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# Background

- Poor WASH conditions contribute to approximately 1.2 million deaths annually. (WHO 2023)
- Heavy burden on children under 5 in LMICs ( highest burden in Sub- Saharan Africa and South Asia).
- WASH, food safety & nutrition jointly influence enteric disease & malnutrition.
- These conditions perpetuate a vicious cycle of poverty and health inequalities.
- Integrated interventions: well-established conceptual links, but limited empirical evaluation.



# Background

- Economic evidence for WASH and nutrition interventions remains limited and fragmented.
- Trial-based studies often have short time horizons and limited generalizability.
- Model-based economic evaluations extend trial findings by:
  - Synthesizing evidence from multiple sources
  - Extrapolating outcomes to long-term horizons and wider populations (Chen et al. 2024)
- Enables assessment of long-term costs and benefits.
- Supports efficient resource allocation and intervention prioritization, aligned with standardized guidance. (NICE, 2022).

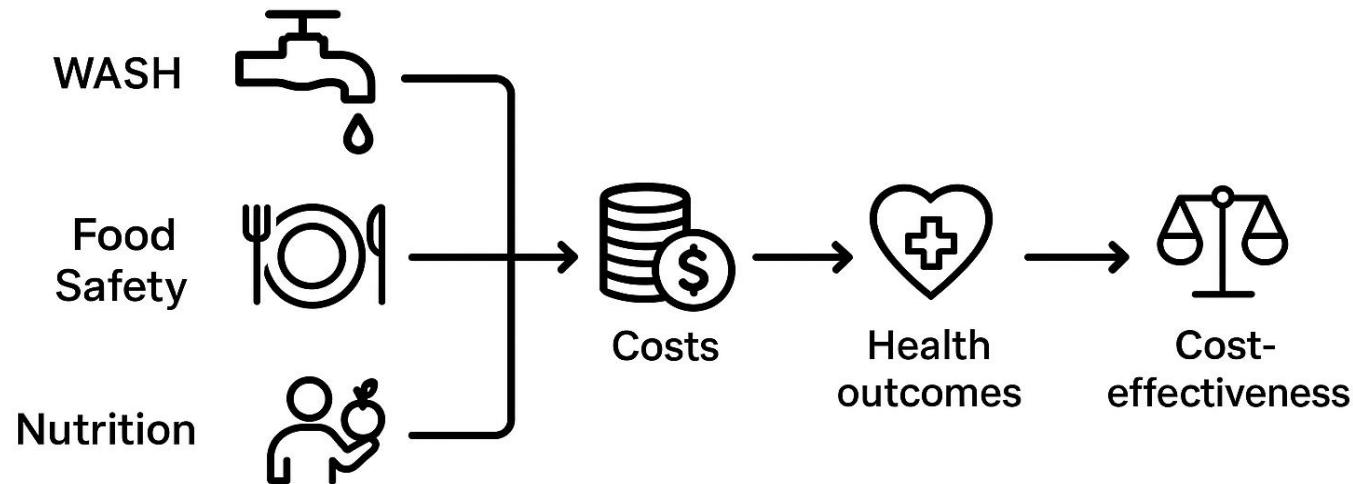
# Rationale

- Methodological challenges are particularly high in WASH contexts (Barrington et al. 2025).
- Interventions often require long study horizons and produce long-term impacts.
- Outcomes may include environmental effects and community-level spillovers, which are difficult to capture using conventional models.



# Objectives

- To identify, evaluate and narratively synthesize model-based economic evaluations of
  - Water, Sanitation and Hygiene (WASH) interventions
  - Food safety
  - Nutrition
- Provide practical recommendations to improve future studies and support cost-effective interventions.



# Methods

## Search Strategy

- Databases and registers: MEDLINE, EMBASE, Cochrane, Econ Lit, GH CEA registry, Scopus, Web of Science, CINAHL.
- using keywords such as ‘WASH’, ‘diarrhea’, ‘economic evaluation’, decision model’ and ‘LMICs’.
- No time restrictions.
- Guided by PRISMA guidelines and PICOS framework.
- Protocol registered in PROSPERO under CRD420251015041.

