Flow rate accuracy of ambulatory elastomeric and electronic infusion pumps used to deliver continuous infusions at home

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Background

In Australia, intravenous antimicrobials for administration in the home are often prescribed as 24-hour continuous infusions for administration by elastomeric or electronic infusion devices.

Infusion devices have different properties and flow rates. Conditions experienced during home infusions may differ to those under which an infusion device was originally tested.

This study assessed the impact of changes in infusion device height and/or back pressure on flow rate and the volume of solution delivered by infusion devices commonly used in the home.

Methods

Simulated infusions were undertaken in the laboratory with four elastomeric infusion devices (Baxter Infusor LV10, Leventon Dosi-Fuser®, Nipro Surefuser™, B. Braun Easypump®) and one electronic device (ambIT® Continuous) (Fig 1).

Fig 1. Infusion devices tested in this study

Volume delivered after one day, infusion duration, average and peak flow rates and time spent within stated accuracy were determined for each infusion device using gravimetric technique (Fig 2).

Experiments were repeated after altering the height of the device relative to the output (±40cm, ±20cm) and/or adding a back pressure (10-30mmHg) to the output of an attached catheter. All tests were conducted in accordance with the standard testing conditions for these devices, and were repeated five times.

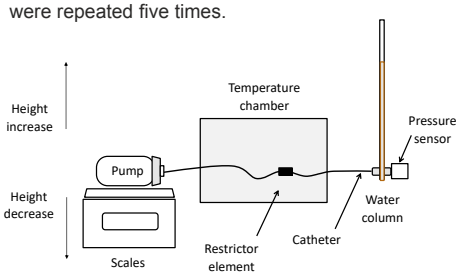

Fig 2. Experiment set-up

The infusion device was placed on the scales and the restrictor was maintained at skin temperature within a temperature chamber. The end of the infusion line was connected to a fluid column of varying height.

Results

The infusion flow profiles for each device tested in this study are shown in Fig 3.

- Elastomeric device flow rates often deviated from the rates specified by the manufacturer.
- Flow rates were faster at the start of the infusion. The initial peak was most pronounced with the Easypump®, where the rate in the first hour was 2.4 times faster than the rate specified for this device.
- Almost all the infusions with elastomeric devices extended beyond the stated infusion time of 24 hours (27 hours for the Easypump®).
- In contrast, relatively constant flow rates were observed with the ambIT Continuous®.

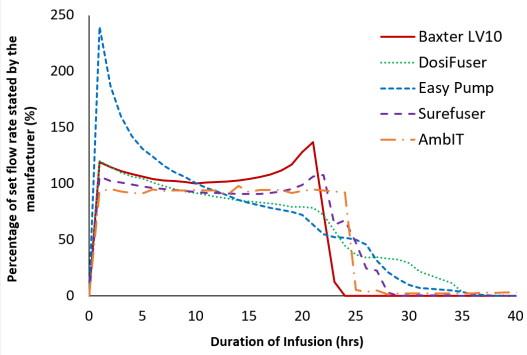

Fig 3. Infusion device flow profiles over a 40-hr period

Mean flow rate was determined after testing each brand of infusion device on five occasions, with back pressure = 0mmHg and infusion pump height = 0cm.

Varying the height or applying back pressure led to further changes in average flow rates and the volume delivered by the elastomeric devices, but had little effect on the electronic device (Fig. 4).

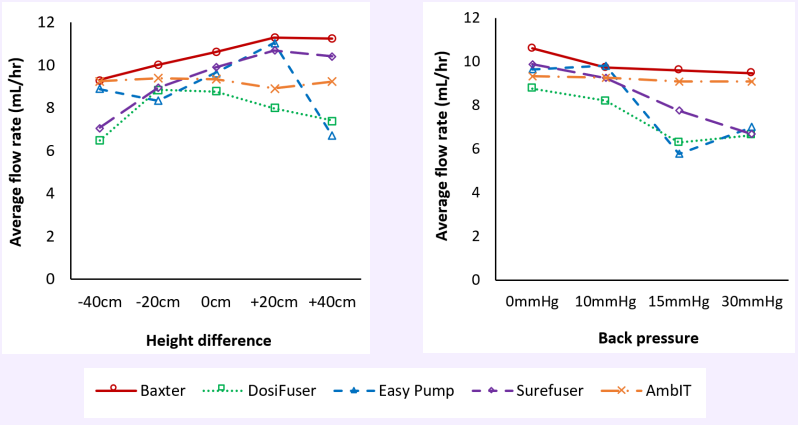

Figure 4. Impact of variation in device height or back pressure on average flow rates

Conclusions

The mean volume delivered by each device was within the stated accuracy range when tested under standard conditions. The flow rate and volume delivered varied when height or back pressure differences were applied to elastomeric infusion devices. Further studies assessing the actual volume delivered to the patient under real-world conditions are warranted.

During a simulated infusion, the height at which the infusion device was situated, and the back pressure or resistance applied to the device frequently impacted on the performance of a range of elastomeric devices, but had less impact on the single electronic device tested in this study.

It is important for clinicians and patients to be aware of the advantages and practical limitations of infusion devices when selecting a device to deliver a continuous 24-hour infusion in the home.

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