had fully developed decentralized clinical pharmacy services prior to conversion.

One limitation of the pharmacist work sampling studies might be the accuracy of self reporting of activities. This method was chosen due to the clinical commitment of the pharmacists being studied and the

difficulties in locating each person within a short period of time. The pager system used was felt to be an acceptable compromise given the need to collect numerous samples. Another limitation was the fact that the locator took a lunch break and staffing levels did not permit coverage during that time. Pharmacists tried to take lunch at the same time as the locator, but this was not always possible. However, the same problems were encountered in the pre and post study periods and the proportion of samples collected in each time period were the same.

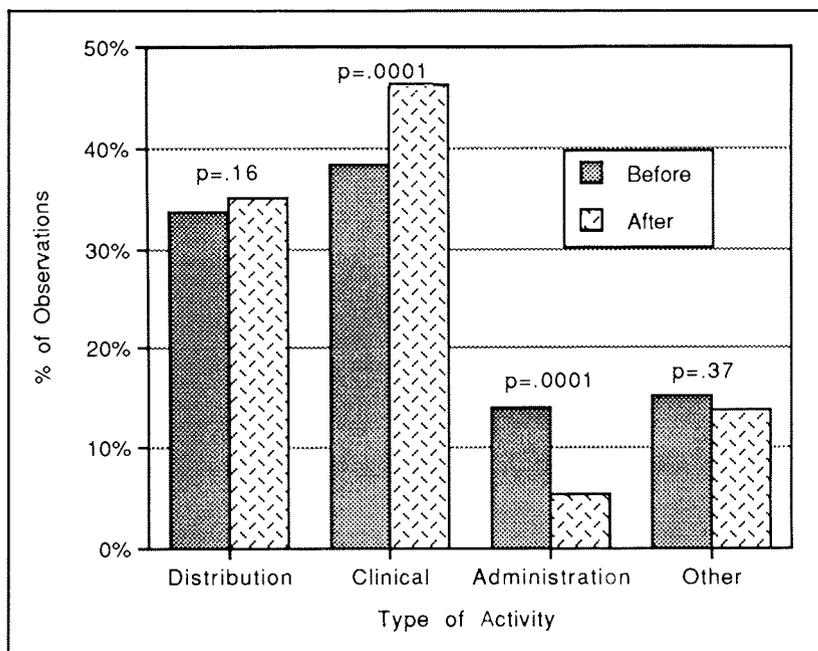


Figure 7: Work sampling of pharmacists' activities

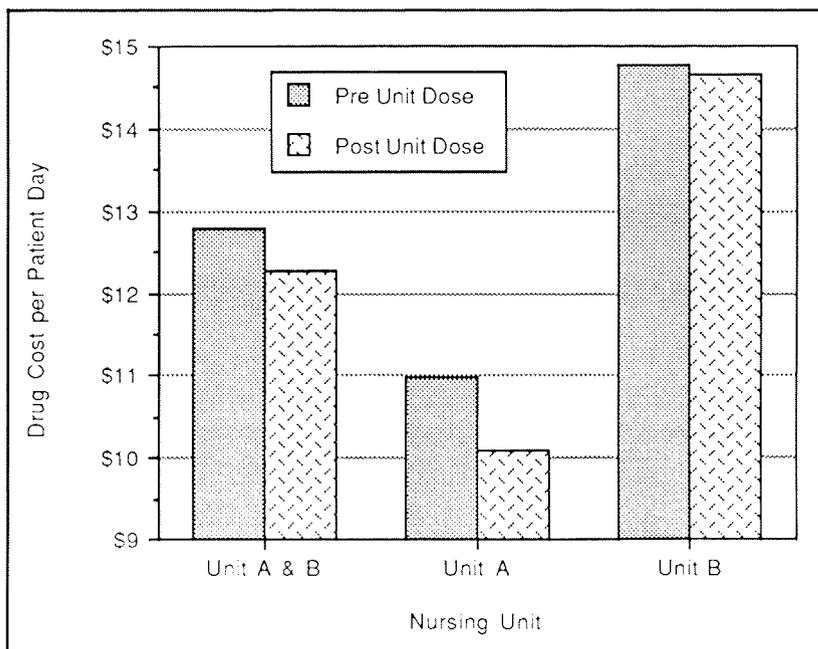


Figure 8: Average drug cost per patient day for a three-month period on Units A and B

