Guidelines for the use of the CME McKinley T34 Syringe Pump for Adults in Palliative Care
These guidelines have been produced following extensive consultation with practitioners to support the delivery of consistent, high quality care through best practice in the hospital, hospice and community setting throughout Scotland.

These guidelines apply to the use of the CME McKinley T34 syringe pump for subcutaneous infusions in adults in palliative care.

Administration of medications via other routes and its use in paediatrics are outwith the scope of these guidelines, therefore it is recommended that other specialist reference sources be accessed.

Disclaimer
While every precaution has been taken in the preparation of these materials, neither NHS Education for Scotland nor external contributors shall have any liability to any person or entity with respect to liability, loss or damage caused or alleged to be caused directly or indirectly by the information therein.
NES gratefully acknowledges the hard work and effort made by all who contributed to the development of these guidelines which were adapted, with kind permission from guidance produced by NHS Greater Glasgow & Clyde and NHS Highland.

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- **Dr John Amoore**, Medical Physicist, NHS Ayrshire & Arran

Our thanks also go to **CME McKinley** for kind permission to use images of the McKinley T34 syringe pump within these guidelines.

**Aims**

The aims of these guidelines are to:

- ensure efficient and safe practice across NHSScotland when using the McKinley T34 syringe pump
- improve the standard of care provided to patients.

*It is recommended that these guidelines are easily accessible at all times and a copy kept alongside McKinley T34 syringe pump equipment.*

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Section 1 - Introduction

McKinley T34 syringe pump

The CME McKinley T34 syringe pump is a portable, battery operated device for delivering medication by continuous subcutaneous infusion (CSCI). Syringe pumps are a useful way of delivering medication when the oral route cannot be used for a patient and are of particular use in palliative care. If the patient is symptomatic, subcutaneous (SC) bolus dose of medication should be given as the first option for treatment before considering setting up a syringe pump.

The McKinley T34 syringe pump is most commonly used to deliver one, two or three medicine combinations at a predetermined rate via the SC route over a 24 hour period. Four groups of medicines are commonly prescribed for use in syringe pumps:

- analgesics (usually diamorphine, morphine or oxycodone)
- anti-emetics (metoclopramide, cyclizine, haloperidol, levomepromazine)
- sedatives (midazolam)
- anti-secretory drugs (hyoscine butylbromide, glycopyrronium).

Typical indications include its use in pain and symptom control:

- intractable nausea and vomiting
- gastro-intestinal obstruction
- dysphagia
- head and neck lesions/surgery
- severe weakness or unconsciousness
- malabsorption
- unsatisfactory response to oral medicines (uncommon)
- severe stomatitis
- patient compliance (also consider transdermal route for analgesia).

Syringe pumps will not deliver better symptomatic management than the oral route unless there is a problem with absorption or administration.
Advantages include:
- acceptability and reliability
- reduced need for regular injections
- maintenance of patient mobility
- constant therapeutic drug levels over a 24 hour period
- only requires being re-filled every 24 hours.

Disadvantages include:
- potential source of infection
- skin site reactions
- in emaciated patients or those on long term infusions, skin site availability may become an issue
- need for daily nurse visit in the community.

Many patients and relatives associate the use of syringe pumps with `the end of life`. It is vitally important to explain the use of the syringe pump as an alternative means of delivering medication and address any concerns they may have.

Safety and risk management
Subcutaneous administration of medicines carries well documented risks. Syringe pumps may be used infrequently and competency can be difficult to maintain as a result. The Scottish Executive Health Department publication provides guidance on the principles to minimise these risks (CRAG/NHS Scotland 2002) http://www.crag.scot.nhs.uk/publications/inpa.pdf

Syringe pump maintenance
All syringe pumps must be serviced regularly according to local guidance and at least annually, whether used or not, to ensure their function is maintained. Syringe pumps should be sent for maintenance checks immediately if they have been dropped, suffered fluid ingress (e.g. had fluid spilt over them or dropped in a bath) or if there is any doubt as to their functional operation whilst in use.
Those who manage palliative care services should ensure that maintenance arrangements for the syringe pumps are in place. A register of all such devices within each NHS Board is maintained by the Medical Physics Department who must be notified, according to procedure, of any new syringe pumps or if any have been removed from service. Further information on requirements is available from your local Medical Physics Department.

**Remember – the McKinley T34 Syringe Pump is expensive and arrangements must be made to return it to the Medical Physics Department when it is no longer required.**

**Cleaning and Decontamination**

Carry out cleaning of the syringe pump and lockbox with a damp disposable cloth (use warm water and general purpose detergent). Dry thoroughly. If any additional cleaning is required e.g. contamination with bodily fluids or cleaning the threads of the screws the actuator moves along, contact your local Medical Physics Department and/or Infection Control Team for advice. Do not use chemicals such as Xylene, acetone/similar solvents or Cliniwipes as this will damage components and labels. Lockboxes should not be cleaned with alcohol-based products as this causes the lockbox to become more brittle.

The syringe pump must never be submerged in water, and if it is accidentally dropped in water, it must be withdrawn from use immediately and sent to your local Medical Physics Department.

