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Research and Education

Guidelines for

Subcutaneous Infusion Device Management in Palliative Care and other settings

Third Edition

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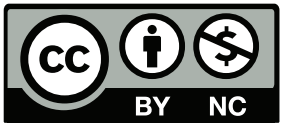

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Guidelines for Subcutaneous Infusion Device Management in Palliative Care and other settings – 3rd Edition

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Disclaimer

Background

Subcutaneous infusion devices are commonly used for symptom management in palliative care and in other settings to treat pain and distressing symptoms when alternate routes of administration are inappropriate or ineffective.

These devices are power driven and deliver medications at a controlled rate, providing symptom control via a continuous subcutaneous infusion of drugs. However, their clinical use has evolved rather than being subject to close multi-professional scrutiny and guideline formation.

Many of the medications used in subcutaneous infusions have narrow margins of error, so any errors that occur during prescription, preparation, administration and documentation of these infusions can result in adverse drug events and present an on-going risk for patient safety.[1]

There is evidence that such adverse incidents arise[1] as a result of:

- Errors in drug calculations;
- Drug incompatibilities and instabilities;[1]
- Equipment failure (including disconnection)
- Incorrect rates of infusion;
- Inadequate user training;
- Inadequate documentation and record keeping;
- Poor servicing of equipment.

All editions of Guidelines including this version have been developed in consultation with Expert Multidisciplinary Review Panels in response to a lack of standardised information about subcutaneous infusion device management in contemporary practice.

The guidelines are intended to avoid duplication of information and support primary care and specialist providers in palliative care who may not use such devices on a regular basis.

Aims

The *Guidelines for Subcutaneous Infusion Device Management in Palliative Care and other settings* are intended to provide clinicians caring for people approaching end of life with guidelines to inform practice, develop policy, procedures, training and education programs in relation to use of a portable subcutaneous infusion device in palliative care and other settings.

Scope

Component One:
Literature Review & Development of Clinical Practice Guidelines

A literature review was undertaken in 2018 – 2019 using CINAHL and PubMed databases to identify evidence from 2010 to 2018 regarding subcutaneous infusion device management. CINAHL, Medline, PsycArticles and PsycInfo were searched for previous editions.

The review was again limited to adults, English language and covered the 9-year period from last edition to present (2010 – 2019). Search terms from previous reviews were included: syringe drivers, subcutaneous infusions, end-of-life care, palliative care, subcutaneous infusion devices, McKinley T34, Niki T34 and CADD. This review extended the previous search terms to include patient and carer experience of use of subcutaneous devices at end of life and additional search terms: patient experience, family experience, perceptions.

Users of these Guidelines should note that it is important to review the information in this document in conjunction with organisational policies and manufacturers' guidelines for the appropriate use of these devices.

In addition, clinical notes, websites and books about subcutaneous infusion devices identified as relevant to the project were examined. A total of 43 published and unpublished papers were considered for inclusion in the original guidelines; 24 were included.

The second edition included 14 additional papers and a further 11 are included in this third edition.

A summary of the literature used to develop these guidelines is presented in Appendix B.

Component Two: Multidisciplinary Expert Review of Draft Guidelines

An Expert Multidisciplinary Review Panel made up of individuals working in relevant clinical areas was assembled. Panel members included palliative care nurses and a pharmacist with expertise in palliative care medications.

The Multidisciplinary Review Panel reviewed the evidence available and the draft guidelines and provided feedback on their quality and relevance. The Review Panel also provided comments on the format for presenting, disseminating and promoting uptake of the guidelines.

Component Three: Dissemination of Final Guidelines

The guidelines have been prepared as a formal report providing a detailed summary of the evidence. They are also available on the CPCRE web site to enhance accessibility.

SECTION ONE

The patient experience

Summary

- Health care professionals will consider a subcutaneous infusion of drugs to manage distressing symptoms when other routes are inappropriate or no longer effective;
- Commencement of a subcutaneous infusion via a portable device requires careful explanation to be given to the patient and their family.

Discussion

Health professionals may give medications via a subcutaneous cannula when alternative routes of medication administration are not appropriate or are ineffective.[2] Subcutaneous infusion devices are commonly used by health professionals to administer a continuous dosage of medications via a subcutaneous cannula for comfort from distressing symptoms.

The compact size of the subcutaneous infusion devices facilitates independence and the option of being cared for at home. Health professionals have assumed that the use of a subcutaneous infusion device is acceptable to the patient however there has been little research into their attitudes and the experience of the patient.[3]

Studies have reported that the devices are well accepted and able to achieve almost 100% compliance amongst people with life-limiting conditions[5] but being attached to a subcutaneous infusion device can pose difficulties for the patient and family/carer. In practical terms, consideration should be given to aspects of normal daily activities including clothing, bathing, sleeping and driving as well as battery life or access to charging stations.

Health care professionals should be mindful of how the patient and family perceive the experience of a subcutaneous infusion device. Perceptions and experience of having a subcutaneous infusion device are varied and individual to the patient, the environment and the underlying reason for use of the device.

Some people may negatively view the device as an invasion of their body privacy or perceive the commencement of the infusion via the device as an indicator of poor prognosis.[6] Remembering that advance care planning goals may not have been considered, the commencement of a subcutaneous infusion via a portable device requires careful explanation to be given to the patient and their family.[7]

SECTION TWO

Equipment guidelines and principles

Summary

- The Niki T34® is commonly used in end of life care across all settings as well as in complex symptom management in other areas of care;
- Other devices e.g. CADD Ambulatory Infusion Systems®, GemStar® and WalkMed® may also be in use in some settings;
- The service provider organisation's protocol regarding the preparation and set-up for initiating or changing the device should always be used to guide practice;
- A Luer-Lok® syringe should be used to prevent risk of disconnection; syringes should be validated for use with the device selected;[8] 20 ml is the recommended minimum size;[9]
- An aseptic technique should be used when preparing and setting up the infusion;[10]
- A minimum volume extension set should be used to minimise dead-space in the line;[8]
- When changing the extension set and/or cannula, prime the line after drawing up the prescribed medications in the syringe[8,11] and document the line change and the time the syringe is calculated to finish;
- A Teflon® or Vialon® cannula, such as the BD Saf-T-Intima®, should be used in preference as they are associated with significantly less risk of site inflammation than metal butterfly needles;[7,12,13]
- There have been reports of kinking cannulae creating occlusion alarms when used with McKinley giving sets[14] and fracture at the junction of the hard plastic and the softer Teflon or Vialon catheter tubing when kinking has occurred.

Discussion

There are several types of subcutaneous infusion devices available for use in palliative care. It is important for the service provider organisation to verify the equipment used with the different devices as they work differently and have differing associated costs.

It is important that the service provider organisation's protocol regarding the preparation and set-up for initiating or changing the device be based on current evidence and best practice.

Data for microbiological stability, physical and chemical compatibility relating to drugs, syringes and delivery lines most commonly relate to a 24-hour period. For this reason, it is still recommended that a 24-hour subcutaneous infusion period is used.

Management Principles

When setting up the equipment for a subcutaneous infusion via a device, it is important to verify with the organisation's protocol, if available, for the preparation and set-up of the device.

If more than one device is used in a single setting, it is recommended that the organisation implement strategies to manage potential risks regarding staff being competent with several devices.

The management principles are essentially the same for all subcutaneous infusion devices and include:

- Ensuring that the person and the family have received a full explanation of how the infusion device works, and its indications for use;[9]
- The infusion device should be used for the delivery of drugs over a 24-hour period, reducing the risk of microbiological and chemical instability;
- The person or family decision-maker have consented to initiation of the subcutaneous infusion device.

- Bolus doses of medication when a subcutaneous infusion is running will be discussed in section 4;
- Employ an aseptic technique when changing the device and re-siting the cannula;[9]
- A Luer-Lok® syringe[8] is recommended to prevent accidental disconnection of the tubing from the syringe;
- A 20 ml syringe is the recommended minimum size to reduce the risk of adverse site reactions and incompatibility, as well as the effect of priming the line;[8]
- The Niki T34® detects the syringe size and brand, removing concerns about barrel size and consequent dosing issues;[7] it works with syringes up to 50 ml in volume; an electronic menu guides setting up the infusion;

  Note: the Niki T34® device detects the parameters of the syringe and seeks confirmation from the user during the set-up phase that the syringe has been correctly detected. Due to the physical length of the screw driving the syringe plunger forward there are limits to the maximum amount that can be delivered from larger syringes; some smaller syringes will have an undeliverable volume left in the syringe when the actuator has driven to the zero position.[15]

  Note: some services may recommend use of a larger volume syringe as standard practice. Check your local organisational guidelines.
- Once set up, the Niki T34® should be protected from direct sunlight;[14]
- The CADD Ambulatory Infusion Systems®, GemStar® and WalkMed® devices do not use a syringe; similar principles for subcutaneous infusions apply;
- When changing the extension set and/or cannula, prime the line after drawing up the prescribed medications, attaching the syringe to the line and before connecting to the patient.

- After priming the line, measure the volume to be infused. Document the line change and the time the infusion is calculated to finish;
- Consider using a tamper-proof 'lock-box'[8] or device lock system if there is a possibility of the patient or others tampering with the device or using the boost facility. A tamper-proof box may be mandatory within individual organisations as a risk mitigation strategy.

  Note: Lockable clear plastic covers have been devised to place over some devices to prevent accidental, or intentional activation of the boost button or tampering with the rate control.

Table 1: General principles: subcutaneous infusion devices

- Several devices are available for management of subcutaneous infusion.
- Any device should be used according to your organisation's policies, protocols and guidelines. If there is no organisational policy or guideline, refer to your local specialist palliative care service or to CPCRE Guidelines: https://www.health.qld.gov.au/cpcre/subcutaneous/guidelines
- With all devices, each time a new line is used, prime the line before connecting it to the patient;[8]
- Devices such as the Niki T34® have a sensor system which detects the size and make of syringe; it then asks the operator for confirmation.

