Interventions to improve water quality for preventing diarrhoea (Review)

Clasen TF, Alexander KT, Sinclair D, Boisson S, Peletz R, Chang HH, Majorin F, Cairncross S

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[Intervention Review]

Interventions to improve water quality for preventing diarrhoea

Thomas F Clasen[1], Kelly T Alexander[1], David Sinclair[2], Sophie Boisson[3], Rachel Peletz[4], Howard H Chang[5], Fiona Majorin[3], Sandy Cairncross[6]

[1]Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA. [2]Department of Clinical Sciences, Liverpool School of Tropical Medicine, Liverpool, UK. [3]Faculty of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine, London, UK. [4]Aquaya Institute, Nairobi, Kenya. [5]Department of Biostatistics and Bioinformatics, Rollins School of Public Health, Emory University, Atlanta, GA, USA. [6]Department of Disease Control, Faculty of Infectious and Tropical Diseases, London School of Hygiene & Tropical Medicine, London, UK

Contact address: Thomas F Clasen, Department of Environmental Health, Rollins School of Public Health, Emory University, 1518 Clifton Road NE, Atlanta, GA, 30322, USA. thomas.clasen@lshtm.ac.uk.

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A B S T R A C T

Background

Diarrhoea is a major cause of death and disease, especially among young children in low-income countries. In these settings, many infectious agents associated with diarrhoea are spread through water contaminated with faeces.

In remote and low-income settings, source-based water quality improvement includes providing protected groundwater (springs, wells, and bore holes), or harvested rainwater as an alternative to surface sources (rivers and lakes). Point-of-use water quality improvement interventions include boiling, chlorination, flocculation, filtration, or solar disinfection, mainly conducted at home.

Objectives

To assess the effectiveness of interventions to improve water quality for preventing diarrhoea.

Search methods

We searched the Cochrane Infectious Diseases Group Specialized Register (11 November 2014), CENTRAL (the Cochrane Library, 7 November 2014), MEDLINE (1966 to 10 November 2014), EMBASE (1974 to 10 November 2014), and LILACS (1982 to 7 November 2014). We also handsearched relevant conference proceedings, contacted researchers and organizations working in the field, and checked references from identified studies through 11 November 2014.

Selection criteria

Randomized controlled trials (RCTs), quasi-RCTs, and controlled before-and-after studies (CBA) comparing interventions aimed at improving the microbiological quality of drinking water with no intervention in children and adults.

Data collection and analysis

Two review authors independently assessed trial quality and extracted data. We used meta-analyses to estimate pooled measures of effect, where appropriate, and investigated potential sources of heterogeneity using subgroup analyses. We assessed the quality of evidence using the GRADE approach.

Main results

Forty-five cluster-RCTs, two quasi-RCTs, and eight CBA studies, including over 84,000 participants, met the inclusion criteria. Most included studies were conducted in low- or middle-income countries (LMICs) (50 studies) with unimproved water sources (30 studies) and unimproved or unclear sanitation (34 studies). The primary outcome in most studies was self-reported diarrhoea, which is at high risk of bias due to the lack of blinding in over 80% of the included studies.

Source-based water quality improvements

There is currently insufficient evidence to know if source-based improvements such as protected wells, communal tap stands, or chlorination/filtration of community sources consistently reduce diarrhoea (one cluster-RCT, five CBA studies, *very low quality evidence*). We found no studies evaluating reliable piped-in water supplies delivered to households.

Point-of-use water quality interventions

On average, distributing water disinfection products for use at the household level may reduce diarrhoea by around one quarter (Home chlorination products: RR 0.77, 95% CI 0.65 to 0.91; 14 trials, 30,746 participants, *low quality evidence*; flocculation and disinfection sachets: RR 0.69, 95% CI 0.58 to 0.82, four trials, 11,788 participants, *moderate quality evidence*). However, there was substantial heterogeneity in the size of the effect estimates between individual studies.

Point-of-use filtration systems probably reduce diarrhoea by around a half (RR 0.48, 95% CI 0.38 to 0.59, 18 trials, 15,582 participants, *moderate quality evidence*). Important reductions in diarrhoea episodes were shown with ceramic filters, biosand systems and LifeStraw® filters; (Ceramic: RR 0.39, 95% CI 0.28 to 0.53; eight trials, 5763 participants, *moderate quality evidence*; Biosand: RR 0.47, 95% CI 0.39 to 0.57; four trials, 5504 participants, *moderate quality evidence*; LifeStraw®: RR 0.69, 95% CI 0.51 to 0.93; three trials, 3259 participants, *low quality evidence*). Plumbed in filters have only been evaluated in high-income settings (RR 0.81, 95% CI 0.71 to 0.94, three trials, 1056 participants, fixed effects model).

In low-income settings, solar water disinfection (SODIS) by distribution of plastic bottles with instructions to leave filled bottles in direct sunlight for at least six hours before drinking probably reduces diarrhoea by around a third (RR 0.62, 95% CI 0.42 to 0.94; four trials, 3460 participants, *moderate quality evidence*).

In subgroup analyses, larger effects were seen in trials with higher adherence, and trials that provided a safe storage container. In most cases, the reduction in diarrhoea shown in the studies was evident in settings with improved and unimproved water sources and sanitation.

Authors' conclusions

Interventions that address the microbial contamination of water at the point-of-use may be important interim measures to improve drinking water quality until homes can be reached with safe, reliable, piped-in water connections. The average estimates of effect for each individual point-of-use intervention generally show important effects. Comparisons between these estimates do not provide evidence of superiority of one intervention over another, as such comparisons are confounded by the study setting, design, and population.

Further studies assessing the effects of household connections and chlorination at the point of delivery will help improve our knowledge base. As evidence suggests effectiveness improves with adherence, studies assessing programmatic approaches to optimising coverage and long-term utilization of these interventions among vulnerable populations could also help strategies to improve health outcomes.

PLAIN LANGUAGE SUMMARY

Interventions to improve water quality and prevent diarrhoea

This Cochrane Review summarizes trials evaluating different interventions to improve water quality and prevent diarrhoea. After searching for relevant trials up to 11 November 2014, we included 55 studies enrolling over 84,000 participants. Most included studies were conducted in low- or middle-income countries (LMICs) (50 studies), with unimproved water sources (30 studies), and unimproved or unclear sanitation (34 studies).

What causes diarrhoea and what water quality interventions might prevent diarrhoea?

Diarrhoea is a major cause of death and disease, especially among young children in low-income countries where the most common causes are faecally contaminated water and food, or poor hygiene practices.

In remote and low-income settings, source-based water quality improvement may include providing protected groundwater (springs, wells, and bore holes) or harvested rainwater as an alternative to surface sources (rivers and lakes). Alternatively water may be treated at the point-of-use in people's homes by boiling, chlorination, flocculation, filtration, or solar disinfection. These point-of-use interventions have the potential to overcome both contaminated sources and recontamination of safe water in the home.

What the research says

There is currently insufficient evidence to know if source-based improvements in water supplies, such as protected wells and communal tap stands or treatment of communal supplies, consistently reduce diarrhoea in low-income settings (*very low quality evidence*). We found no trials evaluating reliable piped-in water supplies to people's homes.

On average, distributing disinfection products for use in the home may reduce diarrhoea by around one quarter in the case of chlorine products (*low quality evidence*), and around a third in the case of flocculation and disinfection sachets (*moderate quality evidence*).

Water filtration at home probably reduces diarrhoea by around a half (*moderate quality evidence*), and effects were consistently seen with ceramic filters (*moderate quality evidence*), biosand systems (*moderate quality evidence*) and LifeStraw® filters (*low quality evidence*). Plumbed-in filtration has only been evaluated in high-income settings (*low quality evidence*).

In low-income settings, distributing plastic bottles with instructions to leave filled bottles in direct sunlight for at least six hours before drinking probably reduces diarrhoea by around a third (*moderate quality evidence*).

Research assessing the effects of household connections and chlorination at the point of delivery will help improve our knowledge base. Evidence indicates the more people use the various interventions for improving water quality, the larger the effects, so research into practical approaches to increase coverage and help assure long term use of them in poor groups will help improve impact.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

Point-of-use water quality interventions for preventing diarrhoea in rural settings in low- and middle-income countries

Patient or population: adults and children
Settings: low- and middle-income countries in rural areas
Intervention: point of use water quality interventions
Comparison: no intervention

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	Number of participants (trials)	Quality of the evidence (GRADE)
	Assumed risk	Corresponding risk			
Diarrhoea episodes	**No intervention**	**Chlorination**	**RR 0.77** (0.65 to 0.91)	30,746 (14 trials)	⊕⊕○○ **low**[1,2,3,4]
	3 episodes per person per year	**2.3 episodes** (2.0 to 2.7)			
	No intervention	**Flocculation/disinfection**	**RR 0.69** (0.58 to 0.82)	11,788 (4 trials)	⊕⊕⊕○ **moderate**[1,3,4,5,6]
	3 episodes per person per year	**2.1 episodes** (1.7 to 2.5)			
	No intervention	**Filtration**	**RR 0.48** (0.38 to 0.59)	15,582 (18 trials)	⊕⊕⊕○ **moderate**[1,3,4,5]
	3 episodes per person per year	**1.4 episodes** (1.1 to 1.8)			
	No intervention	**Solar disinfection (SODIS)**	**RR 0.62** (0.42 to 0.94)	3460 (4 trials)	⊕⊕⊕○ **moderate**[1,3,4,5]
	3 episodes per person per year	**1.9 episodes** (1.3 to 2.8)			

The **assumed risk** is taken from Fischer Walker 2012 and represents an estimated average for the incidence of diarrhoea in low- and middle-income countries. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

[1]Downgraded by 1 for serious risk of bias: the outcome was measured as self-reported episodes of diarrhoea, and is susceptible to bias as most studies were unblinded.

[2]Downgraded by 1 for serious inconsistency: statistical heterogeneity was very high with six out of fourteen trials having point estimates close to no effect. A subgroup analysis by adherence with the intervention (assessed by measurements of residual chlorine in drinking water) found larger effects in the studies with better adherence but the results remained inconsistent.

[3]No serious indirectness: these studies are mainly from low- and middle-income countries, in settings with both improved and unimproved water sources and sanitation.

[4]No serious imprecision: The analysis is adequately powered to detect this effect.

[5]No serious inconsistency: The evidence of benefit is consistent across trials, but there is substantial statistical heterogeneity in the size of the effect.

[6] This analysis excludes one additional study which found a much larger effect than seen in the other four trials and was considered an outlier (Doocy 2006 LBR).

BACKGROUND

Description of the condition

Diarrhoeal disease is the third leading cause of mortality in low-income countries, causing an estimated 1.4 million deaths in 2012 (WHO 2014;GBD 2015). Young children are especially vulnerable, with diarrhoea accounting for more than a quarter of all deaths in children aged under five years in Africa and Southeast Asia (Murray 2012; Lanata 2013; Walker 2013).

The bacterial, viral, and protozoan pathogens causing diarrhoeal disease are primarily transmitted via the faecal-oral route, through the consumption of faecally contaminated food and water (Byers 2001). Among the most important of these are rotavirus, *Cryptosporidium sp.*,*Escherichia coli*,*Salmonella sp.*,*Shigella sp.*,*Campylobacter jejuni*,*Vibrio cholerae*, norovirus, *Giardia lamblia*, and *Entamoeba histolytica* (Leclerc 2002; Kotloff 2013), though the relative importance of these varies among settings, seasons, and population groups.

An estimated 1.1 billion people worldwide rely on water supplies that are at high risk of faecal contamination (Bain 2014). Moreover, nearly half the world's population lack household water connections (WHO/UNICEF 2015), and are at increased risk of unsafe water due to contamination during collection, storage, and use in the home (Wright 2004).

Description of the intervention

Interventions to improve the microbiological quality of water can be grouped into four main categories:

- Physical removal of pathogens (for example, filtration, adsorption, or sedimentation).
- Chemical treatment to kill or deactivate pathogens (most commonly with chlorine).
- Disinfection by heat (for example, boiling or pasturization) or ultraviolet (UV) radiation (for example, solar disinfection, or artificial UV lamps).
- Combination of these approaches (for example, filtration or flocculation combined with disinfection).

In higher-income countries, and in many urban settings worldwide, drinking water is treated centrally at the source of supply and distributed to consumers through a network of pipes and household taps. Alternatively, water may be treated at any point in the distribution network, or at the 'point-of-use' (POU) in people's homes, schools, or workplaces.

In remote and low-income settings, source-based water quality improvement may include providing protected groundwater (springs, wells, and bore holes) or harvested rainwater as an alternative to surface sources (rivers and lakes). These improvements frequently also improve both the quantity and access to water by increasing the volume or frequency of water delivery or reducing the time spent in collecting water. This may result in significant benefits not only in health but also in economic and social welfare (Hutton 2013; Stelmach 2015).

Potential and widely used POU interventions for remote or low-income settings include boiling, filtration, chlorination, flocculation, and solar disinfection. These interventions have the potential to overcome both contaminated sources and recontamination of safe water in the home (Wright 2004). A review commissioned by the World Health Organization (WHO) identified a wide variety of options for household-based water treatment and assessed the available evidence on their microbiological effectiveness, health impact, acceptability, affordability, sustainability, and scalability (Sobsey 2002).

How the intervention might work

Health authorities generally accept that microbiologically safe water plays an important role in preventing outbreaks of waterborne diseases (Reynolds 2008). Moreover, there is evidence that chlorination and filtration of municipal water supplies contributed to substantial health gains in the late 19^{th} and early 20^{th} century (Cutler 2005).

However, much of the epidemiological evidence for increased health benefits following improvements in the quality of drinking water has been equivocal, particularly in low-income settings (Clasen 2006; Waddington 2009; Cairncross 2010).

This may be due to the variety of alternative transmission pathways, such as ingestion of contaminated food, person-to-person contact, or direct contact with infected faeces. In addition, interventions which only target the home may fail if unsafe water is consumed at work or school. Consequently, effective programmes may require combined interventions to address not only water quality, but also water quantity and access, the proper disposal of human faeces (sanitation), and the promotion of hand washing and hygiene practices within communities.

The effectiveness of individual water quality interventions may also vary between settings due to the varied prevalence of the organisms causing diarrhoea. For instance, ceramic filters are only marginally protective against viral illness, while chlorination may provide little protection against *Cryptosporidium*.

Why it is important to do this review

This is an update of a Cochrane Review that was first completed in 2006 (Clasen 2006). The review concluded that, in general, interventions to improve microbiological quality of drinking water are effective in preventing diarrhoea, and that interventions at the household level were more effective than those at the source.

New studies have been recently published, and other unpublished studies have been made available to us. In this Cochrane Review update, we have reapplied the inclusion criteria, repeated data extraction, added new studies, and used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to assess the quality of the evidence. We were also able to apply statistical methods to unify the measures of effect and to apply additional criteria for subgrouping based on study design, setting, and length of follow-up.

OBJECTIVES

To assess the effectiveness of interventions to improve water quality for preventing diarrhoea.

METHODS

Criteria for considering studies for this review

Types of studies

Cluster-randomized controlled trials (cluster-RCTs), quasi-randomized controlled trials (quasi-RCTs) and controlled before-and-after studies (CBAs).

Types of participants

Children and adults.

Types of interventions

Intervention

Any intervention aimed at improving the microbiological quality of drinking water.
We included interventions that combined improvements in water quality with hygiene or health promotion, but excluded studies that combined water quality interventions with other water, sanitation, and hygiene (WASH) interventions, such as improvements in water quantity or sanitation. We also excluded studies where the water quality intervention was implemented away from the home, such as at schools, clinics, markets, or workplaces.

Control

No intervention, or a dummy intervention.

Types of outcome measures

Primary

- Diarrhoea episodes among individuals, whether or not confirmed by microbiological examination.

The WHO's definition of diarrhoea is three or more loose or fluid stools (that take the shape of the container) in a 24-hour period (WHO 1993). We defined diarrhoea and an episode in accordance with the case definitions used in each trial. In the 'Summary of findings' tables, we have converted the results to episodes per year from a baseline of three episodes/child year in 2010 (Fischer Walker 2012).

Secondary

- Death.
- Adverse events.

We excluded studies that had no clinical outcomes; for example, studies that only report on microbiological pathogens in the stool.

Search methods for identification of studies

We attempted to identify all relevant studies regardless of language or publication status (published, unpublished, in press, and in progress).

Electronic searches

We searched the following databases using the search terms and strategy described in Appendix 1: Cochrane Infectious Diseases Group Specialized Register (11 November 2014); Cochrane Central Register of Controlled Trials (CENTRAL), published in the Cochrane Library (7 November, 2014); MEDLINE (1966 to 10 November 2014); EMBASE (1974 to 10 November 2014); and LILACS (1982 to 7 November 2014).

Searching other resources

Conference proceedings

We searched the conference proceedings of the following organizations for relevant abstracts: International Water Association (IWA) (1990 to 11 November 2014); and Water, Engineering and Development Centre, Loughborough University, UK (WEDC) (1973 to 11 November 2014).

Researchers and organizations

We contacted individual researchers working in the field and the following organizations for unpublished and ongoing studies: Water, Sanitation and Health Programme of the WHO; World Bank Water and Sanitation Program; UNICEF Water, Sanitation and Hygiene; and IRC International Water and Sanitation Centre; Foodborne and Diarrhoeal Diseases Branch, Division of Bacterial and Mycotic Diseases, Centers for Disease Control and Prevention (CDC); US Agency for International Development (USAID), including its Environmental Health Project (EHP); and the UK Department for International Development (DFID).

Reference lists

We checked the reference lists of all studies identified by the above methods.

Data collection and analysis

Selection of studies

Two review authors (RP and SB) independently reviewed the titles and abstracts located in the searches and selected all potentially relevant studies. After obtaining the full-text articles, they independently determined whether they met the inclusion criteria. Where they were unable to agree, they consulted a third review author (TFC) and arrived at a consensus. We have listed the potentially relevant studies that were ultimately excluded together with the reasons for exclusion in the 'Characteristics of excluded studies' section.

Data extraction and management

Two review authors (RP and SB) used a pre-piloted form to extract and record the data described in Appendix 2. One review author entered the extracted data into Review Manager (RevMan) (KA).

Assessment of risk of bias in included studies

Two review authors (KA and FM) independently assessed the risk of bias of the included studies and resolved differences of opinion through discussion.

For cluster-RCTs we used the Cochrane 'Risk of bias' assessment tool (Higgins 2011). We followed the guidance to assess whether adequate steps were taken to reduce the risk of bias across five domains: sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessors; and incomplete outcome data.

For sequence generation and allocation concealment, we reported the methods used. For blinding, we described who was blinded and the blinding method. For incomplete outcome data, we reported the percentage and proportion of participants lost to follow-up. For selective outcome reporting, any discrepancies between the methods used and the results were stated in terms of the outcomes measured or the outcomes reported. For other biases, we described any other trial features that could have affected the trial result (for example, if the trial was stopped early).

We categorized our 'Risk of bias' judgements as 'low', 'high', or 'unclear'. Where risk of bias was unclear, we attempted to contact the study authors for clarification and we resolved any differences of opinion through discussion. We classified the inclusion of randomized participants in the analysis as 'low risk' if 90% or more of all participants randomized to the study were included in the analysis.

For quasi-RCTs and CBA studies, we used two additional criteria:

1. Comparability of baseline characteristics: we classified studies as 'low risk' if there were no substantial differences between groups with respect to water quality, diarrhoeal morbidity, age, socioeconomic status, access to water, hygiene practices, and sanitation facilities.
2. Contemporaneous data collection: we classified studies as 'low risk' if data were collected at similar points in time, 'unclear' if the relative timing was not reported or not clear from trial, or 'high risk' if data were not collected at similar points in time.

Measures of treatment effect

Two review authors independently extracted and, where necessary, calculated the measure of effect of the intervention on diarrhoea. We extracted the measure of effect as reported by the authors of each study, whether it be risk ratios (RRs), rate ratios, odds ratios (ORs), longitudinal prevalence ratios, or means ratios. In using these various measures of effect, we noted the design effect in treating all such measures of effect as equivalent for common outcomes such as diarrhoea and the debate about methodologies for converting such measures of effect into a single measure (Zhang 1998; McNutt 2003).

For purposes of analysis, we transformed ORs into RRs using the assumed control risk and the formula prescribed in Higgins 2011 (Section 12.5.4.4).

Unit of analysis issues

A number of the included studies had multiple intervention arms (for example, treating water with bleach or with a flocculant and disinfectant) and compared two or more intervention groups against a single control group. In some analyses, we included multiple comparisons from the same study, which double counts the control group participants and yields results in the meta-analysis that are artificially precise. Unfortunately, because of the way data was presented in included studies, it was not possible to correct for this error by dividing the control group participants between multiple groups.

Dealing with missing data

When data was missing or incomplete we attempted to contact the study authors.

Assessment of heterogeneity

We assessed the statistical heterogeneity between trials by visually examining the forest plots for overlapping confidence intervals (CIs), applying the Chi^2 test with a 10% level of statistical significance, and using the I^2 statistic with a value of 50% to denote moderate levels of heterogeneity.

Assessment of reporting biases

When there were sufficient studies, we assessed the possibility of publication bias by constructing funnel plots and looking for asymmetry.

Data synthesis

We entered the estimates of effect using the generic inverse variance method on the log scale (Higgins 2006), and analysed the data using Review Manager (RevMan).

We stratified our primary analysis by intervention type, and study design (cluster-RCT, quasi-RCT, or CBA). When appropriate we used meta-analyses to derive pooled estimates of effect using a random-effects model because of the substantial heterogeneity in study settings, interventions, and outcome measures.

We summarized the evidence using 'Summary of findings' tables that we created using the GRADE Guideline Development Tool (GRADEpro GDT). The quality of evidence was rated using the GRADE approach, which consists of five factors that are used to assess the quality of the evidence: study limitations (risk of bias), inconsistency, indirectness, imprecision, and publication bias (Guyatt 2008).

Subgroup analysis and investigation of heterogeneity

We investigated the potential causes of heterogeneity by conducting the following subgroup analyses: age (all ages versus children under five years old); adherence with intervention (< 50%, 50% to 85%, > 85%); water source; water access; water quantity; sanitation conditions; country income level; and length of follow-up. In the subgroup analyses based on water source, we followed terminology used by the WHO/UNICEF Joint Monitoring Programme (JMP) on Water and Sanitation (WHO/UNICEF 2015), using 'unimproved' to extend to unprotected wells or springs, vendor- or tanker-provided water or bottled water, and 'improved' to extend to household connections, public standpipes, boreholes, protected dug wells or springs, or rainwater collection; we categorized studies as 'unclear' with respect to water supply if they contained insufficient information.

We used the same definitions from the WHO/UNICEF JMP criteria to classify sanitation conditions as 'improved' (connection to a public sewer or septic system, pour-flush latrine, simple pit latrine, ventilated improved pit latrine) or 'unimproved' (service or bucket latrines, public latrines, open latrines); where the necessary information was unclear or unreported, we categorized the sanitation facilities as 'unclear'.

To subgroup studies based on access to water source, we used the classifications defined by the Sphere Project 2011, classifying access as 'sufficient' if a consistently available source was located within 500 m, with queuing no more than 15 minutes and filling time for a 20 L container no more than three minutes, 'insufficient' if any access failed any such criteria, and 'unclear' if such criteria was unreported or unclear.

The quantity of water available to study participants was considered 'sufficient' if consisting of a minimum of 15 L per person per day. For country income level, we used the World Bank classification of country income levels (high, upper middle, lower middle, low) (World Bank Country and Lending Groups).

Sensitivity analysis

We conducted a sensitivity analysis to investigate the robustness of the results to each of the 'Risk of bias' components by including only studies that were at low risk of bias. We used this information to guide our judgements on the quality of the evidence.

In addition, we explored the impact of non-blinding of POU interventions using a Bayesian meta-analysis with bias correction. For this purpose, we assumed the true log relative risks from non-blinding studies are subject to a multiplicative bias that results in the observed relative risks being inflated in magnitude. We assumed the bias is normally distributed with a mean 1.48 or 1.65 and a corresponding standard deviation (SD) of 0.17 or 0.13. These values were derived from the additive bias correction employed in Wood 2008 and Savović 2012. While we believe an attempt to adjust for non-blinding is appropriate, we urge caution in relying on these adjusted estimates since the basis for the adjustment is from clinical (mainly drug) studies that may not be transferable to field studies of environmental interventions and because methodology for the adjustment has not been validated.

