How can « e-tools » help reduce medication errors?

Computerized Physician Order Entry (CPOE) and Automated Medication Dispensing System (ADSs) in the Intensive Care.

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Pharmacie, HUG
Référant soins intensifs et anesthésie

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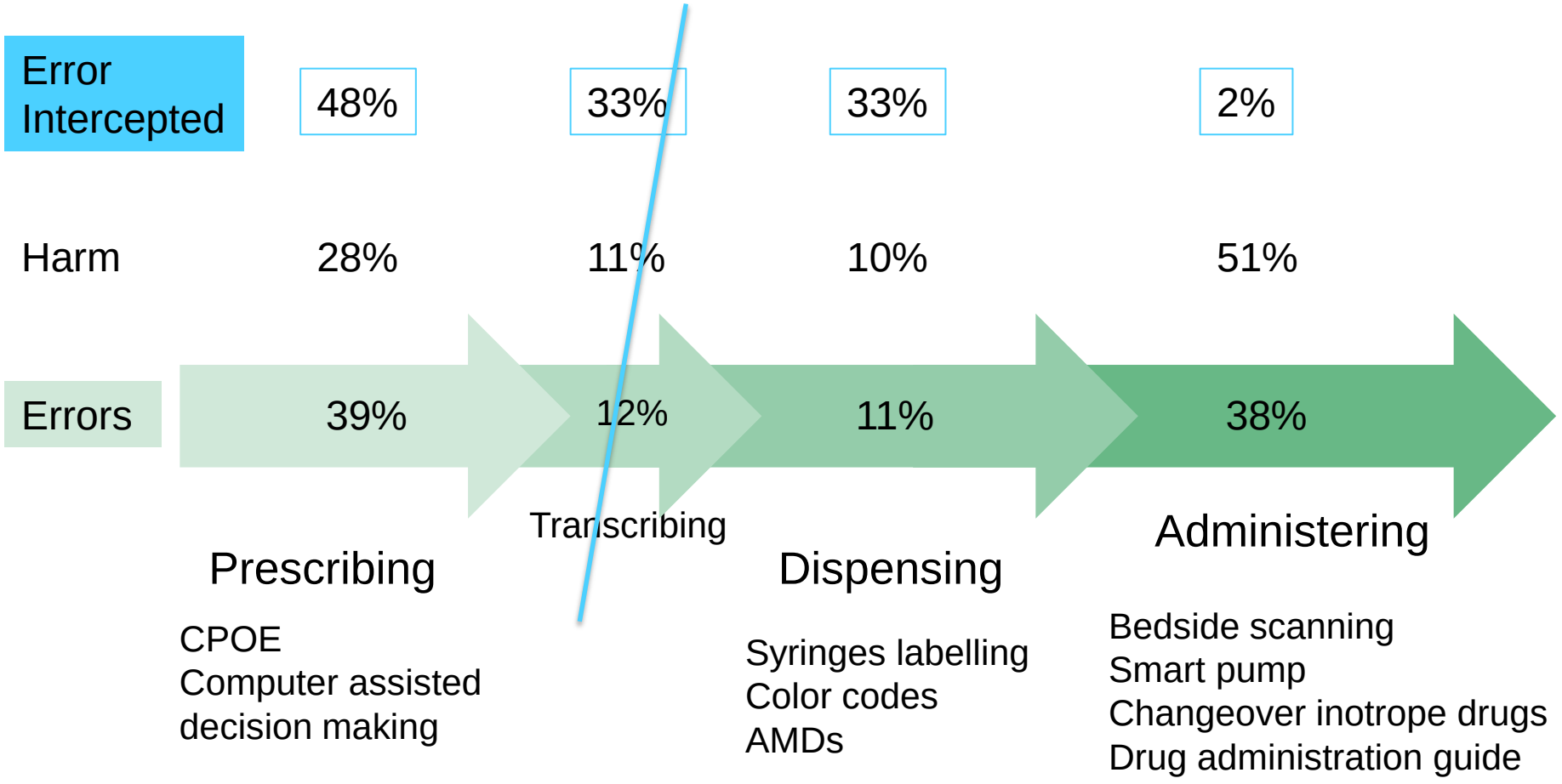
Errors and Drug process



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Adapted from ISMP 2011, Leape 1995

ISMP: Institute for safe medication practices

In the literature

- **Lack of similar setting**
- **Limited sample sizes (insufficient power)**
- **Multiple variables involved (economics, quality, human resources)**
- **Few « before and after » type studies**

James K.L, Int J Pharm Pract, 2009,17 (1);9-30
Keers R.N, Drug Saf, 2014, 37:317–332

Geneva ICU setting

34 médecins (7 adjoints, 18 chefs de clinique, 20 internes)

180 infirmiers (144 ETP)

