

A Deep Convolutional Neural Network for Kawasaki Disease Diagnosis

KD-CNN is a novel **deep learning-based** screening tool which uses **smartphone photographs** to **differentiate** between Kawasaki disease (KD) and its look-alike diseases.

Importance of KD early diagnosis

KD is the **#1 cause of acquired heart disease** in children, yet it is commonly misdiagnosed.

Why is diagnosis difficult? 1) KD lacks a specific diagnostic test, 2) relies on visual examination of clinical signs, 3) often confused with look-alikes

10-day window for most effective treatment; up to **25%** develop coronary artery aneurysms when untreated

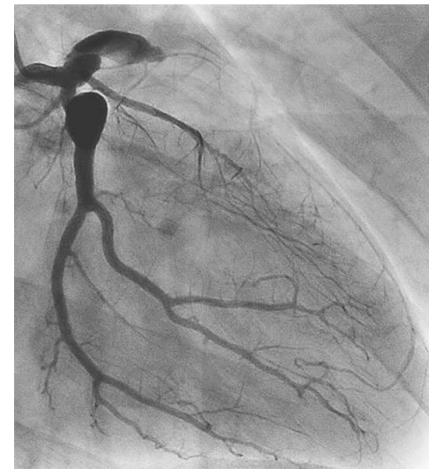
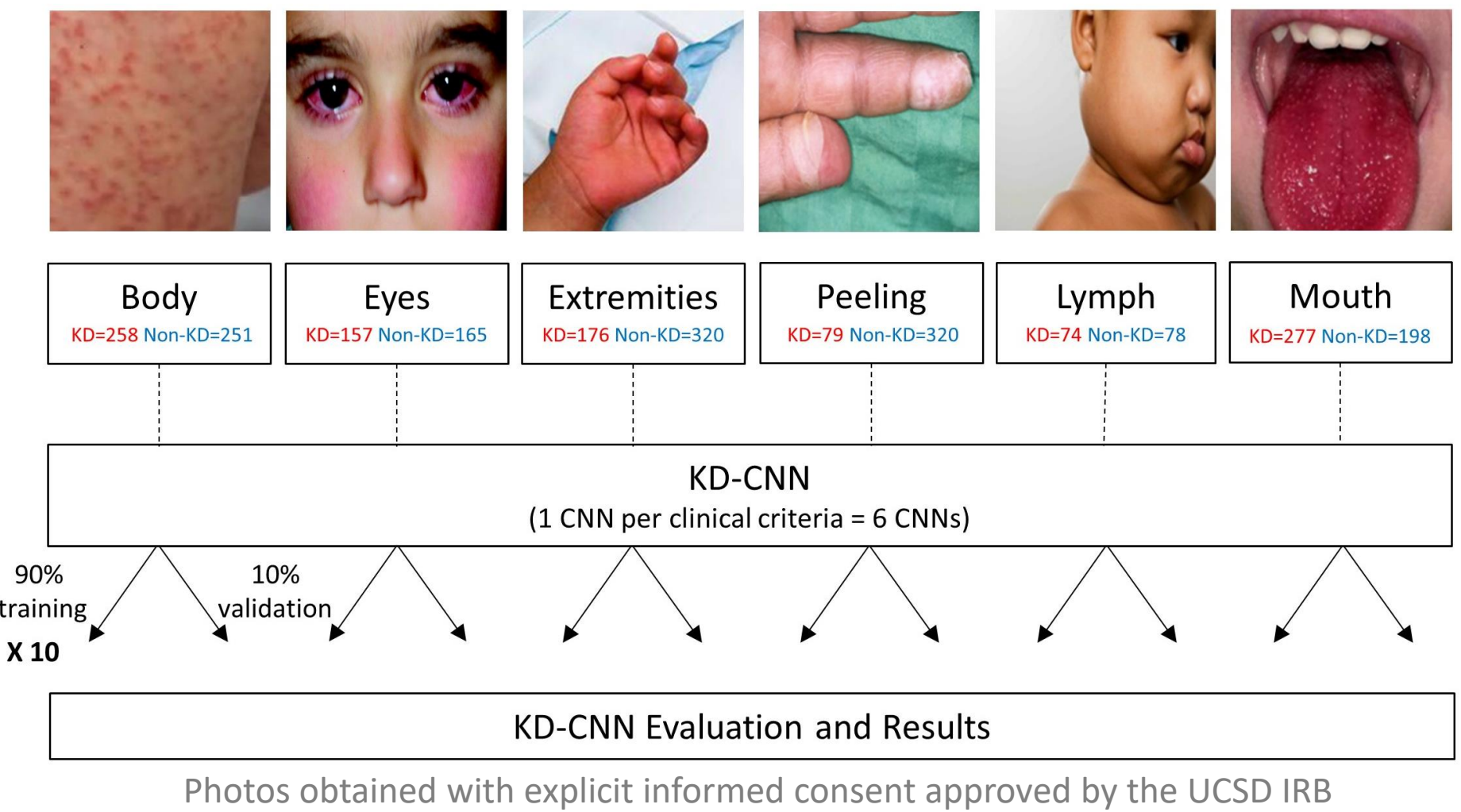


