

11/2/2025

WASH ACCESS AND INFANT MORTALITY: UNDERSTANDING GLOBAL INEQUALITY

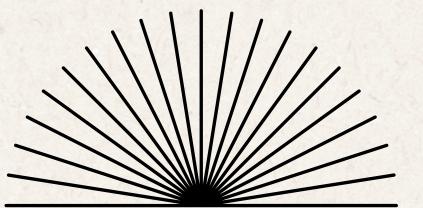
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FAIR Forward Hack 2025

BioData Sage



Agenda

03	Overview
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Water

02



Sanitation

03



Hygiene



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What is WASH?

WASH stands for Water Supply, Sanitation, and Hygiene. The essential services needed to prevent disease and support healthy living.

Research Question

What factors of water supply, sanitation, and hygiene are the biggest contributors to a country's infant mortality rate?



World Health Organization

Logo @ WHO - Used for educational purposes.

Data Sources

WHO/UNICEF Joint Monitoring Program (JMP) - WASH Dataset

Tracks access to water supply, sanitation, and hygiene services across populations

unicef The UNICEF logo, featuring the word "unicef" in a blue sans-serif font next to a blue circular emblem with two children's profiles facing each other.

Logo © UNICEF - Used for educational purposes.

WHO Health Inequality Data Repository - Under-five Mortality(U5MR) Dataset

Provides child mortality rates across countries and inequality dimensions

Data Cleaning & Processing

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Goal: Clean data to reflect only the information that we would need for analysis.

Create a new dataset that would reflect these changes that we could use to begin data analysis and exploration.

	setting	date	source	indicator_abbr	indicator_name	dimension	subgroup
1	Afghanistan	2000	JMP	hh_san_bas	Population using basic sanitation services (%)	Place of residence	Rural
2	Afghanistan	2000	JMP	hh_san_bas	Population using basic sanitation services (%)	Place of residence	Urban
3	Afghanistan	2000	JMP	hh_san_lim	Population using limited sanitation services (%)	Place of residence	Rural
4	Afghanistan	2000	JMP	hh_san_lim	Population using limited sanitation services (%)	Place of residence	Urban
5	Afghanistan	2000	JMP	hh_san_ns	Population practising open defecation (%)	Place of residence	Rural
6	Afghanistan	2000	JMP	hh_san_ns	Population practising open defecation (%)	Place of residence	Urban
7	Afghanistan	2000	JMP	hh_san_unimp	Population using unimproved sanitation services (%)	Place of residence	Rural
8	Afghanistan	2000	JMP	hh_san_unimp	Population using unimproved sanitation services (%)	Place of residence	Urban
9	Afghanistan	2000	JMP	hh_wat_bas	Population using basic drinking water services (%)	Place of residence	Rural