- Use of the boost facility, if available on the device, is not advocated. A boost dose rarely provides adequate analgesia to relieve uncontrolled pain and may lead to overdosing of other drugs being infused.[8]
- The use of prescribed prn (breakthrough) medication is recommended for management of uncontrolled symptoms.[16,17]
- Breakthrough medication is defined as extra medication that may be required for symptoms that are not controlled by the medications prescribed for continuous delivery via the subcutaneous infusion device.

Information about specific devices should be sought from the manufacturer or supplier. The following sites may be helpful for pumps commonly used at end of life:

- Niki T34®: (register to access the online training)
https://bd.elmg.net/?rc=7b6f23b585c234a036e1a0752a7d0894
https://www.infusystem.com/images/manuals/Niki%20T34.pdf

- CADD Ambulatory Infusion Pumps:
https://www.eviq.org.au/clinical-resources/pumps/458-cadd-legacy-1-cadd-legacy-plus-and-cadd-so

- SureFuser:
https://vimeo.com/335281438

SECTION THREE

Selection, preparation and maintenance of the site

Summary

- General principles for appropriate site selection include:[8]
  - Assessing the patient's mobility, agitation and/or distress;
  - Using an area with a good depth of subcutaneous fat;
  - Using a site that is not near a joint;
  - Selecting a site that is easily accessible for routine checks.
- The patient's preference for site should be considered;
- The longevity of the site can vary considerably from 1–14 days;[12]
- Select and use sites on a rotating basis;[8]
- The upper, anterior chest wall above the breast, away from the axilla or the abdomen are the preferred sites;[8]
- Dependent upon mobility, the upper arm and thigh may also be used;
- Careful placement and strapping of the tubing is recommended to prevent dislodgement if the tubing is accidentally pulled;
- Use of a transparent, semi-occlusive dressing to cover the site is recommended to allow for inspection of the site;[10]
- Site reactions can be caused by factors including: the tonicity (concentration) of the medication, the pH of the solution, infection, and prolonged presence of a foreign body (the cannula);[4]
- The site should be inspected regularly for early identification of issues and reduce the risk of site related complications.

Discussion

When selecting a site for commencement or continuation of a subcutaneous infusion it is important to consider the patient's mobility, agitation and distress as all will impact upon site selection.

The chest or abdomen are generally the preferred sites,[8] specifically the upper, anterior chest wall above the breast, away from the axilla.[8] This site allows for easy access, is rarely oedematous, and permits easy inspection by the caregiver.[8]

If the patient is cachectic, the abdomen may be a more appropriate site. The upper arm can be used, but it makes it difficult for the patient to lie on their side and may lead to problems such as bruising. If the patient is distressed or agitated, using the area around the scapula may be useful to prevent dislodgement.[10]

Site problems will cause the patient discomfort and may interfere with drug absorption and compromise effective symptom control. Selection of an appropriate site for subcutaneous infusion can help to avoid problems and minimise restrictions on the patient's normal functioning. The patient's preference for site should be considered.

Management Principles

When managing a subcutaneous infusion, it is important to consider the organisation's policies and verify the protocol for preparation and set-up of the device.

Site selection

General principles for appropriate site selection include:[8]

- Use of an area with good depth of subcutaneous fat;
- Use of a site that is not near a joint;
- Selection of a site that is easily accessible such as the chest or abdomen;
- Use of correct insertion technique (table 2);

Inappropriate sites for subcutaneous infusions include:[2]

- Areas of infected, broken, inflamed or bruised skin;
- Near or over a joint or bony prominence;

- Skin folds or breast tissue;
- Where scarring is present;
- Sites of tumour;
- Skin sites that have recently been irradiated;
- Wherever ascites or pitting oedema are present;
- Areas of lymphoedema or where lymphatic drainage may be compromised.[2]

Site maintenance
The longevity of the site can vary considerably from 1–14 days.[12]

Many variables influence the longevity of the site, such as the type of medication and cannula/needle used. Rather than relying on a timeframe for re-siting the infusion, the onset of a site reaction should dictate this practice.[10]

The service provider organisation's protocol regarding site change should be used to guide practice.

Site irritation
Many factors contribute to site reactions such as the tonicity (concentration) of the medication, the pH of the solution, infection and prolonged presence of a foreign body (the cannula).[4]

Specific drugs used in palliative care that may cause site irritation include clonazepam,[2] cyclizine, ketamine, ketorolac, levomepromazine, methadone, morphine tartrate and promethazine.[8] In consultation with the treating medical officer, consider the following techniques to minimise site irritation:

Reducing site irritation

- Diluting the medications by using a larger syringe size;[8]
  Note: a syringe larger than 30 ml should not be used if a locked box is required;

- Change to a 12-hour regime allowing for further dilution of the drugs;
- Using normal saline (0.9%) if applicable, instead of water for injection;[8]
- Adding 1 mg of dexamethasone to the syringe.
  Note: One Australian trial found that the addition of 1 mg of dexamethasone to syringe drivers can significantly extend the longevity of the subcutaneous infusion site;[19]
- Using a Teflon® or Vialon® cannula reduces site inflammation and improves longevity.[8,14,]

In the context of subcutaneous fluid administration for rehydration, a UK study suggests absorption is increased by injection of 1500 units of hyaluronidase into the site prior to the infusion commencing if the skin is not already irritated.[15] The injection is given once per site, not daily.[8] This low dose of hyaluronidase is contraindicated in patients with asthma.[15]

Site inspection

Meticulous site inspection is integral to early identification and prevention of site related complications and should be performed as part of routine care.[10]

It is recommended that the site be checked regularly with minimum being 4 hourly and more often if clinical judgement indicates need.

Problems at the cannula insertion site may cause patient discomfort, interfere with drug absorption and compromise effective symptom control. When inspecting the site, check for:

- Tenderness or hardness at the site;
- Presence of a haematoma;
- Leakage at the insertion site;
- Swelling. A sterile abscess can occur at the insertion site causing local tissue irritation;[8]

- Erythema (redness);
- Presence of blood in the tubing;
- Displacement of the cannula.[8]

At least 4 hourly checks of the site are recommended. Other important patient checks include:

- Asking the patient how they feel (or a family member/carer if the patient is not able to comprehend or answer).
- Are they experiencing pain and/or are other symptoms controlled?
- The patient's preference for site should be considered.
- Ensure that the infusion device is working eg. Niki T34®: LED light flashes green. Gemstar®: arrows progress across screen. WalkMed®: squares progress across screen.
- Check the volume remaining in syringe or cassette and that the device is running to time.
- Check that there are no leakages, and that the connections to the syringe/line/cannula are firm.

Management Guidelines

Table 2: Principles for site preparation and cannula insertion

- It is important to refer to the protocols used within individual organisations for site preparation and cannula insertion;
- A Teflon® or Vialon® cannula is recommended; the BD Saf-T-Intima® commonly used in clinical practice in Australia has a Vialon®cannula.[8]

Preparing the site and inserting the cannula include:

- Using the guidelines (see preferred sites p. 11) and in combination with the patient and family, select a suitable site;[8]
- Select and use sites on a rotating basis;[10]
- An aseptic technique must be employed as many patients who require a subcutaneous infusion are immuno-compromised. Ensure hands are washed thoroughly;[8]
- Prepare the skin using an antiseptic with residual activity, eg a solution containing 0.5% to 2% chlorhexidine gluconate;
- Ensure skin is dry before insertion;
- The point of the cannula should be inserted just beneath the epidermis.

  Note: for thin people the angle of the cannula on insertion may need to be less (30 degrees) than for a person with more subcutaneous tissue (45 degrees). A deeper infusion may prolong the life of the insertion site.

To insert:

- Grasp the skin firmly to elevate the subcutaneous tissue;
- Insert the cannula and release the skin;
- Remove the stylet if using a BD Saf-T-Intima®. Take care to hold the cannula in situ when removing the stylet so that it is not accidentally removed from the patient;

  Note: if a metal needle is used, place the needle bevel downwards to deliver the drugs more deeply into the skin and minimise irritation.
- Change extension tubing when cannula is changed;
- When tubing is placed against the skin, form a loop to prevent dislodgement if the tubing is accidentally pulled;[15]
- Use a transparent, semi-occlusive dressing to cover the site; this permits inspection of the site by the caregiver;[8,15]
- Where relevant, place the syringe in the device;
- Document that the infusion has been commenced as per local drug administration policies.

Table 3: Principles for site inspection and maintenance

- It is important to refer to the protocols used within individual organisations for site inspection and assessment;
- Site inspection allows for early identification of problems and prevention of site related complications;
- The longevity of a site can vary considerably from 1 – 14 days.[5,8]

Site assessment should include noting:

- Tenderness or hardness at the site;
- Presence of a haematoma;
- Leakage at the insertion site;
- Any swelling;[9]
- Any erythema (redness);
- The presence of blood in the tubing;
- Displacement of the cannula;[8]
- Inquiring of the person or their proxy if symptom/s are controlled.

Site maintenance:

- Meticulous site inspection facilitates early identification of problems and prevention of site related complications;[5,15]
- Minimise tonicity by reducing concentration of the medication by using larger syringe size and more diluent;[8]
- Use Teflon® or Vialon® cannula to reduce site inflammation.