Neuro
Poly-neuro
Cardio
Polycardio

36 bed

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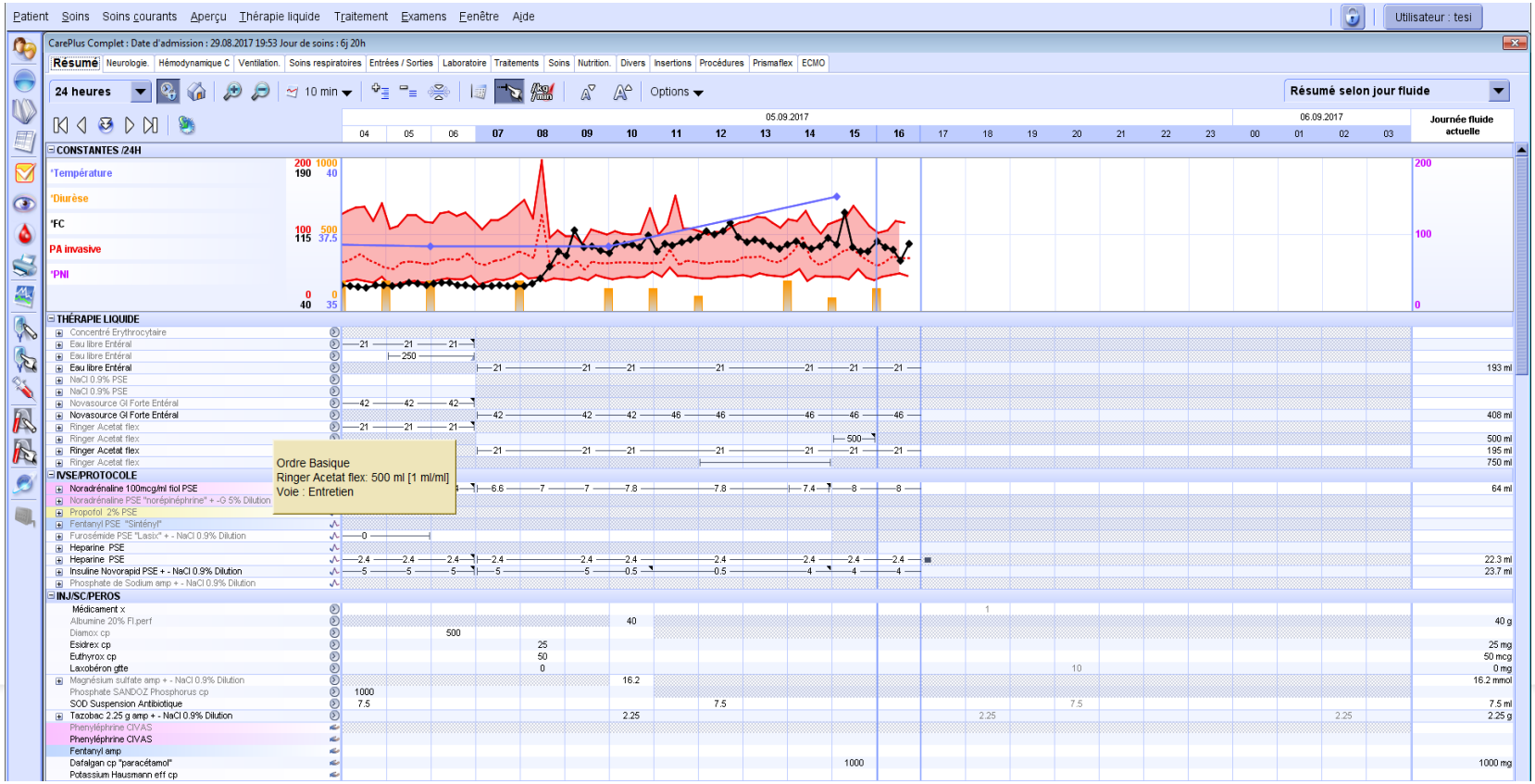
Prescribing

Computerized Physician Order Entry (CPOE)

ICU Geneva: Clinisoft® (2003)



Overview Clinisoft

*Température
*Diurèse
*FC
PA invasive

THÉRAPIE LIQUIDE
Eau libre Entéral
Eau libre Entéral
Eau libre Entéral
Glucose 5% flex
Glucose 5% flex
Glucose 5% flex
Glucose 5% flex
Glucose 5% flex
NaCl 0.9% PSE

IVSE/PROTOCOLE
Dobutamin PSE
Nitroprussiate PSE "Nitropress" + -G 5% Dilution
K-Cl PSE (Hypertonique)
Amiodarone PSE "Cordarone" + -G 5% Dilution
Furosémide PSE "Lasix" + - NaCl 0.9% Dilution
Heparine PSE
Insuline Novorapid PSE + - NaCl 0.9% Dilution

INJ/SC/PEROS
Solu-cortef amp

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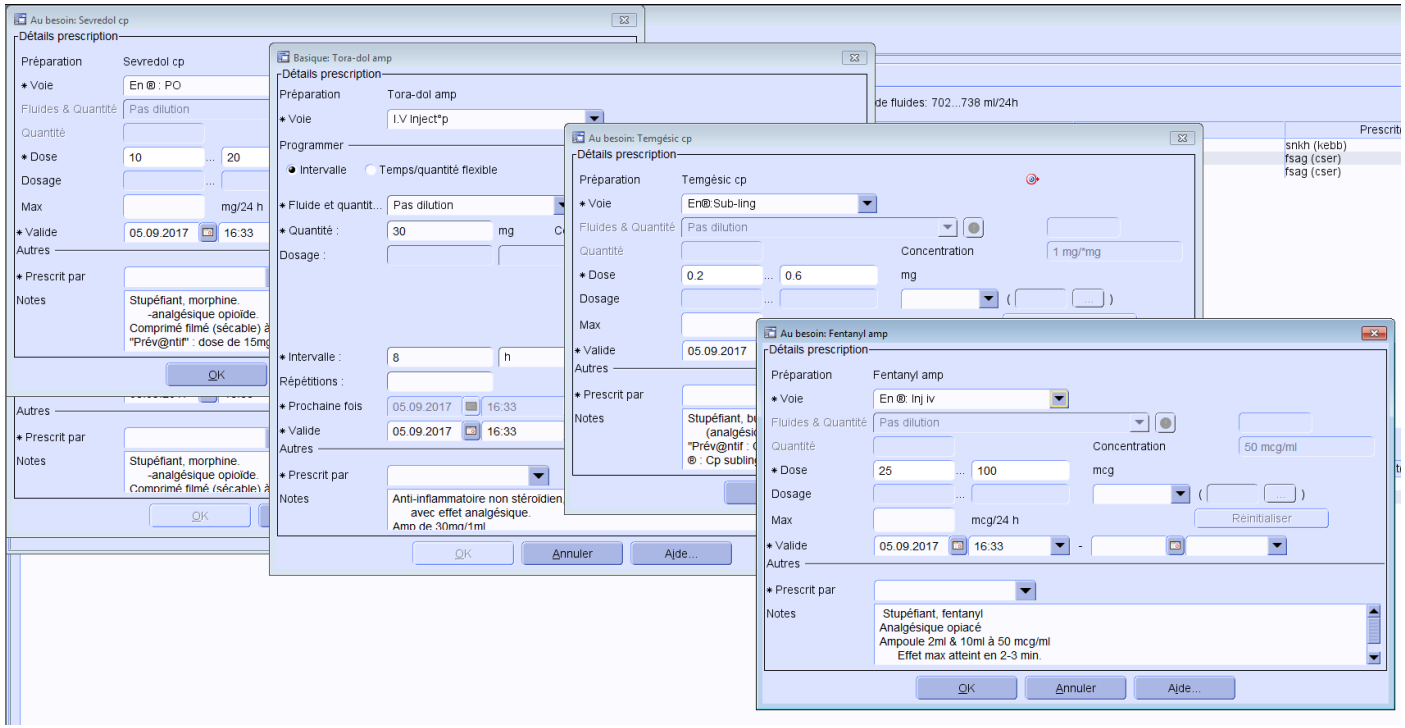
Order sets for specific protocols

