Evidence base: Water, Sanitation and Hygiene Interventions

Literature Review : September 2010

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Introduction

This document is primarily intended for UNICEF WASH officers, though we welcome use by others. It is a compilation of facts and figures drawn together from the existing literature on the effectiveness of WASH interventions. Any views expressed are not those of UNICEF. This document will not be published, and therefore should not be referenced. Since all the supporting literature is included you can freely use the information, but ensure the respective individual papers are referenced.

Hopefully this document will enhance your WASH country programming, advocacy and/or awareness raising initiatives. In case you have questions or comments, please contact tdooley@unicef.org

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Appendix: References

1. The effectiveness of Sanitation and Handwashing with Soap interventions to reduce the incidence of diarrhoea

Over the years several systematic reviews and meta-analyses have been conducted to estimate the overall effectiveness of WASH interventions to reduce the incidence of diarrhoea in children under 5. Such analyses attempt to pool the results of a variety of individual impact studies. Depending on the methodology adopted for conducting such an analysis (involving various choices regarding search criteria, inclusion criteria, methods for combining studies with different outcome measures, etc etc), the results vary.

One method is not indisputably better than the other. Therefore, below the various results of these meta-analyses are presented for handwashing and sanitation interventions.

Handwashing with Soap

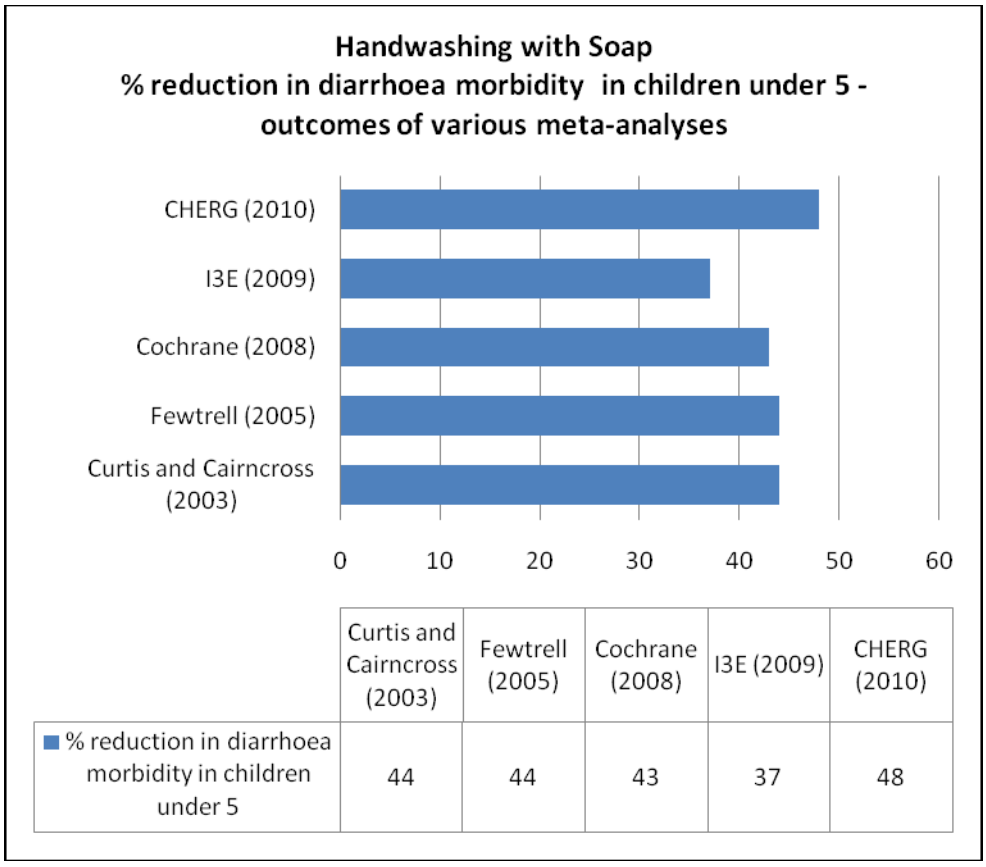
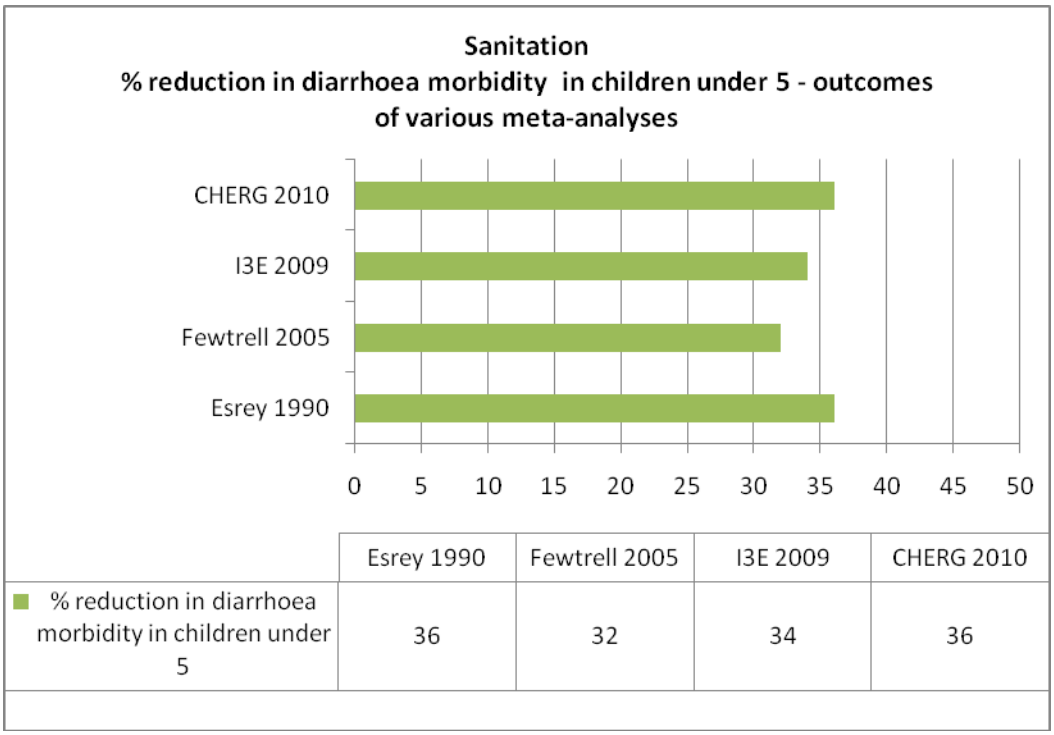