SECTION FOUR

Drugs and Diluents

Summary

- Subcutaneous infusion devices are commonly used to deliver drugs to treat a variety of symptoms including pain, nausea, vomiting, agitation, delirium, breathlessness and 'noisy breathing';
- A variety of drugs can be used and can be combined with no clinical evidence of loss of efficacy;
- Combinations of drugs must be checked for compatibility at time of prescription and prior to administration;[6,17]
- The more drugs that are mixed and delivered concurrently, the greater the risk of incompatibility[2] and reduced efficacy;
- 2-3 drugs may be mixed in a subcutaneous infusion (occasionally up to 4);[8,22]
- If incompatibility is an issue, the use of two subcutaneous infusion devices[5] or regular or prn subcutaneous injection should be considered;
- Before mixing any drugs together in a subcutaneous infusion, check for stability information[5,8] and check with hospital pharmacist;
- Medications to be infused subcutaneously should be diluted so that site longevity is not unnecessarily impacted;[4,8]
- Normal saline is the diluent most commonly used in Australia,[20] though it may be more likely to cause precipitation;[18,]
- Water for injection used as a diluent has been linked to site pain due to its hypotonicity;[8]
- 5% dextrose is not commonly used in Australia as a diluent.[8]

Discussion

A subcutaneous infusion of drugs is a commonly used method for delivering a range of medications at end of life, particularly when other drug routes are no longer available, or are unacceptable to the patient.

Pain is the most common symptom for which control is sought, but the use of subcutaneous infusion devices is not limited to analgesic administration.

Drugs to control other symptoms, such as nausea, vomiting, dyspnoea, agitation, delirium and terminal phase 'noisy breathing' can also be prescribed for continuous subcutaneous infusions and administered in the same syringe or cassette.

Commonly, two–three drugs and occasionally up to four drugs[8,17] may be mixed in a syringe/cassette for subcutaneous infusion. The maximum number of drugs that most clinicians are prepared to mix in a single infusion is four.

The more drugs that are mixed, the greater the risk of precipitation and reduced efficacy. It has been reported that a wide variety of drugs can be used in different combinations with no clinical evidence of loss of efficacy.[16] If compatibility is an issue, the use of two infusion devices may be considered.[17]

Drugs

In the Australian context, symptoms that are encountered at the end of life are generally well controlled using nine commonly used medications. These include:

- morphine sulphate/hydrochloride/tartrate (an opioid);
- hydromorphone (Dilaudid®, an opioid);
- haloperidol (Serenace®, an antipsychotic/antiemetic);
- midazolam (Hypnovel®, a short acting benzodiazepine);

- metoclopramide (Maxolon®, an antiemetic);
- hyoscine butylbromide (Buscopan®, an antimuscarinic);

  Note: hyoscine hydrobromide (Hyoscine®) is sometimes used but should be used with caution as it crosses the blood-brain barrier with risk of delirium.
- clonazepam (Rivotril®, a benzodiazepine) and
- fentanyl (an opioid).

An important safety consideration, before mixing any drugs together in a subcutaneous infusion, is to check for stability information.[8,17,20]

Detailed drug compatibility tables have been prepared showing compatibility data for various combinations of drugs.[8]

Check with hospital pharmacists to confirm information or clarify any questions regarding stability. Temperature may affect the stability of drugs. This can be overcome by ensuring the infusion device is placed on top of bed clothes and outside of clothing, rather than beneath them.[8]

Medications contraindicated for use via subcutaneous infusion:
Drugs such as prochlorperazine (an antiemetic), diazepam (an anxiolytic) and chlorpromazine (an antipsychotic) are specifically contraindicated for use in subcutaneous infusions due to severe localised reactions.[2,5]

There are several drugs that have also been linked to abscess formation when used in subcutaneous infusions. These include pethidine (pethidine hydrochloride), prochlorperazine (Stemetil®) and chlorpromazine (Largactil®).[8]

Diluents

The choice between water for injection and 0.9% saline (normal saline) as a diluent is a matter of debate. The literature is divided with some recommending water for injection as the diluent[8,15,20] and other more recent literature recommending normal saline as the diluent.[23]

Normal saline can be used for most drugs, the main exception being cyclizine.[8]

Normal saline is the diluent most commonly used in Australia for two reasons:

- most drugs can be diluted with normal saline with only two exceptions: cyclizine and diamorphine (neither of which are commonly used in Australia);
- normal saline is isotonic, as are most injectable formulations. By diluting with normal saline, the tonicity of the solution is unaltered.

Water for injection is hypotonic. Its use as a diluent will potentially produce a hypotonic solution that may contribute to the development of site reactions.[8]

In summary, the use of water for injection has been linked to pain due to its hypotonicity, although normal saline is more likely to cause precipitation of cyclizine and diamorphine.[8]

Previous editions of this publication indicated some ambiguities given the lack of clinical evidence or recommendations regarding diluents.[20] The literature review for this edition found no further clarifying research.

Table 4: Commonly used drugs in subcutaneous infusions

DRUG	INDICATION	COMMON DOSAGE	INJECTION STRENGTH
morphine sulphate/tartrate (tartrate is used rather than sulphate for larger doses as it is more soluble).	Opioid for pain control. Morphine is 2-3 times more potent when given parenterally than orally.[18] Morphine is physically compatible with most other drugs commonly used in syringe drivers.	There is no maximum dosage of morphine. Usual starting dose is 10-20 mg per 24 hours, which can be increased if pain is uncontrolled.	(as sulphate) 5mg/ml; 10mg/ml; 15mg/ml; 30mg/ml (as tartrate) 80mg/ml
hyoscine hydrobromide (Hyoscine)	Antimuscarinic useful for drying secretions (e.g. sialorrhoea, drooling, death rattle), intestinal colic, inoperable bowel obstruction.	200-400 microgram SC stat 600-1200 microgram per 24 hours	400 microgram/ml 600 microgram/ml
clonazepam (Rivotril)	A benzodiazepine derivative with antiepileptic properties. Several indications in palliative care: terminal agitation, anxiety, myoclonus; seizures, and neuropathic pain.	Usual dose is 1-4 mg per 24 hours.	1mg/ml
hydromorphone (Dilaudid)	Opioid for pain control, 5 times more potent than morphine. Often used when morphine is not effective or not tolerated.	There is no maximum dosage of hydromorphone. Usual starting dose is 2-4mg/24 hours; can be increased if pain uncontrolled.	2mg/ml; 10mg/ml as 1 & 5 ml ampoules

haloperidol (Serenace)	An antipsychotic agent and antiemetic. Used in low doses to control nausea and vomiting, and has minimal sedative properties at this dosage. Higher doses may control agitation and confusion.	As an antiemetic, 0.5-5 mg over 24 hours. To control delirium associated agitation, 1-20mg over 24 hours.	5mg/ml
midazolam (Hypnovel)	A short acting benzodiazepine, used to control seizures, anxiety and terminal agitation. Tolerance can develop and the dose may need to be increased.	2.5-60 mg over 24 hours.	5mg/ml
metoclopramide (Maxolon)	An antiemetic and gastrokinetic, indicated when nausea is associated with gastric/bowel stasis.	30-120 mg over 24 hours. Occasional extrapyramidal side effects.	5mg/ml
hyoscine butylbromide (Buscopan)	An antimuscarinic used mainly for the treatment of intestinal colic. Often used to dry terminal secretions. Not directly an antiemetic, but does reduce gastrointestinal secretions.	60-180 mg over 24 hours.	20mg/ml
fentanyl	An opioid for pain control, 100 times more potent than morphine.[18] Not commonly given in the community as not PBS listed.	600 mcg/24 hours in a subcutaneous infusion is equivalent to a 25 mcg/hr fentanyl patch. 90mg OME/24 hours.	50microgram/ml

Please refer to the disclaimer on page 3.

This information is intended as a guide only. It is important to refer to organisation guidelines and seek pharmacist support where available.

To determine drug incompatibilities, you should refer to your pharmacy manual, refer to your onsite pharmacist where available or contact your local specialist palliative care service (see Table 9).

SECTION FIVE

Person and Family education needs

Summary

- The commencement of a subcutaneous infusion may be seen by the patient and/or family as an indicator of the person transitioning to dying or it may be perceived as a positive experience in relieving symptom distress;[27]
- Service provider organisations should establish a policy and process for educating and supporting family caregivers about subcutaneous infusions and administering breakthrough medication when one is prescribed;
- Patient and family education promote safety and acceptance of the subcutaneous infusion device for providing improved symptom control;[3]
- Education aimed at supporting preparedness for care, providing emotional support and communications with health professionals and others may improve outcomes for the bereaved family and family caregivers.

Discussion

Family carers are important for the dying person as they provide practical, emotional and social support. If the person is dying at home, they also provide physical care, anticipatory care, financial support, and assist with coordinating care and potentially advocate for the person.[14]

Subcutaneous infusions via a driver/device are commenced in palliative care when the person's symptoms are not being adequately controlled by medications given via other routes or when the person has deteriorated and is no longer able to swallow prescribed medications.

Managing end of life medications can be a source of stress for the person and family care givers.[16,23]
Careful explanation and education about what the device will do, its advantages and possible disadvantages will improve confidence of family care givers.[5,14]

Patient and family education (Table 5) should include:

- Explanation and education about what the device will do;
- Its advantages and possible disadvantages;
- Safety aspects;
- Practical ways to manage the device in their everyday life;

Table 5: Activities of daily living

Carrying the infusion device	• If not supplied by service provider, purchase of a belt bag to conceal and carry the device discreetly may be useful; • Do not cover pump with blankets or pillow as this may cause overheating and impact on safe functioning.
Showering	• Infusion devices must not be immersed in water and may be damaged by steam; • Person and carer should be given clear, written instructions about disconnection from and reconnection to the infusion device for the purpose of showering; • The period of disconnection should be as brief as possible.
Breakthrough of pain or unrelieved symptoms	• The person and carer should be reassured that if the person continues to experience some pain or other symptoms, breakthrough medication can be given on these occasions.[16] **Note:** Breakthrough medication is defined as extra medication that may be required for symptoms that are not controlled by the medications prescribed and delivered via the subcutaneous infusion device.