- Analgesia
- Transit for paraplegic



Helpful for students and new medical staff

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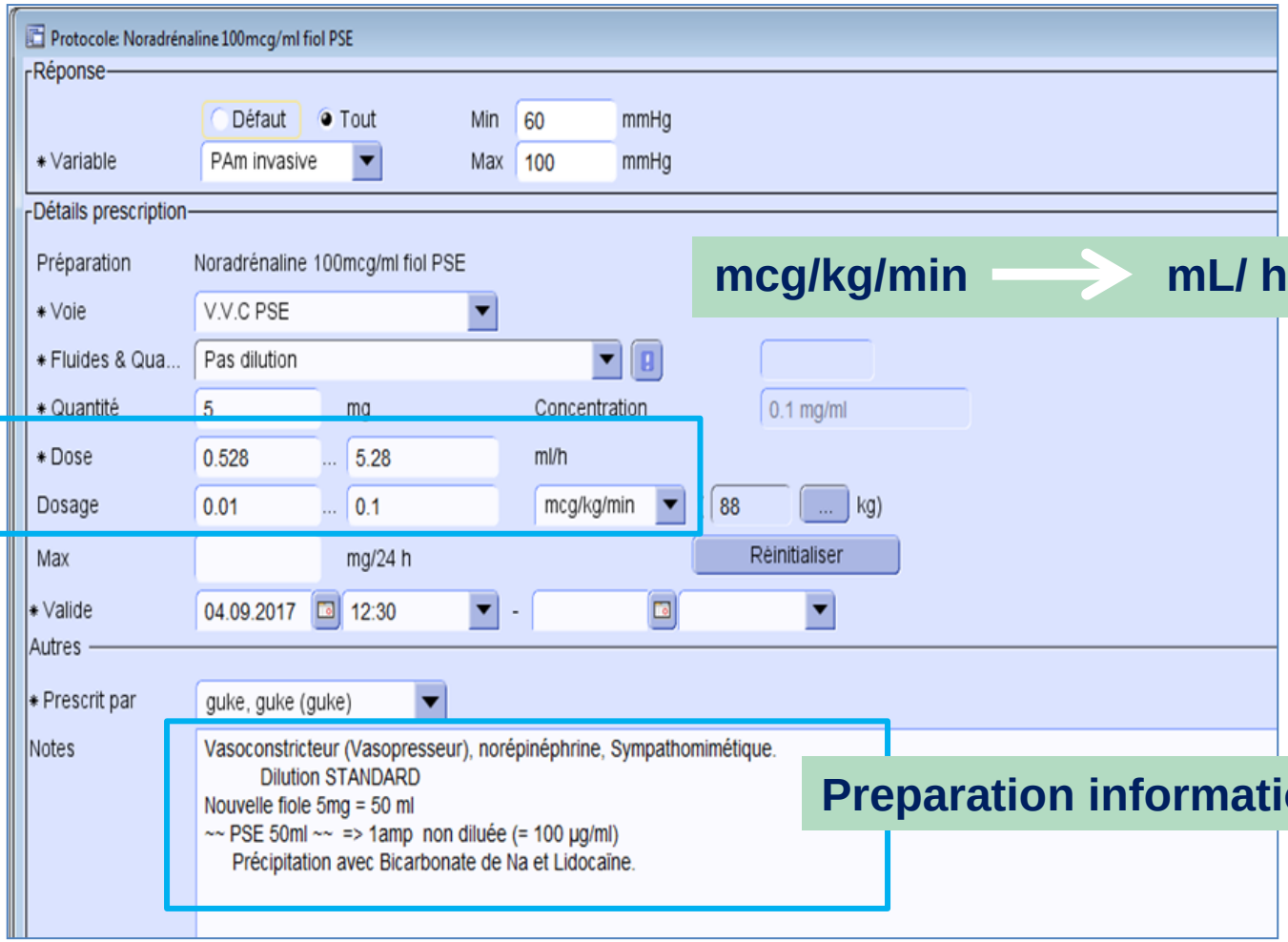
Doses parametered

Harmonization of languages between doctors, nurses and pharmacists



Advantages of Clinisoft®

ICU

- Dosing range
- Computing dose with patient weight with converter
  (mcg /kg/min versus mL/h)
- Order sets
  - Analgesia
  - Transit (paraplegic)
  - Organ donors