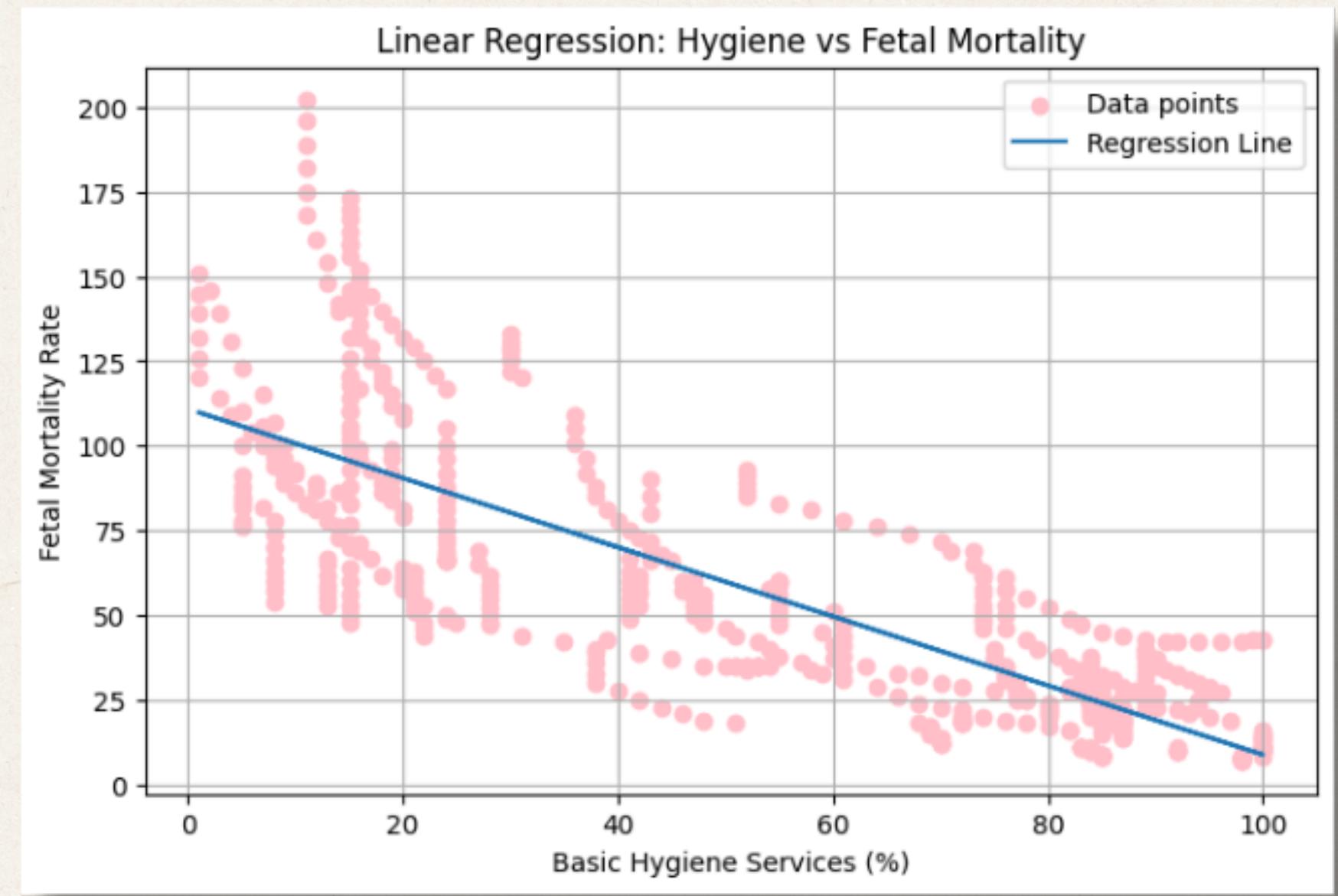
	setting	date	source	indicator_abbr	indicator_name	dimension
1	Afghanistan	1962	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
2	Afghanistan	1962	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
3	Afghanistan	1963	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
4	Afghanistan	1963	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
5	Afghanistan	1964	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
6	Afghanistan	1964	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
7	Afghanistan	1965	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
8	Afghanistan	1965	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
9	Afghanistan	1966	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
10	Afghanistan	1966	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex
11	Afghanistan	1967	UN IGME estimate	u5mr	Under-five mortality rate (deaths per 1000 live births)	Sex

```
indicator_name_1 | indicator_name_2 | ... | indicator_name_36 | under_5_mortality  
country_1  
country_2  
country_3  
country_4
```

Ranking Indicators by Correlation

using Pearson's correlation coefficient.

Indicators	Pearson Coefficient
Population using basic hygiene services (%)	-0.799412
Population using basic sanitation services (%)	-0.793215
Population using unimproved drinking water services (%)	0.774946
Population using basic drinking water services (%)	-0.772797
Population using safely managed drinking water services (%)	-0.725338

