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## **Delivering chemotherapy at home: how much do we know?**

Delivering care closer to home has become a priority within the NHS as it reduces the burden on secondary and tertiary care while maximising convenience to the patient and supporting the ethos of person-centred care.

Home chemotherapy is one example of such care as it allows patients to receive their treatment in the comfort of their home avoiding the stress and inconvenience of hospital visits (Corbett et al 2015).

Traditionally, home chemotherapy entails the delivery of the treatment under supervision by a specialised nurse. With the advent of ambulatory devices, this term has evolved to include ambulatory chemotherapy. These devices, also known as infusion pumps, allow patients to safely receive prolonged infusions unsupervised with community nurses visiting the patient at the end of the infusion to disconnect the device.

Specialised community nurses can deliver a range of chemotherapeutic agents at home that differ in complexity. Some agents such as intravenous cytarabine used for the treatment of paediatric leukaemia are described by community nurses as simple due to the small volume involved. While others such as subcutaneous azacitidine for myelodysplastic syndromes (MDS) are more complicated due to the need to maintain a cold chain (Murthy et al 2019).

Infusion pumps can be loosely categorised into mechanical pumps (ex battery operated) or elastomeric pumps (infusors). The latter are disposable balloon pumps that are silent and light weight. These are used to deliver prolonged infusions at home such as 5 fluorouracil for the treatment of bowel cancer. Patients are usually

connected to these devices at the cancer centre and then visited by the community nurses at the end of infusion for disconnection. Patients can also come back to the cancer centre to be disconnected.

With the increased use of this service, nurses were facing a problem that was not previously described. When the nurses were presenting to disconnect the elastomeric pumps at the scheduled time, they found that some pumps have not finished infusing all the chemotherapy volume. At this point the nurse has two options: to disconnect and dispose of the pump or allow the pump to continue infusing. Even though, option one follows the prescribed protocol, it translates into patients not receiving their full doses. While option two allows the full dose to be infused, it translates into increased patient wait times or disrupted schedules for the district/community nurses who have to come back at a later time to disconnect the patient.

Variation in the delivery of home chemotherapy via elastomeric pumps was expected but not scientifically measured. Therefore, we initially decided to conduct four experiments in the laboratory (Salman et al 2013) whereby we investigated the flow rate accuracy and end of infusion time of the commercially available elastomeric pumps. Temperature of both the flow controller and the actual elastic reservoir were taken into consideration as well as the viscosity of the diluent. The experiment was simple, vary both temperature and viscosity and observe how these devices would perform. The measured flow rate did not match the specified flow rate, and varied with temperature and the viscosity of diluents. However, the temperature around the pump changes significantly from user to user and over time. This temperature fluctuation will not only cause further inconsistencies in the pump flow rates but also to the stability of the chemotherapy regimen.

The performance of elastomeric pumps was not only affected by the temperature surrounding the pumps, but also the viscosity of chemotherapeutic regimes and/or the combination of both. The viscosity of chemotherapeutic regimes is unlikely to be the same as 0.9% sodium chloride or 5% dextrose solutions used to calibrate the pumps. The findings of these simple experiments concluded that flow rate and end of infusion time of elastomeric pumps were affected by different laboratory-based conditions. However, these factors are unpredictable and uncontrollable in practice. With all the different factors affecting the accuracy of these pumps, it is difficult to duplicate the same use conditions experienced during standard clinical practice. There was a need to evaluate the performance of these pumps in real practice and while used by the patients.

Consequently, we conducted a two-phase study (Salman et al 2017) to observe and evaluate patients receiving home chemotherapy via elastomeric pumps (5FU infused via a 48 hour elastomeric pump) at three gastrointestinal medical day units (MDU). Ethical approval to conduct both phases was sought and granted from the Clinical Audit committee (CAC). Phase 1 was an observational cross-sectional study, elastomeric pumps connected to patients were observed at connection and disconnection in the medical day unit or at home with the help of a district nurse. The status of the pump at disconnection time and the volume remaining in the pump were recorded. The action taken in the event of unfinished pumps was noted to evaluate the hospital policy. Instructions given to patients and nurses actions in the event of an unfinished pump were recorded along with the additional time the patient had to wait. Results of this phase of the study showed that 50% of the 92 cases/pumps that were followed, covering 50 cases disconnected at MDU and 42 at home by community nurses, did not finish on time. This had caused not only disruption to some of the

patients and ambulatory home chemotherapy services but also sub-therapeutic dosing as pumps were discarded with left over infusion.

