Impact of standardized concentrations on drug infusion process in PICU/NICU: a simulation study from prescription to administration

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Background

Intravenous (IV) drug infusions

PICU N ICU

HIGH RISK PROCESS

2 methods for preparation/administration are common:

1. Standardizing the infusion rate by varying the drug concentration (VarC)
   In our PICU/NICU, IV-infusions prepared in VarC
   Move to?

2. Standardizing the drug concentration (StdC) and varying the infusion rate
   StdC are advised in the USA to reduce risks of preparation errors.1

Aims

To perform a SIMULATION STUDY to assess the impact of standard concentration (StdC)
   on IV drug prescription, preparation and administration

Methods

2 experiences

1. Electronic prescription
   10 physicians

2. Preparation & Administration
   10 PICU / 8 ICU nurses

Fictive cases

5 drugs
   • midazolam
   • fentanyl
   • noradrenaline
   • ketamine
   • furosemide

for 15 fictive patients
   (different dosage /weight)

Design

Two-sessions study

VarC vs StdC

preparation with the rule of six2 (adapted to the body weight and infusion rate)

3 dilutions (low, medium, high) per drug

150 prescriptions / 270 preparations (each session)

Issues

Precision

Analysis #1: deviation from target in %, mediane (IQR25-75%)

Analysis #2: deviation of more than 20% from target (> = 20%) of :

Drug concentration (DC) (quantitative analysis),

Dose (extrapol from DC and rate calculation),

Rate (calculated by nurses)

Time (mean ± SD in sec.)

Results

Drug concentration (DC)

Analysis #1: Concentration deviation
   4.4% [2.0 to 11.5] vs 4.1% [1.6 to 8.4] p=0.004
   Analysis #2: Concentration > ± 20%
   44/270 (16.3%) vs 23/270 (8.5%) p=0.005

Analysis #1: Dose deviation
   4.4% [2.0 to 11.1] vs 11.8% [5.1 to 23.3] p<0.0001
   Analysis #2: Dose > ± 20%
   42/270 (15.6%) vs 83/270 (30.7%) p<0.0001

For StdC when compared to VarC
   the drug concentration was more precise with a significant reduction (almost by 50%) in the number of samples with a measured deviation of more than 20%.

But the precision of the delivered dose was less precise with a significant increase (almost by twice) in the number of values with more than 20% above target.

Global Preparation time
   was shorter due to a strong reduction of preparation time

No association with age, years of experience, number of worked hours before study, pediatric or adult ICU nurses was observed on precision.

Conclusion

Preparation time and drug concentration precision was strongly improved with StdC.

Strategies to deal with the longer prescription time and poor dose and rate precision should be considered before moving to StdC.