**Derivation and external validation of clinical prediction rules identifying children at risk of linear growth faltering**

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# SUPPLEMENT

Supplementary file 1A: Full list of considered predictor variables

|  |  |  |
| --- | --- | --- |
| GEMS cases | GEMS controls | MAL-ED |
| Study site (site)  Child sex (f3\_gender)  Loss of skin turgor (f3\_drh\_turgor)  Intravenous rehydration (f3\_drh\_iv)  Hospitalized (f3\_drh\_hosp)  Your relationship to the child (f4a\_relationship)  Where child’s father lives (f4a\_dad\_live)  Primary caregiver’s max school (f4a\_prim\_schl)  People living in house 6 months (f4a\_ppl\_house)  Children under 60 months in the house (f4a\_yng\_children)  How many rooms used for sleeping (f4a\_slp\_rooms)  Predominant floor (f4a\_floor)  Electricity (f4a\_house\_elec)  Bicycle/rickshaw (f4a\_house\_bike)  Telephone (f4a\_house\_phone)  Television (f4a\_house\_tele)  Car/truck (f4a\_house\_car)  Animal-drawn cart (f4a\_house\_cart)  Motorcycle/scooter (f4a\_house\_scoot)  Refrigerator (f4a\_house\_fridge)  Agricultural land (f4a\_house\_agland)  Radio (f4a\_house\_radio)  Boat with motor (f4a\_house\_boat)  None of the above assets (f4a\_house\_none)  Electricity (f4a\_fuel\_elec)  Biogas (f4a\_fuel\_biogas)  Straw/shrubs/grass (f4a\_fuel\_grass)  Liquid propane gas (f4a\_fuel\_propane)  Coal/lignite (f4a\_fuel\_coal)  Animal dung (f4a\_fuel\_dung)  Natural gas (f4a\_fuel\_natgas)  Charcoal (f4a\_fuel\_charcoal)  Agricultural crop residue (f4a\_fuel\_crop)  Kerosene (f4a\_fuel\_kero)  Wood (f4a\_fuel\_wood)  Other fuel (f4a\_fuel\_other)  Goat (f4a\_ani\_goat)  Sheep (f4a\_ani\_sheep)  Dog (f4a\_ani\_dog)  Cat (f4a\_ani\_cat)  Cow (f4a\_ani\_cow)  Rodents (f4a\_ani\_rodents)  Fowl (f4a\_ani\_fowl)  Other animal (f4a\_ani\_other)  No animals (f4a\_ani\_no)  Water piped to house (f4a\_water\_house)  Covered well in house/yard (f4a\_water\_covwell)  Water piped into yard (f4a\_water\_yard)  Covered public well (f4a\_water\_covpwell)  Public tap (f4a\_water\_pubtap)  Protected spring (f4a\_water\_prospring)  Open well in house/yard (f4a\_water\_well)  Unprotected spring (f4a\_water\_unspring)  Open public well (f4a\_water\_pubwell)  River/stream (f4a\_water\_river)  Pond/lake (f4a\_water\_pond)  Deep tube well (f4a\_water\_deepwell)  Rainwater (f4a\_water\_rain)  Shallow tube well (f4a\_water\_shallwell)  Bought water (f4a\_water\_bought)  Other water source (f4a\_water\_othr)  Bore hole (f4a\_water\_bore)  Main source of drinking water (f4a\_ms\_water\*)  How often is water available (f4a\_water\_avail)  Did you give the child stored water (f4a\_store\_water)  Do you usually treat drinking water? (f4a\_trt\_water)  Usual treatment method (f4a\_trt\_method)  How are child’s feces disposed (f4a\_disp\_feces)  Facility used to dispose of feces (f4a\_fac\_waste)  How many households share facility? (f4a\_share\_fac)  Wash hands before eating? (f4a\_wash\_eat)  Wash hands before cooking (f4a\_wash\_cook)  Wash hands before you nurse? (f4a\_wash\_nurse)  Wash hands after you defecate (f4a\_wash\_def)  Wash hands after handling animals (f4a\_wash\_animal)  Wash hands after cleaning a child (f4a\_wash\_child)  Wash hands other times (f4a\_wash\_othr)  What do you use to wash your hands? (f4a\_wash\_use)  Is the child currently breastfed? (f4a\_breastfed)  How long as this diarrhea episode lasted (days)? (f4a\_drh\_days)  Maximum number of loose stools (f4a\_max\_stools)  Blood in stools (f4a\_drh\_blood)  Vomiting 3 or more times per day (f4a\_drh\_vomit)  Very thirsty (f4a\_drh\_thirst)  Drank much less than usual (f4a\_drh\_lessdrink)  