Figure 1 Outcomes of various handwashing meta-analyses on the reduction in diarrhoea morbidity in children under 5

The similarity among the results for hand washing with soap is striking (see figure 1). The most recent analysis (CHERG 2010) comments that studies in the literature are remarkably consistent showing a reduction in diarrhoea by 42-48%. That study eventually takes 48%, which is the reduction found for the more severe types of diarrhoea. From the above it is legitimate to continue to use the numbers widely used and published for Global Handwashing Day, that handwashing with soap can reduce the incidence of diarrhoea in children under 5 by 44%.

Sanitation



	Esrey 1990	Fewtrell 2005	I3E 2009	CHERG 2010
% reduction in diarrhoea morbidity in children under 5	36	32	34	36

Figure 2 Outcomes of various sanitation meta-analyses on the reduction in diarrhoea morbidity in children under 5 ('sanitation' here means to use of toilets/latrines)

The impact of sanitation estimated by the different reviews looks rather consistent (see figure 2). Because sanitation is a primary barrier in the transmission of faecal-oral pathogens it is extremely plausible that the safe disposal of excreta indeed has a considerable protective effect.

The number of rigorous studies however, compared for example to handwashing with soap, is limited. A recent Cochrane review (that has one of the most stringent inclusion criteria) concludes that:

> *Major differences among the studies, including the conditions in which they were conducted and the types of interventions deployed, as well as methodological deficiencies in the studies themselves, makes it impossible to estimate with precision the protective effective of sanitation against diarrhoea. Further research, including randomized controlled trials, is necessary to understand the full impact of these interventions.*
>
> (Cochrane 2010)

Nevertheless, in the CHERG 2010 review (in which 5 authors participated who were also involved in the Cochrane 2010 review) the authors conclude:

> *Despite the limitations of sanitation studies, there is not enough evidence to justify a departure from the prevailing consensus, published two decades ago and widely cited with approval since then, that sanitation reduces diarrhoea risk by about **36%**.*
>
> (CHERG 2010)

Another critical recommendation from the Cochrane 2010 review is to study the extent to which any benefits from increasing sanitation coverage and the use of latrines is conferred on non-adopters, as with insecticide treated bednets,

rendering the health impact of the intervention a "public good". This recommendation has relevance for the "total sanitation" approaches that have been widely adopted. The relapse to open defecation as observed in a number of instances evokes the question of how high latrine coverage should be to see a significant community wide health impact. It is plausible that compliance ought to be very high. But the more exact answer is yet unknown.

Meta Analyses Specific to Urban Sewerage systems.

The above meta analyses on the impact of sanitation have not adequately addressed the impact of sewerage systems (Fewtrell 2005 for example does not incorporate any study on sewage and I3E only included 4 studies of sewerage in their analysis).

A recent meta-analysis (Norman and Colleagues 2010) specifically looked at urban sewage systems. From 25 studies, the pooled estimates show that sewerage systems typically reduce diarrhoea incidence by about 30% (in areas with flush toilets discharging either to septic tanks or open drains prior to the intervention) and as much as 59% in areas with very poor levels of sanitation prior to the intervention (where there is widespread reliance on open defecation, or unsanitary household or public latrines, or where many flush toilets discharge directly into the environment).

The cost for sewerage systems are higher, but the health benefits, especially in areas of poor levels of existing sanitation, are large. The authors advice to carefully estimate in each context the cost-effectiveness of adopting sewerage systems over less capital intensive sanitation systems.

Impact of sewerage on intestinal parasites

This study (Barreto and colleagues 2010) deserves special attention because is the first solid study that demonstrates the impact of improvements in sanitation on the prevalence of intestinal parasites at the scale of an entire city.

In Salvador (Brazil, population 2.4 million) household sewerage connections went up from 26% to 80%. 300.000 household connected to the network over 8 years. An earlier publication (Barreto and colleagues 2007) concluded that as a result of the project the overall prevalence of diarrhoea among children 0-36 months fell by 22%. The below results on Roundworms, Whipworm and Giardia were obtained through a laboratory tests on the stool of the research population, and presented in table A1:

Intestinal Parasite	*% reduction in prevalence in children 0 – 36 months of age*
Ascaris lumbricoides (roundworm)	42%
Trichuris trichiura (whipworm)	62%
Giardia duodenalis (protozoa)	59%

Table A1. The % reduction in the prevalence of intestinal parasites in children under 4 as a result of a city-wide sewerage project in Salvador, Brazil (Barreto and colleagues 2010)

The reductions are significant. The authors conclude that environmental sanitation was the key variable in the reduction, which stresses that the parasite transmission prevented by the program was mainly in the public domain – rendering interventions like these public goods.

Sanitation has a larger impact in high risk areas

In the meta-analysis on sewerage systems one of the key facts presented is the higher impact in areas with poorer levels of baseline sanitation (overall reduction 30%, reduction in areas with poor sanitation prior to the intervention: 59%).

The Salvador project in Brazil (Barreto and colleagues 2010) found a similar pattern for the reductions in the prevalence of intestinal parasites. For all three species of parasite (table 1), the effect of the intervention was higher in areas with poorer levels of sanitation prior to the interventions.

