# Potential Reduction in Child Mortality through Expanding Access to Safe Drinking Water in India

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The Jal Jeevan Mission (JJM) aims to provide safe and adequate drinking water through individual household tap connections by 2024 to all households in rural India. We estimate that if JJM succeeds in this mission, it will prevent around 1,36,000 under-5 deaths per year. However, this will require that water delivered through JJM is free from microbiological contamination.

In 2019, at the inception of JJM, more than 50% of the population did not have access to safe drinking water[1]. Although geogenic contaminants such as arsenic, fluoride, and nitrate are widespread in certain regions of India, the most ubiquitous type of contamination is microbial. Diarrhea is the third most common responsible disease for under-five mortality in India.[2]

Water treatment is a cost-effective way to reduce diarrheal disesase and child mortality. A recent meta-analysis of 15 randomized controlled trials conducted by Kremer et al (2022) suggests that the expected reduction in all-cause under-5 mortality from water treatment is around one in four.[3] This meta-analysis also suggests that water treatment is among the most cost-effective ways to reduce child mortality.

Providing piped water is an important step towards improving water quality. However, it is critical that it be free of microbial contamination. Even in cases where water is treated at a central location, negative pressure in pipes can cause contamination. For example, a 2019 study in Maharashtra found high rates (37%) of E. coli contamination in piped water samples.[4]

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[1] Niti Aayog. 2019. "COMPOSITE WATER MANAGEMENT INDEX report."

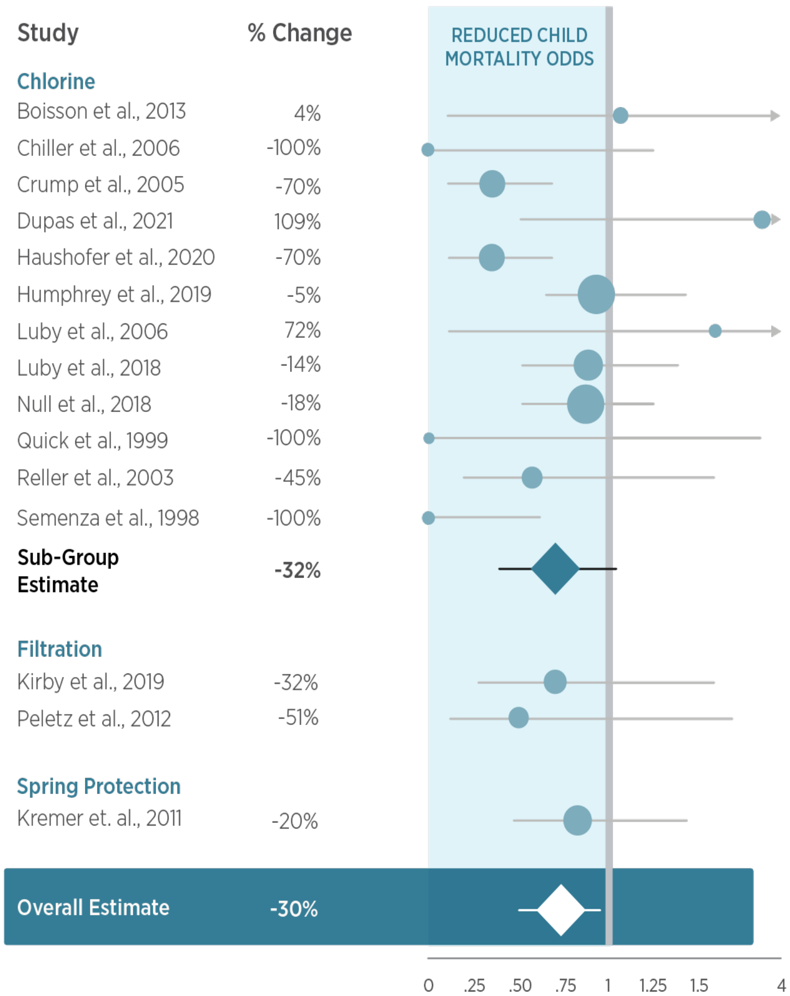
[2] Lakshminarayanan, S., and R. Jayalakshmy. 2015. "Diarrheal diseases among children in India: current scenario and future perspectives".

[3] Kremer, Michael, Stephen Luby, Ricardo Maertens, Brandon Tan, and Witold Więcek. "Water Treatment and Child Mortality: A Meta-analysis and Cost-effectiveness Analysis." Working paper, Development Innovation Lab, 2022. https://bfi.uchicago.edu/wp-content/uploads/2022/03/BFI_WP_2022-26.pdf

[4] Rayasam SDG, Ray I, Smith KR, Riley LW. Extraintestinal Pathogenic Escherichia coli and Antimicrobial Drug Resistance in a Maharashtrian Drinking Water System. Am J Trop Med Hyg. 2019 May;100(5):1101-1104. doi: 10.4269/ajtmh.18-0542. PMID: 30834880; PMCID: PMC6493927.

Treatment of water closer to the point of use may be necessary in systems where water pressure is not constant.

**Figure 1: Estimated reduction in child mortality from water treatment (Kremer 2022).**



To illustrate the potential magnitude of the benefits of access to clean drinking water, we use the findings from Kremer et al (2022) to estimate the expected number of lives saved due to safe water treatment in the context of India.

Our calculation is as follows:

$$(Number\ of\ deaths\ in\ households\ without\ access\ to\ safe\ water) = D_{WS}$$
$$= \frac{D}{(p + (1.25 \times (1 - p))} \times (1 - p) \times 1.25$$
$$= \frac{8{,}40{,}402}{(63\% + (1.25 \times (1 - 63\%))} \times (1 - 63\%) \times 1.25$$
$$= 3{,}55{,}777$$

Where:

- $D$ = The annual number of under-5 deaths in India, taken from the Global Burden of Disease
- $p$ = The proportion of households with access to safe drinking water as of 2019. The data is from WHO/UNICEF's Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
- We assume that, at baseline, child mortality in households without access to safe water is 25% higher than that in households with access to safe water

And so:

$$(Number\ of\ U5\ lives\ saved\ by\ safe\ water\ treatment = D_{WS} \times \beta \times (T_{JJM} \div T_{MA})$$
$$= 3{,}55{,}777 \times 25\% \times (90\% \div 59\%)$$
$$= 1{,}35{,}678$$

Where:

- $\beta$ = The estimate from Kremer et al (2022) that the expected reduction in all-cause child mortality from water treatment in a new setting is 25%.[5]
- $(T_{JJM} \,/\, T_{MA})$ = The ratio of effective treatment rates under JJM and in the meta-analysis. The water treatment interventions in this meta-analysis increased the share of the population drinking safe water to around 59%. We assume that under JJM this increase will be to 90%.

This calculation is conservative, as it assumes that households which don't have access to safely managed water have child mortality rates 25% higher than those which do. However, the mortality difference between these households would likely be larger, if households with access to safely managed water also have better nutrition, or access to better medical care.

Cost-effectiveness analysis in Kremer et al. 2022 also suggests that water treatment is among the most cost-effective ways to reduce child mortality. This implies that efforts to reach as many people as possible with safe water are likely to have very large net benefits. The Jal Jeevan Mission's ambition to bring safe drinking water to all rural homes is therefore likely to be highly valuable, preventing around 1,36,000 child deaths annually. We hope to work with the Ministry and assist in this effort by testing possible solutions to water quality treatment such as re-chlorination.

[5] The meta-analysis estimates a reduction in the odds of child mortality of 30% from water treatment but taking into account uncertainty due to heterogeneity across studies, the expected reduction in a new setting is 25%.