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Validation of lung nodule detection a year before diagnosis in NLST dataset based on a deep learning system

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Background: A deep learning system for lung nodule detection from low dose CT scans was trained on a public database. This study aims to evaluate its performance on an independent screening dataset and specifically its ability to detect malignant lesions one year prior to diagnosis.

Methods: The algorithm was solely trained on the LIDC-IDRI dataset containing 888 CT scans where radiologists characterized nodules exclusively based on radiological criteria. We tested the framework on 1179 patients from the NLST study with biopsy-confirmed nodule malignancy, for which 2 CT scans are available one year apart. Among them, 177 were diagnosed with cancer the last year. For those cases, the algorithm was applied both on the image at diagnosis and on the image one year before. Thus, the NLST test dataset is larger than the LIDC training set and corresponds to distinct populations.

Results: The system detected 75% of all annotated nodules from 1179 patients, including 68% of the 2352 benign nodules and resulted in 12 extra candidate nodules per scan in average. Among the 177 malignant nodules, the system detected 172 regions of interest within 3 cm of their ground truth location corresponding to a sensitivity of 97%. The 5 undetected lesions were located next to the mediastinum. On the corresponding image one year prior to diagnosis, 20 nodules were not visible, and the algorithm detected 152 malignant nodules among the 157 visible nodules.

Conclusion: The algorithm only trained on the LIDC-IDRI dataset without any biopsy characterization of lung nodules showed good performance at detecting malignant biopsy-confirmed lesions even one year prior to their detection by radiologists.