Table 6: Patient and family education	
Information about the device	• Niki T34® has a green light that will flash intermittently above ON/OFF button and/or ‹‹‹Pump Delivering animation at the bottom of the LCD display when pump is functioning correctly; • Arrows run across the screen when the GemStar® is working; • A flashing light on the LCD screen indicates normal operating mode of CADD® Infusion Pumps; • Instruct the person/family to have a spare battery available (9 volt for the Niki T34®; or other relevant size battery for other devices). • Encourage the person/family to check the device to ensure it is working normally but encourage them not to worry about checking it overnight. • Provide written troubleshooting guidelines for the person and carer.
Alarms	• Infusion devices generally will alarm if the reservoir (syringe or cassette) is empty, or; • There is a blockage (e.g. kinked tubing) or; • There is air in the tubing; • Niki T34® will have message on screen indicating reason for alarm; • Instruct the person/carer not to panic and; • How to contact the relevant health professional.
Person/Family believes: there is something wrong with the infusion device, or the alarm sounds.	**Check:** Is the person experiencing increase of pain or other symptoms (indicating infusion not working)? • Occlusion – is there a kink in the tubing – untwist it; • Niki T34® has a Low/End battery alarm when battery charge is almost or fully depleted; • When there is insufficient charge to complete the current program, change battery, then hold down ON/OFF button until 'beeps' indicate turned on, press 'Yes' to confirm and re-start the program.

Table 6: Patient and family education	
Syringe is empty, the cannula has come out, the cannula site is swollen or painful.	The person/family carer will need to contact their healthcare provider. Give breakthrough medication as needed if person is experiencing pain or another symptom. Provide information and contact details for healthcare provider.

SECTION SIX

Assessment and Troubleshooting

Summary

- Thorough assessment is important when caring for a person with a subcutaneous infusion;[4,9]
- Assessment should include observation of:
  - The device, that it is functioning correctly;
  - The cannula insertion site, that it is patent;
  - The person, how are they feeling and are symptoms controlled?
- When troubleshooting the equipment used in subcutaneous infusions, it is important to understand the normal functioning of the device, and staff should be competent in management of the device in use;
- Drug calculations should be checked according to legislative requirements, organisational policy and protocols when the subcutaneous infusion device is set up and refilled;
- Ensure that drugs being delivered in combination are compatible;[8]
- Ensure that the organisational protocol regarding priming of the line is followed;[8,9,10]
- Ensure that a spare battery is always available for battery-driven devices.[8]

Discussion

Health care professionals should be mindful of how the person and family perceive the experience of a subcutaneous infusion device. Some may perceive the infusion as a foreshadowing of imminent death and others may have experienced high distress due to uncontrolled symptoms.

They will need good explanations and education about the reasons for an infusion, how the device works, how to care for and observe the site, and be confident in administering breakthrough medications if required.

Meticulous site inspection is integral to early identification and prevention of site related complications reducing the risk of distress for the person and their carer due to site related problems.

Principles of assessment, recording and documentation include:

- Ask the person how they feel (or family member/carer, if the person is unable to comprehend/reply), for example: are their pain and other symptoms controlled?;
- Careful inspection of site, at least 4 hourly, for signs of inflammation and site reaction;[18]
- Careful inspection of syringe volume remaining, at least 4 hourly;[8]
- Careful inspection of tubing for patency at least 4 hourly;[15]
- Document assessment findings regarding symptom control, efficacy of intervention, site patency, tubing and syringe status;
- Site inspection should be performed as part of routine care and includes principles such as checking for tenderness at the site, presence of a haematoma and leaking at the insertion site.[5,9,15]

Management Guidelines

Assessment recommendations are presented in Table 8.

Comprehensive troubleshooting guidelines are presented in Table 9.

Please note: If any of the following problems [Table 7 and/or 8] cannot be explained, the device may be faulty and should be checked by a medical engineer.

All devices should be periodically serviced by a qualified medical engineer according to manufacturer's guidelines.

Table 7: Assessment

Potential problem	Reducing potential problems
1. Cannula site: swelling, bruising, inflammation, infection, abscess development	Carefully inspect site at least daily, and up to 4 hourly and document findings;[29] If patient reports site tenderness or it becomes red, change site.
2. Precipitation/crystallising in tubing	Ensure that the drugs being delivered in single infusion are compatible;[16,31] Carefully inspect tubing, at least 4 hourly, and document findings.
3. Disconnection of tubing	Use Luer-Lok® syringes; Carefully inspect tubing, at least 4 hourly, and document findings.
4. Inappropriate dosages being delivered due to: I. Confusion due to unfamiliar infusion device II. Incorrect setting III. Confusion regarding priming of the line IV. Device running too fast/too slow	Ensure only one type of subcutaneous infusion device is used in each setting to reduce confusion; Ensure correct syringe size and make is detected by device sensor (Niki T34®); Ensure that organisational protocol is followed regarding priming of the line (refer to Section One); Check rate setting on device, and document; Document the time the device is set up and infusion commenced; Check infusion progress at least 4 hourly, and document findings.
5. Calculation errors	Ensure that drug calculations are checked according to legislative requirements and organisational policy and protocols.
6. Tampering with syringe driver settings	Use tamperproof 'lock- box' NIKI T34®;[29,32] Use key-pad lock if function is available.
7. Battery running flat	Ensure battery has sufficient charge; Ensure a spare battery appropriate to the device is available.

Table 8: Troubleshooting		
Clinical situation	**Possible cause(s)**	**Suggested solution(s)**
1. Device alarms	Reservoir (syringe/cassette) is empty; Tubing is kinked, cannula is blocked, plunger is jammed; Flat battery/loss of power; Air in line.	Re-fill reservoir; Un-kink tubing; check plunger is not sticking; Change battery; attach to power source; Remove air per manufacturer or workplace guidelines.
2. Infusion has not run to time	Rate set incorrectly, or has been altered; Syringe type and make incorrectly detected (Niki T34®); Device has been immersed in water.	Set correct rate; Use 'lock- box' (Niki T34®)[27,29] to prevent tampering with settings; Check syringe type and make; Instruct that device should not be immersed.
3. Infusion has ended early	Rate set incorrectly; Rate has been altered;	Check rate setting; Use 'lock- box' (Niki T34®) to prevent tampering with settings. [25,27,28]
4. Infusion has yet to complete	Device has been stopped; Rate setting is incorrect	Check for possible causes and correct; Empty reservoir (syringe/ cassette) Occlusion at cannula site or kinked tubing Flat battery/loss of power Check device setting to ensure delivery over 24 hours.

Table 8: Troubleshooting		
Clinical situation	**Possible cause(s)**	**Suggested solution(s)**
5. The infusion has stopped (e.g. light is not flashing/ arrows not running across screen)	Infusion has finished;	Reload reservoir (syringe/ cassette) as per medical order.
	Syringe/cassette incorrectly fitted;	Check set-up of device.
	Occlusion due to kinked tubing;	Check extension set is not kinked, or clamp in place.
	Occlusion due to precipitation of drugs;	Check syringe/cassette and extension set tubing for signs of precipitation (crystallisation)
		Change extension set line, re-site cannula;
		To prevent recurrence, check compatibility of drugs being mixed, increase the dilution, review medication regime, or two devices may need to be used;[8,9]
	Occlusion at cannula site due to inflammation or bruising;	Re-site cannula;
		Observe site for resolution of swelling or bruising;
	Possible battery/power source problem;	Check battery is inserted correctly;
		If battery is flat, change;
		Attach to power source;
	Mechanical malfunction	Send for maintenance
6. Limited cannula access sites	Cachexia;	Consider if a subcutaneous infusion is appropriate;
	Oedema;	Refer to Section 2 of these Guidelines: Site Selection;
	Infection.	Confer with experienced colleagues.

Table 8: Troubleshooting		
Clinical situation	**Possible cause(s)**	**Suggested solution(s)**
7. Cannula site inflamed after 24-48 hours	Skin reaction at the cannula site;	Remove cannula and resite; Observe the old site for ongoing signs of irritation; Consider changing drug combination in infusion when there is repeated site inflammation;[8] Adding 1 mg dexamethasone to the syringe may reduce site irritation;[8,18]
	High drug concentration in reservoir causing irritation;	Increase dilution of drugs in reservoir; Change to larger volume reservoir if needed e.g. change from 20 to 30 ml syringe;
	Site appears infected;	Remove cannula and resite, Observe the old site for signs of infection;
	Infusion includes drugs not appropriate for subcutaneous infusion;	Ensure that drugs are suitable for the subcutaneous route;
	Site of previous radiotherapy;	Resite to area not previously treated.
8. Person experiences pain at cannula site	Shallow cannula insertion; Inflammation at site	Remove cannula and resite; See previous
9. Leakage at cannula site	Cannula position is not stable	Remove cannula and resite.
10. Bleeding cannula site	Trauma or coagulation problem	Remove cannula, apply pressure at old site; Resite if appropriate, observe for further bleeding.

Table 8: Troubleshooting		
Clinical situation	**Possible cause(s)**	**Suggested solution(s)**
11. Person is restless and/or confused	Delirium See Delirium Clinical Care Standard[33] - Possibility of terminal delirium; - Pain and/or bladder or bowel discomfort	Treat the underlying cause as appropriate and if able; Consider resiting the cannula around the scapula; Consider giving a breakthrough dose of an antipsychotic agent such as haloperidol;[8] Check if bladder or rectum is full, and implement appropriate management strategies.
12. Person reports unrelieved and/or poor symptom control	Leakage from the device Therapeutic dose in serum levels has not been achieved >24 hours after commencement of infusion Incorrect dose of medication prepared Medication order is inappropriate	Remove cannula and apply pressure at old site; when resited, observe site for bleeding; Check all connections, changing components as necessary. Consult prescriber and review medications; Give available breakthrough medications until optimal symptom control is achieved. Recheck medication order, draw up the correct dose; Complete an incident form, notify the correct persons of error. Assess the person, confer with medical staff to adjust dosage.