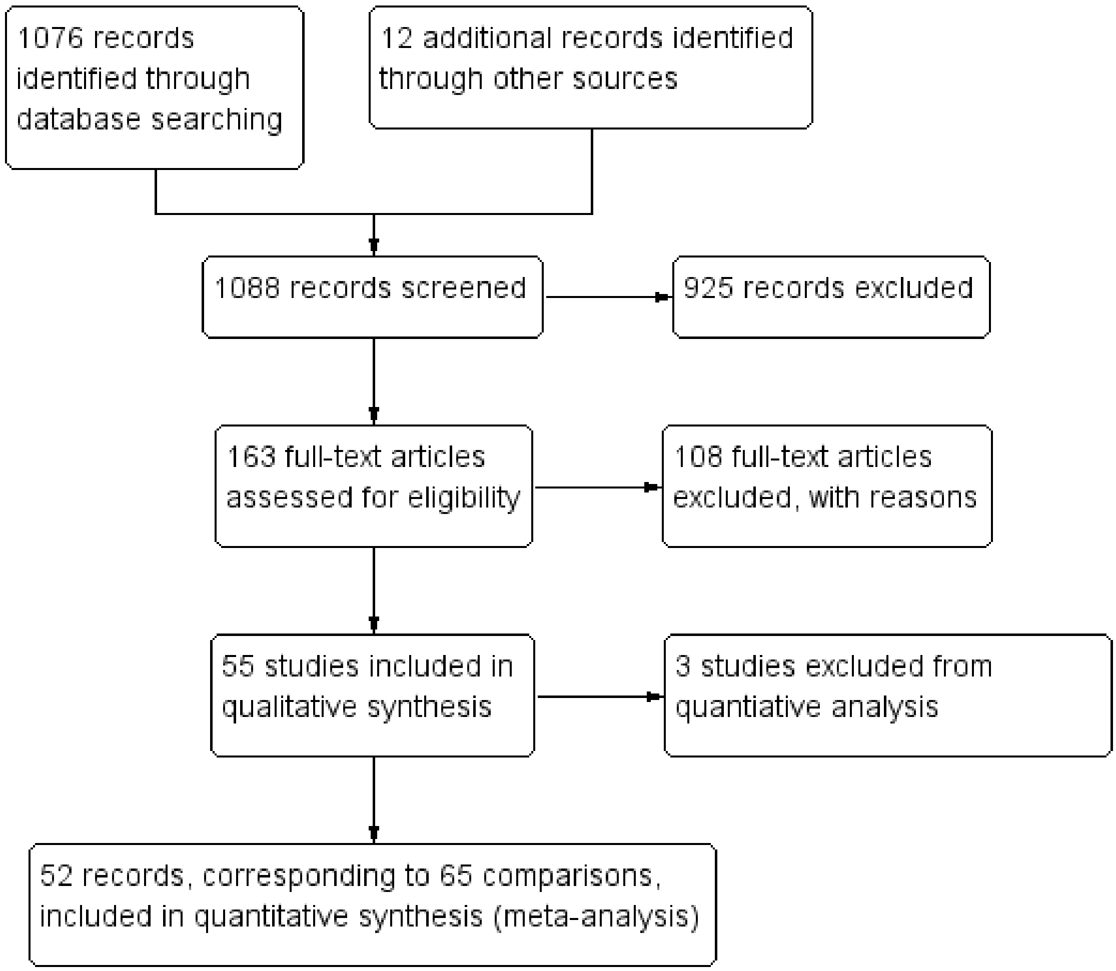
RESULTS

Description of studies

Results of the search

The search strategy identified 1088 titles and abstracts, 1076 from the databases and 12 from the other sources (Figure 1). We screened these titles and abstracts, and obtained the full-text articles of 161 studies for further assessment.

Figure 1. Study flow diagram.



Included studies

Fifty-five studies, including 84,023 participants, met the inclusion criteria (see Characteristics of included studies). Of these, six studies had two relevant intervention arms (Austin 1993; URL 1995; Luby 2004; Crump 2005; Brown 2008; Lindquist 2014), two had three arms (Luby 2006; Opryszko 2010), and one had four arms (Reller 2003), making a total of 65 discrete comparisons. Three included studies had inadequate information on disease morbidity to include in the quantitative analysis (Torun 1982 GTM; Kremer 2011 KEN; Patel 2012 KEN). We contacted the study authors for further information, but no data could be provided. Therefore we have only described these three studies and their results, but have not integrated these studies into the analysis.

Study design and length

Forty-five studies were cluster-RCTs, two were quasi-RCTs, and eight were CBA studies. Most included cluster-RCTs used households as the unit of randomization, though some used neighbourhoods, villages, or communities. Most CBA studies used villages or communities as the unit of allocation. The intervention period ranged from eight weeks to four years. The duration of the cluster-RCTs (median seven months, range 9.5 weeks to 18 months) tended to be shorter than in the CBA studies (median 12 months, range two to 60 months). Studies of source-based interventions were also longer (median 24 months, range eight weeks to two years) than those of POU interventions (median six months, range 9.5 weeks to 17 months).

Participants and settings

Nine studies included data only for children under five years of age, and three studies included data only on adults. The other studies enrolled and presented results for all ages of participants.
Most studies were undertaken in lower middle or low-income countries based on World Bank criteria, but three studies were conducted in the USA (Colford 2002 USA; Colford 2005 USA; Colford 2009 USA), one in Australia (Rodrigo 2011 AUS), and one in Saudi Arabia (Mahfouz 1995 KSA). Five studies were conducted in urban settings (Semenza 1998 UZB; Colford 2002 USA; Colford 2005 USA; Colford 2009 USA; Rodrigo 2011 AUS), five in peri-urban settings (Quick 1999 BOL; Quick 2002 ZMB; du Preez 2010 ZAF; Jain 2010 GHA; Peletz 2012 ZMB), two in urban informal or squatter settlements (Handzel 1998 BGD; Luby 2004), two in camps for refugees or displaced persons (Roberts 2001 MWI; Doocy 2006 LBR), five in multiple settings (URL 1995; Clasen 2005 COL; Stauber 2009 DOM; du Preez 2011 KEN; Boisson 2013 IND), and the others in villages or other rural settings.

Primary drinking water supply and sanitation facilities

The primary drinking water supply before the intervention was 'unimproved' in 30 studies, 'improved' in 15 studies, and 'unclear' or unreported in five studies. Sanitation facilities in trial settings were 'improved' in 12 studies, 'unimproved' in 15 studies, and 'unclear' or unreported in 19 studies. Access to a water source was deemed 'sufficient' in 14 studies, 'insufficient' in four studies, and 'unclear' or unreported in the remaining studies. The quantity of water available to study participants was considered 'sufficient' in eight studies, 'insufficient' in four studies, and 'unclear' in 43 studies.
Seventeen studies measured water quality before the introduction of the intervention as an indication of the ambient risk and the microbiological quality of the water consumed by the control group. Details on the indicators used varied among the studies (see Table 1). Thirty-five studies measured colony-forming units (CFUs) of thermotolerant coliforms, faecal coliforms, or *E. coli*, reporting geometric means, arithmetic means, number of CFUs/100 mL, mean faecal coliforms/100 mL, *E. coli* most probable number, median, or $\log_{10}$CFUs/100 mL. Other studies measured the frequency of samples containing such bacteria, or the CFU of total coliforms or other indicators of microbial contamination. None continually measured the microbiological performance of their interventions against the full range of bacterial, viral, and protozoan pathogens known to cause diarrhoea.
Eight studies did not report actually having measured microbiological water quality at all (Alam 1989 BGD; Xiao 1997 CHN; Luby 2006; Mäusezhal 2009 BOL; Opryszko 2010; Majuru 2011 ZAF; Rodrigo 2011 AUS; Lindquist 2014). Thus, it cannot be concluded definitively that the interventions investigated in these studies actually resulted in an improvement in drinking water quality.
Among the eight studies investigating interventions to improve water quality at the point of distribution, only four tested microbiological water quality (Torun 1982 GTM; Gasana 2002 RWA; Jensen 2003 PAK; Kremer 2011 KEN). As these tests were at the source or point of distribution and not the POU, their results do not reflect possible post-collection contamination.

Interventions

Eight studies evaluated source-based interventions: improved wells or boreholes (Alam 1989 BGD; Xiao 1997 CHN; Opryszko 2010b AFG; Opryszko 2010c AFG) or improved community sources and distribution to public tap stands (Torun 1982 GTM; Gasana 2002 RWA; Jensen 2003 PAK; Kremer 2011 KEN; Majuru 2011 ZAF); none evaluated reliable piped-in household connections.
Fourty-seven studies evaluated POU interventions: chlorination (17 studies), filtration (20 studies), combined flocculation and disinfection (five studies), SODIS solar disinfection (six studies), combination UV disinfection and filtration (one study), and improved storage (two studies). Significantly, there were no eligible studies that investigated the impact of boiling, even though that is by far the most common type of POU water treatment (Rosa 2010).
Many studies provided a supplementary hygiene education or instruction beyond the use of the intervention itself, and among POU interventions the primary intervention was often combined with some form of improved storage. In only three multiple-intervention arm studies did study authors establish different intervention groups with and without hygiene or other non-water improvement steps in order to isolate the impact of water quality (URL 1995; Opryszko 2010; Lindquist 2014).
Except in blinded trials involving placebos, control arms generally continued to use their pre-trial water supply and treatment practices. In one trial of POU chlorination plus a safe storage container, however, control households also received the container (Jain 2010 GHA). In two of the solar disinfection studies (Conroy 1996 KEN; Conroy 1999 KEN) both intervention and control households received plastic bottles for storing their drinking water. The intervention group was instructed to place the bottles on roofs to expose them to the sun, while the control group was told to keep the filled bottles indoors. It is important to note that since

improved storage even in the absence of treatment has been shown to improve microbial water quality (Wright 2004), the comparison between the intervention and control in these studies may understate the effectiveness of the intervention when compared to the controls following customary water handling practices.

Adherence with the intervention

Studies of source water interventions tended to assume adherence based on the fact that the primary water supply had been improved. Some studies of POU water treatment undertook indirect assessments of adherence by measuring residual chlorine levels in stored water, comparing microbiological water quality of intervention and control groups, conducting periodic or post-study surveys, or counting the amount of intervention product used. Most other studies measured adherence only by occasional observation, while eight cluster-RCTs did not report on adherence.

The studies of chlorine residuals reported adherence ranging from a high of 95% (Doocy 2006 LBR) to a low of 11% (Opryszko 2010a AFG). Even among these studies, however, investigators acknowledged that it was not possible to know to what extent intervention group participants actually consumed treated water or avoided consuming untreated water. For those studies that reported on adherence, three took the additional step of investigating and reporting on continued consumption of untreated water (Boisson 2010 DRC; Peletz 2012 ZMB; Boisson 2013 IND) a source of exposure that could be masked by less direct metrics of adherence.

Outcome measures

The studies' main outcome measure was diarrhoeal disease, but different methods were used to define, assess, and report this. Thirty-six studies used the WHO's definition of diarrhoea, while other studies used the following definitions: the mother's or respondent's definition (Austin 1993; Gasana 2002 RWA; Reller 2003; Crump 2005; Chiller 2006 GTM); 'watery diarrhoea as a component of gastroenteritis' (Colford 2002 USA; Colford 2005 USA; Colford 2009 USA; Rodrigo 2011 AUS); the local term (Conroy 1996 KEN; Conroy 1999 KEN; Boisson 2009 ETH); "significant change in bowel habits towards decreased consistency or increased frequency" (Kirchhoff 1985 BRA); or dysentery (du Preez 2010 ZAF; du Preez 2011 KEN). Four studies did not report the case definition used for diarrhoea (Torun 1982 GTM; Xiao 1997 CHN; Günther 2013 BEN; Lindquist 2014).

The method of diarrhoea surveillance and assessment also varied. In most cases, participants were visited on a periodic basis, either weekly (19 studies), fortnightly (16 studies), or more infrequently (14 studies). Participants were asked to recall and report on cases of diarrhoea during a previous period, usually seven days (30 studies) or 14 days (six studies), with four studies having recall periods of one to four days and one trial having a recall period of four weeks (Günther 2013 BEN). Twelve studies asked each participant or a designated householder to keep a log or record to indicate days with or without diarrhoea, one procured data on diarrhoea from family records and disease registries (Mahfouz 1995 KSA), or used paediatricians to assess the participants during regular medical checkups (Gasana 2002 RWA). Only one trial did not report the method (Xiao 1997 CHN).

Using these data, study authors reported diarrhoeal disease using one or more of the following epidemiological measures of disease frequency: incidence (34 studies); period prevalence (12 studies); and longitudinal prevalence (nine studies). The studies also reported other measures of disease, including incidence of persistent diarrhoea, gastrointestinal illness, including specific symptoms thereof, incidence or prevalence of bloody diarrhoea, and days of work or school lost due to diarrhoea (Lule 2005 UGA). Seven studies also reported on mortality (Crump 2005; Colford 2009 USA; Boisson 2010 DRC; du Preez 2011 KEN; Kremer 2011 KEN; Peletz 2012 ZMB; Boisson 2013 IND). None reported adverse events.

None of these studies were primarily designed to investigate the impact of the intervention on death, and as such most were underpowered to evaluate this outcome.

Data presentation

Forty-three studies presented results both for children aged under five years (or a subgroup thereof) and for all ages or older age groups, three presented results only for adults, and nine presented results only for children under five years (or a subgroup thereof). Most of the studies adjusted raw data to account for possible covariates, including age, sex, sanitation or hygiene practices, area of residence, household income or proxies thereof, education or maternal literacy, age and occupation of the head of household, number of participants in the household or absent there from, baseline diarrhoea or conditions at baseline, or other variables associated with the household environment and participant behaviour.

Most studies of interventions at the POU also used statistical methods to adjust their results, either for repeated episodes of diarrhoea by the same participant or for clustering within the household, village or both. The studies that did not adjust for clustering may receive excess weight in meta-analysis due to artificial precision (Kirchhoff 1985 BRA; Austin 1993; Mahfouz 1995 KSA; URL 1995).

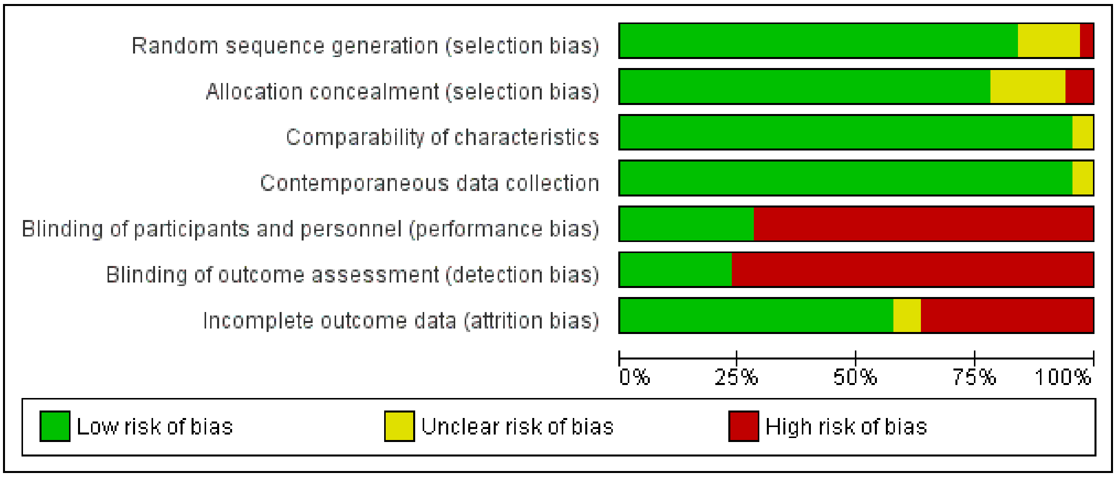
Excluded studies

We excluded 108 studies for the reasons given in the Characteristics of excluded studies table. Two studies that appear to meet this review's inclusion criteria are currently ongoing (see Characteristics of ongoing studies).

Risk of bias in included studies

We have summarized our judgements about the risk of bias of included studies in Figure 2.

Figure 2. Risk of bias graph: summary of authors' judgements about each 'Risk of bias' item presented as percentages across all included studies.



Allocation

The allocation sequence was generated using an adequate method and classified as 'low risk' in 36 of the 45 cluster-RCTs, 'high risk' in two, and 'unclear' in seven Figure 2. The method of allocation concealment was 'low risk' in 34 trials and 'high risk' in two and 'unclear' in nine.

Comparability of baseline characteristics (confounding bias)

All the quasi-RCTs and CBA studies were judged to be at low risk of bias for this criteria except Gasana 2002 RWA, which was at 'unclear' risk.

Contemporaneous data collection

We judged all the quasi-RCTs and CBA studies to be at low risk of bias for this criteria except Gasana 2002 RWA, which was at 'unclear' risk.

Blinding

Nine trials were blinded at the participant level (Kirchhoff 1985 BRA; Austin 1993; Colford 2002 USA; Colford 2005 USA; Colford 2009 USA; Boisson 2010 DRC; Jain 2010 GHA; Rodrigo 2011 AUS; Boisson 2013 IND); all but two of these were blinded at the assessor level as well (Kirchhoff 1985 BRA; Austin 1993). The others followed an open design, classified as 'high risk' of bias. One of the principal objectives of Colford 2002 USA was to assess the effectiveness of its blinding methodology; it therefore provides the most comprehensive analysis of these issues. Colford 2002 USA, Colford 2005 USA, Boisson 2010 DRC and Rodrigo 2011 AUS all used household sham water filters. Austin 1993, Kirchhoff 1985 BRA, Jain 2010 GHA and Boisson 2013 IND, which were assessing the effectiveness of home-based chlorination, provided placebos to control households.

Incomplete outcome data

Twenty four studies were at 'low risk' of bias, 18 at 'high risk', and three studies were unclear.

Effects of interventions

See: **Summary of findings for the main comparison** Summary of findings table 1

Analysis 1: Any water quality intervention versus no intervention

Diarrhoea episodes

An overall pooled analysis, across different trial designs, interventions and settings, finds the risk of diarrhoea to be lower with any water quality intervention compared to no intervention, both among all ages (RR 0.59, 95% CI 0.51 to 0.69, 81215 participants; 52 studies Analysis 1.1), and under fives (RR 0.61, 95% CI 0.49 to 0.75 Analysis 1.2). However, as would be expected given the diverse nature of the trials, statistical heterogeneity between trials is very high (I^2 statistic = 98% and 97%, respectively). Our primary analysis is therefore stratified by the specific intervention type (for example, interventions at water source, POU chlorination, POU filtration), and by study design (for example, cluster-RCT, quasi-RCT, CBAs).

Mortality

Only nine studies reported any deaths among study participants. Five reported the number of deaths in each study arm without differences evident (see Table 2). Two studies reported the total number of deaths without stating how many occurred in each group (du Preez 2010 ZAF; Boisson 2013 IND), and two reported recording deaths but the numbers were not presented in the papers (Boisson 2009 ETH; Kremer 2011 KEN).

None of these studies were primarily designed to investigate the impact of the intervention on mortality, and all were underpowered to investigate these effects.

Adverse events

No trial reported adverse events from the interventions.

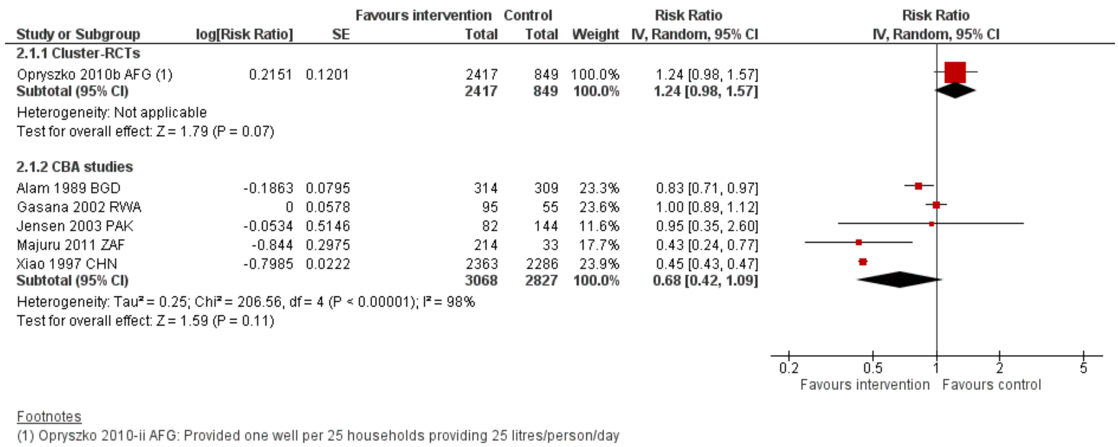
Analysis 2: Interventions at the water source

One cluster-RCT and five CBA studies evaluated interventions at the water source (Table 3). All but one study were from settings with 'unimproved' water sources (unprotected wells or surface water), and all had unclear levels of sanitation. Three studies evaluated improved wells or boreholes, two evaluated chlorination or filtration of community water sources, and one evaluated an improved community piped supply. No studies evaluated reliable household connections to a clean water source (see Table 4 and Table 5 for a description of study settings and interventions).

The single cluster-RCT from Afghanistan reported no statistically significant difference in diarrhoea with improved wells compared to no intervention (one trial, 3266 participants; Analysis 2.1; *very low quality evidence*).

The CBA studies evaluated different interventions, had variable findings, and were all at unclear risk of multiple sources of bias (see Figure 3). Three of the five studies reported statistically significant effects on diarrhoea (Analysis 2.1; Analysis 2.2): in Bangladesh, provision of one hand pump per four to six households (three times as many as control areas) was associated with a small reduction in diarrhoea over three-years follow-up (RR 0.83, 95% CI 0.71 to 0.97); in remote areas in South Africa a new community piped water supply was associated with around a 50% reduction in diarrhoea compared to untreated river water (RR 0.43, 95% CI 0.24 to 0.77); and in China structural well improvements were also associated with around a 50% reduction in diarrhoea (RR 0.45, 95% CI 0.43 to 0.47). In contrast, chlorination and filtration of community water supplies were not associated with positive benefits in Rwanda and Pakistan respectively. Overall, the body of evidence is judged to be of very low quality (Table 3). Given the variability in interventions, further subgroup analyses to try to understand the heterogeneity were not useful.

Figure 3. Forest plot of comparison: 2 Source: water supply improvement versus control, outcome: 2.1 Diarrhoea: CBA studies subgrouped by age.



Analysis 3. POU chlorination

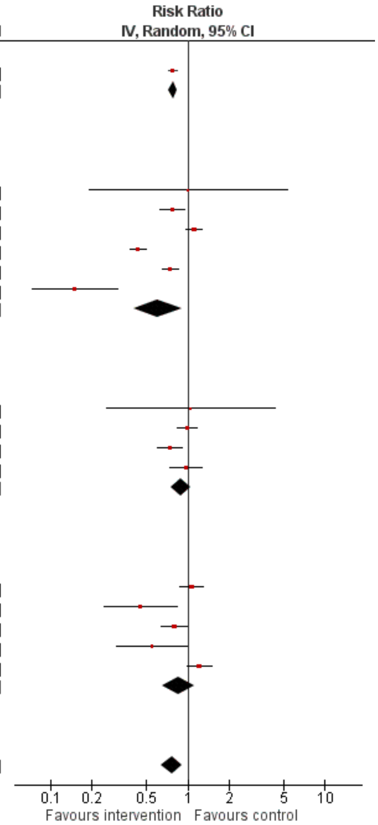
Fourteen cluster-RCTs, with 16 comparisons, evaluated POU chlorination versus control. Chlorine was delivered to households free of charge every one to four weeks, with instructions on how to use it, and in eight trials a water storage container was also provided (see Table 6 and Table 7 for a description of study settings and interventions).

On average, POU chlorination in cluster RCTs reduced the risk of diarrhoea episodes by around a quarter, both for all ages (RR 0.77, 95% CI 0.65 to 0.91; 14 trials, 30,746 participants; Analysis 3.2) and for children under five years of age (RR 0.77, 95% CI 0.64 to 0.92; Analysis 3.2). However, there was substantial heterogeneity in the size of the effect which was not well explained by a series of subgroup analyses (Analysis 3.2 to Analysis 3.9).

As might be expected from an effective intervention, the trials finding larger effects from chlorination tended to be those where adherence with the intervention was higher (as measured by residual chlorine) (Analysis 3.3; Figure 4), but in the four trials which had adequate blinding no effects of water chlorination were seen (Analysis 3.4). A subgroup analysis looking at interventions with and without the provision of water storage containers did not find statistical evidence of subgroup differences (Analysis 3.5). Effects were seen in trials with 3, 6, and 12 months of follow-up, but no effect was demonstrated in the two trials with follow-up longer than 12 months (Analysis 3.9). The funnel plot for this comparison has some asymmetry which may be the result of publication bias (see Figure 5). The overall quality of the evidence was therefore judged to be low (Table 8).

Figure 4. Forest plot of comparison: 3 POU: water chlorination versus control, outcome: 3.3 Diarrhoea: cluster-RCTs; subgrouped by adherence.

