

# Introduction of Infusion Modes

V1.3

# Infusion Modes

universal basic modes	universal special modes	infusion pump specific modes	syringe pump specific modes
Rate mode	Sequence mode	Drip mode	TIVA mode
Time mode	Loading dose mode		TCI mode
Weight mode	Trapezia mode		PCA mode
Bolus mode	Intermittent mode		
	Relay mode		
	Micro mode		

*\*Universal modes can be found on both infusion pump and syringe pump*

# Universal basic modes

Rate mode | Time mode

Infusion Mode	Time Mode	
Drug	---	
Infusion Time	---	h:m:s
Infusion Rate	---	ml/h
VTBI	---	ml

Infusion Mode	Rate Mode	
Drug	---	
Infusion Rate	---	ml/h
VTBI	---	ml
Infusion Time	---	h:m:s

# Universal basic modes



Rate mode | Time mode



Clinical significance:

- Rate mode: Steady infusion at a standard rate(ml/h)
- Time mode: giving a total volume and infusion time, and finish the infusion within the time.

Blood/Intravenous Infusion Fluid and Additive Chart													
<b>Instructions:</b> Prescriber to sign even if no 'ADDITIVE' is ordered  Additives should not be added to blood products										Unit No: 789 123 4444			
Consultant: <i>Dr JONES</i> Ward: <i>A&amp;E</i> Weight: <i>19kg (1/1/15)</i>										Surname (Block letters) <i>BARKER</i>			
First Names: <i>ELLA</i>													
Date	Type of Stock Iv Fluid	Volume	Time to be infused	Additive			Batch/ Bottle Number	Time started	Signature		Volume Infused	Date and Time	
				Name and dose	Prescriber's Signature	Pharmacist's Signature			Witness	Time Stopped		Dripset Changed	IV Set Changed
1/1/15	SODIUM CHLORIDE 0.9%	320mls	bolus	Electrolyte	/	<i>J Smith, J SMITH</i> 1234							
1/1/15	SODIUM CHLORIDE 0.9% & GLUCOSE 5%	500mls	140 mls/hr	Electrolyte	10 mmols POTASSIUM CHLORIDE	<i>J Smith, J SMITH</i> 1234							
				Electrolyte									
				Drug									
				Electrolyte									
				Drug									
				Electrolyte									
				Drug									
				Electrolyte									
				Drug									

EPMA Supplementary intravenous therapy prescription sheet												
All infusions, infusion fluids, blood and plasma must also be prescribed in EPMA												
Date	Infusion solution	Name and dose of additive	Infusion volume	Duration of infusion	Infusion rate	Proposed start time	Prescriber signature	Infusion bag batch no.	Time actually started	Given by / Checked by	Time finished	Pharmacy use
1/4/2014	Sodium Chloride 0.9%	Phenytoin 1250mg	250ml	35 minutes			Doctor (bleep)					

# Universal basic modes

## Weight mode

Different from the infusion rate(ml/h) in rate mode, weight mode uses the dose rate, calculates from drug concentration and patient's weight through the formula.

Infusion Mode	Weight Mode	
Drug Info	---	◀ mg/ml ▶
Weight	---	◀ kg ▶
DoseRate	---	◀ mg/kg/min ▶
Infusion Rate	---	ml/h
VTBI	---	ml

**Patient body weight**

**Dosage (mcg/kg/min)**

**Calculate** = **Reset** X

**7.2**  
mL/h

Infusion rate

[See detailed calculation information](#)

# Universal Basic modes

Weight mode

**Ketamine prescription:**  
Options: set rate OR infusion range

PLEASE REFER TO YOUR LOCAL HOSPITAL POLICY OR  
PROCEDURE FOR PREFERRED KETAMINE DELIVERY OPTIONS

Route	Drug Print 'ketamine'	Amount (mg)	Additional drug	Amount (mg or microgram)	Diluent	Total volume (mL)
IV	Ketamine	200 mg	NIL <small>If no additional drug - print NIL</small>		0.9% sodium chloride	50mL
Concentration mg per mL		Infusion rate mg per hr and mL per hour		Infusion range (if applicable)		
4 mg per mL		.....4 ..mg per hour = .....1 .....mL per hour		Range FROM: 4 .....mg per hour TO 8 .....mg per hour = .....1 .....mL per hour .....2 .....mL per hour		
Date:	15/04/13	Prescriber's signature & print name:		TSmith SMITH	Pharmacy:	

Two further prescription boxes are provided for when alterations are indicated for the ketamine dose, concentration or infusion rate.

- Depending on the drug or the patient, a doctor's order may come in the form of an infusion rate or in the form of a drug dose.
- The drug instructions also follow the dosage rate.

## Levophed (Norepinephrine Bitartrate): Side Effects, Interactions, Warning, Dosage & Uses

### Average Dosage

Add a 4 mL ampul (4 mg) of LEVOPHED to 1,000 mL of a 5 percent dextrose containing solution. Each mL of this dilution contains 4 mcg of the base of LEVOPHED. Give this solution by intravenous infusion. Insert a plastic intravenous catheter through a suitable bore needle well advanced centrally into the vein and securely fixed with adhesive tape, avoiding, if possible, a catheter tie-in technique as this promotes stasis. An IV drip chamber or other suitable metering device is essential to permit an accurate estimation of the rate of flow in drops per minute. After observing the response to an initial dose of 2 mL to 3 mL (from 8 mcg to 12 mcg of base) per minute, adjust the rate of flow to establish and maintain a low normal blood pressure (usually 80 mm Hg to 100 mm Hg systolic) sufficient to maintain the circulation to vital organs. In previously hypertensive patients, it is recommended that the blood pressure should be raised no higher than 40 mm Hg below the preexisting systolic pressure. The average maintenance dose ranges from 0.5 mL to 1 mL per minute (from 2 mcg to 4 mcg of base).

# Universal basic modes

Weight mode——BSA

BSA is short for Body Surface Area (unit: m<sup>2</sup>).

Formula for calculating human body surface area:

Stevenson's formula:

$$\text{BSA (m}^2\text{)} = 0.0061 \times \text{height (cm)} + 0.0128 \times \text{weight(kg)} - 0.1529$$

Infusion Mode	Weight Mode
Drug Info	mg/ml
Weight	kg
DoseRate	mg/kg/min
Infusion Rate	ml/h
VTBI	ml

Select Units
kg
m <sup>2</sup>

Infusion Mode	Weight Mode
Drug Info	mg/ml
BSA	m <sup>2</sup>
DoseRate	mg/m <sup>2</sup> /min
Infusion Rate	ml/h
VTBI	ml



# Universal basic modes

## Weight mode——BSA

- It's a special unit for weight mode, we usually use kg as the weight's unit. It's useful for some drugs which are toxic and have side effects and require liver and kidney to metabolize. Like chemotherapeutic drugs.
- Chemotherapeutic drugs have great side effects so we need to take strict control on the dose.
- Before excrete from the body, chemotherapeutic drugs will go through the liver and kidney for metabolizing. Let's see an example:
- For an adult obese patient and a lean patient, there is little difference in organ size, but big difference in body weight.
- So if we use kg as weight's unit to calculate the dose, it will cause the obese to exceed the standard dose, and the lean to appear under-dose.
- But if we use body surface area to calculate the dose, it is a reasonable and constant dose for both groups. So the dose of chemotherapeutic drugs should be calculated by BSA.

Stevenson's formula:

$$\text{BSA (m}^2\text{)} = 0.0061 \times \text{height (cm)} + 0.0128 \times \text{weight(kg)} - 0.1529$$

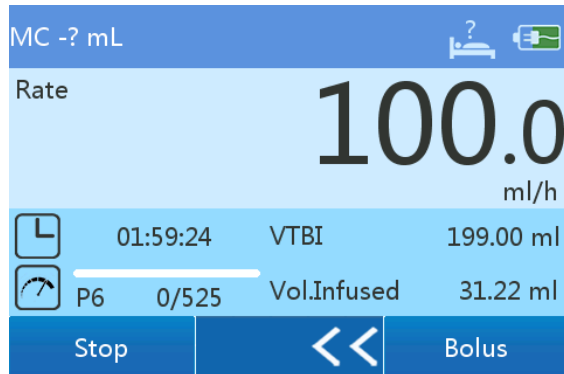


# Universal Basic modes

## bolus mode

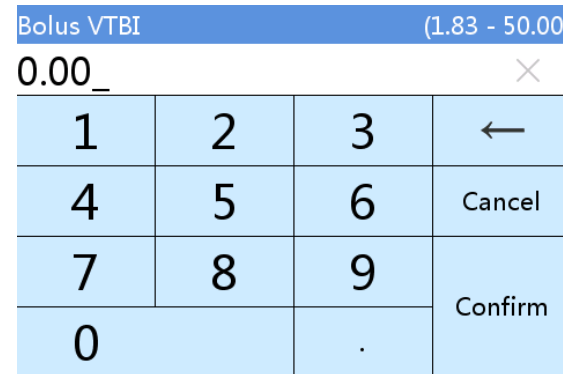
- Bolus is a kind of infusion mode that requires temporary dose increase in emergency during infusion.
- There are 3 bolus ways: manual bolus, semi-aoto bolus and automatic bolus.
- Manual bolus is the default option, and you can choose either semi-aoto bolus or automatic bolus.

