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Errors in Pediatric Prehospital Simulation Scenarios

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Background: Medication errors are a critical safety issue in prehospital care. Length based tapes (LBT) for pediatric drug dosing is part of the recommended ambulance equipment list endorsed by the AAP. A new LBT system, known as Handtevy, allows rapid determination of critical drug doses without performing calculations. The frequency of medication errors between different LBT systems is not known.

Objective: To compare the type and rate of errors in medication administration between two LBT systems during pediatric prehospital simulation scenarios.

Methods: We enrolled ALS-certified prehospital providers (PHPs) in a randomized cross-over trial comparing the Broselow and Handtevy LBT. PHPs performed 2 pediatric resuscitation simulations: cardiac arrest with epinephrine administration and hypoglycemia mandating dextrose. Participants repeated each scenario utilizing both LBT systems with a change in manikin size to prevent memorization of dose. Facilitators identified errors by monitoring medication preparation and the volume administered into a hidden syringe inside the manikin. Errors were classified as Procedural and/or Cognitive. Overall accuracy, number and type of errors were calculated and compared between the two LBT systems. We defined a medication error as the administration of +/- 10% of the indicated dose based on the LBT.

Results: We enrolled 68 PHPs, performing 272 simulations. Overall, errors in dosing were noted in 34.2% of scenarios. Procedural errors were most common, occurring in 30.8% of scenarios, with no difference between Handtevy and Broselow. Frequent types of procedural errors included pushing the wrong dose (16.1%), and using the tape incorrectly (9.9%). Cognitive errors occurred in 25.3% of scenarios and were more frequent when using Broselow compared to Handtevy (38.2% vs. 12.4%, $p < 0.05$). The most common type of cognitive error was an unaided calculation (11%), followed by choosing the wrong concentration (8.8%). Cognitive errors were particularly common with Broselow during administration of dextrose (OR 13.4, 95% CI 5.7, 31.2). When comparing by medication, the LBTs were similar in overall accuracy for epinephrine (62.1% vs. 68.5%). For dextrose, Handtevy resulted in far more accurate dosing compared to Broselow (76.4% vs 33.3%, $p < 0.05$).

Conclusion: In prehospital simulation scenarios, procedural errors are very common. The Handtevy LBT system results in fewer cognitive errors, particularly in scenarios requiring dextrose administration.

Table 1

	Handtevy	Broselow	p value
Epinephrine			
Overall correct %	62.1%	68.5%	
Errors/scenario			
Procedural errors/scenario	0.31	0.34	
Cognitive errors/scenario	0.10	0.06	
Affective errors/scenario	0	0	
Dextrose			
Overall % correct	76.4%	33.3%	<0.05
Errors/scenario			
Procedural errors/scenario	0.26	0.46	<0.05
Cognitive errors/scenario	0.17	1.04	<0.05
Affective errors/scenario	0.03	0.09	

Table 2

Type of Error	Overall rate (H and B combined)
Procedural	84/272 (30.8%)
Pushed wrong dose	44/272 (16.1%)
Incorrect use of tape	27/272 (9.9%)
Diluted incorrectly	20/272 (7.3%)
Fingerstick	3/272 (1.1%)
Cognitive	69/272 (25.3%)
Unaided calculation	30/272 (11%)
Faulty recall of dose	13/272 (4.8%)
Choosing wrong concentration	24/272 (8.8%)
Affective	8/272 (2.9%)

Table 3

	Handtevy			Broselow		
	Epi	Dex	combined	Epi	Dex	combined
Procedural						
Pushed wrong dose	13/67 (19.4)	9/70 (12.8)	22/137 (16.0)	10/68 (14.7)	12/68 (17.6)	22/136 (16.1)
Incorrect use of tape	8/67 (11.9)	3/70 (4.2)	11/137 (8.0)	12/68 (17.6)	4/68 (5.8%)	16/136 (11.8)
Diluted incorrectly	0/68	6/70 (8.5)	6/138 (4.3)	1/68 (1.4)	13/68 (19.1)	14/136 (10.2)
Fingerstick						
Cognitive						
Unaided calculation	0/67 (0)	6/70 (8.5)	6/137 (4.3)	0/68 (0)	24/68 (35.2)	24/136 (17.6)
Faulty recall of dose	0/67 (0)	0/70 (0)	0/137 (0)	0/68 (0)	13/68 (19.1)	13/136 (9.5)
Choosing wrong concentration	4/67 (5.9)	6/70 (8.5)	10/137 (7.2)	2/68 (2.8)	17/68 (25.0)	19/136 (13.9)
Affective	0/67 (0)	2/70 (2.8)	2/137 (1.4)	0/68 (0)	6/68 (8.8%)	6/137 (4.3)