
PHARMACY PRACTICE



Pharmacy Support of a Provincial Neonatal Transport Team

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In 1981, the Manitoba Neonatal Transport Program was implemented to provide for the safe transport of sick newborns and infants from rural and community hospitals to the neonatal intensive care units (NICU) located in two tertiary care hospitals, the Health Sciences Centre and St. Boniface General Hospital of Winnipeg. Based in the NICU of the Health Sciences Centre, the Neonatal Transport Team services the entire province of Manitoba as well as patients referred from out of province facilities including the Northwest Territories.

Due to the large geographical area serviced and the need to transport infants from remote locales, the Neonatal Transport Team must carry all the items necessary to provide full intensive care support for the infant.^{1,2} This includes all of the equipment (e.g., self-powered incubator, monitors, infusion pumps, ventilator), disposables (e.g., catheters, gauze, sutures), intravenous fluids, oxygen and medications which may be required. Ambulance and aircraft size and operational concerns impose space and weight limitations for the Neonatal Transport Team.³

This report will describe the support provided by the Health Sciences Centre Department of Pharmaceutical Services to the Manitoba Neonatal Transport Program. In particular, the development of an exchangeable drug box to improve the storage and distribution of medications will be outlined. The workload involved in maintaining this system and the cost savings achieved through improved inventory control will be shown. In addition, the other services provided to the Neonatal Transport Team such as staff education and drug information will be described in order to provide a complete picture of the role of the Department of Pharmaceutical Services.

Inventory Control

Prior to December 1986, the Manitoba Neonatal Transport Team obtained their medication supply from the ward stock of the NICU at the Health Sciences Centre or by sending a stock requisition to the pharmacy. Medications stable at room temperature were stored in a large transport basket along with the other medical supplies. Medications requiring refrigeration were obtained from the NICU prior to each transport. Nar-

cotic and controlled drugs were removed from a locked drawer in NICU from a supply designated for the Neonatal Transport Team.

Although the above system has been utilized commonly by transport teams, it has many drawbacks and deficiencies.^{1,4,5} Large quantities of drugs were stocked to replenish the transport baskets. The medications in the basket were distributed throughout the other supplies which made them difficult to locate, check and restock. The baskets were to be restocked after each trip and the entire contents checked weekly. However, the large stock of backup medications were often not checked and, consequently, expired medications were added to the basket on occasion. The medications were organized poorly in the basket, from a pharmacist's perspective, with medications for internal use stored below or adjacent to liquids for external use only. Since stock was drawn from the pharmacy and NICU, the cost accounting for the Neonatal Transport Team medications may not have been accurate. The system of accounting for controlled drugs was somewhat haphazard. The transport team nurse would leave a note in the narcotic

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drawer listing which medications were taken. At shift change, if the controlled drugs count was out and in the absence of an explanatory note, the assumption was that the Neonatal Team nurse had the drugs or that the necessary documentation had not yet been completed. Only if the count was incorrect for two consecutive shifts did the nurse investigate.

In December 1986, the NICU Satellite Pharmacy opened at Health Sciences Centre. A staff of five pharmacists with a part-time pharmacy technician and a clinical coordinator provide a combined drug distribution and clinical pharmacy service to this 18-bed unit. Medications were distributed in a unit dose system with a complete intravenous admixture service. With the establishment of this 24-hour service, we attempted to resolve some of the deficiencies noted above. The large backup stock was returned to the pharmacy for credit. As medications from the transport basket were used, they were replaced by stock issued and charged from the NICU Satellite Pharmacy. Prior to each transport, narcotic and controlled drugs were supplied in a pocket-size slide box, heat sealed in a plastic bag for security. All narcotic drug usage was documented after each trip.

In 1988, the Nurse Coordinator, Neonatal Transport Team approached the NICU Satellite Pharmacy staff to assist with organizing the medications in the transport basket. In January 1989, a transport drug box exchange program was implemented to improve control of the distribution and storage of all drugs used by the neonatal transport program.

Because the Neonatal Transport Team was carrying a great deal of equipment and supplies, the size of the container for the medications was a critical factor in selecting the type of medication system to be used. The medications carried by the Neonatal Transport Team were di-

vided into three categories: small, frequently used medications; narcotic and controlled drugs; and, medications or solutions requiring special handling.

A small, durable, lightweight container was chosen to hold the majority of the medications. A commercially available, plastic fishing box with movable dividers and a clear cover on both sides was ideal. Each compartment was lined with foam and the larger vials were secured with an elastic band to prevent breakage. Each compartment was labelled with the drug name and stocking level for ease of replenishment. The contents of this box are listed in Table I. Six transport drug boxes were designed and stocked.

