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A Novel Hybrid Deep Learning Architecture for Predicting Acute Kidney Injury Using Patient Record Data and Ultrasound Kidney Images

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Abstract : Acute kidney injury (AKI) is the sudden onset of kidney damage in which the kidneys cannot filter waste from the blood, requiring emergency hospitalization. AKI patient mortality rate is high in the ICU and is virtually impossible for doctors to predict because it is so unexpected. Currently, there is no hybrid model predicting AKI that takes advantage of two types of data. De-identified patient data from the MIMIC-III database and de-identified kidney images and corresponding patient records from the Beijing Hospital of the Ministry of Health were collected. Using data features including serum creatinine among others, two numeric models using MIMIC and Beijing Hospital data were built, and with the hospital ultrasounds, an image-only model was built. Convolutional neural networks (CNN) were used, VGG and Resnet for numeric data and Resnet for image data, and they were combined into a hybrid model by concatenating feature maps of both types of models to create a new input. This input enters another CNN block and then two fully connected layers, ending in a binary output after running through Softmax and additional code. The hybrid model successfully predicted AKI and the highest AUROC of the model was 0.953, achieving an accuracy of 90% and F1-score of 0.91. This model can be implemented into urgent clinical settings such as the ICU and aid doctors by assessing the risk of AKI shortly after the patient's admission to the ICU, so that doctors can take preventative measures and diminish mortality risks and severe kidney damage.

Keywords : Acute kidney injury, Convolutional neural network, Hybrid deep learning, Patient record data, ResNet, Ultrasound kidney images, VGG
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