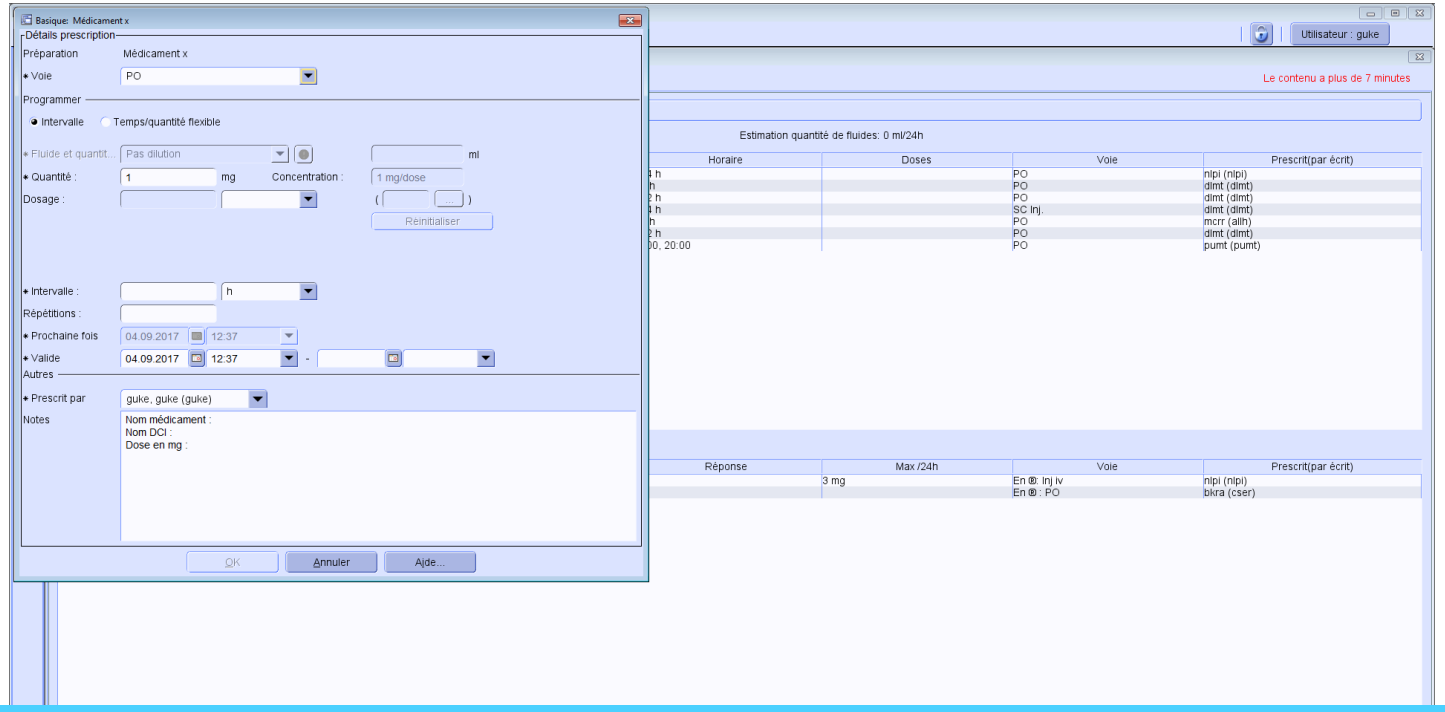
Pharmacy

- Drug inventory parametered
- Drug preparation and dilution (adapted to the standardized dilutions) documented
- Perfusion information
  - Compatibilities
  - Central/Peripherical
  - Filtration needed

Multiple information <u>while</u> prescribing

Ways of bending the rules

Prescription of « Médicament X »



Balancing the risk of prescription without net and the absence of an hard limit needed for exceptions

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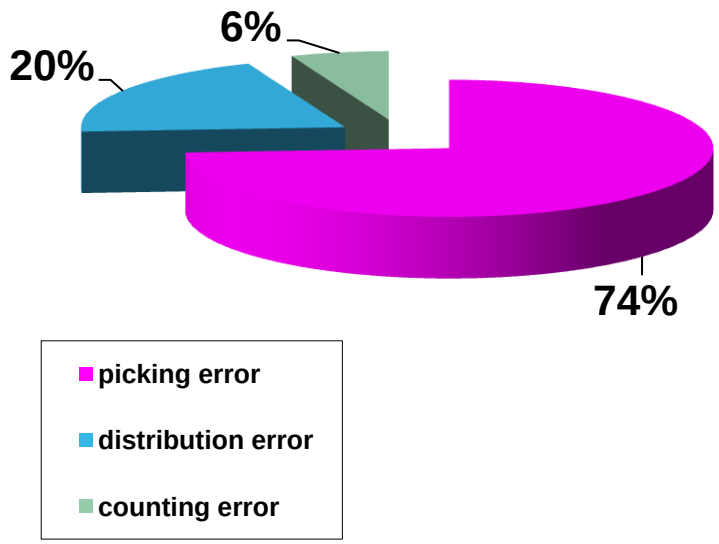
Dispensing and preparing

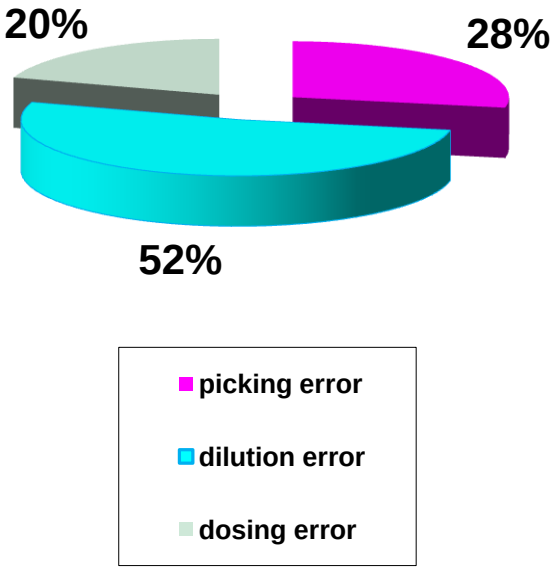
Drug organizer observation:

Mean rate of preparation error: **3%** (n=30)



Diluted syringes preparation:

Mean rate of preparation error : **6.5%** (n=28)



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Garnerin Ph et al. Eur J Clin Pharmacol 2007;63:769
Keeer et al. Druf Saf 2014; 37: 317-332
Camiré E et al, CMAJ, 2009, 28, 180

Non e-tool to tackle picking errors

Look and sound-alike

Exemples de cas de confusions rapportés aux HUG :

Nom de marque ↔ Nom de marque

Aldozone°	Aldactone°
Céfuroxime°	Ceftriaxone°
Nalbuphine°	Naloxone°
Naropine°	Nalbuphine°
Rapidocaine°	Ropivacaine°
Ropivacaine°	Bupivacaine°
Sandostatine°	Sandimmun°
Toradol°	Tramadol°
Valcyte°	Valtrex°

Nom de marque ↔ Nom de DCI

Rapidocaine°	ropivacaine
Sandostatine°	somatostatine

Nom de DCI ↔ Nom de DCI

acide folique	acide folinique
céfuroxime	ceftriaxone
cefuroxime	cefazoline
cefepime	cefixime
éphedrine	phenylephrine
valganciclovir	valaciclovir