The transport drug box is sealed with a label which includes the box

number, the expiry date and the initials of the pharmacist who checked the box. Three of the boxes are kept in the three transport baskets and the remainder are stored in the NICU Satellite Pharmacy. When a box has been opened or has expired, the nurse exchanges this box for another. At the pharmacist's convenience, the contents of the box are replenished and checked. The box is sealed and the charging and workload documentation is completed.

Some items are too large to fit in the transport drug box or require special storage or handling (Table II). The external use liquids (e.g., alcohol) and normal saline ampoules are kept in the transport basket with the other supplies required to insert an intravenous line. The prefilled

Table I. Contents of Neonatal Transport Drug Box

Drug	Qty	Drug	Qty
Albumin 25% - 50 mL inj	1	Heparin 1000 Units/mL inj - 10 mL	1
Ampicillin 500 mg inj	2	Naloxone 0.4 mg/mL inj - 1 mL	2
Aminophylline 50 mg/mL inj - 10 mL	1	Pancuronium 2 mg/mL inj - 2 mL	2
Calcium Gluconate 100 mg/mL inj - 10 mL	2	Phenobarbital 30 mg/mL inj - 1 mL	5
Chloral Hydrate 50 mg/mL oral - 10 mL	1	Phenytoin 50 mg/mL inj - 2 mL	2
Digoxin 50 mcg/mL inj - 1 mL	2	Potassium Chloride 2 mmol/mL inj - 10 mL	2
Dopamine 40 mg/mL inj - 10 mL	1	Sodium Bicarbonate 1 mmol/mL inj - 50 mL	1
Exosurf® Neonatal	2	Sodium Chloride 4 mmol/mL inj - 30 mL	1
Furosemide 10 mg/mL inj - 2 mL	2	Sterile Water for Injection - 10 mL	4
Gentamicin 10 mg/mL inj - 2 mL	2	Vitamin K ₁ 10 mg/mL inj - 1 mL	2

Table II. Additional Items Carried in Basket

Alcohol, Isopropyl 70% -50 mL bottle
Alprostadil (Prostaglandin E ₁) 500 mcg/mL inj - 1 mL ampoule
Atropine 0.1 mg/mL - 5 mL prefilled syringe
Chemstrip® bG test strips - bottle
Epinephrine 0.1 mg/mL - 10 mL prefilled syringe
Normal Saline injection - 10 mL ampoule
Povidone-Iodine Swabsticks
Sodium Bicarbonate 0.5 mmol/mL - 10 mL prefilled syringe

medication syringes are large and less frequently used. They are kept in the base of the transport basket. The alprostadil injection (Prostin® VR) must be refrigerated and is dispensed to the nurse, as required, prior to departure. The above items are replaced and charged as they are used or expired.

The drug box and the prefilled syringes are stored in the removable base of the transport basket. The items are easily located and secured from breakage. The drug box is small and fits well on the top of the incubator or work space in the aircraft or ambulance when in use.

The narcotic and controlled drug system implemented above was continued. Although it is not necessary to keep the prepackaged drugs in the pharmacy, nursing considered the security, stocking, counting and documenting issues as well as the convenient location of the NICU Satellite Pharmacy and chose to leave these medications in the pharmacy. The contents of the narcotic drug box are listed in Table III.

The NICU Satellite Pharmacy maintains three narcotic boxes and assumes the responsibility for stocking and counting these controlled medications. Prior to each transport, the nurse is issued a narcotic drug box. At the conclusion of the trip the box is returned to the pharmacy and usage recorded on the narcotic and controlled drug card. A log is maintained of the issues and returns of the narcotic drug boxes and usage of the controlled medications. This method is simple and ensures security and proper documentation. Table IV lists the actual amount of drugs used in each fiscal year from 1987 to 1990 compared to the number of times the narcotic drug box was issued.

A concern of the Department of Pharmaceutical Services was the time required to maintain this drug distribution system. Although the system was convenient for the Ne-

onatal Transport Team and solved many of the deficiencies noted earlier, it had to be time and cost efficient to maintain. Figure 1 shows the workload measurement statistics related to the maintenance of this system for two consecutive fiscal years. The three components of the workload (i.e., ward stock, drug boxes and narcotics) are displayed.