Results revealed that there was no policy that guides the nurses in the event of fast or slow pumps, and therefore the nursing staff had developed different approaches to deal with this unexpected variation in performance of elastomeric pumps. These approaches included: discard the pump immediately (73%), patient was asked to wait in the MDU before disconnection (11%), patient was sent home and asked to come back the next day (8%) and patient was given advice over the phone (8%).

In another study conducted by us at another cancer centre (Saleh et al 2015), similar results were observed where a significant number of patients were presenting with unfinished pumps. This study also included a survey of the nurses (hospital and district) to gauge their knowledge of these pumps.

50% of the respondents stated that they had no formal training about the elastomeric pumps.

As part of the survey, the nurses were presented with pictures of pumps containing different volumes and were asked to choose the pumps which they thought were empty. A significant number of nurses misidentified pumps that contained more than 20mL as empty.

These findings highlight the need for further nurse support and training with the use of the elastomeric pumps.

Moreover, our study also included a patient survey to evaluate their knowledge on handling the pump while at home. The results also highlighted gaps in their knowledge where some patients were placing the pumps under their pillow while asleep which might increase pump ambient temperature.

It is however important to note that despite all of variations in the performance of elastomeric pumps, patients reported high satisfaction with these pumps overall.

Home chemotherapy with its various forms has revolutionised patient care and has been linked with improved patient quality of life.

However, there are several recommendations to consider to maintain an optimal delivery.

- A Hospital policy to address unfinished pumps
- Nurse support which includes training on the use of the elastomeric devices and spill kits
- Patient counselling on the handling of the pumps while at home (ex while sleeping, bathing etc) and instructions to contact the district nursing team in case of fast or slow infusions.
- Streamlined service where nurses communicate with patients ahead of time to plan a suitable disconnection time
- The particular characteristics of the chemotherapy delivered at home including stability of the solution (ex azacytidine is only stable for 1 hour at room temperature)

## Conclusion

Delivering chemotherapy at home has become more common with the advent of elastomeric pumps. However, nursing staff responsible for connecting or disconnecting these pumps at the patients' homes need to be supported and provided with the required training and policies.

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## Abstract

Ambulatory chemotherapy offers many advantages from supporting a closer to home treatment approach to lowering the cost of care. Ambulatory devices such as elastomeric pumps can deliver prolonged infusions of a variety of chemotherapy agents nowadays. Elastomeric pumps are preferred by the patients as they get them connected at the hospital or cancer centres then go back home where they can have visits from the district nursing team. This supports minimal disruption to careers and families . Despite all the advantages, experiments carried out by the authors and others in the literature showed that the performance of these pumps

vary depending on temperature or viscosity of diluent or both. Interestingly, a two-phase study that was carried out to observe and evaluate GI patients receiving ambulatory chemotherapy concluded that in 50% of the observed cases the infusion pump did not finish on time. This caused disruption to these patients' treatment schedule and in some cases resulted in sub-therapeutic dosing.

**Keywords:** home chemotherapy, ambulatory chemotherapy, elastomeric pumps, nurses, infusers

**CPD questions:**

How does ambulatory chemotherapy support person centred care?

What are the limitations of ambulatory chemotherapy?

What is the role of the nurse in ambulatory chemotherapy?

**Key points:**

- Elastomeric pumps have revolutionised the delivery of chemotherapy at home.
- The optimised use of elastomeric pumps requires the support and training of the nursing staff involved in this service
- Variations in temperature and solution viscosity affect the infusion rate of elastomeric pumps which may lead to sub-therapeutic dosing.
- Patient education and streamlined communication channels will enhance the ambulatory chemotherapy service.