Belly pain (f4a\_drh\_bellypain)  Irritable or restless (f4a\_drh\_restless)  Decreased activity or lethargy (f4a\_drh\_lethrgy)  Loss of consciousness (f4a\_drh\_consc)  Rectal straining (f4a\_drh\_strain)  Rectal prolapse (f4a\_drh\_prolapse)  Cough (f4a\_drh\_cough)  Convulsions (f4a\_drh\_conv)  Very thirsty (f4a\_cur\_thirsty)  Wrinkled skin (f4a\_cur\_skin)  Irritable or restless (f4a\_cur\_restless)  Dry mouth (f4a\_cur\_drymouth)  Fast breathing (f4a\_cur\_fastbreath)  ORALITE or ORS (f4a\_hometrt\_ors)  Homemade fluid (f4a\_hometrt\_maize)  Special mile or infant formula (f4a\_hometrt\_milk)  Home remedy/herbal medication (f4a\_hometrt\_herb)  Zinc (f4a\_hometrt\_zinc)  No special remedies given (f4a\_hometrt\_none)  Any other liquids (f4a\_hometrt\_othrliq)  Antibiotics (f4a\_hometrt\_ab)  Other treatment (f4a\_hometrt\_othr1)  Other treatment (f4a\_hometrt\_othr2)  How much offered to drink (f4a\_offr\_drink)  Seek outside care (f4a\_seek\_outside)  Pharmacy (f4a\_seek\_pharm)  Friend/relative (f4a\_seek\_friend)  Traditional healer (f4a\_seek\_healer)  Unlicensed practitioner (f4a\_seek\_doc)  Licensed practitioner (f4a\_seek\_privdoc)  Bought a remedy (f4a\_seek\_remdy)  Other hospital/center (f4a\_seek\_other)  Length/height-for-age z-score (f4b\_haz)  Axillary temperature (f4b\_temp)  Respiratory rate per minute (f4b\_resp)  Chest indrawing (f4b\_chest\_indrw)  Eyes (f4b\_eyes)  Mouth (f4b\_mouth)  Skin pinch (f4b\_skin)  Mental status (f4b\_mental)  Rectal prolapse (f4b\_rectal)  Bipedal edema (f4b\_bipedal)  Abnormal hair (f4b\_abn\_hair)  Undernutrition (f4b\_under\_nutr)  Skin as ‘flaky paint’ appearance (f4b\_skin\_flaky)  Staff observed a stool sample (f4b\_observe\_stool)  Nature of the stool (f4b\_nature\_stool)  Receive rehydration here (f4b\_recommend)  Child was admitted to hospital (f4b\_admit)  Child age (months) (base\_age) | Study site (site)  Your relationship to the child (f7\_relation)  Where child’s father lives (f7\_dad\_live)  Primary caregiver’s max school (f7\_prim\_schl)  People living in house 6 months (f7\_ppl\_house)  Children under 60 months in the house (f7\_yng\_childrn)  How many rooms used for sleeping (f7\_slp\_rooms)  Predominant floor (f7\_floor)  Electricity (f7\_house\_elec)  Bicycle/rickshaw (f7\_house\_bike)  Telephone (f7\_house\_phone)  Television (f7\_house\_tele)  Car/track (f7\_house\_car)  Animal-drawn cart (f7\_house\_cart)  Motorcycle/scooter (f7\_house\_scoot)  Refrigerator (f7\_house\_fridge)  Agricultural land (f7\_house\_agland)  Radio (f7\_house\_radio)  Moat with motor (f7\_house\_boat)  None of the above assets (f7\_house\_none)  Electricity (f7\_fuel\_elec)  Biogas (f7\_fuel\_biogas)  Straw/shrubs/grass (f7\_fuel\_grass)  Liquid propane gas (f7\_fuel\_propane)  Coal/lignite (f7\_fuel\_coal)  Animal dung (f7\_fuel\_dung)  Natural gas (f7\_fuel\_natgas)  Charcoal (f7\_fuel\_charcoal)  Agricultural crop residue (f7\_fuel\_crop)  Kerosene (f7\_fuel\_kero)  Wood (f7\_fuel\_wood)  Other fuel (f7\_fuel\_other)  Goat (f7\_ani\_goat)  Sheep (f7\_ani\_sheep)  Dog (f7\_ani\_dog)  Cat (f7\_ani\_cat)  Cow (f7\_ani\_cow)  Rodents (f7\_ani\_rodents)  Fowl (f7\_ani\_fowl)  Other animals (f7\_ani\_other)  No animals f7\_ani\_no  Water piped to house (f7\_water\_house)  Covered well in house/yard (f7\_water\_covwell)  Water piped into yard (f7\_water\_yard)  Covered public well (f7\_water\_covpwell)  Public tap (f7\_water\_pubtap)  Protected spring (f7\_water\_prospring)  Open well in house/yard (f7\_water\_well)  Unprotected spring (f7\_water\_unspring)  Open public well (f7\_water\_pubwell)  River/stream (f7\_water\_river)  Pond/lake (f7\_water\_pond)  Deep tube well (f7\_water\_deepwell)  Rainwater (f7\_water\_rain)  Shallow tube well (f7\_water\_shallwell)  Bought water (f7\_water\_bought)  Other water source (f7\_water\_othr)  Bore hole (f7\_water\_bore)  Main source of drinking water (f7\_ms\_water\*)  How often is water available (f7\_water\_avail)  Did you give the child stored water? (f7\_store\_water)  Do you usually treat drinking water? (f7\_trt\_water) Do you usually treat drinking water? (f7\_trt\_method)  How are child’s feces disposed (f7\_disp\_feces)  Facility use to dispose of feces (f7\_fac\_waste)  Wash hands before eating? (f7\_wash\_eat)  Wash hands before cooking? (f7\_wash\_cook)  Wash hands before you nurse (f7\_wash\_nurse)  Wash hands after you defecate? (f7\_wash\_def)  Wash hands after handling animals? (f7\_wash\_animal)  Wash hands after cleaning child? (f7\_wash\_child)  Wash hands other times? (f7\_wash\_othr)  What do you use to wash your hands? (f7\_wash\_use)  Is the child currently breastfeeding? (f7\_breastfed)  Seek outside care? (f7\_seekcare)  Length/height-for-age z-score (f7\_haz)  Axillary temperature (f7\_temp)  Calculated respiratory rate (f7\_resp)  Bipedal edema (f7\_bipedal)  Abnormal hair (f7\_abn\_hair)  Undernutrition (f7\_under\_nutr)  Skin as ‘flaky paint’ appearance (f7\_skin\_flaky)  Child age (months) (base\_age) | Cumulative diarrheal episode count (diar\_epi\_ct)  HAZ measurement no more than 31 days before onset of diarrhea (HAZ\_1)  Diarrheal episode duration (days) (diar\_dur)  Cumulative days within diarrheal episodes (diar\_days\_sum)  Dairrhea duration categorization (diar\_dur\_cat)  Max loose stools at episode (loose\_stool\_max)  Blood in stool at episode (blood)  Days with vomiting at episode (vomit\_dur)  Days with decreased appetite at episode (app\_dec\_dur)  Max dehydration categorization (dehyd\_max\_cat)  Fever at episode categorization (fev\_bin)  Cumulative days in this ALRI episode (ALRI\_dur)  Age (days) (age)  Total days of breastfeeding (breast\_totdays\*\*)  Days since last diarrheal episode (diar\_days\_since)  ORT administered, caregiver report (ORT\_caregiver)  Hospitalized (hosp)  Indrawing, fieldworker assessment (indraw\_any)  Caregiver reported sleepiness (sleepy\_any)  Caregiver reported difficult to awaken (unawake\_any)  Caregiver reported use of antibiotics (abx\_any)  Caregiver reported use of ORT (ORT\_any)  If hospitalized that diarrhea episode (hosp\_any)  First day of the diarrhea episode (first\_diar\_day)  Breastfed within first 24hr of birth (breast\_24)  Time between birth and first breastfeeding (time\_to\_breast)  Fed colostrum (colostrum)  Prelacteal feeding (prelacteal)  Sex (sex)  Total days in all diarrheal episodes (tot\_diar)  Drinking water source (water\_source)  Persons sleeping in dwelling (ppl\_slp)  Mean people per room (mean\_ppl)  Improved/unimproved sanitation (sani\_score)  Improve/unimproved drinking water (water\_score)  Household has a bed (bed)  Household has a television (tv)  Household has a refrigerator (fridge)  Household has a table (table)  Household has a chai (chair)  Main material of roof (roof)  Main material of floor (floor)  Main material of walls (wall)  Household has a bank account (bank)  Kitchen located in a separate room (kitchen)  Years of formal education mother received (edu)  Mother ever attended formal schooling (edu2)  Total number of rooms in house (rm\_ct)  Noniles of average monthly household income in USD (income\_score)  Fewer than 2 people per room (two\_ppl\_rm)  Toilet/latrine has concrete floor (sani\_concrete)  Toilet/latrine type (sani\_type)  Country (country) |

