
PHARMACY PRACTICE



Cost Effective and Efficient Delivery of Medications through Multi-dose IV Pumps

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Fiscal restraint can be “the mother of innovation” and certainly a major agent for change. Our search for improved cost effective systems lead us to evaluate the “Abbott Plum Pump” for use in our IV program.

During the spring of 1992, the pharmacy and nursing departments developed I.V. Therapy goals to be implemented over a two-year period. The system had to be cost-effective and efficient for both nurses and pharmacists. It was determined a Central Intravenous Additive (CIVA) Program would allow us to achieve our goals. Medication would be prepared in the pharmacy department and administered by the nursing department. In addition to pharmacy preparing single dose medications the option of multi-dose was considered, which consisted of mixing a 24-hour supply of medication in one bag or syringe to be delivered by IV pump. The advantages of multi-dose CIVA include the possibility to aseptically prepare medication and improve the accuracy of dosing intervals while reducing the cost of supplies and administration time.

We assembled a multi-disciplinary team consisting of Bio-

medical Engineering, Nursing, Pharmacy and Purchasing representatives. Our first task was to choose an IV pump that would satisfy our existing programs, significantly reduce the cost of IV supplies, and be able to meet the future goal of single and multiple dose delivery. The Abbott Plum Pump, with its ability to deliver two infusions concurrently and to deliver multiple doses at programmable intervals, we believed would meet these goals.

Biomedical Engineering, Nursing, and Abbott Laboratories together resolved the educational and technical challenges and by the fall of 1992 the Abbott Plum Pumps were implemented on all nursing units. The technical challenges included proper cleaning technique, unusual alarms, correct priming technique, and program corrections. One of the major educational challenges was to successfully implement the use of the IV pump in all nursing units. Because the pump was pivotal to the IV program, this multi-dose system would not become a reality if rejected by nursing staff. To accomplish a smooth introduction, the pump was initially simplified by removing the multi-dose

capacity until nursing staff became comfortable with its basic operation. Intensive inservice sessions were conducted prior to implementing the pump in each area. The purchasing department negotiated a contract that reduced our tubing costs and upgraded all of our IV pumps to multi-dose capacity.

We felt that we had successfully accomplished adequate staff competency levels as judged by the feedback from the Nursing Pharmacy Liaison Committee, and by the spring of 1994, we began introducing pharmacy prepared multi-dose IV therapy. This program consists of either a syringe or a bag with a 24-hour supply of medication being delivered via the programmable Abbott Plum Pump. The nurse programs the pump once a day to deliver the required medication at specific intervals over a 24-hour period. Each nurse is accountable for the dose delivered on his/her shift. Dosing is checked by reviewing the programming history on the pump and subsequently entered on the medication administration record. Multi-dosing reduces the cost of the IV supplies as well as time spent mixing and delivering med-

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Table I. Cost comparison of gravity and multi-dose pump syringe system of two drugs IV TID – plus normal saline 100 ml/hr over three days

Supplies	Gravity System			Multi-Dose		
	Nursing Unit Supply Costs	# of Bags Mixed	Administration Trips/Day	Nursing Unit Supply Costs	# of Syringes Mixed	Administration Trips/Day
DAY 1						
Syringes	✓			✓	2	2
Needles	✓			✓		
Continuous Flow Set	✓					
Minibags	✓	6	6			
Pump tubing				✓		
Normal Saline Bags			3	✓		3
Leur Lock Tip Cap	✓			✓		
	\$9.67	6	9	\$13.80	2	5
DAY 2 & 3	15.24	12	18	2.24	4	9
Total for three days therapy	\$24.91	18	27	\$16.04	6	14

*Savings = \$ 8.87 IN SUPPLIES
 = 12 FEWER DRUGS MIXED
 = 13 FEWER TRIPS FOR ADMINISTRATION

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ications (Table I). All aspects of the labelling, timing, and rate of introduction of the Multi-dose CIVA Program were developed and implemented by the multi-disciplinary team of pharmacy, nursing and biomedical staff.

The full program has now been introduced and offers single-dose syringes and bags for those situations where multi-dose is not appropriate. Patients are selected daily by the nurse and pharmacist and their IV program designed to deliver the most cost-effective therapy considering the care requirements. (Table II)

We have not yet completed the full cost/benefit studies, but preliminary cost analysis suggests that a multi-dose CIVA program may have several advantages. (Tables III & IV) In December 1994, approximately 52% of our prepared IV doses were delivered by multi-dose or syringe, and our drug wastage was 5.8%. Preliminary data show supply savings of \$38,000 without CIVA, and based on December data, indicate a further \$11,800 savings from the CIVA minibag reduction (Table V). The lack of syringe

Table II. IV Selection Criteria

Syringe, if main IV rate sufficient for dilution. →	Multi-dose, if therapy likely to remain unchanged.
Bag, if main IV rate insufficient for dilution. →	Multi-dose, if therapy likely to remain unchanged.
Availability of stability data, medication compatibility, number of medications, fluid restrictions, and patient mobility are other factors that will affect the selection of delivery method.	

