Enhancing Bedside Nursing Care Using AI

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Introduction

- More than 290,000 patients suffer from an in-hospital cardiac arrest (IHCA) annually. The majority occur in medical-surgical nursing units, with most IHCA events considered preventable.
- Higher patient-to-nurse ratios have been associated with a 5% decrease in IHCA survival rate. Additionally, nursing units characterized by limited technological resources have shown diminished survival rates
- The modified early warning score (MEWS) a weighted track and trigger system developed in 1997, is commonly used in hospitals to detect clinical decline and IHCA
- The MEWS has been found to have low sensitivity and high false alarm rates due to the subjective nature of the tool and the tool's inability to adapt to changing patient conditions
- Artificial intelligence (AI) has been suggested as a strategy to improve IHCA prediction

Purpose

This research aims to integrate AI to enhance bedside nursing care by improving the prediction of IHCA occurrences in medical-surgical units.

Study Design

- Retrospective secondary analysis of the Medical Information Mart for Intensive Care (MIMIC) IV-ED
- 448,972 ED encounters from 2011 to 2019
- All adult patients (≥ 18 yr old) were eligible for inclusion
- Patients were excluded if they presented to the ED in active cardiac arrest
- Primary outcome: IHCA as defined by ICD-10 codes I46.2, I46.8 and I46.9

Methods

- Developed a multi-layer perceptron (MLP) classifier architecture
- The MLP model was trained using clinical features, including age, gender, and dynamic changes in vital signs prior to IHCA. Data divided into training and validation sets 70:30
- The model consisted of two hidden layers of 60 nodes after flattening.
- The sigmoid activation function and mean squared error loss function were employed with a dropout parameter (p=0.1) and three batch normalization layers.
- Hyperparameters: 30 epochs, batch size of 10, and Adam optimization learning rate of 0.00001
- Model performance was evaluated with the area under the receiver operating characteristic curve (AUROC), sensitivity and specificity
- Predictive performance was compared to a logistic regression model and previously reported MEWS predictive performance

Results

Pending Analysis

Implications

This study endeavored to improve the prediction of IHCA in medical-surgical nursing units. Our MLP model demonstrated improved IHCA prediction compared to the MEWS. This research suggests that AI models, such as an MLP, can more accurately discern patterns within nursing-sensitive data to improve IHCA prediction. This is vital as medical-surgical nursing units see increasing patient acuity and nurse-to-patient ratios. Adapting this innovative technology to run within the electronic medical record would enhance bedside nursing care and improve patient outcomes

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