CareFusion

Modern T C I Pumps and clinical application

Gyula Vértesy
Carefusion Alaris products

Our vision

Improve the safety and cost of healthcare for generations to come.

CareFusion

CareFusion

The scale to address healthcare's most pressing challenges

Global Position	R&D Investment	Patents/Pending
~$4 billion Top 10 med-tech company	>$150 Million	~3,200
Customers	**Employees**	**Clinical Expertise**
25,000, 120 countries	>14,000	>78,000 clinicians trained annually

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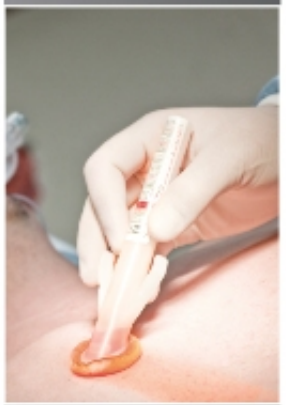
Proven technology

Pyxis®	Alaris® and MaxGuard®	AirLife® and Viasys®	ChloraPrep®	AVAmax®, PleurX® and V. Mueller®	Jaeger®, Nicolet® SensorMedics®
					
Dispensing	Infusion	Respiratory	Skin prep	Surgical and interventional	Diagnostics

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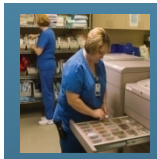
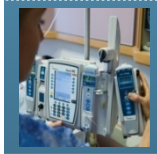
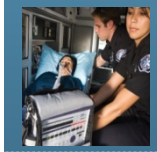
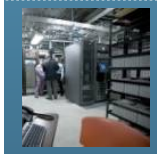
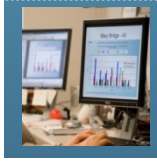
Heritage of Innovation

 **Pyxis ®**	Automated, decentralized medication dispensing
 **Alaris®**	SMART Pumps with Guardrails® safety software
 **ChloraPrep®**	2% Chlorhexidine gluconate/70% Isopropyl Alcohol for pre-operative skin preparation
 **Viasys®**	BiCore technology to help reduce ventilation days
 **Alaris®, Pyxis®**	Wireless data to monitor medication safety
 **MedMined™**	Surveillance services

CareFusion

Syringe Pumps & Large Volumetric Pumps (LVP's)

- 1968 IVAC founded in San Diego
- 2004 Cardinal Health – Acquisition Alaris Medical Systems
- 2009 Care Fusion
- World wide market leader


INFUSIONE
13.0ml/h
2.00µg/kg/h
+ REGOLARE −
FENTANYL *
VOLUME
997ml
9.98mg
2h 18m 58s
PRESSIONE
6
300mmHg
VOLUME
VOI
Alaris®
CC
58.
INFUSIONE
3.66ml/h
0.15µg/kg/min
+ REGOLARE −
NORADRENALINA *
VOLUME
152ml
9h 05m 14s
PRESSIONE
12
300mmHg
VOLUME
VOI
Asena®
CC
MK III
NORADRENALINA
INFUSIONE
2.00ml/h
BRAUN OMNIFIX 50
VOLUME
76.2ml
22h 22m 45s
PRESSIONE
28
300mmHg
VOLUME
VOI
CASIX 1/2
INFUSIONE
9.00ml/h
PRESSIONE
33
1250ml
0h 53m 45s
300mmHg
VOLUME
VOI

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Focus on

- **SAFETY**
- **OR**
- **High Critical Care**

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ALARIS Infusion Pumps

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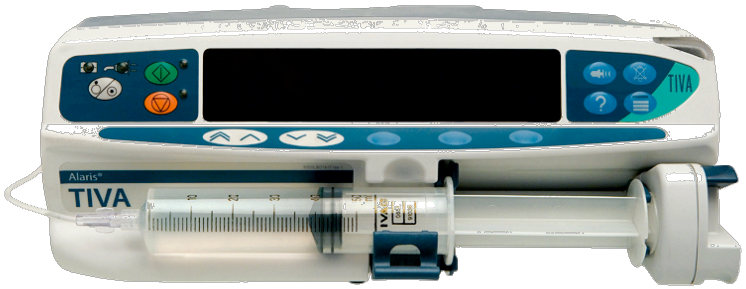
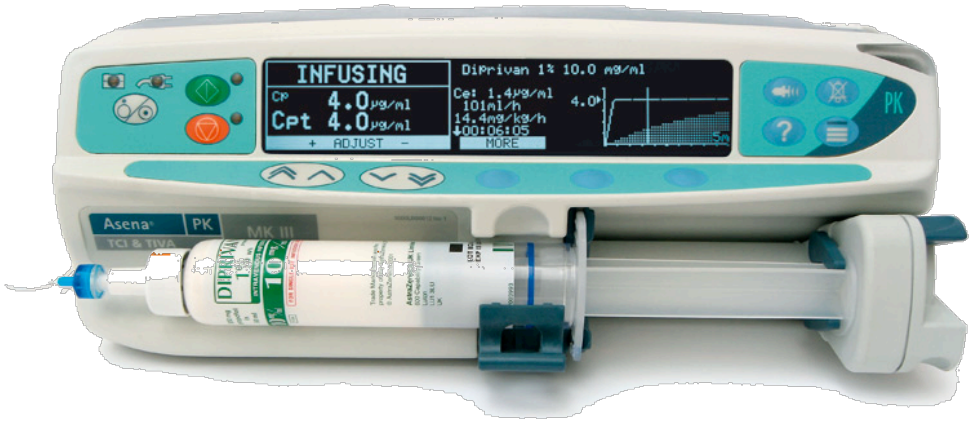

TIVA
Alaris®
TIVA


INFUSING
DiPrivan 1% 10.0 mg/ml
Cp 4.0µg/ml
Cpt 4.0µg/ml
Ce: 1.4µg/ml
101ml/h
14.4mg/kg/h
00:06:05
+ ADJUST −
MORE
PK
Asena
PK
MK III
TCI & TIVA


IVAC TCI
INFUSING
ALARIS

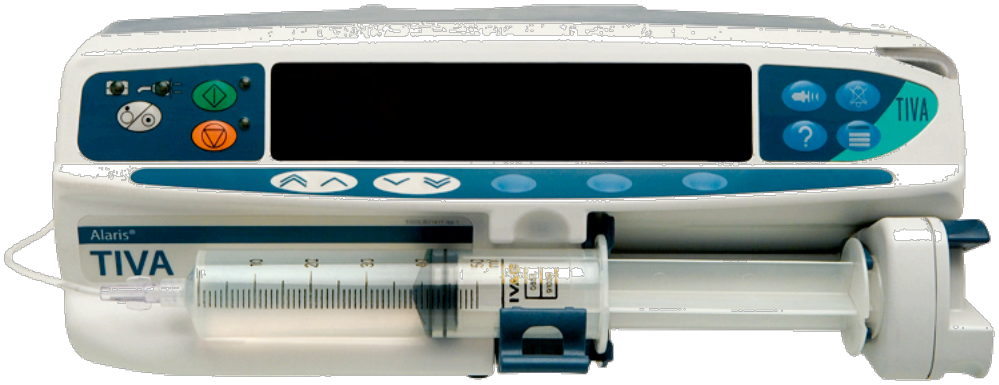
CareFusion

What can do a pump 4 U ?

Help your Job
PREPARE Programmed
More Focus on your patient

TIVA

- Give accuracy
- Pregprogramming
  INDUCTION
  MAINTENANCE
  BOLUS hands free
  Fast operation



- Preparation ..
  give more time , Focus on your patient !
  Lot of INFO

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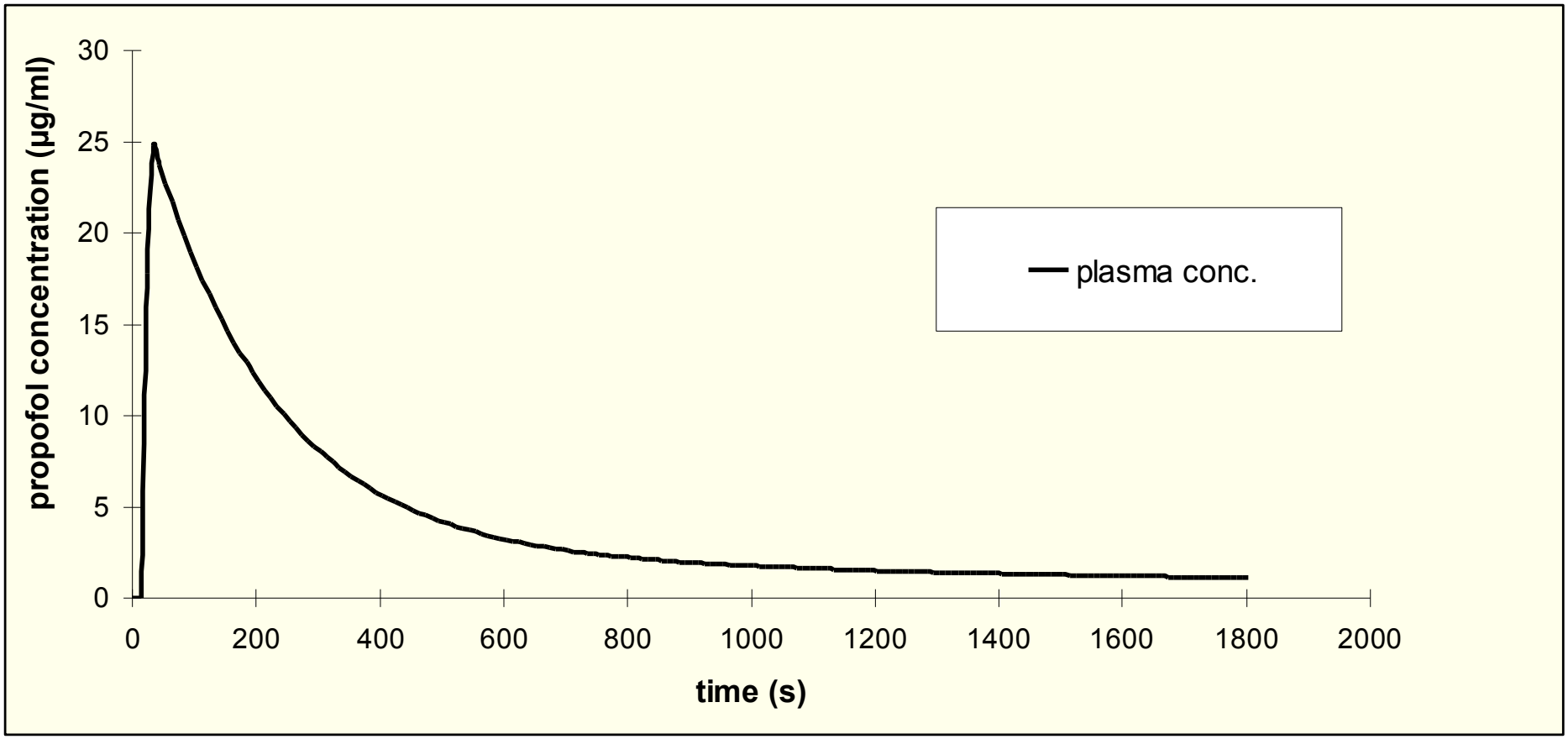
Single bolus administration

