

When and how to use a
syringe driver
in palliative care

Syringe drivers are often required to provide medicines for symptom management in patients who are terminally ill. They allow continuous subcutaneous administration of medicines to enable effective symptom control when medicines given by other routes are inappropriate or no longer effective. With guidance and support from the local hospice or district nursing services, General Practitioners can arrange a syringe driver infusion for a patient in their home or in a residential care facility, prescribe and monitor the appropriate mix of medicines and manage breakthrough symptoms.

What is a syringe driver?

A syringe driver is a small, portable, battery operated device that administers medicines subcutaneously over a selected time period, usually 24 hours. Medicines are drawn up into a syringe that is then attached to the driver, which is set to move the plunger of the syringe forward at an accurately controlled rate. Syringe drivers can be used either short-term or long-term, for patients who are ambulatory and those who are confined to bed. Syringe drivers can be placed into a carry bag or pouch when a patient is mobile or be tucked under a pillow if the patient is bed-bound.

Indications for use of a syringe driver

Continuous subcutaneous administration of medicines using a syringe driver often becomes necessary for the control of symptoms during palliative care. A syringe driver is useful when the oral route of administration is not possible and repeated subcutaneous doses are inappropriate, ineffective or impractical. Although medicines can also be administered by other routes, such as rectal or sublingual, a further advantage of a continuous subcutaneous infusion is that any peaks and troughs of intermittent delivery methods are avoided (Table 1)

The Niki T34 is used in a community setting

The lockable, battery operated, Niki T34 syringe driver is the current device available in New Zealand for the continuous subcutaneous administration of medicines in a community setting. The Graseby syringe driver has been gradually phased out of use as it was not tamper-proof. Concerns were also raised by the Health and Disability Commissioner after a number of cases occurred due to errors with syringe driver use.¹ As a result, a recommendation was made that there be consistency in the type of syringe driver used throughout New Zealand. Initially the preferred replacement option was the AD Ambulatory Syringe Driver, however, the company involved was unable to supply and support these drivers and a further decision was made so that by 30 June, 2011, the Niki T34 syringe driver was used exclusively.²

Table 1: Advantages and disadvantages of using a syringe driver⁴⁻⁶

Advantages	Disadvantages
<ul style="list-style-type: none"> ■ The ability to gain effective symptom control due to steady plasma drug concentrations without peaks and troughs ■ Allows management of multiple symptoms through the use of combinations of medicines given via a single route ■ The single route of administration minimises the need for repeated injections or multiple oral medicines ■ Subcutaneous administration of medicines is more comfortable for the patient than intramuscular injections (particularly if the patient is cachexic) and is simpler and less invasive than medicines given intravenously ■ The ability for patients who are still mobile to remain so, and once set up enables more independence 	<ul style="list-style-type: none"> ■ Medicine requirements must be anticipated for a 24 hour period and can result in a loss of flexibility in dosing ■ Medicines given by other routes (including “as needed” subcutaneous injections) may be required to manage the patients symptoms for the initial four hours of the syringe driver infusion while the medicines reach a plasma concentration that provides effective symptom control ■ An increase in the patients symptoms may require additional injections for relief ■ Local reactions such as pain, inflammation or infection can cause discomfort and interfere with the delivery and absorption of the medicines ■ Patients may see the use of a syringe driver as a final step before death and find its use disconcerting and obtrusive ■ The patients symptoms and effectiveness of the infusion must still be reassessed regularly

Consider using a syringe driver when:³

- The patient is unable to take medicines by mouth due to nausea and vomiting, severe oral lesions, e.g. mucosal ulceration, dysphagia, weakness, sedation or coma
- There is poor absorption of oral medicines
- Pain is not able to be controlled using orally administered medicines
- There is a malignant bowel obstruction and further surgery is inappropriate (therefore avoiding the need for an intravenous infusion or the insertion of a nasogastric tube)
- The patient does not wish to take regular medicine by mouth

