Can the display of drug strength information on medication labels influence the frequency of drug selection errors ?

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Purpose

The label is an important interface between the drug and the healthcare worker. Case reports suggest that their characteristics can contribute to the occurrence of medication errors. The purpose of our study was to assess how the display of drug strength information on medication labels influences the frequency of drug selection errors.

Methods

Five different professional groups of fifteen volunteers each had to complete a series of 72 on-screen tasks.

- The series was constructed from an initial set of 24 distinct tasks.
- For each task, a label corresponding to a target drug instruction made of two pieces of information (quantity-volume, volume-concentration or quantity-concentration) had to be selected from a list of 10 items.
- The volunteer had to click on the right answer or on the button « no corresponding label ».
- The set was presented 3 times using 3 different drug label formats incorporating various levels of standardization.

Characteristics of the 3 levels of standardization:

- **Format A** : no standardization, only two pieces of information were given on labels and concentration was expressed either in mg/ml or as a percent (%). Mental calculations were necessary.
- **Format B** : complete information (concentration, quantity, and volume) was provided in a random sequence. Concentration was only expressed in mg/ml. No calculations were needed.
- **Format C** : maximal standardization. Complete information was made available in a fixed sequence.

Format A   **Format B**   **Format C**
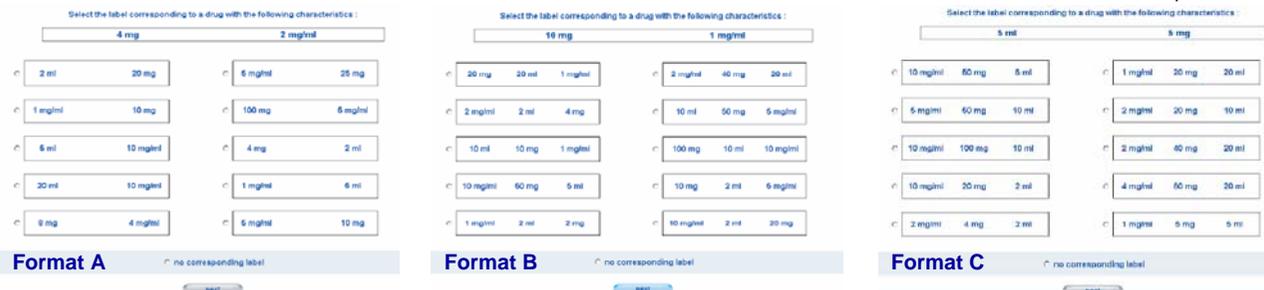
Results

The frequency of drug selection errors was significantly associated to the level of standardization (Fig. 1), the professional group (Fig. 2) and the individual volunteers (Fig. 3).
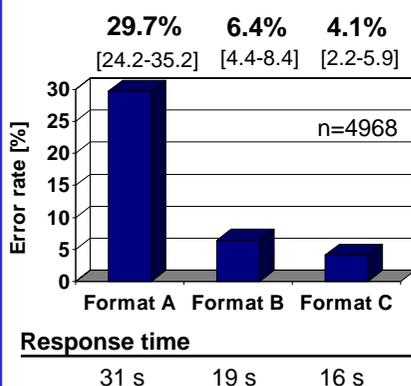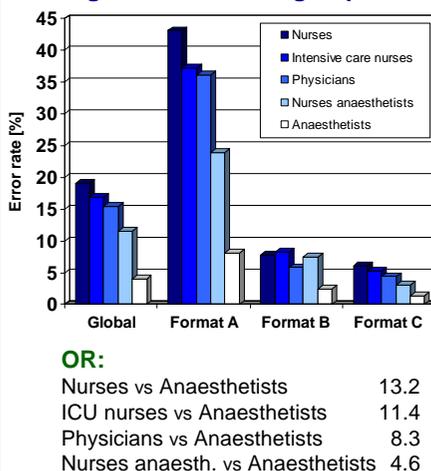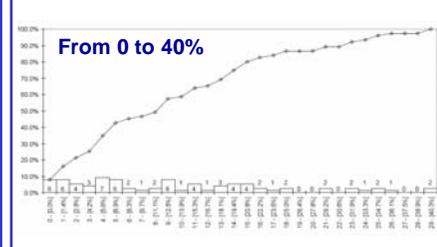
Fig. 1: Level of standardization

29.7%	6.4%	4.1%
[24.2-35.2]	[4.4-8.4]	[2.2-5.9]

n=4968

Error rate [%]

Format A   Format B   Format C

Response time

31 s	19 s	16 s

OR 1 vs 3= 12.1 [8.9-16.5], p<0.001
OR 2 vs 3= 1.7 [1.2-2.3], p=0.001

Fig. 2: Professional group

Legend: Nurses, Intensive care nurses, Physicians, Nurses anaesthetists, Anaesthetists

Error rate [%]

Global   Format A   Format B   Format C

OR:

Nurses vs Anaesthetists	13.2
ICU nurses vs Anaesthetists	11.4
Physicians vs Anaesthetists	8.3
Nurses anaesth. vs Anaesthetists	4.6

Fig. 3: Interindividual variability

From 0 to 40%

Concentration in % or mg/ml ?
In Format A, the error rate was higher when the concentration was expressed in % rather than in mg/ml:

%	34.9 %
mg/ml	24.4 %

OR = 1.8 [1.5-2.2], p<0.001

Conclusions

National regulatory bodies should enforce the use of a standard requiring that concentration expressed in "mg/ml", total amount and total volume be displayed on medication labels at fixed locations. Nursing and medical schools as well as healthcare organisations should implement ways for better selecting and training healthcare professionals with regard to arithmetic skills.

These conclusion were applied to our own productions, with some other criteria, such as colour code for anaesthesiology drugs and the use of tall man letters to differentiate similar names. An example of such a label is displayed in Figure 4.

Fig. 4: Exemple of application to our own CIVAS production