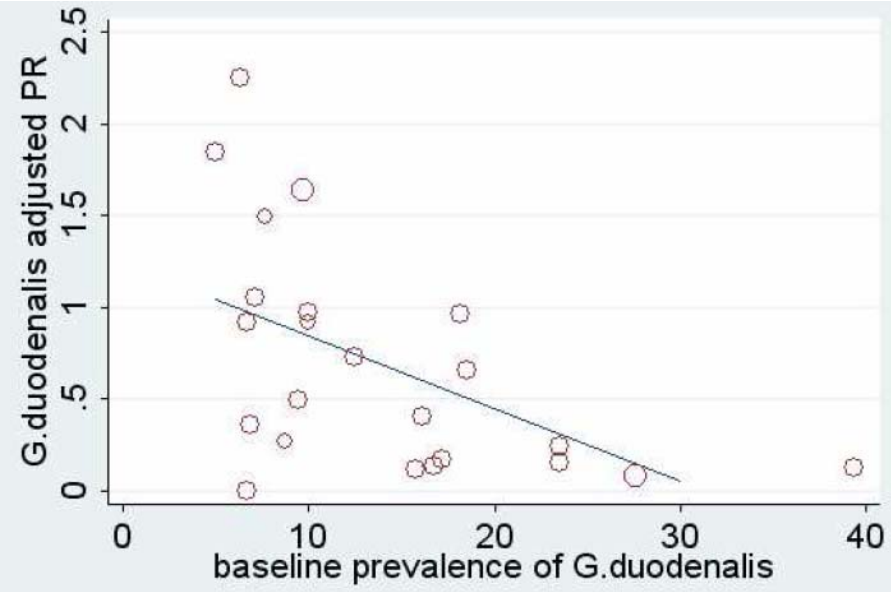


Figure 3. The relation between the baseline prevalence of Giardia (horizontal axis) and the reduction in Giardia prevalence in children under 4 (vertical axis). This graph shows that the higher the baseline prevalence was, the bigger the reduction the sanitation project caused.

The difference was highest for Giardia (see figure 3), with a striking correlation between the baseline prevalence prior to the intervention (horizontal axis) and the impact ratio (vertical axis) (in figure 3, a low prevalence-ratio accounts for a more considerable reduction in prevalence. The prevalence ratio is the prevalence after the intervention divided by the prevalence before the intervention)

The limited amount of studies that demonstrate that sanitation has a higher impact on populations living in areas with high exposure levels of faecal-pathogens suggest that greater health gains can be made when areas with currently very poor levels of sanitation are targeted.

Regardless of the fact that universal usage of sanitation facilities is the ultimate goal, these finding can have policy implication regarding the short term target population.

2. Evidence Specific to Hand washing with Soap (Fact Sheet)

- Handwashing at critical times - including before eating or preparing food and after using the toilet - can reduce diarrhoea rates by almost 40 per cent (3IE 2009).
- Handwashing with soap can reduce the incidence of acute respiratory infections (ARI's) by around 23 per cent (WELL 2007).
- One study assessed the effect of hand washing promotion with soap on the incidence of pneumonia and found that children younger than 5 years in households that received plain soap and hand washing promotion had a 50% lower incidence of pneumonia than controls.
- Pneumonia (a lower respiratory infection) is the number one cause of mortality among children under five years old, taking the lives of an estimated 1.8 million children per year (SOWC 2008).
- Handwashing can be a critical measure in controlling pandemic outbreaks of respiratory infections. Several studies carried out during the 2006 outbreak of severe acute respiratory syndrome (SARS) suggest that washing hands more than 10 times a day can cut the spread of the respiratory virus by 55 per cent (BMJ 2009).
- Handwashing with soap is has been cited as one of the most cost-effective interventions to prevent diarrhoeal related deaths and disease (Cairncross and Valdmanis 2006).
- A review of several studies shows that handwashing in institutions such as primary schools and daycare centers reduce the incidence of diarrhoea by an average of 30 per cent (Cochrane 2008).
- Rates of handwashing around the world are low. Observed rates of handwashing with soap at critical moments – i.e, before handling food and after using the toilet - range from zero per cent to 34 per cent (Scott et al 2003).
- A recent study shows that handwashing with soap by birth attendants and mothers significantly increased newborn survival rates by up to 44 per cent (Rhee et al 2008).
- The lack of soap is not a significant barrier to handwashing – with the vast majority of even poor households having soap. Soap was present in 95 per cent of households in Uganda, 97 per cent of households in Kenya and 100 per cent of households in Peru (curtis et al 2009).
- Water alone is not enough, and soap is rarely used for handwashing. Laundry, bathing and washing dishes are seen as the priorities for soap use (GHD Planners Guide).
- New studies suggest that handwashing promotion in schools can play a role in reducing absenteeism among primary school children. In China, for example, promotion and distribution of soap in primary schools resulted in 54 per cent fewer days of absence among students compared to schools without such an intervention (Bowen et al 2007).

3. Effectiveness of Multiple Interventions

Multiple interventions do not de facto deliver greater benefits. That finding is important since WASH interventions are commonly manifold. Water supply interventions combined with sanitation and/or hygiene, for example, are estimated to reduce diarrhea morbidity by 19% (3IE 2009 - not shown in Chart 1), which is lower than the pooled effectiveness of sanitation interventions alone. It is difficult to assess whether the perceived lack of complementarity between multiple interventions involving water and sanitation and/or hygiene is due to lack of compliance or lack of efficacy (3IE 2009) (lack of compliance = for example that the population does not consistently disinfect their water AND wash their hand with soap at critical times, which leads to a reduction in the effectiveness of this multiple intervention).

Another review alludes to the same explanation, suggesting that the piecemeal implementation of more ambitious programmes may result in an overall lack of focus or attention which affect compliance, which is typical for sanitation programmes combined with hygiene promotion (Fewtrell et al 2005).

