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Enhancing epidemiological safety in prehospital care by detecting adverse events in patient care records

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Keywords

Adverse Safety Events, Patient Care Records, Chart Review, classification, neural network

Abstract

Introduction

The term Adverse Safety Events (ASEs) refers to harm from medical errors and, if considered a disease, would rank third among the leading causes of death in the U.S. Patient safety research has traditionally performed manual review of patient care records (PCR) to characterize ASEs and develop prevention strategies. Manual review is labor-intensive, which prohibits continuous monitoring and improvement. Automating detection of ASEs would overcome these barriers and allow the healthcare community to address safety issues at a population scale.

Objective

To demonstrate the feasibility of automatically detecting safety events in PCRs.

Materials

88 PCRs of pediatric out-of-hospital cardiac arrests (OHCA).

Methods

Clinical experts manually reviewed the PCRs to establish ground truth determination of airway and medication ASEs. We extracted features from the structured and unstructured parts of the PCRs, built predictive models, and evaluated the predictions against ground truth using stratified K-fold (K=5) cross-validation and balanced accuracy. The unstructured narratives were transformed into vector-based feature embeddings using Bidirectional Encoder Representations from Transformers (BERT). We used logistic regression, decision trees, random forests, k-nearest neighbors, and neural networks to build predictive models.

Results

For structured data, decision trees had the best accuracy (77±4%) detecting airway events and random forests had the best accuracy (57±14%) detecting medication events. For unstructured data, logistic regression performed best detecting airway (50±7%) and medication (61±1%) events. Logistic regression using combined features detected airway (64±3%) and medication (62±1%) events with slightly better accuracy.

Conclusion

The results are modest but compelling because they demonstrate the feasibility of automatically detecting ASEs after training on a very small dataset. The models performed best using structured data for airway events and unstructured data for medication events. Accuracy increased using both types of data. This suggests information about ASEs exist in different parts of the chart, which necessitates a holistic approach.