# Huicho et al. Drivers of the progress achieved by Peru in reducing childhood diarrhoea mortality: A country case study

**Online Supplementary Material**

## Table S1

## Coverage and data sources of interventions used in LiST analyses (1980-2015).

| Intervention | Age Range | 1980 Coverage/ Prevalence (%) | Earliest Measured Data (%) | 2000 Coverage/ Prevalence (%) | 2015 Coverage/ Prevalence (%) | 2030 Target Coverage/ Prevalence (%) | Data Source Notes |
|---|---|---|---|---|---|---|---|
| Zinc for treatment of diarrhea | | 0.0 | 0.0 | 0.0 | 0.0 | 90.0 | No data on zinc for treatment of diarrhea in Peru. |
| Rotavirus vaccine | | 0.0 | 3.0 (WHO/UNICEF 2008) | 0.0 | 87.0 (WHO/UNICEF 2015) | 90.0 | |
| ORS | | 0.0 | 20.7 (DHS 1991) | 21.9 (Interpolated) | 28.2 (DHS 2014) | 90.0 | Assumed coverage was 0 in 1980 and used linear interpolation between 1980 and earliest measured data. |
| Antibiotics for dysentery | | 2.7 (Interpolated) | 20.5 (DHS 1991) | 17.3 (DHS 2000) | 16.0 (DHS 2014) | 90.0 | Assumed coverage was 0 in 1960 and used linear interpolation between 1960 and earliest measured data. |
| Persistent diarrhea treatment | | 0.0 | 0.0 | 0.0 | 33.0 | 90.0 | No data on persistent diarrhea treatment in Peru. Coverage in 2015 based on expert opinion. |
| Changes in age-appropriate breastfeeding | 0-1 months (exclusive breastfeeding) | | 77.8 (DHS 1996) | 85.6 (DHS 2000) | 68.9 (DHS 2012) | 90.0 | |
| | 1-5 months (exclusive breastfeeding) | | 50.6 (DHS 1996) | 65.2 (DHS 2000) | 67.5 (DHS 2012) | 90.0 | |
| | 6-11 months (any breastfeeding) | | 90.3 (DHS 1996) | 94.7 (DHS 2000) | 92.0 (DHS 2012) | 92.0 | |
| | 12-24 months (any breastfeeding) | | 65.0 (DHS 1996) | 68.0 (DHS 2000) | 65.8 (DHS 2012) | 90.0 | |
| Early initiation of breastfeeding | | 40.2 (Assumed equal to earliest measured data) | 40.2 (DHS 1996) | 44.9 (DHS 2000) | 53.7 (DHS 2012) | 90.0 | Assumed 1980 coverage equal to earliest measured data. Intervention not scaled |
| Vitamin A supplementation | | 0.0 | 3.78 (DHS 2000) | 3.78 (DHS 2000) | 4.5 (DHS 2012) | 90.0 | Assumed 1990 year of introduction. Used linear interpolation between 1990 and earliest measured data |
| Changes in stunting prevalence | | 38.2 (Majid et al) | 31.1 (DHS 1996) | 30.5 (Interpolated) | 17.3 (DHS 2013) | 8.7 | Overall stunting rates obtained from Majid *et al.* Age structure from earliest measured data and modeled overall stunting rate used to |

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|---|---|---|---|---|---|---|---|
| | | | | | | | calculate 1980 stunting distributions, segregated by age. |
| Changes in wasting prevalence | | 1.8 (1991 DHS) | 1.4 (DHS 1996) | 1.1 (Interpolated) | 0.5 (DHS 2013) | - | |
| Improved water source | | 71.7 (Interpolated) | 77.7 (JMP 1996) | 79.8 (JMP 2000) | 86.7 (JMP 2015) | 90.0 | Assumed coverage was 0 in 1960 and used linear interpolation between 1960 and earliest measured data. |
| Improved sanitation | | 48.6 (Interpolated) | 59.0 (JMP 1996) | 62.9 (JMP 2000) | 76.2 (JMP 2015) | 90.0 | Assumed coverage was 0 in 1960 and used linear interpolation between 1960 and earliest measured data. |
| Water connection in the home | | 33.0 | 60.8 (JMP 1996) | 64.7 (JMP 2000) | 78.2 (JMP 2015) | - | |
| Hand washing with soap | | 33.0 | 60.8 (JMP 1996) | 64.7 (JMP 2000) | 78.2 (JMP 2015) | 90.0 | Assumed coverage equal to coverage of water connection in the home in 1980 and linear scale up to earliest measured data from JMP |