Study or Subgroup	log[Risk Ratio]	SE	Intervention Total	Control Total	Weight	Risk Ratio IV, Random, 95% CI
3.3.1 Residual chlorine in 86 to 100% of samples						
Handzel 1998 BGD (1)	-0.2485	0.0338	140	136	8.5%	0.78 [0.73, 0.83]
Subtotal (95% CI)			**140**	**136**	**8.5%**	**0.78 [0.73, 0.83]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 7.35 (P < 0.00001)						
3.3.2 Residual chlorine in 51 to 85% of samples						
Austin 1993b GMB	0.01	0.8544	72	72	0.9%	1.01 [0.19, 5.39]
Crump 2005a KEN (2)	-0.2614	0.1072	2249	1138	7.6%	0.77 [0.62, 0.95]
Jain 2010 GHA (3)	0.1113	0.068	1610	1630	8.2%	1.12 [0.98, 1.28]
Mengistie 2013 ETH (4)	-0.8348	0.0663	427	422	8.2%	0.43 [0.38, 0.49]
Quick 1999 BOL (5)	-0.2944	0.068	400	391	8.2%	0.74 [0.65, 0.85]
Semenza 1998 UZB (6)	-1.8971	0.3704	791	792	3.4%	0.15 [0.07, 0.31]
Subtotal (95% CI)			**5549**	**4445**	**36.5%**	**0.60 [0.40, 0.91]**
Heterogeneity: Tau² = 0.21; Chi² = 118.46, df = 5 (P < 0.00001); I² = 96%						
Test for overall effect: Z = 2.42 (P = 0.02)						
3.3.3 Residual chlorine in ≤ 50% of samples						
Austin 1993a GMB	0.0513	0.7245	143	144	1.2%	1.05 [0.25, 4.35]
Boisson 2013 IND (7)	-0.0101	0.0838	6119	5965	8.0%	0.99 [0.84, 1.17]
Reller 2003b GTM (8)	-0.3011	0.1111	97	24	7.6%	0.74 [0.60, 0.92]
Reller 2003c GTM (9)	-0.0305	0.1335	97	24	7.2%	0.97 [0.75, 1.26]
Subtotal (95% CI)			**6456**	**6157**	**23.9%**	**0.90 [0.76, 1.06]**
Heterogeneity: Tau² = 0.01; Chi² = 4.74, df = 3 (P = 0.19); I² = 37%						
Test for overall effect: Z = 1.27 (P = 0.20)						
3.3.4 Residual chlorine not reported						
Kirchhoff 1985 BRA (10)	0.0677	0.0993	56	56	7.7%	1.07 [0.88, 1.30]
Luby 2006a PAK	-0.7985	0.3123	1747	617	4.1%	0.45 [0.24, 0.83]
Lule 2005 UGA (11)	-0.2231	0.1138	1097	1104	7.5%	0.80 [0.64, 1.00]
Mahfouz 1995 KSA (12)	-0.5978	0.305	159	152	4.2%	0.55 [0.30, 1.00]
Opryszko 2010c AFG (13)	0.1906	0.1076	2026	849	7.6%	1.21 [0.98, 1.49]
Subtotal (95% CI)			**5085**	**2778**	**31.1%**	**0.85 [0.65, 1.12]**
Heterogeneity: Tau² = 0.07; Chi² = 17.57, df = 4 (P = 0.001); I² = 77%						
Test for overall effect: Z = 1.14 (P = 0.26)						
Total (95% CI)			**17230**	**13516**	**100.0%**	**0.77 [0.65, 0.91]**
Heterogeneity: Tau² = 0.09; Chi² = 168.65, df = 15 (P < 0.00001); I² = 91%						
Test for overall effect: Z = 3.08 (P = 0.002)						
Test for subgroup differences: Chi² = 4.45, df = 3 (P = 0.22), I² = 32.6%						



Footnotes

(1) Handzel 1998 BGD: Free chlorine was measureable in 77% of samples - Unclear whether testing was testing was during unannounced visits

(2) Crump 2005-i KEN: Free chlorine residuals > 0.1 mg/L in 85% of samples during scheduled visits and 61% of samples during unnannounced visits

(3) Jain 2010 GHA: Free chlorine residuals > 0.2 mg/L in 74-89% of samples - Unclear whether testing was during unannounced visits

(4) Mengistie 2013 ETH: Free chlorine residuals > 0.2 mg/L in 76-77% of samples - Testing was during unannounced visits

(5) Quick 1999 BOL: The proportion of stored water samples with detectable levels of total chlorine increased from 71 % at the time of the first observation to...

(6) Semenza 1998 UZB: Chlorine was detected in 73% of household samples at the end of the study.

(7) Boisson 2013 IND: Free chlorine was measureable in 32% of samples - Unclear whether testing was testing was during unannounced visits

(8) Reller 2003-ii GUA: Participants had free chlorine >0.1 mg/mL in 36% of samples - Testing during unannounced visits

(9) Reller 2003-iii GUA: Participants had free chlorine >0.1 mg/mL in 44% of samples - Testing during unannounced visit

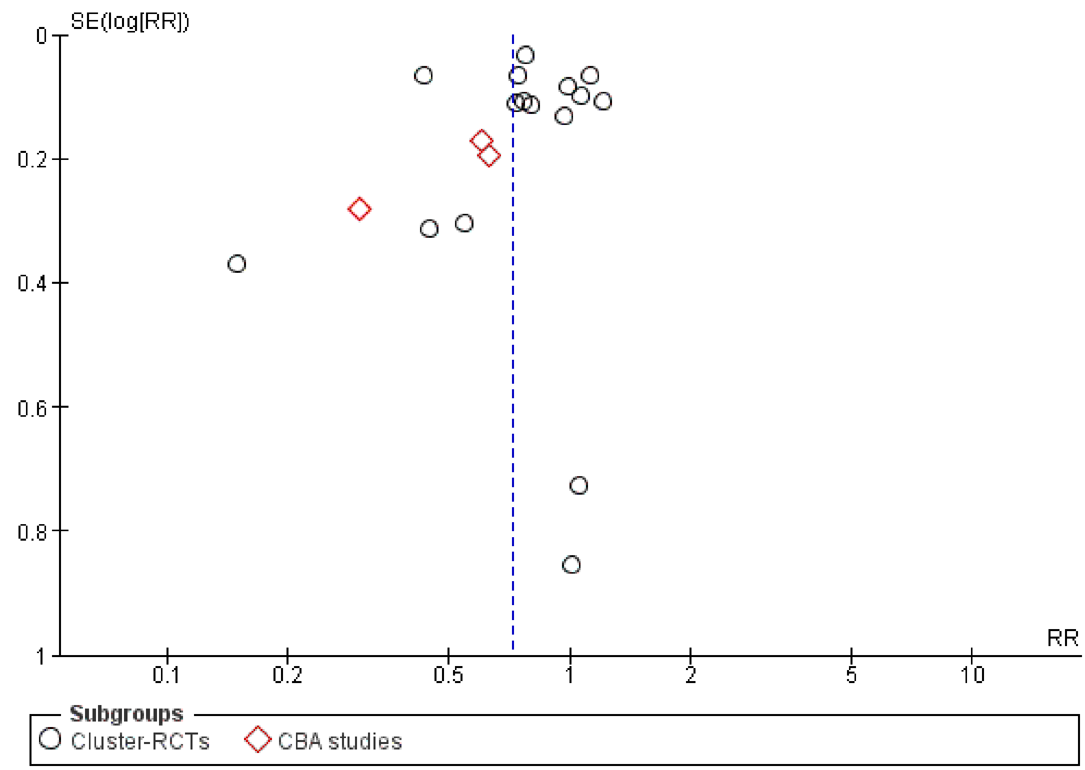
(10) Kirchhoff 1985 BRA: The chlorination was performed daily by blinded health staff.

(11) Lule 2005 UGA: Compliance not reported

(12) Mahfouz 1995 KSA: The average free residual chlorine is reported as 0.13 ppm

(13) Opryszko 2010-iii AFG: Self reported use of Chlorine in the previous two weeks was 82%

Figure 5. Funnel plot of comparison: 3 POU: water chlorination versus control, outcome: 3.1 Diarrhoea: subgrouped by study design.



An additional two CBA studies evaluated POU chlorination but only provide very low quality evidence of any effect (Analysis 3.1, Table 8).

Analysis 4. POU combined flocculation and disinfection

Five cluster-RCTs from low-income settings evaluated interventions where sachets of flocculant and disinfectant were distributed to households to treat water from unimproved sources (three trials), improved sources (one trial), and unclear sources (one trial). Four trials also provided water containers and mixing equipment (see Table 9 and Table 10 for a description of study settings and interventions). None of the trials blinded the outcome assessment. Four of the five trials found statistically significant reductions in diarrhoea with the intervention (Table 11), but statistical heterogeneity in the size of this effect made pooling the data difficult (I^2 statistic = 99%; Analysis 4.1). This heterogeneity relates to one trial from Liberia IDP camps, Doocy 2006 LBR, where the flocculation and disinfection kits reduced diarrhoea by 88% (RR 0.12, 95% CI 0.11 to 0.13; one trial, 2191 participants). Exclusion of this potential outlier finds a more modest effect with the other four trials both for all ages (RR 0.69, 95% CI 0.58 to 0.82; four trials, 11788 participants; Analysis 4.2) and for children under five years of age (RR 0.71, 95% CI 0.61 to 0.84; Analysis 4.2).

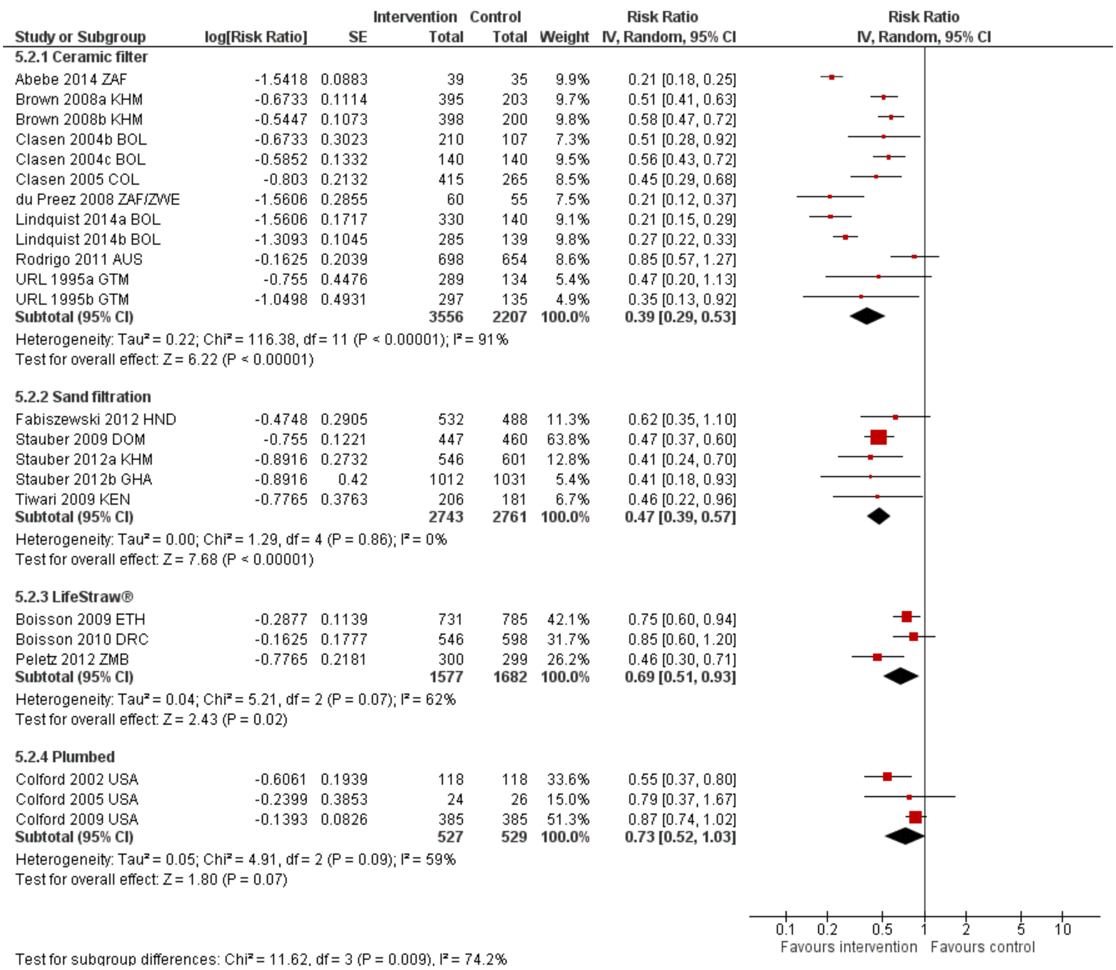
Adherence with the intervention, as measured by residual chlorine, was generally low (< 50%), but higher in the trial from Liberia showing large effects (Analysis 4.3). Larger effects tended to also be seen in the trials also providing water storage containers (Analysis 4.4). The effects were present in trials with both improved and unimproved water source and sanitation (Analysis 4.5; Analysis 4.6; Analysis 4.7). None of the trials had follow-up longer than

12 months (Analysis 4.8).

Analysis 5. POU filtration

Overall 20 cluster-RCTs evaluated POU filtration: ceramic filtration (nine trials), biosand filtration (five trials), LifeStraw® filters (three trials), and plumbed-in filtration (three trials) (see Table 12 and Table 13 for a description of study settings and interventions). On average, POU filtration technologies reduced diarrhoea by around a half, both for all ages (RR 0.48, 95% CI 0.38 to 0.59; 18 trials, 15,582 participants; Analysis 5.1) and for children under five years of age (RR 0.49, 95% CI 0.38 to 0.62; Analysis 5.1). However, the number of trials and the quality of evidence was different for each specific intervention (Analysis 5.2; Figure 6). The lack of blinding in these studies is a major concern: of the five trials with adequate blinding only one found a statistically significant effect (Analysis 5.3). The quality of evidence was therefore downgraded for all types of filters due to risk of bias (Table 14).

Figure 6. Forest plot of comparison: 4 POU: filtration versus control, outcome: 4.2 Diarrhoea: cluster-RCTs: subgrouped by type of filtration.



POU ceramic filters reduced diarrhoea by around 60% in nine trials mainly from low- or middle-income countries, regardless of whether the water source or sanitation was classified as improved or unimproved (RR 0.39, 95% CI 0.29 to 0.53, eight trials, 5763 participants; Analysis 5.3; Analysis 5.4; *moderate quality evidence*). Similarly, biosand filtration reduced diarrhoea by around a half consistently across five trials from low- or middle-income settings, again regardless of whether the water source or sanitation was improved or unimproved (RR 0.47, 95% CI 0.39 to 0.57, four trials, 5504 participants; Analysis 5.6; Analysis 5.7; *moderate quality evidence*).

On average, the use of LifeStraw® filters reduced diarrhoea by around a third in three trials from low-income settings with unimproved water sources (RR 0.69, 95% CI 0.51 to 0.93; three trials, 3259 participants; Analysis 5.2; *low quality evidence*).

Plumbed-in filtration has only been evaluated in high-income settings (USA). There is a modest effect in all three trials, although only one reaches standard levels of statistical significance. The overall meta-analysis has similar effect sizes with both fixed effects and random effects models, but wider confidence intervals with random effects (Fixed-effects: RR 0.81, 95% CI 0.70 to 0.94; Random-effects: RR 0.73, 95% CI 0.52 to 1.03; three trials, 1056 participants; Analysis 5.2; *moderate quality evidence*).

Adherence with the filtration systems was reported by 14 trials, of which eight assessed this by self-reported use which is at high risk of bias due to the lack of blinding. Adherence was generally reported as high, and larger effects were apparent in trials with higher adherence (Analysis 5.8). A subgroup analysis looking at filtration interventions with and without the provision of water storage containers (excluding the trials evaluating plumbed in filtration), found larger effects in the nine trials providing containers (Analysis 5.9). Effects were seen in trials with 3, 6, and 12 months of follow-up, but no effect was demonstrated in the one trial with follow-up longer than 12 months (Analysis 5.10).

Analysis 6. POU solar disinfection (SODIS)

Four cluster-RCTs and two quasi-RCTs evaluated solar disinfection of water from improved sources (one study) and unimproved sources (five studies) in low-income settings. Plastic bottles were distributed to households with instructions to leave filled bottles in direct sunlight for at least six hours before drinking (see Table 15 and Table 16 for a description of study settings and interventions).

Overall in the cluster-RCTs, solar disinfection reduced diarrhoea by around a third for all ages (RR 0.62, 95% CI 0.42 to 0.94; four trials, 3460 participants; Analysis 6.1), and almost a half in children under five years of age (RR 0.55, 95% CI 0.34 to 0.91; Analysis 6.2). The largest effect was seen in the trial with the highest adherence (Analysis 6.3). The quality of evidence was downgraded to moderate due to the lack of blinding and the inherent risk of bias (Table 17).

In the quasi-RCTs the observed effect was lower (RR 0.82, 95% CI 0.69 to 0.97; two trials, 555 participants; Analysis 6.1).

Analysis 7. POU UV disinfection

One cluster-RCT from Mexico evaluated an UV tube disinfection technology (Gruber 2013 MEX; see Table 18 and Table 19 for a description of the study setting and intervention).

The effect on diarrhoea among all age populations did not reach standard levels of statistical significance (RR 0.79, 95% CI 0.49 to 1.27; one trial, 1913 participants; Analysis 7.1), and did not report separately for children under five years of age.

Analysis 8. POU improved storage

Two trials from Malawi and Benin evaluated the distribution of improved water storage containers in settings with improved water sources (see Table 20 and Table 21 for a description of the study setting and intervention).

Overall, there was no statistically significant effect on diarrhoea for all ages (RR 0.91, 95% CI 0.74 to 1.11; two trials, 1871 participants; Analysis 8.1), or children under five years of age (RR 0.69, 95% CI 0.47 to 1.01; Analysis 8.1). Both studies were at high risk of bias due to being non-blinded, and the overall quality of the evidence was judged to be low (Table 22).

Analyses adjusted for non-blinding

In Table 23 we have presented meta-analysis results adjusted for non-blinding using an approach described in the Methods section and based in part on those employed by other researchers (Hunter 2009; Wolf 2014). In these analyses, the effects of POU chlorination and filtration are smaller but remain statistically significant; the effect of POU solar disinfection becomes borderline non-significant.

DISCUSSION

Summary of main results

There is currently insufficient evidence to know if source-based improvements such as protected wells, communal tap stands, or chlorination/filtration of community sources consistently reduce diarrhoea (*very low quality evidence*).

The distribution and promotion of point-of-use water chlorination products may reduce diarrhoea by around one quarter (*low quality evidence*). Similarly, distribution and promotion of flocculation and disinfection sachets probably reduces diarrhoea but had highly variable effects (*moderate quality evidence*).

Point-of-use filtration systems probably reduce diarrhoea by around a half (*moderate quality evidence*). This reduction was apparent for ceramic filters, biosand systems and LifeStraw® filters, but plumbed in filtration has only been evaluated in high- income settings and a statistically significant effect has not been demonstrated.

In low-income settings, distribution of plastic bottles with instructions to leave filled bottles in direct sunlight for at least six hours before drinking (SODIS) probably reduces diarrhoea by around a third (*moderate quality evidence*).

In subgroup analyses, larger effects were seen in trials with higher adherence, and trials that provided a safe storage container.

Overall completeness and applicability of evidence

Fifty-five studies met the inclusion criteria, of which most studies were conducted in low- or middle-income countries (50 studies), with unimproved water sources (30 studies), and unimproved or unclear sanitation (34 studies).

For water source interventions, there are simply too few studies to make conclusions about what may or may not be effective in different settings. While protective effects were seen in some individual trials, it is unclear whether these effects could be expected to be reproducible in other settings, and all of the trials had multiple potential sources of bias. Significantly, we found no studies evaluating reliable, piped-in water supplies.

In contrast, some POU interventions do appear to be broadly protective against diarrhoea across many settings regardless of whether water sources and sanitation are 'improved' or 'unimproved'. This finding affirms the current strategy of the WHO and UNICEF to promote POU water treatment and safe storage, even though this will not increase the number of households with access to improved water supplies and therefore will not contribute towards achieving current international water targets (WHO 2011). The effectiveness of POU interventions in settings without improved sanitation contradicts earlier findings that interventions to improve water quality are effective only where sanitation has already been addressed (Esrey 1986; VanDerslice 1995), or that environmental interventions to prevent diarrhoea are effective only by employing an integrated approach (Eisenberg 2007).

Although we provide average estimates of effect for each individual POU intervention, we recommend caution in using these estimates to conclude the superiority of one intervention over another. Such an observational analysis would be highly susceptible to confounding by study setting and population, and may not represent true differences in the size of the effects. Head-to-head trials would be necessary to reliably conclude superiority and these were not the focus of this review.

As few studies continued follow-up beyond 12 months, we are unable to comment reliably on the long-term sustainability of these effects. While pooled estimates of studies with follow-up periods under 12 months were generally protective, those with follow-up periods in excess of 12 months were not.

Quality of the evidence

The quality of evidence for the effects of the individual interventions on diarrhoea ranged from moderate (for ceramic filters and biosand filtration), to low (for distribution of chlorination kits, flocculation and disinfection sachets, and LifeStraw® filters), to very low (for water source improvements).

The primary reason for downgrading the quality of evidence was the risk of bias inherent in unblinded studies evaluating the efficacy of an intervention on a self-reported outcome. Notably, only one of the nine blinded trials reported a statistically significant protective effect, but this observation may be explained by other confounding factors present in these nine trials (see Table 24):

1. Four studies were conducted in high-income countries where the water was of good microbiological quality even in the control groups (Colford 2002 USA; Colford 2005 USA; Colford 2009 USA; Rodrigo 2011 AUS).
2. One further trial from Ghana found very low levels of faecal contamination of water supplies in the control group which were likely to present only minimal risk (Jain 2010 GHA).
3. Three studies had either low adherence with the intervention (Austin 1993; Boisson 2013 IND), or very high reported use of drinking untreated water from other sources (Boisson 2010 DRC).
4. Two studies employed control interventions which may have improved water quality: Boisson 2010 DRC employed a "placebo" that actually removed one log (90%) of faecal indicator bacteria and Jain 2010 GHA provided control households with safe storage.

The second common reason for downgrading the quality of evidence was unexplained heterogeneity. For some of the POU interventions, the protective effect varied considerably across studies. Some of this variability could be explained by adherence with the intervention, with larger effects in studies with higher adherence, but some variability remained which we were unable to explain despite multiple subgroup analyses. This is likely to reflect important underlying clinical heterogeneity: the aetiology and epidemiology of diarrhoea is complex and variable, transmission pathways are multiple, and even the portion of diarrhoea that is waterborne is not well understood (Eisenberg 2012).

There was also some evidence of possible publication bias in the trials evaluating home chlorination but this was not strong enough to further downgrade the quality of evidence.

Potential biases in the review process

A number of the included studies had multiple intervention arms comparing two or more intervention groups against a single control group. In some analyses, we included multiple comparisons from the same trial which double counts the control group participants and yields results in the meta-analysis that are artificially precise. However, this bias is unlikely to have significantly impacted the overall quality of evidence or conclusions.

Agreements and disagreements with other

studies or reviews

Our results are generally consistent with the prior version of this Cochrane Review (Clasen 2006) and with other reviews of water quality interventions (Fewtrell 2005; Arnold 2007; Waddington 2009; Cairncross 2010; Wolf 2014).

One additional review of water quality interventions reports no effect with POU interventions once blinding is taken into account (Engell 2013). While we share the concerns about the lack of blinding in many of these trials (and have downgraded the quality of evidence accordingly), and also found no effect in any of the trials with adequate blinding, we have identified several possible confounders in this observation (discussed above), and retain low to moderate confidence that these interventions are effective.

Although we found no controlled trials evaluating piped-in water supplies, a recent review that also included some observational studies reported some evidence of a protective effect with this intervention (Wolf 2014).

The finding of larger effects with increased adherence is consistent with modelling data based on quantitative microbial risk assessment which suggest a dose-response association between water quality and diarrhoea (Brown 2012; Enger 2013).

AUTHORS' CONCLUSIONS

Implications for practice

Interventions that address the microbial contamination of water at the POU are important interim measures to improve drinking water quality until homes can be reached with safe, reliable, household piped-water connections.

Implications for research

Rigorously conducted RCTs that compare various approaches to improving drinking water quality will help clarify the potential for water quality interventions to prevent endemic diarrhoea. It is particularly important that such trials be designed to minimize reporting bias, such as through the use of objective outcomes.

Among source-based interventions, there is a need for studies to assess household connections and other approaches (such as chlorination at the point of delivery) that are more likely to ensure safe drinking water from source through to the POU.

There is also a need for longer-term studies in programmatic settings on approaches to optimise the coverage and long-term utilization of these interventions among vulnerable populations.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Abebe 2014 ZAF

Methods	RCT
Participants	Number: 74 individuals Inclusion criteria: 18 years or older, receiving anti-retroviral therapy for at least 6 months
Interventions	1. Ceramic water filter impregnated with silver nanoparticles
Outcomes	1. Incidence of diarrhoea 2. Water quality 3. Presence of *Cryptosporidium* in stool
Notes	Location: rural South Africa Length: 12 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Permuted block randomization system.
Allocation concealment (selection bias)	Low risk	Permuted block randomization system.
Comparability of characteristics	Unclear risk	Not described.
Contemporaneous data collection	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	> 20% loss to follow-up.

Alam 1989 BGD

Methods	Quasi-RCT
Participants	Number: 623 children Inclusion criteria: households with children aged 6 to 23 months
Interventions	1. Improved water supply and hygiene education (3 subunits) 2. Primary drinking supply (2 subunits)
Outcomes	1. Incidence of diarrhoea among children aged 6 to 23 months by water source, hygiene practices, and household socioeconomic characteristics
Notes	Location: 5 political subunits in a village in rural Bangladesh Length: 3 years Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrevelant to study design.
Allocation concealment (selection bias)	Low risk	Irrevelant to study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrevelant to study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrevelant to study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrevelant to study design.

Austin 1993a GMB

Methods	RCT
Participants	Number: 287 children Inclusion criteria: households with children aged 25 to 60 months (group B) from villages primarily using open, shallow wells for drinking water

Interventions	1. Sodium hypochlorite solution used at household level (11 villages) 2. Primary drinking supply (11 villages)
Outcomes	1. Longitudinal prevalence of diarrhoea 2. Change in nutritional status using weight-for-height Z-score
Notes	Location: 22 rural villages in The Gambia Length: 20 weeks Publication status: PhD dissertation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number table.
Allocation concealment (selection bias)	Low risk	Numbers assigned to villages.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	89.4% of participants included in analysis.

Austin 1993b GMB

Methods	See Austin 1993a GMB
Participants	Number: 144 children between 6 and 24 months Inclusion criteria: as above
Interventions	As above
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number table.
Allocation concealment (selection bias)	Low risk	Numbers assigned to villages.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	89.4% of participants included in analysis.

Boisson 2009 ETH

Methods	RCT
Participants	Number: 196 children under 5, 1516 people, 313 households Inclusion criteria: householders were eligible to participate in the study if (i) at least one member of the household worked away from home during the day in a setting without adequate water supply, and (ii) the household was not already practicing an effective POU water treatment method
Interventions	1. LifeStraw® personal distributed to each household member over the age of six months. A special attachment was given for children under 3
Outcomes	1. Incidence of diarrhoea among young children in the preceding seven days (recorded fortnightly); other health conditions also recorded 2. Water quality, flow rate and iodine residual 3. Acceptability and use
Notes	Location: rural Oromia, Ethiopia Length: 5 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement

Boisson 2009 ETH (*Continued*)

Random sequence generation (selection bias)	Low risk	Lottery used to randomly allocate eligible households into intervention and control groups
Allocation concealment (selection bias)	Low risk	Lottery used to randomly allocate eligible households into intervention and control groups
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	4% of person-weeks data lost to follow-up.