**Mobile phone use - Patients should be aware that there is a small risk of mobile phones interfering with the McKinley T34 syringe pump. To reduce this risk, patients and carers should only use a mobile phone out with one metre of the pump as recommended by McKinley and should preferably switch off the phone when not in use. If the patient requires using the phone, it should be held in the opposite hand from the side where the syringe pump is situated. If the phone is left switched on it should be kept one metre away from the syringe pump.**
Incident reporting

Systems are in place in each NHS Board to monitor and report incidents involving syringe pumps and staff should be familiar with the relevant incident reporting system and relevant documentation. **All incidents must be investigated.** Audit of this information, along with audit against the standards for the use of syringe pumps assists in identifying training needs.

What defines an incident?

When a pump is involved in an incident it should be preserved intact, providing all relevant information to the Medical Physics Department such as operation of the pump that caused harm (adverse event) or could have caused harm (near miss) to the patient or carer. Specific examples include:

- administration of incorrect medication, dose and/or diluent
- infusions completing ahead of intended time (finishing > 1 hour early, assuming a 24 hour infusion, that is approximately 5% or more early)
- infusions carrying on beyond intended time of completion (carrying on for > 1 hour late, assuming a 24 hour infusion, that is approximately 5% or more late – alternatively > 5% of the prescribed medication remaining in the pump at the end of the prescribed infusion period)
- device not alarming during an alarm condition.

Please note that where there is a known reason for the infusion not completing on time (e.g. the pump was stopped to enable the patient to bathe; changing the infusion set) then allowance should be given for this delay in deciding whether to report this as an incident.

**Remember - Any device and consumable involved in an adverse incident should be `quarantined` i.e. removed from use and sent to the Medical Physics Department immediately. The syringe and SC infusion line should be kept intact with the syringe pump where possible. Where the syringe contains Controlled Drugs (CDs) contact Medical Physics Department and/or Pharmacy Department to discuss appropriate action.**
The syringe and SC infusion line should be kept intact within the pump, with only the battery removed to prevent inadvertent use of the pump. The full details of the infusion, including copies of the fluid delivery documentation, should be provided to the Medical Physics Department. Where the pump was involved in an incident involving serious harm to the patient, the clinical lead should consider contacting the Incident Reporting and Investigation Centre of Health Facilities Scotland before forwarding it to the Medical Physics Department.

**Who can report incidents?**

All healthcare staff have a professional responsibility to report an incident to their line manager as per local policy. A clear description of the incident should be reported with the following information provided:

- patient name
- Community Health Index (CHI) number
- name and dose of each medicine prescribed
- name of the diluent
- total volume in the syringe at the start of the infusion
- date and time the infusion started
- pump identification – manufacturer’s serial number, maintenance or asset number
- where the syringe pump is to be returned
- date and time of incident.

**Hazard Warning Notification**

All NHS Boards operate a cascade system for hazard warning notification. Individuals with responsibility for managing areas where syringe pumps are in use must ensure relevant notices are acted and reported on.
Training
All staff using the McKinley T34 syringe pump must be competent and are accountable in the use and operation of such devices. All managers should ensure that relevant training takes place (e.g. at induction) and a record of staff who are trained and competent to use such devices is maintained (The Management of Infusion Systems, SEHD, 1995).

Registered nurses are accountable for ensuring their practice is evidence based and taking appropriate action to ensure they are competent when using the syringe pump for palliative care in accordance with the Nursing and Midwifery Council (2008), The Code: Standards of Conduct, Performance and Ethics for Nurses and Midwives. This includes seeking support from their line managers and completing appropriate training. www.nmc-uk.org/aArticle.aspx?ArticleID=3057

Competencies on the use of syringe pumps are available on the Skills for Health website at www.skillsforhealth.org.uk

<table>
<thead>
<tr>
<th>Qualifications required</th>
<th>Registered nurses – currently registered with the Nursing &amp; Midwifery Council (NMC).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional requirements</td>
<td>Has undergone training on syringe pump management for patients requiring palliative care.</td>
</tr>
<tr>
<td>Continuing training requirements</td>
<td>Request supervised practice by informing manager when training is required. It is the responsibility of each individual registered nurse to ensure they keep up to date with this aspect of care.</td>
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</tbody>
</table>
Before setting up the McKinley T34 syringe pump, it is important that discussions take place with the patient and family/carer as to the reasons for its use, how it works and how to respond to any incidents which may occur. The setting up of the syringe pump should only be undertaken by, or under the supervision of, appropriately trained personnel.

Component parts of the McKinley T34 syringe pump

- Infusion light status indicator
  - Green (running)
  - Red (stopped)

- Syringe Flange
- Collar Sensor
- Barrel Clamp
- Arm & Sensor
- Plunger Sensor
- Actuator
- Power ON/OFF
- YES/START
- NO/STOP
- Actuator Movement Forward(FF)/Back
- Scroll UP/DOWN
- INFO
Equipment required:

- McKinley T34 syringe pump and plastic lockbox and key
- Good quality 9V PP3 alkaline battery (as per local procurement). The use of rechargeable batteries is not recommended.
- holster (for mobile patient)
- luer-lock syringe 20ml or 30ml as per local guidance
- cannula and SC infusion line (small priming volume) as per local guidance
- needleless connection system as per local guidance
- impregnated alcohol wipe
- transparent surgical dressing e.g. Tegaderm®
- syringes and needles to prepare medication
- prescribed medicines including correct diluent
- subcutaneous infusion monitoring chart as per local guidance
- adhesive label identifying patient and prescribed medicines
- clean tray or surface for preparation.