Image courtesy of NEJM

*All images and graphics created by author unless stated otherwise

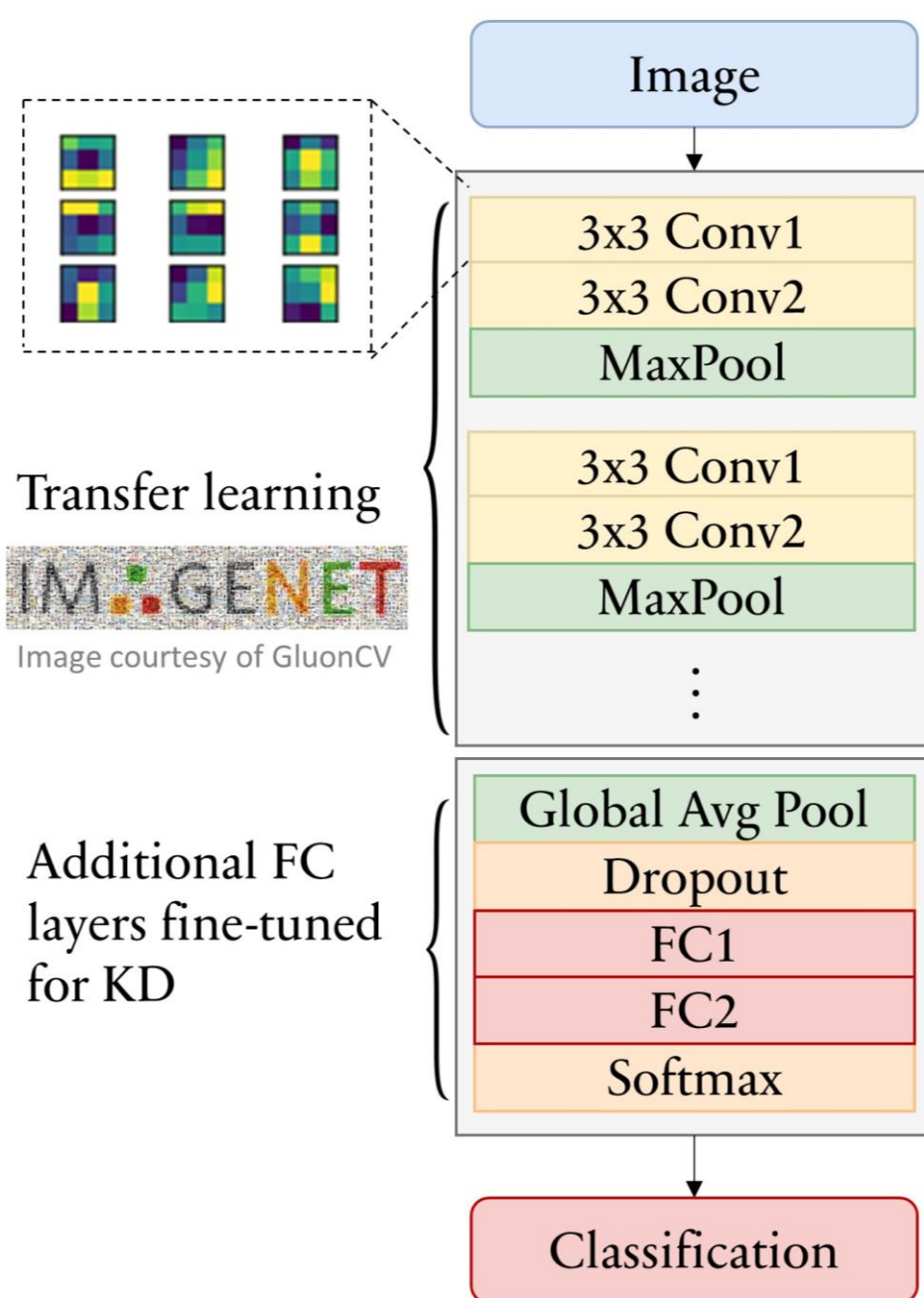
Research Question

Given that KD criteria are visual findings, can we develop image-based models to aid detection?