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium



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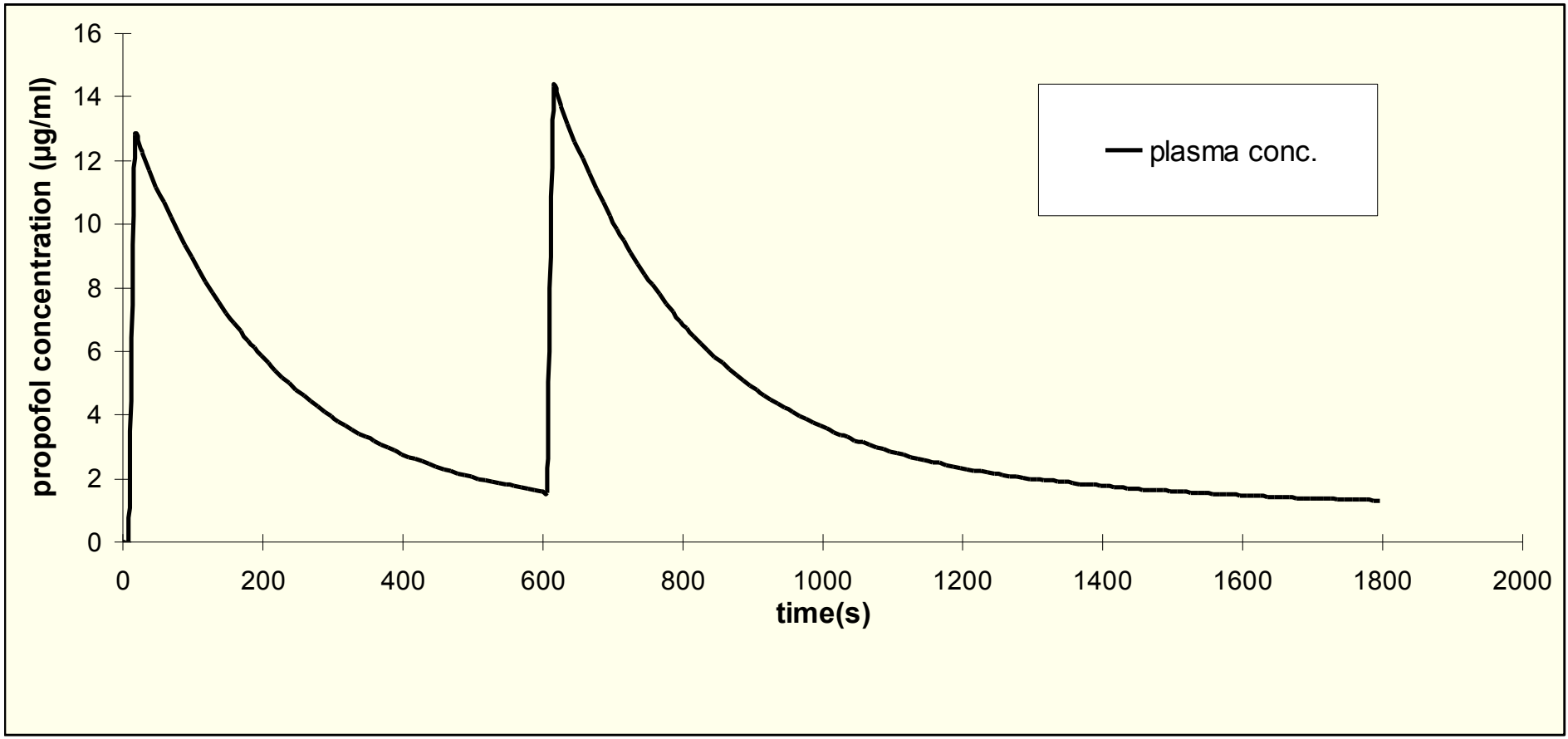
Repeated bolus administration

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium



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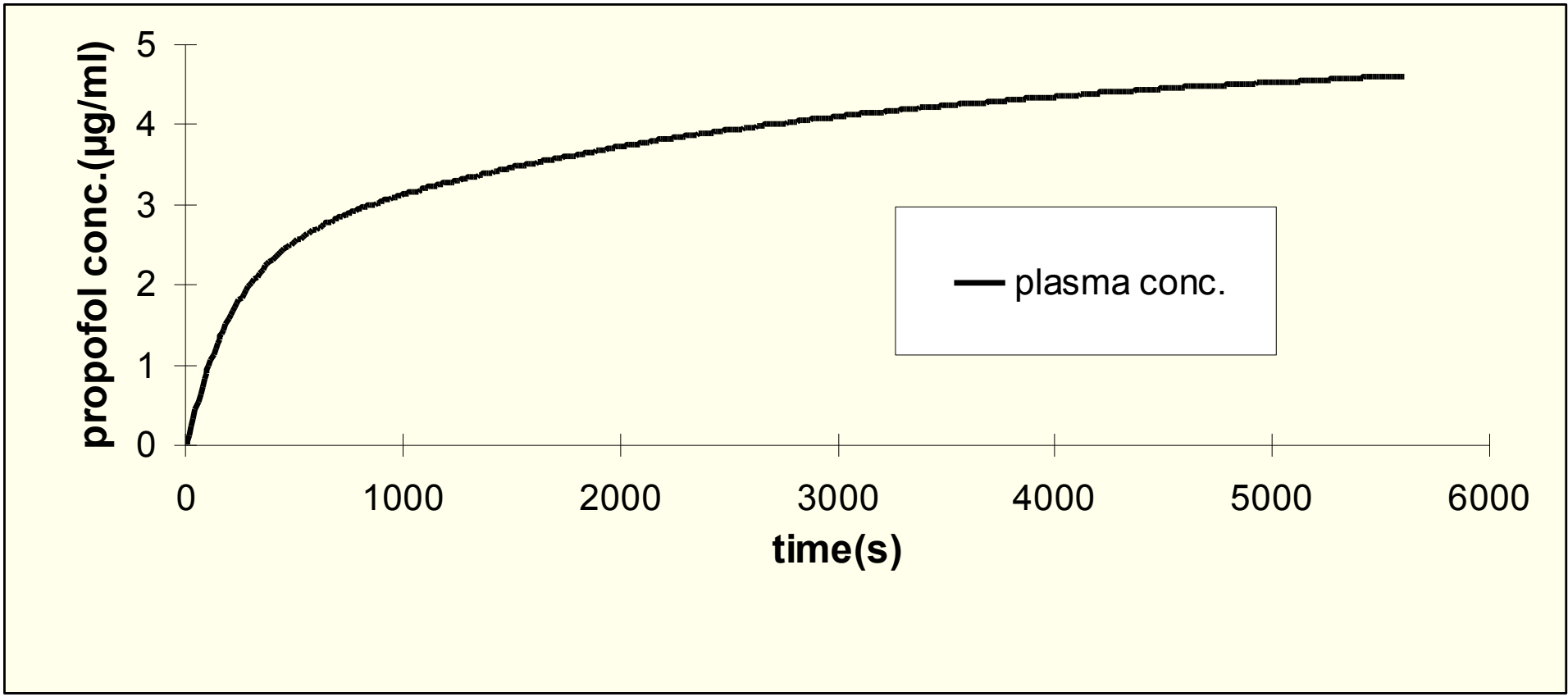
Continuous infusion
i.e. a syringe pump set at 90 ml/h

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium



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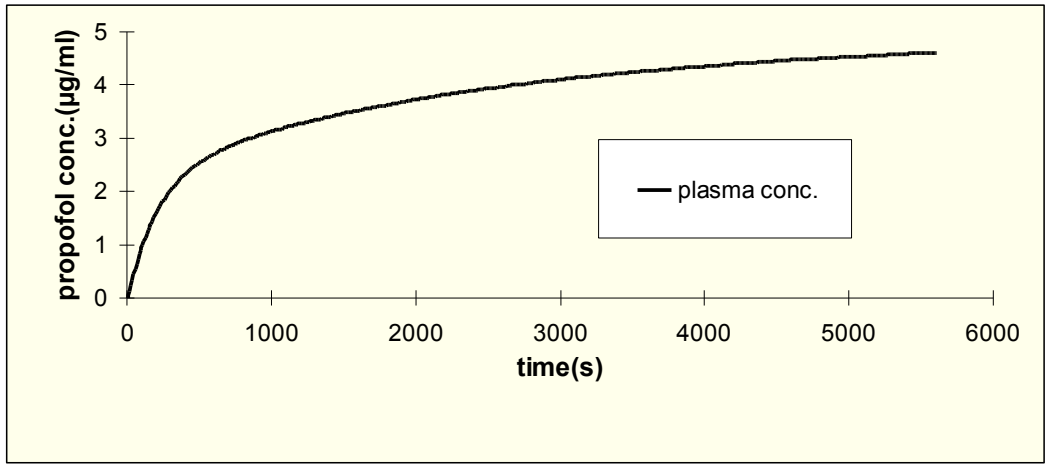
Why isn't a manual infusion sufficient for anaesthesia?