### manual bolus:



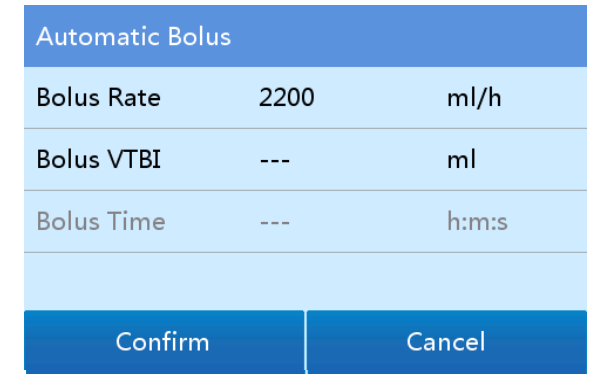
Click **【Bolus】** for 2 seconds to get started during the infusion.

### semi-aoto bolus:



Click **【bolus】** to pop up the interface of bolus VTBI. After set up this parameter, click **【Confirm】** to get bolus started.

### automatic bolus:

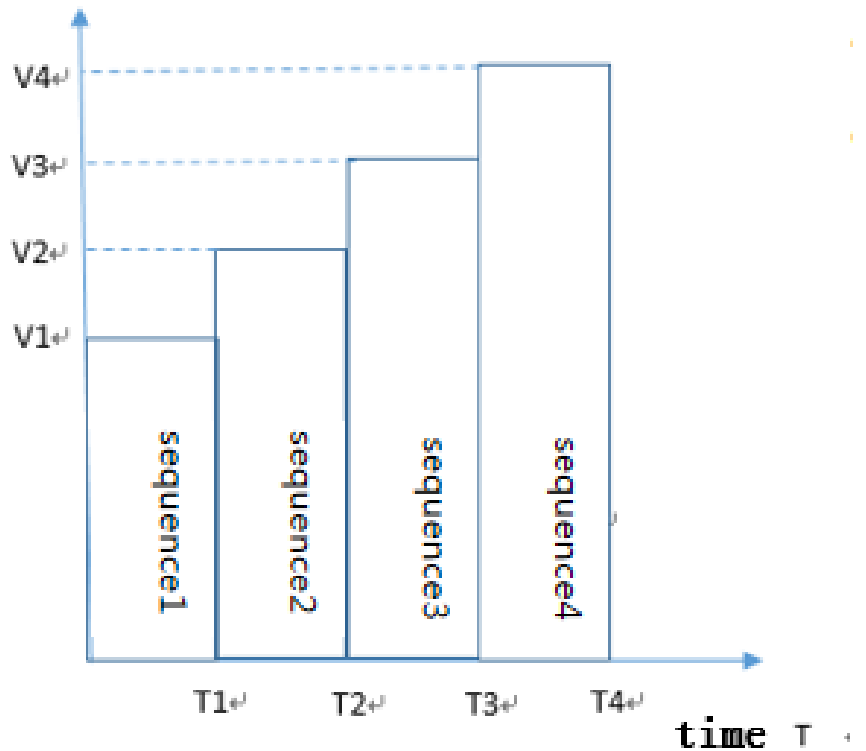


Click **【Bolus】** to pop up the interface to change bolus rate and VTBI. Click **【Confirm】** to get bolus started.

# Universal special modes

## Sequence mode

rate  $V_i$



- Some brands also call this mode as multi-rate mode, Program mode or program infusion mode.
- We can set **10** different infusion sequences, and the VTBI, time and rate for each sequence.
- Each sequence proceeds one by one automatically, so as to provide patients with different treatment options at different stages.

Infusion Mode	Sequence Mode	
Drug	---	
Sequence AMT.	3	
Infused Vol.	--- ml	--- h:m:s
1/4		

Infusion Mode	Sequence Mode	
S1VTBI	3.33	ml
S1Infusion Time	00:09:59	h:m:s
S1Infusion Rate	20.00	ml/h
2/4		

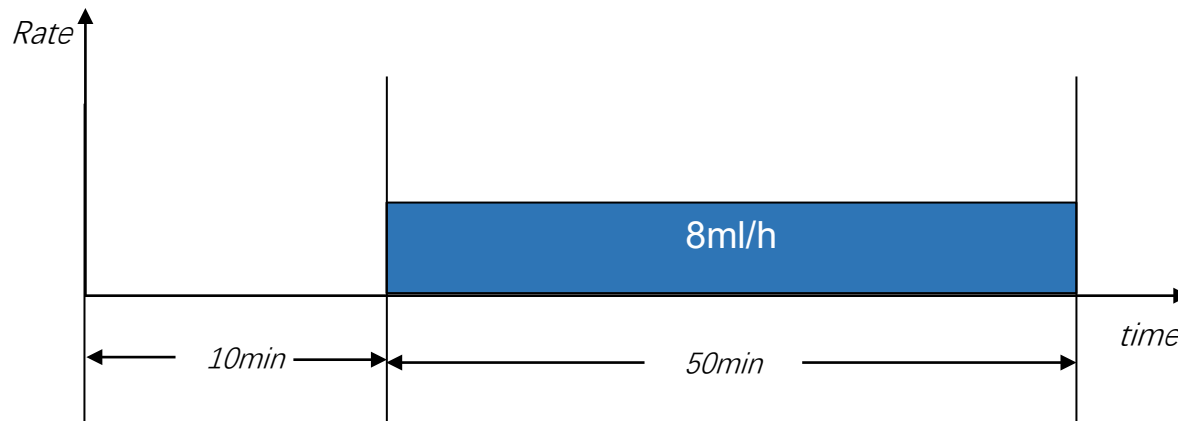
# Universal special modes

## Sequence mode

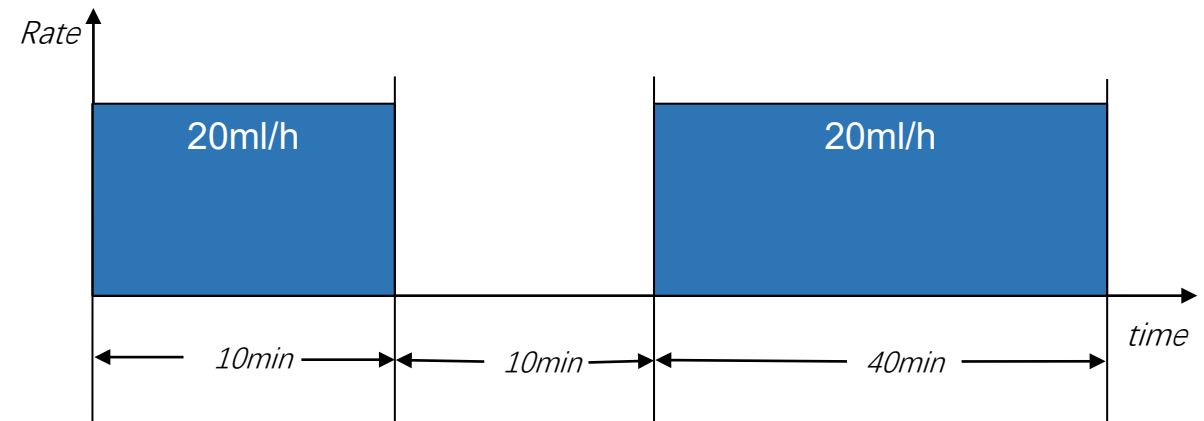
### Clinical application:

- When some tumour drugs, oxytocin or insulin are used, different rates of treatment are needed at different times. If there is no such automatic adjustment function of the treatment program, the nurses need to constantly adjust the rate and increase the repetitive workload.
- Sequence mode can be used as "Delayed startup mode" or "Pause mode".

Delayed startup



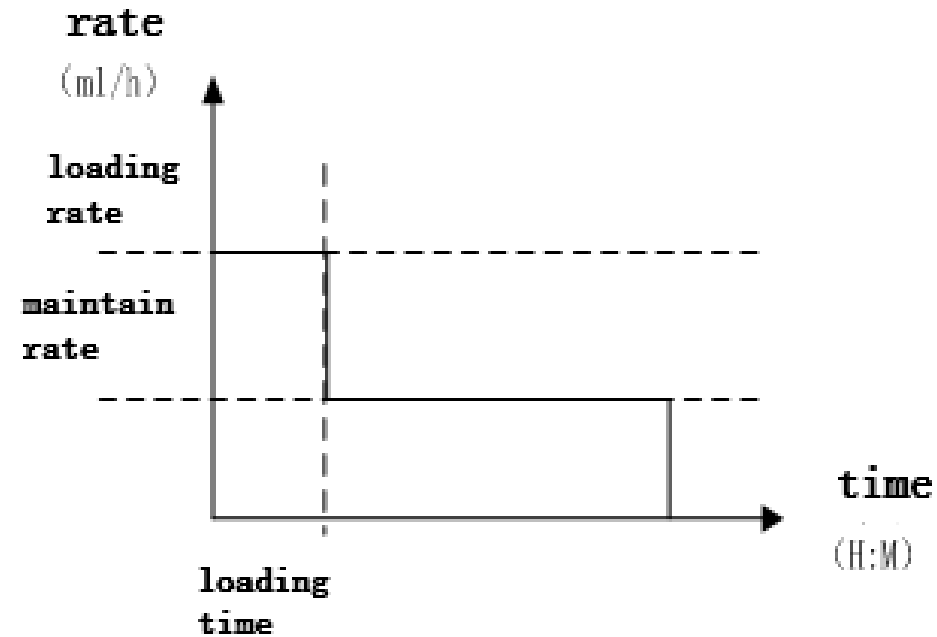
Pause



# Universal special modes

## Loading dose mode

- Loading dose mode is a commonly used special sequence mode.
- There are 2 sequences, one is called "loading sequence", the other is "maintain sequence".