Box 1: Hand Washing With Soap C**ombined with Point of Use Water Treatment**

In Karachi, Pakistan, where diarrhea is the leading cause of childhood death, a study was conducted to see whether the effectiveness of hand washing with soap (HWWS) and point of use (POU) water treatment could lead to a combined impact on diarrhoea morbidity. The individual interventions demonstrated the magnitude of both measures to significantly reduce diarrhea (from 51% for HWWS to 65% lower prevalence of diarrhea for flocculent-disinfectant POU water treatment). There was however no benefit by combining hand washing promotion with water treatment (55% reduction), albeit both measures block different transmission pathways.
The authors could not find an answer to the question if there was no additive impact, or whether the study could not elicit them.
Study: Luby et al 2006

Eisenberg and colleagues argue that the extent to which WASH interventions should be integrated depends on the **critical path** among the ways that enteric pathogens potentially travel to human hosts, and the consequent ways to block them (Eisenberg et al 2007), which intuitively makes sense (see box 2).

The argument of critical pathways relates to the primary and secondary barriers as brought forward by Curtis and colleagues 2000: primary barriers are high potential critical paths blockers. Though the critical path conceptualization allows for the analysis of more complex situations (e.g. the effect of water borne disease due to upstream contamination), the bottom-line of both articles is similar: **if the interventions do not block the critical paths they are unlikely to be effective**. Curtis and colleagues therefore argue there are **two principal interventions** [1]that establish the primary barrier for preventing stool pathogens to enter the domestic environment: **save excreta disposal and hand washing**. Eisenberg and colleagues argue that when sanitation conditions are poor, water quality improvements may have minimal impact regardless of the amount of water contamination,

Box 2: Recommendation for Integrating WASH Interventions to Reduce the Burden of Diarrhoeal Disease

In qualitative terms, Eisenberg and colleagues developed a dynamic version of the F-diagram in order to simulate the different **pathways** enteric pathogens potentially take in a community so as to determine how the efficacy of water quality interventions depends on the level of both household- and community-level transmission, and the conditions under which water quality interventions, hygiene and sanitation improvements, or both, are effective in reducing the burden of disease in a community. Their conclusion is that the benefits of a **water quality intervention depend on sanitation and hygiene conditions**. When sanitation conditions are poor, water quality improvements may have minimal impact regardless of the amount of water contamination. **If each transmission pathway alone** is sufficient to maintain diarrhoeal disease, single-pathway interventions will have minimal benefit, and ultimately an intervention will be successful only **if all sufficient pathways are eliminated**. However, when **1 pathway is critical** to maintaining the disease, public health efforts should **focus** on this critical pathway (Eisenberg et al 2007).

[1] Among transmissions through food-borne, flies, bottle-feeding, animal feaces, water, hand washing an

thereby subscribing to the **importance of ensuring safe hygiene and excreta disposal**.

The effectiveness of point-of-use water treatment seems to suggest water is another critical path. The evidence presented earlier concerning the significant deterioration in water quality from the source up to the point-of-use suggest that **water can be a critical path** indeed, but as a result of **inadequate excreta disposal, water storage and water handling**.

Nonetheless, to determine the most effective intervention in each context (or combination of interventions) to curb the prevalence of diarrhoeal diseases in a community - the context's critical paths of pathogens demands strong consideration.

4. Global Costs of Attaining the MDG for Water Supply and Sanitation

At the start of 2008 WHO updated their cost estimates for meeting the water and sanitation MDG. Based on coverage levels in 2004, estimates are given for each consecutive year until 2015 (for developing countries). Most previous studies have ignored the costs of maintaining existing coverage levels. Therefore, the new estimates of cost include the operation, maintenance and replacement of existing coverage as well as new services. Adding these factors can help to paint a better picture of the 'real' (or hidden) cost for attaining the MDG. The results are shown in the below two graphs.

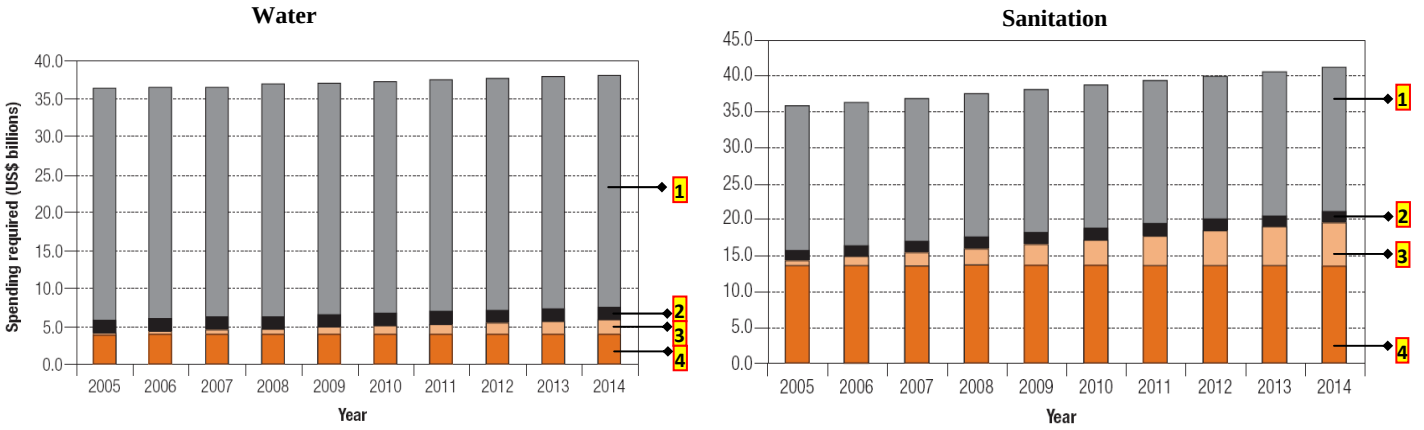


Chart 2 and 3: Estimated capital and recurrent costs for existing and new coverage for Water (left) and Sanitation (right) (Source WHO 2008)

Key to Chart 2 and Chart 3

1 Existing coverage - recurrent
2 Existing coverage - capital
3 New coverage - recurrent
4 New coverage - capital

Highlights:

- The total estimated spending required for meeting the individual water and sanitation goals in developing countries is approximately between $35 and $40 billion per annum. That adds up to an overall total between $70 and $80 billion per annum for water and sanitation combined.
- The magnitude of the requirements for new coverage highlights a disparity between the two sectors (12% for water, 40% for sanitation). This difference is largely explained by the lower baseline and therefore larger number of persons or households to achieve coverage for sanitation as opposed to water.

