Telemedicine Diagnostic Challenges for Diabetic Retinopathy

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- Financial Disclosures
  - None

Telemedicine Diabetic Retinopathy Screening

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- Performed in primary care setting
- Nonmydriatic fundus camera
- Images transmitted to reading center, reviewed and report returned to primary care physician OR
- Automated image analysis performed at point of care

Telemedicine Diabetic Retinopathy Screening

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- Diagnostic Challenges
  - Ungradable images
  - Diabetic macular edema
  - Wide-field imaging
  - Other pathology

Ungradable Images

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- What is an ungradable image?

Ungradable Images

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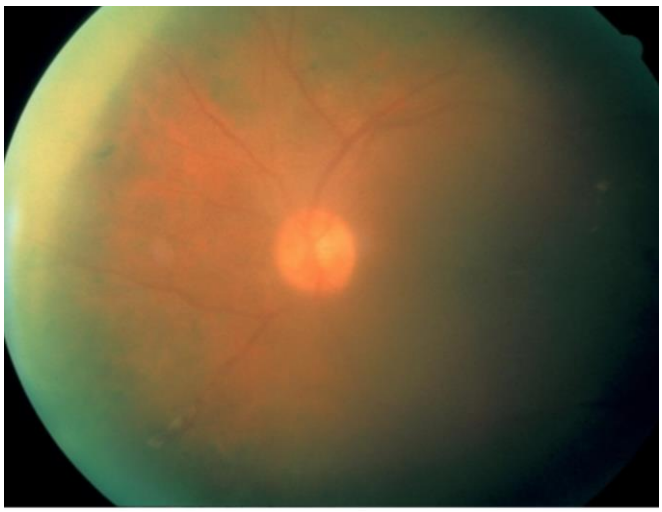
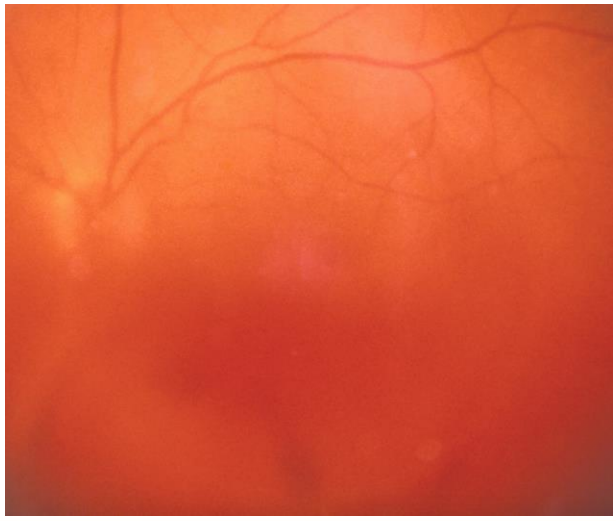


Ungradable Images



Ungradable Images

- Image quality depends on
  - Imaging device
  - Acquisition procedures
  - Operator
  - Patient

Ungradable Images

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- Validation
  - Comparing a telemedicine diabetic retinopathy evaluation protocol to a reference standard
  - Clinical validation is outcome oriented
    - How well is presence or absence of any disease detected
    - Presence or absence of moderate or worse diabetic retinopathy
    - Presence or absence of vision-threatening disease
    - Presence or absence of specific diabetic retinopathy lesions

Ungradable Images

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- Validation
  - Sensitivity, specificity, false positives, false negatives, positive and negative predictive value
  - Both good sensitivity and good specificity are important
    - Higher sensitivity reduces false negatives
    - Higher specificity reduces false positives (which reduce efficiency and increase cost)
  - Target sensitivity 80% and specificity 95% suggested as minimum performance standards

Ungradable Images

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- Validation
  - Sensitivity and specificity calculations must include ungradable images
    - High ungradable rates act to lower specificity since ungradable images result in referral
  - Minimum acceptable value of 5% ungradable rate suggested by UK Diabetic Retinopathy Screening Program

Ungradable Images

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- Validation
  - How sensitive can the system be made (minimize false negatives) with manageable level of specificity
  - Measures must be tied to a particular diagnostic target to have clinical relevance
  - Ongoing relevance of a program's validation can only be established with robust quality assurance

Diabetic Macular Edema

- Clinically includes identification of retinal thickening
  - Requires OCT or stereo imaging
- Without assessment of retinal thickening, interpretation is based on surrogate markers (hard exudates, microaneurysms, hemorrhages in macula)

Diabetic Macular Edema

- Macular edema is not completely defined or identified by surrogate markers
- Surrogate markers may be present in absence of macular edema

Wide Field Imaging

- More than 3 times retinal surface area imaged than conventional fundus cameras
- Reduced ungradable rate
- Reduced imaging time
- Large and expensive

Wide Field Imaging

- Diabetic retinopathy severity level more severe in up to 10% compared to field of view of reference standard
- Relevance with existing knowledge base for detection and treatment of diabetic retinopathy

Other Posterior Segment Pathology

- Detection of signs of other diseases such as glaucoma and macular degeneration

Artificial Intelligence

- Culture change
- Are physicians and patients in the primary care setting ready to trust what a machine “thinks” and “sees?”

Telemedicine Diagnostic Challenges for Diabetic Retinopathy

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- Proper integration of telemedicine into a systematic approach that optimizes conventional and telemedicine strategies is paramount
- Further development and adoption of standardized operations for telemedicine diabetic retinopathy screening [and appropriate reimbursement] are needed to realize its full potential for diabetic eye disease