Chen T, Chefd’hotel C. Deep Learning Based Automatic Immune Cell Detection for Immunohistochemistry Images. In: Wu G, Zhang D, Zhou L, eds. *Machine Learning in Medical Imaging: 5th International Workshop, MLMI 2014, Held in Conjunction with MICCAI 2014, Boston, MA, USA, September 14, 2014. Proceedings*. Cham: Springer International Publishing; 2014:17-24. doi:10.1007/978-3-319-10581-9\_3.

CNN approaches that identify individual cells. Although poses a problem, would need to retrain model for new cell types and stains. doesn’t work for cytokines that are floating extracellularly because there aren’t any features to detect other than diffused stain.

Training takes large data sets which small labs may not have when running novel IHC experiments.

Though a tested and verified trained CNN model would be useful for popular IHC protocols.

Cataldo SD, Ficarra E, Macii E. Computer-aided techniques for chromogenic immunohistochemistry: Status and directions. *Computers in Biology and Medicine*. 2012;42:1012-1025.

For further work, if one wanted to train a ML classifier to classify scores like a particular researcher or standards body, you could use a linear SVM, multilayer perceptron, convolutional neural networks, or other classifiers on the deconvoluted images to produce a trained model. (cite) Otherwise, just use the same segmentation model to output a percentage. And score based on percentage range.

For this automated image analysis system, producing stained samples would have to undergo strict processes to reduce variability,

Include isotypes, negative and positive controls for calibration. For comparative analyses between patients, or if making a statistical model. Also stain concentration to intensity tables.