Telemedicine Diagnostic Challenges for Diabetic Retinopathy

Ingrid Zimmer-Galler, M.D.
Johns Hopkins Office of Telemedicine

Financial Disclosures
• None
Telemedicine Diabetic Retinopathy Screening

• 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

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

• What is an ungradable image?
Ungradable Images

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

• 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

• 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

• 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

• 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

- 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