

From Machine to the Real World: Assessing the Accuracy of a Machine-to-Machine (M2M) Deep Learning Model to Detect Glaucoma during a Population-Based Screening Effort in Brazil

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Abstract

Purpose : To evaluate the ability of a deep learning model trained to objectively quantify neural loss in fundus photographs to detect patients with glaucoma during ophthalmic screening in Brazil.

Methods : A deep convolutional neural network was trained to objectively predict retinal nerve fiber layer thickness from fundus photographs using 66,555 pairs of optical coherence tomography and photos from 10,144 eyes of 6,039 subjects. Data for training and validation of the algorithm was extracted from the Duke Glaucoma Registry. The trained Machine-to-Machine (M2M) deep learning model was then subsequently used to objectively detect glaucomatous damage on the fundus photographs of 3347 eyes of 1,990 subjects examined as part of population-based screening projects in 3 cities of Brazil (Bahia, Curitiba and Rio de Janeiro). Fundus photographs during the screening projects were obtained with a smartphone-based fundus camera (Phelcom Eyer, Phelcom). Photographs were also subjectively assessed by masked graders.

Results : The trained M2M model predictions had high correlation with the actual RNFL thickness measurements on the DGR dataset ($r = 0.81$; $P < 0.001$). When tested in the

discriminate eyes detected as glaucomatous versus normal, if graders were used as the reference standard ($P < 0.001$).

Conclusions : A deep learning model trained to quantify neural damage on fundus photographs was able to objectively detect glaucomatous damage on data from a real-world screening project.

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