These numbers are based upon the values quoted in the Pharmacy Workload Measurement System.⁶ In the fiscal years 1989 and 1990, the total workload was 47.9 hours and 109.8 hours, respectively. In 1990, the Department instituted a policy for the counting of all stock narcotics

and controlled drugs at the end of each shift in all areas of the pharmacy. In the NICU Satellite Pharmacy, this required counting the stock twice daily because of the 24-hour service (previously counted once weekly). This resulted in an additional workload of 49.8 hours which is included in the total workload figure for 1990-1991.

One goal of this program was to document a cost savings through improved inventory control. Figure 2 shows the total drug costs for each fiscal year from 1984 to 1990 compared to the number of transports. The costs are actual charges which have not been corrected to 1991

Table III. Contents of Narcotic Drug Box

	Qty
Fentanyl 50 mcg/mL inj - 5 mL	2
Diazepam 5 mg/mL inj - 2 mL	1

Table IV. Narcotic and Controlled Drug Usage

	FISCAL YEAR ¹			
	1987	1988	1989	1990
Diazepam	0	0	0	2
Fentanyl	6	16	24	25
Morphine	5	1	2	1
Phenobarbital	39	30	38	- ²
Number of boxes issued	157	174	187	199

¹ April 1 - March 31

² Moved to transport drug box

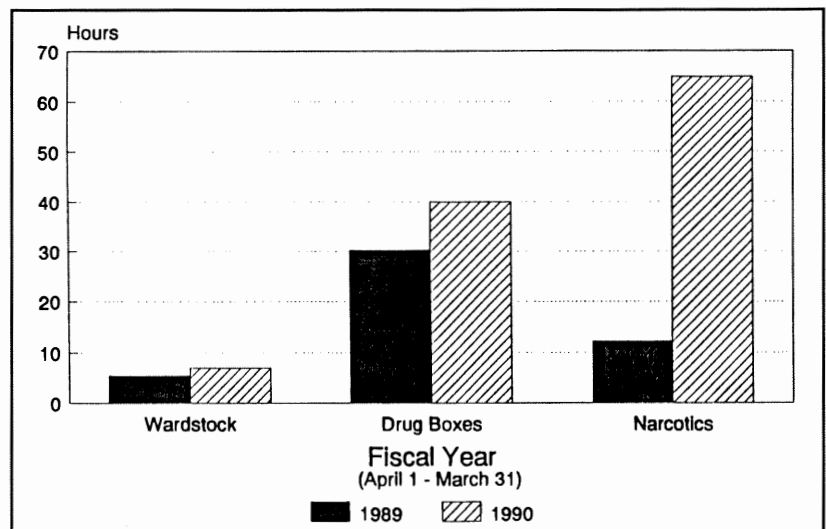


Figure 1. Workload Measurement for Two Consecutive Years.

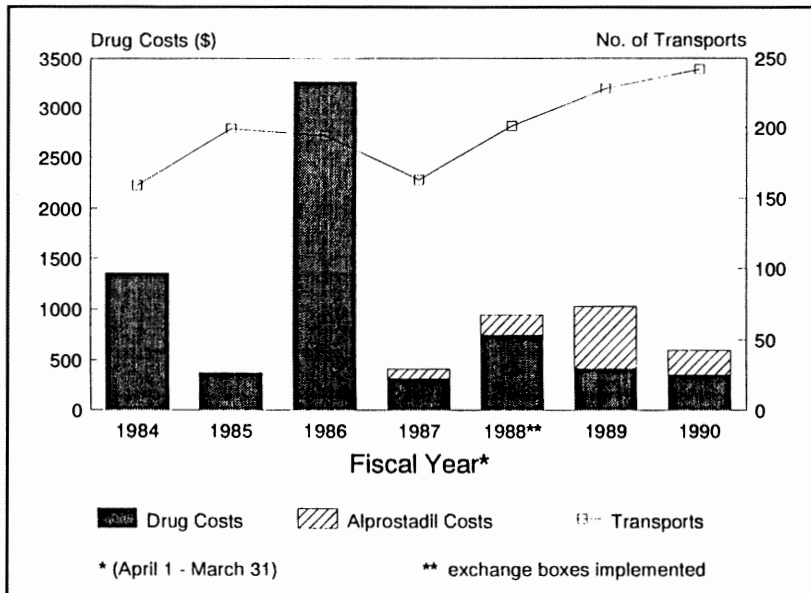


Figure 2. Total Costs of Drugs and Number of Transports 1984-1990.

dollars. Although the number of transports has increased 150 percent, the drug costs have not shown a commensurate increase. There is a significant degree of variability in the annual drug expenditures unrelated to the number of transports. Prior to the addition of Exosurf® Neonatal in 1992, the most expensive medication carried by the Neonatal Transport Team is alprostadil injection (Prostin VR®; \$97.25/ampoule in 1988; \$122.10/ampoule in 1990). From 1987 to 1990, alprostadil injection accounted for a significant portion of the total inventory costs. Unfortunately an inventory breakdown was not available for the previous years. Overall, direct inventory costs decreased relative to the number of transports and the effect of inflation on drug costs.

