Human Grading Versus Retmarker Automated Grading System in Diabetic Retinopathy Screening

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Background and Aims

Evaluate the benefits of using automated grading system (Retmarker technology, www.remarker.com, Critical Health SA) in screening Diabetic Retinopathy and compare this system with the golden standard (human grading).

Materials and Methods

Anonymous Retinal images (2 per eye) from 1092 patients screened between 2009 and 2010 were obtained using a 45-degree fixed Cannon-45NM non-mydriatic camera on a Diabetic Retinopathy screening program run by APDP - Associação Protectora dos Diábéticos de Portugal, www.apdp.pt.

Images were taken and graded by an experienced ophthalmologist. Additionally, images were evaluated by an automated grading system – Retmarker – with two possible outcomes: “Disease” or “No disease”. The outcome is “Disease” when signs of treatable disease are detected and “No Disease” when no such signs are found.

Retmarker technology performs a 2-step analysis based on the detection of Microaneurysms and Lesion Activity (progression) within the macular region. Results of the automated analysis were compared with those obtained manually by experienced ophthalmologists.

Finally, an image quality evaluation module was tested. Using this module all retinographies considered as with insufficient quality (illumination and contrast) are referred to a specialist.

Results

From 1092 patients Retmarker software classified 553 (50.6%) as having “No disease” and 539 (49.4%) as having “Disease”, thus requiring further manual grading.

Retmarker achieved a sensitivity of 81.4% and a specificity of 52% with a negative predictive value of 98.6% and a positive predictive value of 6.5% when compared with human grading based on patient referral criteria.

Out of the 1092 patients a total of 8 cases (0.73%) marked by the human grading as having signs of Diabetic Retinopathy were not detected by the automated system.

Making use of the image quality evaluation module, sensitivity increases, only 4 cases are not referred and specificity slightly decreases.

Table 1 - Retmarker Automated Grading vs Human Grading

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>True Positive</th>
<th>False</th>
<th>True</th>
<th>False</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Negative Predictive Value</th>
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</thead>
<tbody>
<tr>
<td>Automated Algorithm</td>
<td>1092</td>
<td>35</td>
<td>504</td>
<td>545</td>
<td>8</td>
<td>81.4%</td>
<td>52.0%</td>
<td>98.6%</td>
</tr>
<tr>
<td>Automated Algorithm with Image Quality Evaluation</td>
<td>1092</td>
<td>38</td>
<td>602</td>
<td>447</td>
<td>4</td>
<td>90.7%</td>
<td>42.8%</td>
<td>98.1%</td>
</tr>
</tbody>
</table>

Conclusion

Automated grading of Diabetic Retinopathy may safely reduce the burden of grading patients with and without disease in Diabetic Retinopathy screening programs.

The novel two-step automated analysis system using Retmarker has the capability to reduce the workload of human grading by approximately 60.6%, while achieving a high sensitivity of 81.4% (or 90.7% with the inclusion of image quality evaluation), as detailed in table 1.

Non-automated screening programs are associated with high costs. Applying an automated program, such as the described, an important reduction in the number of cases that experts need to grade can be achieved, thus driving significant cost savings.

Most importantly, an automated system, although not providing full detection, provides consistency by eliminating subjectivity.

In addition, by combining fundus exams it becomes possible to obtain information regarding the activity of the disease (using co-registration of consecutive fundus exams), which is difficult to achieve without an automated tool with co-registration capabilities such as the one herein presented.