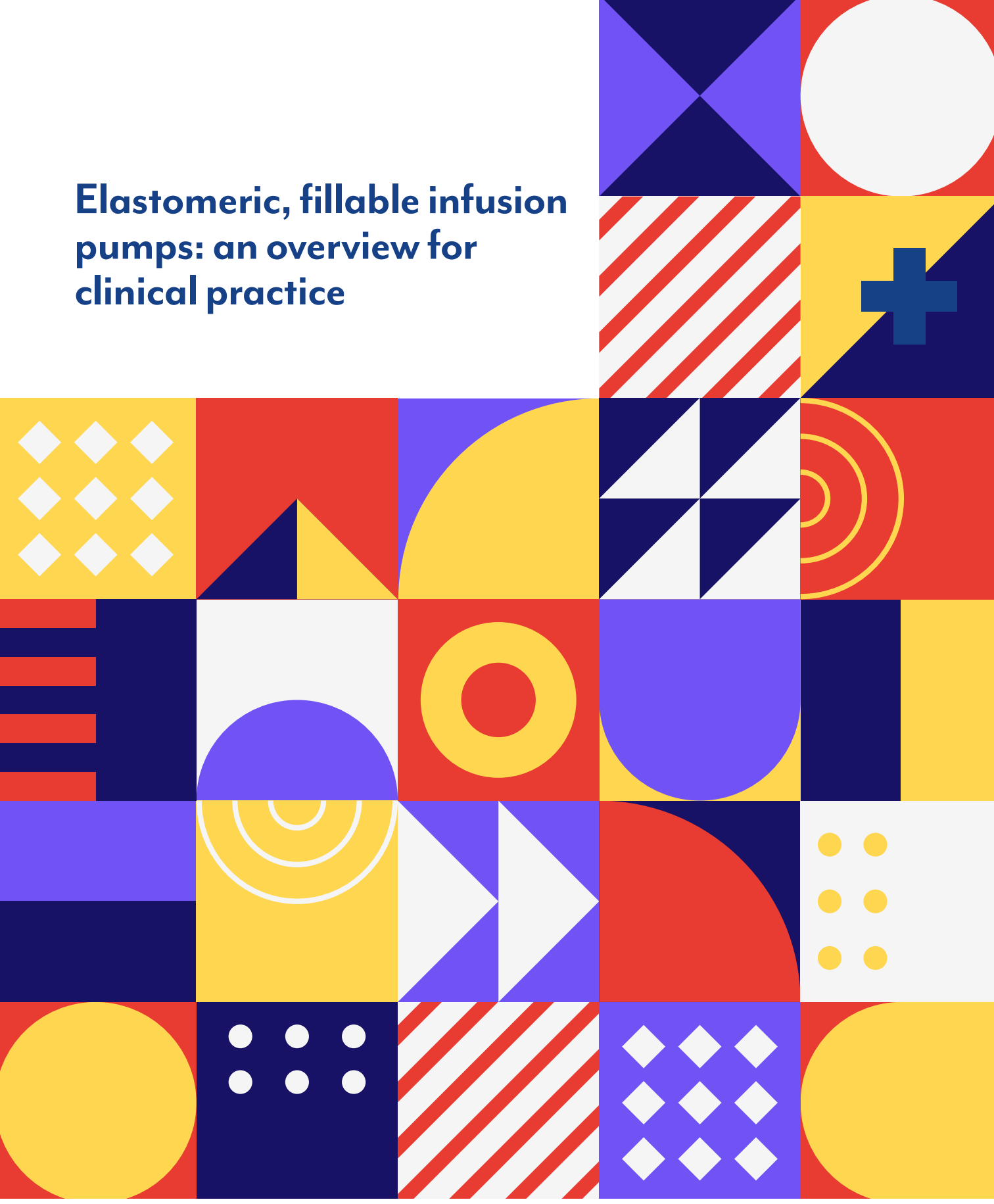
# Elastomeric, fillable infusion pumps: an overview for clinical practice



