External validation of paediatric pneumonia and bronchiolitis risk scores in Kenya

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Motivation

Acute lower respiratory tract infections (ALRIs) are **a leading cause of paediatric mortality** in low- and middle-income countries (LMICs).

In recent years, substantial research has been done to **enhance risk stratification** of children presenting with ALRIs, in a bid to improve health outcomes in resource-limited settings.

We sought to **compare the performance of several paediatric ALRI risk scores** in the prediction of mortality among children hospitalised with ALRIs in Kenya.

Methodology

Assessed risk scores

We evaluated and compared the performance of:

5 paediatric pneumonia risk scores which were developed using data from LMICs	**1 paediatric bronchiolitis severity score** which has previously been externally validated in an LMIC

Additionally, we *modified* the ReSVinet score through the addition of three separate nutrition status indicators (Mid-upper arm circumference (MUAC), Weight-for-age z-score (WAZ) and Weight-for-length z-score (WLZ)) in an attempt to improve its discrimination in our LMIC cohort.

Dataset

We performed a secondary analysis of data collected as part of an ongoing respiratory pathogen study taking place **at Kilifi County Referral Hospital, Kilifi, Kenya**.

We analysed the data of **2182 children aged 2-24 months** who were admitted to hospital with symptoms of severe ALRI between January 2015 and December 2024.

Each score was retrospectively evaluated using the child's symptoms recorded ***at the time of admission.***

Performance evaluations

We wanted to see how well these scores predicted the risk of **in-hospital mortality.**

- **Discrimination** was assessed using the area under the receiver operating curve (AUROC)
- **Calibration** could not be formally assessed due to a lack of reporting of full model details.

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Results

Table 1: (a) Summary of risk score development datasets. (b) External validation results.

Score name	Development dataset					External validation AUROC (95% CI)
	Time period	Location	Age range	Outcome	Method used	
RISC (HIV-Negative)	1998-2001	South Africa	0-24 months	Mortality	Multivariable logistic regression. Coefficients rounded to create simplified risk scores	**0.70 (0.66 – 0.75)**
mRISC	2009-2012	Kenya	0-59 months			**0.76 (0.72 – 0.80)**
RISC-Malawi	2011-2014	Malawi	2-59 months			**MUAC version: 0.83 (0.79 – 0.86) WAZ version: 0.78 (0.73 – 0.82)**
PREPARE	1994-2011	Various	2-59 months			**0.79 (0.75 – 0.82)**
PERCH	2011-2012	Various	1-59 months			**0.77 (0.73 – 0.81)**
ReSVinet	-	-	-	Severity of bronchio-litis	Systematic review + expert consensus	**0.72 (0.67 – 0.76)**
ResVinet + Nutrition	-	-	-	-	-	**Using MUAC: 0.79 (0.76 – 0.83) Using WAZ: 0.75 (0.71 – 0.79) Using WLZ: 0.73 (0.68 – 0.77)**

RISC: Respiratory Index of Severity in Children; mRISC: modified RISC; PREPARE: Pneumonia Research Partnership to Assess WHO Recommendations; PERCH: Pneumonia Etiology Research for Child Health

Differences between RISC-Malawi and other scores:

- RISC-Malawi is the only score which uses MUAC as a measure of malnutrition.
- RISC-Malawi used a *higher scaling coefficient* than other scores. This may have resulted in a lower loss of information when coefficients were rounded.

Conclusions

- **RISC-Malawi (MUAC)** showed **significantly greater discrimination** than all other assessed scores, apart from ReSVinet + Nutrition using MUAC
- The addition of MUAC as a malnutrition indicator **significantly increased** the discrimination of the ReSVinet score

Further work

- Further external validation studies are needed to assess the ***generalisability*** of these results across different locations and settings.
  - Our group are carrying out external validation studies in Bangladesh and South Africa.
- Qualitative examination into reasoning behind performance differences may be justified e.g. the power of using MUAC over other malnutrition indicators to identify those at high risk of mortality.
- Feasibility and implementation studies are needed to **quantify the utility** of these scores in clinical practice.