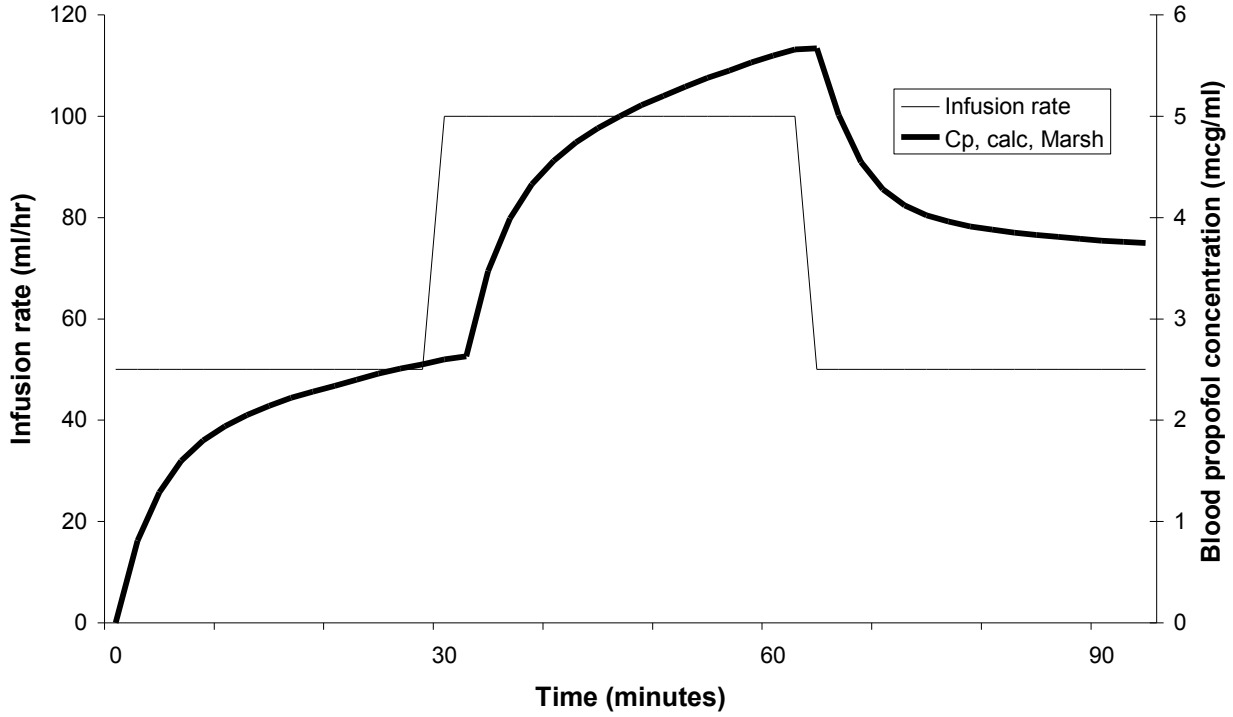
With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium



It takes a long time to reach steady state.

Even after 12 hours the blood concentrations are still rising. This is because it takes approx 24 h for the drug to equilibrate throughout all the tissues.

Why isn't a manual infusion sufficient for anaesthesia?

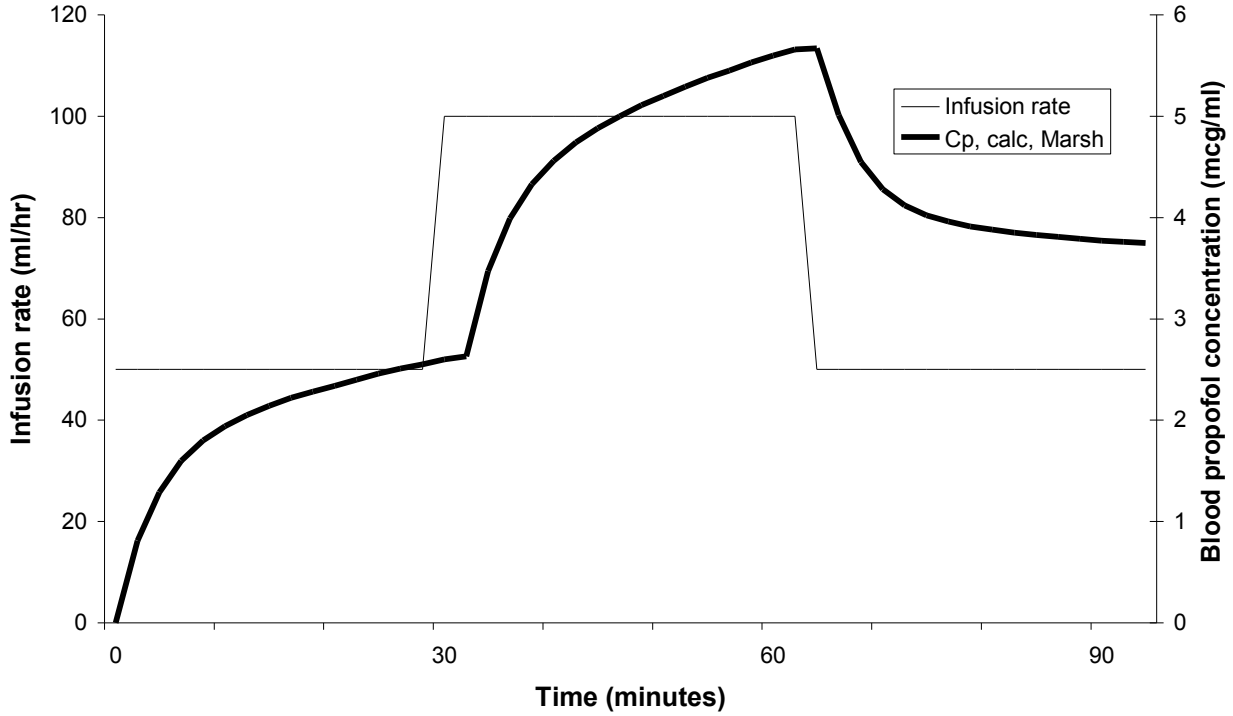


Manually controlled infusion of propofol: Note that when the infusion rate is halved or doubled there is a long delay before the blood propofol concentration halves or doubles.

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium

CareFusion

Why isn't a manual infusion sufficient for anaesthesia?



Too much might give adverse effects: You could manually stop the pump for awhile but will you remember to start it again?

Too little might cause pain and awareness. A bolus could be given, but what dose is appropriate?

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium

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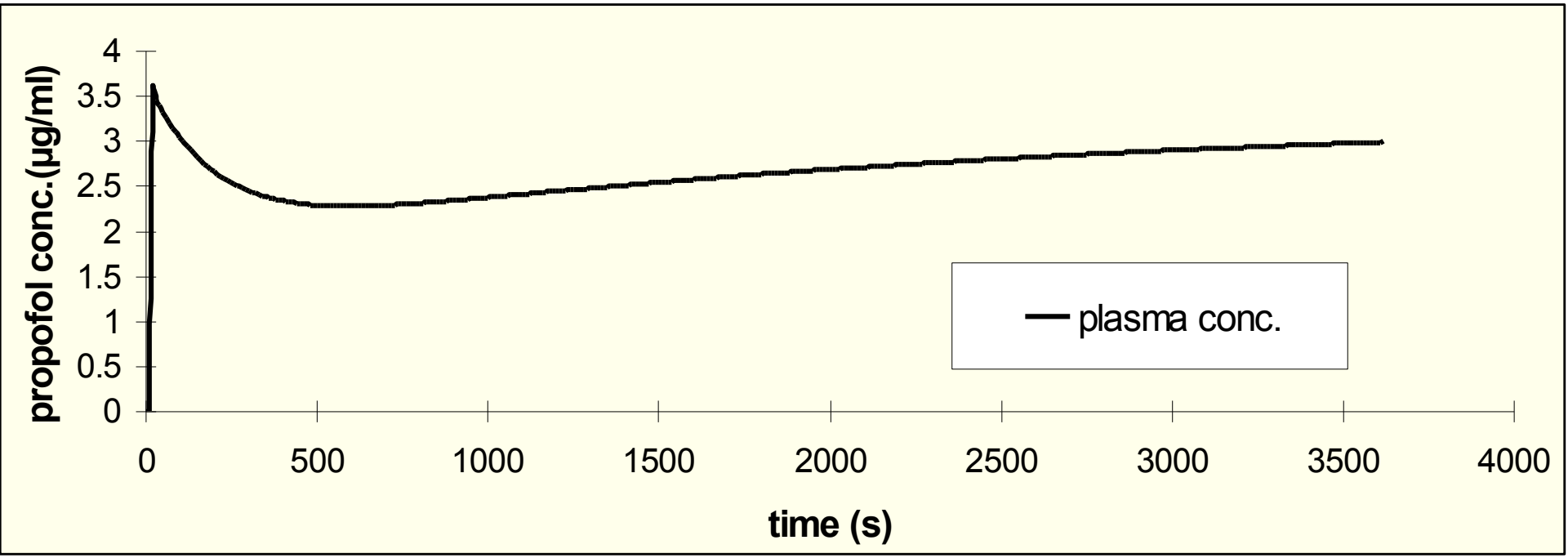
Bolus + continuous infusion
Like normal TIVA

With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium



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What is TCI?

