Evaluation of A Low Cost Ophthalmoscope (Arclight) For Red Reflex Assessment Amongst Health Care Workers in Malawi

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Red Reflex Video using Arclight Attached to Mobile Phone Camera
What is the importance of an accurate red reflex assessment?

- **Normal reflex**
- **Red reflex absent**
- **Red reflex abnormal**
Cataract

Lifelong Blindness
Retinoblastoma
Death
Research Article
The Arclight Ophthalmoscope: A Reliable Low-Cost Alternative to the Standard Direct Ophthalmoscope

Andrew Blaikie and colleagues discuss the Arclight, a cheap, portable device for use in low and middle-income countries that was inspired by a Christmas article in The BMJ.

"Wow, it really works!"—eternal health worker, Malawi, 2016

"Less is more"—Peter Belfer, Archimedes, 1868–1940

Around 285 million people in the world are estimated to be visually impaired, and 360 million are hearing impaired. With the majority of cases considered preventable or treatable if diagnosed promptly. Ophthalmoscopes and otoscopes are typically designed for wealthy countries and are complex, heavy, and expensive; their basic designs have remained relatively unchanged for over 100 years. Very few practitioners in low and middle-income countries have these essential tools. If they do, they are typically hand-held items that don't work because they need pads that are hard to find or expensive, such as bulbs and batteries. Instead of relying on these outdated tools, the Arclight was conceived to meet the needs of low and middle-income countries.

Frugal inspiration from The BMJ at Christmas

In 2009 the Christmas issue of The BMJ contained an article describing a cheap, homemade ophthalmoscope. This inspired the Arclight, a prototype pocket-sized (110 mm x 110 mm x 9 mm), weighing 143 g ophthalmoscope, otoscope, and lamp powered by a slim rechargeable lithium battery that is charged by an integrated solar panel and illuminated by a powerful LED light source (figs 1 and 2).

The Fred Hollows Foundation offered seed development funding to develop the prototype into a device ready for market. The simplified design has considerably lower production costs, and the Arclight is now available to low-income users through the standard list of the International Agency for the Prevention of Blindness at a fraction of the cost of traditional devices. Several thousand devices have been distributed to countries around the world, including Malawi, Ethiopia, Kenya, Tanzania, Rwanda, Ghana, Fiji, Indonesia, and the Solomon Islands, enabling healthcare workers to perform comprehensive eye and ear examinations for the first time.

Changing care

The Arclight is tailored to the conditions and needs of low-resource settings so it can be used to identify the most common causes of vision and hearing loss. Although it is still in the early stages of evaluation, preliminary studies from Scotland, Malawi, and Tanzania indicate that the device is more effective than traditional tools for teaching ophthalmoscopy in just a few minutes for screening for signs of diabetic retinopathy and cataract. Studies for other conditions requiring an "alertness" examination, such as congenital cataract and retinoblastoma, which has diagnosed can lead to poor visual outcomes and even death, are currently underway. Consequently Sense International is using the Arclight in a large screening programme of infants aged 0–5 years in Kenya and Uganda. "The hope of the device is being used by the Fred Hollows Foundation in Ethiopia to screen for trachoma for the prevention of blindness that is estimated to affect over three million people worldwide. The otoscope has also been used in Malawi to identify and treat middle ear disease and common infections as part of a hearing impairment prevention programme.

Feedback from formal training with users in Malawi identified several barriers to care, including the need for access to relevant
Aims

- To quantitatively and qualitatively compare the AO with a TDO in the assessment of a range of red reflexes in simulated eyes by Malawian health care workers.
Methods

• 19 optometry students, School of Optometry
• 17 paediatric doctors, Kamuzu Central Hospital
Methods

• Participants were randomly selected to start with either the AO or the TDO (Keeler) before ‘crossing over’ to use the other device.
Methods

• Tested on a selection of ‘simulated eyes’ with a range of ‘pathologies’ and ‘normal’ eyes

• Ease of use (EOU) scores (1 = very easy and 5 = very hard) were recorded and participants were subsequently interviewed.
Simulated Eyes Appearance

Normal
Cataract
Retinoblastoma
## Results

Detection of ‘normal’ and ‘abnormal’ red reflexes

<table>
<thead>
<tr>
<th></th>
<th>Arclight</th>
<th>TDO</th>
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</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>85.4%</td>
<td>83.3%</td>
</tr>
<tr>
<td>Specificity</td>
<td>77.8%</td>
<td>86.1%</td>
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Ease of Use Scores

![Chart showing ease of use scores with frequency on the y-axis and ease of use score on the x-axis. The chart compares AO (in orange) and TDO (in blue). The score 1 has the highest frequency, followed by scores 2 and 3, with scores 4 and 5 having the lowest frequencies.]
Device Preference

Arclight

24

Traditional

1

8
“At outreaches there is no electricity and you run out of power, so with the Arclight you can easily charge it in the sun!”
“The Arclight is so portable, you can easily take it to the village where most people live”
Both groups felt the appearance of the AO was less intimidating and consequently was likely to be of benefit in the examination of young children.
Conclusions

• The Arclight is an equally effective alternative to a traditional direct ophthalmoscope for assessment of the red reflex.

• Its low cost, compact size and solar powered LED illumination make it an ideal tool for a low resource setting.

• The device would benefit health care workers performing adult eye screening, newborn examinations and immunisation programmes in LMICs.

• Further studies should be performed in real world situations.
STOP PRESS!!!!!!

Tanzania
References


Thank You!
Any Questions?