Choice of Syringe

The McKinley T34 syringe pump is calibrated in ml per hour. The standard delivery period for a CSCI in palliative care is 24 hours. It is recommended that only 20ml or 30ml luer-lock syringes are used. 50ml syringes may be used in some circumstances, however the lockbox currently supplied with the syringe pump cannot hold syringes larger than 30ml. It should be noted that different brands of syringes will have different recommended maximum volumes and local guidance should be adhered to at all times.
Documentation

All measurements are in millilitres (ml).

Record list:
- Asset number on the syringe pump
- Date and time
- Flow rate in ml per hour
- Battery percentage
- Diluent name and batch number
- Medicine name(s) and batch number(s)
- Total volume (ml) medicines and diluent
- Site used and appearance
- Appearance of solution in syringe (clear, not cloudy)
- Signature(s) of person(s) preparing and checking

Note that after commencement of the infusion, all measurements of the volume of solution in the syringe must be accessed via the INFO button.

Preparing the syringe

It is considered good practice to make the solution as dilute as possible to reduce the likelihood of drug incompatibility and minimise site irritation.

Remember if the prescription is changed, you must prepare a new syringe. NEVER add an additional medicine to the syringe after the infusion has commenced.

- establish the final volume required and select the appropriate size of syringe
- complete all relevant documentation including a label (see page 16 for information on labelling the syringe)
- wash hands as per hygiene policy
- draw up the prescribed medication(s) and compatible diluent [dilute to the maximum volume of the syringe]
For two drugs in the syringe
- check compatibility
- reconstitute the diamorphine (if prescribed) and draw into luer-lock syringe. Then, dilute to an appropriate volume (total volume less than volume of second drug). If neither of the drugs is diamorphine, follow same procedure with alternative opioid, if prescribed, or otherwise with one of prescribed drugs.
- draw up second drug into a separate syringe of appropriate size and leave needle attached
- pull back plunger on first syringe to beyond final intended volume, and add second drug carefully through the luer end.

For three drugs in the syringe
- check compatibility
- this should be attempted only when evidence of stability exists, or on the advice of a palliative care specialist when other option, e.g. a second syringe pump, is not available or patient is cachectic with few available sites
- proceed in a similar manner to above, diluting two of the drugs as far as possible before adding the third
- if dexamethasone or cyclizine are included in the mixture, add them last once the other two drugs are diluted as far as possible (because they are the commonest causes of incompatibility)
- draw a little air into the syringe, invert it gently several times to mix the contents, and then expel air, taking care not to expel any of the medication
- attach the completed drug additive label.

The following points should be taken into account when using syringe pumps:
- protect the syringe from direct sunlight whenever possible
- carry out a visual inspection of the solution within the syringe at each monitoring check (at least daily) and discard if evidence of crystallisation, precipitation, cloudiness or change in consistency
- avoid mixing medicines in one syringe if compatibility data is not available; do not mix more than three medicines unless on the advice of a palliative care specialist
- do not infuse the contents of the syringe pump over a period longer than 24 hours.
Labelling the syringe

Ensure the label does not interfere with the mechanism of the syringe pump, i.e. where there is contact with the barrel clamp arm. When attaching the label, ensure it does not obscure the visual scales on the syringe which may require to be viewed during the infusion.

The following details are required on the label:

- patient name
- CHI number
- medicine name(s)
- dose of each medicine
- diluent name
- total volume in ml
- date and time prepared
- initials of the individual preparing the syringe.

Battery power

Always check the battery power before commencing the infusion. Press the **INFO** key until the battery level option appears on the screen and then press **YES** to confirm. The average battery life, commencing at 100%, is approximately 3-4 days depending on use. If the battery power has less than 33% life remaining at the start of an infusion then consideration should be made to discarding the battery and installing a new one (as recommended by McKinley). The battery should be removed from the syringe pump when not in use.
Choosing a suitable infusion site
Where possible, involve the patient in the choice of a suitable site. Both the outer arm and upper thigh are commonly used, but avoid the upper arm in bedbound patients who require frequent turning. In other patients, the chest or abdomen may be more suitable. Avoid the chest wall in cachetic patients (danger of causing pneumothorax). The scapula may be considered for confused or delirious patients who may pull on the line.

Acceptable SC cannula insertion sites are shown below

If a local reaction occurs, a new cannula and SC infusion line should be resited. If this recurs then consider diluting the medicine(s) further. The site need not be changed for up to seven days; however it should be regularly assessed (see page 24 - Monitoring the McKinley T34 syringe pump whilst in use). In some exceptional circumstances e.g. extreme cachexia it may be appropriate to leave the cannula in place longer provided the integrity of the site remains.

The following sites should be avoided:
- oedematous areas including lymphoedematous arms (poor drug absorption and increased risk of infection/exacerbation of oedema)
- bony prominences (poor absorption and discomfort)
- irradiated sites (may have poor perfusion and hence poor drug absorption)
- skin folds, sites near a joint and waistband area (movement may displace cannula: discomfort)
- broken skin.
Fitting the syringe to the syringe pump

Before placing the syringe into the pump, ensure the barrel clamp arm is down then press and hold the ON/OFF key until the `pump identification` screen appears. The identification screen briefly shows the pump model, software version and possibly also the location of the pump set by the Medical Physics Department.

The LCD display will indicate `Pre-Loading` and the actuator will start to move. Wait until it stops moving and the syringe sensor detection screen (syringe graphic) appears.