\*f4a\_ms\_water and f7\_ms\_water were recategorized into the following: surface, other unimproved, other improved, piped, other(1, 2)

\*\*breast\_totdays is calculated from the cumulative number of days of each of the following types of breastfeeding, combined using the listed formula: exclusive, predominant, partial, and none; breast\_totdays=(breast\_excl\*1)+(breast\_predom\*0.75)+(breast\_part\*0.5)+(breast\_not\*0))

Supplementary file 1B: Total sample size and growth faltering in GEMS by site

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| N’s | The Gambia | Mali | Mozambique | Kenya | India | Bangladesh | Pakistan |
| Median HAZ at enrollment | -1.2 | -0.9 | -1.2 | -1.3 | -1.3 | -1.2 | -1.9 |
| ≥0.5 decrease in HAZ | 251 (31.9%) | 255 (14.9%) | 145 (34.5%) | 296 (28.4%) | 269 (18.5%) | 304 (23.1%) | 224 (24.9%) |
| ≥1.0 decrease in HAZ | 48 (6.1%) | 51 (3.0%) | 42 (10.0%) | 76 (7.3%) | 55 (3.8%) | 38 (2.9%) | 47 (5.2%) |
| Total | 788 | 1715 | 420 | 1042 | 1457 | 1316 | 901 |

Supplementary file 1C: Total Sample size and growth faltering in GEMS by age

|  |  |  |  |
| --- | --- | --- | --- |
| N’s | 0-11mo | 12-23mo | 24-59mo |
| ≥0.5 decrease in HAZ | 1077 (33.7%) | 584 (22.3%) | 83 (4.6%) |
| ≥1.0 decrease in HAZ | 293 (9.2%) | 64 (2.4%) | 0 (0%) |
| Total | 3196 | 2622 | 1821 |

Supplementary file 1D: Variable importance ordering, cross-validated average AUC, odds ratios, and 95% confidence intervals for logistic regression models predicting growth faltering (≥0.5 decrease in HAZ) in children 0-59mo in LMICs in GEMS and MAL-ED ranked from most to less predictive (highest to lower variance reduction)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| GEMS 0-59mo |  | MAL-ED 0-23mo | |  |
| AUC (95% CI): 0.72 (0.719, 0.724) |  | AUC (95% CI): 0.68 (0.67, 0.69) | |  |
| Variables | OR (95% CI) | Variables | | OR (95% CI) |
| Age (months) | 0.92 (0.91, 0.93) | HAZ | | 1.35 (1.17, 1.55) |
| HAZ | 1.30 (1.24, 1.36) | Age (days) | | 1.00 (1.00, 1.00) |
| Respiratory rate | 1.00 (0.99, 1.00) | Total days breastfed | | 1.00 (1.00, 1.01) |
| Temperature | 1.28 (1.21, 1.36) | Tot. days with diarrhea during study (tot\_diar) | | 0.98 (0.97, 1.00) |
| Num. ppl living in household | 1.00 (0.99, 1.01) | Mean num. people per room | | 1.05 (0.94, 1.16) |
| Num. ppl sleeping in household | 1.00 (0.98, 1.03) | Num. days of diarrhea in lifetime at presentation (diar\_days\_sum) | | 1.02 (0.99, 1.04) |
| Num. days of diarrhea at presentation | 0.98 (0.93, 1.02) | Maternal education (years) | | 0.95 (0.91, 1.00) |
| Num. other households share fecal waste disposal facility | 0.99 (0.97, 1.00) | Num. days since last diarrhea episode (diar\_days\_since) | | 1.00 (1.00, 1.00) |
| Currently breastfeeding | 0.85 (0.74, 0.97) | Num. ppl. sleep in dwelling | | 1.07 (1.01, 1.12) |
| Num. children <60months live in household | 0.99 (0.95, 1.03) | Max. num. loose stools per day in this diarrhea episode | | 0.93 (0.86, 1.00) |
|  |  |  |  |
| 2-variable model fit to 0-23mo |  |  |  |
| AUC (95% CI): 0.63 (0.62, 0.65) |  |  |  |
| Age (months) | 0.95 (0.94, 0.96) |  |  |
| HAZ | 1.31 (1.25, 1.38) |  |  |