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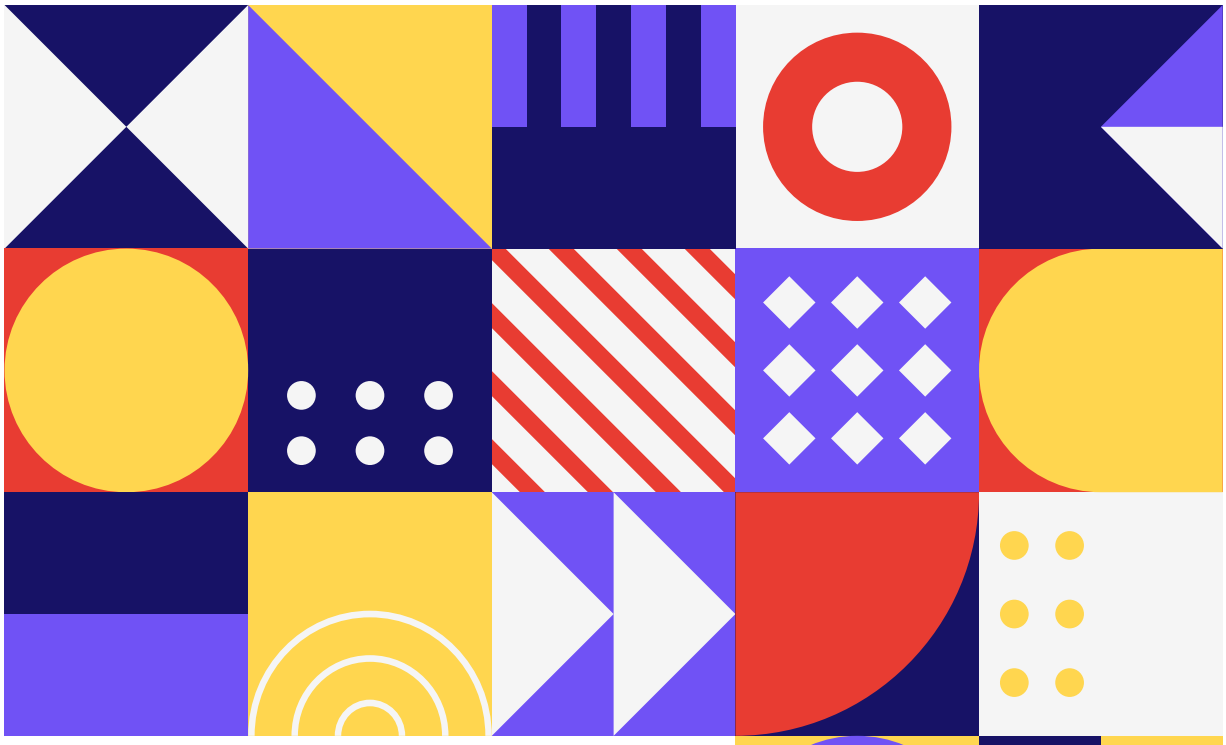

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Project editor: **Sophie Gardner**
Chief sub-editor: **Janet Perham**
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Head of projects: **Camila Fronzo**
Design: **Veesun Ho**
Publishing director: **Andrew Iafrati**
**andrew.iafrati@markallengroup.com**
Managing director: **Anthony Kerr**
**anthony.kerr@markallengroup.com**

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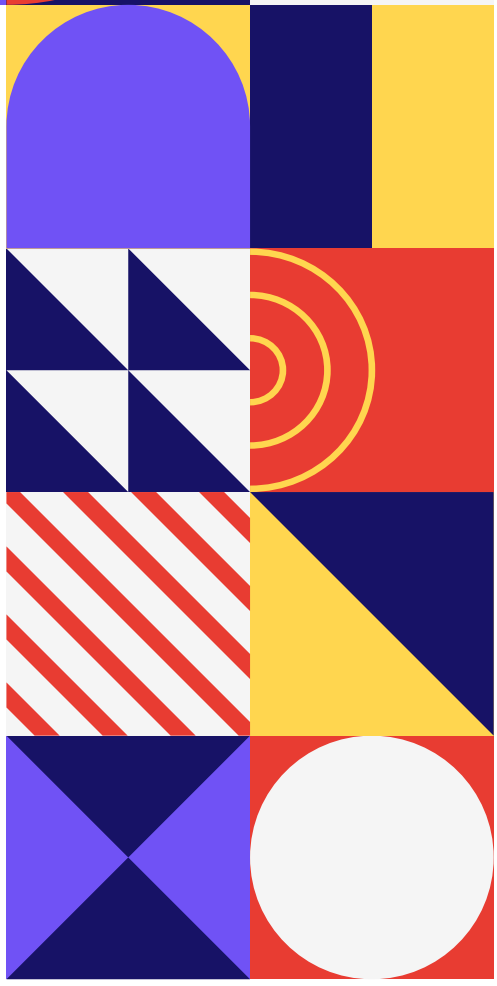

