MedicalXpress

Study examines use of deep machine learning for detection of diabetic retinopathy

November 29 2016

In an evaluation of retinal photographs from adults with diabetes, an algorithm based on deep machine learning had high sensitivity and specificity for detecting referable diabetic retinopathy, according to a study published online by *JAMA*.

Among individuals with diabetes, the prevalence of diabetic retinopathy is approximately 29 percent in the United States. Most guidelines recommend annual screening for those with no retinopathy or mild diabetic retinopathy and repeat examination in 6 months for moderate diabetic retinopathy. Retinal photography with manual interpretation is a widely accepted screening tool for diabetic retinopathy.

Automated grading of diabetic retinopathy has potential benefits such as increasing efficiency and coverage of screening programs; reducing barriers to access; and improving patient outcomes by providing early detection and treatment. To maximize the clinical utility of automated grading, an algorithm to detect referable diabetic retinopathy is needed. Machine learning (a discipline within computer science that focuses on teaching machines to detect patterns in data) has been leveraged for a variety of classification tasks including automated classification of diabetic retinopathy. However, much of the work has focused on "feature-engineering," which involves computing explicit features specified by experts, resulting in algorithms designed to detect specific lesions or predicting the presence of any level of diabetic retinopathy. Deep learning is a machine learning technique that avoids such engineering and allows an algorithm to program itself by learning the

most predictive features directly from the images given a large data set of labeled examples, removing the need to specify rules explicitly. Application of these methods to medical imaging requires further assessment and validation.

In this study, Lily Peng, M.D., Ph.D., of Google Inc., Mountain View, Calif., and colleagues applied deep learning to create an algorithm for automated detection of diabetic retinopathy and diabetic macular edema in retinal fundus (the interior lining of the eyeball, including the retina, optic disc, and the macula) photographs. A specific type of network optimized for image classification was trained using a data set of 128,175 retinal images, which were graded 3 to 7 times for diabetic retinopathy, diabetic macular edema, and image gradability by a panel of 54 U.S. licensed ophthalmologists and ophthalmology senior residents between May and December 2015. The resultant algorithm was validated using 2 separate data sets (EyePACS-1, Messidor-2), both graded by at least 7 U.S. board-certified ophthalmologists.

The EyePACS-1 data set consisted of 9,963 images from 4,997 patients (prevalence of referable diabetic retinopathy [RDR; defined as moderate and worse diabetic retinopathy, referable diabetic macular edema, or both], 8 percent of fully gradable images; the Messidor-2 data set had 1,748 images from 874 patients (prevalence of RDR, 15 percent of fully gradable images). Use of the algorithm achieved high sensitivities (97.5 percent [EyePACS-1] and 96 percent [Messidor-2]) and specificities (93 percent and 94 percent, respectively) for detecting referable diabetic retinopathy.

"These results demonstrate that deep neural networks can be trained, using large data sets and without having to specify lesion-based features, to identify diabetic retinopathy or diabetic macular edema in retinal fundus images with high sensitivity and high specificity. This automated system for the detection of diabetic retinopathy offers several

advantages, including consistency of interpretation (because a machine will make the same prediction on a specific image every time), high sensitivity and specificity, and near instantaneous reporting of results," the authors write.

"Further research is necessary to determine the feasibility of applying this algorithm in the clinical setting and to determine whether use of the algorithm could lead to improved care and outcomes compared with current ophthalmologic assessment."

More information: *JAMA*, DOI: 10.1001/jama.2016.17216

Provided by The JAMA Network Journals