### Medication Cost Analysis

The average medication cost per patient day for units A and B combined decreased from \$12.78 to \$12.27 (4%) (Figure 8). Nursing unit A showed a larger decrease from \$10.99 to \$10.08 per patient day while nursing unit B decreased from \$14.78 to \$14.65. As outlined in the work sampling study of nurses' activities, there was a significant increase in the number of doses given per patient day on unit B post-conversion. Also, the two units studied were general medicine wards with patients ranging in age from birth to 18 years and with many different diagnoses. Therefore drug treatments and the size of doses can vary considerably from one time period to another. Schnell et al also showed variability in changes in drug costs, ranging from 2% to 20% decreases in three hospitals to an increase of 5% in one hospital.<sup>1,2</sup>

Since there are many variables affecting drug costs in a short-term study, a better indication of the overall performance of a system is to monitor trends over longer periods of time. We examined the drug costs per patient day for our hospital compared to the Canadian Hospital Association's Hospital Information System data for Ontario teaching

hospitals.<sup>16</sup> Our hospital's drug costs per patient day have increased an average of 8.2% per year over five years compared to 15% per year for Ontario teaching hospitals. We felt that the implementation of unit dose and IV additive services was the main explanation for this trend since it was maintained despite increases in the acuity of care required by patients and the introduction of many newer, expensive medications. The trend to smaller annual increases in drug costs with improvements in pharmacy systems was also reported by Stroup and Dinel<sup>14</sup> who showed a 9.1% increase in drug costs over one year for one ward converted to a decentralized unit dose system compared to a 10.8% to 49.3% increase in drug costs for wards under a centralized unit dose system.

Schnell et al<sup>1,2</sup> took a more comprehensive approach to costs and concluded that the unit dose system costs no greater than 20% more than a traditional system when drugs, supplies, nursing staff and pharmacy staff costs are all taken into account. From the data on unit dose costs presented by Arrington et al<sup>5</sup> pharmacy labour and supply costs per dose were higher in pediatrics because of the relative lack of dose standardization and the use of liquid medications. However, pharmacy supply and labour costs per patient day were the same as those for adult patients since pediatric patients got fewer doses per day. Therefore, we assumed that the conclusion of Schnell et al was also valid for a pediatric hospital.

## CONCLUSION

The implementation of the unit dose system on two pediatric medical wards resulted in a decrease in nursing time spent on medication related activities, no overall change in

nurses' attitudes to the roles of pharmacists and nurses and significant improvements in their perceptions of the drug distribution system, a reduction in the percentage of medications given in error, a reduction in

the potential for error, no change in the amount of time pharmacists spent on drug distribution, and a reduction in drug costs per patient day. ☒

References on page 50.

### Appendix I: Nurses' Activities

#### Medication-Related

- Processing Medication Orders
- Receiving Medication
- Preparation of Medication
- Administration of Medication
- Nursing Documentation of Medication
- Patient/Parent Education, Nursing Self-Education Related to Medications
- Communication Related to Medication
- Assessment — Medication Related

#### Direct Patient Care

Non-medication related care in the presence of the patient, performed directly for the patient's benefit.

#### Indirect Patient Care

Non-medication related care not performed in the presence of the patient, but for the benefit of the patient indirectly.

#### Other

- Personal
- Travel
- Ward Management

### Appendix II: Pharmacists' Activities

#### Distribution

- Auditing Doctors' Orders
- Pharmacy Computer Entry
- Dispensing, Checking Unit Dose Bins
- Communication with Pharmacy Personnel

#### Clinical

- Communication with Non-Pharmacy Personnel, usually done on the Nursing Unit
- Checking Medication Administration Record
- Rounds
- Teaching/Patient Counselling
- Continuing Education
- Therapeutic Drug Monitoring
- Chart Reviews
- Problem Follow-up
- Medication Room Audits
- Drug Information

#### Administration

Clerical/Administration: Special projects of an administrative nature; Mailing, Filing, Photocopying