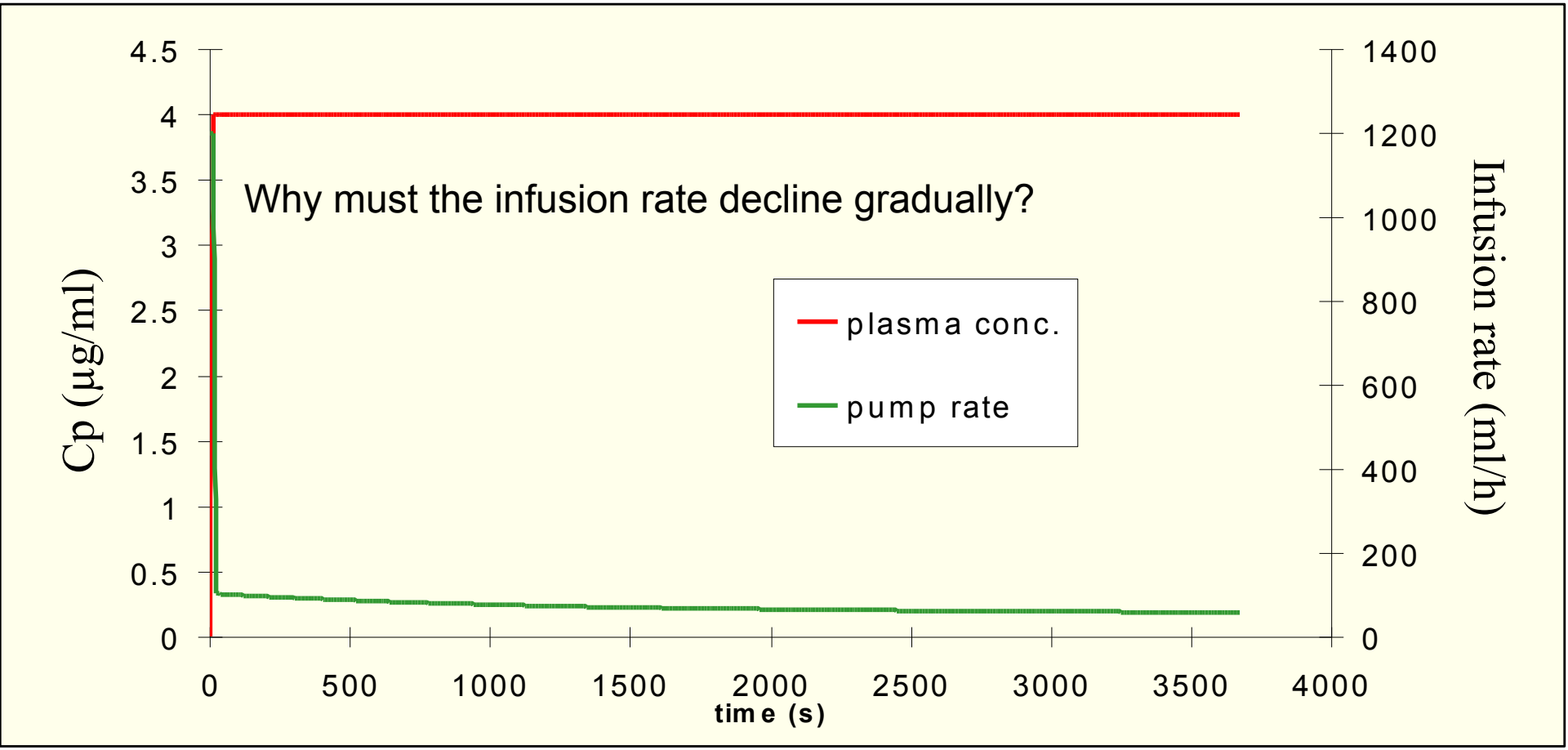
- Instead of setting ml/h or a dose rate (mg/kg/h), the pump can be programmed to target a required blood concentration or "brain concentration".
  Called the effect site concentration, since no one knows where the drug has an effect.

- The pump will automatically calculate how much is needed as induction and maintenance to that concentration.

- A TCI pump algorithm simulates the journey of the drug in the body (absorption, distribution and elimination)

Bolus + profiled infusion : TCI

Less and less drugs will enter from central to peripheral compartments because these get filled up.



With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium

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ALARIS PK
Pharmaco-Kinetic Inf Pump

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What about Pharmacokinetic and Pharmacodynamic models???

Pharmacokinetic (PK)?:

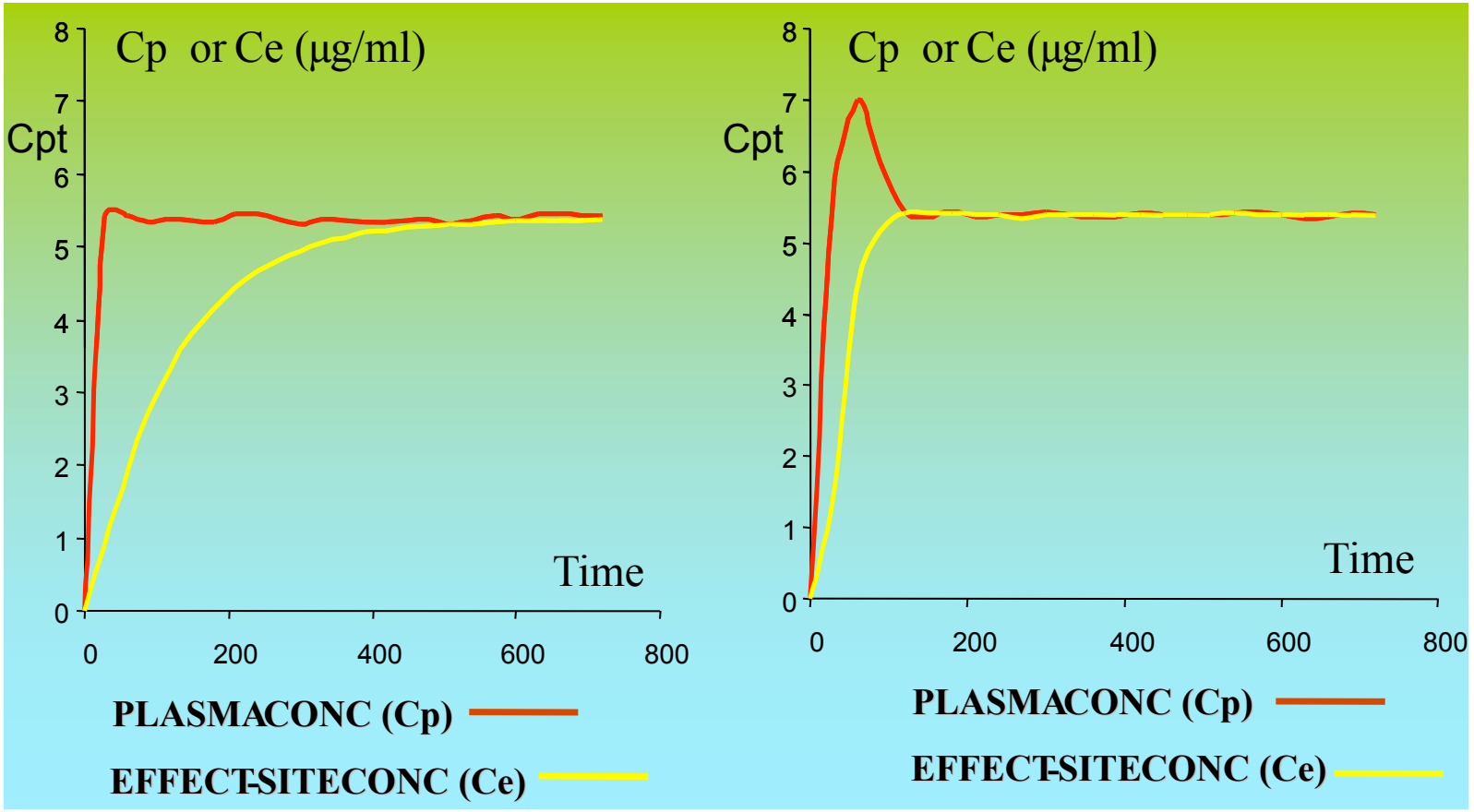
- What the body is doing with a drug. All drugs have their own characteristics. To administer a drug accordingly, the anaesthesiologist needs to know:
  - How the drug is given
  - How is it absorbed
  - How is it distributed in the body
  - How is it metabolized and eliminated from the body

Pharmacodynamic (PD)?:

- What the drug is doing with the body. What effect the drug has and how it works