During `Pre-Loading` the actuator will return to the start position of the last infusion programmed. If the actuator is not in the correct position to accommodate the syringe, leave the barrel clamp arm down and use the FF or BACK keys on the keypad to move the actuator. Forward movement of the actuator is limited, for safety reasons; therefore repeated depressions of the FF key may be required when moving the actuator forward. Backwards movement is not restricted.

To avoid an inadvertent administration of a bolus dose, the syringe must be attached to the pump before being connected to the patient.

When fitting the syringe to the syringe pump:

- check the patient’s name (and wristband if used) against the prescription, according to the local medication policy
- lift the barrel clamp arm and seat the filled syringe collar/ear and plunger so the back of the collar/ear sits in the central slot (ensure correct placement). The syringe collar/ear should be vertical with the scale on the syringe barrel facing forward
- click the syringe plunger into the actuator. This may require some pressure.
lower the barrel clamp arm. The syringe graphic on the screen ceases to flash when the syringe is correctly seated at all three points.

the syringe size and brand option will then be displayed as shown below

if the syringe size and brand match the screen message, press the **YES** key to confirm.

if the syringe size and/or brand do not match, scroll with **UP** or **DOWN** keys until the correct selection appears, then press the **YES** key to confirm.

*Serious incidents have been reported involving uncontrolled flow of medication when the syringe has not been correctly or securely fitted to the syringe pump.*
Connecting the SC infusion line to the syringe

There are two different situations which can occur:

1. A new SC infusion line is required because:
   - a line is not currently in situ
   - the existing line needs to be replaced, e.g. due to site problems or a change in prescribed medication (see page 23).

2. A line is already in situ and can continue to be used (see page 24).

Starting the infusion

*If the patient is symptomatic, a SC bolus dose of medication should be given at the same time as commencing the syringe pump.*

After confirming the syringe type, the next screen message that appears is displayed below:

```
Volume  20.3ml
Duration 24:00
Rate  0.85ml/h
Confirm, Press YES
```

*Example Figures only*

The pump calculates and displays the total volume, duration of infusion (24 hours) and rate of infusion (ml per hour).

*The calculated volume, duration and rate should be checked before pressing YES to confirm or ON/OFF to return to the syringe options.*
After pressing **YES** the next screen message that appears will be:

![Start Infusion?](image)

- check the line is connected to the pump and patient
- press **YES** to start infusion
- when the syringe pump is running, the green LED indicator (above the **ON/OFF** switch) flashes and the screen displays

![Example Figures only](image)

If the infusion has not been started and a button has not been pressed for more than two minutes, an alarm will sound. The message ‘Pump Paused Too Long’ Confirm, Press **YES** will show on the LCD display. To stop the alarm, press **YES** and continue programming the infusion.
Keypad lock

The McKinley T34 syringe pump allows users to lock the operation of the keypad during infusion. The function should be routinely used to prevent tampering with the device. To activate the keypad lock, press and hold the INFO key until a chart is displayed showing a `progress` bar moving from left to right. Hold the key until the bar has moved completely across the screen and a beep is heard to confirm the lock has been activated.

![Keypad Lock Image]

When the keypad is activated the INFO, YES/START and NO/STOP buttons are still active.

To deactivate the keypad lock (pump must be infusing) repeat the above procedure. The `progress` bar will now move from right (lock on) to left (lock off) and a beep will be heard.

Every McKinley T34 syringe pump will be supplied with either a lockbox or non-locking box. After starting the infusion, check the syringe pump is set correctly and place it in the relevant box. Universal keys are supplied to each ward/community nurse. Replacement keys, if required, are the responsibility of individual teams.

**Warning!!!** – To reduce the risk of syphonage, the syringe pump should be placed at the same level as, or lower than, the infusion site.
Changing the SC infusion line when the patient’s medication has been changed

It is considered good practice to change the SC infusion line and use a fresh site when the patient’s prescribed medication has been changed. The need to change the SC infusion line depends on the change in prescription e.g. when a different combination of medicines is prescribed then a fresh SC infusion line should ideally be used.

A change of SC infusion line will also depend on the patient’s condition. In cachetic patients and when a syringe pump has been in use over a long period, alternative sites may be very limited. If the existing site is viable and the medicines are compatible, continued use may be in the patient’s best interest.

Connecting the SC infusion line to a new syringe when a new SC infusion line is required

When a new SC infusion line is required:

- attach the SC infusion line to the syringe and ensure the luer-lock is fully screwed onto the thread of the syringe tip
- prime the tubing with the syringe pump contents until the fluid just shows at the needle tip.

If a new line is required during an infusion, e.g. due to site irritation, it will require to be primed resulting in the syringe pump not delivering medication over the full 24 hour period. Document the time the cannula and SC infusion line are changed on the monitoring chart.

*When a new skin site is required e.g. due to inflammation and pain, a new SC infusion line and cannula must also be used.*
Connecting the SC infusion line to a new syringe when re-siting of line is not required

When an SC infusion line is already in situ and re-siting is not required:

- disconnect the SC infusion line from the previous syringe before removing the syringe from the pump, normally the syringe will be empty, but occasionally it may not. This ensures that the patient does not receive an inadvertent bolus dose when the syringe is removed.
- remove the previous syringe from the pump and attach the new one
- programme the infusion on the pump
- check the SC infusion line is full of fluid and connect it to the new syringe ensuring the luer-lock is fully screwed on to the thread of the syringe tip
- if there is a delay in re-attaching the syringe to the SC infusion line, the line should be capped as per local guidance.