# Elastomeric, fillable infusion pumps: an overview for clinical practice

Andrew Barton, Ed Fisher and Martin Rees-Milton


## Abstract

**Due to advances in elastomeric pump technology, there are now devices available that can be filled with intravenous (IV) therapy at the bed or chair side. These devices are safe, reliable and enable the patient to be mobile when having their infusion. The Surefuser™+ elastomeric infusion pump is available in multiple configurations and allows patients to remain independent and receive IV therapy infusions in their own homes. The pump can also be used in the acute healthcare setting where traditional electronic infusion pumps may not be available. This article provides an overview of the Surefuser+ elastomeric infusion pump, its features and mode of action and how it can be used in clinical practice.**



## Key words

**Intravenous therapy ■ Vascular access ■ Elastomeric infusion pump ■ Surefuser+**


Intravenous therapy (IV) is an essential element of modern health care. New and emerging IV drug therapies are improving patients' outcomes on a regular basis. Advances in chemotherapy are improving cancer survival rates and IV antibiotic therapies are more effective at treating serious infections (Anand et al, 2022). Outpatient parenteral antibiotic therapy (OPAT) or home IV therapy services are now provided by the majority of hospitals in the UK, enabling patients to receive IV therapy treatment in the community or in their own home as a matter of routine (Diamantis et al, 2021).

*The NHS Long Term Plan* (NHS England/NHS Improvement, 2019) outlined the benefits of treating patients closer to home or, where possible, in their own home. This is because patients are often more comfortable and at less risk of hospital-acquired infections in their home and the cost to the NHS is significantly lower (Dimitrova et al, 2021). The benefits of a hospital OPAT service in all its local forms are well documented. However, IV therapy delivered in the patient's home or community setting can present logistical problems in terms of administration and delivery depending on which drug is required.

The administration of IV therapies associated with OPAT has historically been restricted to a limited number of antibiotic regimens. These regimens usually needed to fit into a pathway that prescribes a once or twice a day bolus of an antibiotic, which is considered low risk for community administration. Low risk in this context would mean that the drug would require minimal monitoring of the patient bloods and, where possible, be a non-vesicant (Keller et al, 2018). In the UK, during the COVID-19 pandemic, more IV therapies were administered in the community or home setting than in the acute hospital setting as this was considered safer for clinically vulnerable patients (Hodgkins, 2021). The boundaries of what was possible for administration were opened up to consider any IV therapy that could be administered in the home, with patients' suitability considered on an individual basis, taking into account the volume, administration method, risk of complications and who was going to administer the drug. Monoclonal antibodies (Malani et al, 2021), electrolytes, IV immunoglobulins and even convalescent plasma were all considered for home administration by community nurses (A-Riyami et al, 2022), with some therapies


**Andrew Barton**, Nurse Consultant, Vascular Access and IV Therapy, Frimley Health NHS Foundation Trust, and Chair, NIVAS, andrew.barton@nhs.net

**Case study 1 author: Ed Fisher**, Venous Access Nurse Practitioner, St George's University Hospitals NHS Foundation Trust, London, Edward.Fisher@stgeorges.nhs.uk

**Case study 2 and 3 author: Martin Rees-Milton**, Principal Pharmacist Technical Services, Velindre Cancer Centre, Cardiff


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- Balloon pump: contains the medication for infusion
- Housing: protects the balloon containing the medication
- Balloon volume: the volume of the balloon pump at 100% filling grade
- Scaling: allows monitoring of the infusion progress
- Clamp: allows the infusion to be stopped, if necessary
- Infusion line: carries the medication from the balloon pump to the catheter
- Dual filter: removes air from the infusion line and prevents particles larger than 0.2 µm* from passing through
- Flow regulator: determines the speed of infusion
- Port cap: protects the fill port when not in use
- Hydrophobic filter: allows air to pass, but stops liquids

* Filter is 1.2 µm for short-term continuous infusion

**Figure 1. Surefuser+ elastomeric infusion pump**

even being given by patients themselves at home.

