Figure 3. X-ray original image and its enhanced versions and the segmented lung region of each version.

the training process, it was found that the size of 112×112 pixels expedited the training without affecting the performance metrics.

Classification using pre-trained convolution neural network model

In this research, different versions of either full or segmented chest X-ray images have been introduced to CNN models to train the classifiers. Different experiments have been carried out on the original and segmented lung X-ray images both with their different enhanced versions. The classification has been done using VGG19[14] and EfficientNetB0[16] pre-trained CNN models. After the calculation of different performance metrics, the best model has been selected as the adopted model. The next subsections give a brief description of the used pre-trained models.

VGG19 model

VGG19 is a variant of the VGG CNN model which was created by Visual Geometry Group (VGG) at Oxford University. VGG19 was one of the winners of the Image Net Large Scale Visual Recognition Challenge (ILSVRC) in 2014. The size of the input image to VGG19 is (224×224). VGG19 contains 16 convolution layers, 5 max-pooling layers and 3 fully connected layers. The convolution layers are with (3×3) filters' size, stride of 1 pixel and padding of 1 pixel. The max-pooling layers are with a size of 2×2 and a stride of 2. The rectification (ReLU)