Table 9: Specialist Palliative Care Services	
Queensland	• **Cairns & Hinterland Hospital & Health Service** Gordonvale Hospital & Cairns Palliative Care Service ph: 07 4043 3100 • **Central Queensland Hospital & Health Service** Rockhampton Community Palliative Care Service ph: 07 4920 7500 • **Children's Health Queensland** Paediatric Palliative Care Service ph: 1800 249 648 • **Darling Downs Hospital & Health Service** Toowoomba Hospital ph: 07 4616 6000 • **Gold Coast Hospital & Health Service** Gold Coast Palliative Care Service ph: 1300 763 218 Palliative Care Pharmacist: 07 5519 8241 • **Mackay Hospital & Health Service** Mackay Hospital ph: 07 4885 6000 • **Metro North Hospital & Health Service** North Lakes Community Palliative Care ph: 07 3049 5755 Redcliffe Hospital Palliative Care ph: 07 3883 7050 Royal Brisbane & Women's Hospital Palliative Care ph: 07 3646 6138 The Prince Charles Hospital Palliative Care ph: 07 3139 4482 • **Metro South Hospital & Health Service** Logan Hospital Palliative Care ph: 07 3299 8899 Princess Alexandra Hospital Palliative Care ph: 07 3176 5597 QE II Hospital Palliative Care ph: 07 3182 6370 Redland Hospital Palliative Care ph: 07 3488 3111 • **North West Hospital & Health Service** Mt Isa Hospital ph: 07 4744 4444 • **South West Hospital & Health Service** Roma Hospital ph: 07 4624 2700 • **Sunshine Coast Hospital & Health Service** Sunshine Coast Specialist Palliative Care – Dove PCU ph: 07 5436 8633 Specialist Palliative Care Consult Service ph: 07 5436 8800 • **Torres & Cape Hospital & Health Service** Cairns Palliative Care Service ph: 07 4043 3100 • **Townsville Hospital & Health Service** Townsville Palliative Care Service ph: 07 4433 4242

Table 9: Specialist Palliative Care Services	
Queensland	• **West Moreton Hospital & Health Service** Ipswich Hospital Palliative Care Unit ph: 07 3810 1440 • **Wide Bay Hospital & Health Service** Bundaberg Hospital ph: 07 4150 2222 Hervey Bay Hospital ph: 07 4325 6666
Queensland NGOs	• Mater Brisbane Palliative & Supportive Care Service ph: 07 3163 5200 • St Vincent's Private Hospital Brisbane ph: 07 3240 1111 • Wesley Hospital Brisbane ph: 07 3232 7043
Other States & Territories	https://palliativecare.org.au/directory-of-services

Conclusion

The use of subcutaneous infusion devices in palliative care and other settings to achieve symptom control is standard and accepted practice. Use of subcutaneous infusion devices can provide benefits to the patient in terms of convenience and effective management of symptoms. However, use of such devices is not without some risks and limitations, including inflexibility of prescription, technical problems, safety issues and skin reactions at the cannula site of the infusion.

Subcutaneous infusion devices may also cause concerns and fears for some patients and their families as their use may be associated with disease progression.

The Guidelines presented in this document are intended to promote a standardised approach to clinical care, thereby minimising practice errors that can result in serious adverse events that present an on-going risk for patient safety.

REFERENCES

1. Reymond E, Charles M. An intervention to decrease medication errors in palliative patients requiring subcutaneous infusions: Brisbane South Palliative Care Service and Adverse Drug Event Prevention Program; unpublished report presented to Clinical Services Evaluation Unit, Princess Alexandra Hospital, Brisbane, Australia; 2005.
2. Guidelines for Subcutaneous Infusion Device Management in Palliative Care. (2nd ed). 2013. http://www.health.qld.gov.au/cpcre
3. Therapeutic Guidelines Limited. Therapeutic Guidelines: Palliative Care. Version 4. Melbourne: Therapeutic Guidelines Ltd, 2016.
4. Graham F. The syringe driver and the subcutaneous route in palliative care: the inventor, the history and the implications. *Journal of Pain and Symptom Management* 2005;29(1):32-40.
5. Morgan S, Evans N. A small observational study of the longevity of syringe driver sites in palliative care. *International Journal of Palliative Nursing* 2004;10(8):405-412.
6. Coleridge-Smith E. The use of syringe drivers & Hickman lines in the community. *British Journal of Community Nursing* 1997;2(6):292,294,296.
7. Cunningham in Cruikshank S, Adamson E, Logan J, Brackenridge K. Using syringe drivers in palliative care within a rural, community setting: capturing the whole experience. *International Journal of Palliative Nursing* 2010;10(3):126-132.
8. Tooke L, Howell L. Syringe Drivers: incorrect selection of syringe type from the syringe menu may result in significant errors in drug delivery. *Anaesthetic Intensive Care* 2014;(42):467-472.
9. Dickman A, Schneider J. *The syringe driver: continuous subcutaneous infusions in palliative care*. 4th ed. Oxford: Oxford University Press;2016.
10. Ratcliffe N. Syringe Drivers. Community Nurse 1997;3(6):25-26.
11. Mukoreka J, Sisay I. Safe practice in syringe pump management. *Nursing Times* 2015;111 (14):19-21.
12. Torre M C. Subcutaneous infusion: non-metal cannulae vs metal butterfly needles. *British Journal of Community Nursing* 2002;7(7):365-369.
13. Ross J R, Saunders Y, Cochrane, M, & Zeppetella G. A prospective, within-patient comparison between metal butterfly needles and Teflon cannulae in subcutaneous infusion of drugs to terminally ill hospice patients. *Palliative Medicine* 2002;16(1): 13-16. doi: 10.1191/0269216302pm471oa.
14. Griffith, S. Improving practice using action research: resolving the problem of kinking non-metal cannulae. *International Journal of Palliative Nursing* 2011;17(11).
15. T34® e-learning. 2008. Becton Dickinson Australia/New Zealand. https://bd.elmg.net/?rc=8eb4d38bf17d20725ca8a4d3a58f0b22 downloaded 14/10/2019.
16. Mitten T. Subcutaneous drug infusions: a review of problems and solutions. *International Journal of Palliative Nursing* 2001;7(2):75-85.
17. Lloyd-Williams M, Rashid A. An analysis of calls to an out-of-hours palliative care advice line. *Public Health* 2003;117(2):125.

18. The Eastern Metropolitan Region Palliative Care Consortium (2016) *Syringe Driver Drug Compatibilities – Guide to Palliative Care Practice*. https://mail.barwonmedicarelocal.com.au/images/publications/WestvicNews/Syringe-Driver-Drug-Compatibilities-2016-May-3-final.pdf downloaded 22/01/2018
19. Reymond L, Charles MA, Bowman J, Treston P. The effect of dexamethasone on the longevity of syringe driver subcutaneous sites in palliative care patients. *Medical Journal of Australia* 2003;178:486-489.
20. Freemantle A, Clark D, Crosby V. Safer ambulatory syringe drivers: experiences of one acute hospital trust. *International Journal of Palliative Nursing* 2011;17(2):86-91.
21. Lichter I, Hunt E. Drug combinations in syringe drivers. *The New Zealand Medical Journal* 1995;108(1001):224-226.
22. Dickman A, Bickerstaff M, Jackson R, Schneider J, Mason S, Ellershaw J. Identification of drug combinations administered by continuous subcutaneous infusion that require analysis for compatibility and stability. *BMC Palliative Care* 2017;16:22.
23. Flowers C, McLeod F. Diluent choice for subcutaneous infusion: a survey of the literature and Australian practice. *International Journal of Palliative Nursing* 2005;11(2):54-60.
24. Tait P, Morris B, To T. Core palliative medicines: meeting the needs of non-complex community patients. *Australian Family Physician* 2014;43, No.1-2.
25. Joint Therapeutics Commission. A survey of doctors on their preferred medications for various symptoms in palliative care. Brisbane: Unpublished data;2005.
26. Payne S, Turner M, Seamark D, Thomas C, Brearley S, Wang X, Blake S, Milligan C. Managing end of life medications at home – accounts of bereaved family carers: a qualitative interview study. *BMJ Supportive & Palliative Care* 2015;5:181–188. doi:10.1136/bmjspcare-2014-000658. downloaded 24/01/2018.
27. Cruikshank S, Adamson E, Logan J. & Brackenridge K. Using syringe drivers in palliative care within a rural community setting: capturing the whole experience. *International Journal of Palliative Nursing*, 2010;16(3):126-132.
28. Norton V. Don't wait until we are struggling: what patients and family caregivers tell us about using a syringe driver. *Kai Tiaki Nursing Research* 2014;5(1).
29. Henriksson A, Arestedt K. Exploring factors and caregiver outcomes associated with feelings of preparedness for caregiving in family caregivers in palliative care: A correlational, cross-sectional study. *Palliative Medicine* 2013;27(7):639-646.
30. Government of Western Australia North Metropolitan Health Service Women and Newborn Health Service. *Niki t34 syringe pump: continuous subcutaneous infusion management.* 2017. https://www.kemh.health.wa.gov.au/~/media/Files/Hospitals/WNHS/For%20health%20professionals/Clinical%20guidelines/OG/WNHS.OG.PalliativeNikiT34SyringePump.pdf downloaded 27/05/2020.
31. The Eastern Metropolitan Region Palliative Care Consortium *Syringe Driver Drug Compatibilities – Guide to Palliative Care Practice* 2016. https://mail.barwonmedicarelocal.com.au/images/publications/WestvicNews/Syringe-Driver-Drug-Compatibilities-2016-May-3-final.pdf downloaded 22/01/2018.

32. Ballarat Health Service Clinical Governance Documentation Review Group. *Clinical Practice Protocol, Syringe Driver – NIKI T34*. 2016. downloaded 09/12/2018 http://webapps/airapps/Services/au/org/bhs/govdoc/HTMLViewer.php?id=28957

33. Australian Commission on Safety and Quality in Health Care. Delirium Clinical Care Standard. https://www.safetyandquality.gov.au/our-work/clinical-care-standards/delirium-clinical-care-standard/ downloaded 27/05/2020.