Infusion Mode	LoadingDose	
Drug	---	
VTBI	---	ml
Loading Vol.	---	ml
Loading Rate	---	ml/h

Navigation: ◀ 1/2 ▶ ↶

Infusion Mode	LoadingDose	
Maintain Rate	---	ml/h
LoadingTime	---	h:m:s
Maintain Time	---	h:m:s

Navigation: ◀ 2/2 ▶ ↶

# Universal special modes

## Loading dose mode

### Clinical application:

- When treatment involves the use of "two" different rates.
- Sedative drugs, for example, are first "loading" at a higher rate, and then "maintained" at a lower rate.
- The instructions for amiodarone hydrochloride antiarrhythmic drugs also recommend "induction" before "maintenance" infusion.
- But nimodipine drugs are infused in two stages, first at a low rate, and then adjusted to a higher rate after being tolerated.

Drugs for sexual nerve injury. After admission, the patient was given Nimodipine Injection by micro pump continuously. According to the patient's body weight, the infusion speed was adjusted by two-stage method. That is to say, 2.5 ml/h micro pump infusion was started in 2 h and adjusted to 5 ml/h after good tolerance. Blood pressure changes were closely observed during use.

## Usual Adult Dose for Arrhythmias

IV:

**Initial dose: 1000 mg over the first 24 hours of therapy, delivered by the following infusion regimen:**

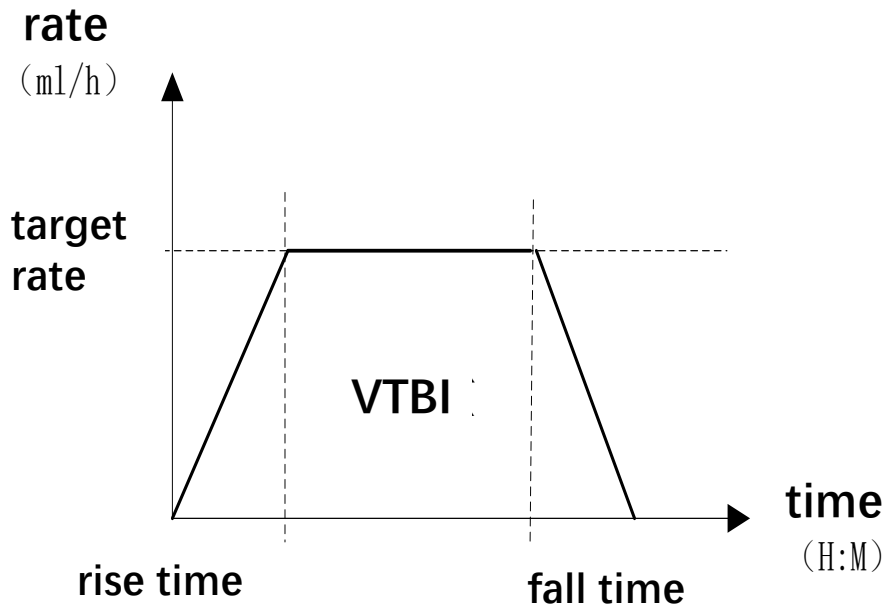
-Loading infusions: 150 mg over the first 10 minutes (15 mg/min), followed by 360 mg over the next 6 hours (1 mg/min)

-Maintenance infusion: 540 mg over the remaining 18 hours (0.5 mg/min)

# Universal special modes

## Trapezia mode

- Trapezia mode is also a commonly used special sequence mode. some brands also call it "ramp up/ramp down mode" .
- It consists of several sequences forming a trapezoidal velocity trend map. The first stage gradually increases to the target rate, maintains, and then gradually decreases to 0 at the end stage.
- You can switch between "total time" mode and "stable rate" mode at the "mode" button.



Infusion Mode	Trapezia Mode	▼
Drug	---	
VTBI	---	ml
Total Time	---	h:m:s ◀ Mode ▶
RiseTime	---	h:m:s
FallTime	---	h:m:s ↶

Infusion Mode	Trapezia Mode	▼
Drug	---	
VTBI	---	ml
Maintain Rate	---	ml/h ◀ Mode ▶
RiseTime	---	h:m:s
FallTime	---	h:m:s ↶

# Universal special modes

## Trapezia mode

### Clinical application :

- It can be used when the treatment involves a slow and gradual increase in doses at the beginning and a gradual decrease in doses at the end.
- Common applications such as parenteral nutrition support (TPN), in order to avoid the rapid increase and decrease of blood sugar in patients. It is necessary to infuse enterogastric nutrition support from a low dose, regularly increase the infusion volume to a stable level, and the TPN infusion can not stop immediately when it is about to be completed, and a gradual reduction process is needed until the infusion is completed.

### Total Parenteral Nutrition (TPN) Order Form

◆ Orders are initiated unless crossed out by provider.

Check box to initiate order.

Please complete this form and fax to (360)933-1197

**Diagnoses:** \_\_\_\_\_ ICD-10: \_\_\_\_\_

#### Medication Orders:

Days per week: \_\_\_\_\_

Cyclic: Infuse over \_\_\_\_\_ hours (Taper up and down x1 hour)

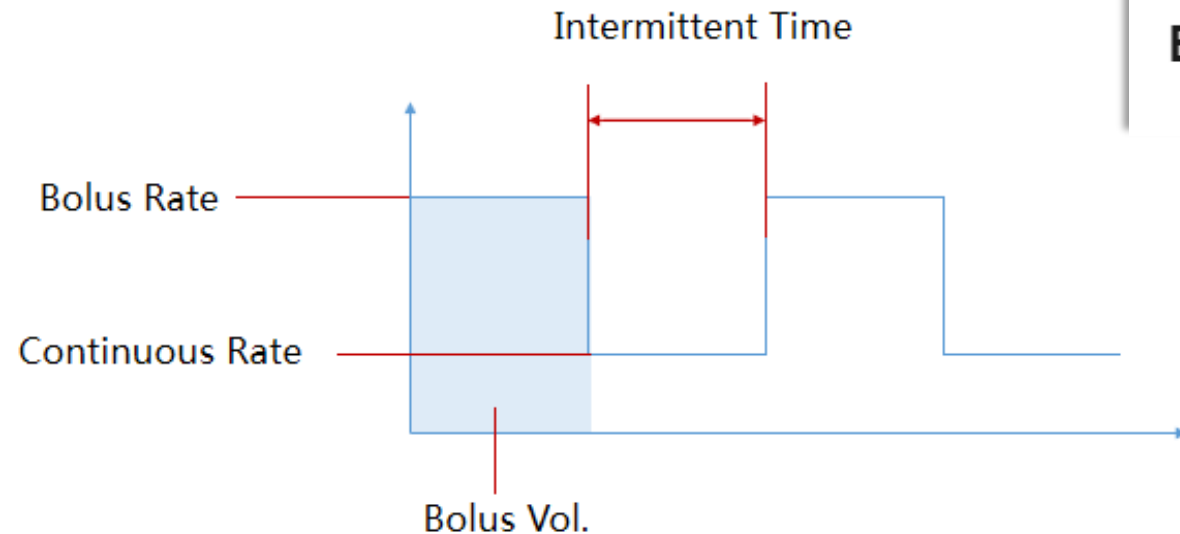
Continuous (24 hours/day)



# Universal special modes

## Intermittent mode

- During the CPR, intravenous infusion of adrenaline is required. The doctor's advice is usually to infuse a certain dose, and then infuse the same dose again after 3 minutes. In this reciprocating cycle, the doctor's advice usually lasts for 30 minutes (rescue time requirement) or will stop the pump manually after the rescue is successful.
- It differs from sequence mode in that the intermittent mode is an infinite cycle with two fixed infusion rates.



## Epinephrine Dosage Guide with Precautions - Drugs.com

The American Heart Association (AHA) recommends:

- IV or intraosseous: 1 mg IV or intraosseous every 3 to 5 minutes during cardiac arrest
- Endotracheal: 2 to 2.5 mg endotracheally every 3 to 5 minutes during cardiac arrest if IV or intraosseous route cannot be established

Use: For administration during cardiac arrest

# Universal special modes

## Micro mode

Infusion Mode	Micro Mode	
Drug	---	
Infusion Rate	---	ml/h
VTBI	---	ml
Infusion Time	---	h:m:s

↩

- Micro mode is a special rate/time mode.
- In micro mode, no matter what infusion device is currently used, the upper limit of rate is 100ml/h and the upper limit of VTBI is 1000ml.
- Micro mode is used to prevent the misuse of large doses in the treatment of special patients (such as Neonates).