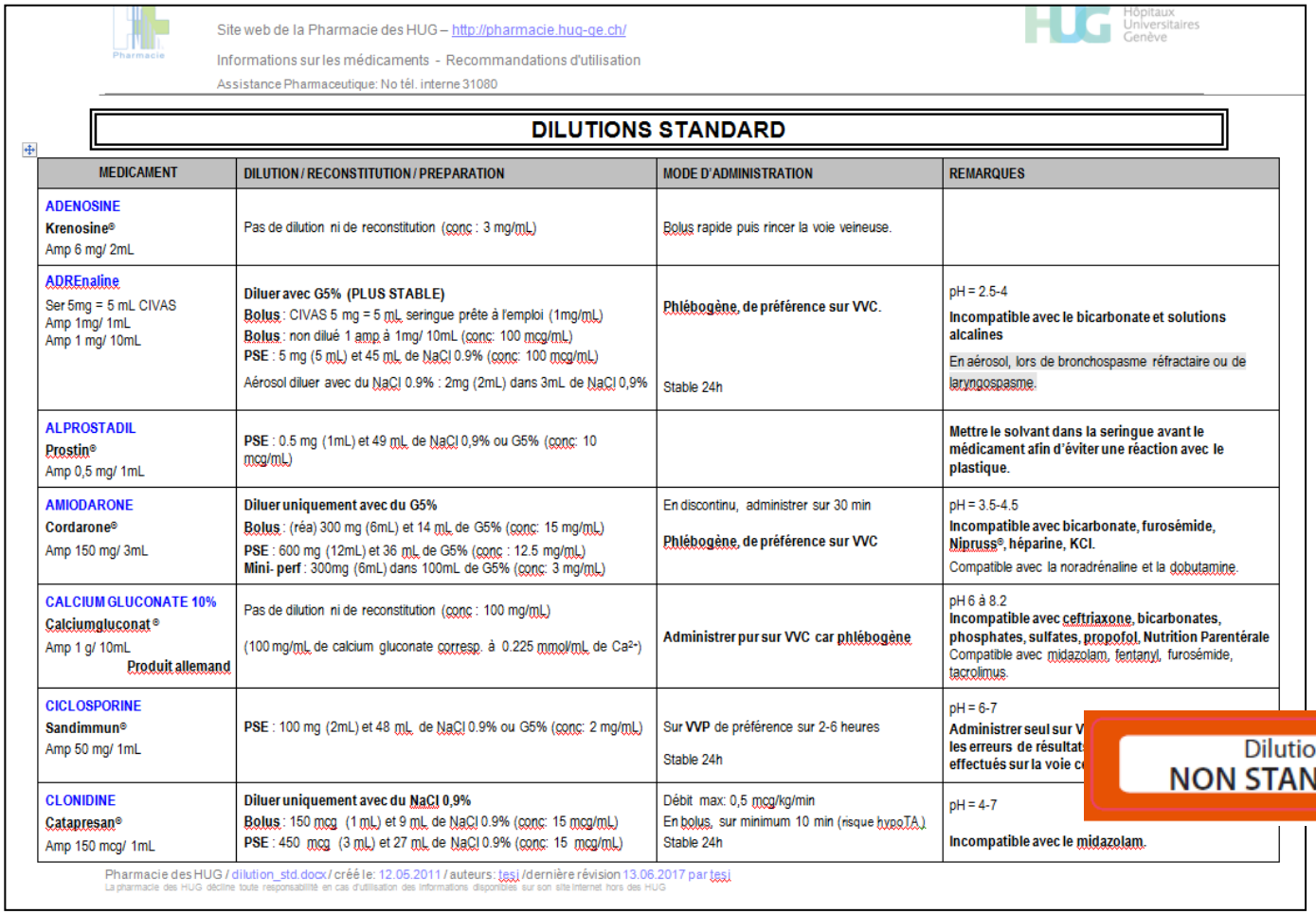
Les erreurs surviennent notamment :

- **lors de transferts de patients entre deux unités**
- **lors de changements de produits aux HUG et dans les stocks (ex. introduction d'un générique)**

Les erreurs sont amplifiées si le produit est du même fabricant (emballages très ressemblants (look-alike))