Search Strategy OVID MEDLINE

	SEARCHES	RESULTS
	<b>HANDWASHING AND DIARRHEA</b>	
1.	(handwash* or (hand adj3 (wash* or hygiene)) or (hand* adj3 soap*) or ((hygiene or handwash*) adj3 (promot* or educat* or behavio* or intervent*))) or (diarrhea or diarrhoea)).mp.	163535
	<b>FOOD SAFETY, NUTRITION AND CHILD PLAY</b>	
2.	((food adj3 (safety or hygiene)) or (nutrition adj3 (intervention* or education* or promot* or program*)) or community nutrition or dietary intake or (malnutrition or undernutrition or stunting or wasting) or (child play adj3 (hygiene or safety or environment*))).mp.	182278
	<b>WASH INTERVENTIONS</b>	
3.	(WASH or (water adj3 sanitation) or (integrated adj3 (intervention* or program*)) or (community-based adj3 (intervention* or program*)) or (combined adj3 (intervention* or program*))).mp.	61574
	<b>COMBINED</b>	
4.	1 or 2 or 3	396547
	<b>ECONOMIC EVALUATIONS</b>	
5.	economic evaluation.mp. or exp Cost-Benefit Analysis/	103808
6.	(cost-utility or (econ adj1 eval*) or (cost adj2 efficien*)).mp.	28951

# Methods

## Eligibility Criteria

### Inclusion

- WASH, food safety and nutrition interventions
- LMIC settings
- Full economic evaluations using decision models
- Reporting DALYs, QALYs, ICERs, costs and clinical outcomes

### Exclusion

- No modelling
- Outside LMICs
- Institutional settings

## Quality Assessment

- Data extraction of study overview ( study site, perspective, type of analysis and findings ).
- and model design and structure (model type, cycle length, time horizon, sensitivity analysis and key states and pathways).
- Philips checklist to assess quality of models (structure , data and consistency).



# Results

- 2439 records identified.
- 22 studies were included in the review.