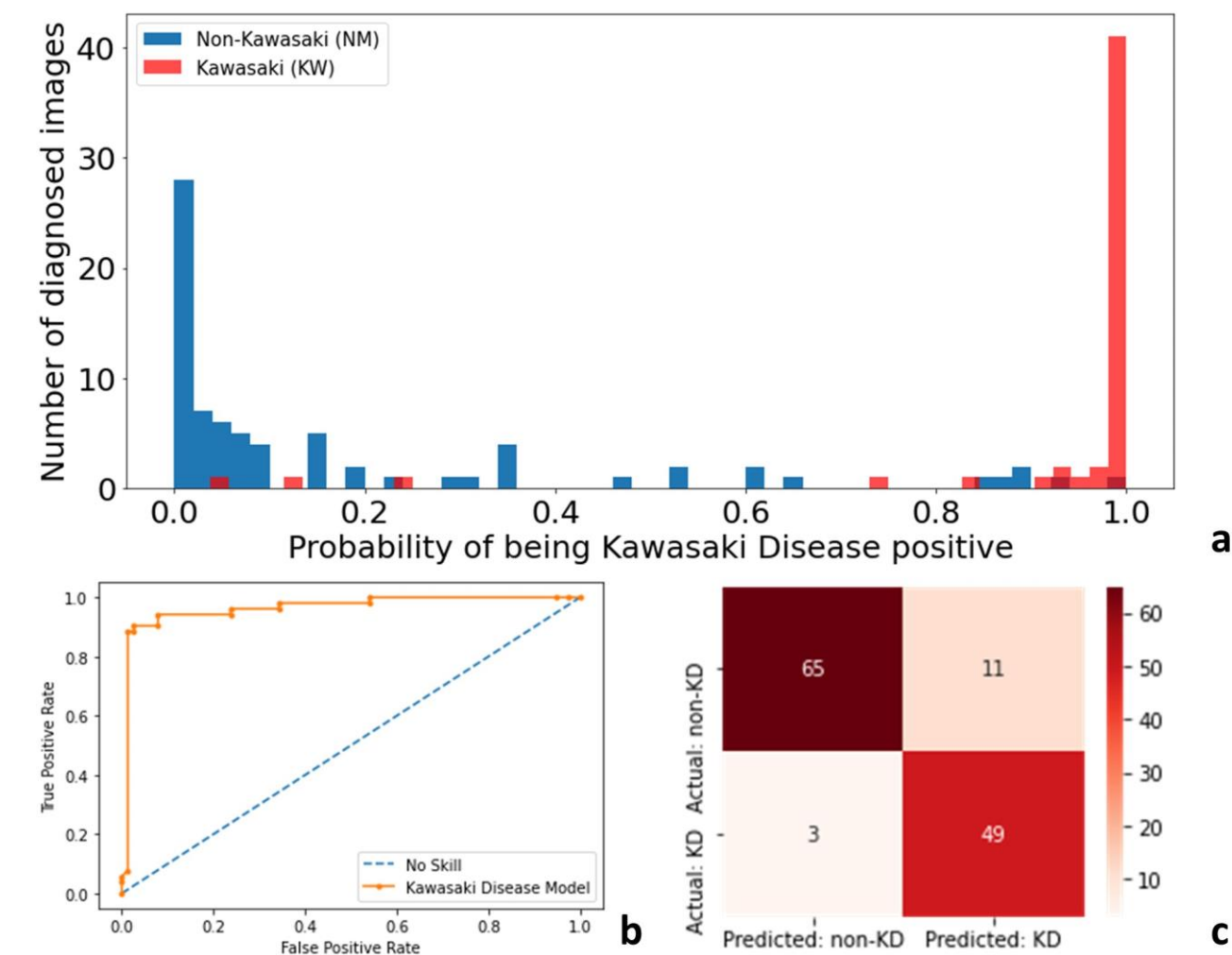
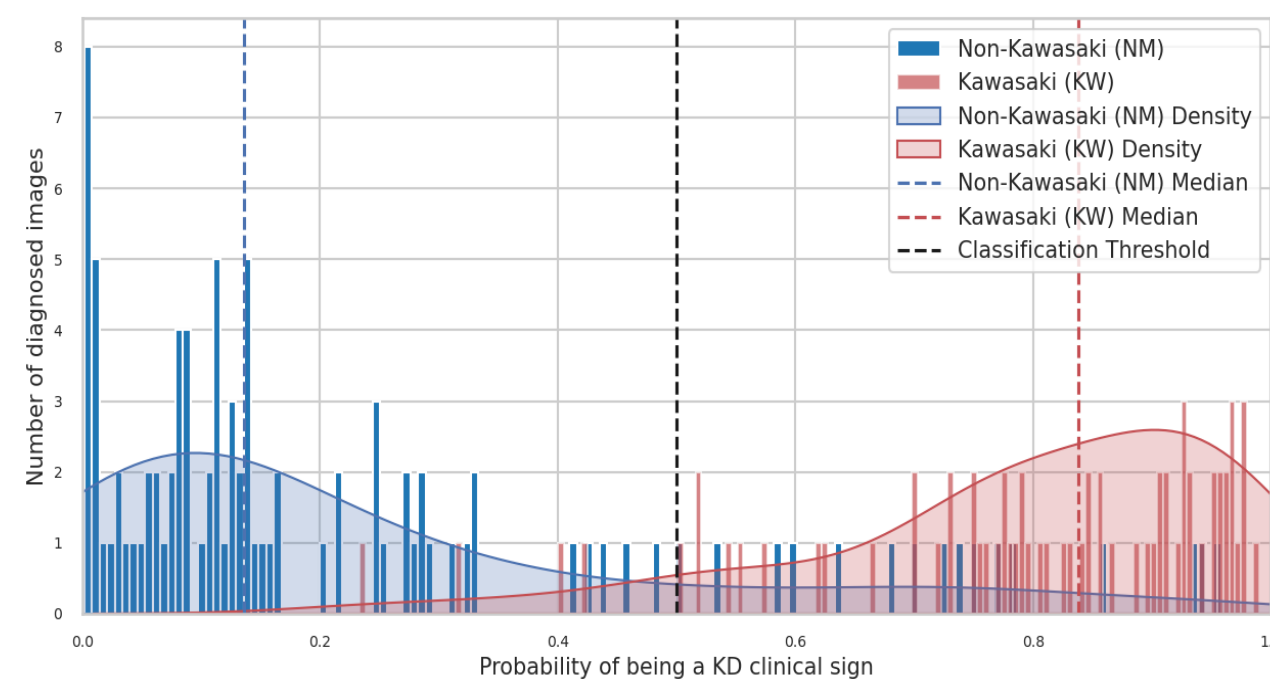
KD-CNN Model Development: Key Challenges

- 1) Learning from limited data
- 2) Mitigating class imbalance
- 3) Medical applicability evaluation



