MEDICATION INCIDENTS REPORTING

Infusion devices

Infusion devices accurately regulate the amount of intravenous solutions containing drugs administered to patients. Sufficient knowledge of the different types of infusion devices available in the hospitals including the understanding of the clinical implications and risk associated with different types and different configurations are essential for the safe administration intravenous medications. Electronic infusion pumps including those used for patient-controlled analgesia present safety challenges. Rates and drug concentrations could be misprogrammed, intravenous lines could be crossed between two pumps, resulting in infusion of the wrong medication or at the wrong rate to patients.

A proportion of medication incidents reported in the in-patient settings has been associated with the operation of infusion pumps. Hence some particular risks and features to note regarding infusion devices are discussed so as to enhance patient safety.

Basic types of infusion device

There are two basic types of powered infusion device. The oldest established is the syringe pump in which the barrel of the syringe is held firm in the device and the mechanism pushes the syringe plunger at a predetermined rate, so delivering fluid into the patients. The alternative mechanism for powered infusion devices is peristaltic pump device which essentially involves a rhythmic squeezing of the infusion set tubing, proximal to distal, thus displacing fluid along the tube from bag or bottle to patient. Considering transportation and significant movement of patient and infusion devices, syringe pumps are preferred to volumetric pumps.

The control of the motor drive mechanisms in all modern pumps is now carried out using a built-in microcomputer with a programme held in memory. Authorised users can change certain background parameters and programme the pump to a certain configuration. The micro-computer also handles all the information input by the user, such as flow rate and volume to be delivered. The programme in the memory then uses the information to control the pump.

Categories of infusion devices

SYRINGE PUMPS- are highly accurate, low volume devices particularly suitable for infusing at low flow rates. Most are designed to be programmed at an infusion rate set in ml per hour, with a type range of 0.1 to 99.9ml/h.

☺ Safety tips

- Adjust the pump settings to the brand of the syringe being used to ensure that the accuracy and alarm functions are not affected. Manual adjusting is still required in some old models.
- Avoid using syringe pumps that the syringe plunger could not be clamped into the drive mechanism, as they carry a potential risk of syphoning if the pump is placed higher than the infusion site.
- Note that at low flow rate settings, the actual flow rate immediately after start-up can be significantly less than the set rate for a considerable period.
- Setup and purge the pump properly so as to take up as much of the backlash and dead space as possible, to avoid delay in receiving treatment by patient.

VOLUMETRIC PUMPS- are designed for, and suited to, the delivery of larger volumes of fluid at medium to high flow rates. Almost all volumetric pumps are accurate to well within the specified ±5% when measured over one hour, but some exhibit as much as ±90% variation if measured over 30 second periods. Modern safety specifications set short term accuracy limits measured over a two-minute observation window at 25ml/h flow rate.

☺ Safety tips

- Use the correct giving set to ensure accuracy and proper alarm responses as all volumetric pumps are designed to use a specific giving set.

PATIENT CONTROLLED ANALGESIA (PCA) PUMPS-most modern devices are based on a syringe pump type mechanism, but some use a volumetric design. They all have more sophisticated programmable features and the additional feature of allowing the patient to use a hand-held switch to "demand' a pre-set dose of analgesic within parameters of time, dose and flow-rate pre-set by the clinical staff. Thus, within safety limits the patient has available IV pain relief when he/she needs it. The principle behind using PCA is that only the patient could assess the severity of his pain and therefore the amount of analgesia required to relieve it. The automatic lockout feature is a safety feature designed to prevent the patient from overdosage of opiate. However, this PCA's built-in safety feature could be circumvented when another person decides to activate PCA for the patient when he/she thinks the patient is in pain.

☺ Safety tips

- To ensure patient safety, patient-controlled analgesia should be exactly that–patient-controlled.
- Educate patients about the correct use of PCA before initiating the therapy and discuss on the subjectivity of pain perception with the patient and family members to minimise the chance of activating the PCA pump by family members.

PUMPS FOR AMBULATORY USE- are small, pocket or pouch sized, battery powered devices, which are intended to be worn by the user. The flow to the patient is usually pulsatile and discontinuous, thus short term accuracy will be poor, with reasonable long term accuracy. Some devices are based on the use of syringes and different sizes can be used so the rate is set in terms of the length of plunger travel displaced in millimetres per hour.

☺ Safety tips

- Give care in performing calculation of the required displacement rate when setting up the pumps to minimise the potential risk of calculation error.
- Beware that some of these syringe driver types are slow running and the setting is in terms of mm per 24h rather than mm per hour.

