

Comparative evaluation of eight tools to prevent drug incompatibilities

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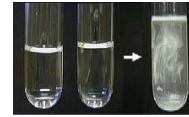
Background and Objective

Intravenous drug administration in neonatal and paediatric intensive care units (PICU; NICU) is critical because of poor venous access, fluid restriction, small catheter diameter and low infusion rate.



Moreover scarce information on physical and chemical compatibilities increases risks.

Eight tools for drug incompatibilities were evaluated in order to improve information delivered to NICU and PICU.



Setting

Neonatal (15 beds) and paediatric intensive care units (10 beds), university hospital



Design

Two experienced clinical pharmacists assessed consensually 8 tools (table 1) with 40 drug pairs usually used in NICU and PICU (table 2). Trissel's Handbook 14th ed. served as reference.

Creation of the 40 pairs			
40 pairs of drugs (concentration and solvent associated)	20 pairs incompatibles I	I1 : 10 pairs incompatibles immediately or in 1 hour	20 pairs compatibles C
		I2 : 10 pairs incompatibles between 1 and 4 hours	
	C1 : 10 pairs incompatibles between 4 and 24 hours		
	C2 : 10 pairs incompatibles after 24 hours or never		

Table 2: The 40 pairs of drugs composed by 20 pairs compatibles (= stable for at least 4h) and 20 pairs incompatibles

The scores were calculated for 3 criteria and corrected for the reference, which totalised 250 points for each criteria (see Appendix):

- **Accuracy:** summation of tools' sensitivity, specificity, positive and negative predictive values
- **Completeness:** number of drug pairs documented
- **Comprehensiveness:** presence/absence of 16 items in the tool as temperature, solvent, recipient, concentration, etc..

Applicability was assessed by 7 pharmacists working in the drug information centre. The scoring combined the time needed to classify 5 drug pairs and their evaluation using visual analogical scales for design, usefulness, reliability and ergonomic.

The global scores for accuracy, completeness, comprehensiveness and applicability were finally calculated.

The percentage of non-conform answers (NCA) were calculated for pharmacists ($n_{\max} = 45$: 5 pairs x 8 tools) and tools ($n_{\max} = 35$: 5 pairs x 7 pharmacists).

Reference and its abbreviation	
Trissel handbook 14 th ed.	Ref
Tools and their abbreviations	
CHUV 9.0 cross-table	CHUV
KIK 3.0 database	KIK
King 2008 cross-table	King
Neofax 2007 handbook	NeoF
Perfysi 2 database	Perf
pH 2007 cross-table	pH
Stabilis 3 database	Stab
Thériaque 2007 database	Thé

Table 1: The 8 tools and the reference

Results

The highest scores for accuracy (234/250; table 3) and comprehensiveness (159/250; table 5) were determined for Thériaque, the one of completeness for KIK (219/250; table 5), the one of applicability for pH table (298/250; table 4).

Tool	TP	FN	TN	FP	Sen	Spe	PPV	NPV	Accuracy
Ref	20	0	20	0	1	1	1	1	250
Thé	14	1	16	1	0.93	0.94	0.93	0.94	234
Perf	14	0	8	2	1	0.80	0.88	1	230
CHUV	13	0	7	4	1	0.64	0.76	1	213
King	10	0	5	6	1	0.45	0.63	1	192
NeoF	10	4	12	3	0.71	0.80	0.77	0.75	190
Stab	16	0	1	6	1	0.14	0.73	1	179
pH	11	7	11	3	0.61	0.79	0.79	0.61	175
KIK	17	0	0	8	1	0	0.68	0	105

Table 3: Accuracy of the 8 tools (TP= True-positive; FN= False negative; TN= True negative; FP= False positive; Sen= Sensitivity; Spe= Specificity; PPV= Positive predictive value; NPV= Negative predictive value)

Tool	Time	Design	Ergonomic	Reliability	Usefulness	Applicability
pH	150	46	58	18	26	298
CHUV	150	39	38	18	21	266
Ref	50	50	50	50	50	250
King	100	32	34	23	21	211
NeoF	75	37	40	21	18	191
Perf	50	36	34	39	32	191
Thé	27	42	41	39	38	188
Stab	33	27	13	29	10	112
KIK	27	22	21	18	17	105

Table 4: Applicability of the 8 tools

- The range of pharmacists' NCA was between 9% (4/45 NCA) and 33% (15/45).

- The range of tools' NCA was between 6% (2/35) and 49% (18/35), being the lowest for pH table and the highest for Perfysi. This last result may be explained by the construction of this tool, which pools information from different references. The absence of consensus may be related to the need for interpretation, with different possible conclusions.

- The best global scores were obtained by Thériaque database and pH table (781 and 780/1000 respectively; table 5)

Tool	Accuracy score	Completeness score	Comprehensiveness score	Applicability score	Global score
Ref	250	250	250	250	1000
Thé	234	200	159	188	781
pH	175	200	107	298	780
CHUV	213	150	93	266	722
Perf	230	138	109	191	667
NeoF	190	181	70	191	632
King	192	131	47	211	581
KIK	105	219	115	105	544
Stab	179	150	80	112	521

Table 5: Tool Evaluation summary

Conclusion

Both Thériaque database and pH table excelled as drug incompatibility tools. However users should understand the limitations of all resources. Large ranges of pharmacists' and tools' NCA illustrate how results are influenced by different interpretations. A standardisation should be applied. Tools with low NCA percentage may be interesting for use by nurses in care units.

Appendix - Evaluation parameters

Sensitivity= $Sen = TP / (TP + FN)$; Specificity= $Spe = TN / (TN + FP)$; PPV= $TP / (TP + FP)$; NPV= $TN / (TN + FN)$; Accuracy score= $(Sen + Spe + PPV + NPV) \times 62.5$; Completeness score= Number of pairs x 6.25 ; Comprehensiveness score= Number of items x 2.08 ; Applicability score= $[1 / (\text{time to classify 5 pairs}) \times 1000 / 3.33] + [EVA_{\text{design}} \times 7.04] + [EVA_{\text{usefulness}} \times 5.44] + [EVA_{\text{reliability}} \times 5.32] + [EVA_{\text{ergonomic}} \times 6.49]$; Global score= Accuracy score + Completeness score + Comprehensiveness score + Applicability score