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An application for investments in cataract surgery, Ethiopia

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Evaluation of an application for investments in cataract surgery, Ethiopia

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Abstract

Problem The World Health Organization recommends a benchmark for uncorrected visual acuity of $\geq 6/12$ in 80% of patients at 4 to 6 weeks following cataract surgery. In low-resource countries, reaching this benchmark is challenging and assessing progress is difficult.

Approach This intervention involved modest investments recommended by the Better Operative Outcome Software Tool (BOOST) application (app). The investments targeted specific causes of poor cataract surgery results at hospitals in Ethiopia to improve vision outcomes. Fifteen ophthalmic surgeons from 11 public secondary and tertiary eye care centres in five regional Ethiopian states collected pre-intervention data using the BOOST app. Based on 20 consecutive patients with vision $< 6/60$, BOOST identified case selection, intraoperative complications or postoperative refractive error as the leading causes of poor outcomes. Each facility then invested US\$ 2500 to target its leading cause, recorded outcomes for 60 consecutive cataract patients and then compared the proportion with uncorrected vision $\geq 6/12$ before and after the intervention.

Local setting All 11 centres are Orbis International partners and services provided at the facilities are highly subsidized or free of charge.

Relevant changes After implementing targeted interventions at the facilities to address undetected ocular comorbidity, surgical complications or postoperative refractive errors, 501 (56.0%) of 894 patients had good results ($\geq 6/12$), compared to 289 (32.2%) of 897 patients before the intervention.

Lessons learnt Using the BOOST app as an approach for quality monitoring and improvement enables benchmarking across contexts and can enhance surgical outcomes when paired with recommended targeted investments.

Introduction

Cataract is the leading cause of vision impairment worldwide, affecting approximately 100.5 million people,¹ yet it can be treated with simple, inexpensive surgery, restoring vision in 90% of patients.² However, outcomes are often poor in low-resource settings,³ due to inappropriate case selection, surgical complications, uncorrected refractive errors and postoperative sequelae.⁴ Improving poor surgical outcomes is crucial to enhancing cataract surgical quality.⁵ The World Health Organization (WHO) proposes a benchmark for uncorrected visual acuity of $\geq 6/12$ at 4 to 6 weeks following surgery in 80% of patients.^{6,7} However, this benchmark is challenging to attain and progress is difficult to assess in low-resource countries with poor postoperative follow-up. The difficulties are due to insufficient data collection, inadequate transportation infrastructure that restricts patients' ability to attend return visits, financial constraints and limited patient understanding of their disease.

A strategy for improving cataract surgical outcomes involves strengthening quality improvement processes within surgical centres.⁸ One of the challenges of collecting quality improvement data in low-resource settings can be a lack of tools and data management systems at the point of care. Recognizing this gap, stakeholders, including the nongovernmental organization Orbis International, developed the Cataract BOOST (Better Operative Outcomes Software Tool) application (app). The results of the PRECOG study informed the development of the app and created an international database that the BOOST app can access. BOOST can be downloaded onto Android devices and Windows computers and is free to use. The app allows users, in this case the cataract surgeons, to collect data immediately after surgery, when patient follow-up is highest;⁸ compare performance anonymously against other users locally and globally; and receive tailored suggestions addressing their most common causes of poor outcomes.

An initial study in 18 low- and middle-income countries found that BOOST facilitated better monitoring of outcomes, but despite users receiving BOOST-generated recommendations, patients' visual outcomes did not improve.⁹ We hypothesized that targeted investments to remediate identified shortcomings would enhance the app's impact. The current intervention aimed to test the hypothesis that modest investments, directed to specific parts of the operative process by user-specific BOOST feedback, would increase the proportion of patients meeting WHO vision targets postoperatively.

Local setting

All participating facilities are government-owned and all services provided at the facilities, including cataract surgeries, are highly subsidized or free of charge. In Ethiopia, cataract surgeries are performed by ophthalmic surgeons, either ophthalmologists or non-physician cataract surgeons. Manual, small-incision cataract surgery is the predominant surgical approach across all the facilities.

Approach

The National Research Ethics Review Committee of Ethiopia and regional health bureaus' institutional review boards approved the intervention. Practising cataract surgeons and ophthalmologists recruited patients from 1 January 2022 to 30 May 2024.

