

Risk and accuracy of outpatient-identified hypoxaemia for death among suspected child pneumonia cases in rural Bangladesh: a multifacility prospective cohort study

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Background: Hypoxaemic pneumonia mortality risk in low-income and middle-income countries is high in children who have been hospitalised, but unknown among outpatient children. We sought to establish the outpatient burden, mortality risk, and prognostic accuracy of death from hypoxaemia in children with suspected pneumonia in Bangladesh.

Methods: We conducted a prospective community-based cohort study encompassing three upazila (subdistrict) health complex catchment areas in Sylhet, Bangladesh. Children aged 3–35 months participating in a community surveillance programme and presenting to one of three upazila health complex Integrated Management of Childhood Illness (IMCI) outpatient clinics with an acute illness and signs of difficult breathing (defined as suspected pneumonia) were enrolled in the study; because lower respiratory tract infection mortality mainly occurs in children younger than 1 year, the primary study population comprised children aged 3–11 months. Study physicians recorded WHO IMCI pneumonia guideline clinical signs and peripheral arterial oxyhaemoglobin saturations (SpO₂) in room air. They treated children with pneumonia with antibiotics (oral amoxicillin [40 mg/kg per dose twice per day for 5–7 days, as per local practice]), and recommended oxygen, parenteral antibiotics, and hospitalisation for those with an SpO₂ of less than 90%, WHO IMCI danger signs, or severe malnutrition. Community health workers documented the children's vital status and the date of any vital status changes during routine household surveillance (one visit to each household every 2 months). The primary outcome was death at 2 weeks after enrolment in children aged 3–11 months (primary study population) and 12–35 months (secondary study population). Primary analyses included estimating the outpatient prevalence, mortality risk, and prognostic accuracy of hypoxaemia for death in children aged 3–11 months with suspected pneumonia. Risk ratios were produced by fitting a multivariable model that regressed predefined SpO₂ ranges (<90%, 90–93%, and 94–100%) on the primary 2-week mortality outcome (binary outcome) using Poisson models with robust variance estimation. We established the prognostic accuracy of WHO IMCI guidelines for death with and without varying SpO₂ thresholds.

Findings: Participants were recruited between Sept 1, 2015, to Aug 31, 2017. During the study period, a total of 7440 children aged 3–35 months with the first suspected pneumonia episode were enrolled, of whom 3848 (54.3%) with an attempted pulse oximeter measurement and 2-week outcome were included in our primary study population of children aged 3–11-months. Among children aged 3–11 months, an SpO₂ of less than 90% occurred in 102 (2.7%) of 3848 children, an SpO₂ of 90–93% occurred in 306 (8.0%) children, a failed SpO₂ measurement occurred in 67 (1.7%) children, and 24 (0.6%) children with suspected pneumonia died. Compared with an SpO₂ of 94–100% (3373 [87.7%] of 3848), the adjusted risk ratio for death was 10.3 (95% CI 3.2–32.3; p<0.001) for an SpO₂ of less than 90%, 4.3 (1.5–11.8; p=0.005) for an SpO₂ of 90–93%, and 11.4 (3.1–41.4; p<0.001) for a failed measurement. When not considering pulse oximetry, of the children who died, WHO IMCI guidelines identified only 25.0% (95% CI 9.7–46.7; six of 24 children) as eligible for referral to hospital. For identifying deaths, in children with an SpO₂ of less than 90% WHO IMCI guidelines had a 41.7% sensitivity (95% CI 22.1–63.4) and 89.7% specificity (88.7–90.7); for children with an SpO₂ of less than 90% or measurement failure the

guidelines had a 54.2% sensitivity (32.8–74.4) and 88.3% specificity (87.2–89.3); and for children with an SpO₂ of less than 94% or measurement failure the guidelines had a 62.5% sensitivity (40.6–81.2) and 81.3% specificity (80.0–82.5).

Interpretation: These findings support pulse oximeter use during the outpatient care of young children with suspected pneumonia in Bangladesh as well as the re-evaluation of the WHO IMCI currently recommended threshold of an SpO₂ less than 90% for hospital referral.