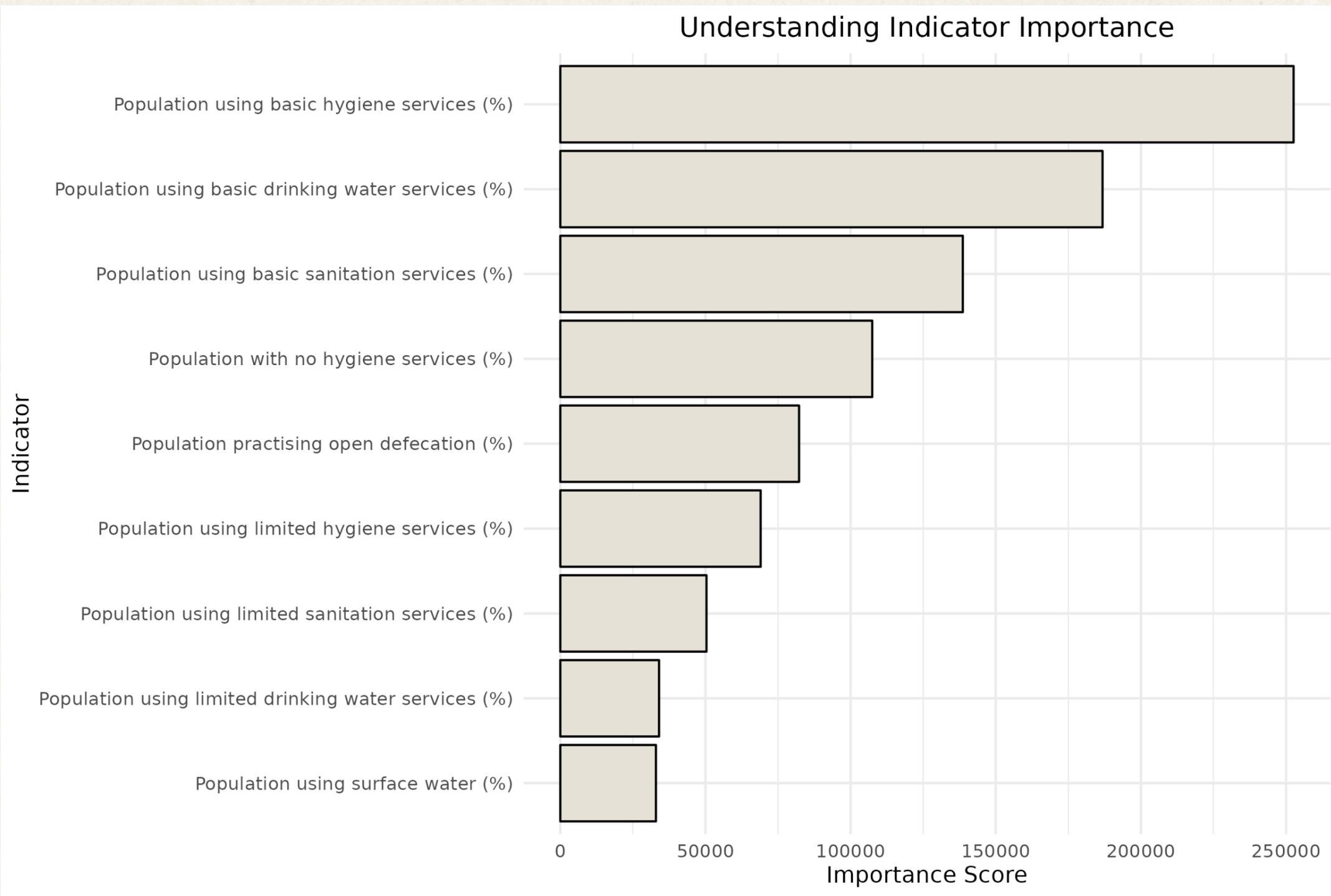


Random Forest Regression Results

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Random Forest Model Summary

- Model built using **tidymodels** with the **ranger engine**
- 500 trees, optimized mtry, minimum node size = 2
- set.seed = 253 for reproducibility
- Model performance:
 - $R^2 = 0.998$ (model explains nearly all variation)
 - RMSE = 1.697
 - MAE = 1.057
- Variable importance (Gini index) used to determine which WASH indicators contribute most to predicting infant mortality



Findings, Interpretation & Context

Results:

Both Pearson's Correlation Coefficient and Random Forest modeling indicated that the population using basic hygiene services have the biggest correlation and contribution to understanding infant mortality. Two key published studies corroborate these findings.