- The annual new coverage capital costs for sanitation are around $14 billion. The previous WHO estimate was 9.5 billion (Hutton and Haller 2004).
- The first years' $70 billion annual price tag for water and sanitation combined translates to a per-capita per annum spending requirement of $12.
- Given the lack of up-to-date data on actual spending by households on water supply and sanitation in developing countries, it is not possible to estimate the current financial gap at the global level. Whilst it is known the $70 billion per annum by far exceeds the amount the sector has received from governments and external support agencies (e.g. about $15 annually in the 1990s).

Distribution	Rural	Urban	Recurrent	Investment	Existing coverage	New coverage
Water	32%	68%	84%	16%	88%	12%
Sanitation	41%	59%	57%	43%	60%	40%

Table 1: Distribution of total costs for meeting the water and sanitation MDGs (new and existing coverage)

WHO Regions	AFR-D	AFR-E	WPR-B	AMR-D	SEAR D	SEAR-B
US$	67	63	40	38	33	26

Table 2: Required per capita spending for increased coverage over the years 2005-2015 per WHO region for water and sanitation combined

The authors underline that a significant proportion of funding for increased coverage is required for investment purposes in rural Asia and Africa. The combined water and sanitation per capita spending for increased coverage over the years 2005-2015 is shown in table2 (not per annum). Increased funding made available for existing coverage is needed in urban areas, and with a more balanced regional distribution.

5. Investment Benefits (Cost/Benefit)

Until now the cost-benefit studies of WHO have specifically calculated cost-benefit ratios with respect to new coverage. The latest cost estimates, summarized above, does not point out the implications the additional costs of attaining the MDGs have for previously estimated cost-benefit ratios. Surely the benefits of investments in new coverage can not squarely be applied to investments in existing sanitation coverage. Therefore, the below cost-benefit figures only apply to new coverage only.

WHO 2004 (new coverage only)

Present day, the press and literature on cost-benefits frequently quote figures that originate from a WHO 2004 report (Hutton and Haller 2004). Following from that report (which did not directly present figures for exclusively sanitation) the benefits of wat&san are often grouped together, which causes confusion. To clarify this, the table below expresses the benefits for meeting the individual MDG's:

Table 3: Breakdown of the Global gains made for attaining the WATSAN MDG (new coverage only)

	Sanitation MDG	**Water MDG**	**Total**
1 Annual number of diarrhoeal cases avoided	390 million	155 million	546 million
2 Annual health sector treatment costs saved	$5 billion	$2 billion	$7 billion

3 Annual patient treatment costs saved	$244 million	$97 million	$341 million
4 Total Health Related Monetary Gains (2+3)	$5.2 billion	$2.1 billion	$7.3 billion
5 Productive days gained due to less diarrhoeal illness	230 million productive days	90 million productive days	320 million productive days
6 School attendance days gained due to less diarrhoeal illness	194 million school days	78 million school days	272 Million school days
7 Healthy baby/infant days gained due to less diarrhoeal illness	1.1 billion 1.2 baby/infant days	0.4 billion baby/infant days	1.5 billion baby/infant days
8 Total Productivity Gains (result of 5+6+7)	$6.8 billion	$3.1 billion	$9.9 billion
9 Annual time gain due to more convenient water and sanitation	16 billion working days	4 billion working days	20 billion working days
10 Annual Value of Time Savings (result of 9)	$51.5 billion	$12 billion	$63.5 billion
11 Value of deaths averted	$2.5 billion	$1.1 billion	$3.6 billion
Total economic benefits of interventions	**$66 billion**	**$18 billion**	**$84 billion**
Total cost of interventions	**$9.5 billion**	**$1.8 billion**	**$11.3 billion**
Estimated return on $1 investments	**$7**	**$10**	**$7.4**

WHO 2007 (new coverage only)

A more recent WHO report estimates, based on the improvement trends between 1990 and 2004, the world will fall short of meeting the Sanitation MDG by 564 million people in 2015. Subsequently, it conducts a Benefit/Cost-Ratio study for serving that group of people, labelled as the population in the "**countries off-track**". This is a very interesting baseline since it points out what **extra effort is needed** to achieve the **Sanitation and Water MDGs** (That WHO study found that the economic gains of meeting the Sanitation MDG in the countries currently off-track **($35 billion per annum**) can primarily be attributed to **non-health benefits**; predominantly in **saved time** due to better access to sanitation facilities (**90%**). Table 4 presents the cost benefit for different scenario's per region (cost-benefit ratios are the total benefits divided by the total costs, or the return in $ on a $1 investment):

Annual economic benefit estimates for achieving the Sanitation MDG in the "off-track countries" ***$ 35 billion***
Annual cost estimates for achieving the Sanitation MDG for the "off-track countries" ***$ 3.8 billion***
*Return on $1 investment in improving sanitation in the MDG "off-track countries"* ***$ 9.1***

World Region *	MDG			Universal		
	Water	Sanitation	W&S	Water	Sanitation	W&S
Sub-Saharan Africa	2.8	6.6	5.7	3.9	6.5	5.7
Arab States	6.1	5.3	5.4	5.9	12.7	11.3
East Asia & Pacific	6.9	12.5	10.1	6.6	13.8	12.2
South Asia	3.5	6.9	6.6	3.9	6.8	6.6
Latin America & Caribbean	8.1	37.8	35.9	17.2	39.2	36.3
Eastern Europe & CIS	8.3	27.8	18.9	8.9	29.9	27.4
Non-OECD	**4.4**	**9.1**	**8.1**	**5.8**	**11.2**	**10.3**

* Regional groupings reflect those used in the UNDP Human Development Report 2005

Table 4: Cost benefit ratio for achieving six water and sanitation coverage scenarios

6. Cost-Effectiveness Analyses

It is not always possible to quantify all impacts in dollar units. In that case, a cost-effectiveness analysis (CEA) can be undertaken. CEA shows the cost of achieving a given output. The output is measured in its **natural unit** such as healthy life years gained, disability-adjusted life-years (DALYs) averted, or time saved. CEA is the method of choice for resource allocation decision in the health sector (Haller et al 2007). See box 4 for the definition of DALY.