The method of infusion therapy for home IV patients has historically been restricted to a bolus administration once or twice a day. This method ensured that the visit by a community nurse could be as brief as possible, around 30 minutes. Infusions via a pump or gravity are often avoided in home IV therapy administration due to the extended time a visit can take and the logistical issues that can occur with infusions. Electronic ambulatory infusion pumps are widely used for parenteral home nutrition, which is often administered overnight in large volumes (Pironi et al, 2020). Often patients will require additional IV treatment such as antibiotics or additional IV fluids, and this is where elastomeric pumps can be utilised successfully. Patients who are already self-administering their parenteral nutrition can easily be trained to use elastomeric pumps.

Within many OPAT services, it is commonplace for patients to self-administer IV therapy in the home, or for this to be undertaken by a relative or carer (Hatcher et al, 2019); however, there are still some limitations as to who is suitable to carry out this activity. The patient's or carer's ability to administer from start to finish needs to be assessed by the responsible nursing team, which is usually the OPAT nurse. This will ensure that the patient is capable and willing to undertake self-administration (Chapman et al, 2019). They must have good dexterity, eyesight, mental capacity, and a willingness to learn and carry out the administration. Historically, even if the patient or carer was willing and able to do so, a bolus administration once or twice a day was usually considered the safest option; infusion therapy was often less favoured for self-administration because an infusion pump was required in many cases. However, with the advent of elastomeric pumps, the risks associated with priming and setting an infusion pump have disappeared. Patients are able to connect themselves or be connected to an elastomeric pump, which will safely deliver the antibiotic regimen. These pumps are usually pre-primed by the homecare service, making them easy to use and the safest way to self-deliver OPAT at home (Voumard et al, 2018).

There are several safety benefits associated with elastomeric pumps, especially when compared to electronic pumps or gravity infusions. Electronic pumps and gravity infusions need to have the infusion rates set manually, which can lead to mistakes if incorrectly programmed or if the wrong drip rate is set. Smart elastomeric pumps are pre-set to deliver at a specific rate, which removes the issue of human error. The use of these pumps can improve patient outcomes because they improve the reliability of the infusion being delivered and improve the regulation of the therapeutic window of the drug (Diamantis et al, 2021).

## Elastomeric infusion pumps

Elastomeric infusion pumps can deliver infusions over a longer period of time. They can be set up, connected, operated and disconnected by the patient or a community nurse with minimal training. This enables the patient to remain independent and mobile, as they are free to move around while the infusion is running (Karimaghaei et al, 2022). Elastomeric pumps can be safer than powered pumps,

because it is not possible to accidentally change settings and flow rates while the pump is in use.

There are two main types of infusion:

- Continuous infusion
- Bolus infusion.

Elastomeric infusion pumps can be presented to the patient in two ways:

- Pre-filled (by the pharmacy service provider)
- Self-filled (by the patient in their own home).

There are some drawbacks to elastomeric infusion pumps. For example, drug stability can be an issue, and there is scarcity of data on the drug stability with pre-filled elastomeric pumps used to deliver an infusion over a 6-, 12- or 24-hour period. The little data available on drug stability and longer infusion pumps show mixed results (Fernández-Rubio et al, 2021; Esteban-Cartelle et al, 2022). However, on request, Nipro can provide information on a range of commonly used drugs.

The new generation of elastomeric pumps can now provide longer infusion periods, with options to use them up to 1 week. These pumps can be filled by the hospital pharmacy and also have a place in the acute setting – they are not solely for OPAT community use.

## Surefuser™+

Surefuser+ is a lightweight, fully closed, single-use elastomeric pump for the safe delivery of drugs administered intravenously (*Figure 1*). It is a self-powered infusion pump that uses the force of a deflating medical grade isoprene balloon to infuse medication via a catheter. The pump does not require any batteries or electricity and is silent in operation. It is filled with the desired amount of IV drug therapy by the community nurse or patient/carer for self-administration. As the balloon inflates, the energy generated is used to push out the medication from the balloon into the infusion line over time. To ensure that the medication flows at a constant rate, a flow regulator is integrated in the infusion line – the flow regulator determines how fast medication will be administered. The flow rates are fixed, reducing the risk of dosing errors.

Although Surefuser+ does not require any intervention during treatment, external factors, such as temperature and pump height and positioning, can affect infusion speed. It is best to keep such factors as constant as possible to ensure a predictable treatment duration. The flow regulator (*Figure 2*), which regulates how fast the medication flows, is calibrated at skin temperature. Therefore, it is important to keep it attached to the patient's skin at all times.

