HHS Public Access

Author manuscript

Int J Tuberc Lung Dis. Author manuscript; available in PMC 2021 January 22.

Published in final edited form as:

Int J Tuberc Lung Dis. 2020 April 01; 24(4): 362–363. doi:10.5588/ijtld.19.0805.

Computer-assisted interpretation of chest radiographs: signs of hope for silicosis and tuberculosis

A. S. Laney[1], **E. Pontali**[2]

[1]Surveillance Branch, Respiratory Health Division, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, WV, USA

[2]Department of Infectious Diseases, Galliera Hospital, Genoa, Italy

Although silicosis, tuberculosis (TB) and the comorbid condition of silicotuberculosis are diseases of antiquity, accurate and consistent diagnostic technologies for such conditions have only relatively recently been developed. Autopsies of Egyptian mummies have revealed that silicosis and TB have been accompanying mankind for at least 2500 years, and osteological evidence of TB dates to over 7000 years ago.[1,2] However, widespread use of chest radiography as a diagnostic tool for silicosis and TB were not available until the early 1900_s, and consistent and accurate diagnosis remained a challenge through the mid-20th century, particularly in resource-poor regions. Since that time, medical technology and standards have improved at a remarkable pace and experts can now—within minutes—accurately and non-invasively identify likely cases of silicosis and pulmonary TB. For population-based medical monitoring programs, using expert readers who are proficient in classifying radiographs using established systems such as the one specified in the *International Labour Office Guidelines for the Classification of Radiographs of Pneumoconioses*[3] currently remains the gold standard for consistent and high-quality assessment of radiographic findings of pneumoconiosis.

Throughout the 20th century, advances in computing technologies proceeded at the speed of Moore's law. Artificial Intelligence (AI), machine learning, and deep learning have flourished in recent years, particularly in the field of pattern recognition.[4] As radiographic classification of lung shadows is ostensibly a matter of pattern recognition, the desirability of computer-aided classification is clear, and its feasibility has been documented for a range of chest radiographic appearances.[5–8] Extensive efforts have been made in the preceding decades to operationalize this effort with varying degrees of success across a range of pulmonary diseases, including TB.[9] In this issue of the *Journal*, Young et al. present findings from a study of computer-aided detection of TB and silicosis in a group of southern African gold miners.[10] Using four existing and independent computer-assisted systems, they assessed each system's ability to detect silicosis, TB and silicotuberculosis using expert-

Correspondence to: Emanuele Pontali, Department of Infectious Diseases, Galliera Hospital, Genoa, Italy, pontals@yahoo.com.

Conflicts of interest: none declared.

determined classifications, finding better than expected sensitivities and specificities within these proprietary computer-aided detection (CAD) software programs.

One important implication of their findings is the potential for a CAD system (or an algorithm using multiple systems) to rapidly screen out chest radiographs with no abnormalities. The ability to employ a highly specific algorithm for this purpose, even at the expense of a reduction in sensitivity, would allow for much higher throughput, particularly in working populations where the majority of radiographs will be normal. This would free up expert readers to interpret radiographs that have some suspicion of abnormality. This study by Young et al.[10] is part of a rapidly expanding field of investigation to advance computer-assisted radiographic interpretations of chest radiographs.[11] Although the field is not yet fully mature, as Young et al. point out, there are a variety of ways to increase overall sensitivity and specificity of current systems. Coupled with the exponential rate of advancement in AI technology and machine and deep learning, these findings are encouraging and point to a logical strategy that involves CAD programs to provide the first line of screening of radiographs from large at-risk populations.

References

1. Cockburn A, Barraco RA, Reyman TA, Peck WH. Autopsy of an Egyptian mummy. Science 1975; 187: 1155–1160. [PubMed: 1090004]
2. Masson M, Bereczki Z, Molnar E, et al. 7000 year-old tuberculosis cases from Hungary—Osteological and biomolecular evidence. Tuberculosis (Edinb) 2015; 95 (Suppl 1): S13–S17. [PubMed: 25736538]
3. International Labour Office. Guidelines for the use of the ILO international classification of radiographs of pneumoconioses. Geneva, Switzerland: ILO, 2011.
4. Chartrand G, Cheng PM, Vorontsov E, et al. Deep learning: a primer for radiologists. Radiographics 2017; 37: 2113–2131. [PubMed: 29131760]
5. Ahmad Khan F, Pande T, Tessema B, et al. Computer-aided reading of tuberculosis chest radiography: moving the research agenda forward to inform policy. Eur Respir J 2017; 50:1700953. [PubMed: 28705949]
6. Koesoemadinata RC, Kranzer K, Livia R, et al. Computer-assisted chest radiography reading for tuberculosis screening in people living with diabetes mellitus. Int J Tuberc Lung Dis 2018; 22: 1088–1094. [PubMed: 30092877]
7. Hwang EJ, Park S, Jin KN, et al. Development and validation of a deep learning-based automated detection algorithm for major thoracic diseases on chest radiographs. JAMA Netw Open 2019; 2: e191095. [PubMed: 30901052]
8. Rajpurkar P, Irvin J, Ball RL, et al. Deep learning for chest radiograph diagnosis: A retrospective comparison of the CheX-NeXt algorithm to practicing radiologists. PLoS Med 2018; 15: e1002686. [PubMed: 30457988]
9. Harris M, Qi A, Jeagal L, et al. A systematic review of the diagnostic accuracy of artificial intelligence-based computer programs to analyze chest x-rays for pulmonary tuberculosis. PLoS One 2019; 14: e0221339. [PubMed: 31479448]
10. Young C, Barker S, Ehrlich RI, et al. Computer-aided detection for tuberculosis and silicosis in chest radiographs of Southern African gold miners. Int J Tuberc Lung Dis 2020; 24: 444–451.
11. Li Z, Wang C, Han M, et al. Thoracic disease identification and localization with limited supervision. The IEEE Conference on Vision and Pattern Recognition, 2018: pp 8290–8299.