**Table S2**
**Interventions' coverage (%) between years 2015 to 2030.**

| Interventions | Data source for 2015 coverage | Coverage (%) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
| Zinc for treatment of diarrhea[1] | No data for this intervention in Peru | 0.0 | 6.0 | 12.0 | 18.0 | 24.0 | 30.0 | 36.0 | 42.0 | 48.0 | 54.0 | 60.0 | 66.0 | 72.0 | 78.0 | 84.0 | 90.0 |
| Rotavirus vaccine[1] | WHO/UNICEF | 87.0 | 87.2 | 87.4 | 87.6 | 87.8 | 88.0 | 88.2 | 88.4 | 88.6 | 88.8 | 89.0 | 89.2 | 89.4 | 89.6 | 89.8 | 90.0 |
| ORS[1] | DHS | 37.4 | 40.9 | 44.4 | 47.9 | 51.4 | 54.9 | 58.4 | 61.9 | 65.5 | 69.0 | 72.5 | 76.0 | 79.5 | 83.0 | 86.5 | 90.0 |
| Antibiotics for dysentery[1] | DHS | 16.0 | 20.9 | 25.9 | 30.8 | 35.7 | 40.7 | 45.6 | 50.5 | 55.5 | 60.4 | 65.3 | 70.3 | 75.2 | 80.1 | 85.1 | 90.0 |
| Persistent diarrhoea treatment[1] | Based on expert opinion | 33.0 | 36.8 | 40.6 | 44.4 | 48.2 | 52.0 | 55.8 | 59.6 | 63.4 | 67.2 | 71.0 | 74.8 | 78.6 | 82.4 | 86.2 | 90.0 |
| Changes in age-appropriate breastfeeding practices[2] | | | | | | | | | | | | | | | | | |
| Exclusive breastfeeding; <1 month | DHS | 68.9 | 70.3 | 71.7 | 73.1 | 74.5 | 75.9 | 77.4 | 78.8 | 80.2 | 81.6 | 83.0 | 84.4 | 85.8 | 87.2 | 88.6 | 90.0 |
| Predominant breastfeeding; <1 month | | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| Partial breastfeeding; <1 month | | 22.5 | 21.0 | 19.6 | 18.2 | 16.8 | 15.4 | 14.0 | 12.6 | 11.2 | 9.8 | 8.4 | 7.0 | 5.6 | 4.2 | 2.8 | 1.4 |
| Not breastfeeding; <1 month | | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Exclusive breastfeeding; 1-5 months | | 67.5 | 69.0 | 70.5 | 72.0 | 73.5 | 75.0 | 76.5 | 78.0 | 79.5 | 81.0 | 82.5 | 84.0 | 85.5 | 87.0 | 88.5 | 90.0 |
| Predominant breastfeeding; 1-5 months | | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 | 4.8 |
| Partial breastfeeding; 1-5 months | | 25.2 | 23.7 | 22.2 | 20.7 | 19.2 | 17.7 | 16.2 | 14.7 | 13.2 | 11.7 | 10.2 | 8.7 | 7.2 | 5.7 | 4.2 | 2.7 |
| Not breastfeeding; 1-5 months | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Any breastfeeding; 6-11 months | | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 | 92.0 |
| Not breastfeeding; 6-11 months | | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Any breastfeeding; 12-23 months | | 65.8 | 67.4 | 69.0 | 70.6 | 72.3 | 73.9 | 75.5 | 77.1 | 78.7 | 80.3 | 81.9 | 83.5 | 85.2 | 86.8 | 88.4 | 90.0 |
| Not breastfeeding; 12-23 months | | 34.2 | 32.6 | 31.0 | 29.4 | 27.7 | 26.1 | 24.5 | 22.9 | 21.3 | 19.7 | 18.1 | 16.5 | 14.8 | 13.2 | 11.6 | 10.0 |
| Vitamin A supplementation[2] | UNICEF | 4.5 | 10.2 | 15.9 | 21.6 | 27.3 | 33.0 | 38.7 | 44.4 | 50.1 | 55.8 | 61.5 | 67.2 | 72.9 | 78.6 | 84.3 | 90.0 |
| Changes in stunting prevalence[2] | DHS | 17.3 | 17.3 | 17.3 | 16.2 | 15.2 | 14.1 | 13.0 | 11.9 | 10.8 | 9.7 | 8.7 | 8.7 | 8.7 | 8.7 | 8.7 | 8.7 |
| Combination of Improved Water Source and Improved Sanitation[3] | JMP | 76.2 | 77.1 | 78.0 | 79.0 | 79.9 | 80.8 | 81.7 | 82.6 | 83.6 | 84.5 | 85.4 | 86.3 | 87.2 | 88.2 | 89.1 | 90.0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hand washing with soap[3] | DHS - used coverage of water connection in the home as a proxy | 78.2 | 79.0 | 79.8 | 80.6 | 81.4 | 82.2 | 82.9 | 83.7 | 84.5 | 85.3 | 86.1 | 86.9 | 87.6 | 88.4 | 89.2 | 90.0 |