Boisson 2010 DRC

Methods	RCT
Participants	Number: 190 children under 5, 1144 people, 240 households Inclusion criteria: unimproved water sources that tested over 1000 thermotolerant coliforms (TTC)/100 ml, reported low use of household water treatment, were easily accessible all year round and were motivated to take part in the project
Interventions	1. LifeStraw® Family filter
Outcomes	1. Incidence of diarrhoea among young children in the preceding seven days (recorded monthly); cough and fever also recorded 2. Filter and water quality monitoring 3. Compliance
Notes	Location: rural eastern province of Kasai, Democratic Republic of Congo Length: 12 months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number generator.

Allocation concealment (selection bias)	Low risk	"Randomisation was stratified by village and was conducted by the trial manager who played no part in the collection of the data"
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Double-blinded; however filters removed turbidity, so controls were not always successfully blinded
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Double-blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	18.2% person-weeks missing due to families moving out of study area, or not being home at time of visit

Boisson 2013 IND

Methods	RCT
Participants	Number: 2986 children under 5, 12,454 people, 2163 households Inclusion criteria: households were eligible if there was at least one child under 5, and they lived permanently in the study area
Interventions	1. Sodium dichloroisocyanurate (NaDCC) disinfection tablets
Outcomes	1. Longitudinal prevalence of diarrhoea among children under 5 2. Diarrhoea among participants of all ages 3. Weight-for-age z-score, school absenteeism, health care expenditures; adherence; water quality
Notes	Location: informal settlements of Orissa, India Length: 12 months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"The randomisation list was generated using Stata 10 and was conducted by the trial manager who played no part in the collection of the data"

Boisson 2013 IND (*Continued*)

Allocation concealment (selection bias)	Low risk	"The randomisation list was generated using Stata 10 and was conducted by the trial manager who played no part in the collection of the data"
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	"The active and placebo tablets were packaged in identical boxes of three strips containing ten tablets each"
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"The labeling of the boxes was conducted by members of staff who were neither involved in the implementation nor data collection or analysis"
Incomplete outcome data (attrition bias) All outcomes	High risk	12% days of observation lost to follow-up.

Brown 2008a KHM

Methods	RCT
Participants	Number: 239 children under 5, 1196 people, 180 households (across both interventions) Inclusion criteria: households were eligible if they stored drinking water at the household level, if they have at least one child under 5, and if the household was located in the study village
Interventions	1. Iron-rich Cambodian Ceramic Water Purifier 2. Water quality
Outcomes	1. Longitudinal prevalence of diarrhoea for all household members
Notes	Location: rural Kandal Province, Cambodia Length: 18 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table.
Allocation concealment (selection bias)	Low risk	Households were approached in group-randomized order.
Comparability of characteristics	Low risk	Irrelevant to study design.

Brown 2008a KHM *(Continued)*

Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	2% households lost to follow-up.

Brown 2008b KHM

Methods	See Brown 2008a KHM
Participants	As above
Interventions	1. Cambodian Ceramic Water Purifier
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table.
Allocation concealment (selection bias)	Low risk	Households were approached in group-randomized order.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	2% households lost to follow-up.

Chiller 2006 GTM

Methods	RCT
Participants	Number: 3401 persons from 514 households Inclusion criteria: households with at least one child under 1 year
Interventions	1. Flocculant-disinfectant sachets used at household level 2. Primary drinking supply
Outcomes	1. Longitudinal prevalence of diarrhoea (portion of total days of diarrhoea out of total days of observation) among all ages 2. Incidence of persistent diarrhoea
Notes	Location: 42 neighbourhood clusters in 12 rural villages in Guatemala Length: 13 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator used to assigned neighbourhoods to intervention or control group
Allocation concealment (selection bias)	Low risk	Random number generator used to assigned neighbourhoods to intervention or control group
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 8% of households lost to follow-up.

Clasen 2004b BOL

Methods	RCT
Participants	Number: 324 persons of all ages from 60 households Inclusion criteria: all households in the community

Interventions	1. Household gravity water filter system using imported ceramic filter elements 2. Primary drinking supply
Outcomes	1. Period prevalence of diarrhoea (7-day recall) among all ages 2. Microbial water quality
Notes	Location: rural Bolivian community Length: 9 months Publication status: unpublished

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Households were randomly allocated by names drawn from a hat in a public assembly
Allocation concealment (selection bias)	Low risk	Households were randomly allocated by names drawn from a hat in a public assembly
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No participants lost to follow-up.

Clasen 2004c BOL

Methods	RCT
Participants	Number: 50 households with 280 persons, of which 32 (11%) were under age 5 Inclusion criteria: all households in the community
Interventions	1. Household gravity water filter system using imported ceramic filter elements 2. Primary drinking supply
Outcomes	1. Period prevalence of diarrhoea (7-day recall) among householders assessed at approximately 6-week intervals

Notes	Location: rural Bolivia Length: 6 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Households were randomly allocated by lottery, half to an intervention group and half to a control group
Allocation concealment (selection bias)	Low risk	Households were randomly allocated by lottery, half to an intervention group and half to a control group
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 1% participants lost to follow-up.

Clasen 2005 COL

Methods	RCT
Participants	Number: 140 children under 5, 680 people, 140 households Inclusion criteria: all households in the community
Interventions	1. Ceramic water filter
Outcomes	1. Diarrhoea prevalence during previous seven days 2. Water quality
Notes	Location: three rural villages in Colombia Length: six months Publication status: journal

Risk of bias

Clasen 2005 COL (*Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Public lottery.
Allocation concealment (selection bias)	Low risk	Lottery conducted at each study site to randomly allocate households
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	5% of households lost to follow-up.

Colford 2002 USA

Methods	RCT
Participants	Number: 236 people from 77 households Inclusion criteria: families were required to own their own homes, use municipal tap water as their main drinking water and have no seriously immunocompromised household members
Interventions	1. Household reverse osmosis filters 2. Primary drinking supply
Outcomes	1. Incidence of watery diarrhoea 2. Gastrointestinal illness and various other symptoms 3. Water consumption 4. Effectiveness of blinding
Notes	Location: urban community in California, USA Length: 4 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement

Colford 2002 USA (*Continued*)

Random sequence generation (selection bias)	Low risk	Two random sequences generated to allocated households to intervention or control groups
Allocation concealment (selection bias)	Low risk	Two random sequences generated to allocated households to intervention or control groups
Comparability of characteristics	Unclear risk	Irrelevant to study design.
Contemporaneous data collection	Unclear risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	One investigator, not involved in analyses prepared coded labels for the placebo and active devices
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Triple-blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 1% households lost to follow-up.

Colford 2005 USA

Methods	RCT
Participants	Number: 50 HIV+ people, all over 30 years Inclusion criteria: confirmed HIV+ status, uses tap water 75% of the time, no children residing in the home
Interventions	1. Countertop water filtration device
Outcomes	1. Episodes of "highly credible gastrointestinal illness" 2. Diarrhoea episodes calculated
Notes	Location: San Francisco, USA Length: 12 months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer generated random numbers.
Allocation concealment (selection bias)	Low risk	The manufacturer provided a list of device serial numbers and their corresponding active/sham status to facilitate device assign-

		ment. All study participants, the study investigators (including clinic personnel and those performing data analysis) and the device installer were blinded throughout the trial as to device assignment
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	All study participants, the study investigators (including clinic personnel and those performing data analysis) and the device installer were blinded throughout the trial as to device assignment
Blinding of outcome assessment (detection bias) All outcomes	Low risk	All study participants, the study investigators (including clinic personnel and those performing data analysis) and the device installer were blinded throughout the trial as to device assignment
Incomplete outcome data (attrition bias) All outcomes	Low risk	10% participants withdrew from study (mixed from active and sham devices)

Colford 2009 USA

Methods	Randomized controlled (crossover) trial
Participants	Number: 988 people, 714 households Inclusion criteria: households were eligible if they had one or more persons 55 or older
Interventions	1. Countertop water filtration and UV device
Outcomes	1. Episodes of "highly credible gastrointestinal illness" 2. Diarrhoea episodes calculated
Notes	Location: Sonoma County, USA Length: 13.5 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Households were block-randomized in blocks of 10, with an equal probability of receiving either a sham or an active device
Allocation concealment (selection bias)	Low risk	Households were block-randomized in blocks of 10, with an equal probability of receiving either a sham or an active device

Colford 2009 USA *(Continued)*

Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	All study staff involved in installation and contact with participants were blinded to device assignments throughout the trial
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessors blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	"Among households initially assigned to receive an active device, 89% completed cycle 1 and 83% also completed cycle 2; among households initially assigned to receive a sham device, 90% completed cycle 1 and 82% also completed cycle 2"

Conroy 1996 KEN

Methods	RCT
Participants	Number: 206 Maasai children aged 5 to 16 years in 3 adjoining areas of single province Inclusion criteria: all households in the village
Interventions	1. Solar disinfection in plastic bottles at household level 2. Primary drinking supply
Outcomes	1. Period prevalence of diarrhoea
Notes	Location: single province of rural Kenya Length: 12 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Interventions assigned by alternate household.
Allocation concealment (selection bias)	High risk	Interventions assigned by alternate household.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.

Conroy 1996 KEN (*Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up.

Conroy 1999 KEN

Methods	RCT
Participants	Number: 349 Maasai children < 6 years in 140 households Inclusion criteria: all households in the village
Interventions	1. Solar disinfection in plastic bottles at household level 2. Primary drinking supply
Outcomes	1. Period prevalence of diarrhoea
Notes	Location: rural Kenya Length: 1 year Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Interventions assigned by alternate household.
Allocation concealment (selection bias)	High risk	Interventions assigned by alternative household.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Not blinded.

Conroy 1999 KEN (*Continued)*

Incomplete outcome data (attrition bias) All outcomes	High risk	> 20% children lost to follow-up.

Crump 2005a KEN

Methods	RCT
Participants	Number: 6650 persons of all ages in 604 family compounds Inclusion criteria: family compounds with at least 1 child < 2 years and likely to be using highly turbid source water
Interventions	1. Sodium hypochlorite used at household level 2. Primary drinking water supply
Outcomes	1. Longitudinal prevalence (weeks with diarrhoea/weeks of observation) among all ages 2. Breastfeeding and consumption of food and water for children < 2 years 3. Deaths 4. Use of intervention 5. Mothers' knowledge of and acceptance of intervention (weeks 5 and 15) 6. Microbial water quality and turbidity 7. Mothers' knowledge of and attitudes to intervention
Notes	Location: 49 rural villages in western Kenya Length: 20 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient detail.
Allocation concealment (selection bias)	Unclear risk	Insufficient detail.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.

Incomplete outcome data (attrition bias) All outcomes	High risk	82% participants lost to follow-up.

Crump 2005b KEN

Methods	See Crump 2005a KEN
Participants	As above
Interventions	1. Flocculant-disinfectant sachets used at household level 2. Primary drinking water supply
Outcomes	As above
Notes	As above

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Insufficient detail.
Allocation concealment (selection bias)	Unclear risk	Insufficient detail.
Comparability of characteristics	Low risk	Irrelevant to study design,
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	82% participants lost to follow-up.

Doocy 2006 LBR

Methods	RCT
Participants	Number: 2191 persons of all ages (1138 intervention, 1053 controls), of which 735 are children < 5 (395 intervention, 340 controls) Inclusion criteria: households in settlement area not using treated water for drinking

Interventions	1. Flocculant-disinfectant sachets used at household level, plus water storage vessel 2. Primary drinking supply; also received vessel
Outcomes	1. Longitudinal prevalence (days with diarrhoea/total days of observation) 2. Prevalence of bloody diarrhoea 3. Utilization and acceptability data from exit survey
Notes	Location: Liberian camp for displaced persons Length: 12 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random division of households by blocks and subsections.
Allocation concealment (selection bias)	Low risk	Households were systematically selected based on their assigned plot number
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	1% of households lost to follow-up.

du Preez 2008 ZAF/ZWE

Methods	RCT
Participants	Number: 115 children < 5 years Inclusion criteria: households were randomly selected from a list of eligible households from an earlier study: if they had no in-house piped water, and if they had at least one child 12 to 24 months of age
Interventions	1. Household commercial ceramic filter using imported components (60 children) 2. Primary drinking supply (55 children)

du Preez 2008 ZAF/ZWE *(Continued)*

Outcomes	1. Incidence of diarrhoea 2. Incidence of bloody diarrhoea and non-bloody diarrhoea 3. Microbiological water quality
Notes	Location: rural South Africa and Zimbabwe Length: 6 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Reported to be randomized, but no description of method of randomization process
Allocation concealment (selection bias)	Unclear risk	Insufficient detail.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient detail.

du Preez 2010 ZAF

Methods	RCT
Participants	Number: 824 children, 649 households Inclusion criteria: households were eligible if they had no in-house piped water, and if they had at least one child over 6 months and under 5 years
Interventions	1. SODIS (438 children) 2. Primary drinking supply (386 children)
Outcomes	1. Incidence of dysentery 2. Incidence of non-dysentery diarrhoea

Notes	Location: four peri-urban districts of Gauteng Province, South Africa Length: 12 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number table.
Allocation concealment (selection bias)	Low risk	This table was not available to field workers until after the sample frame was drawn up
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	13% of children lost to follow-up.

du Preez 2011 KEN

Methods	RCT
Participants	Number: 1089 children, 765 households Inclusion criteria: eligible households stored water in containers in-house, did not have a drinking water tap in the house or yard, and had at least one child (but not more than 5) between 6 months and 5 years old residing in the house
Interventions	1. SODIS (404 households) 2. Primary drinking supply (361)
Outcomes	1. Episodes of dysentery and non-dysentery diarrhoea 2. Height-for-age and weight-for-age 3. Microbial water quality
Notes	Location: three urban slums, three rural areas near Nakuru, Kenya\ Length: 17 months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random numbers between zero and one were generated and allocated to the households. If the random number allocated to a household was less than 0.5 the household was randomized to the test group. If the allocated number was above 0.5 the house was randomized to the control group
Allocation concealment (selection bias)	Low risk	Field workers were unaware of how the numbers were allocated
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	4% children lost to follow-up.

Fabiszewski 2012 HND

Methods	RCT
Participants	Number: 230 children < 5, 1020 people, 178 households Inclusion criteria: households were eligible if they had a least one child under 5, did not have year-round access to piped water, and did not use bottled water
Interventions	1. Biosand filter (90 households) 2. Primary drinking supply (86 households)
Outcomes	1. Incidence of diarrhoea 2. Microbial water quality
Notes	Location: 11 rural communities in Copan, Honduras Length: six month follow-up Publication status: journal

Risk of bias

Fabiszewski 2012 HND (*Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generation.
Allocation concealment (selection bias)	Low risk	No one knew which group they were assigned to until the day before
Comparability of characteristics	Low risk	Irrelevant to this study design.
Contemporaneous data collection	Low risk	Irrelevant to this study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 1% lost to follow-up.

Gasana 2002 RWA

Methods	Quasi-RCT
Participants	Number: 150 children < 5 years Inclusion criteria: all households with at least one child < 5
Interventions	1. Improved source: pipes to stand post; sedimentation tank; ceramic filter; storage tank; and communal tap (95 children) 2. Primary drinking supply (55 children)
Outcomes	1. Incidence of diarrhoea
Notes	Location: rural Rwanda Length: 24 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Irrelevant to study design.
Allocation concealment (selection bias)	Low risk	Irrelevant to study design.

Comparability of characteristics	Unclear risk	Not described.
Contemporaneous data collection	Unclear risk	Not described.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant to study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant to study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant to study design.

Gruber 2013 MEX

Methods	RCT
Participants	Number: 1916 people, 444 households Inclusion criteria: households were eligible if they did not have access to centrally treated drinking water and collected water from local sources year-round
Interventions	1. UV water treatment and storage system (Mesita Azul)
Outcomes	1. Diarrhoea prevalence 2. Microbial water quality
Notes	Location: rural Baja California Sur, Mexico Length: 15 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Eligible communities assigned a random number between zero and one by an investigator using STATA
Allocation concealment (selection bias)	Low risk	Every 2 months another community was randomly allocated to intervention group; no one knew in advance
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.

Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	15% participants lost to follow-up.

Günther 2013 BEN

Methods	RCT
Participants	Number: 364 intervention households; 347 control households Inclusion criteria: all households in intervention villages
Interventions	1. Improved water vessel for fetching 2. Improved water vessel for storing
Outcomes	1. Water quality of stored water 2. Diarrhoea prevalence
Notes	Location: rural Benin Length: 3 months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Insufficient detail.
Allocation concealment (selection bias)	Unclear risk	Insufficient detail.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.

Incomplete outcome data (attrition bias) All outcomes	High risk	64% of sample with follow-up data (due to budgetary constraints)

Handzel 1998 BGD

Methods	RCT
Participants	Number: 447 children aged 3 to 60 months from 276 households Inclusion criteria: households with children 3 to 60 months of age using municipal water (household taps) as primary source of drinking water which had tested positive at baseline for *E. coli*
Interventions	1. Household chlorination using sodium hypochlorite solution, special storage vessel and hygiene instruction about why and how to treat water (140 households) 2. Primary drinking supply (136 households)
Outcomes	1. Incidence of diarrhoea 2. Microbial water quality
Notes	Location: informal settlement in urban Bangladesh Length: 8 months Publication status: PhD dissertation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Lottery.
Allocation concealment (selection bias)	Low risk	Consent was obtained from participating households; none knew whether they would be placed into the intervention or comparison group
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.

Incomplete outcome data (attrition bias) All outcomes	Low risk	8% participants lost to follow-up.

Jain 2010 GHA

Methods	RCT
Participants	Number: 549 children under five, 3240 individuals, 240 households Inclusion criteria: households were eligible if there was at least one child < 5
Interventions	1. Chlorine (NaDCC) tablets (120 households) 2. Placebo-tablets without chlorine (120 households)
Outcomes	1. Diarrhoeal episodes 2. Chlorine residuals 3. Microbiological water quality
Notes	Location: peri-urban communities of Tamale, Ghana Length: 12 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number table.
Allocation concealment (selection bias)	Low risk	Only technical staff at Medentech, Ltd knew which tablets were placebo and which were NaDCC
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Triple blinded.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Triple blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 1% of households lost to follow-up.

Jensen 2003 PAK

Methods	Quasi-RCT
Participants	Number: 226 children < 5 years of age Inclusion criteria: all households that had children aged less than five years and that primarily obtained drinking-water from the water supply systems
Interventions	1. Village level chlorination of water supply using calcium hypochlorite (82 children) 2. Primary drinking supply (144 children)
Outcomes	1. Incidence of diarrhoea 2. Microbial water quality
Notes	Location: 2 villages in Pakistan Length: 6 months Publication status: journal Controlled for sanitation and water storage status of households, and for seasonality

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrelevant to study design.
Allocation concealment (selection bias)	Low risk	Irrelevant to study design.
Comparability of characteristics	Low risk	Water quality at baseline significantly different between intervention and control villages
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant to study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant to study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant to study design.

Kirchhoff 1985 BRA

Methods	RCT
Participants	Number: 112 persons (all ages) from 20 families Inclusion criteria: households with at least 2 children living at home and using water from pond exclusively
Interventions	1. Household level chlorination with sodium hypochlorite 2. Primary drinking supply
Outcomes	1. Longitudinal prevalence of diarrhoea 2. Microbial water quality 3. Acceptability of intervention to study population
Notes	Location: rural Brazil Length: 18 weeks Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	Sequences could be related to outcomes (eligible households which agreed to participate were enrolled)
Allocation concealment (selection bias)	High risk	Sequences could be related to outcomes (eligible households which agreed to participate were enrolled)
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Study staff and participants blinded (placebo).
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	Approximately 20% participants lost to follow-up.

Kremer 2011 KEN

Methods	RCT
Participants	Number: 184 springs; 1354 households Inclusion criteria: springs that were not seasonally dry, landownder gave approval to be protected
Interventions	1. Protected springs
Outcomes	1. Diarrhoeal episodes 2. Microbiological water quality
Notes	Location: rural western Kenya Length: 2 years Publication status: economics quarterly journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator assigned springs into year of treatment
Allocation concealment (selection bias)	Low risk	Random selection of households at each intervention spring.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	95% of all households were surveyed for baseline and at least two follow-up rounds

Lindquist 2014a BOL

Methods	RCT
Participants	Number: 330 intervention households; 279 control households Inclusion criteria: households: with children less than 60 months of age, in squatter or low-income rental housing, receive their primary drinking/household water from a non-municipal source, and no access to a direct municipal sewer line. Enrollment was limited to one child per household

Interventions	1. Filter
Outcomes	1. Diarrhoea period prevalence
Notes	Location: rural Bolivia Length: 3 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator.
Allocation concealment (selection bias)	Low risk	Randomization done at neighbourhood level.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	> 20% lost to follow-up.

Lindquist 2014b BOL

Methods	RCT
Participants	Number: 285 intervention households; 279 control households Inclusion criteria: as above
Interventions	1. Filter 2. WASH behaviour change education
Outcomes	As above
Notes	As above

Risk of bias

Lindquist 2014b BOL (*Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator.
Allocation concealment (selection bias)	Low risk	Randomization done at neighbourhood level.
Comparability of characteristics	Low risk	Irrelevant to study design.
Contemporaneous data collection	Low risk	Irrelevant to study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	> 20% lost to follow-up.

Luby 2004a PAK

Methods	Quasi-RCT
Participants	Number: 2365 persons < 15 years from 285 households Inclusion criteria: eligible households included at least one child less than five years of age and two children less than 15 years of age, had sufficient water supply for the children to bathe daily, and planned to continue to reside in their homes for at least the ensuing four months
Interventions	1. Bleach + regular vessel (640 people) 2. Primary drinking supply (1027 people)
Outcomes	1. Longitudinal prevalence of diarrhoea 2. Use of intervention by certain household characteristics
Notes	Location: 3 neighbourhoods in squatter settlements in Karachi, Pakistan Length: 6 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement

Random sequence generation (selection bias)	Low risk	Irrelevant for study design.
Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	Baseline characteristics did not differ significantly between groups
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

Luby 2004b PAK

Methods	See Luby 2004a PAK
Participants	As above
Interventions	1. Bleach + insulated vessel (697 people) 2. Primary drinking supply (1027 people)
Outcomes	As above
Notes	As above

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrelevant for study design.
Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.

Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

Luby 2006a PAK

Methods	RCT
Participants	Number: 5520 persons of all ages Inclusion criteria: running water at least one hour twice a week and at least one child under 5
Interventions	1. Dilute bleach + vessel (1747 people) 2. Primary drinking supply (1852 people)
Outcomes	1. Incidence and longitudinal prevalence of diarrhoea
Notes	Location: 47 squatter settlements of Karachi, Pakistan Length: 8 months Publication status: unpublished

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random number assigned households to groups
Allocation concealment (selection bias)	Low risk	Households consented to study before computer randomly assigned them to specific groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.

Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Overall less than 8% of participants lost to follow-up (averaged across all groups)

Luby 2006b PAK

Methods	See Luby 2006a PAK
Participants	As above
Interventions	1. Flocculant-disinfectant + soap (1806 in flocculant-disinfection group) 2. Primary drinking supply (1852 people)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random number assigned households to groups
Allocation concealment (selection bias)	Low risk	Households consented to study before computer randomly assigned them to specific groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Overall less than 8% of participants lost to follow-up (averaged across all groups)

Luby 2006c PAK

Methods	See Luby 2006a PAK
Participants	As above
Interventions	1. Flocculant-disinfectant + vessel (1833 in flocculant-disinfection group) 2. Primary drinking supply (1852 people, 40.0%)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random number assigned households to groups
Allocation concealment (selection bias)	Low risk	Households consented to study before computer randomly assigned them to specific groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Overall less than 8% of participants lost to follow-up (averaged across all groups)

Lule 2005 UGA

Methods	RCT
Participants	Number: 2201 persons of all ages among 458 households Inclusion criteria: households without access to chlorinated municipal water; at least 1 resident of each household was HIV+
Interventions	1. Household level chlorination using sodium hypochlorite + special vessel (1097 people) 2. Primary drinking supply (1104 people) Note: hygiene education was provided to both groups

Outcomes	1. Incidence of diarrhoea 2. Days with diarrhoea (longitudinal prevalence) 3. Days lost from work or school 4. Aetiology of diarrhoea 5. Frequency of clinic visits and hospitalization 6. Mortality
Notes	Location: households in rural Uganda Length: 5 months Publication status: unpublished Succeeded by 18-month RCT that included cotrimoxazole prophylaxis

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Insufficient detail.
Allocation concealment (selection bias)	Unclear risk	Insufficient detail.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 8% of participants lost to follow-up.

Mahfouz 1995 KSA

Methods	RCT
Participants	Number: 311 children < 5 years (among intervention households, among controls) among 171 families Inclusion criteria: households with at least one child less than 5 years of age
Interventions	1. Household level chlorination using calcium hypochlorite (159 children) 2. Primary drinking supply (152 children)
Outcomes	1. Reported cases of diarrhoea in intervention year compared with previous year

Notes	Location: 9 villages in rural Saudi Arabia Length: 6 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No description of randomization process (for villages). No description of how households were chosen
Allocation concealment (selection bias)	Unclear risk	No description of how chosen families were selected or contacted
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded
Incomplete outcome data (attrition bias) All outcomes	High risk	Large loss to follow-up in intervention and control groups

Majuru 2011 ZAF

Methods	Quasi-RCT
Participants	Number: community 1, 234 individuals; community 2, 173 individuals; reference community, 146 individuals Inclusion criteria: new community level piped water supply
Interventions	1. Community-level piped water supply (2 communities, 407 individuals) 2. Primary drinking water supply, unimproved sources (1 community, 146 individuals)
Outcomes	1. Diarrhoeal episodes
Notes	Location: rural, remote communities, Limpopo Province, South Africa Length: approximately 10 months of follow-up Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Irrelevant for study design.
Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

McGuigan 2011 KHM

Methods	RCT
Participants	Number: 964 children in 782 households Inclusion criteria: households were eligible if they were permanent residents in the area, had at least one child 6 months to 5 years old, and did not use other methods of household water treatment
Interventions	1. SODIS (407 households, 502 children < 5) 2. Primary drinking water supply (375 households, 426 children < 5)
Outcomes	1. Days of dysentery diarrhoea for < 5s 2. Days of non-dysentery diarrhoea for < 5s
Notes	Location: rural communities in Prey Veng and Svey Rieng provinces, Cambodia Length: 12 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomized raffle system of interested households during initial meeting

Allocation concealment (selection bias)	Low risk	Households were randomly allocated to intervention or control groups at community meeting
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	5% of participants had less than 10 months of follow-up.

