Introduction
Uncorrected refractive error is the leading cause of preventable visual impairment worldwide.

- As of 2010, 108 million people were living with moderate to severe vision impairment caused by uncorrected refractive error alone.1
- Vision impairment from uncorrected refractive error causes significant social (reduction in employment) and economic impact ($280 billion loss to global economy due to lost productivity).3
- 90% of this vision impairment occurs in low to middle-income countries and is due to a lack of eye care providers and eye care resources.3
- The World Health Organization (WHO) estimates 656,000 more eye care professionals (OD, MD, opticians) for providing refraction services for the 270 million people in need, costing up to $2.2 billion in facilities and personnel training.4
- One alternative studied is the use of self-adjusting spectacles. Previously, two prototypes (fluid-filled and airwave designs) have proven to offer excellent visual acuity in adults and children.5
- Although these designs were inexpensive, their disadvantages include poor contrast, glare, and poor optical quality.6
- The limitations with these spectacle options led to the creation of the USee device.

Methods

Subjects:
- 48 students from the New England College of Optometry (mean age: 26.2 years, 59.2% female) with:
  - Uncorrected visual acuity of 20/40
  - Known spherical equivalent (SE) refraction error of:
    - ≤ 6.00D myopia or hyperopia in both eyes
    - ≤ 2.00D astigmatism in both eyes

Procedure:
- 1. Auto-refraction
- 2. Monocular self-refraction by the 1See device
- 3. Visual acuity (VA) through pop-in spectacles using the 1See device
- 4. Vision through -1.00SD over the pop-in spectacles
- 5. Clinical manifest refraction by the investigator
- 6. Exit survey on the USee device experience

Evaluation Criteria:
- 1. Monocular VA for the past 30 days
- 2. Significant ocular pathology including amblyopia and or strabismus
- 3. Vision 20/30 or better WITHOUT correction in both eyes

Results

Table 1. Characteristics of Study Population (N = 48)

<table>
<thead>
<tr>
<th>Mean (SD) Age (in years)</th>
<th>25.5 (4.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range (in years)</td>
<td>23 – 42</td>
</tr>
<tr>
<td>Gender (% M/F)</td>
<td>41/59</td>
</tr>
<tr>
<td>Handedness, n (%)</td>
<td>55/45</td>
</tr>
<tr>
<td>Race</td>
<td>African American: 0</td>
</tr>
<tr>
<td>European Origin</td>
<td>66/34</td>
</tr>
<tr>
<td>Asian</td>
<td>28/72</td>
</tr>
</tbody>
</table>

Table 2. Distribution of visual acuity (VA) after refraction.

<table>
<thead>
<tr>
<th>Time Since Last Glasses Worn (in years)</th>
<th>Before Prescription</th>
<th>After Prescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/15 (1.0)</td>
<td>20/15 (1.0)</td>
<td>20/15 (1.0)</td>
</tr>
<tr>
<td>0.15 (0.1)</td>
<td>0.15 (0.1)</td>
<td>0.15 (0.1)</td>
</tr>
<tr>
<td>0.10 (0.1)</td>
<td>0.10 (0.1)</td>
<td>0.10 (0.1)</td>
</tr>
</tbody>
</table>

Table 3. Difference in Spherical Equivalent (SE) in Diopters

<table>
<thead>
<tr>
<th>SE (Diopters)</th>
<th>Mean (SD)</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right eye</td>
<td>-0.16 (0.9)</td>
<td>0.18 (0.6)</td>
<td>-2.23, 3.125</td>
</tr>
<tr>
<td>Left eye</td>
<td>0.1857</td>
<td>0.1857</td>
<td>-2.23, 3.125</td>
</tr>
</tbody>
</table>

Results - cont’d

Figure 1. Modified Bland Altman of difference in SE (MRx vs USee) for right eye.

- “How Would You Rate Your Vision With the Pop-in Glasses?”
- Scoring Criteria: 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent

Discussion

- This pilot study compared the novel self-refraction device (USee) to conventional refraction in adults.
- The mean BCVA was identical between USee refraction and manifest refraction in the better eye. These results are comparable to previous studies with fluid-filled and Airwave designs.
- One difference in this study was the inconsistency between the right and left eyes. Clinical BCVA and USee BCVA were similar for the right eye, but more variable in the left eye. Such results may reduce the impact of the majority (95.9%) of our subjects being right-handed.
- Self-refraction in adults may affect usage in adults. The final vision with the device is better than no correction at all. No prior research has discussed subjective acceptance of self-adjustable spectacles.
- Future research will focus on overall visual function (autostereopsis, contrast, glare) and self-esteem.
- The major limitation of this study was the small sample size. All subjects were also students at the New England College of Optometry with prior visual correction.

Conclusion

- Self-refraction with the USee device demonstrates comparable measures of SE and BCVA to that of manifest refraction and accommodation for low to moderate refractive errors in young adult optometry students.
- Ultimately, it is hoped that the USee can be used to refract and prescribe glasses for patients in developing countries where eye care resources are scarce.
- Future studies will focus on the usability of the USee device in a broader range of ages, including children.

References