In summary, when administering iv medications using infusion pumps, nursing staff should ensure that the infusion rate and dose programmed into the infusion devices are correct for the patient. The pump settings should be independently checked when "high risk" drugs are administered e.g. dopamine, potassium chloride, morphine and insulin. Having two individuals independently checked infusion pump settings for high-risk drugs is one way to discover and avoid errors. The likelihood of a pump setting error or line mix-up is increased when more than one pump is in use or when dual channel pumps with the capacity for multiple rate settings are used. Sufficient user training on the use of equipment, reduction in the variety of equipment models purchased, implementation of clear procedures for operating and checking of equipment as well as periodic maintenance of equipment could reduce the risk to patients arising from the use of iv infusion pump, thereby providing a safer environment for our patients.

References

1. McCarthy JP and Gibson C. Infusion devices. The Hospital Pharmacist 1998;5:41-48.
2. Pasero CL. PCA: for patients only. Am J Nurs 1996;96:22-23.

Recommendations of the Working Group on Infusion devices of HA (March 2001)

1. Standard specifications for Volumetric Infusion Pump, Syringe Infusion Pump and Patient Controlled Analgesia (PCA) Infusion Pump (stationary model and Ambulatory model) should be used and adhered to on future procurement of infusion devices. Appropriate personnel should be appointed to vet potential models against the standard specifications.
2. Standard acceptance checklists for Volumetric Infusion Pump, Syringe Infusion Pump and PCA Infusion Pump (stationary model and Ambulatory model) should be used and adhered to for acceptance of newly acquired infusion devices. Appropriate personnel should be appointed to conduct acceptance testing.
3. The brands and models of the infusion devices listed under the Nominated Product Scheme (NPS) are approved by EMSD for purchase by HA institutions without recourse to quotation seeking.
4. Drip Rate Infusion Pump should be phased out and no further acquisition should be raised.
5. Regarding the use of Syringe Drivers in particular:
   - Use alternative infusion device whenever possible
   - Check frequently for spillage
   - Avoid use with life-threatening drugs
6. Standard "Recommended Procedures for Dealing with Occlusion Alarm in Infusion Pumps" should facilitate a standard handling procedure on the matter.
7. All infusion devices should follow proper maintenance schedule as laid down by manufactures.
8. Maintenance checklists for Volumetric Infusion Pump, Syringe Infusion Pump and PCA Infusion Pump (stationary model and Ambulatory model) should be used and adhered to for maintenance of these infusion devices.
9. All staff involved in the use of infusion devices must be properly trained according to the manufacturer's training manual.
10. An effective communication mechanism should be in place to relay adverse reports on medical equipment including infusion devices. The Radiation Emitting & Biomedical Equipment Section of BSS Division must be informed immediately on safety alert.
11. A contact person should be nominated in each HA institution to be responsible for handling related matters.

PCA analgesia

A newly postoperative patient was placed on PCA iv morphine for postoperative pain relief with bolus 1mg; four-hour maximum dose of 25mg; background infusion of 0.2mg/h. The patient was arousable 3h after OT. Subsequently the patient was found to suffer from acute morphine overdose with bilateral pinpoint pupils and not reactive. Investigation showed that the morphine pump being pressed several times by an unauthorized personnel (a family member) with a total of 12 bolus doses given amounting to 12.6mg iv morphine in 3 hours. PCA was stopped immediately, oxygen and naloxone were administered as antidote. The patient subsequently regained consciousness.

Advice

- Educate patient and family that the PCA pump could only be activated/controlled by the patient him/her-self.
- Encourage family members to remind the patient to activate the PCA pump or notify a staff member if pain control seems inadequate.
- Discontinue PCA if necessary for patient safety.
- Reiterate hospital policy on patient-only use of PCA.

Table 1 Distribution of Incidents

	1 Q/2001		2 Q/2001	
	Freq.	%	Freq	%
Distribution of Cases				
In-patient	2105	41.3	2204	44.0
Out-patient	2998	58.7	2806	56.0
Initiator of Reporting				
Medical	28	0.5	16	0.3
Nursing	462	8.9	546	10.9
Pharmacy	4695	90.5	4455	88.7
Others	1	0.0	4	0.1
Staff Involved				
Medical	4774	88.7	4519	89.2
Nursing	446	8.3	402	7.9
Pharmacy	138	2.6	132	2.6
Others	26	0.5	15	0.3
Patient Outcome				
Patient related	249	4.9	296	5.9
Non-patient related	4856	95.1	4713	94.1