#### Other

- Meetings
- Orientation of Staff, Tours
- Travel
- Personal

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## References

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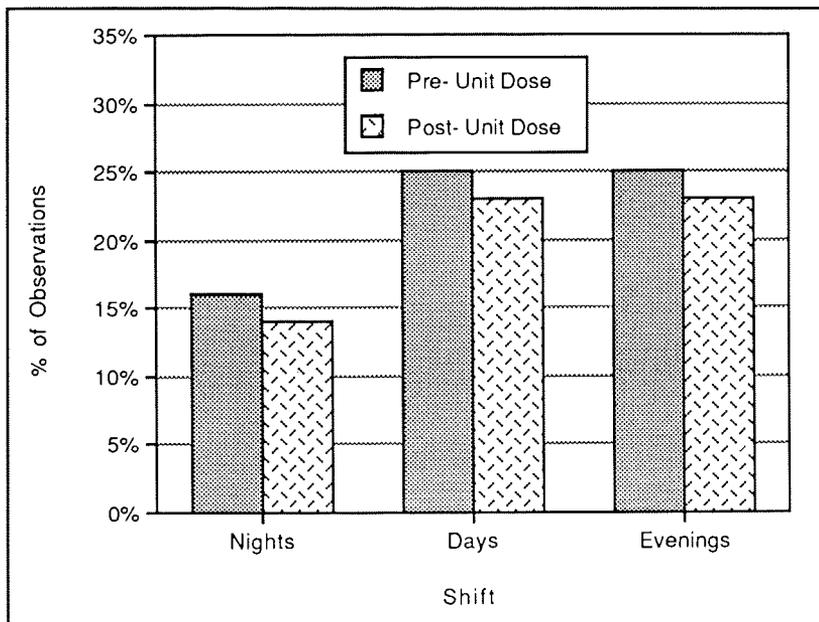
### UNIT DOSE CONVERSION IN PEDIATRICS

References from page 15.

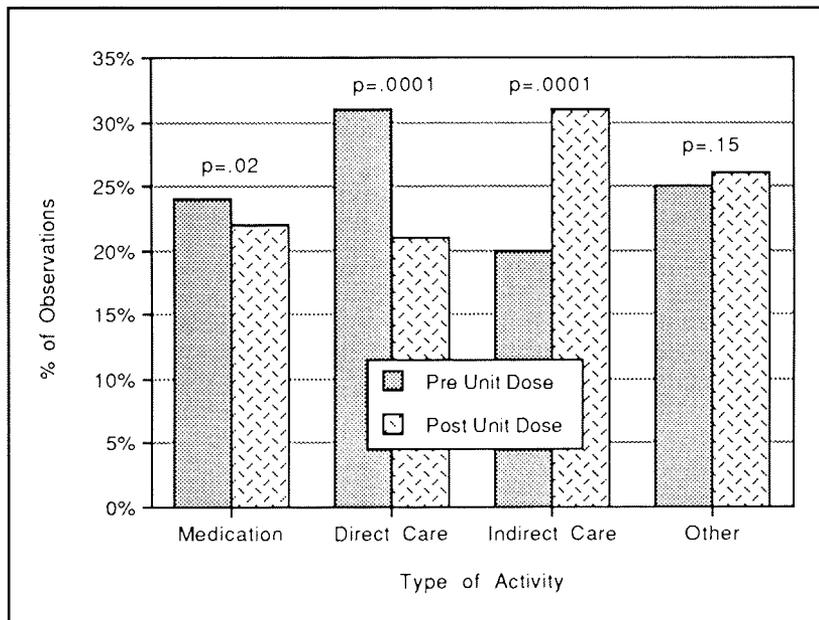
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## CORRECTION

Please be advised of a correction to page 9 of the February 1991 issue of the Journal. Figures 1 and 2 from the article **A Study Pre and Post Unit Dose Conversion in a Pediatric Hospital** were mistakenly transposed. We regret any inconvenience this may have cause. The corrected figures are listed below.



**Figure 1: Nursing time spent on medication related activities by shift (Units A and B combined)**



**Figure 2: Work sampling of nurses' activities (Units A and B combined)**