Supplementary file 1E: **GROWTH FALTERING:** Variable importance ordering and cross-validated average overall AUC and AUC by patient subset and 95% confidence intervals for a 2 (plain text), 5 (bold), and 10 (italicized) variable logistic regression model for predicting growth faltering in children derived in GEMS and MAL-ED data (≥0.5 decrease in HAZ)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Data | GEMS | GEMS | MAL-ED | GEMS | MAL-ED | GEMS | MAL-ED | GEMS | GEMS |
| Patient Subset | 0-59mo (main text model) | 0-11mo | 0-11mo | 12-23mo | 12-23mo | 0-23mo (for external validation) | 0-23mo | 24-59mo | 0-59mo  outcome is any stunting at follow-up |
| AUCs | **0.72 (0.72, 0.72)** | **0.60 (0.59, 0.60)** | **0.60 (0.60, 0.61)** | **0.66 (0.65, 0.66)** | **0.65 (0.64, 0.66)** | **0.64 (0.63, 0.64)** | **0.62 (0.61, 0.63)** | **0.78 (0.77, 0.79)** | **0.96 (0.96, 0.96)** |
|  | *0.72 (0.71, 0.73)* | *0.60 (0.59, 0.60)* | *0.63 (0.62, 0.63)* | *0.70 (0.69, 0.70)* | *0.64 (0.63, 0.65)* | *0.64 (0.64, 0.64)* | *0.63 (0.62, 0.64)* | *0.76 (0.75, 0.77)* | *0.96 (0.96, 0.97)* |
| 1 | Age (months) | HAZ | HAZ | HAZ | Age (days) | HAZ | HAZ | Temp | HAZ |
| 2 | HAZ | Temp | Total days breastfeeding | Respiratory rate | HAZ | Age (months) | Age (days) | Respiratory rate | Age (months) |
| 3 | Respirator rate | Respiratory rate | Age (days) | Temp | Total days breastfeeding | Temperature | Total days breastfeeding | Age (months) | Wasted / very thin |
| 4 | Temperature | Num. people living in household | Tot. days with diarrhea during study | Age (months) | Tot. days with diarrhea during study | Respiratory rate | Tot. days with diarrhea during study | HAZ | Respiratory rate |
| 5 | Num. people living in household | Age (months) | Mean num. of people per room | Num. people living in household | Num. days since last diarrhea episode | Num. people living in household | Mean num. people per room | Num. people living in household | Temperature |
| 6 | Num. rooms used for sleeping | Num. other households share latrine | Num. days of diarrhea in lifetime at presentation | Num. rooms used for sleeping | Num. days of diarrhea in lifetime at presentation | Num. rooms used for sleeping | Num. days of diarrhea in lifetime at presentation | Num. other households that share same fecal waste facility | Num. people living in household |
| 7 | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. ppl. sleep in dwelling | Received recommended rehydration at health center | Mean num. people per room | Num. days of diarrhea at presentation | Num. ppl. Sleep in dwelling | Num. days of diarrhea at presentation | Site |
| 8 | Num. other households that share same fecal waste facility | Num. rooms used for sleeping | Max num. loose stools per day in this diarrhea episode | Num. days of diarrhea at presentation | Maternal education (years) | Num. other households that share same fecal waste facility | Maternal education (years) | Num. rooms used for sleeping | Num. other households that share same fecal waste facility |
| 9 | Breastfed | Num. children <60months live in household | Maternal education (years) | Num. other households that share same fecal waste facility | Num. ppl sleep in dwelling | Num. children <60 months live in household | Num. days since last diarrhea episode | Num. children <60months live in household | Num. rooms used for sleeping |
| 10 | Num. children <60months live in household | Caregiver education | Num. days since last diarrhea episode | Num. children <60months live in household | Num. of diarrhea episodes in lifetime | Caregiver education | Avg. monthly household income in USD, noniles | Type of fecal waste facility used by household | Num. days of diarrhea at presentation |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Data | GEMS | GEMS | GEMS | GEMS | GEMS | GEMS |
| Patient Subset | 0-59mo (main text model) only HAZ considered | Only MUAC considered | HAZ + MUAC considered | main + month of diarrhea | Abx (b/f, during, rx, ever) | ≥1.0 ΔHAZ in  0-59mo |
| AUCs | **0.72 (0.72, 0.72)** | **0.70 (0.70, 0.70)** | **0.72 (0.72, 0.73)** | **0.72 (0.72, 0.72)** | **0.72 (0.72, 0.72)** | **0.80 (0.79, 0.80)** |