Interventions against Diarrhoeal Disease	Cost-effectiveness ratio (US$ per DALY averted)
Cholera immunizations	1,658 to 8,274
Rotavirus immunizations	1,402 to 8,357
Measles immunization	257 to 4,565
Oral rehydration therapy	132 to 2,570
Breastfeeding promotion programs	527 to 2,001
Latrine construction and promotion	≤270.00
House connection water supply	223
Hand pump or stand post	94
Water sector regulation and advocacy	47
Latrine promotion	11.15
Hygiene promotion (including hand washing)	3.35

Table 5: **Cost-effectiveness ratio (US$ per DALY averted). Source: Jamison et al 2006 chapter 2 p.41 ,** Disease Control Priorities in Developing Countries (DCP2)

A cost-effectiveness study on interventions addressing high burden diseases in Low and Middle Income Countries and on WASH interventions in particular published in 2006 (Chapter 2 and 41 of Jameson et al 2006 respectively) demonstrates some **WASH** interventions are among the **top most cost-effective** in averting DALYs related to diarrhoeal diseases. Moreover, it demonstrates that the **differences** in costs per DALY-averted among the different intervention types **are considerable** (see table 5). The costs of **immunization** programmes turn out to be **substantial** when balanced against programmes providing **hardware solutions** and in particular compared to programmes promoting **behavioural change**.

Comparing these figures with the results of intervention impacts on diarrhoea morbidity of 3IE (discussed in section 1) demonstrates there is **almost a one on one correlation** between the ranking of interventions' impact to reduce diarrhoea morbidity and the cost-effectiveness of interventions to divert diarrhoea related DALYs. That does not only result from the health impact feature (as demonstrated by the cost-effectiveness of immunization programmes). Some WASH interventions simply have both: they are **cheap and effective**.

Haller and colleagues argue **caution** should be taken with interpreting cost-effectiveness figures: "Cost-effectiveness analysis is a useful tool for rational decision-making but it has its limitations and it will not provide information for all the factors which need to be taken into account. In order to select the most appropriate intervention for a particular setting, attention should be paid to the health and non-health benefits, the costs, and other parameters such as the environmental and social feasibility, and the sustainability of such an option, which are very much location-specific" (Haller et al 2007).

What should be added to the above is that though interventions might be cost-effective to avert DALYs, that might **not be the reason** for household members **to adopt** the intervention (see the section on

Box 3: DALY

The Disability Adjusted Life Year or DALY is a health gap measure that extends the concept of potential years of life lost due to premature death (PYLL) to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability (1). The DALY combines in one measure the time lived with disability and the time lost due to premature mortality. One DALY can be thought of as one lost year of 'healthy' life and the burden of disease as a measurement of the gap between current health status and an ideal situation where everyone lives into old age free of disease and disability.

Source:WHO website

social marketing). And though results of cost-effectiveness studies should help policy makers (or UNICEF offices) in making informed decisions, they are **not meant for (re-)justifying top-down approaches**.

7. Cost-effectiveness of Water Quality Interventions

WHO has recently conducted a cost-effectiveness analysis (CEA) on water quality interventions (WHO 2008). The gross costs for source based interventions (stand post, borehole, dug well) and the gross costs for household based interventions (chlorination, ceramic filtration, solar disinfection, flocculation disinfection) are dived by the yearly DALYs averted as a result of these interventions in each WHO region (DALYs averted due to less (only endemic) diarrhoeal diseases – it does not address diseases such as typhoid, hepatitis A and E and polio). The estimates are based on a 2006 Cochrane Review (Clasen 2006). His effectiveness estimates for the above interventions are shown in table 6. The results of the CEA are presented in table 7. These data assume 50% coverage of each of the interventions. The Cost Effectiveness Ratio in table 7 (CER) is based on the best available estimate of the true annual cost covered by the intervention, while the range reflects certain variations in such cost.

Intervention type (no. of trials)	Estimate of effect (random effects model)	Equivalent reduction (%) (1-estimate of effect)
Source (6)	0.73	27
Household (32)	0.53	47
Filtration (6)	0.37	63
Chlorination (16)	0.63	37
Solar Disinfection (2)	0.69	31
Flocculation/Disinf* (6)	0.69	31

*Excludes Doocy 2006, identified in the systematic review as a probable outlier.

Table 6: Summary of pooled estimates of effect of water quality interventions for the prevention of endemic diarrhoea (adapted from Clasen 2006)

	Source-Based Interventions		Household-Based Interventions							
	Mean Cost of Stand Post, Borehole and Dug Well		Chlorination		Ceramic Filtration		Solar Disinfection		Flocculation Disinfection	
	CER	Range	CER	Range	CER	Range	CER	Range	CER	Range
Afr-D	106	42-278	46	46-266	125	83-159	54	40-74	415	83-415
Afr-E	123	48-322	53	53-302	142	95-180	61	46-84	94	94-471
Amr-B	1930	760-5067	744	744-4259	2005	1337-2547	861	646-1183	6656	1331-6656
Amr-D	469	184-1230	190	190-1080	508	339-646	218	164-300	1687	337-1687
Emr-B	1511	596-3962	510	510-2921	1375	917-1747	590	443-812	4565	913-4565
Emr-D	145	57-380	78	78-445	209	140-266	90	67-124	695	139-695
Eur-B	2254	888-5909	978	978-5602	2637	1758-3350	1132	849-1557	8754	1751-8754
Sear-B	1025	404-2686	397	397-2272	1069	713-1358	459	344-631	3550	710-3550
Sear-D	143	56-375	125	125-715	336	224-427	144	108-199	1116	223-1116
Wpr-D	1077	424-2822	521	521-2986	1405	937-1786	603	453-830	4668	934-4668