Monitoring the McKinley T34 syringe pump whilst in use

It is recommended best practice, in both the hospital and community setting, when a syringe pump is set-up, reloaded or re-sited to observe the syringe pump during the first 15 minutes to ensure it is functioning correctly. Further monitoring checks should be carried out:

- a minimum of 4 hourly within in-patient settings or as per local policy
- at each visit by a nurse in the community setting – the frequency of this will depend on factors such as other nursing needs of the patient, the willingness or ability of the patient/carer to assist in monitoring, and the risk of instability of the medicine mixture.
The following monitoring checks should be carried out and documented on the Subcutaneous Infusion Monitoring Chart, as follows:

- record the time the syringe pump is checked
- check the infusion site for:
  - redness
  - swelling
  - discomfort/pain
  - leakage of fluid
- check the medication is controlling the patient's symptoms
- check the solution in the syringe and the SC infusion line for cloudiness, presence of large air bubbles (small ones not significant), precipitation or colour change
- record the flow rate and check it is correct
- record the volume of solution to be infused and the volume infused and check from this information that the syringe pump is delivering the medication at the desired rate
- check the battery light is flashing. There is no need to record the battery percentage as this has been carried out already as part of the daily set up.
- record the location of the infusion site when the syringe pump is set up and when the line is changed (this reduces disturbance to the patient during monitoring)
- when the infusion site is changed, record the reason in the `Notes` section
- at each check inspect the SC infusion line to ensure that it is securely attached to both the syringe and the patient and that it is not leaking, kinked or trapped. If there are any problems, then they must be documented.

The individual carrying out the monitoring checks should document and sign the relevant sections of the monitoring chart. If any checks are not carried out e.g. site check to prevent disturbing the patient whilst asleep, record this and the reason on the monitoring chart. If any checks indicate a problem e.g. the infusion is not running at the expected rate, the appropriate action must be taken and documented in the `Notes` section. If an infusion is discontinued before it is complete e.g. because of a change in dose or medicine, document the amount of solution remaining and destroyed (ml) on the monitoring chart.

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In the community setting, the patient and/or carer must be given clear guidance on what to do, and who to contact, in the event of a problem arising.

Action must be taken and documented in the event of:

- significant discrepancies in the actual and expected infusion rate
- signs of incompatibility
- blockage of the SC infusion line
- damage to the syringe barrel or tip, or the presence of a large amount of air, which may indicate the syringe barrel has cracked.
- site reaction.

Care during the infusion

Whilst the syringe pump is in use, the patient and relative/carer should be aware of:

- how to take care of the syringe pump e.g. avoid spillages of liquids or dropping the pump and to report if the green light stops flashing or the alarm sounds
- ensuring the battery is checked daily
- avoiding the use of a mobile telephone within one metre of the syringe pump. Although there are no confirmed reports of mobile telephones interfering with the operation of the syringe pump, following this advice will help reduce any risk.
- ensuring the syringe pump is well supported when the patient is mobile e.g. placed in a pocket or holster
- who to contact when a problem occurs. Their involvement should be assessed according to individual needs, as not all are able/wish to be involved.

Stopping the infusion and removing the syringe pump

When the infusion is nearing completion, a warning will be shown on the LCD display screen 15 minutes before the end of the infusion. When the infusion is complete and the syringe is empty, the pump will stop automatically and an alarm will sound. If the syringe pump is no longer
required for the patient, press **YES** to confirm the end of the infusion, disable the keypad lock and press and hold the **ON/OFF** switch ensuring the pump is switched off.

If the infusion is to be stopped before the syringe is empty, it should also be disconnected from the patient for safety reasons. A syringe that is not empty must never be taken off the syringe pump whilst connected to the patient. If the infusion is to be stopped before the syringe is empty, disconnect the pump from the patient before removing the syringe from the pump.

Clean the pump and lockbox as detailed under Cleaning and Decontamination on page 8 (do not immerse the syringe pump in water). Dry and replace in packaging if no longer required for use.

**How to temporarily stop the infusion**

This is not normal practice and should only be used in exceptional circumstances (this should **not** be used for priming a second line):

- press **STOP**, disable the keypad lock and press and hold the **ON/OFF** button
- do not remove the syringe from the syringe pump
- note the time the syringe pump was stopped on the monitoring chart.

**What to do if the infusion is interrupted**

- to resume the infusion, check the prescription and syringe label match the patient’s details
- press and hold the **ON** button until a beep is heard
- the screen will request confirmation of the syringe size and syringe brand.
- if the syringe size and brand match the screen message press the **YES** key to confirm
- if the syringe size and/or brand do not match, scroll down with the up and down arrows until the correct selection appears, then press the **YES** key to confirm.
The screen message will display:

![Screen message](image)

- press the **YES** key to resume the previous programme: the screen will display `volume, duration and rate`
- check against the monitoring chart that the duration and rate are correct
- press **YES** to confirm and the screen will display `Start Infusion?`, press the **YES** key to confirm
- note the time infusion resumed on monitoring chart.

**WARNING** – If the NO key is pressed, the syringe pump interprets this as a completely new 24 hour period and the remaining contents of the syringe would be delivered over the next 24 hours from confirming `Start infusion?`. The patient would not therefore receive the prescribed dose. If the NO key has been pressed in error, discard the remainder of the syringe contents and prepare and set up a new syringe.