Talking about syringe drivers with patients and family/whānau

Initiating use of a syringe driver in a patient during palliative care may represent a significant and unwelcome milestone for the patient and their family/whānau, because syringe drivers are often required when a patient is close to death. The goals of administering medicines via a syringe driver therefore need

to be discussed with the patient and family and any concerns addressed. A syringe driver simply provides an alternative route for the administration of medicines. For example, a patient with severe nausea and vomiting that temporarily prevents the use of oral medicines may need a syringe driver to gain control of symptoms. It may be possible to revert back to the use of oral medicines once control of the nausea and vomiting is achieved.⁴

Topics of discussion with the patient and family/whānau may include:

- Any past experience they have had with syringe drivers
- The stage of illness they are at and what using a syringe driver means for them for the future, e.g. prognosis
- Reassurance that syringe drivers do not always mean that death is imminent
- Explanation that a syringe driver allows the symptoms associated with the process of dying to be managed, but does not speed up the process of dying
- Addressing any fears or anxieties about the syringe driver, including the medicines used, e.g. opioids
- Advance care planning options and specific advance care directives


Practical aspects of how the syringe driver functions also need to be discussed with the patient and their family/whānau. In many cases, it will be the family who become aware of any issues with the device itself or that the medicines are not controlling the patient's symptoms.

Some of the practical issues that may need to be addressed include:

- Care of the syringe driver once in use
- The safety aspects of the syringe driver
- What to do and where to get advice if the syringe driver is not working properly, or symptoms are not controlled, e.g. who to call if an alarm sounds, ensuring that a spare battery is available
- Ways to carry the infusion device to minimise its intrusion in daily life, e.g. while showering
- The potential need to administer additional medicine via other routes, e.g. at initiation, for breakthrough symptoms

Arranging a syringe driver for a patient

Hospice or district nursing services can provide equipment and certified staff who can work with General Practitioners, patients and their families/whānau. Many patients will also be under the care of a palliative care physician. It is essential that there is good communication between the people who are providing care and support for the patient and their family (this also includes community pharmacy). Many residential aged care facilities have syringe drivers on site and staff trained in their use.

 Hospice New Zealand offers a training programme on managing syringe drivers in primary care. For further information see: www.hospice.org.nz

Most symptoms can be controlled with a continuous subcutaneous infusion

In a palliative care setting, subcutaneous administration of medicines given via a syringe driver is useful for managing symptoms such as pain, nausea, anxiety and restlessness. Injectable forms of medicines to control symptoms can be given alone, or mixed together in a syringe depending on their physical and chemical compatibility and the diluents used (over page).

Choice of medicine and prescribing

In palliative care, medicines may be prescribed for unapproved indications, be administered by an unapproved route or

given in doses not seen in routine day-to-day practice.⁵ Most medicines can be used in a subcutaneous infusion, however, **chlorpromazine, prochlorperazine and diazepam are contraindicated** as they can cause skin reactions at the injection site.

Infusions for administration via continuous subcutaneous infusion using a syringe driver should be prescribed to run over 24 hours, although medicines mixed together may be pharmaceutically compatible and stable for longer than this.

The patient should ideally be reviewed every day so that medicine doses can be adjusted according to their needs.

When prescribing consider:

- The patient's medicine requirements for 24 hours
- The doses that may be required for breakthrough symptoms – these need to be available for immediate use
- The choice of diluent
- The compatibility of the medicines required to manage symptoms (Table 2, over page). In general, avoid combining more than three medicines in one syringe (occasionally more than one syringe driver is required)

Choice of diluent

The choice of diluent for the infusion solution varies according to local guidelines as there is evidence for and against the two most commonly used diluents – sterile water (water for injection) and normal saline (NaCl 0.9%).³ In general, sterile water is used.

Sterile water is compatible with most medicines (with some exceptions, e.g. levomepromazine, ondansetron and octreotide which should be diluted with normal saline) and unlikely to cause precipitation of medicines, but it is hypotonic and may be associated with pain at the infusion site.^{3,7} However, in practice, pain is not that common because of the slow rate of infusion.

Normal saline is also compatible with most medicines (with some exceptions, e.g. cyclizine which should be diluted with sterile water) and may be less irritating at the insertion site because it is isotonic, however, the likelihood of precipitation increases, particularly when more than one medicine is used.