« Infovigilance » sent to Pharmaceuticals

Standardized dilutions



Site web de la Pharmacie des HUG – http://pharmacie.hug-ge.ch/

Informations sur les médicaments - Recommandations d'utilisation

Assistance Pharmaceutique: No tél. interne 31080

DILUTIONS STANDARD

MEDICAMENT	DILUTION / RECONSTITUTION / PREPARATION	MODE D'ADMINISTRATION	REMARQUES
ADENOSINE **Krenosine®** Amp 6 mg/ 2mL	Pas de dilution ni de reconstitution (conc : 3 mg/mL)	Bolus rapide puis rincer la voie veineuse.	
ADREnaline Ser 5mg = 5 mL CIVAS Amp 1mg/ 1mL Amp 1 mg/ 10mL	**Diluer avec G5% (PLUS STABLE)** **Bolus** : CIVAS 5 mg = 5 mL seringue prête à l'emploi (1mg/mL) **Bolus** : non dilué 1 amp à 1mg/ 10mL (conc: 100 mcg/mL) **PSE** : 5 mg (5 mL) et 45 mL de NaCl 0.9% (conc: 100 mcg/mL) Aérosol diluer avec du NaCl 0.9% : 2mg (2mL) dans 3mL de NaCl 0,9%	**Phlébogène, de préférence sur VVC.** Stable 24h	pH = 2.5-4 **Incompatible avec le bicarbonate et solutions alcalines** En aérosol, lors de bronchospasme réfractaire ou de laryngospasme.
ALPROSTADIL **Prostin®** Amp 0,5 mg/ 1mL	**PSE** : 0.5 mg (1mL) et 49 mL de NaCl 0,9% ou G5% (conc: 10 mcg/mL)		**Mettre le solvant dans la seringue avant le médicament afin d'éviter une réaction avec le plastique.**
AMIODARONE **Cordarone®** Amp 150 mg/ 3mL	**Diluer uniquement avec du G5%** **Bolus** : (réa) 300 mg (6mL) et 14 mL de G5% (conc: 15 mg/mL) **PSE** : 600 mg (12mL) et 36 mL de G5% (conc : 12.5 mg/mL) **Mini- perf** : 300mg (6mL) dans 100mL de G5% (conc: 3 mg/mL)	En discontinu, administrer sur 30 min **Phlébogène, de préférence sur VVC**	pH = 3.5-4.5 **Incompatible avec bicarbonate, furosémide, Nipruss®, héparine, KCl.** Compatible avec la noradrénaline et la dobutamine.
CALCIUM GLUCONATE 10% **Calciumgluconat ®** Amp 1 g/ 10mL **Produit allemand**	Pas de dilution ni de reconstitution (conc : 100 mg/mL) (100 mg/mL de calcium gluconate corresp. à 0.225 mmol/mL de Ca^{2+})	**Administrer pur sur VVC car phlébogène**	pH 6 à 8.2 **Incompatible avec ceftriaxone, bicarbonates, phosphates, sulfates, propofol, Nutrition Parentérale** Compatible avec midazolam, fentanyl, furosémide, tacrolimus.
CICLOSPORINE **Sandimmun®** Amp 50 mg/ 1mL	**PSE** : 100 mg (2mL) et 48 mL de NaCl 0.9% ou G5% (conc: 2 mg/mL)	Sur **VVP** de préférence sur 2-6 heures Stable 24h	pH = 6-7 **Administrer seul sur V** **les erreurs de résultat** **effectués sur la voie c**
CLONIDINE **Catapresan®** Amp 150 mcg/ 1mL	**Diluer uniquement avec du NaCl 0,9%** **Bolus** : 150 mcg (1 mL) et 9 mL de NaCl 0.9% (conc: 15 mcg/mL) **PSE** : 450 mcg (3 mL) et 27 mL de NaCl 0.9% (conc: 15 mcg/mL)	Débit max: 0,5 mcg/kg/min En bolus, sur minimum 10 min (risque hypoTA) Stable 24h	pH = 4-7 **Incompatible avec le midazolam.**

Pharmacie des HUG / dilution_std.docx / créé le: 12.05.2011 / auteurs: tesi /dernière révision 13.06.2017 par tesi

La pharmacie des HUG décline toute responsabilité en cas d'utilisation des informations disponibles sur son site Internet hors des HUG

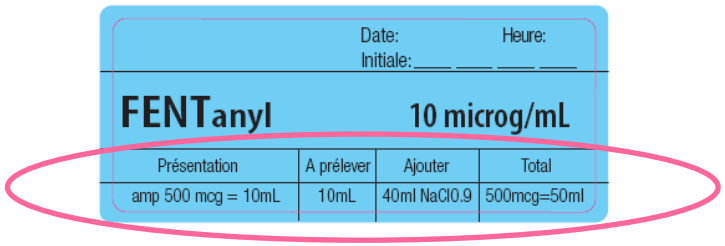
Dilution
NON STANDARD

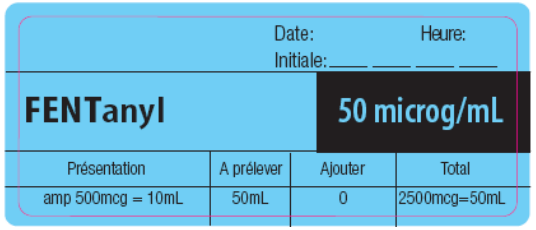
SIPHAROM: groupe de travail soins intensifs et pharmacies romands

http://pharmacie.hug-ge.ch/infomedic/utilismedic/dilutions_std_sia.pdf

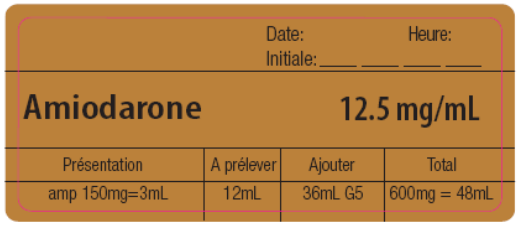
Syringes Labelling

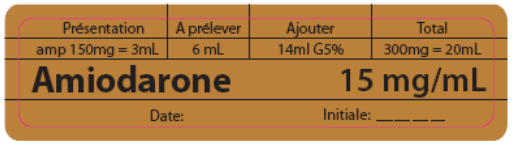
- **DCI and concentration + dilution documented**

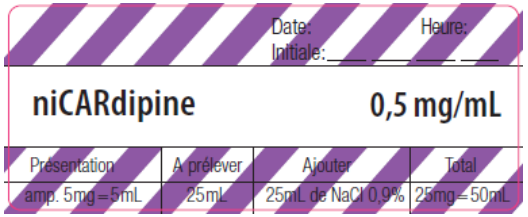




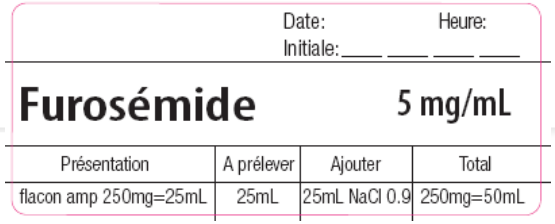
- **2 sizes: continuous perfusion or bolus**

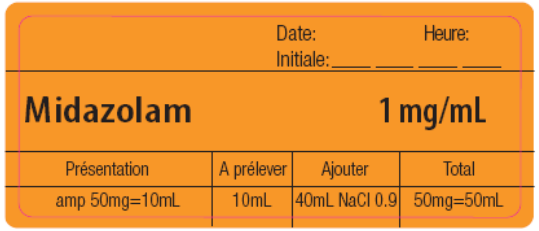


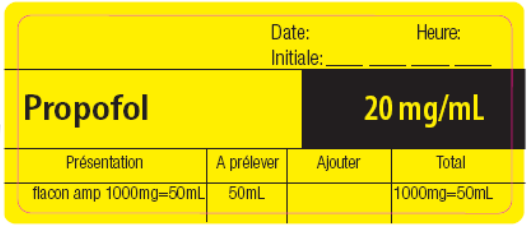




- **Color code (based on ISMP and ISO 26825)**







Example of disposition in the ICU

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Automated Medication Dispensing system (AMDs)