Appendix A – Levels of Evidence [1]

Level of Evidence	Effectiveness
1	1.a Systematic review of Randomised Controlled Trials (RCTs)
	1.b Systematic review of RCTs and other study designs
	1.c RCT
	1.d Pseudo RCTs
2	2.a Systematic review of quasi-experimental studies
	2.b Systematic review of quasi-experimental and other lower study designs
	2.c Quasi-experimental prospectively controlled study
	2.d Pre-test – post-test or historic/retrospective control group study
3	3.a Systematic review of comparable cohort studies
	3.b Systematic review of comparable cohort and other lower study designs
	3.c Cohort study with control group
	3.d Case – controlled study
	3.e Observational study without a control group
4	4.a Systematic review of descriptive studies
	4.b Cross sectional study
	4.c Case series
	4.d Case study
5	5.a Systematic review of expert opinion
	5.b Expert consensus
	5.c Bench research / single expert opinion

[1.] Joanna Briggs Institute. Levels of Evidence. Joanna Briggs Institute.2013. https://joannabriggs.org/jbi-approach-to-EBHC accessed 18/11/2020 Accessed 22 October 2019.

Appendix B – Literature Summary for this edition

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Coleridge-Smith E. The use of syringe drivers & Hickman lines in the community. British Journal of Community Nursing 1997;2(6):292,294,296.						
3	N/A	N/A	N/A	Evidence based guidelines	N/A	N/A
Cunningham in Cruikshank S, Adamson E, Logan J, Brackenridge K. Using syringe drivers in palliative care within a rural, community setting: capturing the whole experience. International Journal of Palliative Nursing 2010;10(3):126-132.						
3	4 palliative care patients, 8 carers and 12 nurses	Australian rural community practice setting.		Unstructured interviews of patients and informal carers; focus groups of nurses.	Literature review	Highlighted need to view commencing of a syringe driver as a holistic experience and opportunity to address issues around death and family carer awareness of approach of death.
Dickman A, Schneider J. The syringe driver: continuous subcutaneous infusions in palliative care. 4th ed. Oxford: Oxford University Press;2016.						
3	N/A	N/A	N/A	Reference book about syringe drivers	N/A	N/A
Dickman A, Bickerstaff M, Jackson R, Schneider J, Mason S, Ellershaw J. Identification of drug combinations administered by continuous subcutaneous infusion that require analysis for compatibility and stability. BMC Palliative Care 2017;16:22.						
3	N/A	UK palliative care services	To identify commonly used drug combinations in CSCI	Surveys & questionnaires of pharmacists; Delphi study of combinations used for complex/ refractory symptom	Survey of practice and Delphi study.	40 drug combinations found to represent approx. two-thirds of combinations recorded. Total of 23 different drugs administered in combination; the median number of drugs in a combination was three. The Delphi study identified five combinations for the relief of complex & refractory symptoms
Flowers C, McLeod F. Diluent choice for subcutaneous infusion: a survey of the literature and Australian practice. International Journal of Palliative Nursing 2005;11(2):54-60.						
3	N/A	Australian practice settings (and national and international literature search).	To determine diluent choice for subcutaneous infusions in the literature and in Australian practice.	Survey of clinical practice settings; literature search.	Literature review considered existing literature, drug databases & directories; involved a survey of palliative care services to examine evidence & experience relating to diluent choice.	With the exception of five drugs for which saline was recommended, there was an inclination to use water unless contraindicated. More research is needed to address formal clinical evidence & ambiguities.

Appendix B – continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Freemantle A, Clark D, Crosby V. Safer ambulatory syringe drivers: experiences of one acute hospital trust. International Journal of Palliative Nursing 2011;17(2):86-91.						
3	N/A	UK acute hospital trust – 2 campuses	To identify & trial ambulatory syringe drivers to potentially adopt, and implement the selected driver and training staff in its use.	Survey of health professionals and evaluation of available devices as 'fit for purpose' before coordinated approach to implementation across the Trust.	Precise guidelines were written; new devices were configured to deliver medication only over a 24-hour period; new ways of prescribing medications for syringe drivers were developed incorporating guidance on diluents.	
Graham F. The syringe driver and the subcutaneous route in palliative care: the inventor, the history and the implications. Journal of Pain and Symptom Management 2005;29(1):32-40.						
4	N/A	N/A	To analyse the adoption of the syringe driver in palliative care.	Literature search	N/A	N/A
Griffith S. Improving practice using action research: resolving the problem of kinking non-metal cannulae. International Journal of Palliative Nursing 2011;17(11):531-536.						
3	N/A	15 bed inpatient unit in rural UK	To find solution to 'kinking' of non-metal cannulae.	Literature review and observational study.	Review of historical incident documentation, development of reporting form placed in patient chart to record issues with occlusion alarms and 'kinked' tubing.	Comparison with literature and adjustments made based on clinician evaluation of problems led to infusion system with lowered risk of issues related to cannulae providing comfortable and long-lasting infusions.
Henriksson A, Arestedt K. Exploring factors and caregiver outcomes associated with feelings of preparedness for caregiving in family caregivers in palliative care: A correlational, cross-sectional study. Palliative Medicine 2013;27(7):639-646.						
4	125 family caregivers of patients with life-threatening illness	3 specialist palliative care units and 1 haematology unit in Sweden	To explore factors associated with preparedness and whether preparedness is associated with caregiver outcomes.	A correlational study using a cross-sectional design.		Preparedness was significantly associated with higher levels of hope and reward and with a lower level of anxiety. Preparedness was not associated with depression or health. Psycho-educational interventions could preferably be designed aiming to increase family caregiver's preparedness to care, including practical care, communication and emotional support.

Appendix B – continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Lichter I, Hunt E. Drug combinations in syringe drivers. The New Zealand Medical Journal 1995;108(1001):224-226.						
3	N/A	Australian practice settings (and national and international literature search).	To determine diluent choice for subcutaneous infusions in the literature and in Australian practice.	Survey of clinical practice settings; literature search.	Literature review considered existing literature, drug databases & directories; involved a survey of palliative care services to examine evidence & experience relating to diluent choice.	With the exception of five drugs for which saline was recommended, there was an inclination to use water unless contraindicated. More research is needed to address formal clinical evidence & ambiguities.
Lloyd-Williams M, Rashid A. An analysis of calls to an out-of-hours palliative care advice line. Public Health 2003;117(2):125.						
4	N/A	A specialist palliative care hospice in the UK	To improve out-of-hours care for terminally ill Patients of the hospice.	Establishment of a 24-hour palliative care advice line. Information requested over a 12-month period was evaluated.	A 24 h advice line was set up to offer information and advice for community medical and nursing staff caring for all patients with palliative care needs, out-of-hours.	Out-of-hours palliative care is an important issue. An advice line may improve this provision by providing information on appropriate medication & patient management. The study also supports the continuing need for palliative care education in the community.
Mitten T. Subcutaneous drug infusions: a review of problems and solutions. International Journal of Palliative Nursing 2001;7(2):75-85.						
3	N/A	N/A	Reviews general issues with the operation of portable syringe drivers and discusses a range of potential problems and solutions.	Evidence based guidelines	N/A	N/A
Morgan S, Evans N. A small observational study of the longevity of syringe driver sites in palliative care. International Journal of Palliative Nursing 2004;10(8):405- 412.						
3	27 Palliative Care patients examining 86 syringe driver sites	UK hospice Setting	To establish the rate of SD reactions, duration of sites and to determine whether a predictable relationship existed between the number of days on a SD and number of sites used consecutively.	Observational study	A proforma was designed to collect information. Data collected included: date and time of set-up; medication doses; date & time site discontinued; presence of site reaction; body site used.	44% discontinued due to site reactions; Location of SD site appeared to be an important factor; Dislodgement 3 x more prevalent from chest wall than upper arm; Sites must be inspected regularly; There is no evidence base - more research is needed.

Appendix B – continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Mukoreka J, Sisay I. Safe practice in syringe pump management. Nursing Times 2015;111(14):19-21.						
3	N/A	N/A	N/A	To identify safe practice in use of syringe drivers to administer medications.	N/A	Syringe pumps have an important role in symptom management. They are often viewed by patients and families as signalling the end of life, but they offer patients the opportunity to receive effective symptom control. It is vital that nurses using pumps have appropriate training and supervision to avoid errors.
Norton V. Don't wait until we are struggling: what patients and family caregivers tell us about using a syringe driver. Kai Tiaki Nursing Research 2014;5(1):12-16.						
3	12 cancer patients & 15 family caregivers.	A hospice in New Zealand	The study looked at the experiences, perceptions and assumptions patients and their family caregiver(s) have about a syringe driver being used in their palliative care,	Thematic analysis of semi-structured interviews.	A semi-structured schedule was used to guide the in-depth interviews. The interviews were conducted in a conversational style, covering relatively neutral and general aspects of the person's life, moving to more specific and intimate questions and ending with a debrief. Patient & family caregiver interview schedules were slightly different to accommodate the unique perspective of each group.	This study reveals that while few people, unsurprisingly, knew much about syringe drivers before using one, all participants, where relevant, became sufficiently knowledgeable about how they operated and skilled in managing disruptions to continuous infusion. This study provides specific advice to be used in the development of an information manual or booklet to supplement the technological information currently available.
Payne S, Turner M, Seamark D, et al. Managing end of life medications at home – accounts of bereaved family carers: a qualitative interview study. BMJ Supportive & Palliative Care 2015; 5:181–188. doi:10.1136/bmjspcare-2014-000658. Downloaded from http://spcare.bmj.com/ on January 24, 2018.						
	59 bereaved family carers	Domestic homes in two contrasting areas in England.	To explore how bereaved family members recall managing end of life medications when delivering care to a patient dying at home in England.	A cross-sectional qualitative design with face to face interviews in homes to elicit chronological narratives of care. A coding framework was applied to data analysis.	Purposively sampled bereaved family carers to select those with direct experience of providing care for an older person dying at home.	Important concerns about managing end of life medication for the dying person at home. Reports of anxiety about giving correct and timely dosages, and concerns about keeping the patient comfortable without overdosing or risking shortening lives.