Compatibility of medicines

When more than one medicine is used in an infusion solution there is a risk that they may not be compatible, either chemically or physically. Increasing the number of medicines in the


Table 2. Compatibility of medicines for syringe driver infusions commonly prescribed in general practice (Adapted from Palliative Care Handbook 2012).⁷

Medicine	Morphine	Oxycodone	Fentanyl	Methadone	Metoclopramide	Cyclizine	Haloperidol	Methotrimeprazine	Midazolam	Clonazepam	Hyoscine butylbromide	Dexamethasone
Morphine	-	NA	NA	NA	Y	Y	Y/SI	Y	Y	Y	Y/?	Y
Oxycodone	NA	-	NA	NA	Y	SI	Y	Y	Y	Y	Y	Y
Fentanyl	NA	NA	-	NA	Y	SI	Y	Y	Y	?	Y	?
Methadone	NA	NA	NA	-	Y	?	Y	Y	Y	Y	?	Y
Metoclopramide	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	Y
Cyclizine [†]	Y	SI	SI	?	Y	-	Y	Y	SI	SI	SI	SI
Haloperidol	Y/SI	Y	Y	Y	Y	Y	-	Y	Y	Y	Y	SI
Levomepromazine (Methotrimeprazine)	Y	Y	Y	Y	Y	Y	Y	-	Y	Y	Y	SI
Midazolam	Y	Y	Y	Y	Y	SI	Y	Y	-	Y	Y	SI
Clonazepam	Y	Y	?	Y	Y	SI	Y	Y	Y	-	Y	Y
Hyoscine butylbromide (Buscopan)	Y/?	Y	Y	?	Y	SI	Y	Y	Y	Y	-	Y
Dexamethasone [‡]	Y	Y	?	Y	Y	SI	SI	SI	SI	Y	Y	-

Y =Compatible SI =Sometimes incompatible (usually at higher doses) NA =Not usually used together ? =unknown

† May crystallize, dilute well

‡ 0.5 to 1mg dexamethasone added to a syringe driver solution may reduce the risk of irritation at the subcutaneous insertion site

 If more than two medicines are to be mixed in an infusion, refer to The Palliative Care Handbook 2012 or contact your local hospice for commonly used combinations and additional compatibility information

solution increases the risk of problems with the combinations. Physical incompatibility usually results in changes in the solution that can be observed such as discolouration, clouding or precipitation of crystals or particles. However, it is important to refer to compatibility tables because a solution can remain clear even if the medicines are chemically incompatible.

Precipitation may occur as a result of a reaction between medicines in a syringe. The risk of precipitation can be minimised by using sterile water as the diluent and by maximising the total volume of the solution in the syringe, i.e. making the solution as dilute as possible.⁷

Once mixed, syringes should be observed for any signs of precipitation or discolouration. Provided that doses are within normal ranges, Table 2 shows which injectable medicines are expected to be compatible in a 24-hour syringe driver solution.

Prescribing the medicines for the syringe driver

Convert the patient's previous 24-hour oral medicine requirements (including regular and "as needed" doses) to the equivalent subcutaneous dose.

Usual starting doses for subcutaneous infusion for commonly used medicines are:

- Morphine – use half the total 24 hour oral dose
- Oxycodone – use half the total 24 hour oral dose
- Metoclopramide, cyclizine and hyoscine hydrobromide (the injectable hyoscine salt Buscopan) – same as the oral dose
- Haloperidol – antiemetic dose is 1 – 2 mg for 24 hours
- Midazolam – 5 – 40 mg over 24 hours

For patients who have not been on opioid medicine for analgesia, an example of an initial starting dose would be 10 mg morphine subcutaneously over 24 hours.³


Prescribe the doses of the subcutaneous medicines to cover a 24-hour period. Check the compatibilities of the medicines in the syringe using the chart in *The Palliative Care Handbook 2012* or Table 2 and decide on the volume to infuse, stating the diluents. A maximum of 24 mL solution in a 30 mL syringe is appropriate for the Niki T34 syringe pump. Smaller syringes, e.g. 10 mL and 20 mL, can also be used, but they should be filled to a maximum of 8 mL and 18 mL respectively. A luer-lock syringe should always be used to avoid any risk of disconnection.