The pump itself is best kept at room temperature. When used inside the patient's home, it should be kept away from heat sources such as radiators. When used outdoors, the pump should be kept out of direct sunlight (especially in the summer) and protected under the patient's clothes during colder periods. The manufacturer recommends using the Surefuser+ carrying bag, because it is thermo-insulated.

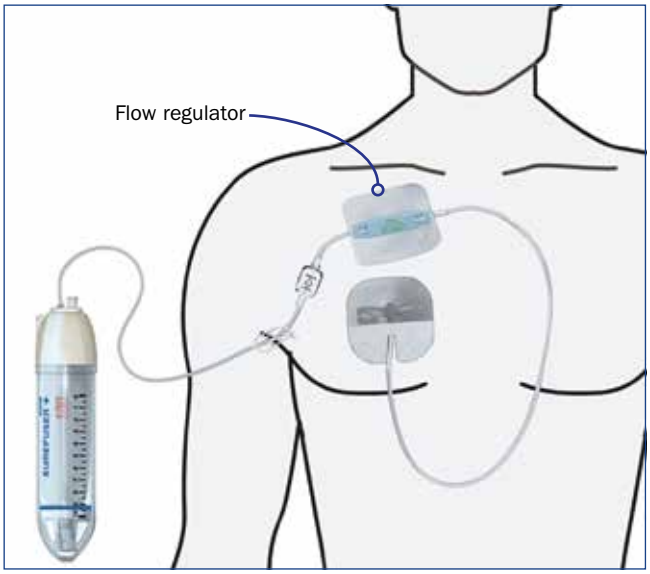


**Figure 2. Flow regulator**

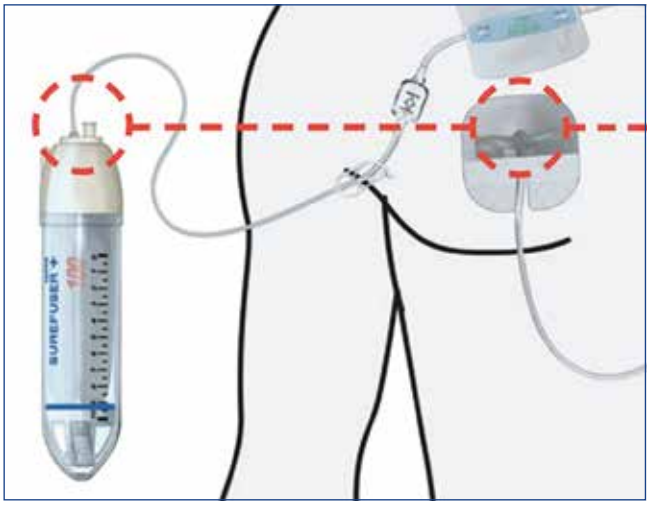

**Figure 3. For normal flow, the pump should be positioned at the same level as the infusion point**

The height position of the pump relative to the infusion point (catheter location) also affects infusion speed (*Figure 3*). For the medication to flow at a normal flow rate, the pump should be positioned at the same level as the infusion point. If the pump is kept in a higher position than the infusion point, flow increases due to gravity. Conversely, if the pump is positioned below the infusion point, flow decreases.

The particle and air filter integrated in the infusion line is hydrophobic (repels water), reducing the

risk of drug leakage. This polyether-sulfone (PES) filter allows air to ventilate from the infusion line as medication passes through. The inline dual filter removes particles and air bubbles. In order to maintain this ventilation, it is important to keep the dual filter dry at all times. It should not be cleaned or disinfected with soap, detergent, or alcohol. Note that perfume contains alcohol, so spraying perfume near the filter should be avoided.

The Surefuser+ pump can be carried in a shoulder bag or pocket so there is no need for bulky drip stands. Patients' mobility is not restricted when attached to the Surefuser+, which can reduce the risk of patients falling or tripping on electrical cables, drip stands and IV lines. This also reduces the risk of vascular access device dislodgement.

The use of Surefuser+ can contribute to reduced length of hospital stay because the mode of infusion delivery via an elastomeric pump is compatible with home IV therapy. It can also save money in IV therapy consumables, time to set up the infusion and reduction in missed doses and other complications.

## Case study 1

This case study discusses a 46-year-old patient who attends a weekly clinic for infusion of magnesium and calcium via her portacath. Her usual regimen consists of a 5-hour infusion through an electronic pump. She is constricted to her chair in clinic because she does not like to walk far with a drip stand.