**What to do if a patient dies when their syringe pump is running**

Stop the syringe pump by pressing the **STOP** button and remove the needle/cannula as soon as possible. Switch off the syringe pump by disabling the keypad lock and then press and hold the **ON/OFF** button.

On the subcutaneous infusion monitoring chart, record the date, time and amount of solution (ml) remaining in the syringe and destroyed and also the signature(s) of the person(s) present and any witnesses.
How to stop the syringe pump and prime an SC infusion line after the infusion has been commenced:

- press the **STOP** key, disable the keypad lock. **DO NOT SWITCH OFF THE SYRINGE PUMP**
- disconnect the existing SC infusion line from the syringe and remove it from the patient
- remove the syringe from the pump then attach and prime a new SC infusion line
- resize the actuator and place the syringe in the pump
- confirm the syringe make and size
- insert the new SC infusion line to a new site
- press the **YES** key to resume the programme: the screen will display `volume, duration and rate`. **Check against the monitoring chart that the duration and rate are correct.** Press the **YES** key to confirm and the screen will display `Start infusion?`, press the **YES** key to confirm.

The time remaining for the infusion will decrease to compensate for the solution that was used priming the second line, the flow rate will remain the same.
Section 3: Prescribing and monitoring of medicines

All medicines administered via the syringe pump should be clearly and correctly prescribed according to local policy and procedures. The following information must be included:
- patient demographic details
- any known allergies
- medicine name (generic in CAPITALS)
- dose over 24 hours
- diluent
- route of administration
- duration of SC infusion
- prescriber’s signature.

The person preparing the medication should check the following:
- prescription
- compatibility of medicines prescribed
- diluent
- infusion volume required
- size of syringe required.

Practitioners administering a medicine that they have not previously used by the SC route should be aware that:
- absorption may be slower than the intramuscular (IM) route
- irritant medicines may cause a greater inflammatory reaction SC than IM
- the recommended maximum volume for a bolus injection is 1ml
- absorption will be severely limited in patients who are ‘shocked’, hypovolaemic or oedematous.

Additional ‘as required’ bolus doses of medication should always be prescribed on the appropriate prescription chart and be available for administration when required.

When a maintenance 24 hour opioid dose is changed, the breakthrough dose should also be adjusted accordingly. A small cannula may be inserted and left in situ for administering breakthrough doses. It may be worth considering alternative medicines and routes e.g. morphine suppositories.
It remains the responsibility of each individual practitioner to ensure that the medicine(s) prescribed are suitable for continuous subcutaneous infusion and are stable under these conditions.

Remember - All medicines not administered to the patient should be accounted for.

Starting syringe pumps in relation to stopping opioids by other routes of administration

If the syringe pump is commenced when the patient’s pain is well controlled then a loading dose of opioid is not necessary. If the patient’s pain is not well controlled, give a subcutaneous breakthrough dose of opioid at the same time as starting the syringe pump (recommended best practice SIGN Guideline 106). This should be approximately 1/6th of the 24 hour dose prescribed in the syringe pump.

Start the syringe pump immediately if:
- the patient is not currently on any opioid OR
- the patient is receiving opioid on an ‘as required’ basis OR
- the patient is receiving immediate release oral opioid preparation e.g. Sevredol®

Patients on modified release oral opioid preparation e.g. MST®
Ideally, start the syringe pump when the next dose of modified release preparation is due, but particularly in the community setting, this may not be a convenient or safe time. A decision on an appropriate time should be based on the clinical status of each individual patient.

Patients on Fentanyl Patches (end of life)
Refer to local palliative care guidelines for details, or consult a pharmacist or palliative care specialist for advice.

When oral treatment is to be re-started
If an oral modified release preparation is being commenced, the continuous subcutaneous infusion should be stopped when the first dose of modified release oral opioid is administered. The patient may require breakthrough medication more frequently until therapeutic levels are reached. If further advice is required, seek guidance from a palliative care specialist.
There are various problems associated with mixing medication in the same syringe, which include:

- degradation of the drug(s) which can lead to decreased efficacy. The rate of degradation may be increased by other drugs which can alter the pH of the mixture. Direct sunlight and heat can also cause degradation of the drug.
- crystallisation/precipitation. This can occur through formation of an insoluble product of a drug interaction, or because a drug alters the pH of the solution rendering a 2nd drug insoluble, or because of an interaction between the drug and the diluent.

Drugs combinations
Where drug combinations (commonly an analgesic and an antiemetic) are used, further criteria must be met:

- the drugs must be compatible with each other
- the diluent must be compatible with the drugs used.

Information about the stability and compatibilities of drug combinations which can be administered via the McKinley T34 syringe pump are available from the Palliative Care Guidelines at [www.palliativecareguidelines.scot.nhs.uk](http://www.palliativecareguidelines.scot.nhs.uk)

Drug combinations outwith those listed in the Palliative Care Guidelines should only be used on the recommendation of a palliative care specialist, or on the advice of a pharmacist. The advice given should be documented clearly in the patient’s notes.

If in doubt about compatibility/stability of medicine combinations, consider using an additional pump or an alternative route of administration. Refer to local guidance for recommendations on the maximum number of medicines which can be mixed in one syringe and their compatibility.
Evidence for the chemical stability of other combinations may not be available, but physical stability data in some literature may be used to inform the choice of combinations. Data usually comes from observations made in clinical practice, often in specialist palliative care units, and is reported as combinations which appear to be physically stable in that they do not change colour or precipitate and appear to be clinically effective.