In 1986, the drug costs were disproportionately high compared to other years. The reasons for this may have included the following. In 1986 the Neonatal Transport Team moved into new facilities adjacent to the renovated NICU. Some of the costs in this year were related to the establishment of a drug supply for the Neonatal Transport Team separate from

the NICU. Much of this supply was returned for credit in early 1987 when pharmacy became involved in the stocking of transport medications. Also during this time, there was an unusual number of transports to an out of province hospital for neonates requiring cardiac surgery. A number of medications were used during these transfers including the routine use of alprostadil injection in any neonate with a potential ductus dependent cardiac lesion. Once again, the exact number of ampoules used in 1986 was unknown.

Other Services

In addition to the inventory control functions described above, the Department of Pharmaceutical Services provides other services to the Neonatal Transport Team.

1. Staff Education

The opening of the NICU Satellite Pharmacy in 1986 was accompanied by the implementation of a unit dose, intravenous admixture program for the NICU. As a result, the transport nurses, who also work in the NICU, would no longer be involved in the mixing and preparation of medications on a daily basis.

In order to keep these skills honed, a one-day pharmacy experience is included in the orientation program for new neonatal transport nurses. The nurse is "buddied" with a NICU pharmacist for the entire shift. The main objective of the pharmacy experience is to review sterile admixture technique and demonstrate competency in the preparation of intravenous medication infusions, small intravenous admixtures and electrolyte solutions.

In addition to the above technical skills, the administration guidelines for the medications carried on transport are reviewed. A calculations quiz must be completed successfully. The quiz includes questions on dosage, dose-volume, dilution and reconstitution, preparation of medication infusions and calculation of rates of infusion.

The nursing staff is encouraged to spend at least one shift per year in the NICU Satellite Pharmacy to maintain their admixture and calculation skills. When new drugs are introduced which require special mixing techniques or handling, all of the transport nurses are required to attend "hands-on" education sessions in the pharmacy.

2. Drug Information

The NICU Satellite Pharmacy assists the Neonatal Transport Team in the field by supplying drug information resources. A list of all medications carried on transport, recommended dosages and routes of administration, dilutions, administration guidelines and select monitoring parameters is included with each transport basket. The chart is laminated for durability and easy cleaning.

In the NICU, standardized concentrations of medication infusions are used. The Neonatal Transport Team has adopted this

approach and pharmacy has provided pre-calculated dose-rate charts for a limited number of concentrations for each applicable medication. These charts assist the nurse in administering such potent medications as dopamine and alprostadil without the risk of calculation errors.

The Neonatal Transport Team has a commitment to the education of medical and nursing practitioners in the rural and community hospitals which it serves. To assist the team in its education efforts and to provide standardized drug dosage information to these hospitals, the pharmacy has prepared a "Neonatal Drug List for Referring Hospitals". The list includes the medications which should be stocked in a labour and delivery room for the care of newborns, recommended concentrations, dosages and administration guidelines.

When the Neonatal Transport Team is in the field, the NICU Satellite Pharmacy, as with the rest of the NICU, provides a sup-

portive role. Requests for drug information or assistance with a difficult case are called to the NICU base.

In conclusion, the Department of Pharmaceutical Services at the Health Sciences Centre provides an important supportive role in the operation of The Manitoba Neonatal Transport Program. An inventory control system based on an exchangeable drug box has proven to be an excellent solution to storage and distribution problems encountered with the previous system. The system is elegant, simple and cost efficient while taking a minimal amount of valuable pharmacy and nursing time.

Beyond the traditional distribution function, the Department supplies additional support to the Neonatal Transport Team through its NICU Satellite Pharmacy. Education and drug information services are available routinely to the team members.

Although the above system arose out of the close liaison between the Neonatal Transport Team and the NICU Satellite Pharmacy, the ex-

change drug box concept could be adapted easily to any centralized pharmacy service. The sealed, exchange drug tray concept is used in other parts of our Department to supply the emergency drugs for the crash carts, the ward emergency carts and specialized procedure trays. ☐

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