Detection of arterial hypertension through electrocardiograms

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Introduction: Comorbidities' awareness is relevant to evaluate patients' conditions. However, very often, the main source of such information is patient self-report, which lacks reliability. Atrial hypertension (AH) is a very relevant comorbidity that may change prognosis for several diseases. Recent studies use electrocardiogram (ECG) to diagnose and even identify relevant patient information, such as gender and age. There is also evidence that it is possible to extract patient comorbidities using the raw ECG signal. Our goal in this work is to identify AH using the 12 lead ECG signal.

Dataset: The dataset used was collected by the telehealth network coordinated by UFMG's hospital. It contains 2.356.873 electrocardiogram exams collected between 2010 and 2016.

Methods: We use a deep neural network model tailored for learning latent features from ECG signal raw data (i.e., end-to-end approach). We divided our data into training, testing and validation, each corresponding to 80%, 10% and 10% of the dataset, respectively. Finally, a random search was performed in order to optimize the hyperparameters of the model.

Results: Our model, which aimed to detect patients with AH, achieved 0.78 recall (SEN), 0.55 precision (PPV), with an overall F1-score of 0.65 (depicted in table 1, which also contains segmented results per age and gender). Despite the absolute figures, these results are significant in practice, in particular the high recall, considering the low prevalence of AH on patients.

Conclusions and future works: We presented a machine learning model that is able to detect AH through ECG signals. Despite its relatively low precision, its results are better than those associated with patient self-report, making it a potentially useful resource for physicians, mainly in telehealth practice. As future works, we intend to extend our model to detect other comorbidities and validate it using external datasets.

Table 1. Automatic diagnosis detection of arterial hypertension results

	Recall (SEN)	Precision (PPV)	Specificity	NPV	F1-score
General	0.784	0.551	0.635	0.838	0.647
Men	0.748	0.533	0.661	0.835	0.622
Women	0.806	0.561	0.617	0.839	0.662
Age (30 - 44)	0.665	0.335	0.650	0.880	0.445
Age (45 - 59)	0.777	0.545	0.599	0.813	0.641
Age (60 - 74)	0.825	0.669	0.604	0.780	0.739
Age (75+)	0.839	0.701	0.605	0.773	0.764