**Medicines NOT suitable for subcutaneous use**

The medicines listed below must **not** be administered by the SC route as they may cause tissue necrosis:

- antibiotics
- diazepam
- chlorpromazine
- prochlorperazine

**The use of medicines outwith a manufacturer’s licence**

The use of medicines outwith a manufacturer’s licence or `off label use` is common practice in palliative care e.g. administration by the SC route, but carries additional responsibilities for prescribers, pharmacists and nurses. Such use can be supported by local policy/guidance and specialist palliative care services.
## Section 5: McKinley T34 Syringe Pump Problem Solving

### Common problems

*Note: When assessing whether an infusion ended early or late, allowance should be made for tolerances in the syringe pump, start-up time and recording the start time. A tolerance of 5% (equivalent to 1 hour for 24 hour infusions), should be allowed, see page 9 as this has already been explained earlier in the document more fully.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>The pump will not start</td>
<td>No battery present.</td>
</tr>
<tr>
<td></td>
<td>Battery inserted incorrectly.</td>
</tr>
<tr>
<td></td>
<td>Cap on battery terminal.</td>
</tr>
<tr>
<td></td>
<td>Battery is depleted/very low.</td>
</tr>
<tr>
<td></td>
<td>Pump is faulty.</td>
</tr>
<tr>
<td>Infusion ended early/late</td>
<td>Drug incompatibility or site problems.</td>
</tr>
<tr>
<td>*See note above</td>
<td>Disconnection of syringe, SC infusion line or cannula.</td>
</tr>
<tr>
<td></td>
<td>Wrong syringe brand confirmed during set up/incorrect volume measured by syringe pump.</td>
</tr>
<tr>
<td></td>
<td>Syringe pump placed &gt; 75cm above infusion site. This can lead to siphonage if the syringe is not secured.</td>
</tr>
<tr>
<td></td>
<td>Air is present in the syringe.</td>
</tr>
<tr>
<td></td>
<td>The syringe pump is faulty.</td>
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### Section 5: McKinley T34 Syringe Pump Problem Solving

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*Note:* When assessing whether an infusion ended early or late, allowance should be made for tolerances in the syringe pump, start-up time and recording the start time. A tolerance of 5% (equivalent to 1 hour for 24 hour infusions), should be allowed, see page 9 as this has already been explained earlier in the document more fully.

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<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The pump will not start</td>
<td>No battery present.</td>
<td>Fit a battery.</td>
</tr>
<tr>
<td></td>
<td>Battery inserted incorrectly.</td>
<td>Re-align battery terminals.</td>
</tr>
<tr>
<td></td>
<td>Cap on battery terminal.</td>
<td>Remove cap.</td>
</tr>
<tr>
<td></td>
<td>Battery is depleted/very low.</td>
<td>Fit a new battery.</td>
</tr>
<tr>
<td></td>
<td>Pump is faulty.</td>
<td>Service is required.</td>
</tr>
<tr>
<td>Infusion ended early/late</td>
<td>Drug incompatibility or site problems.</td>
<td>Assess patient and discuss with healthcare staff.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If ended late, check if PRN (as required medication) is needed to control symptoms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the pump is continuing to infuse beyond the prescribed time - stop infusion. Assess why and resolve cause. Set up a new infusion if required.</td>
</tr>
<tr>
<td></td>
<td>Disconnection of syringe, SC infusion line or cannula.</td>
<td>Check placement of syringe, SC infusion line and cannula.</td>
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<tr>
<td></td>
<td>Wrong syringe brand confirmed during set up/incorrect volume measured by syringe pump.</td>
<td>Set up a new infusion.</td>
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<tr>
<td></td>
<td>Syringe pump placed &gt; 75cm above infusion site.</td>
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<tr>
<td></td>
<td>Air is present in the syringe.</td>
<td>Check syringe barrel to see if it is cracked. A cracked syringe can lead to siphonage.</td>
</tr>
<tr>
<td></td>
<td>The syringe pump is faulty.</td>
<td>Send syringe pump for servicing.</td>
</tr>
</tbody>
</table>

Guidelines for the use of the CME McKinley T34 Syringe Pump for Adults in Palliative Care
<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
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<td><strong>Infusion is running slow</strong></td>
<td>The syringe pump may have stopped.</td>
</tr>
<tr>
<td></td>
<td>Cannula site requires to be changed.</td>
</tr>
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<td>Pressure/kinking on the SC infusion line or cannula.</td>
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<td>Irritation from prescribed medication.</td>
</tr>
<tr>
<td></td>
<td>Cannula insertion technique.</td>
</tr>
<tr>
<td><strong>The pump has stopped before the syringe has emptied</strong></td>
<td>Exhausted battery.</td>
</tr>
<tr>
<td></td>
<td>The syringe pump is faulty.</td>
</tr>
<tr>
<td>Fault</td>
<td>Possible cause</td>
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<td></td>
</tr>
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<td>The syringe pump is faulty.</td>
<td></td>
</tr>
</tbody>
</table>
Precipitation, cloudiness or colour change in syringe contents or line

In the event of the syringe or SC infusion line contents precipitating, becoming cloudy or changing colour the infusion should be stopped. Discussions should take place with the prescriber or pharmacist around:

- compatibility information
- diluent (seek advice on whether sodium chloride 0.9% is appropriate)
- diluting the medicine(s) in a larger volume
- separating the medication into 2 syringe pumps or give one medicine as a SC bolus
- ensuring the syringe pump is kept away from sunlight and heat as well as hot pack/heat pad or hot water bottle.