Mengistie 2013 ETH

Methods	RCT
Participants	Number: 36 clusters, 569 households, 845 children < 5 Inclusion criteria: households were eligible if they had at least one child < 5
Interventions	Chlorine disinfection (WaterGuard) (427 children < 5) Primary drinking supply (422 children < 5)
Outcomes	Diarrhoeal episodes for children < 5 Intervention compliance
Notes	Location: rural communities, Kersa district, Ethiopia Length: 16 weeks Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer generated random sample.
Allocation concealment (selection bias)	Low risk	Randomization of clusters done in community meeting.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.

Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	2% to 3% of person-weeks of observation lost.

Mäusezhal 2009 BOL

Methods	RCT
Participants	Number: 484 households, 819 children < 5 Inclusion criteria: communities had to have at least 30 children < 5 and rely on contaminated drinking water sources
Interventions	1. SODIS (11 communities, 262 households, 441 children) 2. Primary drinking water supply, unimproved sources (11 communities, 222 households, 378 children)
Outcomes	1. Diarrhoeal episodes for children < 5 2. Dysentery episodes for children < 5
Notes	Location: rural Totora District, Cochabamba Department, Bolivia Length: 12 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random assignment during public event.
Allocation concealment (selection bias)	Low risk	Balls with community codes inscribed on them were drawn from a box; the first ball drawn would be the intervention community
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.

Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	21% of person-days of observation missing.

Opryszko 2010a AFG

Methods	RCT
Participants	Number: 553 households, 4507 individuals Inclusion criteria: inadequate access to improved water sources; high areas of diarrhoeal disease according to 2004 census
Interventions	1. Chlorine disinfection (with improved storage vessel); Improved water supply (tube wells); hygiene promotion (261 households, 1958 individuals) 2. Primary drinking supply (292 households, 2549 individuals)
Outcomes	1. Diarrhoea prevalence 2. Dysentery-diarrhoea prevalence
Notes	Location: rural communities, Wardak province, Afghanistan Length: 16 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly allocated.
Allocation concealment (selection bias)	Low risk	Randomly allocated by numbered lists.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.

Opryszko 2010a AFG *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	10% of households data missing at follow-up.

Opryszko 2010b AFG

Methods	See Opryszko 2010a AFG
Participants	Number: 600 households, 4,966 individuals Inclusion criteria: inadequate access to improved water sources; high areas of diarrhoeal disease according to 2004 census
Interventions	1. Improved water supply (tube wells) 2. Primary drinking supply (292 households, 2549 individuals)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly allocated.
Allocation concealment (selection bias)	Low risk	Randomly allocated by numbered lists.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	10% of households data missing at follow-up.

Opryszko 2010c AFG

Methods	See Opryszko 2010a AFG
Participants	Number: 591 households, 4575 individuals Inclusion criteria: inadequate access to improved water sources; high areas of diarrhoeal disease according to 2004 census
Interventions	1. Chlorine disinfection (Clorin); Improved storage vessel (299 households, 2026 individuals) 2. Primary drinking supply (292 households, 2549 individuals)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly allocated.
Allocation concealment (selection bias)	Low risk	Randomly allocated by numbered lists.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	10% of households data missing at follow-up.

Patel 2012 KEN

Methods	RCT
Participants	Number: 42 schools Inclusion criteria: schools were eligible if they were not near urban centres and did not have pre-existing water-treatment promotion activities
Interventions	1. Chlorine disinfection (WaterGuard); improved vessel (22 schools) 2. Primary drinking supply (20 schools)

Patel 2012 KEN (*Continued*)

Outcomes	1. Student's knowledge and practice of using WaterGuard 2. Any illness 3. Diarrhoeal illness 4. Acute respiratory illness
Notes	Location: rural Nyanza province, Kenya Length: 2 years Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random allocation from census list.
Allocation concealment (selection bias)	Low risk	Random allocation from census list.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	32% students lost to follow-up.

Peletz 2012 ZMB

Methods	RCT
Participants	Number: 120 households, 599 individuals, 121 children < 2 Inclusion criteria: mothers who disclosed their HIV status, had a child 6-12 months old, and permanently resided in the catchment area
Interventions	1. Filter (LifeStraw® Family); two 5 L storage vessels (61 households, 299 individuals, 61 children < 2) 2. Primary drinking supply (59 households, 300 individuals, 60 children < 2)
Outcomes	1. Use of filter 2. Microbiological water quality 3. Longitudinal diarrhoeal prevalence

	4. Weight-for-age Z-scores
Notes	Location: two peri-urban neighbourhoods, Chongwe district, Zambia Length: 12 month Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator.
Allocation concealment (selection bias)	Low risk	Randomization conducted by person not involved in study.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	More than 80% of person-weeks of observation completed.

Quick 1999 BOL

Methods	RCT
Participants	Number: 791 persons of all ages from 127 households Inclusion criteria: all households in the community
Interventions	1. Household level chlorination + vessel + hygiene education (400 people, 64 households) 2. Primary drinking supply (391 people, 63 households)
Outcomes	1. Mean episodes of diarrhoea per person 2. Microbiological water quality
Notes	Location: 2 peri-urban communities in Bolivia Length: 5 months Publication status: journal

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Randomized by public lottery into two groups.
Allocation concealment (selection bias)	Low risk	Randomized by public lottery into two groups.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 10% of participants lost to follow-up.

Quick 2002 ZMB

Methods	Quasi-RCT
Participants	Number: 1584 persons of all ages from 260 households Inclusion criteria: lack of piped water and presence of health clinic in community
Interventions	1. Household level chlorination + vessel + hygiene education (166 households) 2. Primary drinking supply (94 households)
Outcomes	1. Incidence of diarrhoea 2. Microbiological water quality
Notes	Location: 2 peri-urban communities in Zambia Length: 3 months Publication status: journal

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrelevant for study design.

Quick 2002 ZMB (*Continued)*

Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

Reller 2003a GTM

Methods	RCT	
Participants	Number: 492 households Inclusion criteria: household with a child < 12 months or mother in last trimester of pregnancy	
Interventions	1. Flocculant-disinfectant (102 households) 2. Primary drinking supply (96 households)	
Outcomes	1. Incidence of diarrhoea 2. Intervention knowledge and acceptability 3. Microbiological water quality 4. Intervention utilization	
Notes	Location: 12 villages in rural Guatemala Length: 12 months Publication status: journal	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number generator assigned eligible households to groups
Allocation concealment (selection bias)	Low risk	Random number generator assigned eligible households to groups

Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	Approximately 13% of participants lost to follow-up.

Reller 2003b GTM

Methods	See Reller 2003a GTM
Participants	As above
Interventions	1. Bleach only (97 households) 2. Primary drinking supply (as above)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generator assigned eligible households to groups
Allocation concealment (selection bias)	Low risk	Random number generator assigned eligible households to groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.

Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	Approximately 13% of participants lost to follow-up.

Reller 2003c GTM

Methods	See Reller 2003a GTM
Participants	As above
Interventions	1. Bleach + vessel (97 households) 2. Primary drinking supply (as above)
Outcomes	As above
Notes	As above

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number generator assigned eligible households to groups
Allocation concealment (selection bias)	Low risk	Random number generator assigned eligible households to groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	Approximately 13% of participants lost to follow-up.

Reller 2003d GTM

Methods	See Reller 2003a GTM	
Participants	As above	
Interventions	1. Flocculant-disinfectant + vessel (100 households) 2. Primary drinking supply (as above)	
Outcomes	As above	
Notes	As above	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number generator assigned eligible households to groups
Allocation concealment (selection bias)	Low risk	Random number generator assigned eligible households to groups
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	Approximately 13% of participants lost to follow-up.

Roberts 2001 MWI

Methods	RCT
Participants	Number: 1160 persons of all ages; of these, 208 were children < 5 years Inclusion criteria: all households in refugee camp
Interventions	1. Improved storage: bucket with spout and narrow opening to limit hand entry (310 people including 51 children, 100 households) 2. Primary drinking supply (850 people including 157 children, 300 households)

Outcomes	1. Incidence of diarrhoea 2. Microbiological water quality 3. Incidence of diarrhoea by selected environmental factors
Notes	Location: Malawi refugee camp Length: 4 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	"One fourth of the interviewed households were selected at random to receive the improved buckets"
Allocation concealment (selection bias)	High risk	"One fourth of the interviewed households were selected at random to receive the improved buckets"
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	88.8% of participants lost to follow-up.

Rodrigo 2011 AUS

Methods	RCT
Participants	Number: 300 households, 1352 individuals, 185 children < 5 Inclusion criteria: households were eligible if they use untreated rainwater as their primary drinking source
Interventions	1. Water filters (Freshwater systems) (152 households, 698 individuals) 2. Sham-water filters (148 households, 654 individuals)
Outcomes	1. Episodes of Highly Credible Gastrenteritis 2. Episodes of diarrhoea

Notes	Location: Adelaide, Australia Length: 12 months Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number sequence by independent researcher.
Allocation concealment (selection bias)	Low risk	Random number sequence by independent researcher.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Sham device (placebo) utilised.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	High risk	31% households lost to follow-up.

Semenza 1998 UZB

Methods	RCT
Participants	Number and inclusion criteria: 1583 persons of all ages from 240 households, half with access to piped water (first control group) and half without (of which 62 received intervention, and 58 served as a second control group); these included 344 children < 5
Interventions	1. Household level chlorination + vessel + hygiene education 2. Primary drinking supply
Outcomes	1. Incidence of diarrhoea 2. Incidence of diarrhoea by selected household and water management practices
Notes	Location: urban Uzbekistan Length: 9.5 weeks Publication status: journal

Risk of bias

Semenza 1998 UZB (*Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Households randomly selected from map of neighbourhoods.
Allocation concealment (selection bias)	Low risk	Households randomly selected from map of neighbourhoods.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Lost to follow-up not discussed.

Stauber 2009 DOM

Methods	RCT
Participants	Number: 167 households, 907 individuals, 243 children < 5 Inclusion criteria: households were eligible if there was no biosand filter in the house, and there was at least one child < 5
Interventions	1. Biosand filter (81 households, 447 individuals) 2. Primary drinking supply (86 households, 460 individuals)
Outcomes	1. Diarrhoeal incidence 2. Microbiological water quality
Notes	Location: one semi-rural and one urban community, Bonao, Dominican Republic Length: six months follow-up Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generation assigned 50% of households to intervention group

Allocation concealment (selection bias)	Unclear risk	Households were unaware of whether they would be assigned to the intervention or control group until one week before BSF installation, but it is not clear whether this was foreknowledge of group assignment
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	7% participants lost to follow-up.

Stauber 2012a KHM

Methods	RCT
Participants	Number: 189 households, 1147 individuals, 242 children < 5 Inclusion criteria: households were eligible if there was at least one child < 5
Interventions	1. Plastic Biosand filter (7 villages, 90 households, 546 individuals) 2. Primary drinking supply (6 villages, 99 households, 601 individuals)
Outcomes	1. Diarrhoeal incidence 2. Microbiological water quality
Notes	Location: 13 rural communities, Angk Snoul district, Cambodia Length: four months follow-up Publication status: journal

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number generation assigned 7 of 13 villages to intervention group
Allocation concealment (selection bias)	Low risk	All villages were told they would not know to which group they were assigned until halfway through the study (due to surveillance period, pre-intervention)

Stauber 2012a KHM *(Continued)*

Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	4% of person-observation weeks missing.

Stauber 2012b GHA

Methods	RCT
Participants	Number: 2043 individuals, of which 440 were children < 5, from 260 households Inclusion criteria: households were eligible if there was at least one child < 5
Interventions	1. Plastic Biosand filter (117 households, 1012 individuals) 2. Primary drinking supply (143 households, 1031 individuals)
Outcomes	1. Diarrhoeal incidence 2. Microbiological water quality
Notes	Location: six rural communities, Tamale, Ghana Length: three months follow-up Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Random number generator assigned 3 of the 6 villages to the intervention group
Allocation concealment (selection bias)	Unclear risk	Not discussed.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.

Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Less than 3% of households lost to follow-up.

Tiwari 2009 KEN

Methods	RCT
Participants	Number: 387 individuals, of which 114 were children < 5, from 60 households Inclusion criteria: households were eligible if they had at least one child < 3, used river water as their primary or secondary drinking water source, stable residence for next 12 months, and indicators of lower socio-economic status
Interventions	1. Biosand filter (30 households, 118 children) 2. Primary drinking water supply (30 households, 104 children)
Outcomes	1. Microbiological water quality 2. Diarrhoea prevalence in children
Notes	Location: rural households in River Njoro watershed, Nakuru and Molo districts, Kenya Length: six months Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No description of randomization process.
Allocation concealment (selection bias)	Unclear risk	No description of steps to conceal allocation.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.

Incomplete outcome data (attrition bias) All outcomes	Low risk	After randomization, 75 (93%) and 79 (92%) of BSF and control households, respectively, completed the study

Torun 1982 GTM

Methods	Quasi-RCT
Participants	Number: 2103 persons of all ages from 2 villages Inclusion critera: all households within 2 villages
Interventions	1. Source protection (spring), chlorination facilities, "adequate storage", and water mains with faucets to yards of intervention village (1006 people) 2. Primary drinking supply (1097 people)
Outcomes	1. Incidence of diarrhoea
Notes	Location: 2 small villages in Guatemala Length: 12 months Publication status: book

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrelevant for study design.
Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

URL 1995a GTM

Methods	RCT
Participants	Number: 1120 children < 5 years (265 and 289 allocated to the water quality intervention arms, 297 to an education only arm, and 269 to the control arm) from 680 families from three demographic regions Inclusion criteria: households must have children <5 and have indicators of low socio-economic status and microbiological contamination of water source
Interventions	1. Locally fabricated ceramic filters (265 children or 23.6%) 2. Primary drinking supply (269 children)
Outcomes	1. Incidence of diarrhoea 2. Nutritional status (weight/age)
Notes	Location: 3 demographic regions of Guatemala Length: 12 months Publication status: unpublished

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Reported to be randomized, but no description of method of randomization process
Allocation concealment (selection bias)	Unclear risk	No description of allocation concealment.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants not blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not discussed.

URL 1995b GTM

Methods	See URL 1995a GTM
Participants	As above
Interventions	1. Locally fabricated ceramic filters + hygiene education 2. Primary drinking supply (as above)
Outcomes	As above
Notes	As above

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Reported to be randomized, but no description of method of randomization process
Allocation concealment (selection bias)	Unclear risk	No description of allocation concealment.
Comparability of characteristics	Low risk	Irrelevant for study design.
Contemporaneous data collection	Low risk	Irrelevant for study design.
Blinding of participants and personnel (performance bias) All outcomes	High risk	No placebo used.
Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessors not blinded.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not discussed.

Xiao 1997 CHN

Methods	Quasi-RCT
Participants	Number: 4649 people of all ages Inclusion criteria: all households within villages
Interventions	1. Improved water supply + sanitation + hygiene education (2363 people) 2. Primary drinking supply (2286 people)
Outcomes	1. Incidence of diarrhoea

Notes	Location: 2 villages in rural China Length: 3 years Publication status: journal

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Irrelevant for study design.
Allocation concealment (selection bias)	Low risk	Irrelevant for study design.
Comparability of characteristics	Low risk	No substantial differences at baseline.
Contemporaneous data collection	Low risk	Data collected at similar points in time.
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Irrelevant for study design.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Irrelevant for study design.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Irrelevant for study design.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Ahoyo 2011	Allocation was neither randomized nor quasi-randomized.
Aiken 2011	Allocation was neither randomized nor quasi-randomized.
Alexander 2013	Outcome measures did not include diarrhoea.
Arnold 2009	Allocation was neither randomized nor quasi-randomized.
Arnold 2012a	Comment paper.
Arnold 2013	Design paper.
Asaolu 2002	Allocation was neither randomized nor quasi-randomized; outcome measures did not include diarrhoea

(*Continued*)

Aziz 1990 BGD	The intervention included the provision of sanitation facilities
Azurin 1974	Outcome measures did not include diarrhoea.
Bahl 1976	Allocation was neither randomized nor quasi-randomized.
Bajer 2012	Allocation was neither randomized nor quasi-randomized, outcome not diarrhoea
Barreto 2007	Allocation was neither randomized nor quasi-randomized.
Barzilay 2011	Allocation was neither randomized nor quasi-randomized.
Bersh 1985	Allocation was neither randomized nor quasi-randomized.
Boubacar 2014	Allocation was neither randomized nor quasi-randomized.
Brown 2012a	Modelling paper.
Capuno 2011	Allocation was neither randomized nor quasi-randomized.
Cavallaro 2011	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Chang 2012	Outcomes did not include diarrhoea.
Chongsuvivatwong 1994	Allocation was neither randomized nor quasi-randomized.
Christen 2011	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Clasen 2012	No water quality intervention.
Colford 2005	Outcomes did not include diarrhoea.
Colwell 2003	Outcomes did not include diarrhoea.
Conroy 2001	Outcomes did not include diarrhoea.
Coulliette 2013	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Crump 2007	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Davis 2011	Outcomes did not include diarrhoea.
Deb 1986	Outcomes did not include diarrhoea.
Denslow 2010	Allocation was neither randomized nor quasi-randomized.
Devoto 2011	Intervention did not affect water quality.

(*Continued*)

Dorevitch 2011	Outcomes did not include diarrhoea.
Dreibelbis 2014a KEN	School-based study.
Dreibelbis 2014b KEN	School-based study.
Dreibelbis 2014c KEN	School-based study.
du Preez 2012	Response to comments.
Eisenberg 2006	Study on risk assessment.
Enger 2012	Modelling paper.
Esrey 1988	Allocation was neither randomized nor quasi-randomized.
Fewtrell 1994	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Fewtrell 1997	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Firth 2010	Outcomes did not include diarrhoea.
Fisher 2011	Allocation was neither randomized nor quasi-randomized.
Freeman 2012	Outcomes did not include diarrhoea.
Freeman 2014a KEN	School-based study.
Freeman 2014b KEN	School-based study.
Freeman 2014c KEN	School-based study.
Fry 2010	Modelling paper.
Galiani 2009	Allocation was neither randomized nor quasi-randomized
Garrett 2008 KEN	The intervention included the provision of sanitation facilities
Ghannoum 1981	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Gorelick 2011	Allocation was neither randomized nor quasi-randomized.
Greene 2012	Outcome not diarrhoea, see Freeman 2012.
Gómez-Couso 2012	Allocation was neither randomized nor quasi-randomized, outcome not diarrhoea
Habib 2013	Water quality intervention applied once children had experienced diarrhoea

(*Continued*)

Harris 2009	Allocation was neither randomized nor quasi-randomized.
Harshfield 2012	Allocation was neither randomized nor quasi-randomized.
Hartinger 2011	Design paper.
Hartinger 2012	Outcome measures did not include diarrhoea.
Hellard 2001	Outcome measures did not include diarrhoea.
Hoque 1996	Allocation was neither randomized nor quasi-randomized.
Huda 2012	Allocation was neither randomized nor quasi-randomized.
Hunter 2010	Allocation was neither randomized nor quasi-randomized
Iijima 2001	Allocation was neither randomized nor quasi-randomized.
Islam 2011	Allocation was neither randomized nor quasi-randomized.
Jensen 2002	Outcome not diarrhoea.
Kariuki 2012	Intervention not water.
Karon 2011	Outcome not diarrhoea.
Keraita 2007	Outcome not diarrhoea.
Khan 1984	Outcome not diarrhoea.
Luby 2008	Allocation was neither randomized nor quasi-randomized.
Luoto 2011	Outcome not diarrhoea.
Luoto 2012	Outcome not diarrhoea.
Macy 1998	Allocation was neither randomized nor quasi-randomized; intervention not an improvement in water quality; outcome not diarrhoea
McCabe 1957	Intervention not an improvement in water quality.
Mertens 1990	Allocation was neither randomized nor quasi-randomized, intervention not an improvement in water quality; outcome not diarrhoea
Messou 1997	The intervention included the provision of sanitation facilities
Mäusezahl 2003	Allocation was neither randomized nor quasi-randomized.

(*Continued)*

Nanan 2003	Allocation was neither randomized nor quasi-randomized.
Nerkar 2014	Allocation was neither randomized nor quasi-randomized.
Nnane 2011	Allocation was neither randomized nor quasi-randomized, no intervention
Oluyege 2011	Allocation was neither randomized nor quasi-randomized, no intervention
Palit 2012	Allocation was neither randomized nor quasi-randomized.
Pavlinac 2014	Allocation was neither randomized nor quasi-randomized.
Payment 1991a	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Payment 1991b	Outcomes did not include diarrhoea.
Peletz 2013	Outcomes did not include diarrhoea.
Pinfold 1990	Intervention not an improvement in water quality; outcome not diarrhoea
Psutka 2012	Allocation was neither randomized nor quasi-randomized, outcomes did not include diarrhoea
Rosa 2014	Outcomes did not include diarrhoea.
Rose 2006	Allocation was neither randomized nor quasi-randomized.
Rubenstein 1969	Allocation was neither randomized nor quasi-randomized.
Russo 2012	Allocation was neither randomized nor quasi-randomized.
Sathe 1996	Allocation was neither randomized nor quasi-randomized.
Shah 2012	Review paper.
Sharan 2011	Allocation was neither randomized nor quasi-randomized, outcome not diarrhoea
Sheth 2010	Allocation was neither randomized nor quasi-randomized, outcome not diarrhoea
Shiffman 1978	Allocation was neither randomized nor quasi-randomized.
Shrestha 2006	Cost-effectiveness paper.
Shum 1971	Allocation was neither randomized nor quasi-randomized, intervention not an improvement in water quality; outcome not diarrhoea
Sima 2012	Allocation was neither randomized nor quasi-randomized.

(*Continued*)

Sorvillo 1994	Outcomes did not include diarrhoea.
Stauber 2013	Outcomes did not include diarrhoea.
Sutha 2011	Review paper.
Tonglet 1992	Allocation was neither randomized nor quasi-randomized.
Trivedi 1971	Allocation was neither randomized nor quasi-randomized.
VanDerslice 1995	Allocation was neither randomized nor quasi-randomized, intervention not an improvement in water quality
Varghese 2002	Allocation was neither randomized nor quasi-randomized.
Wiedenmann 2006	Intervention not an improvement in water quality.
Wolf 2014	Review.
Wood 2012	Qualitative study.
Wu 2011	Allocation was neither randomized nor quasi-randomized.

