Rapid grading of fundus photos for diabetic retinopathy using crowdsourcing (#5356)

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Building a Corps of Citizen Scientists: *Turker Comments*

"This HIT was very good and a nice break from all of the bubbling surveys. Thank you!"

"I have learn about diabetes little bit"

"I really liked seeing the pics of the eye, very interesting"

Future Directions:

- Further refine AMT methodology and interface.
- Expansion of AMT model to large public image datasets.
  - Messidor (n=1200)
- Seek mechanisms to facilitate use of this tool in prospective screening programs.

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Purpose

To develop and validate a novel method for fundus photo grading.

Methods

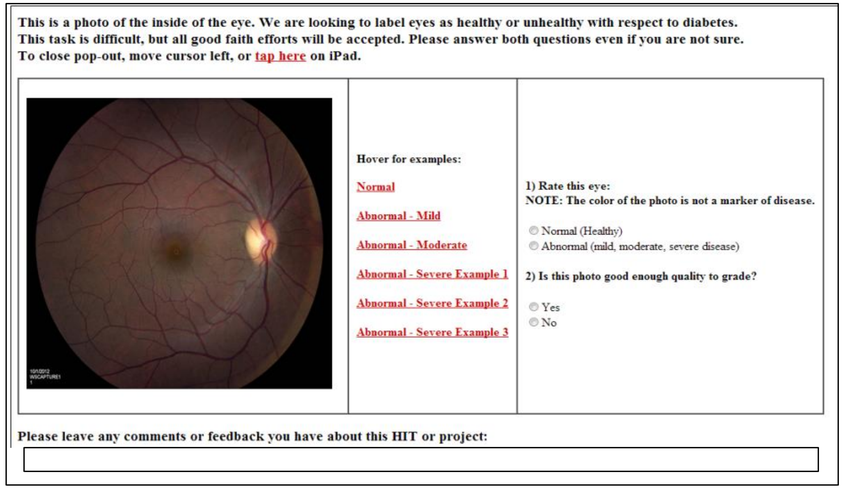
An interface for fundus photo classification was developed for Amazon.com's crowd-sourcing interface (AMT), including 6 annotated training images.

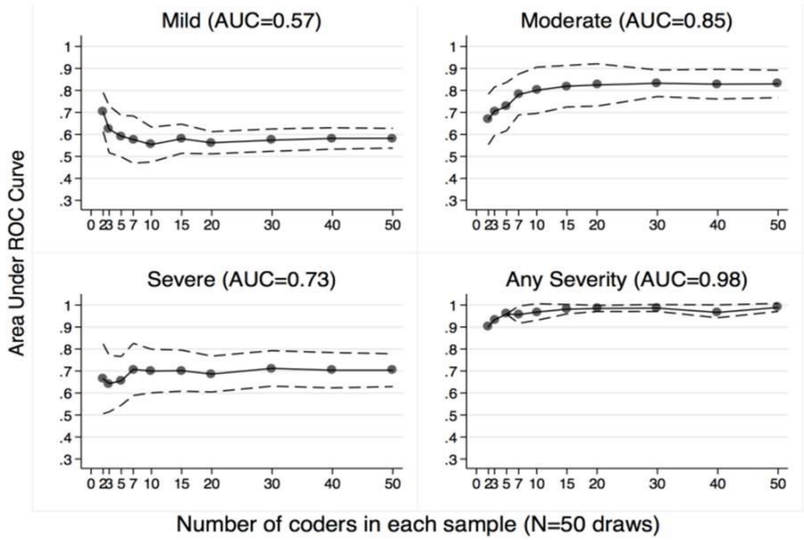
Phase I:

- 19 expert-graded images were posted to AMT for grading by anonymous workers (AWs), with 10 repetitions per photo for an initial proof-of-concept
- AW's were asked to sequentially grade images as:
  - Normal/Abnormal
  - Normal/Mild to moderate/Severe
  - Normal/Mild/Moderate/Severe

Phase II

- 1 image from each of 4 grading categories posted for 500 unique AW interpretations to determine the ideal number of graders.





Mean Time to complete ratings (in seconds)

	Normal/Abnormal (Two-category rating)	Normal/Mild to moderate/ Severe (Three-category rating)	Normal/Mild/Moderate/ Severe (Four-category rating)
Mean time to complete HITs (95% CI)	**25.16 (21.93 - 28.38)**	**50.87 (43.18 - 58.55)**	**54.52 (46.15 - 62.88)**
Effective hourly wage	$14.31	$7.08	$6.60

Results

- **Phase I:**
  - Sensitivity and specificity for any abnormality vs. normal were consistent across the three batches at 93.6-96.4% and 66.7-68.9%
  - Average time to grade each image was 25 seconds, including time to review training images.
- **Phase II:**
  - Maximum AUC was reached after 7 graders for normal versus abnormal (AUC=0.98).
  - AUC was asymptotic after 10 graders for mild , moderate, or severe vs. normal.

Conclusions

- With minimal training, the AMT workforce can rapidly and correctly categorize fundus photos of diabetic patients as normal or abnormal.
- This represents a novel and inexpensive ($1/image) means to screen for diabetic retinopathy.
- Possibilities for microenterprise in emerging markets.