3D MODELING OF OBJECTS RESPONSIBLE FOR FOREIGN BODY INJURIES IN CHILDREN: A NOVEL WEB-BASED APPROACH FOR TARGETED PUBLIC HEALTH PREVENTION AND PEDIATRIC SAFETY

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INTRODUCTION

Injuries caused by foreign bodies (FBs) in children represent a significant public health concern. Characterizing FBs is essential for developing targeted prevention strategies, as the risk of injury and the likelihood of airway or gastrointestinal lodgment are shaped by the interplay of morphology, size, material composition, and the biomechanical dynamics of aspiration or ingestion.




Objective

This study aims to develop a web-based approach that leverages high-resolution 3D scanning technology to characterize FBs for profiling injury risk and establishing targeted prevention strategies to reduce the incidence and severity of pediatric FB injuries.

METHODS

Data were drawn from the Susy Safe registry, a multicenter international database collecting FB injury cases in children under 14 years.

3D Modeling Pipeline

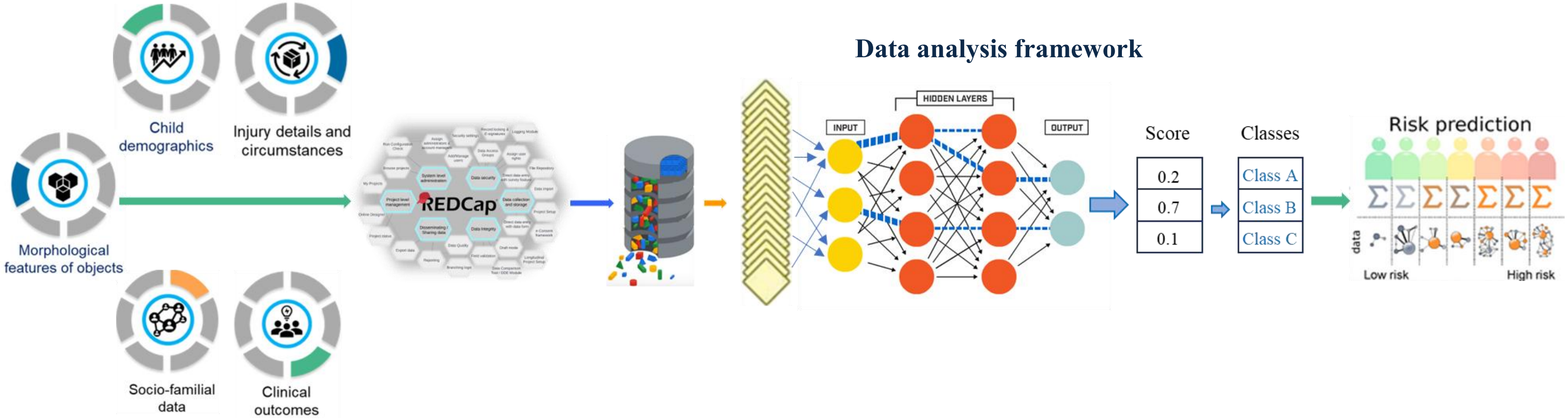
Data acquisition and archiving

- Pre-scan documentation
- Photographic setup and image acquisition
- Pre-scan object preparation
- Scanning procedure
- File storage

Data management

Data analysis framework

- Feature extraction and geometric analysis
- Dimensional threshold evaluation
- Material and structural assessment
- Biomechanical pathways simulation and anatomical fit modeling
- Clinical risk modeling
- Validation and predictive platform integration



RESULTS

The scanning campaign is ongoing. To date, 500 objects have been processed through 3D scanning, the majority (60%) composed of rigid materials. Preliminary findings indicate that objects with spherical shapes and low surface friction are more likely to lodge in the trachea or bronchi (OR 2.8; 95% CI: 1.9-4.2). Irregular or angular objects, especially those with sharp projections, tend to become lodged in the esophagus (OR 3.1; 95% CI: 2.0-4.9) due to mechanical interlocking, increasing the risk of lacerations. Among these, a key retrieved from the oral cavity of a two-year-old female patient is presented (Fig. 1) as a representative example of the detailed 3D reconstructions generated, highlighting the ability to capture surface features and shape complexity.

Figure 1. Pre-scan documentation, 3D reconstruction in matching orientation, and top-view rendering with reference axes and point-to-point measurement grid.