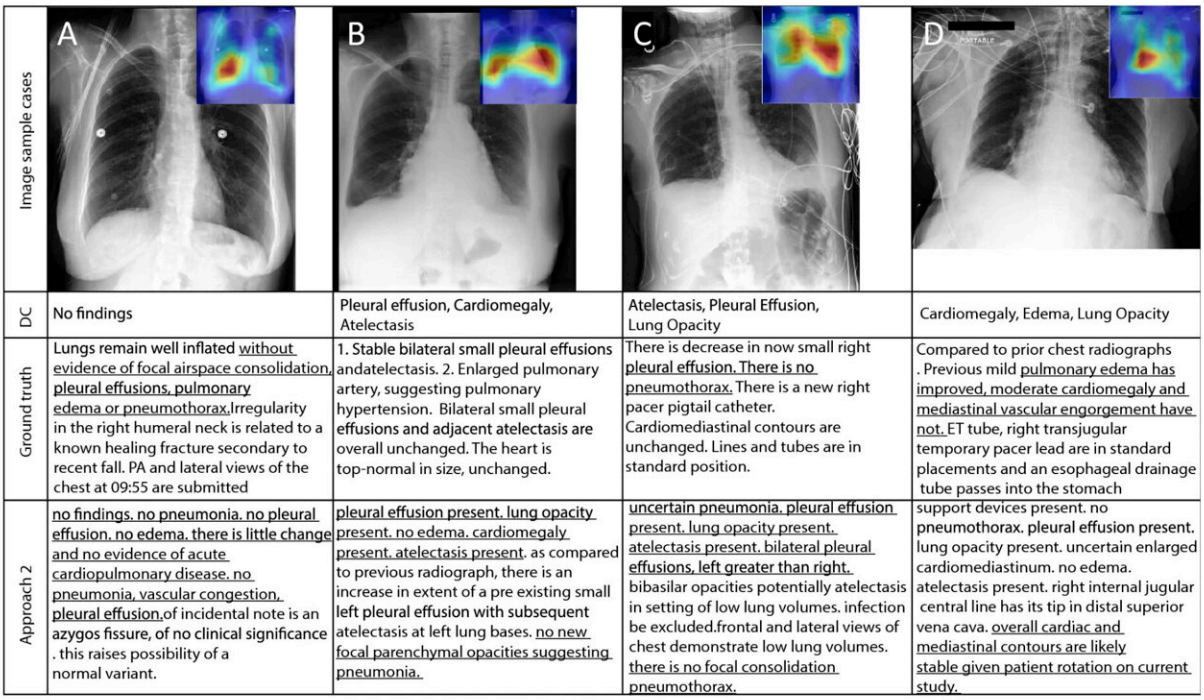
AI diagnoses lung disease based on X-rays

April 17 2023



	A	B	C	D
Image sample cases				
DC	No findings	Pleural effusion, Cardiomegaly, Atelectasis	Atelectasis, Pleural Effusion, Lung Opacity	Cardiomegaly, Edema, Lung Opacity
Ground truth	Lungs remain well inflated without evidence of focal airspace consolidation, pleural effusions, pulmonary edema or pneumothorax.Irregularity in the right humeral neck is related to a known healing fracture secondary to recent fall. PA and lateral views of the chest at 09:55 are submitted	1. Stable bilateral small pleural effusions andatelectasis. 2. Enlarged pulmonary artery, suggesting pulmonary hypertension. Bilateral small pleural effusions and adjacent atelectasis are overall unchanged. The heart is top-normal in size, unchanged.	There is decrease in now small right pleural effusion. There is no pneumothorax. There is a new right pacer pigtail catheter. Cardiomediastinal contours are unchanged. Lines and tubes are in standard position.	Compared to prior chest radiographs . Previous mild pulmonary edema has improved, moderate cardiomegaly and mediastinal vascular engorgement have not. ET tube, right transjugular temporary pacer lead are in standard placements and an esophageal drainage tube passes into the stomach
Approach 2	no findings. no pneumonia. no pleural effusion. no edema. there is little change and no evidence of acute cardiopulmonary disease. no pneumonia, vascular congestion, pleural effusion.of incidental note is an azygos fissure, of no clinical significance . this raises possibility of a normal variant.	pleural effusion present. lung opacity present. no edema. cardiomegaly present. atelectasis present. as compared to previous radiograph, there is an increase in extent of a pre existing small left pleural effusion with subsequent atelectasis at left lung bases. no new focal parenchymal opacities suggesting pneumonia.	uncertain pneumonia. pleural effusion present. lung opacity present. atelectasis present. bilateral pleural effusions. left greater than right. bibasilar opacities potentially atelectasis in setting of low lung volumes. infection be excluded.frontal and lateral views of chest demonstrate low lung volumes. there is no focal consolidation pneumothorax.	support devices present. no pneumothorax. pleural effusion present. lung opacity present. uncertain enlarged cardiomediastinum. no edema. atelectasis present. right internal jugular central line has its tip in distal superior vena cava. overall cardiac and mediastinal contours are likely stable given patient rotation on current study.

The first row contains lung X-ray images. The second row lists the diagnoses made by human radiologists. These are elaborated in the paragraphs provided in the third row. The bottom row contains comparable captions generated by the neural networks. The underlined fragments show that, while the text could clearly use some postediting, the AI- and the human-generated captions substantially coincide. Credit: Alexander Selivanov et al./*Scientific Reports*

Skoltech researchers have trained a neural network to search for lung pathologies on X-ray images and come up with brief verbal descriptions

to accompany them. This task is currently performed by physicians, and it takes several minutes to complete. According to the creators of the artificial intelligence solution, the technology lowers this time to about 30 seconds when no considerable text revision is required. In most cases, the radiologist merely has to confirm the suggested diagnosis—e.g., fibrosis, enlarged heart, or a suspected malignant tumor—or absence thereof. The study has been published in *Scientific Reports*.

The solution relies on modern machine vision and computer linguistics models, including GPT-3 small—the predecessor of the wildly popular GPT-3.5 and GPT-4 models available via the ChatGPT bot.

"Regular models merely classify, but our neural network leverages advanced machine vision and computer linguistics models to automatically describe X-ray images in words," one of its creators, Skoltech Research Scientist Oleg Rogov, commented.

The neural network is trained on data composed of image-text pairs. "We compiled our own radiological dictionary to make the model more accurate, specifically where radiological terms and their usage in texts are concerned. Naturally, we also put together a large integrated database of X-ray images for use as training data," Rogov added, emphasizing that the neural network is only "aware" of those diagnoses that can actually manifest themselves on lung X-rays. The training set was balanced in terms of which diseases are represented.

Possibilities for further development of the system include its application to MRI and CT scans, as well as incorporating active learning. The latter refers to models improving their predictions by taking into account what edits human reviewers make. The solution could also be combined with another neural network, which would graphically highlight the areas of interest mentioned in the caption.

More information: Alexander Selivanov et al, Medical image captioning via generative pretrained transformers, *Scientific Reports* (2023). DOI: 10.1038/s41598-023-31223-5