|  | *0.72 (0.71, 0.73)* | *0.70 (0.70, 0.70)* | *0.72 (0.72, 0.73)* | *0.72 (0.72, 0.72)* | *0.72 (0.72, 0.72)* | *0.80 (0.79, 0.80)* |
| 1 | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) |
| 2 | HAZ | MUAC | HAZ | HAZ | HAZ | HAZ |
| 3 | Respirator rate | Respiratory rate | MUAC | Respiratory rate | Respiratory rate | Respiratory rate |
| 4 | Temperature | Temperature | Respiratory rate | Temperature | Temperature | Temperature |
| 5 | Num. people living in household | Num. people living in household | Temperature | Num. people living in household | Num. people living in household | Num. people living in household |
| 6 | Num. rooms used for sleeping | Num. days of diarrhea at presentation | Num. people living in household | Month | Num. rooms used for sleeping | Num. other households that share same fecal waste facility |
| 7 | Num. days of diarrhea at presentation | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. days of diarrhea at presentation | Num. rooms used for sleeping |
| 8 | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. other households that share same fecal waste facility | Num. days of diarrhea at presentation |
| 9 | Breastfed | Breastfed | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Breastfed | Num. children <60months live in household |
| 10 | Num. children <60months live in household | Num. children <60months live in household | Breastfed | Breastfed | Num. children <60months live in household | Breastfed |
| Rank of additional variable | N/A | N/A | N/A | 6th | 62nd (rx)  71st (during)  78th (ever)  84th (before) | N/A |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Data  Attributable fraction cutoff considered | GEMS | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 |
| Patient Subset | 0-59mo (main text model) | main + Y/N Shigella\* | main + Y/N crypto\* | Main + Y/N Shigella + Y/N crypto\* | main + Y/N any viral\*\* | main + Y/N Shigella\* | main + Y/N crypto\* | Main + Y/N Shigella + Y/N crypto\* | main + Y/N any viral\*\* | main + Y/N Shigella\* | main + Y/N crypto\* | Main + Y/N Shigella + Y/N crypto\* | main + Y/N any viral\*\* |
| AUCs | **0.72 (0.72, 0.72)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.73)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** | **0.73 (0.73, 0.74)** |
|  | *0.72 (0.71, 0.73)* | *0.73 (0.73, 0.74)* | *0.73 (0.73, 0.73)* | *0.73 (0.73, 0.74)* | *0.73 (0.73, 0.73)* | *0.73 (0.73, 0.73)* | *0.73, (0.73, 0.73)* | *0.73 (0.73, 0.74)* | *0.73 (0.73, 0.74)* | *0.73 (0.73, 0.73)* | *0.73, (0.73, 0.74)* | *0.73 (0.73, 0.73)* | *0.73 (0.73, 0.73)* |
| 1 | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) | Age (months) |
| 2 | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ | HAZ |
| 3 | Respirator rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate | Resp rate |
| 4 | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature | Temperature |
| 5 | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household |
| 6 | Num. rooms used for sleeping | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Breastfed | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Breastfed |
| 7 | Num. days of diarrhea at presentation | Num. rooms used for sleeping | Breastfed | Num. rooms used for sleeping | Num. rooms used for sleeping | Breastfed | Breastfed | Num. days of diarrhea at presentation | Breastfed | Breastfed | Breastfed | Num. rooms used for sleeping | Num. days of diarrhea at presentation |
| 8 | Num. other households that share same fecal waste facility | Breastfed | Num. rooms used for sleeping | Breastfed | Breastfed | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. rooms used for sleeping | Breastfed | Num. rooms used for sleeping |
| 9 | Breastfed | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility | Num. other households that share same fecal waste facility |
| 10 | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household | Num. children <60months live in household |
| Rank of additional variable | n/a | 33rd | 18th | 19th (crypto)  30th (shigella) | 22nd | 49th | 20th | 22nd (crypto)  48th (shigella) | 26th | 60th | 56th | 52nd (crypto)  62nd (shigella) | 26th |