Characteristics of ongoing studies *[ordered by study ID]*

Chlorination, Dhaka

Trial name or title	Impact of Low-Cost In-Line Chlorination Systems in Urban Dhaka on Water Quality and Child Health
Methods	RCT
Participants	All poor households, with at least one child under five, that access one of 160 studied shared water points in Dhaka
Interventions	In-line chlorination
Outcomes	Water quality, diarrhoea in children under five, weight of children, cost of instilling and maintaining system, hospital visits, health care expenditures, other household expenditures
Starting date	Early 2015
Contact information	
Notes	Funded by SIEF, World Bank

WASH-B, Bangladesh

Trial name or title	WASH Benefits Bangladesh: A Cluster Randomized Controlled Trial of the Benefits of Water, Sanitation, Hygiene Plus Nutrition Interventions on Child Growth
Methods	Parallel, cluster-RCT
Participants	Estimated enrolment: 5040
Interventions	1. Water quality: Storage vessel and chlorine tablets. 2. Sanitation: a) a sani-scoop hoe dedicated to the removal of human and animal faeces from the compound, b) plastic child potties for children ages 6 months and older until they are using the latrine, and c) a new or upgraded dual pit latrine for each household in the compound. The behavior change components of the intervention will emphasize the use of the latrine for defecation and the safe disposal of faeces in the compound courtyard to prevent contact with young children. 3. Handwashing: The hardware components of the Bangladesh handwashing intervention include two handwashing stations. The first station will be located in the kitchen (location of food preparation), and will include a 16 L bucket with a tap fitting, a stool, bowl and soapy water bottle. The second station will be located near the toilet, and will include a 40 L bucket with tap fitting, stool, bowl and soapy water bottle. The study will provide detergent soap to families free of charge to replenish the soapy water bottles. The behavior change component of the intervention will focus messaging for handwashing at two critical times: after defecation and before food preparation. 4. Nutrition: Mothers will be encouraged to exclusively breastfeed their children through age 6 months. When newborns reach 6 months of age, mothers will be encouraged to continue breastfeeding their children until 24 months, and will receive education about supplementing breastfeeding with healthy complementary foods following infant and young child feeding best practice guidelines from Unicef and the WHO. From ages 6 to 24 months, study children will receive a daily lipid-based nutritional supplement (LNS) that has been developed and tested through the iLiNS project.
Outcomes	1. Length-for-Age Z-scores (time frame: measured 24 months after intervention) (Designated as safety issue: no). Child's recumbent length, standardized to Z-scores using the WHO 2006 growth standards. 2. Diarrhoea Prevalence (time frame: measured 12- and 24-months after intervention).
Starting date	May 2012
Contact information	International Centre for Diarrhoeal Disease Research, Bangladesh
Notes	

WASH-B, Kenya

Trial name or title	WASH-Benefits study, Kenya
Methods	Parallel, cluster-RCT
Participants	Estimated: 8000
Interventions	1. Water quality: intervention villages will receive chlorine dispensers at spring water sources. After filling their plastic jerry can of water from the source, users can place the jerry can under the dispenser, and turn a knob to release 3 mL of chlorine. Behavior change messages will focus on the consistent provision of treated

	water to all children living in the household. 2. Sanitation: a) a sani-scoop hoe dedicated to the removal of human and animal faeces from the compound; b) plastic child potties for children ages 6 months and older until they are using the latrine; and c) a new or upgraded pit latrine for each household in the compound. If participants have a latrine, its structure will be improved if necessary. Plastic slabs will be installed to improve mud or wood floors, and the intervention delivery team will make sure that all latrine structures have walls, doors, roofs that ensure safety and privacy. The behaviour change components of the intervention will emphasize the use of the latrine for defecation and the safe disposal of faeces in the compound courtyard to prevent contact with young children. 3. Handwashing: two handwashing stations in the compound of each respondent, one near the latrine, and one by the cooking area. The handwashing stations are constructed from locally available materials and are of a dual tippy-tap design with independent pedals attached to 5 L jerry cans of clean water and jugs of soapy water. The behavior change component of the intervention will focus messaging for handwashing at two critical times: after defecation and before food preparation. 4. Nutrition: mothers will be encouraged to exclusively breastfeed their children through to 6 months of age. When newborns reach 6 months of age, mothers will be encouraged to continue breastfeeding their children until 24 months, and will receive education about supplementing breastfeeding with healthy complementary foods following infant and young child feeding best practice guidelines from Unicef and WHO. From ages six to 24 months, study children will receive a daily lipid-based nutritional supplement (LNS) that has been developed and tested through the iLiNS project.
Outcomes	1. Length-for-age Z-scores (time frame: measured 24 months after intervention) (designated as safety issue: no). Child's recumbent length, standardized to Z-scores using the WHO 2006 growth standards. 2. Diarrhoea prevalence (time frame: measured 12 and 24 months after intervention)
Starting date	September 2012
Contact information	Innovations for Poverty Action, Kenya
Notes	

DATA AND ANALYSES

Comparison 1. Water quality intervention versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: all ages	64	81215	Risk Ratio (Random, 95% CI)	0.59 [0.51, 0.69]
1.1 Source water improvement	6	9161	Risk Ratio (Random, 95% CI)	0.76 [0.48, 1.19]
1.2 POU treatment	58	72054	Risk Ratio (Random, 95% CI)	0.58 [0.48, 0.69]
2 Diarrhoea: children < 5 years	49		Risk Ratio (Random, 95% CI)	0.61 [0.49, 0.75]
2.1 Source water improvement	4		Risk Ratio (Random, 95% CI)	0.96 [0.82, 1.12]
2.2 POU treatment	45		Risk Ratio (Random, 95% CI)	0.58 [0.46, 0.73]

Comparison 2. Source: water supply improvement versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: CBA studies subgrouped by age	6		Risk Ratio (Random, 95% CI)	Subtotals only
1.1 Cluster-RCTs	1	3266	Risk Ratio (Random, 95% CI)	1.24 [0.98, 1.57]
1.2 CBA studies	5	5895	Risk Ratio (Random, 95% CI)	0.68 [0.42, 1.09]
2 Diarrhoea: CBA studies subgrouped by age	5		Risk Ratio (Random, 95% CI)	Subtotals only
2.1 All ages	5	5895	Risk Ratio (Random, 95% CI)	0.68 [0.42, 1.09]
2.2 < 5 years	3	999	Risk Ratio (Random, 95% CI)	0.92 [0.79, 1.07]

Comparison 3. POU: water chlorination versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: subgrouped by study design	19	34694	Risk Ratio (Random, 95% CI)	0.72 [0.61, 0.84]
1.1 Cluster-RCTs	16	30746	Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
1.2 CBA studies	3	3948	Risk Ratio (Random, 95% CI)	0.51 [0.34, 0.75]
2 Diarrhoea: cluster-RCTs: subgrouped by age	16		Risk Ratio (Random, 95% CI)	Subtotals only
2.1 All ages	16		Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
2.2 < 5 years	15		Risk Ratio (Random, 95% CI)	0.77 [0.64, 0.92]
3 Diarrhoea: cluster-RCTs; subgrouped by adherence	16	30746	Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
3.1 Residual chlorine in 86 to 100% of samples	1	276	Risk Ratio (Random, 95% CI)	0.78 [0.73, 0.83]

3.2 Residual chlorine in 51 to 85% of samples	6	9994	Risk Ratio (Random, 95% CI)	0.60 [0.40, 0.91]
3.3 Residual chlorine in ≤ 50% of samples	4	12613	Risk Ratio (Random, 95% CI)	0.90 [0.76, 1.06]
3.4 Residual chlorine not reported	5	7863	Risk Ratio (Random, 95% CI)	0.85 [0.65, 1.12]
4 Diarrhoea: cluster-RCTs by risk of bias by blinding of participants	16		Risk Ratio (Random, 95% CI)	Subtotals only
4.1 Low risk	5	15867	Risk Ratio (Random, 95% CI)	1.07 [0.97, 1.17]
4.2 High risk	11	14879	Risk Ratio (Random, 95% CI)	0.68 [0.56, 0.83]
5 Diarrhoea: cluster-RCTs; subgrouped by additional water storage intervention	16		Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
5.1 Chlorination kit alone	8		Risk Ratio (Random, 95% CI)	0.75 [0.54, 1.05]
5.2 Chlorination kit plus water storage	8		Risk Ratio (Random, 95% CI)	0.80 [0.66, 0.97]
6 Diarrhoea: cluster-RCTs: subgrouped by sufficiency of water quantity	16	30746	Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
6.1 Sufficient	3	5352	Risk Ratio (Random, 95% CI)	0.90 [0.69, 1.17]
6.2 Insufficient	2	3499	Risk Ratio (Random, 95% CI)	0.91 [0.66, 1.26]
6.3 Unclear	11	21895	Risk Ratio (Random, 95% CI)	0.67 [0.50, 0.88]
7 Diarrhoea: cluster-RCTs: subgrouped by water source	16		Risk Ratio (Random, 95% CI)	Subtotals only
7.1 Improved water source	3	5880	Risk Ratio (Random, 95% CI)	0.82 [0.59, 1.14]
7.2 Unimproved water source	13	24866	Risk Ratio (Random, 95% CI)	0.75 [0.59, 0.93]
8 Diarrhoea: cluster-RCTs: subgrouped by sanitation level	16		Risk Ratio (Random, 95% CI)	Subtotals only
8.1 Improved sanitation	3	4876	Risk Ratio (Random, 95% CI)	0.64 [0.44, 0.92]
8.2 Unimproved sanitation	6	17352	Risk Ratio (Random, 95% CI)	0.81 [0.63, 1.05]
8.3 Unclear	7	8518	Risk Ratio (Random, 95% CI)	0.75 [0.54, 1.05]
9 Diarrhoea: cluster-RCTs; subgrouped by length of follow-up	16		Risk Ratio (Random, 95% CI)	0.77 [0.65, 0.91]
9.1 ≤ 3 months	2		Risk Ratio (Random, 95% CI)	0.42 [0.06, 3.03]
9.2 > 3 to 6 months	7		Risk Ratio (Random, 95% CI)	0.71 [0.51, 0.99]
9.3 > 6 to 12 months	5		Risk Ratio (Random, 95% CI)	0.82 [0.71, 0.96]
9.4 > 12 months	2		Risk Ratio (Random, 95% CI)	0.99 [0.66, 1.48]

Comparison 4. POU: flocculation and disinfection versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: cluster-RCTs	7		Risk Ratio (Random, 95% CI)	0.48 [0.20, 1.16]
2 Diarrhoea: cluster-RCTs: subgrouped by age; excluding Doocy 2006 LBR	6		Risk Ratio (Random, 95% CI)	Subtotals only

2.1 All ages	6	11788	Risk Ratio (Random, 95% CI)	0.69 [0.58, 0.82]
2.2 < 5	6	0	Risk Ratio (Random, 95% CI)	0.71 [0.61, 0.84]
3 Diarrhoea: cluster-RCTs: subgrouped by adherence	7		Risk Ratio (Random, 95% CI)	Subtotals only
3.2 Residual chlorine 51 to 85%	1	2191	Risk Ratio (Random, 95% CI)	0.12 [0.11, 0.13]
3.3 Residual chlorine < 50%	4	6914	Risk Ratio (Random, 95% CI)	0.76 [0.67, 0.85]
3.4 Residual chlorine not measured	2	4874	Risk Ratio (Random, 95% CI)	0.41 [0.26, 0.64]
4 Diarrhoea: cluster-RCTs: subgrouped by additional storage container	7		Risk Ratio (Random, 95% CI)	0.48 [0.20, 1.16]
4.1 No storage container	2		Risk Ratio (Random, 95% CI)	0.81 [0.69, 0.95]
4.2 Storage container	5		Risk Ratio (Random, 95% CI)	0.39 [0.14, 1.08]
5 Diarrhoea: cluster-RCTs: subgrouped by sufficiency of water quantity	7		Risk Ratio (Random, 95% CI)	Subtotals only
5.1 Sufficient	1	3401	Risk Ratio (Random, 95% CI)	0.62 [0.47, 0.82]
5.2 Insufficient	2	5454	Risk Ratio (Random, 95% CI)	0.31 [0.05, 2.09]
5.3 Unclear	4	5124	Risk Ratio (Random, 95% CI)	0.64 [0.49, 0.85]
6 Diarrhoea: cluster-RCTs: subgrouped by water source	7		Risk Ratio (Random, 95% CI)	Subtotals only
6.1 Improved water source	2	4874	Risk Ratio (Random, 95% CI)	0.41 [0.26, 0.64]
6.2 Unimproved water source	4	5704	Risk Ratio (Random, 95% CI)	0.49 [0.14, 1.68]
6.3 Unclear	1	3401	Risk Ratio (Random, 95% CI)	0.62 [0.47, 0.82]
7 Diarrhoea: cluster-RCTs: subgrouped by sanitation level	7		Risk Ratio (Random, 95% CI)	Subtotals only
7.1 Improved sanitation	2	4874	Risk Ratio (Random, 95% CI)	0.41 [0.26, 0.64]
7.2 Unimproved sanitation	2	5592	Risk Ratio (Random, 95% CI)	0.27 [0.05, 1.36]
7.3 Unclear	3	3513	Risk Ratio (Random, 95% CI)	0.79 [0.69, 0.90]
8 Diarrhoea: cluster-RCTs: subgrouped by length of follow-up	7	13979	Risk Ratio (Random, 95% CI)	0.48 [0.20, 1.16]
8.1 ≤ 3 months	2	5592	Risk Ratio (Random, 95% CI)	0.27 [0.05, 1.36]
8.2 > 3 to 6 months	1	3263	Risk Ratio (Random, 95% CI)	0.83 [0.67, 1.03]
8.3 > 6 to 12 months	4	5124	Risk Ratio (Random, 95% CI)	0.64 [0.49, 0.85]

Comparison 5. POU: filtration versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: cluster-RCTs: subgrouped by age	23		Risk Ratio (Random, 95% CI)	Subtotals only
1.1 All ages	23		Risk Ratio (Random, 95% CI)	0.48 [0.38, 0.59]
1.2 < 5 years	19		Risk Ratio (Random, 95% CI)	0.49 [0.38, 0.62]
2 Diarrhoea: cluster-RCTs: subgrouped by type of filtration	23		Risk Ratio (Random, 95% CI)	Subtotals only
2.1 Ceramic filter	12	5763	Risk Ratio (Random, 95% CI)	0.39 [0.29, 0.53]

2.2 Sand filtration	5	5504	Risk Ratio (Random, 95% CI)	0.47 [0.39, 0.57]
2.3 LifeStraw®	3	3259	Risk Ratio (Random, 95% CI)	0.69 [0.51, 0.93]
2.4 Plumbed	3	1056	Risk Ratio (Random, 95% CI)	0.73 [0.52, 1.03]
3 Diarrhoea: cluster-RCTs: subgrouped by blinding of participants	23		Risk Ratio (Random, 95% CI)	Subtotals only
3.1 Low risk	5		Risk Ratio (Random, 95% CI)	0.80 [0.68, 0.94]
3.2 High risk	18		Risk Ratio (Random, 95% CI)	0.41 [0.33, 0.52]
4 Diarrhoea: ceramic filter studies subgrouped by water source	12	5763	Risk Ratio (Random, 95% CI)	0.39 [0.29, 0.53]
4.1 Improved water source	8	3607	Risk Ratio (Random, 95% CI)	0.33 [0.23, 0.46]
4.2 Unimproved water source	4	2156	Risk Ratio (Random, 95% CI)	0.54 [0.48, 0.61]
5 Diarrhoea: ceramic filter studies subgrouped by sanitation level	12	5763	Risk Ratio (Random, 95% CI)	0.39 [0.29, 0.53]
5.1 Improved sanitation	7	4198	Risk Ratio (Random, 95% CI)	0.49 [0.38, 0.64]
5.2 Unimproved sanitation	4	1491	Risk Ratio (Random, 95% CI)	0.35 [0.22, 0.56]
5.3 Unclear	1	74	Risk Ratio (Random, 95% CI)	0.21 [0.18, 0.25]
6 Diarrhoea: sand filter studies: subgrouped by water source	5		Risk Ratio (Random, 95% CI)	0.47 [0.39, 0.57]
6.1 Improved water source	2		Risk Ratio (Random, 95% CI)	0.50 [0.33, 0.75]
6.2 Unimproved water source	2		Risk Ratio (Random, 95% CI)	0.44 [0.25, 0.76]
6.3 Unclear	1		Risk Ratio (Random, 95% CI)	0.47 [0.37, 0.60]
7 Diarrhoea: sand filter studies: subgrouped by sanitation level	5		Risk Ratio (Random, 95% CI)	0.47 [0.39, 0.57]
7.1 Improved sanitation	1		Risk Ratio (Random, 95% CI)	0.47 [0.37, 0.60]
7.2 Unimproved sanitation	3		Risk Ratio (Random, 95% CI)	0.48 [0.34, 0.68]
7.3 Unclear	1		Risk Ratio (Random, 95% CI)	0.46 [0.22, 0.96]
8 Diarrhoea: cluster-RCTs: subgrouped by adherence	23		Risk Ratio (Random, 95% CI)	Subtotals only
8.1 86 to 100%	12	7300	Risk Ratio (Random, 95% CI)	0.43 [0.34, 0.55]
8.2 51 to 85%	4	2346	Risk Ratio (Random, 95% CI)	0.56 [0.33, 0.95]
8.3 ≤ 50%	1	1516	Risk Ratio (Random, 95% CI)	0.75 [0.60, 0.94]
8.4 Not reported	6	4420	Risk Ratio (Random, 95% CI)	0.46 [0.28, 0.75]
9 Diarrhoea: cluster-RCTs: subgrouped by additional water storage intervention	19		Risk Ratio (Random, 95% CI)	Subtotals only
9.1 Filtration alone	8		Risk Ratio (Random, 95% CI)	0.60 [0.48, 0.76]
9.2 Filtration plus storage	11		Risk Ratio (Random, 95% CI)	0.38 [0.29, 0.49]
10 Diarrhoea: cluster-RCTs; subgrouped by length of follow-up	23		Risk Ratio (Random, 95% CI)	0.48 [0.38, 0.59]
10.1 ≤ 3 months	3		Risk Ratio (Random, 95% CI)	0.26 [0.20, 0.33]
10.2 > 3 to 6 months	11		Risk Ratio (Random, 95% CI)	0.52 [0.44, 0.60]
10.3 > 6 to 12 months	8		Risk Ratio (Random, 95% CI)	0.51 [0.30, 0.87]
10.4 > 12 months	1		Risk Ratio (Random, 95% CI)	0.87 [0.74, 1.02]

Comparison 6. POU: solar disinfection versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: subgrouped by study design	6		Risk Ratio (Random, 95% CI)	Subtotals only
1.1 Cluster-RCTs	4	3460	Risk Ratio (Random, 95% CI)	0.62 [0.42, 0.94]
1.2 Quasi-RCTs	2	555	Risk Ratio (Random, 95% CI)	0.82 [0.69, 0.97]
2 Diarrhoea: cluster-RCTs; subgrouped by age	4		Risk Ratio (Random, 95% CI)	Subtotals only
2.1 All ages	4		Risk Ratio (Random, 95% CI)	0.62 [0.42, 0.94]
2.2 < 5	3		Risk Ratio (Random, 95% CI)	0.55 [0.34, 0.91]
3 Diarrhoea: cluster-RCTs; subgrouped by adherence	4		Risk Ratio (Random, 95% CI)	Subtotals only
3.1 86 to 100%	1	928	Risk Ratio (Random, 95% CI)	0.37 [0.29, 0.47]
3.2 51 to 85%	0	0	Risk Ratio (Random, 95% CI)	0.0 [0.0, 0.0]
3.3 ≤ 50%	2	1443	Risk Ratio (Random, 95% CI)	0.80 [0.57, 1.11]
3.4 Not reported	1	1089	Risk Ratio (Random, 95% CI)	0.73 [0.63, 0.85]
4 Diarrhoea: cluster-RCTs; subgrouped by sufficiency of water supply level	4	3460	Risk Ratio (Random, 95% CI)	0.62 [0.42, 0.94]
4.1 Sufficient	2	1443	Risk Ratio (Random, 95% CI)	0.80 [0.57, 1.11]
4.3 Unclear	2	2017	Risk Ratio (Random, 95% CI)	0.52 [0.27, 1.02]
5 Diarrhoea: cluster-RCTs; subgrouped by water source	4		Risk Ratio (Random, 95% CI)	Subtotals only
5.1 Improved water source	1	718	Risk Ratio (Random, 95% CI)	0.64 [0.39, 1.05]
5.2 Unimproved water source	3	2742	Risk Ratio (Random, 95% CI)	0.62 [0.38, 1.02]
6 Diarrhoea: cluster-RCTs; subgrouped by sanitation level	4		Risk Ratio (Random, 95% CI)	Subtotals only
6.1 Improved sanitation	0	0	Risk Ratio (Random, 95% CI)	0.0 [0.0, 0.0]
6.2 Unimproved sanitation	2	1653	Risk Ratio (Random, 95% CI)	0.57 [0.24, 1.39]
6.3 Unclear	2	1807	Risk Ratio (Random, 95% CI)	0.72 [0.63, 0.83]
7 Diarrhoea: cluster-RCTs; subgrouped by length of follow-up	4	3460	Risk Ratio (Random, 95% CI)	0.62 [0.42, 0.94]
7.2 > 6 to 12 months	3	2371	Risk Ratio (Random, 95% CI)	0.59 [0.32, 1.09]
7.3 > 12 months	1	1089	Risk Ratio (Random, 95% CI)	0.73 [0.63, 0.85]

Comparison 7. POU: UV disinfection versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: cluster-RCT	1		Risk Ratio (Random, 95% CI)	Subtotals only

Comparison 8. POU: improved storage versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Diarrhoea: cluster-RCTs: subgrouped by age	2		Risk Ratio (Random, 95% CI)	Subtotals only
1.1 All ages	2		Risk Ratio (Random, 95% CI)	0.91 [0.74, 1.11]
1.2 < 5	1		Risk Ratio (Random, 95% CI)	0.69 [0.47, 1.01]

ADDITIONAL TABLES

Table 1. Water quality indicators post-intervention

Trial	Water quality indicator	Water quality post-intervention: Intervention group	Water quality post intervention: Control group
Abebe 2014 ZAF	CFUs/100 mL	0	80% of control HHs had 10 to 10000
Austin 1993a GMB	Geometric mean CFUs/100 mL	178	3020
Austin 1993b GMB	Geometric mean CFUs/100 mL	42	3020
Boisson 2009 ETH	Arithmetic mean TTC/100 mL (95% CI)	0	725.7 (621.0 to 830.4)
Boisson 2010 DRC	Geometric mean TTC/100 mL (95% CI)	1.3 (0.9 to 1.7)	173.7 (136.6 to 220.9)
Boisson 2013 IND	Geometric mean TTC/100 mL (95% CI)	50 (44 to 57)	122 (107 to 139)
Brown 2008a KHM	Geometric mean *E. coli* /100 mL	17	600
Brown 2008b KHM	Geometric mean *E. coli* /100 mL	15	600
Clasen 2004b BOL	Mean TTC/100 mL	0.13	108
Clasen 2004c BOL	Arithmetic mean TTC/100 mL	100% of intervention households: 0	16% of control households: 0 66% > 10, 34% > 100, and 11% > 1000
Clasen 2005 COL	Arithmetic mean TTC/100 mL (95% CI)	37.3 (6.3 to 48.3)	150.6 (34.8 to 166.4)

Table 1. Water quality indicators post-intervention *(Continued)*

Colford 2002 USA; Colford 2005 USA; Colford 2009 USA	All water met FDA requirements	Not measured because of high water quality	Not measured because of high water quality
Crump 2005a KEN	Samples met WHO guidelines for water quality	82%	14%
Crump 2005b KEN	Samples met WHO guidelines for water quality	78%	14%
du Preez 2008 ZAF/ZWE	Samples met WHO guidelines for water quality	57%	30%
du Preez 2010 ZAF	*E. coli* in concentrations/100 mL	62%	"No significant difference between intervention and control groups"
du Preez 2011 KEN	*E. coli* ln concentrations/100 mL	Storage containers: 0.723 SODIS bottles: -0.727	Not reported
Fabiszewski 2012 HND	Geometric mean *E. coli* counts per 100 mL (95% CI)	23.4 (20.2 to 27.0)	45.4 (38.6 to 53.4)
Gasana 2002 RWA	Total coliforms/100 mL	Range: 3 to 43	Range: 4 to 1100
Gruber 2013 MEX	Samples with detectable*E. coli*	43%	59%
Günther 2013 BEN	*E. coli* contamination > 1000 CFU/100 mL	Not reported specifically; findings imply a 70% reduction in *E. coli* incidence for intervention households	
Handzel 1998 BGD	Stored water samples with *E. coli* 100 MPN/100 mL	3%	16%
Jain 2010 GHA	Samples with *E. coli*	8%	54%
Jensen 2003 PAK	Geometric mean *E. coli* /100 mL	3	49
Kirchhoff 1985 BRA	Mean number of faecal coliforms/dL in the samples	70	16000
Kremer 2011 KEN	Average reduction in log *E. coli*	-1.07, corresponding to a 66% reduction	
Lule 2005 UGA	Median *E. coli* CFU/100 mL	23	59
McGuigan 2011 KHM	Geometric mean CFU/100 mL	6.8	48

Table 1. Water quality indicators post-intervention *(Continued)*

Mengistie 2013 ETH	Mean *E. coli*	0	60
Peletz 2012 ZMB	Geometric mean TTC/100 mL	Stored water: 3	Stored water: 181
Quick 1999 BOL	Median *E. coli* /100 mL	0	6400
Quick 2002 ZMB	Median *E. coli* /100 mL	0	3
Reller 2003a GTM	Samples with < 1 *E. coli* /100 mL (flocculant/disinfectant)	40%	7%
Reller 2003b GTM	Samples with < 1 *E. coli* /100 mL (flocculant/disinfectant+ vessel)	57%	7%
Reller 2003c GTM	Samples with < 1 *E. coli* /100 mL (bleach)	51%	7%
Reller 2003d GTM	Samples with < 1 *E. coli* /100 mL (bleach + vessel)	61%	7%
Semenza 1998 UZB	Faecal colonies/100 mL	47	52
Stauber 2009 DOM	*E. coli* MPN/100 mL	11	19
Stauber 2012a KHM	*E. coli* CFU/100 mL	2.9	19.7
Stauber 2012b GHA	Geometric mean *E. coli* MPN/ 100 mL (95% CI)	Direct filtrate 16 (13 to 20) Stored filtrate: 76 (62 to 91)	490 (426 to 549)
Tiwari 2009 KEN	Geometric mean faecal coliforms/100 mL (95% CI)	30.0 (21.3 to 42.1)	88.9 (58.7 to 135)
URL 1995a GTM	Samples with fecal coliforms	91% had 0 fecal coliforms	Not reported
URL 1995b GTM	Samples with fecal coliforms	91% had 0 fecal coliforms	Not reported

Abbreviations: *E. coli*: *Escherichia coli*; FC: faecal coliform.

Table 2. **Studies reporting deaths**

Study ID	Intervention		Control		P value	Comment
	Deaths	Participants	Deaths	Participants		
Boisson 2010 DRC	12	546	8	598	0.27	-
Colford 2009 USA	7	385	6	385	> 0.05	-
Crump 2005a KEN	17	2249	28	2277	0.108	-
Crump 2005b KEN	14	2124	28	2277	0.052	-
du Preez 2011 KEN	3	555	3	534	> 0.05	-
Peletz 2012 ZMB	3	300	6	299	0.28	-
Boisson 2013 IND	?	6119	?	5965	-	Only reports total deaths (46)
du Preez 2010 ZAF	?	383	?	335	-	Only reports total deaths (7)
Kremer 2011 KEN	?	-	?	-	-	Reports recording deaths but does not state how many
Boisson 2009 ETH	?	731	?	785	-	Reports recording deaths but does not state how many

Table 3. **Summary of findings: improved water source**

Improved water source compared with no intervention for preventing diarrhoea in rural settings in low- and middle-income countries				
Patient or population: adults and children **Settings:** low- and middle-income countries in rural areas **Intervention:** water source improvement **Comparison:** no intervention				
Outcomes	**Illustrative comparative risks* (95% CI)**	**Relative effect (95% CI)**	**Number of participants (studies)**	**Quality of the evidence (GRADE)**

Table 3. Summary of findings: improved water source (*Continued*)

	Assumed risk	Corresponding risk			
	No intervention	**Water source improvement**			
Diarrhoea episodes Cluster-RCTs	**3 episodes per person per year**	**3.7 episodes per person per year** (2.9 to 4.7)	**RR 1.24** (0.98 to 1.57)	3266 (1 trial)	⊕○○○ **very low**[1,2,3]
Diarrhoea episodes CBA studies	-	-	-	5895 (5 studies)	⊕○○○ **very low**[1,4,5]

The basis for the **assumed risk** (for example, the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).
[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. None of these studies blinded participants and outcome assessors to the treatment allocation.
[2]No serious inconsistency.
[3]Downgraded by 2 for serious indirectness: this single RCT from Afghanistan evaluated the provision of protected wells. It is not possible to make broad generalizations to other settings.
[4]Downgraded by 1 for serious inconsistency: statistical heterogeneity was very high (I^2 statistic = 98%), such that the data could not be pooled. Some large and statistically significant effects were seen in some individual trials, but not others.
[5]Downgraded by 1 for serious indirectness: these studies are from a variety of low- and middle-income countries (Bangladesh, Rwanda, Pakistan, South Africa, China). However, as only single trials evaluated each intervention it is not possible to make broad generalizations.