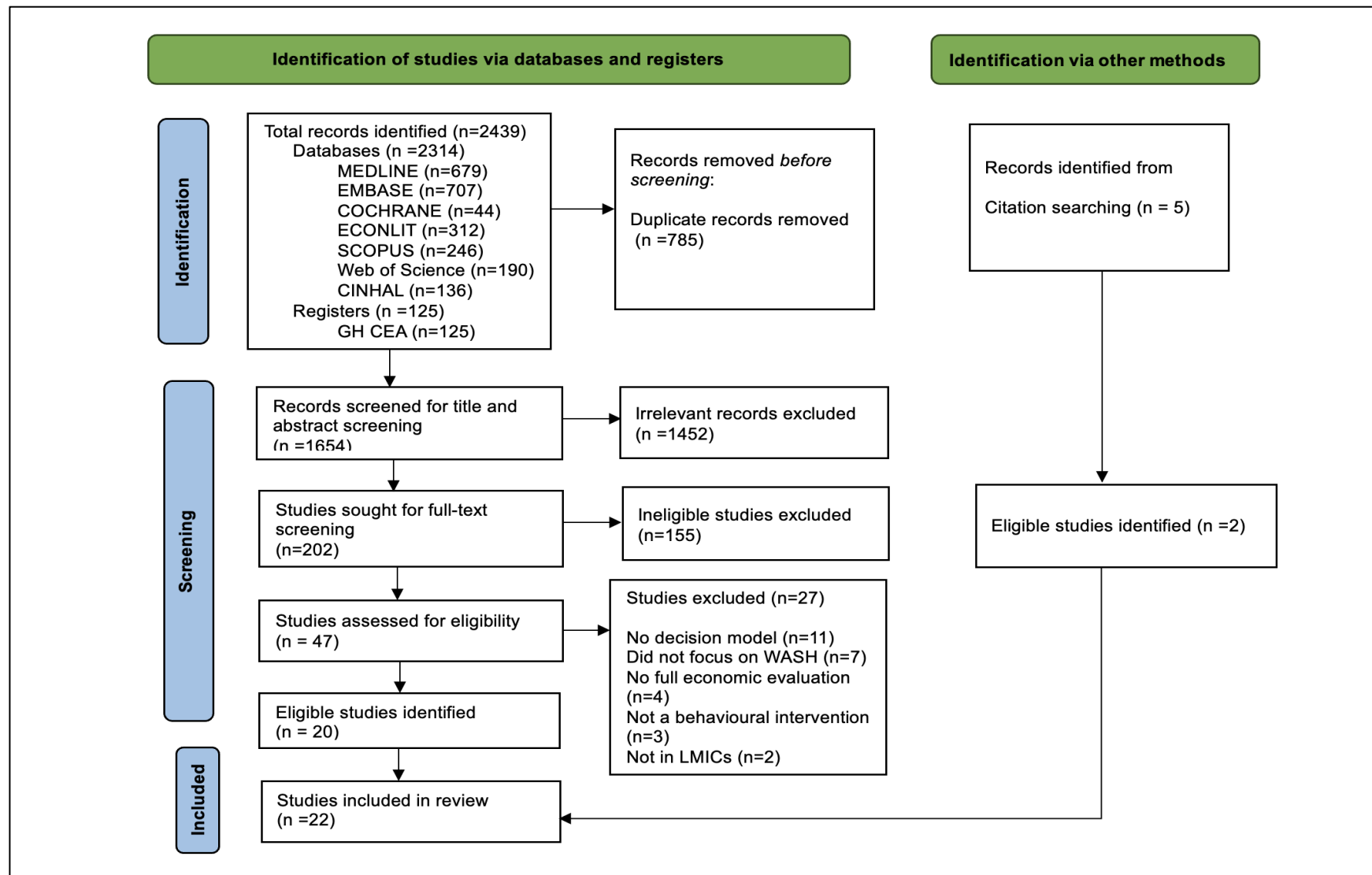


Figure 1: PRISMA flow diagram showing the process of identification and screening of relevant studies

# Results

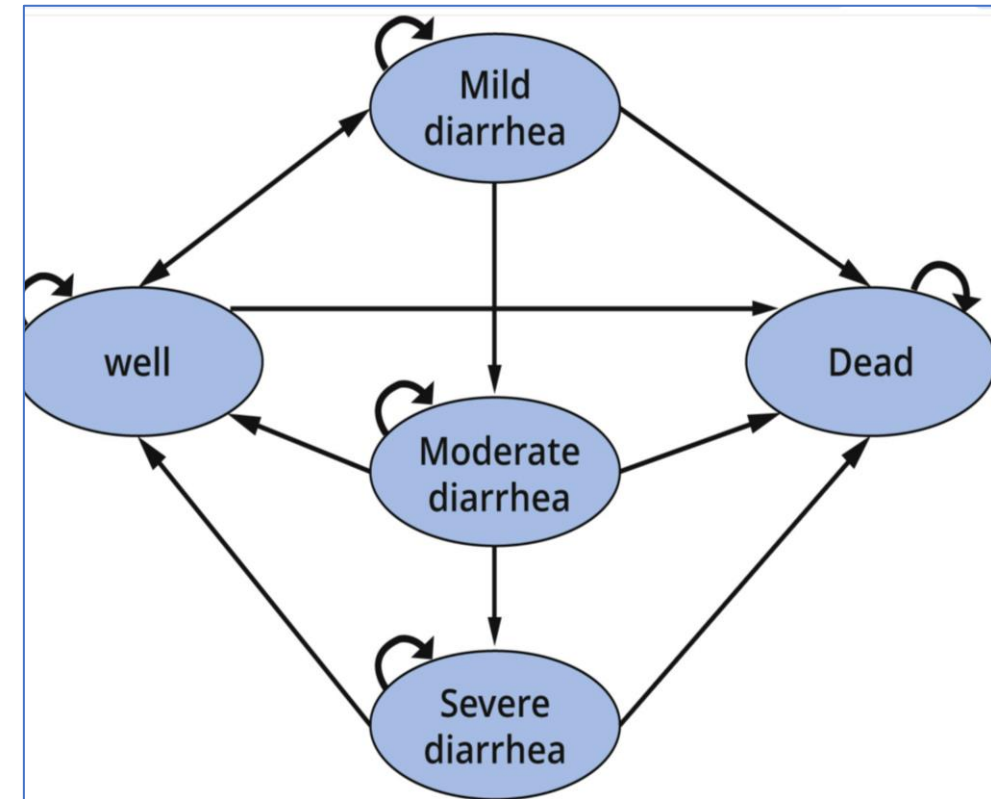
## Study characteristics

- Settings: Africa, South Asia, China, Latin America
- Majority of studies focused on children under five.
- Evaluation types: cost-effectiveness analysis (CEA), cost-utility analysis (CUA), cost-minimization analysis (CMA), cost-consequence analysis (CCA) and cost-of-illness (COI).
- Perspectives: societal , provider and payer
- Intervention groups:
  - 1.nutrition-based
  - 2.treatment-focused
  - 3.behavioral/community-level

# Results

## Modelling Approaches and Quality Assessment

- 22 studies: mainly Markov models & decision trees.
- Focus: disease progression & treatment pathways.
- Data sources were well reported and expert opinion was occasionally used.
- Transition probabilities were well explained but utility data was often less justified.
- Sensitivity analyses was common but probabilistic analyses was less frequent.
- Time horizons, cycle lengths & discounting varied.



# Results

## Modelling Approaches and Quality Assessment

- Health states captured disease/nutrition stages , only few included relapse pathways.
- Internal consistency was tested in most studies and unexpected results were explained.
- External validation was frequent but comparison to prior models was less common.

### Strengths

Good cost & probability reporting.

Use of societal perspective.