Commence a new infusion at a different site with a new cannula and SC infusion line required.

Syringe pump alarm conditions

When the alarm sounds the syringe pump will automatically stop infusing and continue alarming until the problem has been resolved. It is important that patients/carers and relatives are made aware of this and where to seek advice and help in the event of this occurring e.g. local community nursing teams or out of hours nursing services.

When the syringe pump detects a problem, the following occurs:

- an audible alarm is activated
- the infusion stops
- the display indicates the nature of the problem
- the LED indicator turns red.
<table>
<thead>
<tr>
<th>Display</th>
<th>Cause/Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pump paused too long</strong></td>
<td>Pump was left unattended in stopped or programme mode for more than two minutes. When appropriate, start the infusion (checking rate prior to doing so), continue programming or switch pump off.</td>
</tr>
<tr>
<td><strong>Occlusion</strong></td>
<td>Occlusion can be related to drug or site factors e.g. drug incompatibility. Check for trapping or kinking of the SC infusion line. Check cannula and that the patient is not lying on the cannula insertion site.</td>
</tr>
<tr>
<td></td>
<td>When satisfied press <img src="image" alt="START" /></td>
</tr>
<tr>
<td></td>
<td>Check if the pump has been placed lower than cannula site which can increase the risk of alarming. If not resolved re-site cannula. Then if still not resolved send for servicing.</td>
</tr>
<tr>
<td><strong>Syringe displaced</strong></td>
<td>Syringe not correctly fitted/displaced. On screen message identifies which sensor to check.</td>
</tr>
<tr>
<td><strong>Near End</strong></td>
<td>Infusion nearly complete. Infusion does not stop. Prepare to change syringe.</td>
</tr>
<tr>
<td><strong>End programme</strong></td>
<td>Infusion complete. Change syringe or remove infusion if pump discontinued.</td>
</tr>
<tr>
<td><strong>Syringe empty</strong></td>
<td>Infusion stops. Check intended time for completion. Change syringe.</td>
</tr>
<tr>
<td><strong>Low battery</strong></td>
<td>To alert user- the infusion does not stop. Change battery, resume infusion.</td>
</tr>
<tr>
<td><strong>End battery</strong></td>
<td>Battery depleted. Infusion stops. Change battery and resume infusion</td>
</tr>
<tr>
<td><strong>System error</strong></td>
<td>If the screen indicates ‘Switching pump off and on may resolve the problem’, follow advice on screen. If this does not resolve the problem then contact Medical Physics Department for further advice.</td>
</tr>
</tbody>
</table>
Sources of further advice

The first point of contact will often be your local colleagues, including:

**Primary Care**
- Community nurses
- Macmillan GP facilitators
- Macmillan Clinical Nurse Specialists
- Marie Curie Clinical Nurse Specialists
- Specialist Palliative Care Pharmacists

**Acute hospitals**
- Macmillan Clinical Nurse Specialists
- Marie Curie Clinical Nurse Specialists
- Palliative Care Clinical Pharmacists
- Specialist Palliative Care Teams
- Medicines Information Pharmacists
- On-call Pharmacists
- Medical Physics Department
- Consultant Medical Staff

**Hospices**
- Specialist Palliative Care Teams

**Internet resources**
www.palliativecareguidelines.scot.nhs.uk
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**Internet resources**

- [www.palliativecareguidelines.scot.nhs.uk](http://www.palliativecareguidelines.scot.nhs.uk)

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**Glossary**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHI</td>
<td>Community Health Index</td>
</tr>
<tr>
<td>CRAG</td>
<td>Clinical Resource and Audit Group</td>
</tr>
<tr>
<td>CSCI</td>
<td>Continuous Subcutaneous Infusion</td>
</tr>
<tr>
<td>IM</td>
<td>Intramuscular</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>NMC</td>
<td>Nursing and Midwifery Council</td>
</tr>
<tr>
<td>SC</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>SEHD</td>
<td>Scottish Executive Health Department</td>
</tr>
<tr>
<td>WFI</td>
<td>Water For Injection</td>
</tr>
</tbody>
</table>
CME McKinley Medical UK Limited.

Good practice statement for the preparation of injections in near-patient areas, including clinical and home environments.

Dickman A:

Clinical Guideline: McKinley T34 Syringe Pump for use in Palliative Care.

NHS Forth Valley & Strathcarron Hospice, October 2007.
Guidelines for using the McKinley T34 Syringe Pump.

NHS Grampian, July 2009.
McKinley T34 Syringe Pump Guidelines (Palliative Care).

Syringe Pump Guidelines CME McKinley T34 (ml/hour).

McKinley T34 Syringe Pump Guidelines for use in Adult Palliative Care Patients.

NHS Greater Glasgow and Clyde, August 2008.
Guidelines for the Use of Subcutaneous Medications in Palliative Care for Adults – Primary Care and Hospices.

NHS Lothian
NHS Tayside, June 2009.
Policy for Subcutaneous Administration of Medicines by the McKinley T34 Syringe Driver.

Palliative care drug information online
http://www.palliativedrugs.com

Palliative Care Guidelines
http://www.palliativecareguidelines.scot.nhs.uk

Scottish Office Health Department, May 1995.
The Management of Infusion Systems.

Control of pain in adults with cancer.

Skills for Health
www.skillsforhealth.org.uk