Larger volume syringes should be used for medicines that will require more ampoules to be combined to achieve

the total daily dose, e.g. metoclopramide, oxycodone and fentanyl, or medicines that are potentially irritant when given subcutaneously, e.g. cyclizine, methadone and high doses of dexamethasone.

The first syringe of a new prescription will lose some of the solution when the line is primed, therefore the infusion will not run for a full 24 hours. An initial subcutaneous injection may also be required as a loading dose to manage the patient's symptoms for the initial two to four hours of syringe driver use until the medicines in the infusion reach effective blood plasma levels. When an infusion is due to be changed, a delay of an hour or two should not cause problems if the patient's symptoms are well controlled. This can be a concern for patients and families if the clinicians or nurses visit is delayed.

Hospices and residential aged care facilities are likely to have standardised prescribing and administration charts for syringe driver prescriptions. Similar documentation is recommended for patients who are receiving care at home.

 An example of a prescription chart for documenting medicines given via syringe driver is available at: <http://palcare.streamliners.co.nz> click on "forms".


The individual medicines to go in the syringe can be prescribed on a standard prescription for a community pharmacy. Indicate the prescription is for a syringe driver. State the dose and diluents, and remember a triplicate controlled drug prescription for any opioids. Some community pharmacies provide a service for compounding medicine solutions in daily subcutaneous syringes.

Administration instructions do not need to include the rate of infusion, just the infusion duration (usually 24 hours). This is because the Niki T34 syringe driver simplifies administration by detecting the syringe size and volume of medicine, and sets the rate to deliver the infusion over the required time period, e.g. 18 mL in a 20 mL syringe will deliver at 0.75 mL per hour for a 24-hour period.

Controlled drugs that are no longer required for a patient can be returned to the pharmacy or general practice for safe disposal.

Starting the infusion

In most cases, a healthcare professional trained in the use of syringe drivers, e.g. a hospice nurse, district nurse or residential aged care facility nurse, will assist with setting up the continuous subcutaneous infusion.

 A step by step guide for operating the Niki T34 is available from the manufacturer, REM Systems. Instructions are also available online from many hospices.

Selection of the infusion site

Plastic cannulae are recommended, although metal butterfly needles can be used. The preferred sites for insertion of the cannula for a continuous subcutaneous infusion are:

- The anterior chest wall
- The anterior abdominal wall
- The anterior aspect of the upper arms
- The anterior aspect of the thighs

These sites are preferred because they are accessible, both for initial insertion and for monitoring, and they are rarely oedematous.³ The choice of site may be influenced by a number of factors including patient preference, their level of mobility and the patient's condition, e.g. if they are cachexic the abdomen may be the most suitable site, the upper arm should be avoided if the patient is bed-bound and requires regular turning and anterior sites may not be suitable for patients who are agitated as they may dislodge the cannula – a posterior site over the scapula may be preferable.

Inappropriate sites include:^{3,5}

- Lymphoedematous or ascitic areas – as absorption will be reduced and there is an increased risk of infection and leakage
- Areas of skin that are scarred, broken, inflamed, infected or hairy
- Skin folds or skin over bony prominences or near joints
- The anterior chest wall in patients who are very cachexic – there is a small risk of pneumothorax
- The upper abdomen in a patient with an enlarged liver – there is a small risk of puncturing the liver capsule
- Skin that has been irradiated within the last six weeks
- Any area that has a tumour

Minimising reactions at the site of insertion

A number of factors influence the longevity of the insertion site. These include the site selected, the type of cannulae used and the medicine being given. If problems arise with an infusion site the patient may have localised discomfort, or there may be reduced absorption of the medicine and a loss of symptom control. As a general guide, plastic cannulae can stay in place for up to a week or more, whereas metal cannulae remain viable for approximately 72 hours.^{3,6} Provided there is no evidence of a site reaction, it is reasonable to only change

a site when it becomes necessary, e.g. due to pain, swelling or inflammation.^{3,4}

Techniques that may help to prolong the usefulness of a site and to minimise reactions include:

