Monidrop-Moneydrop

Safer, Low Cost, Intravenous Fluid Delivery: The Monidrop® Infusion System

Intravenous fluid delivery is calculated via the drop rate and the flow rate (RCN 2018). The drop factor is the number of drops it takes to make up one ml of fluid and relates to the size of each drop; this cannot be altered.

There are two common sizes; 20 drops per ml (typically for clear fluids) and 15 drops per ml (typically for thicker substances, such as blood). When using electronic infusion controllers, the flow rate needs to be set. The rate is the volume (ml) divided by the duration in hours (mls/hour).

Issues in IV administration

Whether paper and pen or a calculator is used to calculate the volume and rate at which an intravenous drug is to be administered, the aim is to ensure that it is delivered safely and in accordance with the written prescription. Historically, this does not always happen. The National Institute for Health and Care Excellence (NICE 2017), cites the 1999 National Confidential Enquiry into Perioperative Deaths report which highlighted that a significant number of hospitalised patients were dying as a result of infusion of too much or too little fluid. Furthermore, NICE suggests that '…it is likely that as many as 1 in 5 patients on IV fluids and electrolytes suffer complications or morbidity due to their inappropriate administration'.

A study of intravenous drug administration by Cousins et al (2005), found one error in dose or infusion volume and 132 (48% of nurses studied) errors in administration rate; errors in administration rate were also found by Taxis and Barber (2004) and Tissot et al (2003).

Bruce and Wong (2001) and Han et al (2005) found that infusions were being administered slower than prescribed because nurses were not monitoring gravity infusion systems (i.e. no pump) nor were they readjusting the rate to account for any changes in gravity resulting from the patient altering their position.

Various studies indicate some infusion rate errors are due to miscalculation of infusion rates. Calabrese et al (2001) observed medication administration in five intensive care units and found 75 errors out of 187 were due to wrong infusion rates; at least three of these errors were due to miscalculation of the infusion rate required.

A systematic review of the UK literature by McLeod et al (2013) found that medication administration errors were five times more likely in IV administration. In one study, timing errors of ±30 min increased the error rate from 27% to 69% (320 IV doses). Similarly, a Medicines and Healthcare Products Regulator Agency report (2013) found that of 1,805 IV administration errors using an infusion pump, 21% were attributed to user error, with the most common issue being over-infusion. Early results from the ECLIPSE study (Blandford et al 2015) showed an 11.5% infusion error rate (n=2008), with gravity infusion giving the highest errors.

Figure 1

Towards a solution

Currently, powered volumetric infusion pumps aim to provide an accurate flow of fluids over a prescribed period. These employ a linear peristaltic pumping mechanism applied to the infusion tubing ('giving set'). However, this requires specialist administration sets which are more expensive than simple gravity administration sets where the infusion rate is calculated and set by the health care professional. In addition, the early results from the ECLIPSE study (2015) appear to indicate there is no evidence for the benefit of smart pumps. These studies, coupled with the current guidance on IV infusion safety, suggest that a simple but effective method of fluid delivery and monitoring is required to save resources

The Monidrop® (Monidor Finland) tool allows for accurate delivery in infusion speed, target volume and speed and total volume infused (Figure 1). The system is portable and chargeable, and it is compatible with the most commonly used drip sets (20 drops/ml). It attaches to the drip chamber and shows on the screen:

- Infusion speed
- Total volume
- Time
- Targets (volume and speed).

Flow rate can be adjusted by using the administration set's roller clamp; the infusion speed is shown on the system's screen (ml/h). Monidrop® monitors the infusion but does not adjust it. It has a series of built-in alarms which indicate an infusion speed deviating from the preset limits or if it is outside the measurement range of 6ml/h-1200ml/h. The wireless connection enables remote monitoring, thus allowing the system to be used in both acute and home care settings.

An initial study undertaken in the Kuopio University Hospital, Finland (September and December 2017) aimed to determine the benefits and performance of the Monidrop® device in the monitoring of intravenous infusion in the hospital wards. This was a comparative study against conventional clinical practice. The secondary aim was to establish if using the device could improve the accuracy of fluid therapy compared to visual assessment.

Thirty-one patients prescribed intravenous fluid therapy or drug infusion were recruited from the medical ward and the emergency department; 15 were randomised to the Monidrop® group and 16 to the control group. The momentary infusion rate of the

Monidrop® device was measured at 30 minutes and six hours from the beginning of treatment and the patient's total fluid intake and drugs administered were recorded. The alarms raised by the Monidrop® device were recorded and the nurses were asked to assess the appropriateness of those alarms. No adverse events or safety issues occurred during the trial. The Monidrop® device was used for a total of 230 hours. A total of 53 alarms were recorded by the device; 23 (43%) resulted from a variation in the flow rate. Three were evaluated as inappropriate, but no security-related concerns or observations were raised. The primary endpoint of the trial was reached; the device was safe and usable in a clinical environment. Almost all (92.9%) of the nurses found nothing of concern, and only one respondent had paid attention to a seemingly great variation in the readings of the device during the treatment.
The final analysis of the differences between Monidrop® and the control groups is ongoing and will be published in due course.

Monidrop® System

Cost savings

Currently, a commonly used volumetric pump set for blood and blood components costs £2.91 per unit when purchased through the NHS supply chain. Capital outlay will also be required for the actual pump. In a typical 400-bed hospital which uses on average, 9,039 blood administration sets, the cost would be £26,303.49 per annum. A theoretical reduction in use of these sets by 10%, 15%, 20% or 50% would result in savings of £2,630.35, £3,945.52, £3,945.52 and £13,151.75, respectively. A reduction in the use of volumetric pumps and associated costly administration sets could be realised using the Monidrop® system as it facilitates effective blood and blood product administration using a standard administration set costing £0.61.

Conclusion

The Monidrop® system is simple yet effective. Early results from the three-month clinical trial suggest that using the system can prevent over/under delivery of IV fluid. Accurate administration will prevent complications and thus shorter hospital stay and reduced costs.

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