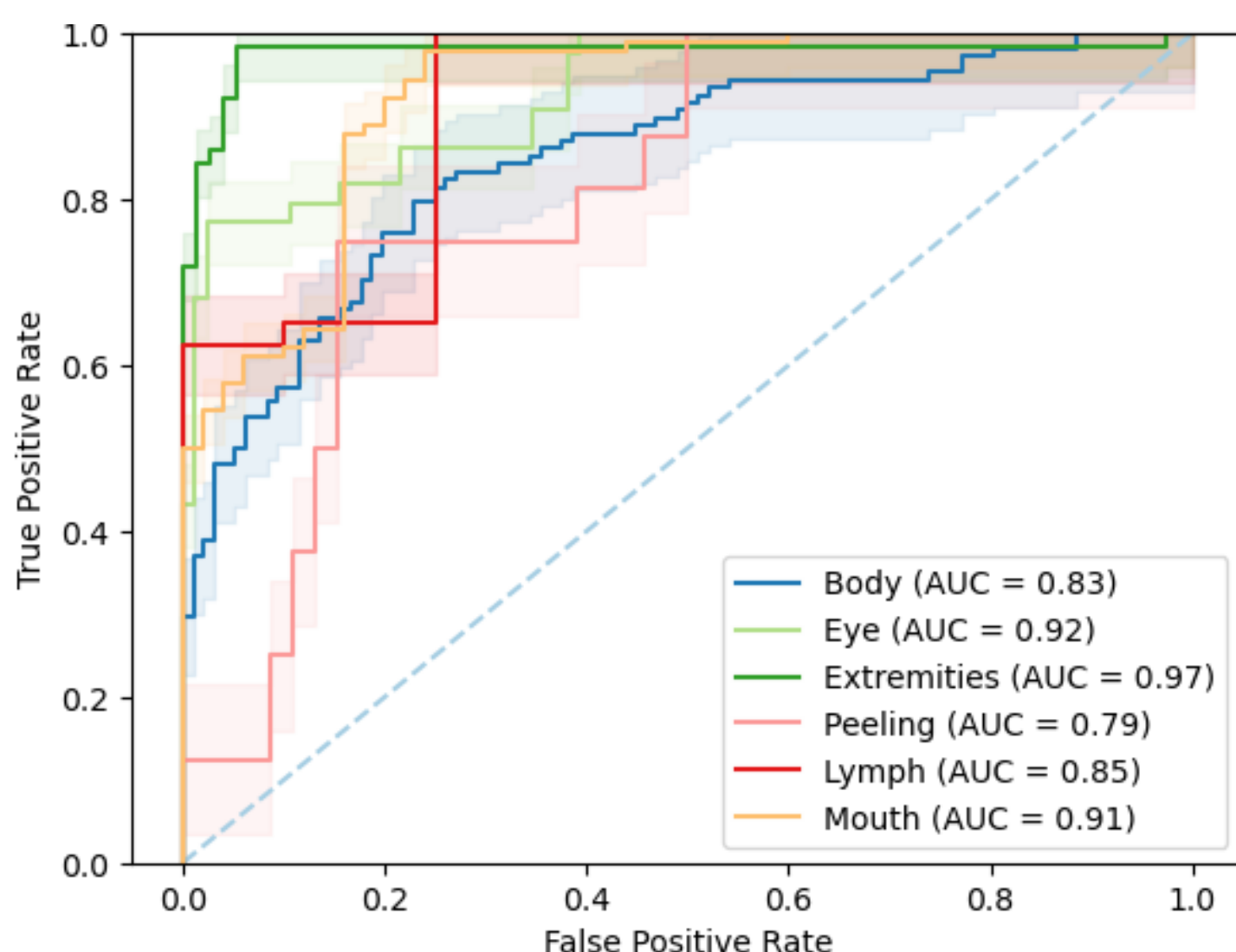
Adaptive weighted loss function increased sensitivity to correctly classify KD:

$$WL(z, y) = -\alpha_y \log \left(\frac{\exp(z_y)}{\sum_{j=1}^2 \exp(z_j)} \right) \quad \alpha_y = 1 - \frac{n_y}{N}$$



Performance quantification and examining potential sources of bias

Results & Clinical Relevance



KD-CNN achieved a median **AUC ROC of 0.90**, indicating high distinguishing capability (where 1 is a perfect classifier), with **80% sensitivity and 85% specificity**.

1. KD-CNN is the **first application** of deep learning for KD screening, which can aid in early detection and reducing coronary artery risks
2. Highlights methods for training CNNs in medical settings with **limited data**
3. **Opens doors for the future application of deep learning for medical diagnosis**