Appendix B – continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
						Family carers require more information about end of life drugs and their effects, support and training in managing medication for a dying person.
Ratcliffe N. Syringe Drivers. Community Nurse 1997;3(6):25-26.						
4	N/A	N/A	N/A	Instructions - Guidelines	N/A	N/A
Ross JR, Saunders Y, Cochrane M, & Zeppetella G. A prospective, within-patient comparison between metal butterfly needles and Teflon cannulae in subcutaneous infusion of drugs to terminally ill hospice patients. Palliative Medicine 2002;16(1):13-16. doi: 10.1191/0269216302pm471oa.						
3	Thirty hospice inpatients	Hospice	To determine difference in time from needle insertion to site reaction using metal needles vs Teflon cannulae for sc administration of drugs in terminally ill patients.	Prospective study of hospice inpatients.	Patients were used as their own control. Prescribed medications were divided equally between two syringe drivers and delivered over 24 hours.	Teflon cannulae had a median life span twice that of metal butterfly needles, making them a cost-effective alternative for sc administration of medications in terminally ill patients.
Tait P, Morris B, To T. Core palliative medicines: meeting the needs of non-complex community patients. Australian Family Physician 2014;43(1-2):29-32.						
			To develop a concise list of core medicines that can provide symptom control in non-complex patients in the last days of life.			This list is intended to support timely access to medicines for palliative patients where their preferred place to die is in the community. It is paramount that the development of core medicines lists takes into account the practical needs of carers and patients and is supported by a multidisciplinary education campaign to ensure prescribing mirrors medicine availability.

Appendix B – continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Tooke L, Howell L. Syringe Drivers: incorrect selection of syringe type from the syringe menu may result in significant errors in drug delivery. Anaesthetic Intensive care 2014; 42:467-472.						
3	N/A	Hospital Neonatal Department in South Africa	To investigate if using non-validated syringes or choosing the incorrect syringe from the menu would have an impact on drug delivery.	N/A	A sample of each syringe type available in the department was obtained. A Vernier calliper (0.02 mm accuracy) was used to determine external dimensions of all syringes. After sectioning each syringe barrel the internal diameters were also measured.	The study provides clear evidence that there are substantial variations in delivered volumes when the incorrect syringe is selected from the menu offered by three brands of syringe drivers.
Torre MC. Subcutaneous infusion: non-metal cannulae vs metal butterfly needles. British Journal of Community Nursing 2002;7(7):365-369.						
1	N/A	N/A	To evaluate the effectiveness of non-metal cannulae compared to metal butterfly needles in maintaining s/c infusion sites in patients receiving palliative care.	Meta-analysis	A mini review of 5 RCTs was conducted.	One study was excluded. It appears that non-metal cannulae are more effective in maintaining s/c infusion sites than butterfly needles. There is no basis to recommend Vialon rather than Teflon cannulae.

Appendix C– Literature Summary from previous editions

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Abbas S, Yeldham M, Bell S. The use of metal or plastic needles in continuous subcutaneous infusion in a hospice setting. American Journal of Hospice and Palliative Medicine 2005;22(2):134-138.						
4	40 patients	UK hospice	N/A	Retrospective clinical audit	Clinical audit methodology	Mean survival of plastic cannula 4.03 days cf 1.8 days for metal needle. Kinking was not a problem; no needlestick injuries were reported.
British National Formulary. 'Syringe drivers.' ‹ww.bnf.org›. Accessed 26th January, 2005						
4	N/A	N/A	N/A	British National Formulary website	N/A	N/A
Coleridge-Smith E. The use of syringe drivers & Hickman lines in the community. British Journal of Community Nursing 1997;2(6):292, 294, 296.						
3	N/A	N/A	N/A	Evidence based guidelines	N/A	N/A
Curtis S, Douglas I. Pyoderma gangrenosum in a syringe driver site of a patient with non-Hodgkins's lymphoma. Palliative Medicine 2006;20:113-114.						
4	Case study	Not specified	N/A	Case study	N/A	When faced with rapidly growing ulcer at site of skin trauma, early involvement of dermatologist can help establish diagnosis of pyoderma gangrenosum.
Dickman A, Schneider J, Varga J. The Syringe Driver (2nd ed). Oxford: Oxford University Press; 2005.						
3	N/A	N/A	N/A	Reference book about syringe drivers	N/A	N/A
Donald AI, Chinthamuneedi MP, Spearritt D. Effect of changes in syringe driver height on flow: a small quantitative study. Critical Care and Resuscitation 2007;9(2):143-147.						
4	N/A	Bench experiment	To quantify flow irregularities in drug delivery caused by syringe pump vertical displacement.	Bench experiment	A standard syringe pump and line set with dye solution was run through a graduated length of tubing. The effect of changing pump height was quantified by measuring progress down the tubing over time.	A 30cm elevation produced significant drug delivery boluses – up to seven times programmed rate at 2mL/hr. Lowering the pump 30cm resulted in no-flow times of up to 180 seconds at 2mL/hr.
Dunne K, Garvey A, Kernohan G, Diamond A, Duffy C, Hutchinson J. An audit of subcutaneous syringe drivers in a non-specialist hospital. International Journal of Palliative Nursing 2000;6(5):214, 216-219.						
3	13 cases of palliative care patients	Not specified	To establish the standard of current practice in wards where syringe drivers were being used.	Clinical audit (retrospective study)	Clinical audit methods.	Highlighted many areas of unregulated practice with regard to setting up, monitoring & maintenance of syringe drivers.

Appendix C– continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Flowers C, McLeod F. Diluent choice for subcutaneous infusion: a survey of the literature and Australian practice. International Journal of Palliative Nursing 2005;11(2):54-60.						
3	N/A	Australian practice settings (and national and international literature search).	To determine diluent choice for subcutaneous infusions in the literature and in Australian practice.	Survey of clinical practice settings; literature search.	Literature review considered existing literature, drug databases & directories; involved a survey of palliative care services to examine evidence & experience relating to diluent choice.	With the exception of five drugs for which saline was recommended, there was an inclination to use water unless contraindicated. More research is needed to address formal clinical evidence & ambiguities.
Gomez Y. The use of syringe drivers in palliative care. Australian Nursing Journal 2000;(2):suppl 1-3.						
3	N/A	N/A	Outlines application of syringe drivers, in particular the Graseby MS16A in a palliative care setting	Evidence based instruction guide	N/A	N/A
Hayes A, Brumley D, Habeggar L, Wade M, Fisher J, Ashby M. Evaluation of training on the use of Graseby syringe drivers for rural nonspecialist nurses. International Journal of Palliative Nursing 2005;11(2):84-92.						
3	270 non-specialist nurses	Rural Grampians Health Region in Victoria, Australia	To assess the impact of a training programme on nurse confidence in setting up and explaining the Graseby syringe driver	Training program	Pre-training post-training and follow up questionnaires	Increases in confidence levels were found in participating nurses in relation to each of the four confidence parameters
Herndon C. Continuous subcutaneous infusion practices of United States hospices. Journal of Pain and Symptom Management 2001;22(6):1027-1034.						
3	3762 US hospice facilities.	N/A	To determine subcutaneous infusion practices in US hospices.	Survey of hospices	Questionnaire	907 respondents; 73% used CSCI to administer medications and/or fluids. Most commonly used drugs: morphine (97%), hydromorphone (60%), haloperidol (14%), midazolam (9%), metoclopramide (8%). Over 75% used normal saline as diluent.
Koshy R, Kuriakose R, Sebastian P, Koshy C. Continuous morphine infusions for cancer pain in resource-scarce environments: comparison of the subcutaneous and intravenous routes of administration. Journal of Pain & Palliative Care Pharmacotherapy 2005;19(1):27-33.						
2	Thirty terminally ill patients.	Cancer Centre Pain Clinic in southern India.	To determine most cost-effective method of parenteral morphine administration for cancer pain management.	Prospective randomised controlled trial	Patients with pain >8/10 on a visual analogue score were randomised to receive continuous morphine infusion	Morphine administered by SC and IV routes produced similar favourable effects on vital parameters and for analgesia.

Appendix C– continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
					either IV or SC. Gravity dependent drip method was used for all infusions because staff trained to use infusion pumps are often not available in outlying centres in developing countries.	
Lichter I, Hunt E. Drug combinations in syringe drivers. The New Zealand Medical Journal 1995;108(1001):224-226.						
2	One hundred consecutive patients in a palliative care setting	New Zealand	To record the combinations of drugs in SD's that were found to be compatible	Experimental	Case series. Because of widely differing views on drugs that can be administered in combination, study was undertaken to record compatible combinations of drugs in syringe drivers. The content of syringe drivers in 100 consecutive patients in whom CSCI was used was recorded. The incidence of skin reactions with the different drugs was noted. The efficacy of combinations used was assessed clinically.	It was found that a wide variety of drugs were used in many different combinations, with no clinical evidence of loss of efficacy. Some drug combinations were incompatible. Drugs known to cause skin reactions were not administered. In this study, skin reactions depended on the number of drugs used in combination. Conclusion: the array of medications able to be used together in syringe drivers enables this method of drug administration to be used successfully in the control of diverse symptoms that may arise in terminal illness.
McLeod F, Flowers C. A practical guide for nurses in diluent selection for subcutaneous infusion using a syringe driver. International Journal of Palliative Nursing 2006;12(12):558-565.						
4	N/A	N/A	To develop an instructional guide to assist nurses select an appropriate diluent for SC infusions in order to standardise practice.	Literature review and consensus of expert group of palliative care nurses.	Literature review and consensus of expert group of palliative care nurses.	Authors recommend that manufacturers specify diluent to be used with their drugs in instructions for use in product packaging.
McQuillan R, Finlay I. The utilization of syringe drivers at a teaching hospital. Palliative Medicine 1996;10(1):52						
4	N/A	University Hospital of Wales	Correspondence about utilisation of syringe drivers at a teaching hospital in Wales	Correspondence	N/A	The most common types of syringe driver used in Britain are the Graseby MS16A and MS26 machines;