Table 7 Cost-effectiveness ratios (CERs) and range of CERs (based on range of costs) in US$ per DALY averted for certain source- and household-based interventions to improve water quality

The below is all copied from the Discussion chapter of the WHO 2008 report:

"Among all water quality interventions to prevent diarrhoea, chlorination (SWS[2]) is the most cost effective, a finding that is consistent with that reported in the WHO World Health Report (WHO 2002). […] Solar disinfection is only slightly less cost effective, owing to its almost identical cost but lower overall effectiveness. Both of these interventions meet the Commission on Macroeconomics (CMH) definition for "highly cost effective" in each of the 10 WHO epidemiological sub-regions included in this analysis. Source-based interventions have mean CER about twice that of chlorination and solar disinfection, and would be considered "highly cost effective" in all but three regions (Afr-D, Amr-B, Wpr-B) where it meets the definition of "cost effective".

*Ceramic filters represent an opportunity to avert higher levels of DALYs with additional investment. This represents additional costs **and** benefits (positive incremental CERs) beyond household-based chlorination, and reflects a potential debate over the resources that individual householders or the public sector may want to deploy in order to achieve health*

[2] Safe Water System" (SWS) developed and promoted by the US Centers for Disease Control and Prevention (CDC)

returns. [...] Combined flocculation-disinfection was strongly dominated by all other interventions except under an assumption in which it can be implemented at its minimum cost. Source-based interventions as well as household-based solar disinfection are weakly dominated by household chlorination and household filtration at their respective point estimates for cost and effectiveness, but such dominance is lost when comparing interventions at their respective ranges of effectiveness and cost. In addition to this uncertainty about their actual cost-effectiveness, there are other reasons not to rule out these interventions completely or to choose among options solely on the basis of cost-effectiveness:

- *First, not all interventions are equally suitable under all circumstances. Household interventions may not be an effective alternative to source-improvements when water quantities are inadequate (Clasen 2006). Household chlorination may not be suitable in settings where the water contains a high level of turbidity or chlorine-resistant pathogens, challenges for which the flocculant/disinfectant was specifically designed (Souter 2003).*
- *Second, source-based interventions yield important benefits in terms of convenience and improved productivity that are not measured in this CEA (Hutton & Haller 2004). Third, user preferences may be more important than cost and effectiveness in scaling up these interventions on a sustainable basis (DuBois 2003).*

Direct cost offsets, even if limited to the WHO estimates of health cost savings, more than offset the costs implementing household-based water quality interventions. This means that governments, who are chiefly incurring such costs, would reduce their overall outlays by investing in the implementation of such interventions rather than in the treatment of cases of diarrhoeal disease. While a finding of such negative costs (i.e., income) are not uncommon in CEAs with high DALYs averted for relatively low costs, it should be noted that these estimates include only health costs offsets, and not other savings that are likely to inure to householders as they begin to adopt household water treatments, such as reduced fuel costs. As a cost-effectiveness rather than cost-benefit analysis, this study also omits the economic value of other benefits (including time savings) that have been shown to ensue from improvements in water supplies (Hutton & Haller 2004)."

8. Social Marketing

The **evidence** that reasons for people to reduce hygiene and sanitation related health risks are **hardly ever health driven** is considerable. Formative research in Kerala state in India suggests that people want to be hygienic for reasons of **comfort**, to **remove smells**, to demonstrate **love for children** and for **social acceptability** (Scott et al 2003). A study in Ghana highlights that motives for hygiene behaviour can be classified in desires **to nurture**, **to void disgust** and the desire to gain **social status** (Scott et al 2007). Health considerations are **not** among the top reasons for rural householders in the Philippines and Benin to be satisfied about their new latrines either (see box 4).

Box **4: Asked to prioritize reasons for satisfaction with their new latrines, rural householders in Philippines and Benin cited the following:**

Rank	Philippines	Benin
1	Lack of smell and flies	Avoid discomfort of the bush
2	Cleaner surroundings	Gain prestige from visitors
3	Privacy	Avoid dangers at night
4	Less embarrassment when friends visit	Avoid snakes
5	Less gastrointestinal infections	Reduce flies in compound

Note that health considerations are at the bottom of the Philippines list and even further down on the Benin list (13th place).

Source: Cairncross 2004 The Case for Marketing Sanitation. Water & Sanitation Programme. World Bank, Nairobi

That awareness, supported by the struggle and failure of conventional education top-down and supply-driven hygiene and sanitation interventions to bring about large-scale behavioural change in the past 25 years, has **created interest in using marketers to trigger behavioural change**.

Box 5: Six Suggested Recommendations as Hypotheses for Testing in the Development of Marketing Approaches for Sanitation in Benin:

1. Advertising campaigns should associate latrines (or other sanitation solutions) with positive values
2. The use of scientific explanations of disease transmission to promote latrines should be avoided
3. Improving latrine designs to enhance attributes important to drive satisfaction could increase their desirability over competing alternatives and lead to broader choices for consumers
4. Bundling the promotion of latrines with other highly desired housing improvements maybe an effective way to raise the image of latrines
5. Recognizing that different lifestyles and village environments give rise to different drives or dissatisfactions
6. Certain population groups may be very unlikely to adopt latrines, no matter how much promotion is done, and should therefore not be targeted.