Interpretation:

Lack of access to running water, and other methods of sanitation as the biggest contributors to infant mortality rates.

Review > *Trop Med Int Health*. 2018 May;23(5):508-525. doi: 10.1111/tmi.13051.
Epub 2018 Apr 23.

Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: updated meta-analysis and meta-regression

Jennyfer Wolf ¹, Paul R Hunter ^{2 3}, Matthew C Freeman ⁴, Oliver Cumming ⁵, Thomas Clasen ⁴, Jamie Bartram ⁶, Julian P T Higgins ⁷, Richard Johnston ¹, Kate Medlicott ¹, Sophie Boisson ¹, Annette Prüss-Ustün ¹

Affiliations + expand
PMID: 29537671 DOI: 10.1111/tmi.13051
[Free article](#)

Abstract

Objectives: Safe drinking water, sanitation and hygiene are protective against diarrhoeal disease; a leading cause of child mortality. The main objective was an updated assessment of the impact of unsafe water, sanitation and hygiene (WaSH) on childhood diarrhoeal disease.

Methods: We undertook a systematic review. Study results were combined and analysed.

Results: A total of 135 studies met the inclusion criteria. Most interventions were associated with lower risk of diarrhoea. Improved access to safe storage reduced diarrhoea risk by 64% (0.42, 0.98), respectively compared to interventions by 25% (RR = 0.75 (0.63, 0.88)). Improved sanitation coverage is reached; and intervention (RR = 0.70 (0.64, 0.77)) vs. no intervention. Result sensitive to certain differences in study methods reduce the associations with diarrhoea to some extent.

Conclusions: Although evidence is limited, improved access to safe storage and higher levels of community coverage are in line with targets of the Sustainable Development Goals.

Wolf et al. (2018)

Meta-Analysis > *Cochrane Database Syst Rev*. 2021 Jan 6;12(1):CD004265.
doi: 10.1002/14651858.CD004265.pub4.

Hand-washing promotion for preventing diarrhoea

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Affiliations + expand
PMID: 33539552 PMCID: PMC809449 DOI: 10.1002/14651858.CD004265.pub4

Abstract in English, Spanish

Background: Diarrhoea accounts for 1.8 million deaths in children in low- and middle-income countries (LMICs). One of the identified strategies to prevent diarrhoea is hand washing.

Objectives: To assess the effects of hand-washing promotion interventions on diarrhoeal episodes in children and adults.

Search methods: We searched CENTRAL, MEDLINE, Embase, nine other databases, the World Health Organization (WHO) International Clinical Trial Registry Platform (ICTRP), and metaRegister of Controlled Trials (mRCT) on 8 January 2020, together with reference checking, citation searching and contact with study authors to identify additional studies.

Selection criteria: Individually-randomized controlled trials (RCTs) and cluster-RCTs that compared the effects of hand-washing interventions on diarrhoea episodes in children and adults with no intervention.

Data collection and analysis: Three review authors independently assessed trial eligibility, extracted data, and assessed risks of bias. We stratified the analyses for child day-care centres or schools, community, and hospital-based settings. Where appropriate, we pooled incidence rate ratios (IRRs) using the generic inverse variance method and a random-effects model with a 95% confidence interval (CI). We used the GRADE approach to assess the certainty of the evidence.

Main results: We included 29 RCTs: 13 trials from child day-care centres or schools in mainly high-income countries (54,471 participants), 15 community-based trials in LMICs (29,347 participants), and one hospital-based trial among people with AIDS in a high-income country (148 participants). All the trials and follow-up assessments were of short-term duration. Hand-washing promotion (education activities, sometimes with provision of soap) at child day-care facilities or schools prevent around one-third of diarrhoea episodes in high-income countries (incidence rate ratio (IRR) 0.70, 95% CI 0.58

Ejemot-Nwadiaro et al. (2021)