

Noninvasive measurement of blood potassium levels through ECG

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Aim: We aim to predict the classification of potassium (K⁺) levels in the blood using non-invasive methods based on ECG readings.

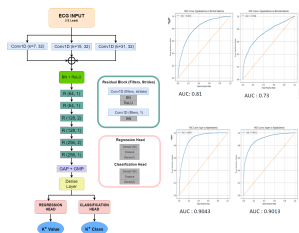
Methods: To predict the K⁺ ion concentration in the blood from the ECG, a deep ResNet architecture was used (see Fig. 1). The ECG data passes through three convolutional layers with different kernel sizes to accurately capture the T-wave, QRS complex, and other relevant features. These features are then processed through six sequential residual blocks.

The model performs multi-task learning to predict both the continuous value of potassium and its corresponding diagnostic class:

- **Hypokalemia:** $K^+ < 3.5$ mEq/L
- **Normal:** $3.5 \leq K^+ \leq 5.5$ mEq/L
- **Hyperkalemia:** $K^+ > 5.5$ mEq/L

Data was sourced from the MIMIC-IV dataset, matching ECG records with potassium lab results within a one-hour window. The original signals were recorded at 500 Hz for 10 s. For model development, the data was segmented into 5s windows, resulting in 30,000 windows for training and 6,000 5s windows reserved for testing.

Results The AUC of hypo and normal is 0.81, hyper and normal is 0.74, and hypo and hyper is 0.90. The precision of the hyper class is 0.81, and the precision of the hypo class is 0.70.



Study	Task	AUC
Galloway et al. (2019)	Hyperkalemia	0.853–0.883
Wang et al. (2021)	Hypokalemia	≈0.80
This work	3-class K ⁺ classification	0.73–0.90
This work	Hypo vs. Normal	0.81
This work	Hyper vs. Normal	0.73
This work	Hyper vs. Hypo	0.90

Table 1: Comparison of AUC Metrics

Figure 1: Proposed Deep ResNet Architecture

Conclusion: The AUC for hypo and normal ranges is 0.81, which is better than what is reported in other studies. the AUC for hypo and hyperkalemia is 0.9, indicating it effectively differentiates between hypo and hyper conditions.