Table III. Supply Cost Savings

	'91 - '92	'94 - '95	Savings
Buretrol	\$12,386	\$2,923	\$9,463
Continuous Flow	25,768	17,490	8,277
Sec Med	7,681	3,339	4,342
Filters	3,420	420	3,000
Y Sets	519	173	346
Partial Fill	47,726	23,475	24,251
			\$49,679
*Data comparison at present rates			
Decrease savings by 14% to account for decreased number of patient days and length of stay.			6,955
Estimated Net Savings			\$42,724
Actual Cost	'91 - '92		
Buretrol	\$13,550		\$10,627
Continuous Flow	28,156		10,666
Sec Med	8,454		5,115
Filters	3,420		3,000
Y Sets	570		397
Partial Fill	58,475		35,000
Actual Cost Reduction			\$64,805

stability data, unavailability of Metronidazole in a form suitable for multi-dose, and incomplete

stability information on some products are limiting factors in a multi-dose program.

Table IV. IV Set Up Costs

Tubing	'91 - '92	'94 - '95
Plumb	\$10,643	\$29,483
Blueline	14,493	
Nitro	2,486	1,993
Micro	2,690	
TPN		3,185
	\$32,312	\$34,662

While standard, single-dose CIVA programs are considered to be cost effective¹, multi-dose programs consume even less resources and cause only minimal increases in pharmacy time. Nurses report great satisfaction with the decrease in time spent mixing and delivering medications with the CIVA Program. The requirements for individual patient selection, IV program design, and increased complexity of labelling add an average of two to three minutes to initial multidose preparation time. IV infection rates and reports of phlebitis have not increased and only one medication error from incorrect programming has been reported in the nine months the program has been in operation.

We believe this program is providing us with safe, efficient, cost-effective IV therapy. In fact, by increasing dosing interval accuracy, ensuring aseptic pharmacy preparation, and instituting a double check safety feature in preparation and labelling (Figure 1), we have increased our quality while reducing costs. ☒

REFERENCES

- Mann J, Wilson W, Darby D, et al. Working Paper on Unit Dose IV Additive Drug Distribution System. CSHP; DIH/6a02-Oct 1990.

Table V. Central IV Additive Supply Savings

Multi-dose bags	-	each bag averages 4 doses
Multi-dose syringe	-	each syringe averages 3 doses
December '94		
Total dose prepared	-	1852
Single bag	-	824 doses
Multi-dose bag	-	220 doses
single syringe	-	492
52% of the doses were mixed in multi-dose bags and syringes therefore saving cost of individual bags.		
928 minibags	=	\$ 1,113.60 for individual bags
928 as multi-dose	=	123.40 for syringes, needles and multi-dose bags
		\$ 990.36/month
Total	\$990.36 x 12 =	\$11,883.00

(BAG)

4SE Pt.# 148.7
PATIENT'S NAME:
 Primary Rate: **NORMAL SALINE AT 30/ML/HR**
 Total Primary Rate:
CONCURRENT ADMINISTRATION
 Additive: **PIPERACILLIN 2G/50ML NORMAL SALINE**
 Secondary Rate: **50 ML/HR**
 Secondary Dose Limit: **50 ML**
MULTI-DOSE SETTING
 Secondary Container Volume: **300 ML**
 Frequency: **Q4H-1800 2200 200 600 1000 1400**
 Date/Time Prepared: **16MAY95 1600**
 Expire Date: **17MAY95**

(SYRINGE)

5S Pte.# 15970.7
PATIENT'S NAME:
 Primary Rate: **2/3'S L/3'S AT 75 ML/HR**
CONCURRENT ADMINISTRATION
 Additive: **CEFAZOLIN 1G/5ML STERILE WATER**
 Secondary Rate: **5 ML/HR**
 Secondary Dose Limit: **5 ML**
MULTI-DOSE SETTING
 Secondary Container Volume: **15 ML**
 Frequency: **Q8H-1800 0200 1000**
 Date/Time Prepared: **17MAY95 1600**
 Expire Date: **18MAY95**
 Additive: **CEFAZOLIN 1G/5ML STERILE WATER**
 Date/Time Prepared: **17MAY95 1600**
 Expire Date: **18MAY95**

Figure 1. Multidose Labelling