# Universal special modes

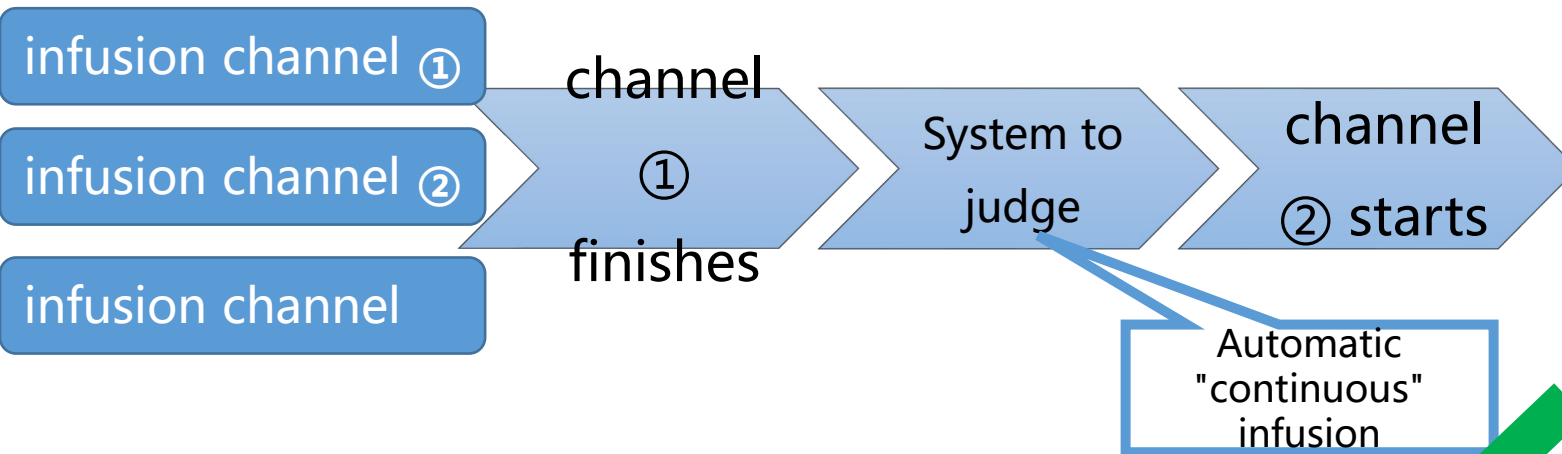
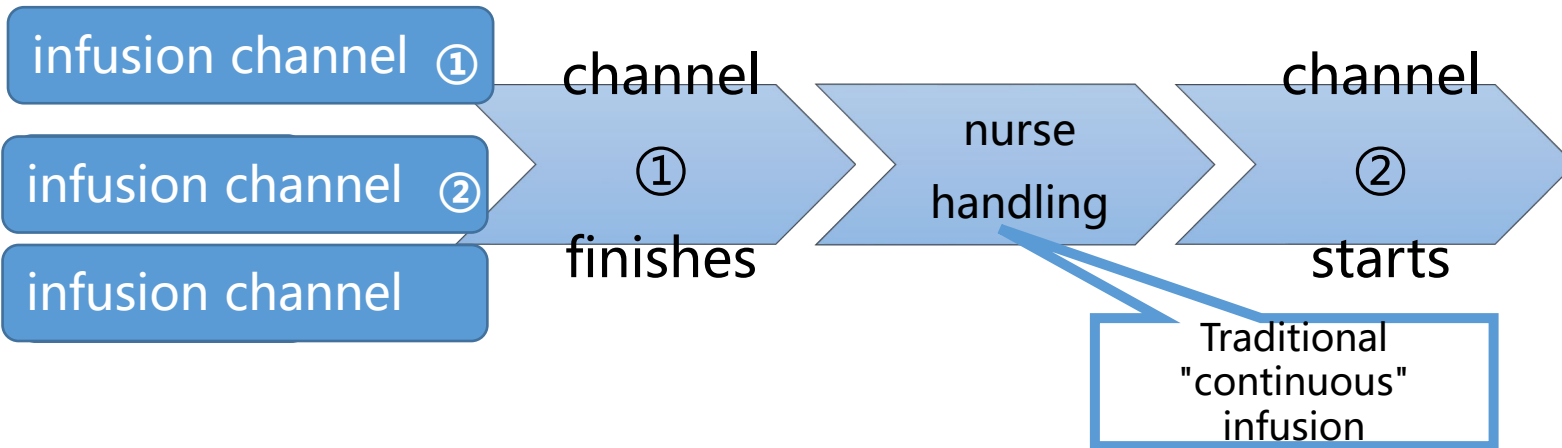
## Relay mode

- Because the volume of the syringes used in the micro infusion pump is small (up to 50/60ml), it needs to be replaced frequently.
- Clinical findings: the replacement of syringes often causes hemodynamic instability<sup>[1][2]</sup> , such as: significant fluctuations in blood pressure, increased heart rate and so on.
- If not treat promptly, it may cause serious clinical consequences, such as fatal arrhythmia, increased risk of bleeding in surgical wounds and cerebrovascular accident , excessive insufficient perfusion, increased occurrence of cerebral hypoxia and myocardial infarction, and threatened the life of patients.
- Manual replacement of vasoactive drug syringes results in up to 18% of complications<sup>[5]</sup>.

1. Argaud L, Cour M, Martin O, et al. Changeover of vasoactive drug infusion pumps: impact of a quality improvement program. *Crit Care* 2007; 11:R133
2. Malanie Arino, Jane P. Barrington, Anne L. Morrison, Donna Gillies Management of the changeover of inotrope infusions in children *Intensive and Critical Care Nursing* (2004) 20,275-280
3. Hollenberg SM. Vasoactive drugs in circulatory shock. *Am J Respir Crit Care Med* 2011; 183:847-55
4. Holmes CL. Vasoactive drugs in the intensive care unit. *Curr Opin Crit Care* 2005; 11:413-7
5. Argaud L et al.: Changeovers of vasoactive drug infusion pumps: impact of a quality improvement program: *Critical Care* Vol 11 No 6 R133, 2007

# Universal special modes

## Relay mode



- Nurses need to wait for channel 1 to be completed before processing channel 2.
- The process results in interruption of infusion.
- When the syringe is replaced manually, the fluctuation of blood pressure is unavoidable.
- Automatic syringe replacement can greatly reduce the interruption time compared with manual replacement.
- Ready the channel 1 and channel 2 and place in the Intelligent Multi-channel workstation.
- The state of each channel is monitored by the computer in the workstation.
- If channel 1 infusion is completed, channel 2 automatically starts.
- No manual replacement is needed to save dressing change time.