Clear transition estimates

### Weaknesses

Limited utility value reporting

Underuse of probabilistic sensitivity analysis

Heterogeneous structures

# Results

## Cost-effectiveness of Interventions

### Nutrition

- SQ-LNS (Uganda): \$242 per DALY averted, >3,600 deaths prevented.
- Micronutrient powders: cost-effective in multiple settings.
- YBB nutrition package (China): reduced stunting at low cost (75% coverage of YYB could avert 1.9 million stunting cases).

# Results

## Cost-effectiveness of Interventions

### Treatment & Behavior Change

- Zinc supplementation: highly cost-effective (<\$10/child) and led to 1.4 DALYs averted.
- CMAM was found to be more cost-effective than inpatient care.
- RUTF dose reduction led to cost-saving (\$15.43/child ).
- BCC programs were cost-effective.
- IMCI + rotavirus vaccination: \$80 per DALY averted.
- Hygiene counselling: low cost per DALY ( \$ 814 for DALY avoided over 4 years).

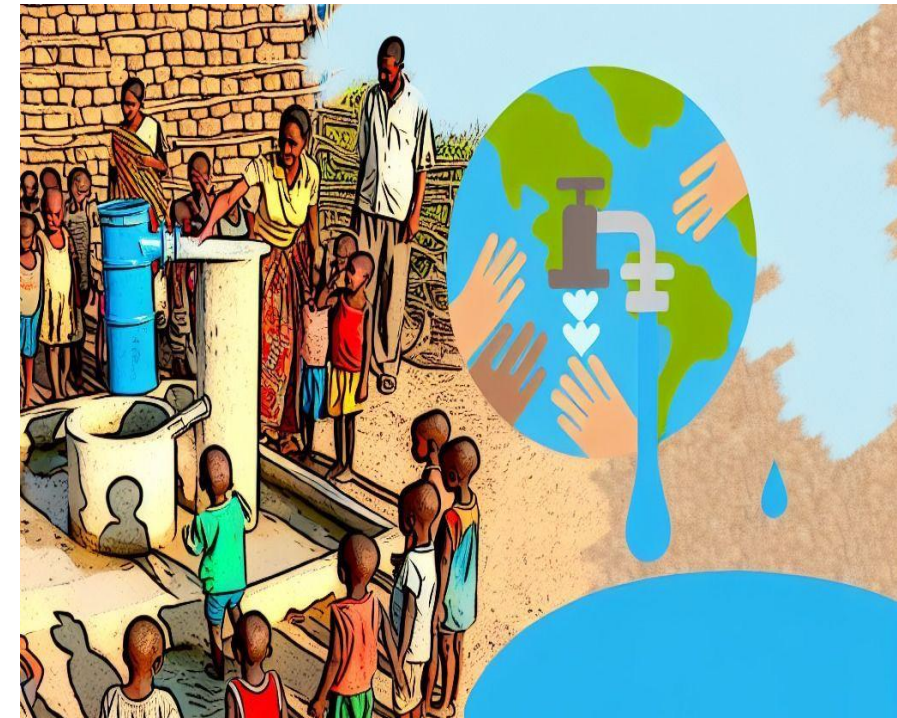
# Discussion

- 22 studies; mainly focused on children under five, interventions appeared to be cost-effective consistently.
- Societal perspective used to capture broader costs & outcomes.
- Methodological heterogeneity: model types, time horizons, outcomes, uncertainty analysis.
- Few models accounted for adherence/defaulting.
- PSA was underused which could have led to potential overestimation of cost-effectiveness.

# Policy implications

- WASH and community-level nutrition interventions yield high health benefits at lower cost.
- Integration with existing programs can improve cost-effectiveness and reach.
- Need methodological consistency: clear structure, perspective, discounting, PSA and value-of-information analysis.
- This allows for comparability and confidence in results and decision making.

- **PRIORITIZATION**
- **INTEGRATION**
- **SCALING**



# Recommendations

- Conduct economic evaluation of integrated WASH–food safety–nutrition interventions.
- Improve transparency & comparability of the models with standard practice.
- Reflect real-world disease dynamics, including recurrence and non-linear progression.
- Include broader study population (pregnant women, adolescents, elderly).
- Use robust PSA and scenario analysis.
- Incorporate safe child play & food safety components.

# Conclusion

- Limited Evidence: Few model-based economic evaluations of WASH, food safety, and community nutrition in LMICs.
- Methodological Challenges: Heterogeneous models, outcomes, and reporting; gaps in transparency and adherence to standard practice.
- Key Finding: Community-level WASH and related interventions appear highly cost-effective with significant health benefits.
- Recommendation: Improve methodological consistency and structural justification to support robust, generalizable evidence for decision-making.

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# Thank You

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