For 3 weeks, we tried the Surefuser+. Delivering medication using the balloon pump was different from using a normal infusion giving set and fluid bag attached to a stand. The instructions provided made it easy to connect and use the pump, with this becoming easier over time. The nurse connecting the pump noted that the process was the same as it would be for setting up a normal infusion.

Once the patient was connected to the pump, the smaller pump meant that she was able to be a lot more mobile. She returned at the end of her infusion and reported how happy she had been to have more manoeuvrability and less hindrance compared to the usual drip stand and electronic pumps.

There are no alarms on the Surefuser+, which meant that confirming the exact end of infusion was initially difficult, but the issue was resolved by following the instructions accompanying the pump and with experience of using it.

Overall, the patient spoke highly of the compact nature of the pump and said she would be happy to have it on a regular basis. She suggested that, if her infusions needed to be of longer duration, this pump would be ideal.

## Case study 2

This case study discusses a 51-year-old patient diagnosed with colorectal cancer. The treatment prescribed was OxMdG 14 day cycle for 12 cycles:

- Oxaliplatin 85 mg/m$^2$ IV infusion day 1
- Fluorouracil 400 mg/m$^2$ IV bolus day 1
- Fluorouracil 2400 mg/m$^2$ IV infusion 46 hours.

The patient had to start treatment before a PICC line could be placed. For cycle 1, the 46-hour fluorouracil infusion had to be administered via a peripheral catheter and involved a 2-day inpatient stay. However, prior to cycle 2 a PICC line was placed and the patient was able to receive the fluorouracil infusion via a Surefuser+ ambulatory pump. The patient attended the hospital on day 1, where they were educated on managing the pump at home. Following the treatment, which took 3.5 hours the patient was discharged. The individual returned 48 hours later for the Surefuser+ pump to be disconnected. The pump disconnection appointment lasted 15 minutes instead of the 30-minute time slot allocated for such a procedure.

The patient reported being really happy that there had been no need to stay in hospital for 2 days attached to an infusion pump. During the previous stay the individual had difficulty sleeping due to the infusion pump alarm being triggered regularly. The patient also found it difficult to wash while attached to the pump. They reported finding the Surefuser+ pump discreet and the education provided on its use beneficial. Having the infusion via the pump did not interrupt life, enabling daily routines and activities to continue for the 2 days at home, which included washing, meeting friends and sleeping.

## Case study 3

This case study discusses a 60-year-old patient who was diagnosed with sarcoma. Their prescribed treatment regimen is trabectedin 1500 µg/m$^2$ as a 24-hour infusion on a 21-day cycle.

The patient attended clinic and was asked to choose between receiving treatment as a continuous IV infusion for 24 hours as an inpatient or to have a PICC line placed and treatment administered over 24 hours via a Surefuser+ ambulatory pump. The patient decided on a PICC placement and infusion via a Surefuser+ pump. Education on the regimen was provided, which included:

- How to wear the pump, how the pump is attached to the skin
- What to check for to ensure the pump is working correctly and, if not, what to do
- Washing and exercise while wearing the pump.

The patient attended the day unit for a 60-minute appointment, where he received his pre-meds via an

IV infusion, and the pump was attached. The patient attended the following day for a 30-minute day-case appointment to disconnect the Surefuser+ pump. The patient commented that the pump did not cause any problems or changes in their daily routine.

## Conclusion

The benefits of using an elastomeric infusion pump is clearly supported in the literature, and appropriate for IV administration both in the community or home setting, and the acute hospital setting. The added benefit of the Surefuser+ pump is that it can be filled by either the infusion nurse, the community nurse or the patient in their own home, and can be used for IV infusions of both short- and long-term duration. The pump is available in over 30 different configurations of volume and infusion duration. At times when there may be shortages of volumetric infusion device components, such as infusion giving sets, the Surefuser+ pump could be used as an alternative to gravity infusions where a pump is indicated. **BJN**

### KEY POINTS

Elastomeric pumps can:

- Facilitate discharge form hospital with intravenous (IV) therapy
- Enable patients to deliver IV therapy at home themselves
- Be used instead of electronic infusion pumps
- Reduce drug wastage and improve drug delivery compliance


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## CPD reflective questions

- How could these types of elastomeric pumps be used in your practice?
- Which patient groups would be most suitable for elastomeric pumps?
- Apart form OPAT, what other clinical specialties would benefit from elastomeric pumps?

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