## Table S3
## Data source documentation.

| Indicator | Source(s) | Assumptions |
|---|---|---|
| Neonatal, infant and under-five mortality rates | United Nations Population Division | None |
| Height-for-age Z score (HAZ) distribution data, segregated by age group | Overall stunting rates (% of children under five greater than -2 SD below reference population mean and % of children under five greater than -3SD below reference population mean) for year 1985[58]<br><br>When available, data from nationally representative surveys were used* | Modeling in LiST required Stunting distribution pattern by age. Matched stunting distribution by age from earliest DHS, or similar survey. Assumed 1980 stunting distribution equal to 1985 stunting distribution[58] |
| Weight-for-age Z score (WHZ) distribution data, segregated by age group | Nationally representative surveys* | Assumed 1980 coverage equal to earliest measured from nationally representative surveys. For subsequent years, linear changes were assumed between measured values from nationally representative surveys |
| Cause of death structure (i.e. percentage of deaths due to each major cause of death) | Maternal Child Epidemiology Estimation | None |
| Antibiotics for dysentery | Nationally representative surveys* | Coverage equal to 0% in year 1960and linear scale up until earliest measured data |
| Early Initiation of breastfeeding | Demographic and Health Surveys, Multiple Indicator Cluster Surveys, other national surveys | Assumed 1980 coverage equal to earliest measured |
| Hand washing with soap | Joint Monitoring Programme | Assumed coverage equal to coverage of water connection in the home in 1980 and linear scale up to earliest measured data from JMP or 2009 global estimate |
| Improved sanitation - Utilization of latrines or toilets + improved water source | Joint Monitoring Programme | Assumed coverage equal to 0% in year 1960 and linear scale up until earliest measured data. Effectiveness applies only when improved sanitation and improved water are both present. |
| Rotavirus vaccine (two doses) | UNICEF vaccine coverage data | Assumed 0% unless measured data available |
| Oral rehydration solution | Nationally representative surveys* | Assumed coverage equal to 0% in year 1980 and linear scale up until earliest measured data |
| Vitamin A supplementation | UNICEF Vitamin A supplementation data | Assumed overage equal to 0% in 1980. Assumed coverage equal to 0% in year 1990 and linear scale up until earliest measured data |
| Persistent diarrhea | None | Assumed coverage equal to 0% in 2000 and 33% in all countries |

*DHS, MICS surveys and other similar surveys. Please note that in Peru there were 10 DGS surveys between 1986 and 2012. Since that time Peru has been running continuous surveys and therefore has yearly estimates of stunting, wasting and coverage of interventions.