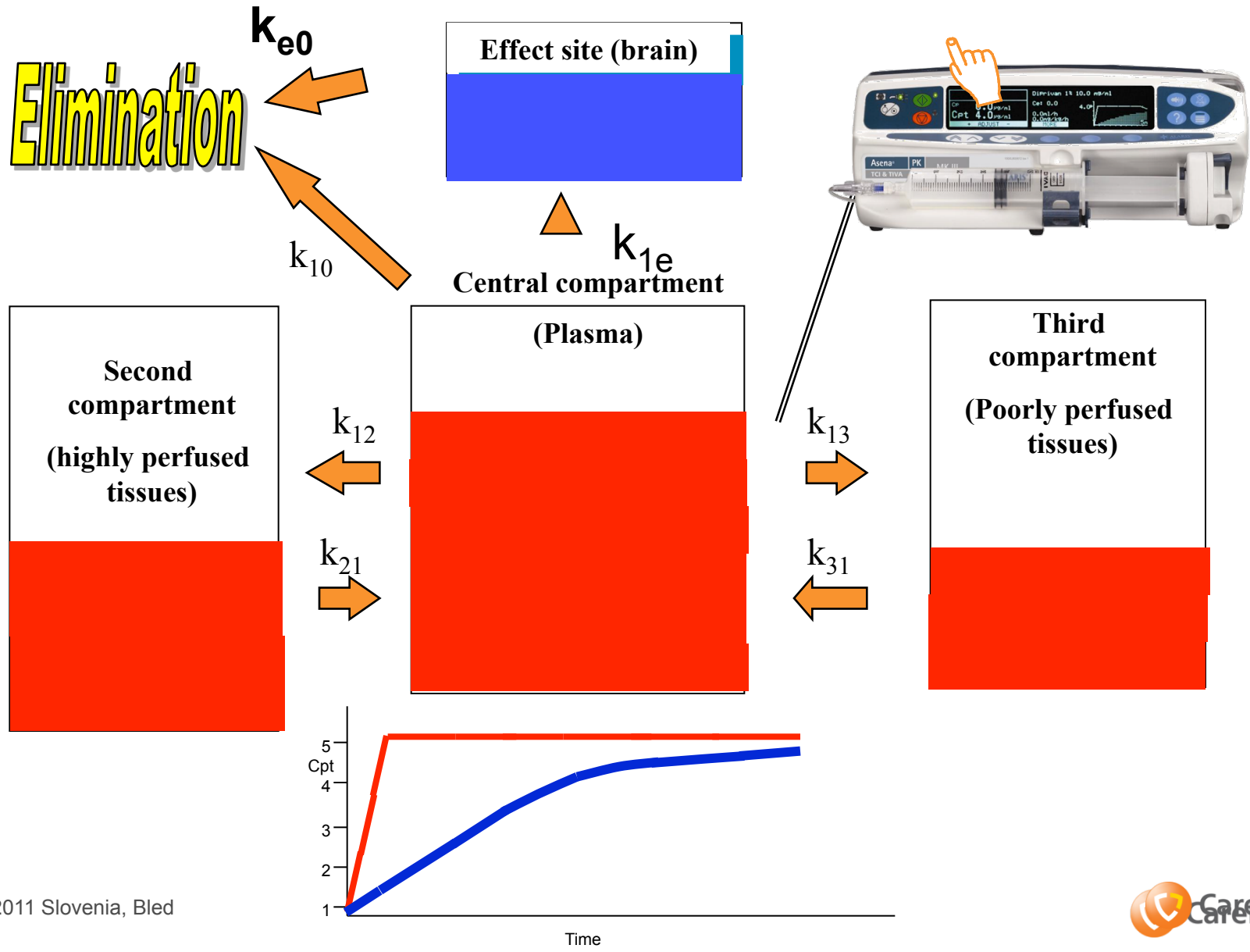
- Note: PK and PD characteristics are mentioned in the prescribed information from the drug manufacturers (for a given population). A Pharmacokinetic model is a mathematical calculation to simulate these characteristic drug behaviours (PK and PD).

Effect site TCI



With kind permission from Prof. Michel Struys, University Hospital of Gent, Belgium

k= Proportions of drug exchanged between compartments per unit of time



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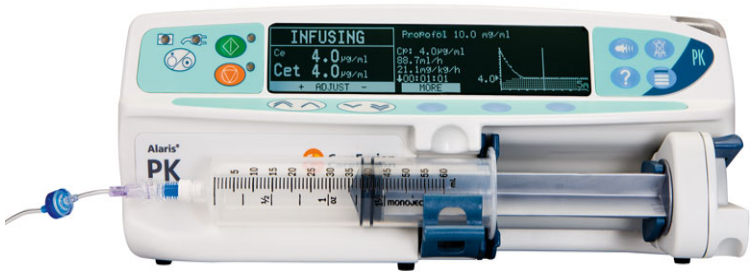
Alaris® PK Syringe Pump: Models

Alaris®PK contains the following models always:

- - **Propofol Marsh** (plasma targeting only)
- **- Remifentanil Minto** (plasma targeting only)
- **- Sufentanil Gepts** (plasma targeting **only**)

Models that are available to order separate:

- - **Propofol Schnider**
  (plasma and effect site targeting)
- **- Alfentanil Maitre**
  (plasma and effect site targeting)
- **- Sufentanil effect site targeting**
- **- Remifentanil effect site targeting**
- **- Propofol Kataria for children**.
  (plasma site targeting)
- **- Paedfusor for children** (plasma site targeting)



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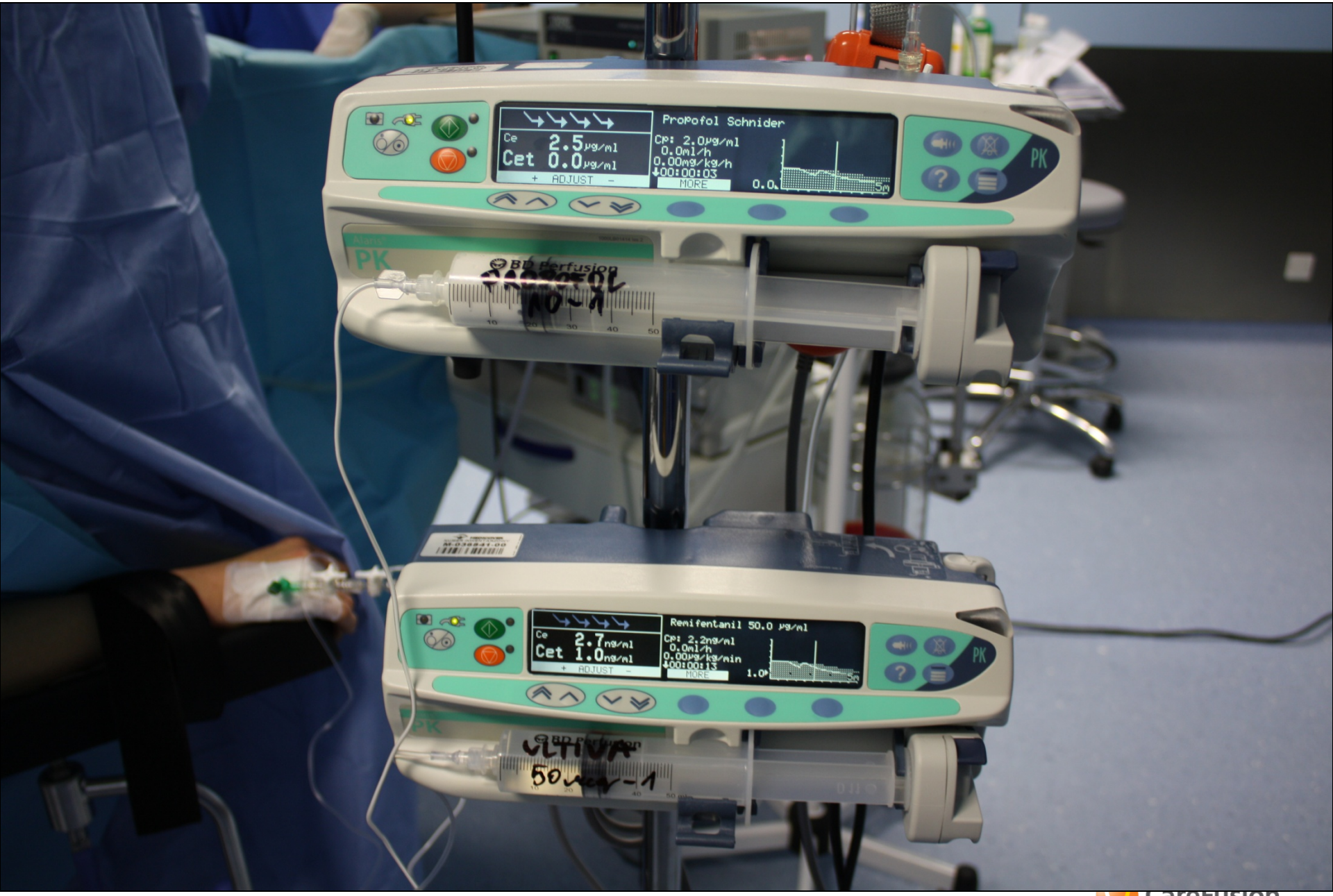
ProPofol Schnider
Ce 2.5µg/ml
Cet 0.0µg/ml
+ ADJUST -
Cp: 2.0µg/ml
0.0ml/h
0.00mg/kg/h
00:00:03
MORE
PK
Remifentanil 50.0 µg/ml
Ce 2.7ng/ml
Cet 1.0ng/ml
+ ADJUST -
Cp: 2.2ng/ml
0.0ml/h
0.00µg/kg/min
00:00:13
MORE
PK