Appendix C– continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
						approx. 2500 of these are sold annually in the UK and a similar number sold abroad. The simple Graseby syringe drivers cost about £600 each; the manufacturer does not recommend routine maintenance. In theory a syringe driver could be in use 100% of the time, but because of loss and under-usage of syringe drivers, they are not used efficiently at some centres.
Mitten T. Subcutaneous drug infusions: a review of problems and solutions. International Journal of Palliative Nursing 2001;7(2):75-85.						
3	N/A	N/A	Reviews general issues with the operation of portable syringe drivers and discusses a range of potential problems and solutions.	Evidence based guidelines	N/A	N/A
Morgan S, Evans N. A small observational study of the longevity of syringe driver sites in palliative care. International Journal of Palliative Nursing 2004;10(8):405-412.						
3	27 Palliative Care patients examining 86 syringe driver sites	UK hospice Setting	To establish the rate of SD reactions, duration of sites and to determine whether a predictable relationship existed between the number of days on a SD and number of sites used consecutively.	Observational study	A proforma was designed to collect information. Data collected included: date and time of set-up; medication doses; date & time site discontinued; presence of site reaction; body site used.	44% discontinued due to site reactions; Location of SD site appeared to be an important factor; Dislodgement 3 x more prevalent from chest wall than upper arm; Sites must be inspected regularly; There is no evidence base - more research is needed.
Negro S, Salama A, Sanchez Y, Azuarat M, Barcia E. Compatibility and stability of tramadol and dexamethasone in solution and its use in terminally ill patients. Journal of Clinical Pharmacy and Therapeutics 2007; 32:441-444.						
4	Six terminally ill patients		To study compatibility and stability of tramadol (100-400mg/day) and dexamethasone (4-40mg/day) combined in solution.	Bench test of solutions. Retrospective study with prospective clinical validation of six terminally ill patients in the home setting	Twelve different solutions were prepared in saline and stored in polypropylene syringes for 5 days at 25 0C. Clinical performance was assessed retrospectively in 6 terminally ill patients.	Tramadol (100-400mg/day) and dexamethasone (4-40mg/day) are stable for at least 5 days when combined in saline and stored in polypropylene syringes at 25 0C.

Appendix C– continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
Ross JR, Saunders Y, Cochrane M, Zeppetella G. A prospective, within-patient comparison between metal butterfly needles and Teflon cannulae in subcutaneous infusion of drugs to terminally ill hospice patients. Palliative Medicine 2002;16:13-16.						
3	30 hospice inpatients	Hospice	To determine difference in time from needle insertion to site reaction using metal needles vs Teflon cannulae for sc administration of drugs in terminally ill patients.	Prospective study of hospice inpatients.	Patients were used as their own control. Prescribed medications were divided equally between two syringe drivers and delivered over 24 hours.	Teflon cannulae had a median life span twice that of metal butterfly needles, making them a cost-effective alternative for sc administration of medications in terminally ill patients.
Smith J, Karthikeyan G. Foreign body occlusion of syringe driver mechanism (Correspondence). European Journal of Anaesthesiology 2007;24:1063-1064.						
4	N/A	Operating Theatre	N/A	Correspondence	N/A	To reduce chances of foreign body occlusion, it is recommended there be a thorough check of all equipment to be used before any procedure; immediately after removal, IV set protective caps be disposed of in an appropriate container; infusion devices to include a cover for moving parts.
Stuart P, Lee J, Arnold G, Davis M. A centralized storage system for the delivery of subcutaneous infusions. British Journal of Nursing 2008;17(8):512-516.						
4	30 inpatients	30 inpatients of a large acute NHS Trust	To identify whether introduction of a centralised storage system of set boxes containing all relevant equipment would resolve delays in obtaining the correct equipment and patients being given drugs prescribed.	Staff surveys	Questionnaires for palliative care team and ward staff.	A centralised storage system of syringe drivers enhanced practice by ensuring a standardised approach to initiation and care of syringe drivers.
Torre M. Subcutaneous infusion: non-metal cannulae vs metal butterfly needles. British Journal of Community Nursing 2002;7(7):365-369.						
1	N/A	N/A	To evaluate the effectiveness of non-metal cannulae compared to	Meta-analysis	A mini-review of 5 RCTs was conducted.	One study was excluded. It appears that non-metal cannulae are more effective in maintaining

Appendix C– continued

Level of Evidence	Sample (if applic)	Setting	Aims	Design	Methods	Results
			metal butterfly needles in maintaining s/c infusion sites in patients receiving palliative care.			s/c infusion sites than butterfly needles. There is no basis to recommend Vialon rather than Teflon cannulae.
Wilcock A, Jacob JK, Charlesworth S, Harris E, Gibbs M, Allsop H. Drugs given by a syringe driver: a prospective multicentre survey of palliative care services in the UK. Palliative Medicine 2006;20:661-664.						
4	18 pharmacists, 2 medical practitioners	15 palliative care services covering 22 inpatient units	To obtain a recent snapshot of practice to aid revision of the syringe driver drug compatibility charts in the UK Palliative Care Formulary.	Prospective survey	Questionnaire administered to pharmacists and medical practitioners regarding drugs, doses, diluent, volume, duration of administration, visual compatibility and site reaction, for every syringe driver in use by palliative care services on 4 separate days.	98% of syringe drivers were for s/c use; 2% for intrathecal/epidural. The majority of s/drivers contained 2 or 3 drugs. 20% contained only 1 drug. Median volume of infusions: 15ml. Duration of infusion 24 hours in 98% of cases. Reports of syringe driver site reactions in 4% of cases.
Wilson V. Clinical guidelines for use of the MS26 daily rate syringe driver in the community. British Journal of Community Nursing 2000;5(4):162-168.						
4	N/A	N/A	N/A	Guidelines for use of the Graseby MS26 in the community.	N/A	N/A

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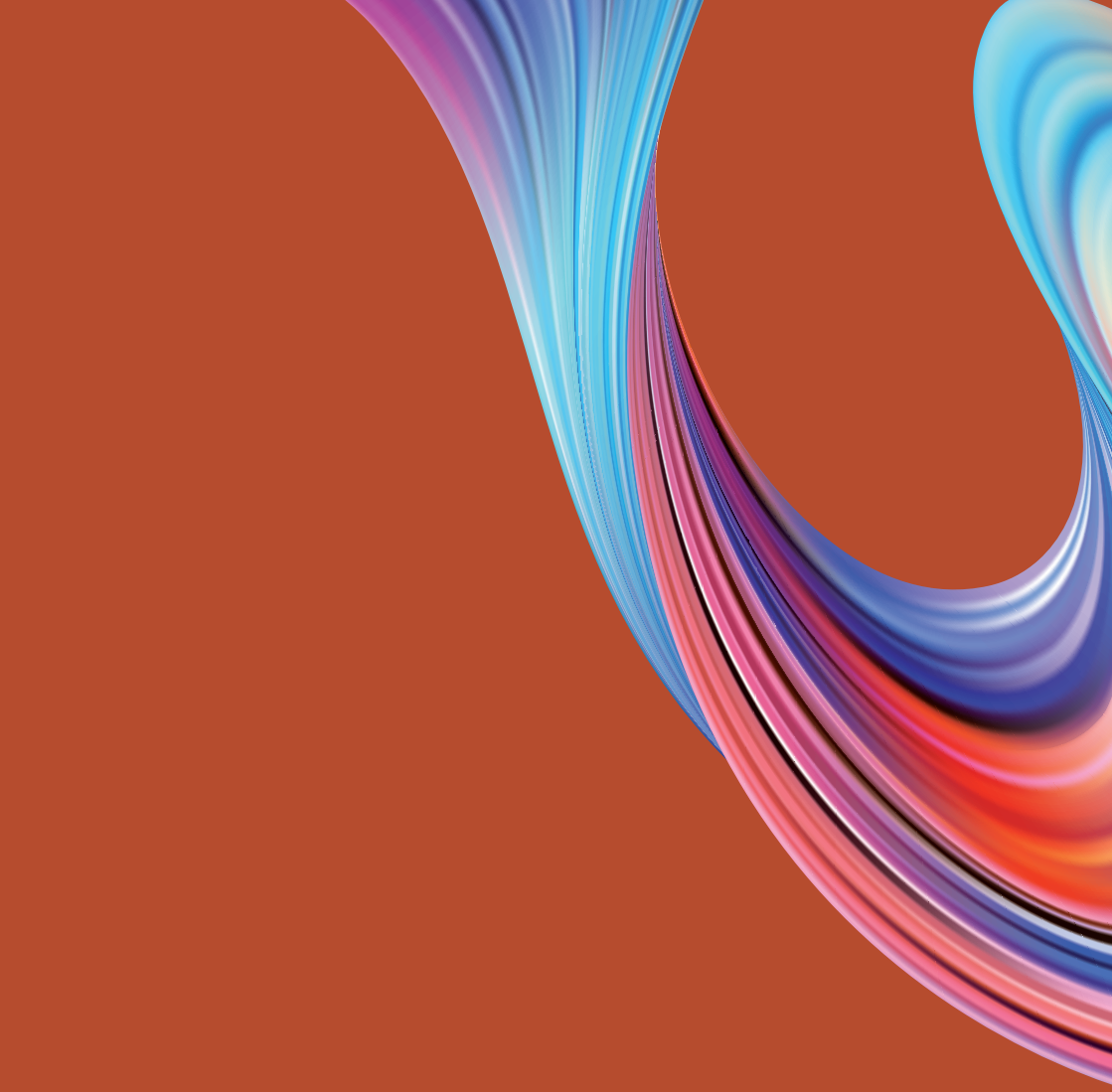

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