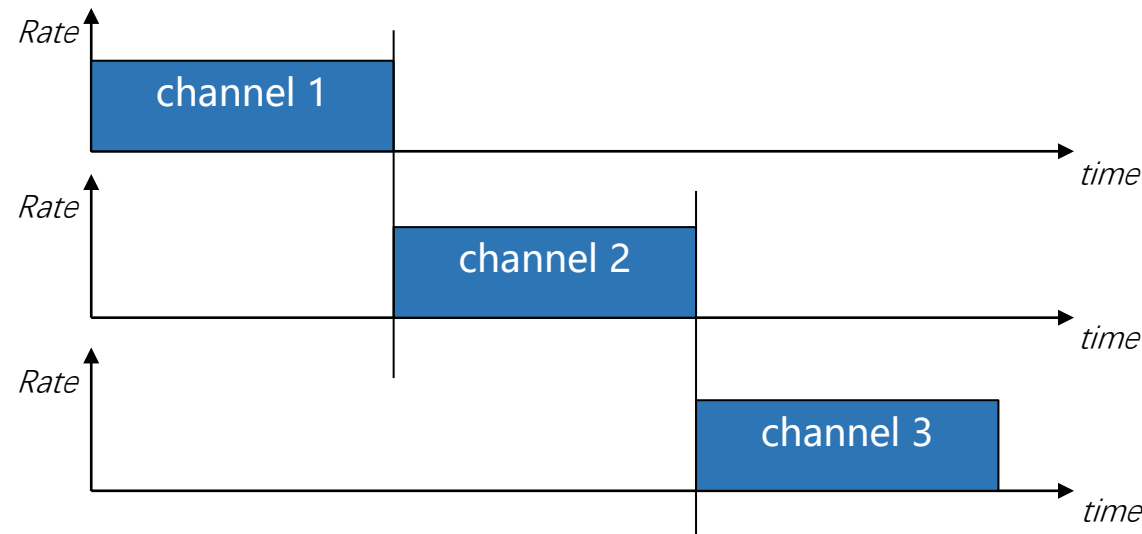
# Universal special modes

## Relay mode

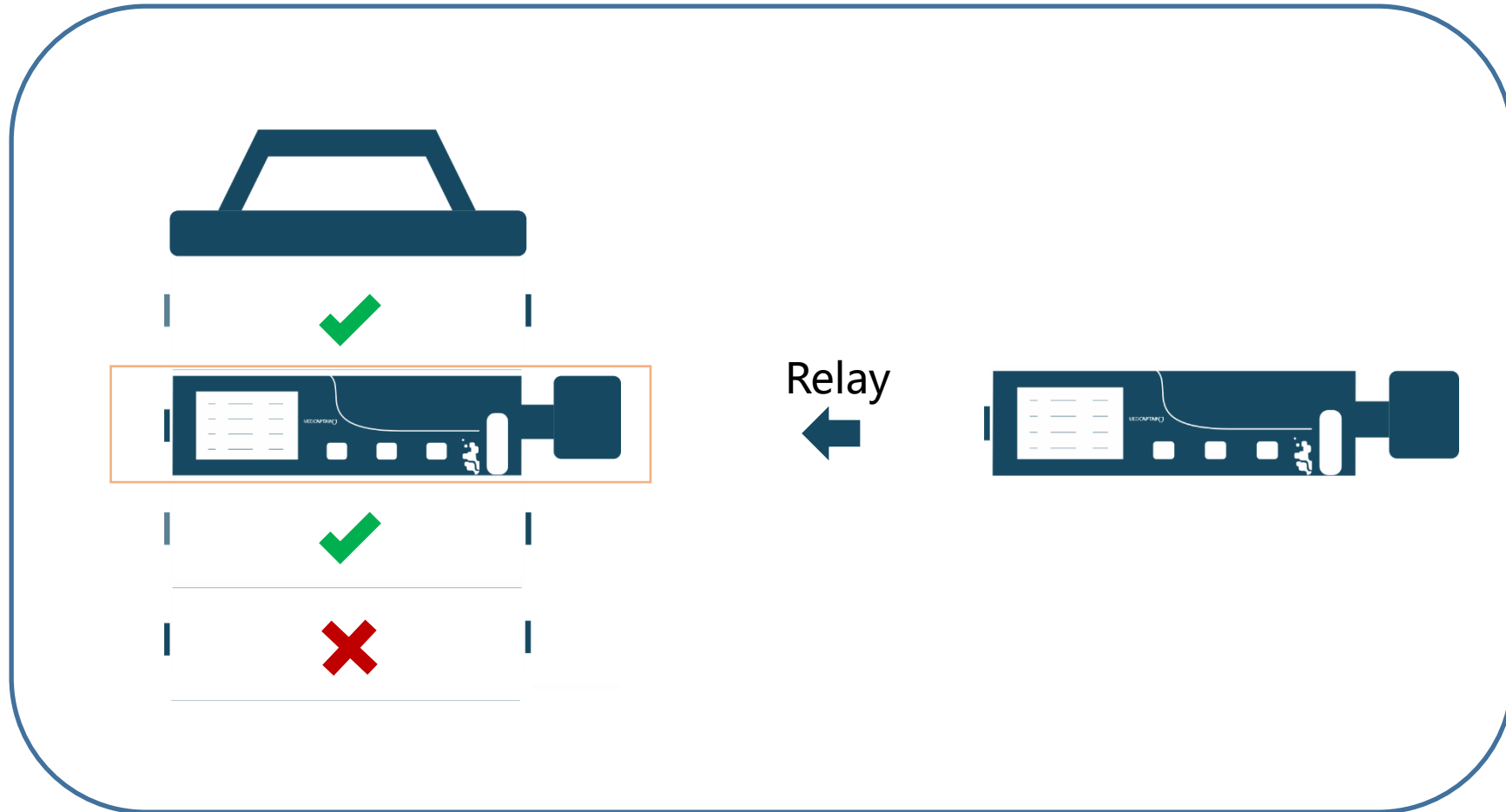
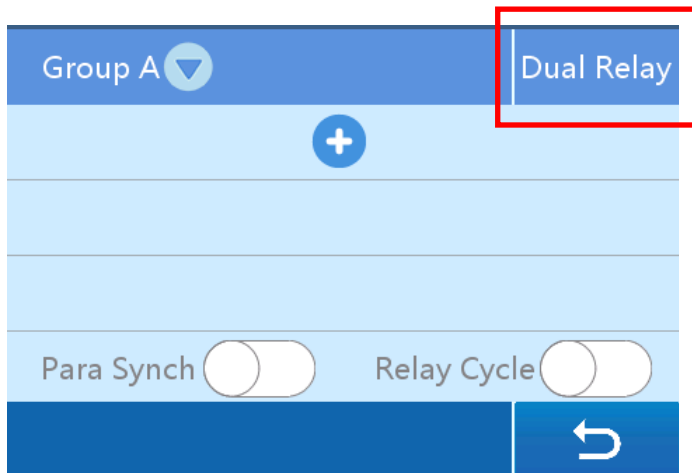
Relay infusion can realize seamless switching between two continuous infusion channels



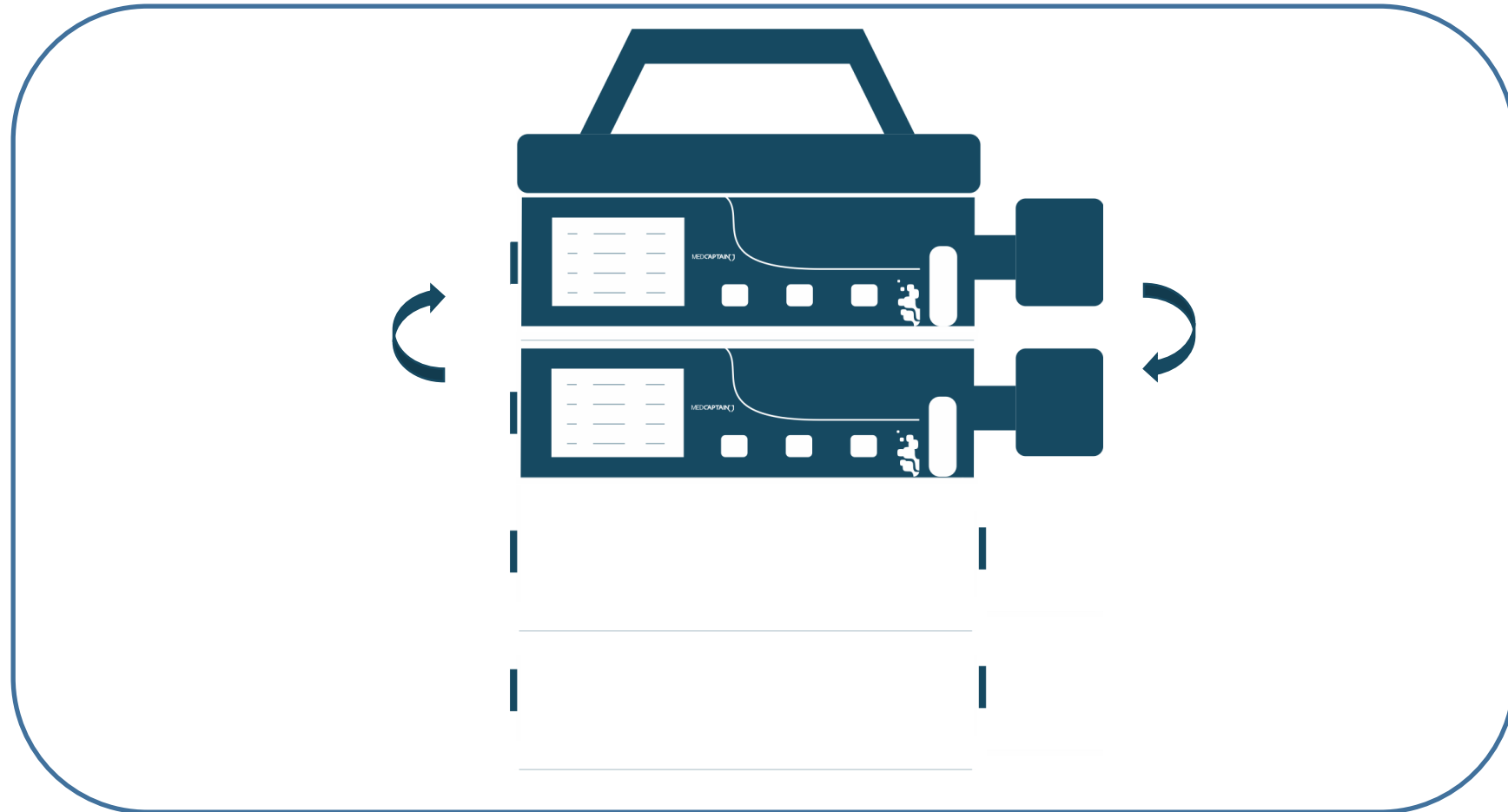
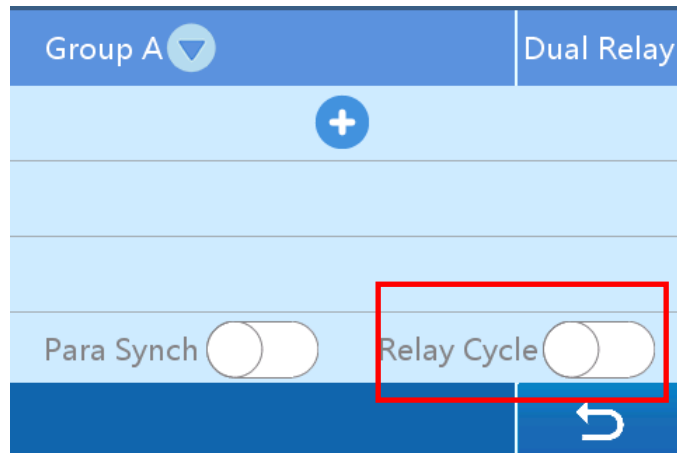
channel 1	Infusion start
channel 2	At the moment when channel 1 finishes, fast steady state infusion is automatically started
channel 3	At the moment when channel 2 finishes, fast steady-state infusion is automatically started
channel .....	Before the last channel ends, the next one enters a waiting state.
key words	Automatic start, fast steady state, seamless docking



