Assessing Pediatric Intensive Care Unit Mattress Compressibility with a Standard Backboard and Real-time Feedback: A simulation-based study
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Backgrounds

• The depth of chest compressions (CC) during cardiac arrest is associated with patient survival and neurological outcomes. 1-3
• Mattress compressiion can reduce the proportion of CCs given with adequate depth due to increased vertical hand movement and fatigue. 4,5
• The use of CPR backboard and mattress firming technology partially attenuate the mattress compressibility. 6,7
• Real-time feedback using single force and deflection sensor fails to adjust mattress compressibility and may overestimate compression depth when CPR is performed on a mattress. 8

Objectives

1. Quantify the amount of depletion when cardiopulmonary resuscitation (CPR) is performed on 2 different PICU mattresses, with or without use of backboard, and identify factors associated with mattress compression depth; 2. Explore factors (i.e. mattress type, use of backboard) associated with mattress compression depth; 3. Explore the effect of feedback sources on effective compression depth by PICU healthcare providers.

Methods

• Simulation used as method of investigation
• Participants: CPR certified Pediatric Intensive Care Unit (PICU) providers
• Simulation Settings
  • Bed height (Hill-Rom 1000™ Medical Surgical Bed, 75cm)
  • Simulation scenario: PICU scenario
  • Outcome Measures
    • Total compression depth: external accelerometer sensor (Laerdal CPR Meter™)
    • Effective compression depth: Internal light sensor (Laerdal Resusci Anne QCPR™ + SIMPad SkillReporter)
    • Mattress compression depth = Total compression depth – Effective compression depth

• Procedures
  • Participants perform 1 min chest compression in following scenarios in random order
    • Typical PICU mattress (Advance 1000™ foam)
    • Typical PICU mattress + CPR board
    • Memory foam PICU mattress (Hill-Rom Accumax Quantum™ VPC)
    • Memory foam PICU mattress + CPR board
  • Repeat each scenario with 2 different sources of feedback
    • Accelerometer sensor
    • Internal light sensor
• Sample size estimation: n = 16
• Statistical analysis: multi-linear linear regression model

Results

• Amount of chest compression depletion
• Effect of foam mattress and use of backboard on depleted depth
• Effect of feedback source on effective compression depth

Conclusions

• Chest compression depth is significantly depleted when CPR is performed on a PICU mattress.
• Mattress firming technology should be considered for patients at high risk of cardiac arrest.
• A CPR board should always be used when managing patients with cardiac arrest.
• When real-time feedback is used, healthcare providers should consider devices that measure sternum-to-spine displacement to improve effective compression depth.
• CPR training should allow healthcare providers to practice chest compressions with real-time feedback on the mattress that patients are typically placed on in their relevant clinical unit.

References