

Supplementary Material

Algorithm development of AI solutions

Solution A (JLK-ICH, version 4.1.0.2, JLK Inc.) was developed using two large-scale brain computed tomography (CT) datasets: a weakly annotated RSNA dataset (27,861 scans, slice-level labeling) and a strongly annotated AI-Hub dataset (53,045 scans, pixel-level segmentation). Four classification networks were trained on both datasets, with strongly annotated models incorporating segmentation loss to improve lesion localization. External validation was performed on 986 CT scans from two institutions, labeled by expert consensus. To enhance the detection of SDH, SAH, and small hemorrhages, five U-Net-based segmentation models were integrated into a weighted ensemble, and case-level hemorrhage probability was derived from the maximum slice-level scores.

Solution B (Hyperinsight-ICH, version 2.1.3, Purple AI Inc.) was trained on 28,351 CT slices from 2,010 AIH patients and 1,000 normal participants. The detection algorithm employed a joint convolutional and recurrent neural network-based sequence module to generate patient-wise and slice-wise probability scores (0–100). For positive cases, anomaly maps were created by subtracting original CT images from restored images, followed by postprocessing using unsupervised training on normal datasets. The AI-assisted output, showing suspected AIH locations and probability scores, was displayed on the radiologists' PACS viewer alongside the original CT images.

Solution C (Heuron-ICH, version 1.0.5.13, Heuron Inc.) is an AI-based triage system for detecting suspected ICH on non-contrast CT and prioritizing cases for review. It was trained on 1,074,271 NCCT images from 27,861 cases, primarily from the RSNA Brain CT Hemorrhage Challenge 2019 dataset, annotated by 60 ASNR-certified neuroradiologists and verified by two senior stroke experts. The architecture consists of a pre-trained `se_resnext50` convolutional neural network encoder and a two-layer bidirectional LSTM for sequential slice analysis. Training was performed using `BCEWithLogitsLoss` with a learning rate of 0.001, batch size of 32, and early stopping, and included preprocessing steps such as center cropping, horizontal flipping, elastic transformations, and class balancing. The dataset was divided into training, validation, and test sets in an 8:1:1 ratio, and a patient-wise probability threshold of 0.6 (optimized for $\geq 90\%$ specificity) was applied. When ICH was suspected, non-diagnostic preview notifications were sent via email, SMS, or mobile app to facilitate prompt clinical attention.

Solution D (AVIEW NeuroCAD, version 1.1, Coreline Soft Inc.) utilized SMART-Net, a supervised multi-task representation transfer learning network for ICH detection and segmentation on non-contrast CT. The upstream stage involved training a ResNet-50 encoder on slice-level multi-pretext tasks (classification, segmentation, reconstruction) with a consistency loss to align outputs, while the downstream stage combined the pre-trained encoder with an LSTM-based 3D classifier for volume-level classification and a Conv3D-based segmenter for volumetric localization. The model was evaluated on four datasets (one internal, three external; total $>1,000$ cases). Ablation studies confirmed that the combination of all three pretext tasks with consistency loss yielded optimal transferability, and the model achieved state-of-the-art AUC, DSC, and false-positive volume performance on both internal and external datasets.