Enhancing AI-guided STEMI detection algorithms by incorporating higher quality fiduciary EKG elements

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Funding Acknowledgement: Type of funding source: None

Background: As EKG interpretation paradigms to a physician-free milieu, accumulating massive quantities of distilled pre-processed data becomes a must for machine learning techniques. In our pursuit of reducing ischemic times in STEMI management, we have improved our Artificial Intelligence (AI)-guided diagnostic tool by following a three-step approach: 1) Increase accuracy by adding larger clusters of data. 2) Increase the breadth of EKG classifications to provide more precise feedback and further refine the inputs which ultimately reflects in better and more accurate outputs. 3) Improving the algorithms' ability to discern between cardiovascular entities reflected in the EKG records.

Purpose: To bolster our algorithm's accuracy and reliability for electrocardiographic STEMI recognition.

Methods: Dataset: A total of 7,286 12-lead EKG records of 10-seconds length with a sampling frequency of 500 Hz obtained from Latin America Telemedicine Infarct Network from April 2014 to December 2019. This included the following balanced classes: angiographically confirmed STEMI, branch blocks, non-specific ST-T abnormalities, normal, and abnormal (200+ CPT codes, excluding the ones included in other classes). Labels of each record were manually checked by cardiologists to ensure precision (Ground truth). Pre-processing: First and last 250 samples were discarded to avoid a standardization pulse. Order 5 digital low pass filters with a 35 Hz cut-off was applied. For each record, the mean was subtracted to each individual lead. Classification: Determined classes were "STEMI" and "Not-STEMI" (A combination of randomly sampled normal, branch blocks, non-specific ST-T abnormalities and abnormal records – 25% of each subclass). Training & Testing: A 1-D Convolutional Neural Network was trained and tested with a dataset proportion of 90/10, respectively. The last dense layer outputs a probability for each record of being STEMI or Not-STEMI. Additional testing was performed with a subset of the original complete dataset of unconfirmed STEMI. Performance indicators (accuracy, sensitivity, and specificity) were calculated for each model and results were compared with our previous findings from past experiments.

Results: Complete STEMI data: Accuracy: 95.9% Sensitivity: 95.7% Specificity: 96.5%; Confirmed STEMI: Accuracy: 98.1% Sensitivity: 98.1% Specificity: 98.1%; Prior Data obtained in our previous experiments are shown below for comparison.

Conclusion(s): After the addition of clustered pre-processed data, all performance indicators for STEMI detection increased considerably between both Confirmed STEMI datasets. On the other hand, the Complete STEMI dataset kept a strong and steady set of performance metrics when compared with past results. These findings not only validate the consistency and reliability of our algorithm but also connotes the importance of creating a pristine dataset for this and any other AI-derived medical tools.

Chronologic Trends of Performance Metrics in the Diagnosis of STEMI in an AI-Augmented 12-lead EKG

	Data prior to adding clusters (Prior Data)		*Data after adding clusters (New Data)*	
	Unconfirmed STEMI	**Confirmed STEMI**	**Unconfirmed STEMI**	**Confirmed STEMI**
Sample Size (N)	8,511	5,087	11,567	7,286
Accuracy (%)	96.5	97.1	96.4	98.1
Sensitivity (%)	96.3	95.8	95.3	98.1
Specificity (%)	96.8	98.5	97.4	98.1