understand these technologies and be involved in current and future studies.

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Commentary: Rise of the machines

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“Never place your trust in us. We’re only human. Inevitably, we’ll only disappoint you.”

—Robert Ford, PhD

The approval of low-dose computed tomography for lung cancer screening by the US Preventive Services Task Force¹ has led to the increased diagnosis of lung nodules with an unknown malignant potential. Nodules with minor concerning features are difficult to differentiate from benign processes without tissue confirmation.² Further, differentiating lower risk malignant lesions from their more invasive counterparts preoperatively would allow surgeons to choose a less-invasive surgical procedure, such as a wedge resection instead of a lobectomy. Ashraf and colleagues³ developed 2 novel machine learning algorithms to predict diagnosis of lung nodules on computed tomography scan. The first is a support vector machine model that uses image features for classification. The second model is a deep learning convolutional neural network. Although the vector machine model requires a smaller dataset, it is much more labor intensive because every nodule requires

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CENTRAL MESSAGE

Utilizing machine learning algorithms and neural networks as an adjunct to human judgment may increase our preoperative decision making as thoracic surgeons.

segmentation. The neural network has quite a bit of potential because it requires significantly less direct user interaction, but the required dataset to learn appropriate imaging features is much larger.

How did the 2 models perform? Looking at the results from the internal training dataset (see the authors' Table 3³), both models struggled with false positives differentiating hyperplasia from adenocarcinoma in situ. What does this mean in the real world? Not much because many still recommend resection for atypical adenomatous hyperplasia. When lumping all noninvasive nodules together against invasive adenocarcinoma, both models performed well with sensitivity and specificity more than 70%. This comparison is important because it helps surgeons determine who should be treated with a sublobar resection. Size is a confounding factor in the models' ability to recognize invasive nodules

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because more than 75% of invasive lesions were >1 cm, whereas all noninvasive nodules were consistently <1 cm in size. The models also performed worse with the external dataset (see the authors' Table E2³). Likely due to overfitting, the model tries to generalize features it learned from the large Chinese dataset when evaluating University of Pittsburgh Medical Center scans.⁴ As the authors point out, tumor biology differs between these populations, but this issue is a real-world example of what machine-learning scientists will face going forward.

Ashraf and colleagues³ show us the potential of machine learning and how it can directly influence our clinical practice. Although the technology still has a ways to go before we can rely on an algorithm, we can only hope that the

next project on their agenda is a battle royale of radiologist versus machine.

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