# Dual Relay

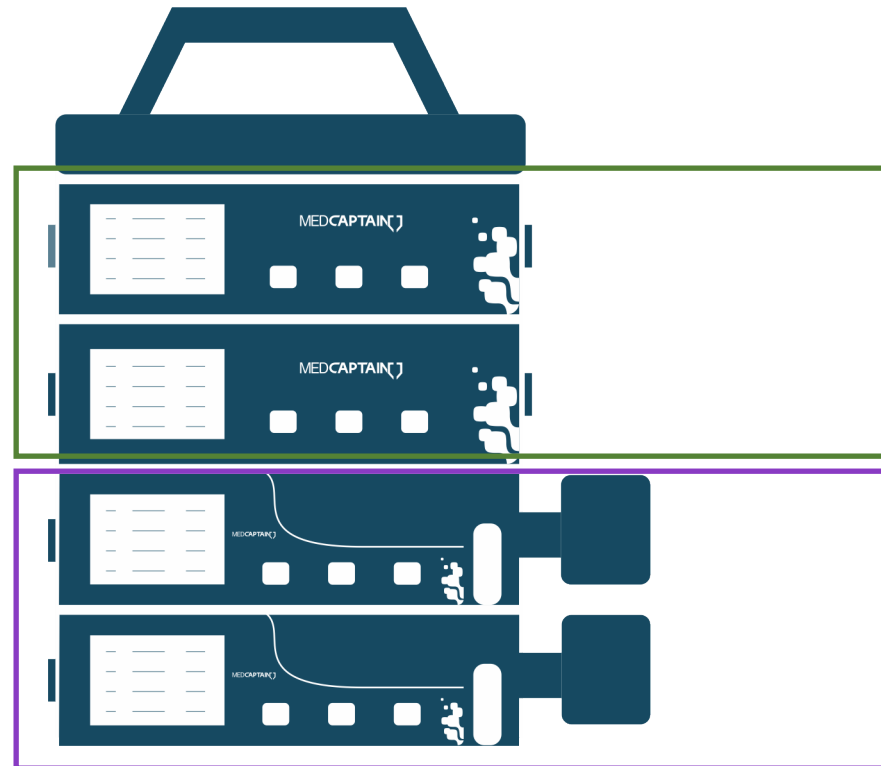


# Relay Cycle





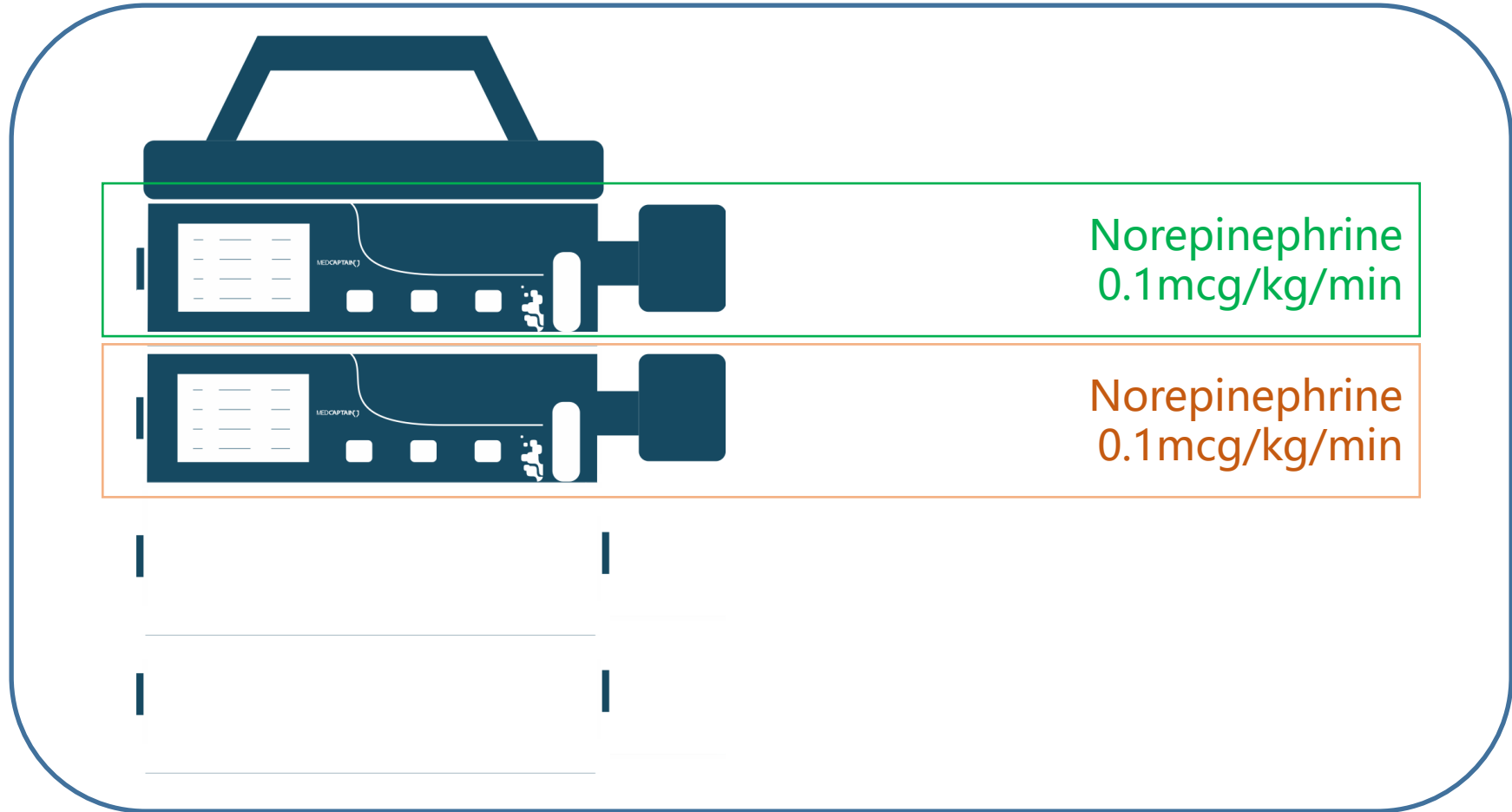
# Relay Group



1. Channel 1 and channel 2 get a relay group A.
2. Channel 3 and channel 4 get another relay group B.

# Parameter Synchronization

Group A		Clear
Relay 1	Pump 1 (Local)	-
Relay 2	Pump 2	-
+		
Para Synch	<input type="checkbox"/>	Relay Cycle <input type="checkbox"/>
		↶



# Infusion pump specific mode

## Drip mode

- Drip mode is a special mode for infusion pump, which needs to be used with drop sensor.
- In drip mode, the machine automatically converts the drip number and rate to better cooperate with the drip sensor to control the infusion.

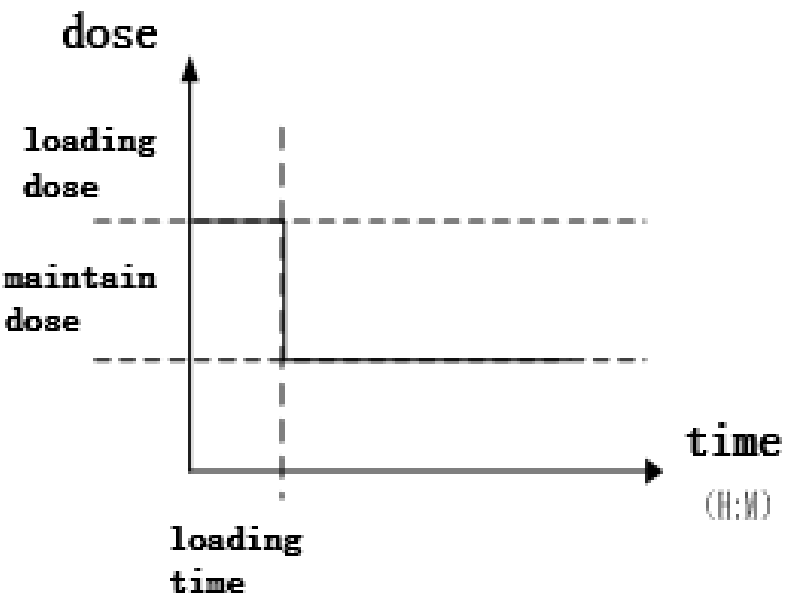


Infusion Mode	Drip Mode	
Drug	---	
VTBI	---	ml
Drop Rate	---	dot/min
Infusion Rate	---	ml/h

# Syringe pump specific mode

## TIVA mode

- TIVA is the abbreviation of total intravenous anesthesia. TIVA mode is an infusion mode designed for total intravenous anesthesia.
- It can also be divided into two stages: induction and maintenance.
- First of all, give a relatively large dose of anesthetics to the patient, to get the patient into the anesthetic state.
- The patient's anesthesia was then maintained with a relatively small amount of continuous anesthesia.