Table 4. Improved water source: description of the interventions

Study ID	Study design	Setting	Incidence of diarrhoea in the control group	Intervention areas		Control areas	
				Water source intervention	Health promotion activ-	Water source	Health promotion activ-

Table 4. Improved water source: description of the interventions *(Continued)*

					ities		ities
Opryszko 2010b AFG	Cluster-RCT	Rural villages	3.1 episodes per person per year	One well per 25 households providing 25 litres/ person/day	None	35% used unprotected hand dug wells	None
Alam 1989 BGD	CBA	Rural villages	4.1 episodes per child per year	Provision of one hand pump per 4-6 households (3 times as many as control areas)	Female health visitors visited peoples homes and organised group discussion and demonstrations to promote hygienic practices for hand pump use, water storage, child faeces disposal, hand washing	Shallow, hand-dug wells; some hand pumps	None described
Gasana 2002 RWA	CBA	Rural villages	3 episodes per child per year	Site A: Sedimentation tank/ Katadyn filter with communal tap Site B: Gravel-sand-charcoal filter on existing water spring Site C: Protective fence around an existing water spring	None described	An existing water spring	None described
Jensen 2003 PAK	CBA	Rural villages	2.8 episodes per person per year	Chlorination of public water supply	None described	Unchlorinated poorly functioning sand filter system	None described

Table 4. Improved water source: description of the interventions *(Continued)*

Majuru 2011 ZAF	CBA	Rural villages	0.6 episodes per person per year	Provision of intermittently operated small community water systems distributing potable water to multiple taps throughout the community	None described	Untreated water from a river and its tributaries	None described
Xiao 1997 CHN	CBA	Rural villages	Not reported	Improved water supply through structural improvements to wells	Hygiene education	Not reported	None described

Table 5. Improved water source: primary drinking water supply and sanitation facilities

Trial	**Description**	**Source**[1]	**Access to source** [2]	**Quantity available**[3]	**Ambient water quality**	**Sanitation**[4]
Alam 1989 BGD	Shallow, hand-dug wells; some hand pumps	Unimproved	Unclear	Unclear	Not tested	Unclear
Gasana 2002 RWA	Spring	Unimproved	Unclear	Unclear	Baseline range 4 to 1100 total coliforms/100 mL	Unimproved
Jensen 2003 PAK	Some slow sand filters in poor condition; some household taps; majority used ground water	Improved	Unclear	Unclear	Baseline geometric mean in intervention village: 13.3 *E. coli* CFU/100 mL; control villages: 137/100 mL	Unclear
Majuru 2011 ZAF	Surface water, boreholes, water tankers	Improved and unimproved	Unclear	Unclear	Not tested	Unclear
Opryszko 2010	35% use unprotected dug wells	Unimproved	Sufficient	Sufficient	Not tested	Unclear

Table 5. Improved water source: primary drinking water supply and sanitation facilities *(Continued)*

Xiao 1997 CHN	Well water	Unimproved	Unclear	Unclear	Not tested	Unclear

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 6. POU chlorination: description of the intervention

Trial	Study design	Chlorination product?	Distributed free?	Frequency of distribution?	Storage container also distributed?	Compliance	Additional hygiene promotion
Austin 1993a GMB	Cluster-RCT	Sodium hypochlorite solution	Yes	Fortnightly	No	40% compliance measured by residual chlorine	None
Austin 1993b GMB	Cluster-RCT	Sodium hypochlorite solution	Yes	Fortnightly	No	59% compliance measured by residual chlorine	None
Boisson 2013 IND	Cluster-RCT	Sodim dichloro-isocyanurate tablets	Yes	Bimonthly	No	32% compliance measured by residual chlorine	None
Crump 2005a KEN	Cluster-RCT	1% sodium hypochlorite	Yes	Weekly	No	61% compliance during unannounced weekly visits measured by residual chlorine	Use of ORS, treatment seeking for diarrhoea
Handzel 1998 BGD	Cluster-RCT	0.25% to 0.3% chlorine solution	Yes	Weekly	Yes	90% compliance based on residual chlorine measure-	Hygiene and sanitation messages

Table 6. POU chlorination: description of the intervention *(Continued)*

						ments	
Jain 2010 GHA	Cluster-RCT	Sodim dichloro-isocyanurate tablets	Yes	Twice weekly	Yes	74% to 89% compliance measured by chlorine residual	ORS provided to those with diarrhoea
Kirchhoff 1985 BRA	Cluster-RCT	10% sodium hypochlorite	Yes	Daily	No	Not reported	Chlorination preformed by study staff
Luby 2006a PAK	Cluster-RCT	Sodium hypochlorite solution	Yes	Unclear	Yes	Yes, though rate unclear	Encouraged to only drink treated water
Lule 2005 UGA	Cluster-RCT	0.5% sodium hypochlorite	Yes	Weekly	Yes	Not reported	hygiene education
Mahfouz 1995 KSA	Cluster-RCT	Packets of 50 g calcium hypochloride 70%.	Yes	Unclear	No	Some residual chlorine in all intervention samples	None
Mengistie 2013 ETH	Cluster-RCT	1. 25% sodium hypochlorite solution	Yes	Weekly	No	80% compliance measured by chlorine residual	None
Opryszko 2010c AFG	Cluster-RCT	0. 05% sodium hypochlorite solution	Yes	Monthly	Yes	78% compliance measured by previous 2 weeks self-report use of chlorine	None
Quick 1999 BOL	Cluster-RCT	MIOX unit electrolytically produced disinfectant with 3% brine solution, hypochlorite, chlorine dioxide, ozone, peroxide and other oxidants	Yes	Weekly	Yes	63% compliance measured by water in vessel with chlorine residual, average across six rounds	Community health volunteers reinforced messages about proper use of the disinfectant and vessels and of different applications for treated water

Table 6. POU chlorination: description of the intervention *(Continued)*

Reller 2003b GTM	Cluster-RCT	Sodium hypochlorite solution (50, 000 ppm)	Yes	Monthly	No	36% compliance measure by residual chlorine > 0.1 mg/L on unannounced visits	Motivational and educational messages about chlorination, use of ORS, care seeking for diarrhoea
Reller 2003c GTM	Cluster-RCT	Sodium hypochlorite solution (50, 000 ppm)	Yes	Monthly	Yes	44% compliance measure by residual chlorine > 0.1 mg/L on unannounced visits	Motivational and educational messages about chlorination, use of ORS, care seeking for diarrhoea
Semenza 1998 UZB	Cluster-RCT	1.5% chlorine solution	Yes	Unclear but households were visited twice weekly	Yes	73% based on residual chlorine levels at time of visit	Only drink chlorinated water and wash all fruit and vegetables with chlorinated water
Luby 2004a PAK	CBA	Bleach (sodium hypochlorite)	Yes	Study workers visited weekly and resupplied the households with dilute bleach	Yes	Not reported	Encouraged regular treatment of drinking water
Luby 2004b PAK	CBA	Bleach (sodium hypochlorite)	Yes	Study workers visited weekly and resupplied the households with dilute bleach	Yes	Not reported	Encouraged regular treatment of drinking water
Quick 2002 ZMB	CBA	0.5% sodium hypochlorite	Yes	Unclear but households were visited once every	HHs paid for vessel	72% compliance measured by water in vessel with	Community volunteers, gave education about

Table 6. POU chlorination: description of the intervention (*Continued*)

				two weeks		chlorine residual	causes and prevention of diarrhoea and safe storage of water and motivated households about the intervention

Table 7. POU chlorination: primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source[2]	Quantity available[3]	Ambient water quality	Sanitation[4]
Austin 1993	Open wells	Unimproved	Sufficient	Unclear	Mean 1871 FC/100 mL in wells; among stored water samples: mean 3358 FC/100 mL in rainy season, 1014 FC/100 mL in dry season	Unclear
Boisson 2013 IND	62% unprotected dug well, 17% tubewell, 14% tap, 5% surface water	Unimproved	Unlcear	Unclear	Baseline not reported. Control households: Geometric mean 122 TTC/100 mL	Unimproved
Crump 2005	50% ponds, 49% rivers	Unimproved	Unclear	Insufficient	Baseline mean 98 *E. coli* / 100 mL	Unclear; 33% defecate on ground
Handzel 1998 BGD	48% tap, 52% tubewell; 61% paid for drinking water	Improved	Sufficient	Sufficient	Baseline geometric mean 138.1 faecal coloform counts/100 mL	Unimproved
Jain 2010 GHA	95% of households use tap, 84% surface water, 46% wells, 35% rainwater, 25% borehole	Improved and unimproved	Unclear	Unclear	Baseline: median *E. coli* MPN 93/100 mL	Unimproved

Table 7. POU chlorination: primary drinking water supply and sanitation facilities *(Continued)*

Kirchhoff 1985 BRA	Pond water stored in clay pots after filtering with cloth	Unimproved	Unclear	Insufficient	Source water: mean 970 faecal coliforms/ 100 mL	Unimproved
Luby 2004	Tanker trucks, municipal taps (household and community level)	Mostly unimproved	Unclear	Unclear	Baseline: approximately 60% of stored drinking water samples were free of *E. coli*	Improved
Luby 2006	Tanker trucks, municipal taps (household and community level), water bearer, boreholes	Mostly improved	Unclear	Unclear	Not tested	Improved
Lule 2005 UGA	16% surface or shallow wells, 50% protected springs, 49% boreholes or taps	Unimproved	Sufficient	Sufficient	Source mean *E. coli* counts: 11/ 100 mL	Improved
Mahfouz 1995 KSA	Shallow wells	Unimproved	Unclear	Unclear	Source: 92% positive with *E. coli*; precise level not reported	Improved
Mengistie 2013 ETH	50% well, 41% spring, 9% river	Unimproved	Unclear	Unclear	Baseline: *E. coli* MPN 70/ 100 mL	Unimproved
Opryszko 2010	35% use unprotected dug wells	Unimproved	Sufficient	Sufficient	Not tested	Unclear
Quick 1999 BOL	Shallow uncovered wells; 38% treated water	Unimproved	Unclear	Unclear	Source water: median colony count *E. coli*: 57, 050/100 mL	Unimproved, but 47% used latrine
Quick 2002 ZMB	Shallow wells; some boiling	Unimproved	Unclear	Unclear	Source water: median colony count *E. coli*: 34/ 100 mL	Unclear

Table 7. POU chlorination: primary drinking water supply and sanitation facilities *(Continued)*

Reller 2003	Surface water from shallow wells, rivers and springs	Unimproved	Unclear	Unclear	Baseline drinking water: median colony count *E. coli* 63/ 100 mL	Unclear
Semenza 1998 UZB	Households without piped water (procured from street tap, neighbour tap, well, vendor, or river)	Unimproved	Unclear	Unclear	Source water: 54 coliform colonies/100 mL	Unclear

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 8. Summary of findings: POU chlorination

POU chlorination compared with no intervention for preventing diarrhoea

Patient or population: adults and children
Settings: low- and middle-income countries
Intervention: distribution of chlorine for POU water treatment and instruction on use
Comparison: no intervention

Outcomes	**Illustrative comparative risks* (95% CI)**		**Relative effect (95% CI)**	**Number of participants (studies)**	**Quality of the evidence (GRADE)**
	Assumed risk	**Corresponding risk**			
	No intervention	**POU Chlorination**			
Diarrhoea episodes cluster-RCTs	**3 episodes per person per year**	**2.3 episodes per year** (2.0 to 2.7)	**RR 0.77** (0.65 to 0.91)	30,746 (14 trials)	⊕⊕○○ **low**[1,2,3,4]

Table 8. Summary of findings: POU chlorination *(Continued)*

Diarrhoea episodes CBA studies	**3 episodes per person per year**	**1.5 episodes per year** (1.0 to 2.3)	**RR 0.51** (0.34 to 0.75)	3948 (2 studies)	⊕○○○ **very low**[5,6,7,8]

The basis for the **assumed risk** is provided in the footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).
[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. Only two of these studies blinded participants and outcome assessors to the treatment allocation, and these two studies found no evidence of an effect with chlorination.
[2]Downgraded by 1 for serious inconsistency: statistical heterogeneity was very high (I^2 statistic = 91%). In a subgroup analysis by compliance with the intervention (assessed by measurements of residual chlorine in drinking water) found larger effects in the studies with better compliance.
[3]No serious indirectness: these studies are mainly from low- and middle-income countries (the Gambia, India, Kenya, Bangladesh, Ghana, Brazil, Pakistan,Uganda, Saudi Arabia, Ethiopia, Afghanistan, Bolivia, Guatemala, and Uzbekistan). The interventions consisted of free distribution of chlorine (every one to four weeks) plus instructions on how to use it. In some cases, the intervention included hygiene education and storage containers in which to treat and store water.
[4]No serious imprecision: the average effect suggests POU chlorination may reduce diarrhoea episodes by about a quarter. The analysis is adequately powered to detect this effect.
[5]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. None of these studies blinded participants and outcome assessors to the treatment allocation.
[6]Downgraded by 1 for serious inconsistency: statistical heterogeneity was very high (I^2 statistic = 63%).
[7]Downgraded by 1 for serious indirectness: there are only two studies (three comparisons) from Pakistan and Zambia.
[8]No serious imprecision.

Table 9. POU flocculation/disinfection: description of the interventions

Study ID	Study design	Setting	Intervention areas			Control areas	
			Water quality intervention	**Health promotion activities**	**Compliance**	**Water source**	**Health promotion activities**
Chiller 2006 GTM	Cluster-RCT	Rural villages	Provided households with a large spoon	None	44% compliance measured by residual chlo-	31% tap, 40% river or spring and 25% well.	None

Table 9. POU flocculation/disinfection: description of the interventions *(Continued)*

			and a wide-mouthed bucket for mixing, a narrow-topped vessel with a lid for storing treated water and provided households with sachets of the flocculant-disinfectant every week		rine at week 10 of study		
Crump 2005b KEN	Cluster-RCT	Rural villages	Each week households were given sachets of the flocculant-disinfectant	None	44% compliance during unannounced weekly visits measured by residual chlorine	50% pond, 49% river and 2% spring	None
Doocy 2006 LBR	Cluster-RCT	Liberian camps for displaced persons	Households received a bucket and large mixing spoon for preparation, a decanting cloth, a funnel and a storage container with a narrow opening and lid. Each household received a maximum of 21 flocculation-disinfectant packets per week	None	85% compliance based on residual chlorine sampling	Received a funnel and an identical storage container	None
Luby 2006b PAK	Cluster-RCT	Squatter settlements	Provided households with floccu-	Field workers educated neighbour-	Yes, though rate unclear	Municipal supply at household	None

Table 9. POU flocculation/disinfection: description of the interventions *(Continued)*

			lant-disinfectant sachets, a water vessel and soap. Weekly distributions of sachets	hoods about health problems resulting from hand and water contamination and instructed households on how and when to wash hands		(33%) , at community tap (37%) , tanker truck (12%), water bearer (13%) and tube well (5%)	
Luby 2006c PAK	Cluster-RCT	Squatter settlements	Flocculant-disinfectant and vessel. Weekly distributions of sachets	Field workers educated neighbourhoods about health problems resulting from hand and water contamination	Yes, though rate unclear	Municipal supply at household (33%) , at community tap (37%) , tanker truck (12%), water bearer (13%) and tube well (5%)	None
Reller 2003a GTM	Cluster-RCT	Rural villages	Weekly distribution of flocculant-disinfectant and gave 2 cloths initially, which could be exchanged	Field workers discussed the importance of water treatment and demonstrated the water preparation process	27% compliance measure by residual chlorine > 0.1 mg/L on unannounced visits	33% tap, 46% river or spring, 21% well.	None
Reller 2003d GTM	Cluster-RCT	Rural villages	Weekly distribution of flocculant-disinfectant and gave 2 cloths initially, which could be exchanged and received a large plastic spoon for stirring, a large-mouthed bucket for mixing, and a vessel with a	Field workers discussed the importance of water treatment and demonstrated the water preparation process	34% compliance measure by residual chlorine > 0.1 mg/L on unannounced visits	33% tap, 46% river or spring, 21% well.	None

Table 9. POU flocculation/disinfection: description of the interventions (*Continued*)

			secure lid and a spigot for storing treated water				

Table 10. POU flocculation/disinfection: primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source[2]	Quantity available[3]	Ambient H_2O quality	Sanitation[4]
Chiller 2006 GTM	Rivers, springs, taps, and wells	Unclear	Unclear	Sufficient	98% of source samples contained *E. coli*; precise level not reported	Mostly unimproved
Crump 2005b KEN	50% ponds, 49% rivers	Unimproved	Unclear	Insufficient	Baseline mean 98 *E. coli* / 100 mL	Unclear; 33% defecate on ground
Doocy 2006 LBR	Surface sources and some tap stands	Unimproved	Unclear	Insufficient	Source water: 88% samples tested positive for faecal contamination; precise level not reported	Unimproved
Luby 2006b PAK	Tanker trucks, municipal taps (household and community level), water bearer, boreholes	Mostly improved	Unclear	Unclear	Not tested	Improved
Reller 2003a GTM	Surface water from shallow wells, rivers and springs	Unimproved	Unclear	Unclear	Baseline drinking water: median colony count *E. coli* 63/ 100 mL	Unclear

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.
[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 11. Summary of findings: POU flocculation and disinfection

POU water flocculation and disinfection compared with no intervention for preventing diarrhoea

Patient or population: adults and children
Settings: low- and middle-income countries
Intervention: distribution of sachets combining water flocculation and disinfection and instructions on use
Comparison: no intervention

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Quality of the evidence (GRADE)
	Assumed risk	Corresponding risk			
	No intervention	Water flocculation and disinfection			
Diarrhoea episodes Cluster-RCTs	**3 episodes per person per year**	**2.1 episodes per person per year** (1.7 to 2.5)	**RR 0.69** (0.58 to 0.82)	11,788 (4 trials)	⊕⊕⊕◯ **moderate**[1,2,3,4]

The basis for the **assumed risk** is provided in the footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).
[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. None of these studies blinded participants and outcome assessors to the treatment allocation.
[2]No serious inconsistency: In the complete analysis of five trials statistical heterogeneity was very high (I^2 statistic = 99%). However, this heterogeneity was related to a single trial showing very large effects conducted in an emergency setting in Liberia possibly due to epidemic diarrhoea. When this trial was removed as an outlier, there was a smaller, but more consistent effect.
[3]No serious indirectness: the studies were conducted in rural areas in Guatemala (two studies), and Kenya (one study), one trial was from a camp for displaced persons in Liberia and one from squatter settlements in Pakistan. Sanitation was improved in only one of these studies.
[4]No serious imprecision: all five studies found benefits with flocculation. The 95% CI of the pooled effect includes the possibility of no effect, but this imprecision is a result of the heterogeneity between studies.

Table 12. POU filtration: description of interventions

Study ID	Intervention subgroup	Study design	Setting	Intervention areas			Control areas	
				Water quality intervention	Health promotion activities	Compliance	Water source	Health promotion activities
Abebe 2014 ZAF	Ceramic filter	Cluster-RCT	Rural	Ceramic water filter impregnated with silver nanoparticles with safe storage containers	Education about safe water and hygiene and information on how to use the filter and maintain it	Not reported	Personal tap in home (44%), community tap (44%) and river (3%)	Received usual clinical care including education about safe water and hygiene at the clinic
Brown 2008a KHM	Ceramic filter	Cluster-RCT	Rural	CWP (Cambodian Ceramic Water Purifier) including safe storage container	None	98% compliance measured by self-report	Surface water (55%) and ground water (48%) during the dry season and surface water (45%), ground water (48%) and rain water (73%) during the rainy season	None
Brown 2008b KHM	Ceramic filter	Cluster-RCT	Rural	CWP-Fe (iron-rich ceramic water purifier) including safe storage container	None	98% compliance measured by self-report	Surface water (55%) and ground water (48%) during the dry season and surface water (45%), ground water (48%) and rain water	None

Table 12. POU filtration: description of interventions *(Continued)*

							(73%) during the rainy season	
Clasen 2004b BOL	Ceramic filter	Cluster-RCT	Rural	Ceramic filters including improved storage	None	67% of households had filters in regular use	68% had taps and 11% boiled water.	None
Clasen 2004c BOL	Ceramic filter	Cluster-RCT	Rural	Ceramic filters including improved storage	None	100% of intervention households' water free of TTC	Water from canal (52%) , river (35%) or rainwater (4%)	None
Clasen 2005 COL	Ceramic filter	Cluster-RCT	Rural and urban affected by conflict	Ceramic water filter system including improved storage	None	Not reported	River (27.6%), rainwater (12.1%), yard tap (67.2%). 70.7% claimed to treat water	None
du Preez 2008 ZAF/ZWE	Ceramic filter	Cluster-RCT	Rural	Ceramic filters including improved storage	None	55% compliance measured by water quality (approximate compliance across intervention households in Zimbabwe and South Africa)	Protected water source (53.8%) and unprotected water source (46.2%)	None
Lindquist 2014a BOL	Ceramic filter	Cluster-RCT	Peri-urban	Received a PointONE Filter and a 30 L bucket (with lid)	Participants were instructed on diarrhoeal transmission (biological versus cultural beliefs-	97% compliance based on reported use	83% used water from tanker trucks and 12% from water coolers	Received weekly messages on life skills and attitudes. Also were instructed on diarrhoeal

Table 12. POU filtration: description of interventions *(Continued)*

					based), prevention and treatment			transmission, prevention and treatment
Lindquist 2014b BOL	Ceramic filter	Cluster-RCT	Peri-urban	Received a PointONE Filter and a 30-L bucket (with lid) and WASH education	Participants received weekly WASH messages on personal and family hygiene, sanitation, boiling and chlorine-based water treatments (excluding filtration), vitamin A, hygienic food preparation and cleaning, and parasite prevention.	90% compliance based on reported use	83% used water from tanker trucks and 12% from water coolers	Received weekly messages on life skills and attitudes. Also were instructed on diarrhoeal transmission, prevention and treatment
URL 1995a GTM	Ceramic filter	Cluster-RCT	Rural	Handmade ceramic water filter	None	87% to 93% use of filter by children	Majority of households collected water from household tap (not chlorinated)	None
URL 1995b GTM	Ceramic filter	Cluster-RCT	Rural	Handmade ceramic water filter	Education on nutrition (ORS, basic nutrition and maternal and child nutrition), health (hygiene) and family values	As above	Majority of households collected water from household tap (not chlorinated)	None

Table 12. POU filtration: description of interventions *(Continued)*

Fabiszewski 2012 HND	Sand filtration	Cluster-RCT	Rural	Hydraid plastic-housing BioSand filter (BSF) + 20 L water jug	Training for the use and maintenance of the BSF and general education about hygiene and sanitation	Not reported	Among all study participants- the main source of drinking water were: protected water sources (49% to 69% households per month), protected sources (24% to 50% per month) , piped water (1% to 11% per month), and rainwater (0% to 2% per month).	Training for the use and maintenance of the BSF and general education about hygiene and sanitation
Stauber 2009 DOM	Sand filtration	Cluster-RCT	Semi-rural and urban	Received a biosand filter and safe storage container	Nothing	Water quality testing, however no intervention household level compliance reported	42% reported treating drinking water.	None
Stauber 2012a KHM	Sand filtration	Cluster-RCT	Rural	Plastic biosand filter. HHs were asked to pay USD 10 for the filter	Health and hygiene education sessions	89% compliance measured by household-reported use at least 3 times per week	Improved water sources during the dry season (7.1%) and during the rainy season (88.9%) . 49.5% reported boiling drinking water	Health and hygiene education sessions

Table 12. POU filtration: description of interventions *(Continued)*

Stauber 2012b GHA	Sand filtration	Cluster-RCT	Rural	Plastic biosand filter	Not specified	97% compliance measured by household-reported use	Use surface water during dry season (95%) and use surface water during rainy season (70.6%). 96.5% reported sieving drinking water through cloth	nothing
Tiwari 2009 KEN	Sand filtration	Cluster-RCT	Rural	Provided with the concrete BioSand Filter	At each visit, three oral rehydration packets and instructions were provided	Not reported	All control houses reported drinking river or unprotected spring water; drink rainwater (96.6%), drink improved source (24.1%). 34.5% reported boiling drinking water	At each visit, three oral rehydration packets and instructions were provided
Boisson 2009 ETH	LifeStraw® Personal	Cluster-RCT	Rural	A LifeStraw® personal pipe-style water treatment device was given to each member of the household >6 months and encouraged to use it at home and	None	13% report use today	The primary drinking water source for 84% was from spring, 12% from rivers, 2.5% from hand dug wells and 4% from communal taps	None

