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COMPUTER-AIDED DETECTION AND IDENTIFICATION OF IMPLANTED CARDIAC DEVICES ON CHEST RADIOGRAPHY UTILIZING DEEP CONVOLUTIONAL NEURAL NETWORKS, A FORM OF MACHINE LEARNING

Moderated Poster Contributions
Arrhythmias and Clinical EP Moderated Poster Theater, Poster Hall, Hall F
Sunday, March 17, 2019, 10:00 a.m.-10:10 a.m.

Session Title: Understanding Implantable Cardioverter Defibrillators
Abstract Category: 05. Arrhythmias and Clinical EP: Devices
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Authors: *Michael Weinreich, Brian Weinreich, Jay J. Chudow, Talia Krumerman, Kusha Rahgozar, Tonusri Nag, Eric Shulman, John Fisher, Kevin J. Ferrick, Montefiore Medical Center, New York, NY, USA*

Background: Identification of implanted cardiac devices is paramount to effective care of patients in the emergency department, operating room, radiology suite, and electrophysiology laboratory. However, without the knowledge of a specific device manufacturer, programming and interrogation procedures cannot be completed. The use of deep convolutional neural networks—a type of artificial computer learning—have allowed for the development of radiographic image recognition algorithms of implanted devices.

Methods: We obtained chest X-rays from patients with implanted pacemakers or defibrillators between 2016-2018 at a single institution. The x-ray images were de-identified and subsequently coded as one of four device manufacturers: Medtronic, St. Jude Medical, Boston Scientific, and Biotronik. From the raw x-ray images, we cropped each image into 400x400px single channel files. We utilized a deep convolutional neural network strategy via a commercially available computational platform to train a model based on the test images. Model parameters were sequentially modified to select the optimal number of neurons and hidden layers producing the highest accuracy, with minimal loss. Validation was completed with the remaining images and Pearson's chi-squared test was used to demonstrate statistical significance.

Results: A total of 1013 chest X-rays with a training:validation ratio of 8:2 were collected. A model with 8, 16, 32, 64 neurons was used. Accuracy was assessed on 203 testing images with correct classification in 191/203 (94.08%; $p < 0.0001$) of cases at 90 epochs. The low level of loss variation suggests avoidance of an overfit statistical model.

Conclusion: Here we report the development and validation of an automated computer-aided detection model to identify implanted cardiac devices on chest radiography with a high accuracy using a machine learning approach. This has the potential to facilitate device identification and interrogation in urgent scenarios in a medical setting with limited EP resources. Development of a mobile device ("app") is planned to assist providers as a point-of-care tool as well as assess MRI compatibility.