Infusion Mode	TIVA Mode	
Drug Info	---	◀ mg/ml ▶ $\frac{+}{\times}$ $\frac{-}{\div}$
Weight	---	kg
LoadingDose	---	◀ mg/kg ▶
Loading Vol.	---	ml

Navigation: ◀ 1/2 ▶ ↻

Infusion Mode	TIVA Mode	
LoadingTime	---	h:m:s
Loading Rate	---	ml/h
Dose Rate	---	◀ mg/kg/min ▶
Maintain Rate	---	ml/h

Navigation: ◀ 2/2 ▶ ↻

# Syringe pump specific mode

TIVA mode

The difference between Loading dose mode and TIVA mode

Infusion Mode	LoadingDose	
Drug	---	
VTBI	---	ml
Loading Vol.	---	ml
Loading Rate	---	ml/h

Navigation buttons: Left arrow, 1/2, Right arrow, Refresh arrow

- The unit of loading mode is ml/h.
- VTBI is required to set, so as to control the end time.
- The rate during the maintenance period is not adjustable.

Infusion Mode	TIVA Mode	
Drug Info	---	◀ mg/ml ▶ $\frac{+}{\times}$ $\frac{-}{\div}$
Weight	---	kg
LoadingDose	---	◀ mg/kg ▶
Loading Vol.	---	ml

Navigation buttons: Left arrow, 1/2, Right arrow, Refresh arrow

- TIVA mode  $\approx$  loading dose mode+weight mode
- No need to set VTBI in TIVA mode. Because the anesthesiologist can not accurately predict the ending time of operation.
- The dose is adjustable during the maintenance period on TIVA mode, and anesthesiologists can adjust the drug delivery according to the operation.

# Syringe pump specific mode

## TIVA mode

The main drug in TIVA mode is propofol. Refer to the instructions of propofol directly.



TABLE 1. PEDIATRIC INDUCTION OF ANESTHESIA

Age Range	Induction Dose Median (range)	Injection Duration Median (range)
Birth through 16 years	2.5 mg/kg (1 mg/kg to 3.6 mg/kg)	20 sec. (6 sec to 45 sec)

TABLE 2. PEDIATRIC MAINTENANCE OF ANESTHESIA

Age Range	Maintenance Dosage	Duration (minutes)
2 months to 2 years	199 mcg/kg/min (82 mcg/kg/min to 394 mcg/kg/min)	65 minutes (12 minutes to 282 minutes)
2 to 12 years	188 mcg/kg/min (12 mcg/kg/min to 1041 mcg/kg/min)	69 minutes (23 minutes to 374 minutes)
>12 through 16 years	161 mcg/kg/min (84 mcg/kg/min to 359 mcg/kg/min)	69 minutes (26 minutes to 251 minutes)

Infusion Mode	TIVA Mode	
Drug Info	10.00	mg/ml
Weight	40.0	kg
LoadingDose	2.50	mg/kg
Loading Vol.	10.00	ml
1/2		

Infusion Mode	TIVA Mode	
LoadingTime	00:01:00	h:m:s
Loading Rate	600.0	ml/h
Dose Rate	161.00	ug/kg/min
Maintain Rate	38.64	ml/h
2/2		

# Syringe pump specific mode

TIVA mode



In the induction period of TIVA model, the dose rate can not be changed. After entering the maintenance period, the dose rate can be modified at any time.



# Syringe pump specific mode

## TCI mode

### Normal TIVA mode

- The dosage was input according to mg/kg/h, and then automatically converted to ml/h.
- Actually, we control the infusion rate of the syringe pump.
- It is a kind of "constant rate pump".
- In clinical operation, the TIVA mode requires the physician to calculate the relationship between the dose and the blood drug concentration, and then adjust the rate during the operation.
- Experienced anesthesiologists can adjust according to their experience.
- It's a challenge for novice physicians.

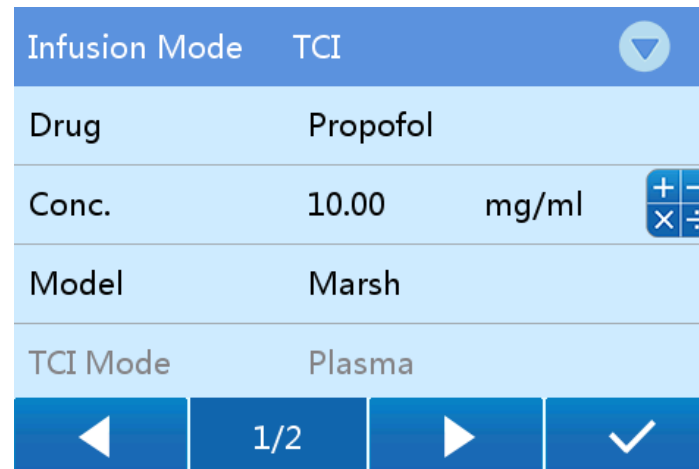
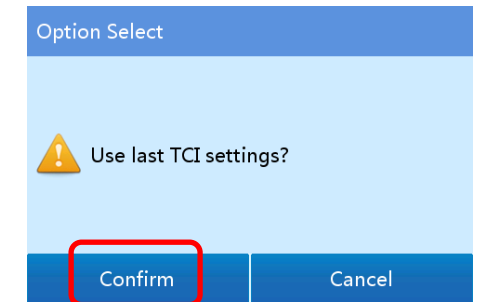
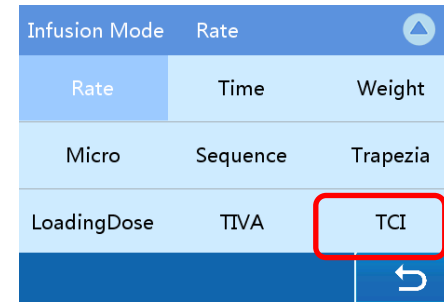
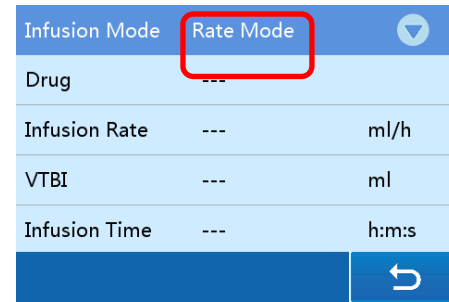
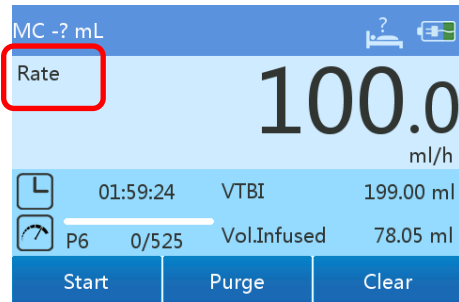
In TCI mode, anesthesiologists only need to input:

- patient's weight
- patient's age
- the target Blood drug concentration(target concentration  $\mu\text{g/ml}$  )
- The machine will automatically adjust the rate to ensure a certain concentration of drugs in the blood.

In clinical practice, blood concentration is really useful for intravenous anesthesia. TCI model eliminates the part of manual calculation of blood drug concentration. Make the anesthesia effect more intuitional.