ICU Geneva: PYXIS® (2015)

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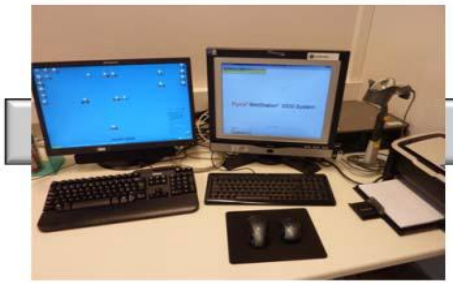
Transfer of charges

Pharmacy

APUS managing the ordering and loading of drugs in the machines

Editing of a « reapro » list



Edition d'une liste de réapprovisionnement
(= médicaments ayant atteint leur seuil de commande)

Remplissage sécurisé par scanning des emballages

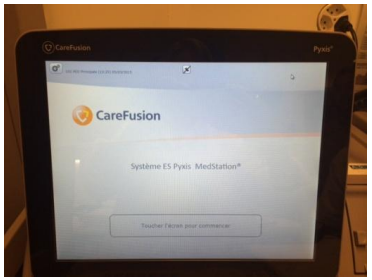
A)

B)

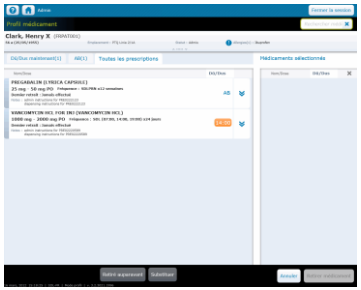
Scanning before loading

ICU

Nurses and doctors picking the drugs for a specific patient via the machines



Biometric login



Patient selection
Drug selection

Electronic opening of corresponding cubies

Logistic advantages with (AMDs)

ICU

- Limited time managing the ward pharmacy
- Limited “errant” drugs in the wards
- Easy narcotics follow up

Pharmacy

- Drugs loaded by dedicated pharmacy staff (APUS)
  - drugs ordering (threshold based on consumptions)
  - scanning of the products
  - expiration dates documented
- Optimized management of drugs needed in the ward (less drug return, less emergencies ordering)

Knowledge of “on site” stock useful when drug shortage

Security advantages with AMDs

ICU

- Secured picking
- Drug information at the point of care.
- Harmonization of practices
- Increased time for ICU related issues.

Optimized information channel to the point of care

Follow up of specific drug use (data extraction from the PYXIS)

Pharmacy

- Secured storage of drugs
- Easy follow up of narcotics (counting)
- Warning pop-up if changes
  - drug shortage
  - drug importation
- Point of care information
  - special administration modalities
  - new drugs

Chappuis C et al. Crit Care Med, 2010, vol 38, 12, 2275-2281
http://pharmacie.hug-ge.ch/rd/posters/ArmoiresAMDEC_JFSPH16.pdf

Advantages of AMDs

- Easy to sort out
- DCI and generic Inventory
- Tracability
- Statistics facilitated
- Narcotics follow up
- Permanent stock status

- Standardization of practice
- Process improved
- Work environment optimized

- Reduction of dispensing errors
- Suppression of picking errors
- Harmonization of practices
- Control and follow up of narcotics and expensive drugs
- Point of care Info « pop-up » (dilution…)

↓ Quantity in stock
Stock value

↓ workload around drugs order and sort out
Specialized staff dedicated to that task

Ways of bending the rules

Time of withdrawal perceived as way too long…

- Skipping patient selection
- Spreading of drugs on top of the machine
- Use of the “old pharmacy”