Ce 2.4µg/ml
Cet 0.0µg/ml
+ ADJUST −
Propofol 1% 10.0 mg/ml
Cp: 1.9µg/ml
0.0ml/h
0.00mg/kg/h
00:00:00
MORE
0.0
5m
PK
BD Perfusion


Remifentanil 50.0 µg/ml
Ce 2.7 ng/ml
Cet 1.0 ng/ml
+ ADJUST −
CP: 2.0ng/ml
0.0ml/h
0.00µg/kg/min
00:00:13
MORE
1.0
5m
PK
ULTIVA
50 mcg/-1
10
20
40
50 ml

Decrement concentration

- Estimation of the time required to reach a lower plasma concentration (Decrement time). Especially useful when patient is waking up.
- TUNE yr pump for the patient
- If we use an IoC Monitor this is not an issue.

clinical experience proved:

- **TCI is Patient friendly**
  (less nausea/vomiting)
- **Economical**
- **Environmentally and Personnel friendly**
  (gas is a gas)
- **Would increase productivity nice for the PATIENT**
  (patient wakes up faster and smoother)

Clinical benefits of TCI
Demonstrated through publications

- You have **a better control over the anaesthesia**. Not so "bumpy".
- The **targeted concentrations are achieved rapidly** and **maintained constant.**
- **No overshoot at induction** and less cardio-respiratory depression.
- Save expensive drugs, by **optimizing the infusion.**
- About 75% less risk of postoperative complications (vomiting, nausea) than after inhalation anaesthesia.
- Limits the need for anti-emetic therapy and improves post operative time for patient and nurses.
- It's **fully automatic** and you <u>do not need to calculate the infusion rate</u>

Clinical benefits of TCI
Demonstrated through publications

- When a syringe is changed you will see how the blood concentration is reduced.
  This is automatically compensated for when you press start again with.

- Avoid errors in dosage (including soft and hard dosing limits). Shorter time to discharge.

- Saves nursing time in recovery room and allows patients an early return to work.

Use Conscious monitors

- BIS
- AEP
- CSI
- CSM

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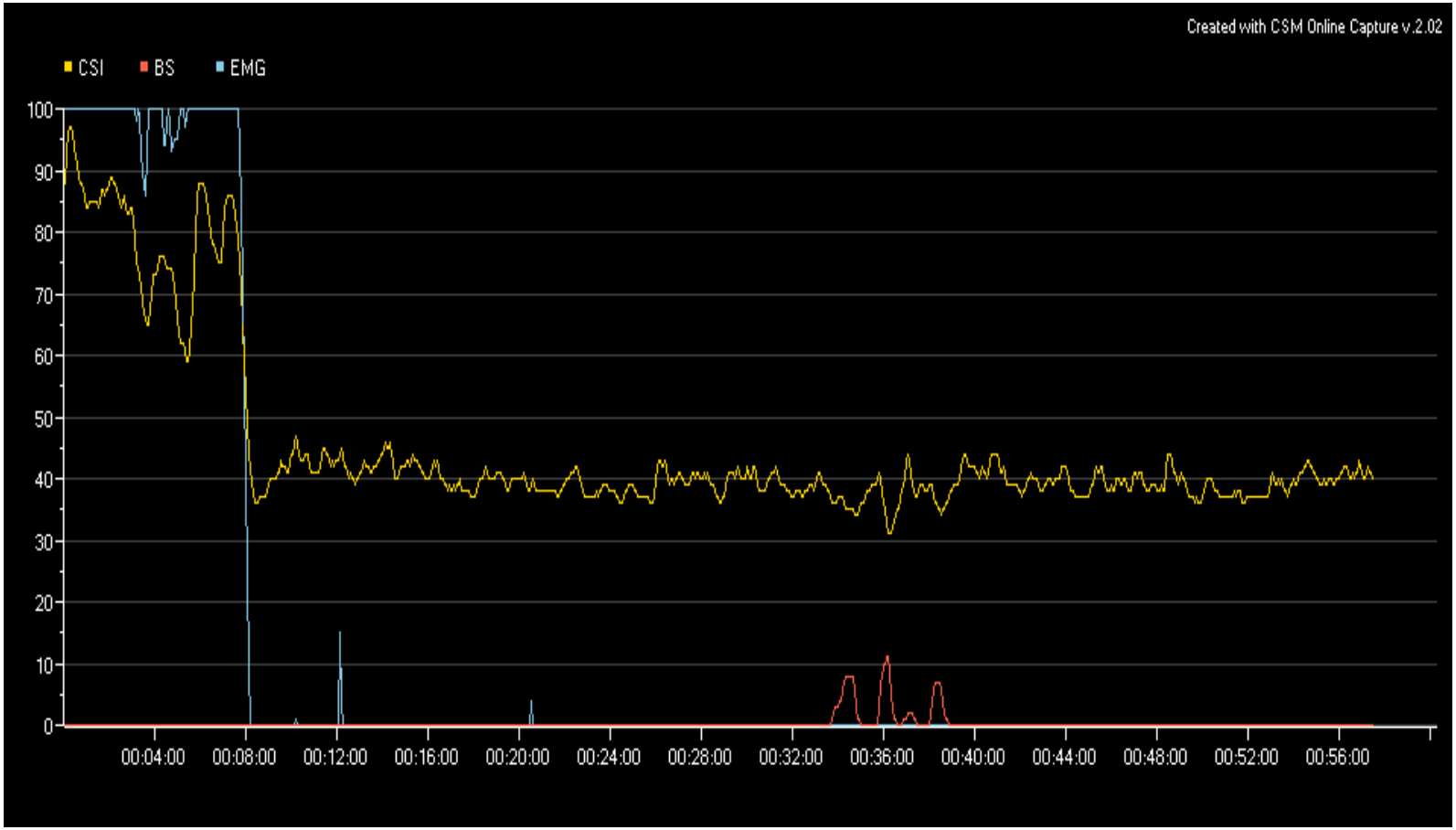
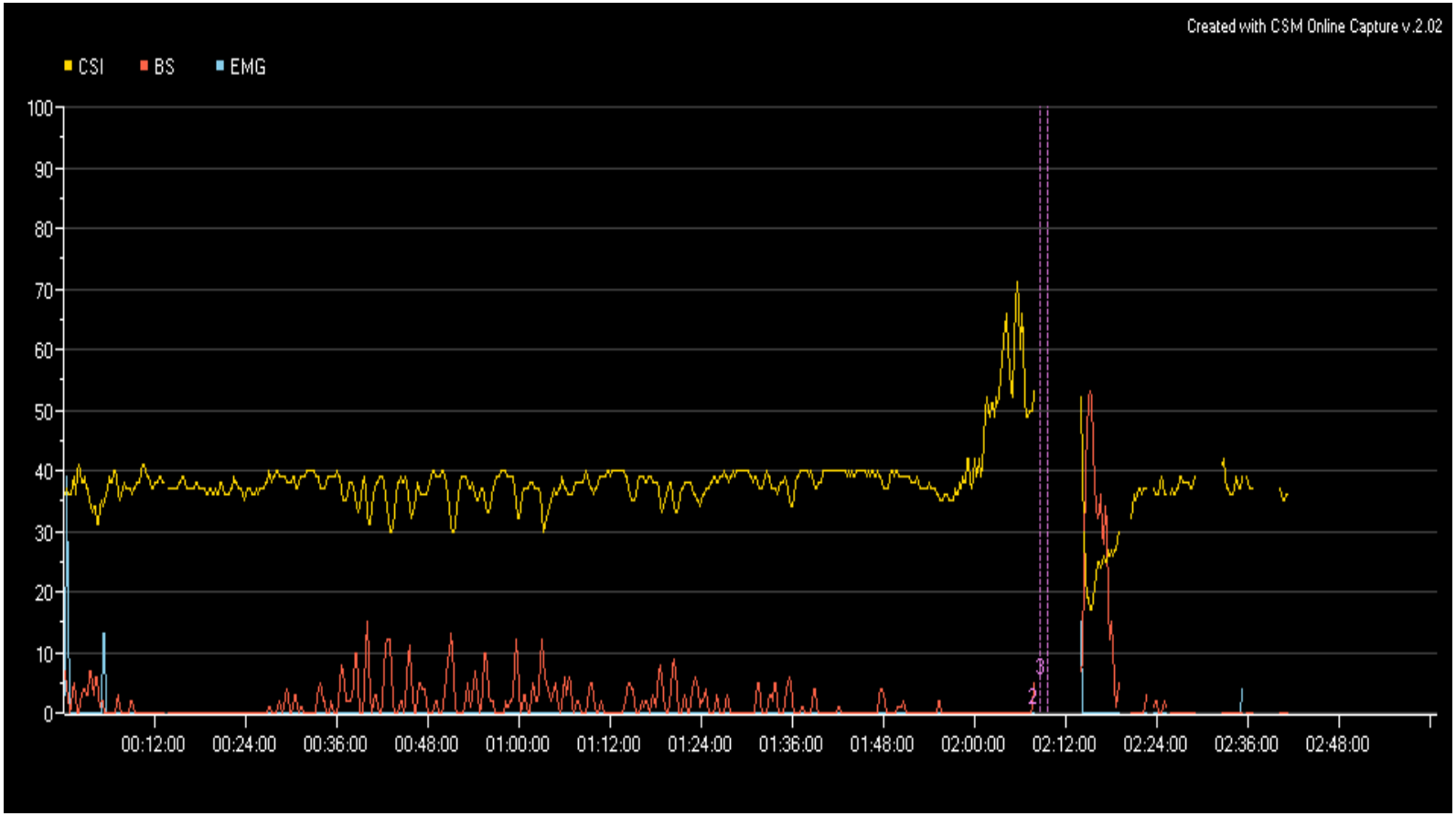
Cerebral State Monitor



Cerebral State Monitor II.