**Table S4**

## Description of the interventions and risk factors included in each universal coverage scale-up scenario for years 1980 to 2015.

| | Scenario 1<br>Direct Diarrhea Interventions | Scenario 2<br>Direct Diarrhea Interventions and Nutrition Interventions | Scenario 3<br>All interventions that affect diarrhea mortality |
|---|---|---|---|
| Interventions scaled up to universal coverage (90%)<br><br>(For stunting, target = reduction by 50%, for wasting target= <5%) | • Antibiotics for dysentery<br>• Oral rehydration solution<br>• Persistent diarrhea treatment<br>• Rotavirus vaccine<br>• Zinc | • All direct diarrhea interventions<br>• Vitamin A<br>• Stunting prevalence<br>• Wasting prevalence<br>• Breastfeeding practices<br>• Early initiation of breastfeeding | • All direct diarrhea interventions<br>• All nutrition interventions<br>• Improved sanitation + improved water source<br>• Water connection in the home<br>• Handwashing |

**Table S5**

## Description of the interventions and risk factors included in each universal coverage scale-up scenario for years 2015 to 2030.

| | Scenario 1<br>Direct Diarrhea Interventions | Scenario 2<br>Direct Diarrhea Interventions and Nutrition Interventions | Scenario 3<br>All interventions that affect diarrhea mortality |
|---|---|---|---|
| Interventions scaled up to universal coverage (90%)<br><br>(For stunting, target = reduction to 8.7% in year 2025) | • Antibiotics for dysentery<br>• Oral rehydration solution<br>• Persistent diarrhea treatment<br>• Rotavirus vaccine<br>• Zinc | • All direct diarrhea interventions<br>• Vitamin A<br>• Stunting prevalence<br>• Breastfeeding practices | • All direct diarrhea interventions<br>• All nutrition interventions<br>• Improved sanitation + improved water source<br>• Handwashing |

**Table S6**
**Number of diarrhea deaths reduction attributable to different interventions in Peru comparing first to last year in a time period.**

| Interventions | 1980-2000 Attribution | 2000-2015 Attribution | 1980-2015 Attribution |
|---|---|---|---|
| Zinc for treatment of diarrhea[1] | 0 | 0 | 0 |
| Rotavirus vaccine[1] | 0 | 292 | 1,480 |
| ORS[1] | 1,225 | 165 | 1,135 |
| Antibiotics for dysentery[1] | 72 | 0 | 34 |
| Persistent Diarrhoea Treatment[1] | 0 | 67 | 239 |
| Changes in age-appropriate breastfeeding practices[2] | 418 | 0 | 269 |
| Early initiation of breastfeeding[2] | 16 | 0 | 0 |
| Vitamin A supplementation[2] | 25 | 1 | 24 |
| Changes in stunting prevalence[2] | 1,395 | 132 | 1,935 |
| Changes in wasting prevalence[2] | 179 | 23 | 201 |
| Combination of Improved Water Source and Improved Sanitation[3] | 1,176 | 83 | 1,385 |
| Water connection in the home[3] | 2,983 | 299 | 3,510 |
| Hand washing with soap[3] | 1,119 | 79 | 1,317 |
| **Total Scenario 1 (Direct[1])** | 1,297 | 524 | 2,888 |
| **Total Scenario 2 (Direct[1] + Nutrition[2])** | 3,330 | 680 | 5,317 |
| **Total Scenario 3 (Direct[1] + Nutrition[2] + WASH[3])** | 8,608 | 1,141 | 11,529 |

**Table S7**
**Percent of DSMR reduction attributable to different interventions (%), Peru, 2015-2030, by scenario.**

| Interventions | Scenario 1 (Direct[1]) | Scenario 2 (Direct[1] + Nutrition[2]) | Scenario 3 (Direct[1] + Nutrition[2] + WASH[3]) |
|---|---|---|---|
| Zinc for treatment of diarrhea[1] | 70 | 47 | 43 |
| Rotavirus vaccine[1] | 3 | 3 | 3 |
| ORS[1] | 204 | 140 | 127 |
| Antibiotics for dysentery[1] | 29 | 20 | 18 |
| Persistent Diarrhoea Treatment[1] | 46 | 31 | 28 |
| Changes in age-appropriate breastfeeding practices[2] | | 77 | 72 |
| Vitamin A supplementation[2] | | 22 | 21 |
| Changes in stunting prevalence[2] | | 72 | 68 |
| Combination of Improved Water Source and Improved Sanitation[3] | | | 21 |
| Hand washing with soap[3] | | | 17 |
| **Total** | 352 | 412 | 418 |