

Every Newborn BIRTH multi-country validation study: informing measurement of coverage and quality of maternal and newborn care

Survey of women's report for 33 maternal & newborn indicators: EN-BIRTH multi-country validation study

Additional File 3: Definitions and formulas for validation metrics

Table 1. Table of definitions of validation metrics (Adapted from Day et al [1] and Munos et al [2])

TERM	DEFINITION	FORMULA*
SENSITIVITY (SE)	The proportion of individuals who truly received an intervention who were classified as having received the intervention by survey questions.	$\frac{a}{a + c}$ $\frac{TP}{TP + FN}$
SPECIFICITY (SP)	The proportion of individuals who truly did not receive an intervention who were classified as not having received the intervention by survey questions.	$\frac{d}{b + d}$ $\frac{TN}{FP + TN}$
PERCENT AGREEMENT (ACCURACY)	The proportion of individuals surveyed who were correctly classified as having received or not having received the intervention.	$\frac{a + d}{n}$ $\frac{TP + TN}{n}$
VALIDITY RATIO	The population-level validity of the measure using survey coverage and observed coverage.	$\frac{\text{Survey coverage}}{\text{Observed coverage}}$
POSITIVE PREDICTIVE VALUE (PPV)	The probability that an intervention reported as received has been observed as received	$\frac{a}{a + b}$ $\frac{TP}{TP + FP}$
NEGATIVE PREDICTIVE VALUE (NPV)	The probability that an intervention not reported had been observed as not received	$\frac{d}{c + d}$ $\frac{TN}{FN + TN}$
AREA UNDER THE RECEIVER OPERATING CHARACTERISTIC CURVE (AUC)	The probability that a test will correctly classify a randomly selected set of one positive observation and one negative observation.	Calculated as the area under the curve of sensitivity plotted against (1 – specificity)
INFLATION FACTOR (IF)	The degree to which the indicator would be over or under-estimated by women's self-report using a ratio of the estimated survey-based coverage accounting for sensitivity and specificity to its true (observed) coverage.	$\frac{\text{Observed coverage} \times (SE + SP - 1) + (1 - SP)}{\text{Observed coverage}}$

*Variables defined in Table 2

Table 2. Two-by-two validation table

		GOLD STANDARD		
		Positive	Negative	Total
SURVEY MEASUREMENT	Positive	a True Positive (TP)	b False Positive (FP)	a+b TP+FP
	Negative	c False Negative (FN)	d True Negative (TN)	c+d FN+TN
	Total	a+c TP+TN	b+d FP+FN	n

1. Day LT, Ruysen H, Gordeev VS, Gore-Langton GR, Boggs D, Cousens S, et al. "Every Newborn-BIRTH" protocol: observational study validating indicators for coverage and quality of maternal and newborn health care in Bangladesh, Nepal and Tanzania. *J Glob Health*. 2019;9:010902.
2. Munos MK, Blanc AK, Carter ED, Eisele TP, Gesuale S, Katz J, et al. Validation studies for population-based intervention coverage indicators: design, analysis, and interpretation. *J Glob Health*. 2018;8:020804.