Effectiveness of Phototherapy Units in Cameroon

Summary
Neonatal hyperbilirubinemia continues to be a leading cause of morbidity and mortality in resource-limited countries. The aim of this study was to measure the effectiveness of existing phototherapy units at a local hospital in Cameroon using an irradiance meter. Phototherapy units (n = 4) in one newborn nursery in Cameroon were evaluated. The average irradiance of the functioning units was 2.87 mW/cm²/nm, which is substantially below the recommended range of 10–30 mW/cm²/nm. With simple improvements, one new prototype unit was developed. Its irradiance was 23.3 mW/cm²/nm. We concluded that irradiance of phototherapy units should be measured, as many local nurseries worldwide may not be delivering effective treatment. Simple and cost-effective changes to phototherapy units can make a substantial improvement in irradiance.

Key words: jaundice, newborn, phototherapy.

Introduction
Neonatal hyperbilirubinemia continues to be a leading cause of morbidity and mortality in resource-limited countries [1]. Effective phototherapy is essential in treating neonatal jaundice and in preventing its sequelae, including acute bilirubin encephalopathy and kernicterus. The quality of phototherapy can be determined by measuring the irradiance produced by the light bulbs using an irradiance meter. To be effective, bulb irradiance should measure at least 8–10 mW/cm²/nm [2]. Increasing irradiance has been shown to directly correlate with decreasing unconjugated bilirubin levels [3]. Intensive phototherapy delivers an irradiance of ≥30 mW/cm²/nm [3]. The purpose of this study was to measure the irradiance of existing phototherapy units at a local hospital in Cameroon. Cost-effective and sustainable improvements were then employed to improve the phototherapy to reach a goal of >10 mW/cm²/nm.

Methods
Phototherapy units (n = 4) in one newborn nursery in Cameroon were evaluated. Irradiance was measured using the Ohmeda BiliBlanketTM Meter. Each existing phototherapy unit consisted of three light bulbs that were positioned approximately 15cm above an average-sized infant (Fig. 1). One of the four units did not have functioning bulbs, so its data were not included. One local electrician, carpentry staff and a US professional engineer were recruited to help develop more effective units. Interventions to improve irradiance included using new blue light bulbs, adding additional bulbs for a total of six per unit, developing a system of bulb rotation to ensure new bulbs are always in use, painting the inside of the basket white to maximize reflected light and adding an extra mattress beneath the infant to decrease distance between the patient and lights (Fig. 2).

Results
None of the previously existing phototherapy units at this Cameroonian nursery met the standards for effective phototherapy. The irradiance of the three functioning units were 2.0, 2.9 and 3.7, with an average of 2.87 mW/cm²/nm. This is substantially below the recommended level. With the simple improvements described in the Methods section, one prototype unit was developed. Its irradiance was 23.3 mW/cm²/nm. Now additional phototherapy units are under construction after local workers were trained how to replicate them.

Discussion
This study demonstrated the importance of measuring irradiance in determining the quality of phototherapy. Variable phototherapy approaches have been demonstrated worldwide, and unfortunately, many are ineffective [4]. Irradiance measurements are an easy way to evaluate effectiveness, and they are essential in making sure neonates with unconjugated hyperbilirubinemia get proper treatment [5]. Existing phototherapy guidelines exist, but appropriate implementation requires technical and operational support [4].

Conclusion
The irradiance of phototherapy units should be measured, as many local nurseries worldwide, including Cameroon, may not be delivering effective treatment. Simple changes to phototherapy units can make a substantial improvement in irradiance and impact in preventing the morbidity and mortality associated with neonatal hyperbilirubinemia [5]. Goal irradiance for phototherapy units should be...
Fig. 1. Previously existing phototherapy unit.

Fig. 2. New and improved phototherapy unit.
10–30+ μW/cm²/nm. Educating and equipping local workers to deliver and maintain improvements is important in providing a sustainable solution.

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