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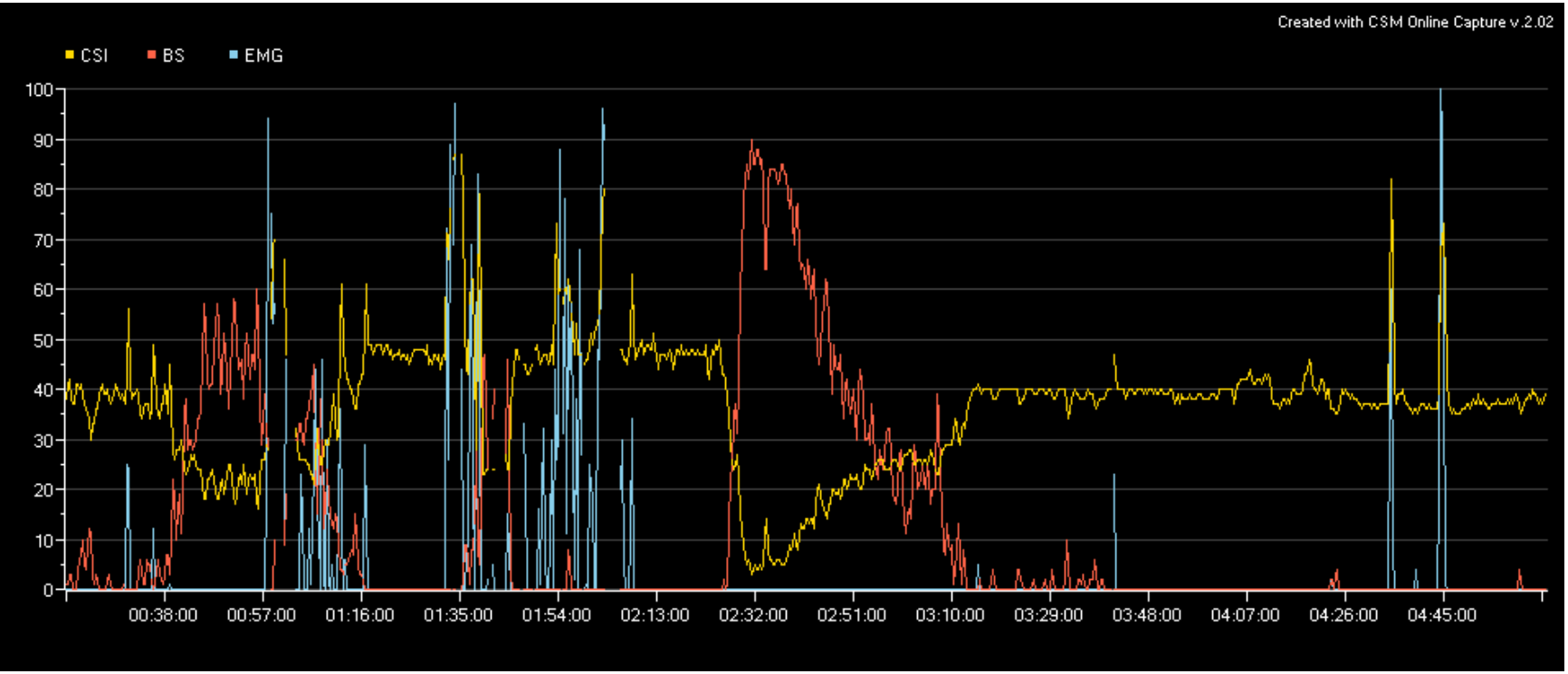
In this graph you can see how much the electrocauter can disturb the EEG waves or a mal-position of the aortic canula totally disturbs our measurements. Deciding whether this is an artefact or the patient is really awake is exclusively our task.. The anaesthetist will always be an essential „tool", or „piece of furniture" in the theatre



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2008: Children models introduced

	Marsh	Kataria	Paedfusor
V1	0.228 L/kg	0.52 L/kg	0.458 L/kg
V2	0.463 L/kg	1.0 L/kg	1.34 L/kg
V3	2.893 L/kg	8.2 L/kg	8.20 L/kg
K_{10} (min^{-1})	0.119	0.066	70 x Weight $^{-0.3}$/458.4
K_{12} (min^{-1})	0.112	0.113	0.12
K_{13} (min^{-1})	0.042	0.051	0.034
K_{21} (min^{-1})	0.055	0.059	0.041
K_{31} (min^{-1})	0.0033	0.0032	0.0019

What about obese patients?

- In my clinical experience I have carried out more than 2000 open heart operation narcoses. (1000 op recorded)
- I work a lot with obese patients, at least 50 patients above 150 kgs.
- This model warns the anaesthetist that patients above 150 kgs. are above the safety zone, and are therefore at risk.
- We have two possibilities, either to accept this warning, or – in my experience – to increase the height setting of the patient on the machine and with this 'trick' I can make a safe narcosis.
- I always check, however, with the anaesthesia level measurement.

Future…

- New, improved models, drugs
- **Closed loop anaesthesia**
- Would be used to automatically control the narcosis if we knew how to provide an EEG signal which was clean and free from noise to control the pump

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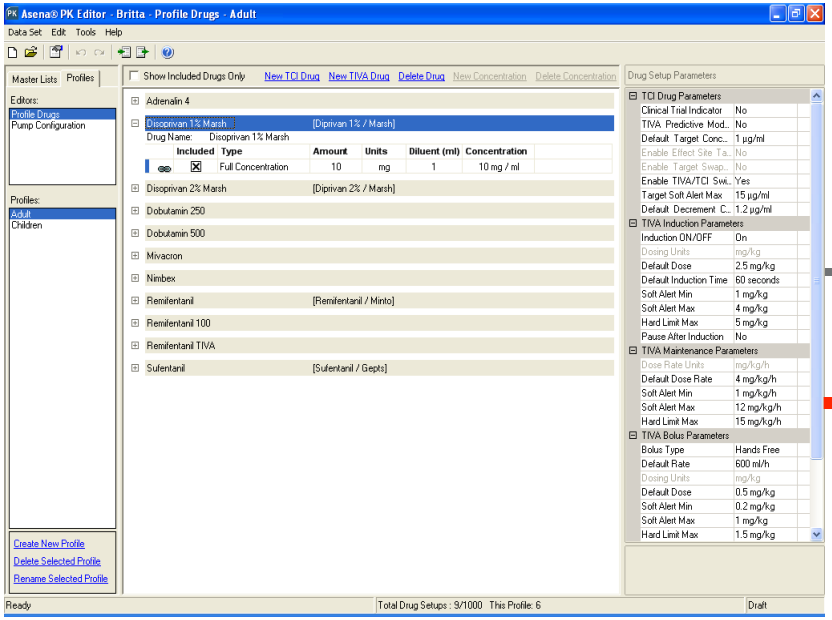
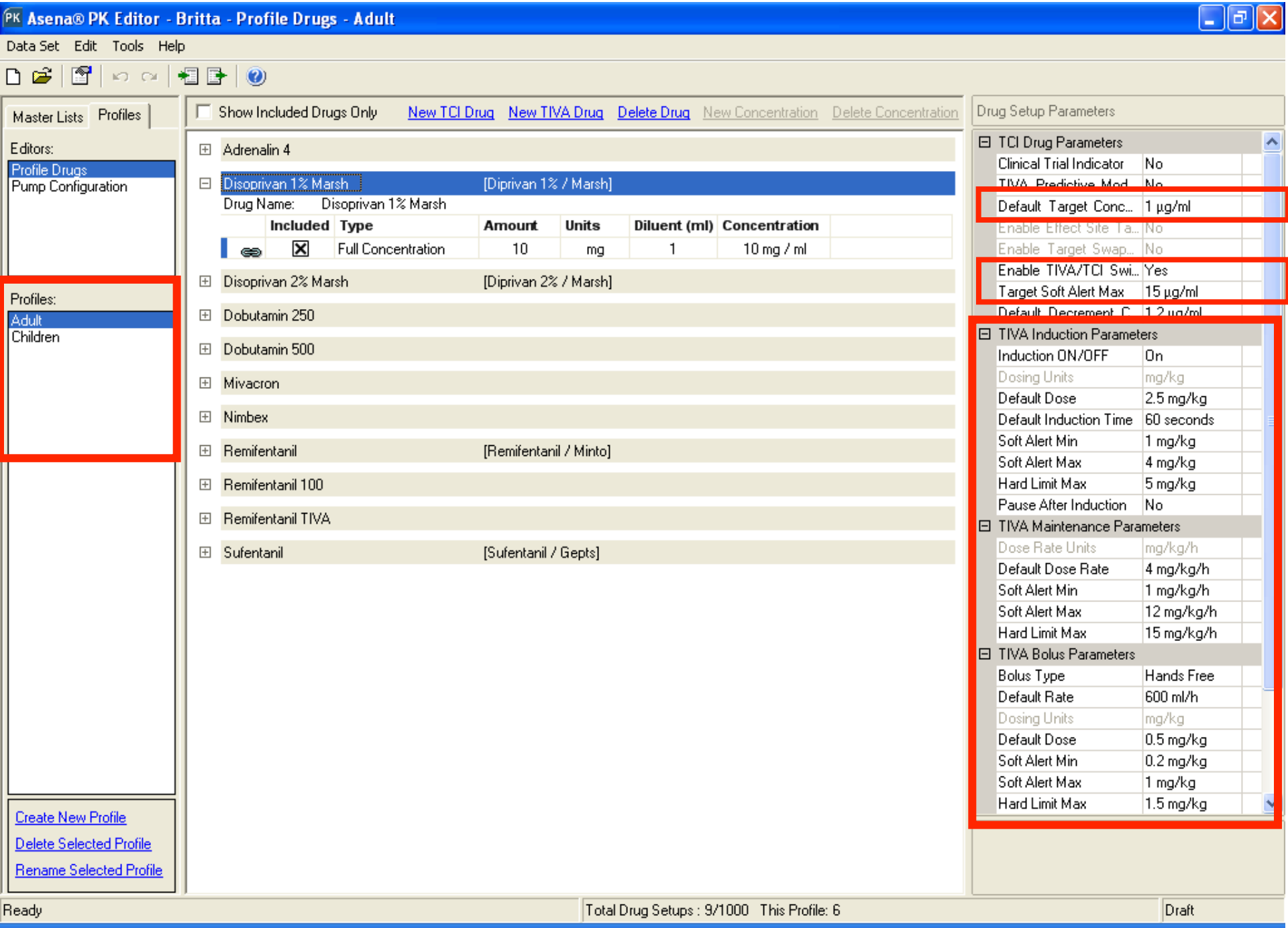
Set up the pump as you like
Tailort for your dept using the
PK Editor®Software