Pre-intervention

We selected 11 Orbis-partner secondary and tertiary hospitals in five regional states in Ethiopia for participation due to their having limited access to outcomes monitoring tools. The authors recruited 15 surgeon participants from eleven eye care units (three tertiary and eight secondary centres); 10 were trained ophthalmologists and five were non-physician cataract surgeons. These surgeons represented all available surgeons at the selected Orbis-partner hospitals. Participants downloaded the BOOST app onto mobile devices and Orbis Ethiopia personnel provided instruction on how to use the app for collecting cataract surgical data.^{10,11} To provide baseline data for comparison, before receiving and implementing targeted investments, each participating surgeon used BOOST to record de-identified demographic and clinical patient characteristics, including uncorrected pre-operative visual acuity in both eyes. They recorded the characteristics of 60 consecutive patients aged 35 years or older who had not previously undergone cataract

surgery. Trained medical personnel (other than the surgeon) measured uncorrected visual acuity of the operative 1–3 days postoperatively, with surgeon identity masked at each facility.

After recruiting the 60 consecutive pre-intervention cataract patients, surgeon participants enrolled a further 20 consecutive postoperative cataract patients with poor ($< 6/60$) uncorrected visual acuity persisting after 4 weeks. In the BOOST app, the surgeons selected a reason for poor outcomes from the following three options: undetected ocular comorbidity, surgical complications or postoperative refractive error. BOOST then calculated the most common cause for poor outcomes at each facility and suggested targeted interventions.

Intervention with targeted investments

In collaboration with the Ethiopian health ministry, Orbis provided each participating facility with US\$ 2500 to support the interventions recommended by BOOST to address the most common causes of poor surgical outcomes. This investment was not sufficient to upgrade all aspects of the surgical process but could address the most pressing issues when accurately identified. The facility and intervention personnel decided together which recommended intervention would most likely address the identified reason for poor vision outcomes.

For example, the BOOST app suggested steps to improve the accuracy of the pre-operative examination, including provision of indirect ophthalmoscopes and training in their use to decrease undetected ocular comorbidities. Orbis Ethiopia, in collaboration with the principal investigators, organized training sessions to address the BOOST app recommendations. A local cornea surgeon and Assistant Professor at Jimma University delivered two training sessions, one week each. The training underscored the significance of addressing the challenges identified by BOOST through careful case selection and improved ocular biometry. Orbis Ethiopia also enhanced the stock of available lenses. Additionally, Orbis Ethiopia delivered surgical training to reduce intraoperative complications. Following the recommendations, 10 facilities provided training to improve case selection and address surgical complications; three facilities provided biometry equipment and associated training to improve refractive error outcomes; and 11 facilities procured a range of intraocular lenses and surgical instruments identified as needed to reduce complications and improve outcomes.

Post-intervention

Surgeons recorded post-intervention uncorrected visual acuity in BOOST 1–3 days after surgery in the 60 additional consecutive cataract patients described above. The surgeons then compared the proportion achieving the WHO benchmark of $\geq 6/12$ in the operative eye with pre-intervention results.

We used linear regression with generalized estimating equations accounting for the correlation of outcomes within surgeons to compare mean postoperative visual acuity before and after the intervention. We then summarized causes of poor visual outcome for cohorts at each facility and across the study.

Relevant changes

User satisfaction

Among 15 participating surgeons, four (26.7%) had performed fewer than 500 lifetime surgeries and 11 (73.3%) had performed more than 500. When asked, all the 15 surgeons reported that BOOST improved their subjective surgical performance.

Causes of poor outcomes

Among 300 patients (20 consecutive patients for each of 15 surgeons) with poor outcomes, the leading cause was inappropriate case selection (188; 62.7%), that is, the presence of serious ocular morbidity besides cataract (Table 1). Surgical complications accounted for 63 (21.0%) patients and refractive error 49 (16.3%) patients. The leading cause of poor outcomes across surgeons was case selection (14; 93.3%) with surgical complication as the leading cause for one surgeon (1; 6.7%).