# Syringe pump specific mode

TCI mode

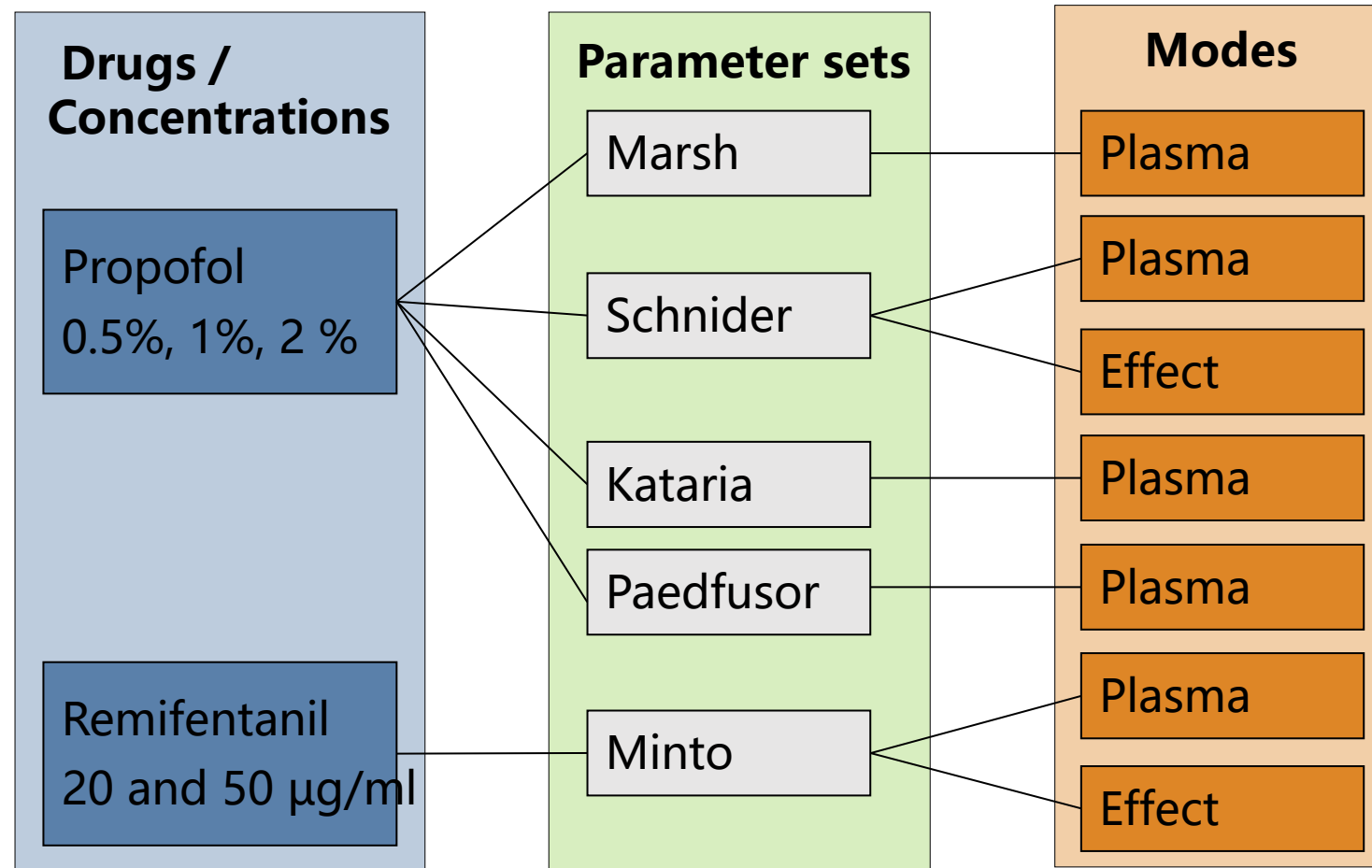


Now TCI is ready to use.  
The default drug is Propofol

# Syringe pump specific mode

TCI mode

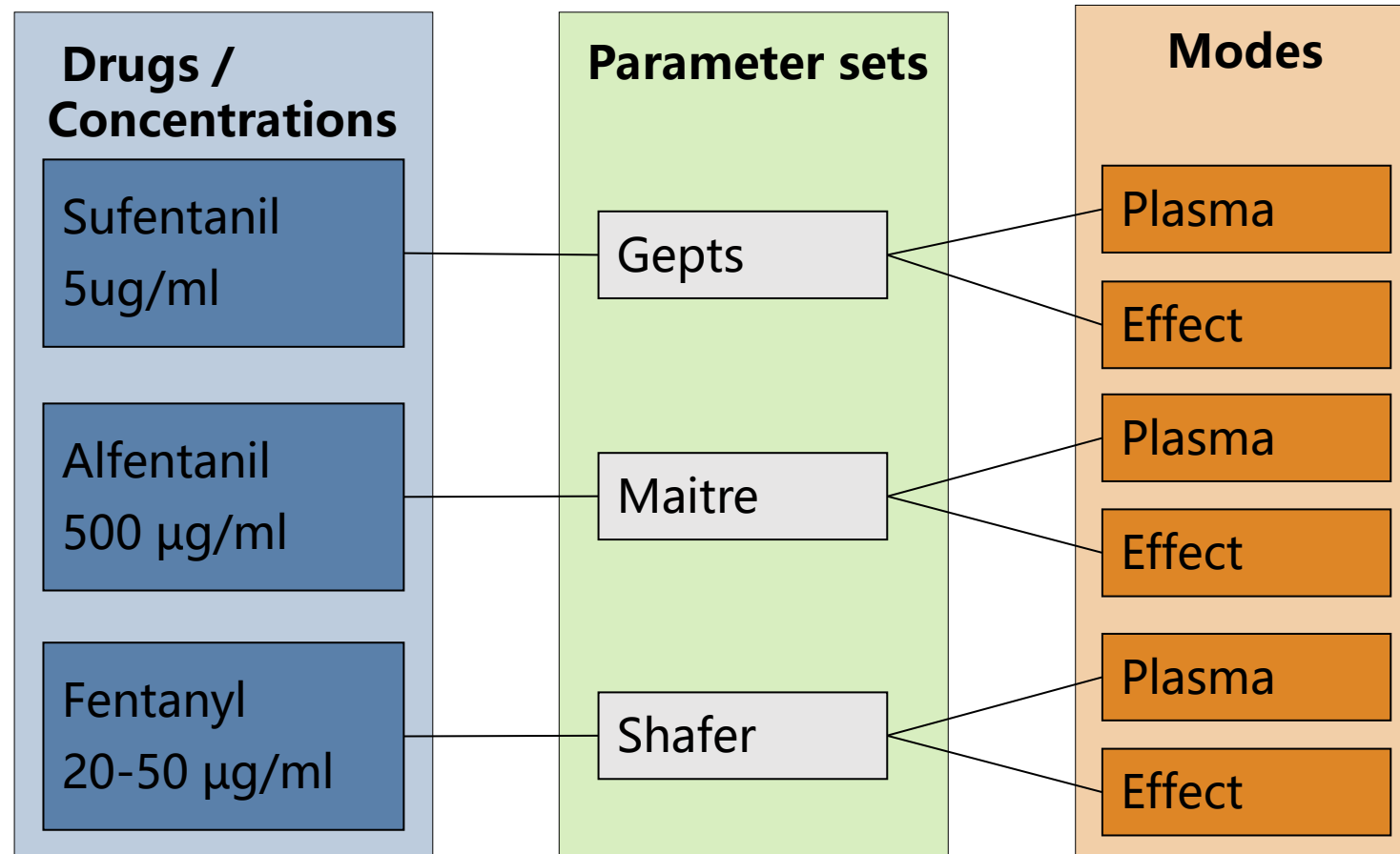
Standard Drugs



# Syringe pump specific mode

TCI mode

\*Optional Drugs



# Syringe pump specific mode

PCA mode

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*PCA = Patient Controlled Analgesia*



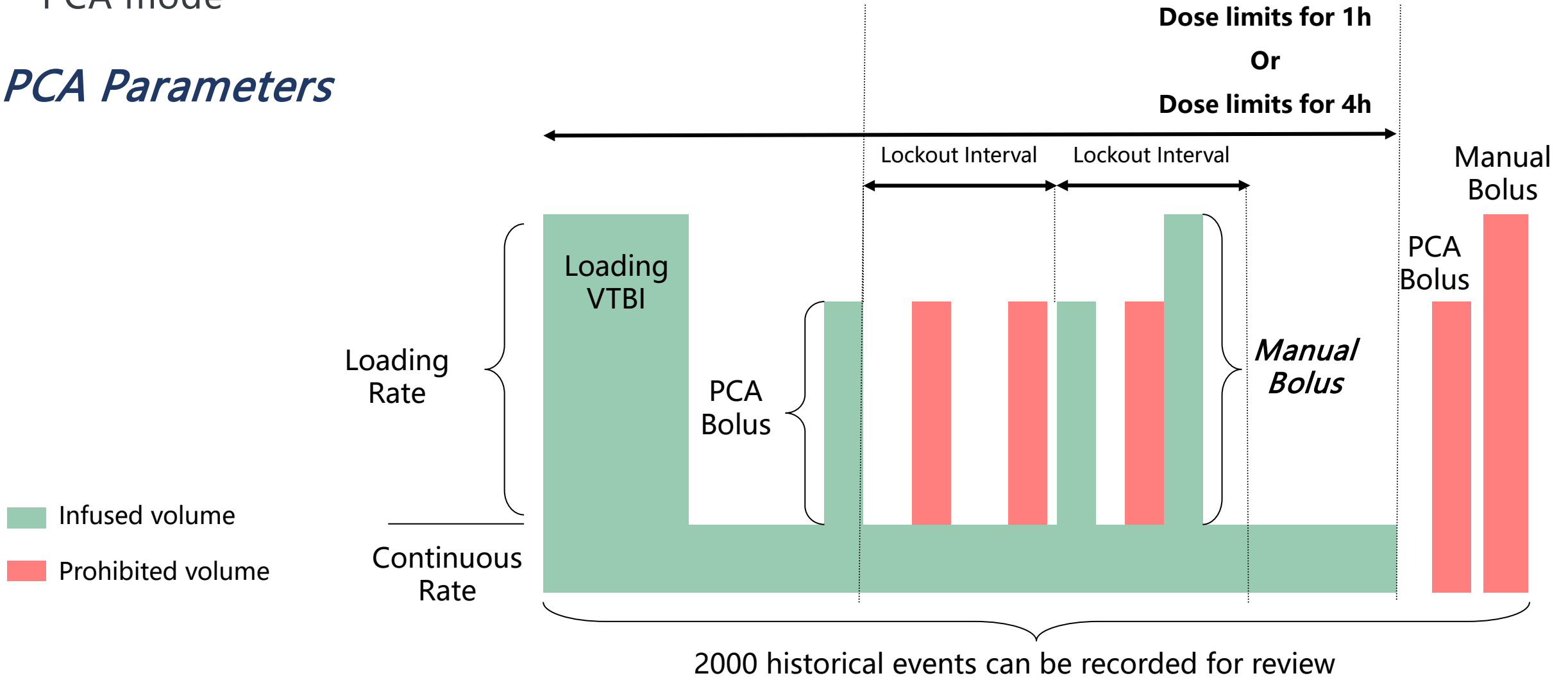
**PCA** is a method that allows patients to decide when they need more pain relief and then to give it to themselves.

Instead of ringing for a nurse, they can press the button attached to the pump, which delivers the pain relief straight into their body.

# Syringe pump specific mode

PCA mode

## PCA Parameters





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Thank you