Table 2: Distribution of errors

	1 Q/2001		2 Q/2001	
	Freq.	%	Freq.	%
Prescribing Error				
Wrong Drug	297	10.1	298	10.3
Wrong Dosage form	200	6.8	173	6.0
Wrong strength/dosage	1050	35.6	916	31.8
Wrong Duration	151	5.1	208	7.2
Wrong Frequency	402	13.6	400	13.9
Wrong Route	38	1.3	58	2.0
Wrong Abbreviation	36	1.2	44	1.5
Wrong Instruction	184	6.2	190	6.6
Wrong Patient	60	2.0	69	2.4
Double Entry	82	2.8	79	2.7
Drug Omission	56	1.9	65	2.3
Others	396	13.4	383	13.3
Rx Incompleteness				
Missing Drug Name	59	3.0	52	2.8
Missing Dosage Form	149	7.6	121	6.5
Missing Drug Strength	309	15.8	315	17.0
Missing Duration/Quantity	319	16.3	295	16.0
Missing Frequency	357	18.2	330	17.8
Missing Dose	105	5.4	75	4.1
Missing Dr. Signature	203	10.4	218	11.8
Others	457	23.3	443	24.0
Dispensing Error				
Wrong Drug	54	37.0	54	37.2
Wrong Dosage form	16	11.0	8	5.5
Wrong Strength/dosage	27	18.5	30	20.7
Wrong Quantity	9	6.2	6	4.1
Wrong Patient	10	6.8	13	9.0
Wrong label information	20	13.7	18	12.4
Double dispensing	2	1.4	1	0.7
Drug Omission	3	2.1	3	2.1
Others	5	3.4	12	8.3
Administration Error				
Wrong Drug	20	10.8	23	10.5
Wrong Dosage form	0	0.0	0	0.0
Wrong Dose	13	7.0	32	14.6
Wrong Flow rate	10	5.4	23	10.5
Wrong Patient	13	7.0	11	5.0
Wrong Route/method	4	2.2	4	1.8
Wrong Time	22	11.8	24	10.5
Extra Dose	44	23.7	36	16.4
Dose Omission	50	26.9	49	22.4
Unordered Drug	2	1.1	0	0.0
Others	8	4.3	18	8.2

Tables 1-5 summarised the medication incident (MI) statistics for the first two quarters of 2001 (Jan-Mar 01, and Apr-Jun 01). Of 41 eligible hospitals/institutions, there are a total of 5,105 medication incidents notification were received during 1st and 2nd quarters of 2001, respectively.

"Nil incident to report" were submitted by 4 hospitals in the first two quarters of 2001. The rates of reported MIs were 69 per 100,000 items dispensed in the first and second quarters of 2001.

Table 3: Distribution of incidents by error type

	1 Q/2001		2 Q/2001	
	Freq.	%	Freq.	%
Prescribing	2952	56.3	2883	56.6
Incomplete Rx	1958	37.4	1849	36.3
Dispensing	146	2.8	145	2.8
Administration	186	3.5	220	4.3

Table 4 Distribution of incidents by attributed causes

Underlying Causes	1 Q/2001		2 Q/2001	
	Freq.	%	Freq.	%
Communication failure/misinterpretation of order	65	1.2	54	1.1
Non-compliance with policies/procedures	328	6.2	319	6.3
Incorrect computer entry	151	2.8	157	3.1
Miscalculation	12	0.2	15	0.3
Mislabelling	76	1.4	64	1.3
Similar Drug Name/Appearance	33	0.6	45	0.9
Transcription	239	4.5	180	3.5
Distraction	1104	20.8	845	16.6
Inadequate Knowledge/Skills	193	3.6	155	3.0
Lack of Supervision	5	0.1	6	0.1
Complicated Dosage Regimen	1	0.0	2	0.0
Illegible handwriting	85	1.6	98	1.9
Unclear Prescription	101	1.9	100	2.0
Commercial Packaging/Product Labelling	1	0.0	0	0.0
Medicine unavailable	4	0.1	5	0.1
Storage Problem	2	0.0	4	0.1
Unknown	2467	46.5	2528	49.6
Others	439	8.3	522	10.2

5,105 and 5,010 MIs reported in the first two quarters of 2001, respectively. Approximately 95% of these were rectified before reaching the patients and over 99% of incidents with no impact on patients.

Table 5 Distribution of incidents by severity

	1 Q/2001	2 Q/2001
	Freq.	
No. of preventive interventions	4856	4713
No. of incidents	249	297
Severity Index of incidents		
1	202	235
2	41	56
3	6	5
4	0	1
5	0	0
6	0	0

6= an incident occurred that resulted in patient death
5= patient received medication incorrectly and sustained permanent injury
4= patient injured by the error and required either antidote to reverse the process or transferred to a higher level of care
3= patient required increasing monitoring with a change in vital sign as a result of the incident but no ultimate injury
2= patient required increasing monitoring as a result of the incident but no change in vital sign and no patient injury
1= incident occurred that did not result in patient injury