Asena® PK Editor - Britta - Profile Drugs - Adult
Data Set Edit Tools Help
Master Lists Profiles
Editors:
Profile Drugs
Pump Configuration
Profiles:
Adult
Children
Create New Profile
Delete Selected Profile
Rename Selected Profile
Show Included Drugs Only
New TCI Drug
New TIVA Drug
Delete Drug
New Concentration
Delete Concentration
Adrenalin 4
Disoprivan 1% Marsh [Diprivan 1% / Marsh]
Drug Name: Disoprivan 1% Marsh
Included Type Amount Units Diluent (ml) Concentration
Full Concentration 10 mg 1 10 mg / ml
Disoprivan 2% Marsh [Diprivan 2% / Marsh]
Dobutamin 250
Dobutamin 500
Mivacron
Nimbex
Remifentanil [Remifentanil / Minto]
Remifentanil 100
Remifentanil TIVA
Sufentanil [Sufentanil / Gepts]
Drug Setup Parameters
TCI Drug Parameters
Clinical Trial Indicator No
Default Target Conc... 1 µg/ml
Enable Effect Site Ta... No
Enable Target Swap... No
Enable TIVA/TCI Swi... Yes
Target Soft Alert Max 15 µg/ml
TIVA Induction Parameters
Induction ON/OFF On
Dosing Units mg/kg
Default Dose 2.5 mg/kg
Default Induction Time 60 seconds
Soft Alert Min 1 mg/kg
Soft Alert Max 4 mg/kg
Hard Limit Max 5 mg/kg
Pause After Induction No
TIVA Maintenance Parameters
Dose Rate Units mg/kg/h
Default Dose Rate 4 mg/kg/h
Soft Alert Min 1 mg/kg/h
Soft Alert Max 12 mg/kg/h
Hard Limit Max 15 mg/kg/h
TIVA Bolus Parameters
Bolus Type Hands Free
Default Rate 600 ml/h
Dosing Units mg/kg
Default Dose 0.5 mg/kg
Soft Alert Min 0.2 mg/kg
Soft Alert Max 1 mg/kg
Hard Limit Max 1.5 mg/kg
Ready
Total Drug Setups : 9/1000 This Profile: 6
Draft

Intravenous anaesthesia

- Patient friendly
- Personnel friendly
- Economical
- Environmentally friendly
- Would increase productivity

- And, this is how it is used:

With the kind permission from Dr Terje Dybvig, Volvat Medical Centre, Norway

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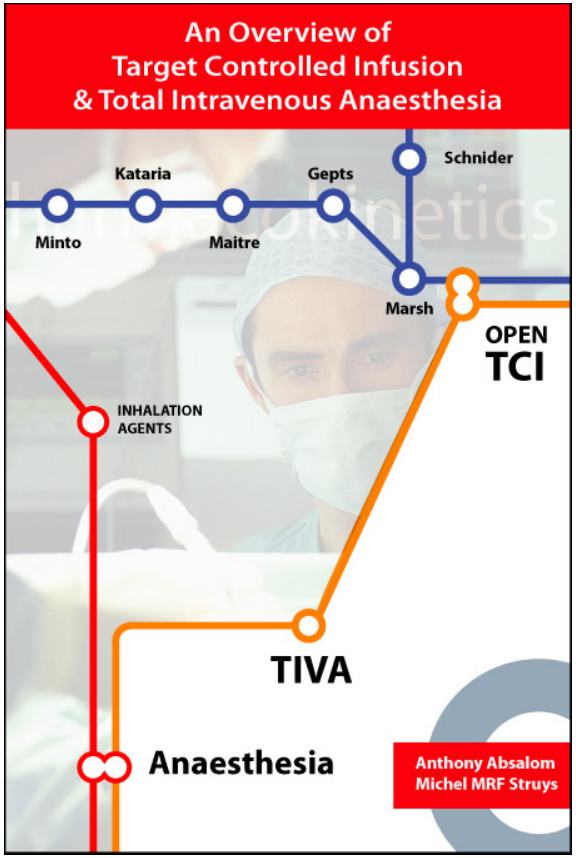
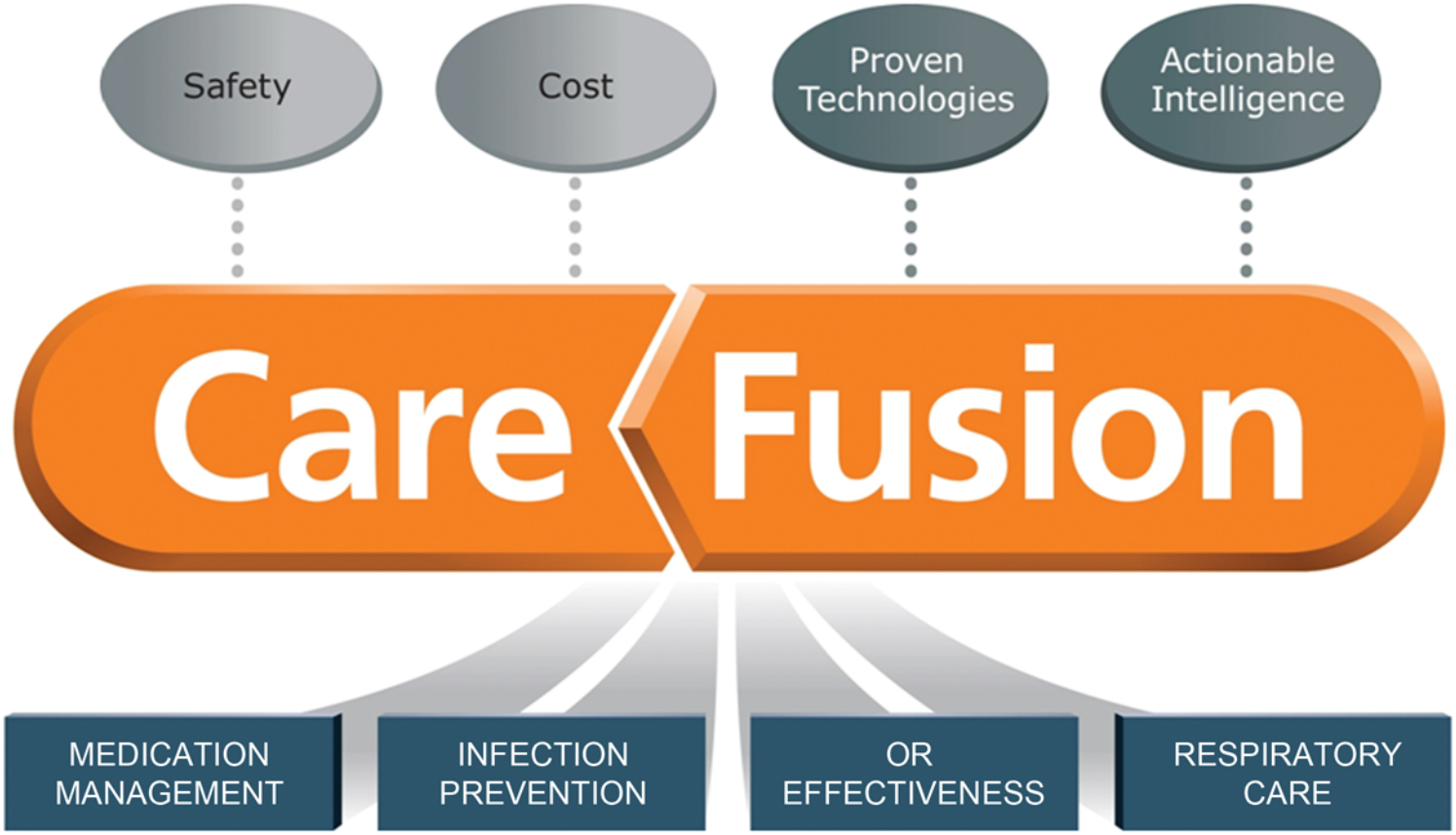


Our name describes what we do



CareFusion

Our vision

Improve the safety and cost of healthcare for generations to come.

CareFusion

Thank you