Pre- versus post-intervention vision results

Among 897 patients included in pre-intervention analysis, 828 (92.3%) were blind (best corrected visual acuity $< 3/60$) in the pre-operative eye. Among 894 surgeries performed after the intervention, 853 (95.4%, P -value: 0.007) were blind pre-operatively. Most patients from both groups underwent small incision cataract surgery (pre-intervention cohort 896; 99.9%; and post-intervention cohort 892; 99.8%), with intraocular lens implantation, (pre-intervention cohort 891; 99.3%; and post-intervention cohort 892; 99.8%). The proportion meeting WHO benchmarks increased to 56.0% (501/894) post-intervention, compared with 32.2% (289/897) pre-intervention.

Mean uncorrected postoperative visual acuity improved from 0.592 (SD: 0.428) LogMAR [Snellen equivalent 6/24] pre-intervention to 0.441 (SD: 0.357) LogMAR [Snellen equivalent 6/19] post-intervention (*P*-value: < 0.0001).

Lessons learnt

By providing a modest investment to participating facilities to implement the BOOST-generated recommendations, the proportion of patients achieving the WHO benchmark of $\geq 6/12$ in the immediate postoperative period increased. This intervention, therefore, aligns with WHO's goals of enhancing cataract surgical outcomes, as part of delivering high-quality, patient-centred eyecare.^{7,12}

While our partners in Ethiopia experienced an improvement in postoperative outcomes, we note that effective use of the BOOST app is best suited to programmes that can integrate targeted funding with timely action and we recognize that there can be financial challenges in addressing the recommendations generated by BOOST. Specifically, we aimed to implement the intervention in Zambia as well as in Ethiopia; however, the five Orbis partner hospitals in Zambia experienced significant delays due to logistical issues procuring the targeted investments, which didn't allow for effective comparison of the intervention.

Additional factors contributed to delays and setbacks during project implementation. First, disruptions due to the coronavirus 2019 pandemic and related control measures caused implementation delays. Second, study participants encountered unexpected issues with the BOOST app, including the inability to synchronize and upload data and the need to update the app to reflect the $> 6/12$ benchmark (which was previously $> 6/18$ in earlier versions of the app). We communicated with the app developers to resolve these technical issues, but it still caused delays. Third, security concerns in Ethiopia interfered with some participants' routine activities and training availability, requiring close monitoring of the situation and collaboration with partner hospitals to implement strategies to prioritize participant safety. Finally, some participants faced challenges in identifying 20 patients with poor outcomes, so we scheduled additional support visits and arranged joint virtual calls to assist with identifying patients that met the eligibility criteria.

While the investments of US\$ 2500 applied by this intervention may be unaffordable in some low-resource settings, the failure of a prior BOOST study to improve cataract surgical

outcomes,⁹ suggests these modest investments may be necessary to realize significant outcome improvements.

Additional studies support the effectiveness of routine surgical outcome monitoring as a quality improvement tool in low- and middle-income countries.^{13–15} Through outcomes monitoring with the BOOST app, selection of patients with comorbidities was the most common cause of poor postoperative visual outcomes. Improving recognition of pre-existing ocular comorbidities can be addressed by improving comprehensive pre-operative examinations through practical training and the provision of equipment such as indirect ophthalmoscopes as done in this intervention. Future studies should test locally relevant interventions to better identify ocular comorbidities besides cataract, including retinal diseases and glaucoma.

This article highlights the potential of appropriate digital-tools to support quality improvement in cataract surgery in low-resource settings. Future work should focus on scaling the use of digital apps, ensuring access to modest, targeted funding for equipment and training and testing strategies to improve pre-operative examinations with implementation of a randomized controlled trial to increase confidence in findings.

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Competing interests:

None declared.

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Box 1. Summary of main lessons learnt

- Implementing targeted investments can lead to a significant increase in the proportion of cataract patients achieving the WHO vision benchmark in the immediate post-operative period.
- Strategies in Ethiopia should focus on enhancing quality of pre-operative examinations, to address comorbidities as the leading cause of poor visual outcomes.
- Using the BOOST app or similar digital health quality monitoring platform, is beneficial when integrated as part of a broader quality improvement initiative, rather than as a standalone monitoring tool.

Table 1. Most common causes of vision loss for 20 consecutive patients with postoperative vision < 6/60 for each of 15 surgeon participants, Ethiopia, 2022–2024

Cause of poor visual outcome	No. cataract patients (%) <i>n</i> = 300
Case selection (ocular comorbidity besides cataract)	188 (62.7%)
Refractive error	49 (16.3%)
Surgical complication	63 (21.0%)