- Make the solution as dilute as possible – use a larger syringe
- When possible, select a solution that is close to physiological tonicity – sterile water is hypotonic, normal saline is isotonic, and solutions with high concentrations of some medicines become hypertonic
- Use plastic cannulae as they cause less site irritation than metal cannulae
- In a patient who has been prone to site problems, consider rotation of the site of infusion before any localised reactions develop
- Avoid oedematous areas when selecting the site for infusion
- Use 0.5 – 1 mg of dexamethasone in the syringe driver solution to reduce site reactions, particularly if the medicines used are known to be irritant, e.g. methadone⁶
- Consider the use of heparinoid (Hirudoid) cream (not subsidised) on inflamed sites if there is no infection present⁶

Monitoring the infusion

Patients being cared for at home should ideally have a daily visit from a health professional for review of symptom control and monitoring of the infusion. This should occur at least every four hours when patients are in a hospice or residential aged care facility.

A check should be made of the:

- Cannula site – for redness, swelling, leakage or cannula blockage or displacement
- Tubing – for kinks or knots in the tubing
- Syringe – for precipitation or crystallisation, discolouration of solution
- Syringe driver – to ensure that the syringe remains in the correct position, that the infusion is running at the correct rate and the syringe driver battery has enough power to last until the next check

Managing breakthrough symptoms


First check that the medicines are being delivered effectively via the syringe driver.

Breakthrough pain can be treated with additional subcutaneous doses of the opioid being used (usually morphine). If possible,


doses should be given through a side port in the syringe driver cannula line to minimise patient distress. This can be given as often as required to relieve breakthrough pain. Doses can be prescribed in a flexible manner to achieve good symptom control, e.g. 2.5 mg morphine as required every 15 minutes up to a total of three doses over 60 minutes.

Extra doses of antiemetics and other medicines in the syringe can also be given subcutaneously at the usual dose. If supplementary doses are required regularly for breakthrough symptoms, include these doses when calculating the amount of medicine needed for the subsequent 24 hour period. If the patient's symptoms remain uncontrolled despite an increase in dose, consider an alternative medicine (e.g. because nausea may have many underlying causes it may be relieved by different medicines) and consider a discussion with a palliative care physician. Also consider other methods to relieve a patient's distress – sometimes taking the time to sit and listen can be as effective as administering a medicine.

Further resources

 General Practitioners and other carers can access 24-hour telephone help from their nearest hospice:

www.hospice.org.nz/find-your-local-hospice-service

 The Palliative Care Handbook, Guidelines for clinical management and symptom control. 6th Edition, 2012 is available as a printed copy (yellow book) free-of-charge from any hospice or download an electronic version from:

www.hospice.org.nz

ACKNOWLEDGEMENT Thank you to **Suzanne Brocx**, Palliative Care Specialist Nurse Educator/Advisor, North Haven Hospice, Whangarei and **Helen Cleaver**, Palliative Care Clinical Nurse Specialist, Southern DHB, Dunedin for expert guidance in developing this article.

References

1. Health and Disability Commissioner (HDC). Decision 05HDC05278. HDC; 2005. Available from: www.hdc.org.nz/decisions--case-notes/commissioner's-decisions/2005/05hdc05278 (Accessed Nov, 2012).
2. Health Benefits Limited (HBL). Syringe driver update. HBL; 2010. Available from: www.hbl.health.nz (Accessed Nov, 2012).
3. Ministry of Health (MOH). Guidelines for syringe driver management in palliative care in New Zealand. Wellington: MOH; 2009. Available from: www.health.govt.nz (Accessed Nov, 2012).
4. National Health Service (NHS). Guidelines for health professionals in the community on the use of syringe drivers for adults in palliative care. United Kingdom: NHS; 2010. Available from: www.oxfordshirepct.nhs.uk (Accessed Nov, 2012).
5. National Health Service (NHS) Greater Glasgow Primary Care Palliative Care Team. Guidelines for the use of subcutaneous medications in palliative care for adults - primary care and hospices. Glasgow: NHS; 2010. Available from: www.nhsggc.org.uk (Accessed Nov, 2012).
6. Te Omanga Hospice. Te Omanga Hospice syringe driver protocol. Lower Hutt; 2011. Available from: www.teomanga.org.nz (Accessed Nov, 2012).
7. MacLeod R, Vella-Brincat J, Macleod S. The palliative care handbook. 6th Edition. Hospice New Zealand; 2012.