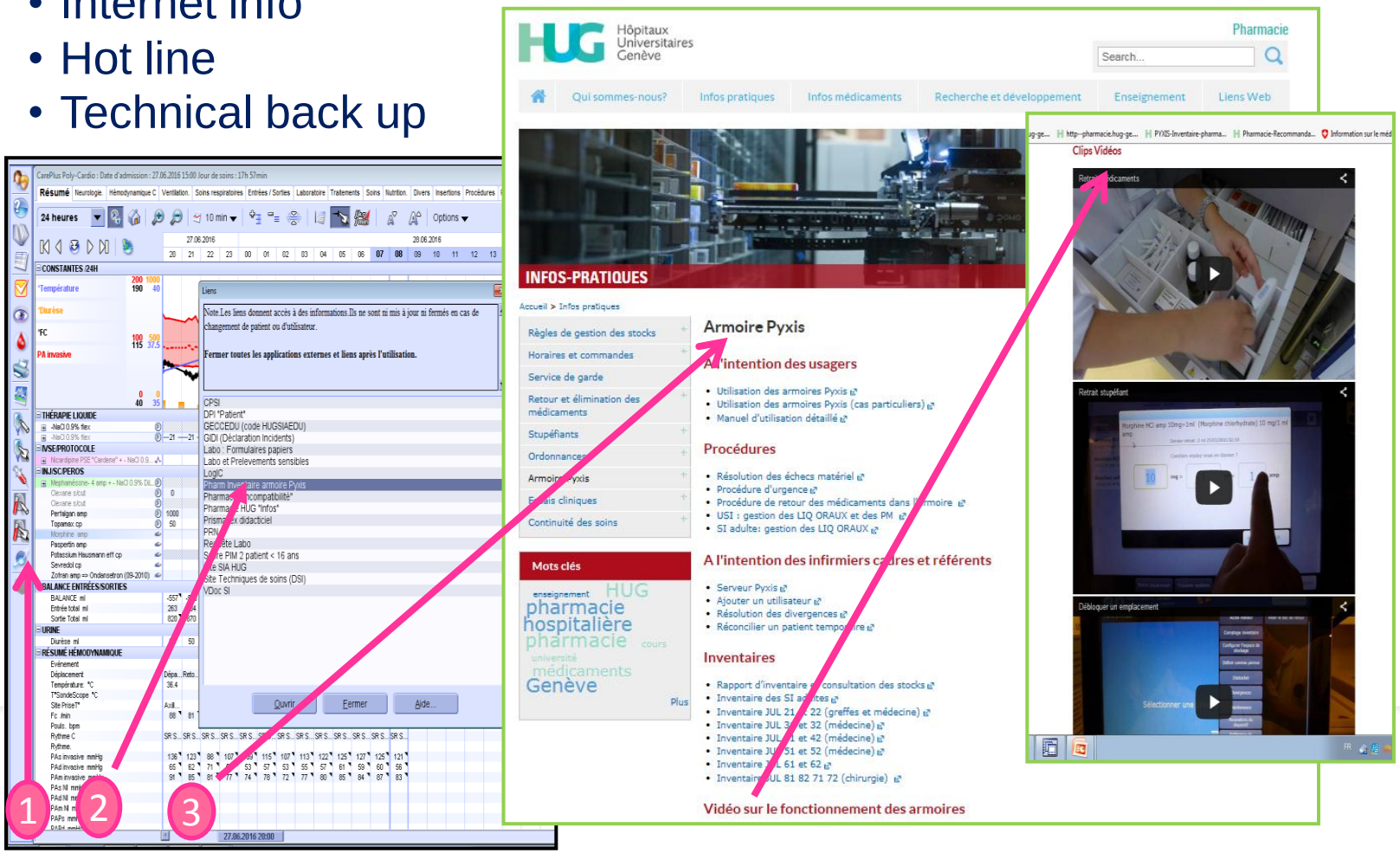
Less than 2 minutes to act

→ **use of the Emergency trolley**

Human-Computer interface

PYXIS Utilization Support aside implementation

- Staff training
- Internet info
- Hot line
- Technical back up

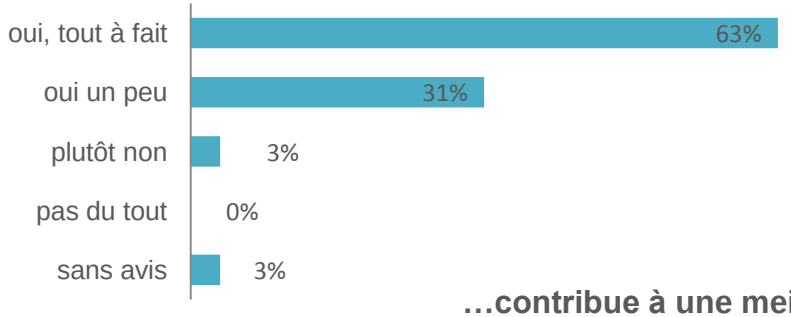


Users satisfaction

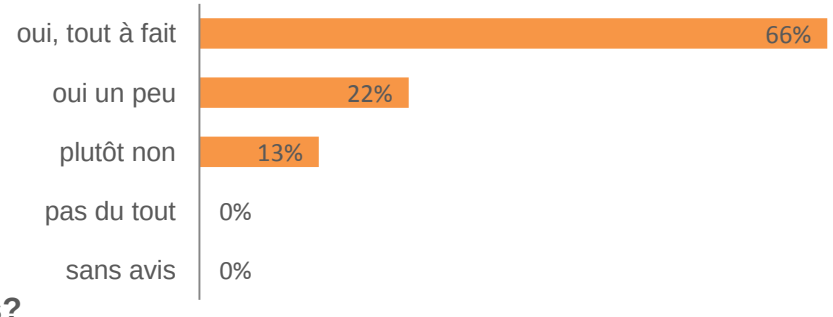
Pediatric intensive care n=32

Security: 63%
Drug storage management: 66%
Tracability: 66%

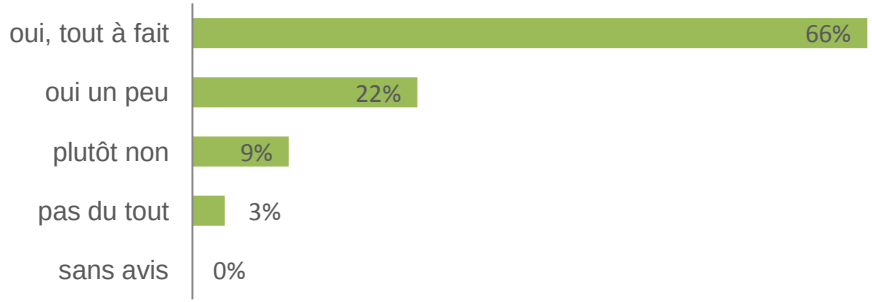
…contribue à l'amélioration de la sécurité des soins?



…contribue à une meilleure traçabilité des médicaments ?



…contribue à une meilleure gestion de stocks des médicaments?



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Savin C, François O, Fonzo C, HUG, 2015

Integration in the whole drug process

Robotized distribution

Automated dispensing

Computerized prescription

Pharma Industry stock

Pharmacy stock

Ward stock

Clinical information system

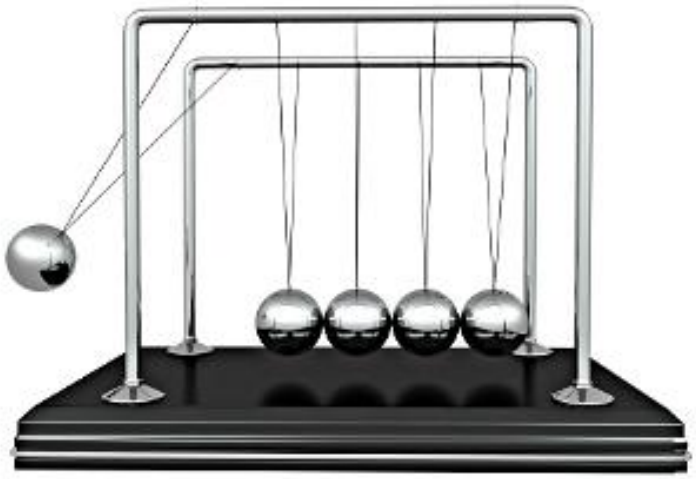
Logistic information system

Distribution with scanning

Bedside scanning

e-tools are securing the system if :

fully integrated in the medication process and
adopted by the staff



Newton's cradle

but get ready to see new issues arising!