Table 12. POU filtration: description of interventions *(Continued)*

				away from home				
Boisson 2010 DRC	LifeStraw® Family	Cluster-RCT	Rural	Households received a LifeStraw® Family filters	None	76% compliance measured by self-report use today or yesterday (at 14 month follow-up)	Received a placebo filter.	None
Peletz 2012 ZMB	LifeStraw® Family	Cluster-RCT	Peri-urban	Households received a LifeStraw® Family filter and two 5 L safe storage containers	None	87% compliance measured by improved water quality	46% use unprotected dug wells, 19% boreholes, 17% public standpipes, 12% protected dug well, 5% piped into home or yard and 2% surface water	None
Colford 2002 USA	Plumbed in filter	Cluster-RCT	Urban	Installation of water treatment devices to 1 tap in HH that include: a 1-micron absolute prefilter cartridge and a UV lamp	None	96% compliance measured by not dropping out of study (plumbed-in unit)	Sham device	None
Colford 2005 USA	Plumbed in filter	Cluster-RCT	Urban	Installation of filter (1-micron filter and a UV lamp) to main faucet of household	All participants received the current CDC safe drinking water guidelines for im-	90% compliance measured by not dropping out of study (filter attached to kitchen	Sham device	All participants received the current CDC safe drinking water guidelines for im-

Table 12. POU filtration: description of interventions (*Continued*)

					muno-compromised persons	sink)		muno-compromised persons
Colford 2009 USA	Plumbed in filter	Cluster-RCT	Urban	Installation of filter (1-micron filter and a UV lamp) to main faucet of household	None	83% compliance measured by not dropping out of study (filter attached to kitchen sink)	Sham device	None
Rodrigo 2011 AUS	Ceramic filter/plumbed in	Cluster-RCT	Urban	Bench-top silver impregnated ceramic water treatment units, which required participants to use fill it but then households that had rainwater piped into kitchen were offered an under sink unit	None	Not reported	Sham water treatment unit	None

Table 13. POU filtration: primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source [2]	Quantity available[3]	Ambient H_2O quality	Sanitation[4]
Abebe 2014 ZAF	In-home taps or community taps	Improved	Sufficient	Unclear	80% of households had contamination between 10 to 10000 CFUs/100 mL	Unclear
Brown 2008	62% households rely on surface water	Unimproved	Unlcear	Unclear	Baseline not reported. Control house-	Improved

	during dry season and 55% rely on surface water during rainy season				holds: Geometric mean 600 *E. coli* /100 mL	
Clasen 2004b BOL	80% yard taps supplied by untreated surface source, 20% directly from untreated surface sources	80% improved, 20% unimproved	Sufficient	Sufficient	Baseline arithmetic mean 86 TTC/100 mL	Unimproved
Clasen 2004c BOL	Irrigation canals and other surface sources	Unimproved	Sufficient	Sufficient	Baseline arithmetic mean 797 TTC/100 mL	Unimproved
Clasen 2005 COL	67% yard tap from municipality (not treated), 28% river, 12% rainwater	Unimproved	Unclear	Unclear	Baseline not reported. Control households: arithmetic mean 151 TTC/100 mL	Mostly improved
du Preez 2008 ZAF/ZWE	Protected wells	Improved	Sufficient	Unclear	Baseline not reported. Control households: 30% samples post-intervention met WHO guidelines for water quality	Improved
Lindquist 2014	Municipal supply	Improved	Sufficient	Unclear	Not tested	Unimproved
URL 1995	Household tap (27%), public tap (21%), well (23%)	Improved	Unclear	Unclear	Range 5 to 260; average 106 faecal coliforms/100 mL across three sites	Improved
Fabiszewski 2012 HND	49% to 69% households use unprotected sources, 24% to 50% use protected	Improved and unimproved	Unclear	Unclear	Geometric mean *E. coli* concentrations of both unprotected and protected	Unimproved

Table 13. POU filtration: primary drinking water supply and sanitation facilities (*Continued*)

	sources, 1% to 11% piped water, 0% to 2 % rainwater				sources were > 100 MPN/100 mL	
Stauber 2009 DOM	Unclear	Unclear	Unclear	Unclear	Baseline: geometric mean 21 MPN *E. coli* / 100 mL	Improved
Stauber 2012a KHM	77% used improved water source during dry season, 89% during rainy season	Improved	Unclear	Unclear	Baseline: geometric mean 27.5 CFU/100 mL	Unimproved
Stauber 2012b GHA	Surface water 70% in dry season, 95% in rainy season	Unimproved	Unclear	Unclear	Baseline: geometric mean 792 or 832 *E. coli* /100 mL for control and intervention households, respectively	Unimproved
Tiwari 2009 KEN	Primarily river water; 27% drink protected sources	Unimproved	Unclear	Unclear	Baseline not reported. Control households: 88.9 faecal coliforms/ 100 mL	Unclear
Boisson 2009 ETH	84% springs, 12% river, 2% handdug well, 4% communal tap	Unimproved	Unclear	Unclear	Baseline arithmetic mean 449 TTC/100 mL	Unimproved
Boisson 2010 DRC	97% surface water, 38% rainwater, 16% springs	Unimproved	Unclear	Unclear	Source drinking water: 75% of household samples > 1000 TTC/ 100 mL	Unimproved
Peletz 2012 ZMB	46% unprotected dug wells, 22% taps, 16% borehole or protected dug well,	Improved and unimproved	Unclear	Unclear	Unfiltered water: Geometric mean 190 TTC/100 mL	Unimproved

Table 13. **POU filtration: primary drinking water supply and sanitation facilities** *(Continued)*

	2% surface water					
Colford 2002 USA	Household taps supplied by municipal water treatment	Improved	Sufficient	Sufficient	Data from water treatment plant: met US federal and California drinking water standards	Improved
Colford 2005 USA	Household taps supplied by municipal water treatment	Improved	Sufficient	Sufficent	Data from water treatment plant: met US federal drinking water standards	Improved
Colford 2009 USA	Household taps supplied by municipal water treatment	Improved	Sufficient	Sufficient	Data from water treatment plant: met US federal drinking water standards	Improved
Rodrigo 2011 AUS	Untreated rainwater	Improved	Sufficient	Sufficient	Not tested	Improved

Abbreviations: TTC: thermotolerant coliforms, MPN: most probable number, CFU: colony-forming units

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 14. **Summary of findings: POU filtration**

POU filtration compared with no intervention for preventing diarrhoea

Patient or population: adults and children
Settings: low-, middle- and high-income countries
Intervention: distribution of water filters and instructions on use
Comparison: no intervention

Outcomes	Illustrative comparative risks* (95% CI)	Relative effect (95% CI)	Number of participants	Quality of the evidence

Table 14. **Summary of findings: POU filtration** *(Continued)*

				(studies)	(GRADE)
	Assumed risk	**Corresponding risk**			
	No intervention	**Water filtration**			
Diarrhoea episodes Cluster-RCTs	**3 episodes per person per year**	**All filters** **1.4 episodes per person per year** (1.1 to 1.8)	**RR 0.48** (0.38 to 0.59)	15,582 (18 trials)	⊕⊕⊕○ **moderate**[1,2,3,4]
	3 episodes per person per year	**Ceramic filters** **1.1 episodes per person per year** (0.8 to 1.5)	**RR 0.39** (0.29 to 0.53)	5763 (8 trials)	⊕⊕⊕○ **moderate**[2,4,5,6]
		Biosand filters **1.4 episodes per person per year** (1.2 to 1.7)	**RR 0.47** (0.39 to 0.57)	5504 (4 trials)	⊕⊕⊕○ **moderate**[4,7,8,9]
		LifeStraw®filters **2.1 episodes per person per year** (1.5 to 2.8)	**RR 0.69** (0.51 to 0.93)	3259 (3 trials)	⊕⊕○○ **low**[2,4,10,11]
		Plumbed filters **2.2 episodes per person per year** (1.6 to 3.1)	**RR 0.73** (0.52 to 1.03)	1056 (3 trials)	⊕⊕⊕○ **moderate**[2,4,12,13]

The basis for the **assumed risk** is provided in the footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **RR:** risk ratio.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).

[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants, this outcome is susceptible to bias from lack of blinding. Only five studies blinded participants and outcome assessors to the treatment allocation and only one found an effect of the intervention.
[2]No serious inconsistency: statistical heterogeneity was very high, however there is consistency in the direction of the effect.
[3]No serious indirectness: these studies are from a variety of low-, middle-, and high-income countries (South Africa, Ethiopia, Democratic Republic of Congo, Cambodia, Bolivia, Colombia, USA, Australia, Honduras, Zimbabwe, Zambia, Dominican Republic, Ghana, Kenya and Guatemala).
[4]No serious imprecision.
[5]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants, this outcome is susceptible to bias from lack of blinding. Only one of these studies, Rodrigo 2011 AUS, blinded participants and outcome assessors to the treatment allocation.
[6]No serious indirectness: these studies are from a variety of low-, middle-, and high-income countries (South Africa, Cambodia, Bolivia, Colombia, Zimbabwe, Guatemala and Australia). The interventions consisted of distribution of water filters (which included a safe storage chamber) plus instructions on how to use them. In some cases, the intervention included hygiene education.
[7]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants, this outcome is susceptible to bias from lack of blinding. None these studies blinded participants and outcome assessors to the treatment allocation.
[8]No serious inconsistency: there was no statistical heterogeneity between studies, I^2 statistic = 0%.
[9]No serious indirectness: the studies were conducted in a variety of rural and urban settings in a variety of low- and middle-income countries (Honduras, Dominican Republic, Cambodia, Ghana and Kenya). The interventions consisted of distribution of water filters plus instructions on how to use them. In some cases, the intervention included hygiene education and a separate storage vessel.
[10]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. Only one of these studies, Boisson 2010 DRC, blinded participants and outcome assessors to the treatment allocation and found no evidence of effect of the filter.
[11]Downgraded by 1 for some indirectness, the studies were only performed in three sub-Saharan African countries (Ethiopia, Democratic Republic of Congo, and Zambia).
[12]No serious risk of bias: the three studies blinded participants and outcome assessors to the treatment allocation.
[13]Downgraded by 1 for some indirectness, the three studies were only performed in the USA in water conditions that presumed to meet US EPA standards.

Table 15. POU solar disinfection (SODIS): description of the interventions

Study ID	Study design	Setting	Intervention areas			Control areas	
			Water quality intervention	Health promotion activities	Compliance	Water source	Health promotion activities
Conroy 1996 KEN	Quasi-RCT	Rural	Children were given two 1.5 L plastic bottles and told to keep the bottles on the roof of the hut throughout the day in full sunlight	None	100%- random checks by project workers uncovered no evidence of non-compliance	Children were given two 1.5 L plastic bottles and told to keep the bottles indoors	None
Conroy 1999 KEN	Quasi-RCT	Rural	Mothers were given plastic bottles and	None	Not reported	Mothers were given plastic bottles and	None

			told to keep the bottles on the roof of the hut throughout the day in full sunlight			told to keep the bottles indoors	
du Preez 2010 ZAF	Cluster-RCT	Peri urban	Received two 2 L polyethylene terephtalate (PET) bottles for each child. Carers were instructed to fill one bottle and place it in full, unobscured sunlight for a minimum of 6 h every day	None	25% compliance measured by participants filling out diarrhoeal diaries at least 75% of the time	No SODIS bottles and maintain their usual practices	None
du Preez 2011 KEN	Cluster-RCT	Peri urban and rural	Received two 2 L PET bottles for each child. Carers were instructed to fill one bottle and place it in full, unobscured sunlight for a minimum of 6 h every day	None	Not specified.	No SODIS bottles and maintain their usual practices	None
Mäusezhal 2009 BOL	Cluster-RCT	Rural	Households were supplied regularly with clean, PET bottles. They were instructed to expose the waterfilled bottles for at least 6 h to the sun	Households were taught about the importance and benefits of drinking only treated water, the germ-disease concept, and promoted hygiene measures such	32% compliance measured by observation	Drinking water from spring (48.1%), tap (51.9%), river (22.1%), rain (14.9%) and dug well (14.9%)	None

Table 15. POU solar disinfection (SODIS): description of the interventions *(Continued)*

				as safe drinking water storage and hand washing			
McGuigan 2011 KHM	Cluster-RCT	Rural	Households were provided with two transparent 2 L plastic bottles for each child and a sheet of corrugated iron on which to place the bottles to expose them to sunlight. Carers were instructed to fill one bottle and place it in full, unobscured sunlight for a minimum of 6 h every day	The parents or carers were given verbal and written information on the disease concept and a simple explanation of the solar disinfection process and its effect on the microbial quality of their drinking water and subsequently the health of their children	90% (5% of children having < 10 months of follow-up and 2.3% having < 6 months)	Almost all of the households (97%) obtained water from unprotected boreholes. An important subgroup of these, 25%, drew water from shallow tube wells fitted with hand pumps. The remainder used unprotected wells or surface ponds	None

Table 16. POU solar disinfection (SODIS): primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source[2]	Quantity available[3]	Ambient H_2O quality	Sanitation[4]
Conroy 1996 KEN	Open water holes, tank fed by untreated piped water supply.	Unimproved	Unclear	Unclear	Source water: 10^3 CFU/100 mL	Unclear
Conroy 1999 KEN	Open water holes, tank fed by untreated piped water supply.	Unimproved	Unclear	Unclear	Source water: 10^3 CFU/100 mL	Unclear
du Preez 2010 ZAF	39% standpipes, 28% protected bore-	Mostly improved	Sufficient	Sufficient	Baseline not reported. Interven-	Unclear

Table 16. POU solar disinfection (SODIS): primary drinking water supply and sanitation facilities *(Continued)*

	hole, 10% unprotected boreholes, protected springs				tion households: 62% of samples met WHO guidelines for water quality; no significant difference from control households	
du Preez 2011 KEN	Spring, protected and unprotected dug wells protected, canals, other	Mostly unimproved	Unclear	Unclear	50% of samples from stored water had 10 CFU/100 mL or less; no significant difference for intervention and controls	Unclear
Mäusezhal 2009 BOL	48% spring, 52% tap, 22% river, 15% rain, 15% dug well	Improved and unimproved	Sufficient	Sufficient	Not tested	Unimproved
McGuigan 2011 KHM	97% households use unprotected sources: unprotected wells, surface ponds	Unimproved	Unclear	Unclear	Baseline not reported. Control households: geometric mean 48 CFU/100 mL	Unimproved

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 17. Summary of findings: POU solar disinfection (SODIS)

POU solar disinfection (SODIS) of water compared with no intervention for preventing diarrhoea					
Patient or population: adults and children **Settings:** low- and middle-income countries **Intervention:** distribution of plastic bottles with instructions on using them to treat water using the SODIS method **Comparison:** no intervention					
Outcomes	**Illustrative comparative risks* (95% CI)**		**Relative effect (95% CI)**	**Number of participants (studies)**	**Quality of the evidence (GRADE)**
	Assumed risk	**Corresponding risk**			
	No intervention	**SODIS**			
Diarrhoea episodes Cluster-RCTs	**3 episodes per person per year**	**1.9 episodes per person per year** (1.3 to 2.8)	**RR 0.62** (0.42 to 0.94)	3460 (4 trials)	⊕⊕⊕○ **moderate**[1,2,3,4]
Diarrhoea episodes Quasi-RCTs	**3 episodes per person per year**	**2.5 episodes per person per year** (2.1 to 2.9)	**RR 0.82** (0.69 to 0.97)	555 (2 studies)	⊕⊕○○ **low**[1,5,6,7]
GRADE Working Group grades of evidence **High quality:** further research is very unlikely to change our confidence in the estimate of effect. **Moderate quality:** further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate. **Low quality:** further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. **Very low quality:** we are very uncertain about the estimate.					

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).

[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. None of these studies blinded participants and outcome assessors to the treatment allocation.

[2]No serious inconsistency: statistical heterogeneity was very high (I^2 statistic = 89%), however there is consistency in the direction of the effect. This heterogeneity may relate to differences in compliance across the studies, however compliance was not measured in the same way across studies.

[3]No serious indirectness: the studies were conducted in peri-urban South Africa (one study), peri-urban and rural Kenya (one study), rural Bolivia (one study) and rural Cambodia (one study).

[4]No serious imprecision: the average effect suggests that the intervention may reduce diarrhoea episodes by about one third.

[5]No serious inconsistency: statistical heterogeneity was low (I^2 statistic = 0%).

[6]Downgraded by 1 for serious indirectness: there are only two studies and both were conducted in the same province in Kenya (one study included children five to 16 years old and the other included children younger than six years old).

[7]No serious imprecision.

Table 18. POU UV: description of the interventions

Study ID	Study design	Setting	Intervention areas			Control areas	
			Water quality intervention	Health promotion activities	Compliance	Water source	Health promotion activities
Gruber 2013 MEX	Cluster-RCT	Rural	Promotion of the UV Tube disinfection technology and safe storage	Unclear	51% compliance measured by access to treatment device	Unclear	None

Table 19. POU UV: primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source[2]	Quantity available [3]	Ambient H_2O quality	Sanitation[4]
Gruber 2013 MEX	Unclear	Unclear	Unclear	Unclear	Baseline: 60% of samples with detectable *E. coli*	Improved

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 20. POU Improved storage: description of the interventions

Study ID	Study design	Setting	Intervention areas			Control areas	
			Water quality intervention	Health promotion activities	Compliance	Water source	Health promotion activities
Günther 2013 BEN	Cluster-RCT	Rural	Provided households with a new 30 L household wa-	None	After 7 months, 88% of households were still using the im-	68% only consume improved water source	None

Table 20. POU Improved storage: description of the interventions (Continued)

			ter storage with a tap at the bottom, a new plastic container to transport water from the water source to the household and a sign attached to the transport and storage containers which emphasized the importance of avoiding hand-contact with the water and to only use water from an improved water source		proved storage containers		
Roberts 2001 MWI	Cluster-RCT	Refugee camp	All of the participating household's water collection vessels were exchanged for improved buckets (20 L with a narrow opening to limit hand entry). Households were offered 1 improved bucket in exchange for 1 vessel, 2 for 2, and 3 improved buckets for any number of	None	Intervention householders received buckets; actual use was not reported	Provided with 20 L standard ration bucket	None

Table 20. POU Improved storage: description of the interventions *(Continued)*

			containers > 2. Households were asked never to put their hands in the improved buckets and were shown how to rinse the bucket without hand entry				

Table 21. POU Improved storage: primary drinking water supply and sanitation facilities

Trial	Description	Source[1]	Access to source[2]	Quantity available[3]	Ambient H_2O quality	Sanitation[4]
Günther 2013 BEN	Public tap or pump	Improved	Sufficient	Unclear	12% source water contaminated (≥ 1000 CFU per 100 mL)	Unclear
Roberts 2001 MWI	Traditional pots or standard ration buckets filled at refugee camp water point	Improved	Unclear	Unclear	Source water: 71% of samples had ≤ 1 faecal coliform/ 100 mL	Unclear

[1]'Improved' includes household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; 'unimproved' includes unprotected well, unprotected spring, vendor-provided water, bottled water; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

[2]'Sufficient' means located within 500 m, queuing no more than 15 minutes, no more than three minutes to fill 20 L container, and maintained so available consistently; 'insufficient' means that it does not meet any of above; and 'unclear' means unclear or not reported; definition based minimum standards established by The Sphere Project 2011.

[3]'Sufficient' means a minimum of 15 L/day/person; 'insufficient' means less than 15 L/day/person; and 'unclear' means unclear or not reported; definition based on minimum standards established by The Sphere Project 2011.

[4]'Improved' means connection to a public sewer or septic system, pour flush latrine, simple pit latrine, or ventilated improved pit latrine; 'unimproved' means service or bucket latrine, public latrines, open latrines; and 'unclear' means unclear or not reported; definition based on WHO/UNICEF 2015.

Table 22. Summary of findings: POU improved water storage

Improved water storage compared with no intervention for preventing diarrhoea					
Patient or population: adults and children in sub-Saharan Africa **Settings:** areas with improved water sources **Intervention:** distribution of improved water containers **Comparison:** no intervention					
Outcomes	**Illustrative comparative risks* (95% CI)**		**Relative effect (95% CI)**	**Number of participants (studies)**	**Quality of the evidence (GRADE)**
	Assumed risk	**Corresponding risk**			
	No intervention	**Water storage**			
Diarrhoea episodes Cluster-RCTs	**3 episodes per person per year**	**2.7 episodes per person per year** (2.2 to 3.3)	**RR 0.91** (0.74 to 1.11)	1871 (2 trials)	⊕⊕○○ **low**[1,2,3,4]
The basis for the **assumed risk** is the median control group risk across studies. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI). **CI:** confidence interval; **RR:** risk ratio.					
GRADE Working Group grades of evidence **High quality:** further research is very unlikely to change our confidence in the estimate of effect. **Moderate quality:** further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate. **Low quality:** further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate. **Very low quality:** we are very uncertain about the estimate.					

The assumed risk is based on 2.9 episodes/child year in 2010 (Fischer Walker 2012).
[1]Downgraded by 1 for serious risk of bias: as diarrhoea episodes were reported by participants this outcome is susceptible to bias from lack of blinding. None of these studies blinded participants and outcome assessors to the treatment allocation.
[2]No serious inconsistency.
[3]Downgraded by 1 for indirectness: only 2 studies, from rural Benin and a refugee camp in Malawi, have been conducted to assess improved water storage.
[4]No serious imprecision.

Table 23. Estimates of household-level interventions after adjustment for non-blinding

POU intervention	**Number of comparisons**	**Not adjusted for non-blinding**		**Adjusted for non-blinding**	
		RR	**95% CI**	**RR**	**95% CI**
All	55	0.56	(0.46 to 0.68)	0.70	(0.64 to 0.77)

Table 23. Estimates of household-level interventions after adjustment for non-blinding *(Continued)*

Chlorination	19	0.72	(0.61 to 0.84)	0.80	(0.69 to 0.92)
Filtration	23	0.48	(0.38 to 0.59)	0.62	(0.55 to 0.70)
Flocculation and disinfection	7	0.48	(0.20 to 1.16)	0.65	(0.40 to 1.09)
SODIS	6	0.68	(0.53 to 0.89)	0.80	(0.60 to 1.01)

Abbreviation: SODIS: solar disinfection; CI: confidence interval.

Table 24. Potential reasons for finding of no-effect in trials with adequate blinding

Study	Risk from ambient water quality	Compliance	Other issues
Colford 2002 USA	Very low (USA)	High (Sham filter)	None
Colford 2005 USA	Very low (USA)	High (Sham filter)	None
Colford 2009 USA	Very low (USA)	High (Sham filter)	None
Rodrigo 2011 AUS	Very low (Australia)	Not reported	None
Jain 2010 GHA	Low (11 CFU/100 mL)	High (RFC)	Control group received jerry can; 13 week follow-up
Kirchhoff 1985 BRA	Very high (mean 16000 FC/dL)	Not reported	Only 112 persons from 16 households; 18 week trial
Austin 1993	High (1871 FC/100 mL)	Low ("50% to 60%")	No test of blinding; not peer reviewed
Boisson 2010 DRC	High (75% of samples > 1000 TTC/100 mL)	High, but 73% of adults and 95% of children drank from untreated sources	"Placebo" removed > 90% of TTC in control arm
Boisson 2013 IND	Moderate (mean 122 TTC/100 mL)	Low and inconsistent (32% of samples positive for RFC)	None

Abbreviations: TTC: thermotolerant coliforms, CFU: colony-forming units, FC: faecal coliforms, RFC: residual free chlorine.

WHAT'S NEW

Last assessed as up-to-date: 11 November 2014.

Date	Event	Description
21 October 2015	Amended	Amended author affiliations.

HISTORY

Protocol first published: Issue 2, 2004

Review first published: Issue 3, 2006

Date	Event	Description
15 October 2015	New search has been performed	The review authors updated the review, and included several new studies, a 'Summary of findings' table, and 'Risk of bias' assessments
15 October 2015	New citation required and conclusions have changed	The review authors performed an updated literature search, reapplied the inclusion criteria, repeated data extraction, added new studies, and used the GRADE approach to assess the quality of the evidence. They also applied statistical methods to unify the measures of effect and applied additional criteria for subgrouping based on study design, setting, and length of follow-up

CONTRIBUTIONS OF AUTHORS

TC and SC conceived the review. TC coordinated the review. TC, KA, SB, RP, HC, and SC designed the review. TC and authors of the initial review drafted the protocol. SB and Cochrane Infectious Diseases Group (CIDG) performed the search strategy. SB and RP screened search results. KA, SB, and RP retrieved papers. SB and RP applied inclusion criteria. KA, SB, and RP extracted data. KA, SB, RP, HC, and FM computed estimates of effect. KA, TC, FM, and DS applied quality criteria. KA contacted study authors for additional information. TC, KA, HC, DS, and CIDG addressed statistical issues. KA entered data into Review Manager (RevMan). TC, KA, and DS drafted the review. SB, RP, HC, and SC commented on the review. TC, KA, HC, FM, and DS prepared tables. KA prepared figures. TC is guarantor of this Cochrane Review.

DECLARATIONS OF INTEREST

TC, KA, SB, and SC have provided research or consulting services for Unilever, Ltd., Medentech, Ltd., DelAgua Health and Science, Ltd., and Vestergaard-Frandsen SA who manufacture or sell household-based water treatment devices.

SOURCES OF SUPPORT

Internal sources

- Liverpool School of Tropical Medicine, UK.

External sources

- Department for International Development (DFID), UK.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Risk of bias has been assessed using GRADE rather than the original methods expressed in the protocol. Statistical methods have been used to pool odds ratios, rate ratios, RRs and longitudinal prevalence ratios. Subgrouping has been done separately for each water quality intervention, and additional subgrouping has been conducted based on study design and length of follow up. Data has been provided on adjustment of studies for non-blinding.

INDEX TERMS

Medical Subject Headings (MeSH)

Diarrhea [*prevention & control]; Randomized Controlled Trials as Topic; Water Purification [*methods; standards]; Water Supply [*standards]

MeSH check words

Adult; Child; Humans