\*n=4277 due to missing etiology data

\*\*viral etiology include astrovirus, norovirus GII, rotavirus, sapovirus, and adenovirus, n=4277 due to missing etiology data

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | The Gambia | Mali | Mozambique | Kenya | India | Bangladesh | Pakistan | Fit in data from Africa | Fit in data from Asia |
|  |  |  |  |  |  |  |  |  |  |
| AUCs |  |  | sample size too small |  |  |  |  | 0.72 (0.72, 0.73) | 0.70 (0.70, 0.70) |
|  | **0.67 (0.66, 0.67)** | **0.82 (0.82, 0.83)** |  | **0.71 (0.70, 0.72)** | **0.76 (0.75, 0.76)** | **0.71 (0.71, 0.72)** | **0.68 (0.67, 0.69)** | **0.73 (0.72, 0.73)** | **0.72 (0.71, 0.72)** |
|  | *0.69 (0.68, 0.70)* | *0.82 (0.81, 0.82)* |  | *0.72 (0.71, 0.72)* | *0.77 (0.76, 0.78)* | *0.70 (0.70, 0.71)* | *0.68 (0.67, 0.69)* | *0.73 (0.72, 0.73)* | *0.72 (0.72, 0.72)* |
| 1 | HAZ | Age |  | Age | HAZ | Age | Age | Age | Age |
| 2 | Age | HAZ |  | HAZ | Age | HAZ | HAZ | HAZ | HAZ |
| 3 | Respiratory rate | Respiratory rate |  | Respiratory rate | Temperature | Respiratory rate | Temperature | Respiratory rate | Respiratory rate |
| 4 | Num. people living in household | Temperature |  | Temperature | Respiratory rate | Temperature | Respiratory rate | Temperature | Temperature |
| 5 | Temperature | Breastfed |  | Breastfed | Num. other households that share same fecal waste facility | Num. people living in household | Num. people living in household | Num. people living in household | Num. people living in household |
| 6 | Num. rooms used for sleeping | Num. people living in household |  | Num. days of diarrhea at presentation | Num. people living in household | Num. days of diarrhea at presentation | Num. days of diarrhea at presentation | Breastfed | Num. other households that share same fecal waste facility |
| 7 | Num. children <60months live in household | Num. rooms used for sleeping |  | Num. people living in household | Num. days of diarrhea at presentation | Type of fecal waste facility used by household | Num. children <60months live in household | Num. rooms used for sleeping | Num. days of diarrhea at presentation |
| 8 | Num. days of diarrhea at presentation | Num. children <60months live in household |  | Num. other households that share same fecal waste facility | Caregiver education | Num. rooms used for sleeping | Num. rooms used for sleeping | Num. days of diarrhea at presentation | Num. rooms used for sleeping |
| 9 | How much offering child to drink | Num. other households that share same fecal waste facility |  | How much offering child to drink | Num. rooms used for sleeping | Num. other households that share same fecal waste facility | Caregiver education | Num. children <60months live in household | Caregiver education |
| 10 | How often main water source available | Num. days of diarrhea at presentation |  | Num. children <60months live in household | How much offering child to drink | Caregiver education | Child receive recommended rehydration | Num. other households that share same fecal waste facility | Type of fecal waste facility used by household |
|  |  |  |  |  |  |  |  | 2-variable CPR performance in data from Asia | 2-variable CPR performance in data from Africa |
|  |  |  |  |  |  |  |  | 0.70 (0.68, 0.72) | 0.72 (0.71, 0.74) |

# REFERENCES

1. Bank TW. Metadata Glossary: Improved water source (% of population with access).

2. Progress on household drinking water, sanitation and hygiene 2000-2020: Five years into the SDGs. Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF); 2021.