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Fabricating Low-Cost Hearing Aids in Uganda: Audiometric Outcomes from a Locally Sourced, 3D-Printed Intervention for School Children in Mbarara

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| Abstract

Hearing loss in children is a substantial barrier to education and social development in low-resource settings. In sub-Saharan Africa, access to conventional hearing aids remains limited due to high costs, supply chain difficulties, and a shortage of specialist fitters. This underscores a need for locally sustainable assistive technology solutions. This study aimed to develop, fabricate, and field-test a low-cost hearing aid for school children in Uganda. The primary objective was to assess the functional audiometric outcomes of devices utilising locally sourced electronic components and 3D-printed casings. A prototype hearing aid was designed using open-source plans and adapted for local fabrication in Mbarara. Casings were 3D-printed with available filament, and devices were assembled using commercial amplifier modules and microphones. A pre-test/post-test study was conducted with a cohort of school children diagnosed with mild to moderate hearing loss. Functional gain was measured using pure-tone audiometry before and after device fitting. The locally fabricated devices provided a measurable functional gain. Post-intervention audiometry showed an average improvement of 25 dB in hearing thresholds across key speech frequencies (500-4000 Hz) for the cohort. Qualitative feedback from users and teachers indicated improved classroom engagement. The study demonstrates the feasibility of locally manufacturing basic hearing aids using 3D printing and readily available components. This approach

can deliver significant functional hearing improvement for children in resource-constrained environments, presenting a potential model for decentralised assistive technology provision. Further research should focus on device durability, long-term user outcomes, and establishing sustainable local maintenance and fitting networks. Scaling such interventions requires parallel investment in training community-based audiometric technicians. assistive technology, hearing loss, 3D printing, low-cost devices, audiology, Uganda, global health This work contributes a practical, locally adaptable fabrication protocol and preliminary efficacy data for a low-cost hearing aid within the African context, directly addressing a gap in accessible paediatric audiological care.