Source: Jenkins and Curtis 2005

Social marketing is the application of **marketing** to achieve **behaviour change for social good**, and has previously been exploited in public health to achieve large-scale changes in health-related personal and household behaviours (e.g. use of bed nets to prevent malaria, condoms to prevent HIV, household disinfectant to treat drinking water) (Jenkins and Scott 2007). The objective of social marketing can **bring together** two sectors to pool resources which normally have **different responsibilities**: the **public** and **private** sector.

Social Marketing: Hand Washing with Soap

In some cases social marketing initiatives have proven to be **successful** in establishing the **behavioural change** that has been so difficult to achieve with conventional hygiene education programmes. The results of a campaign that involved a marketing approach to stimulate HWWS in Ghana reported that **hand washing** rates from baseline to follow-up **increased** by **13%** after using the toilet and by **41%** before eating (Curtis et al 2007). The Public-Private Partnership for Hand washing (at www.globalhandwashing.org), with the objective to reduce the incidence of diarrhoeal diseases in poor communities through Public-Private Partnerships (PPPs) promoting hand washing with soap, has initiated and reviewed PPP's for hand washing. Their website is very resourceful and, among others, the website contains the following documents:

- Public-Private Partnerships for Health: A Review of Best Practices.
- The Handwashing Handbook: A Guide for Developing a Hygiene Promotion Program to Increase Hand washing with Soap.
- Health in Your Hands: Lessons from Building Public-Private Partnerships for Washing Hands with Soap.

(see box 7 for a conclusion on social marketing taken from a study on hand washing in Ghana).

Box 6: Hopes and Desires: Marketers

Hygiene promotion is unlikely to be successful unless its messages are based upon the hopes and desires of the target population, an idea central to marketing. By borrowing techniques from industry, by investigating target audiences as consumers expected to make behavioral choices on a range of factors, including but not only health, we were able to propose novel means to promote safe hand washing behaviors. The nationwide program based on these approaches that is now up and running will be the target of intensive scrutiny, and lessons as to what works and what does not in changing behavior will be learnt. In the meantime, formative research offers a powerful tool in the hands of experienced researchers, to lay the ground work for effective behavior change programs. To successfully promote healthy hygiene behaviours we need a shift in our approach, to learn from marketers and, more importantly, from our target audiences themselves. Health may be in our hands, but it is not always in our heads.

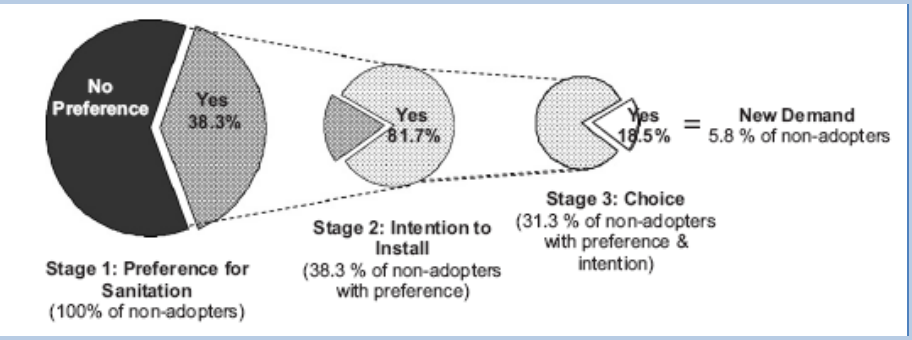
Source: Scott et al 2007

Social Marketing for Sanitation

A brief but comprehensive field note on the use of social marketing to promote household latrine adoption has been written by Sandy Cairncross (Cairncross 2004). The reasons to market sanitation are described as follows:

- Marketing ensures that people **choose** to receive what they want and are **willing to pay** for it.
- Marketing is **financially sustainable.**
- Marketing is **cost-effective** and can be **taken to scale.**
- **Provision of hardware is not enough** (those who buy a latrine will use and maintain it, opposed to subsidized latrines).

Box 7: In Ghana a survey to assess sanitation demand broke down the road to construct a latrine among those without such a facility in preference, intention and choice. The analysis showed that 81.7%, of the 38.3% of the households without latrines that have a preference for sanitation, has the intention to construct a latrine 'somewhere next year'. Only 18.5% of this group expressed a high likelihood of building a latrine within the next 12 months (choice, see figure below).
Marketing is unlikely to address some of the constraining factors withholding the ones with the intention to construct a latrine to move to the choice stage. Those factors include legal constrains for tenants, lack of pit emptying services and a lack of financing and credit options for home improvement. There public sector intervention is required. Marketing strategies aimed at the preference and choice stages do appear to be promising ways to increase household sanitation demand in Ghana.



Source: Jenkins and Scott 2007

The '**4P**' marketing approach suggested in that document (**Product, Price, Place and Promotion**) has been extend with a **fifth 'P'** (**Policy**) by Scott and Jenkins, as frequent local or national governments' policies can constrain the sanitation marketing process (Scott and Jenkins 2005). The fifth 'P' relates to Cairncross' idea of **state involvement** in marketing sanitation. The subsequent **new role** of the **public sector** is presented in Box 8. In a different article analyzing determinants of new demand for latrines in Ghana, Jenkins and Scott argue for the use of a strategy that uses marketing along with two other primary tools for behaviour change – **education and law** – to achieve public social or health goals, because **marketing alone can not overcome all the constraining factors blocking latrine adoption** (Jenkins and Scott 2007). The bottom-line is that the **public sector** should definitely **not merely hand over sanitation** improvement responsibilities to the private sector, but should **become a champion in enabling the private sector to serve consumers** efficiently. The initiation of a Public Private Partnership between governments and the private sector could facilitate this process.

Collaboration between the two inherently sheds light on **different responsibilities between the public and private sector** (the public sector has an interest to provide services for all, or in particular the poor, and not only those that can afford a latrine). A recommendation done by Jenkins and Curtis for development of marketing approaches in Benin states that: "Certain population groups may be very unlikely to adopt latrines, no matter how much promotion is done, and **should therefore not be targeted**" (see recommendation no. 6 in box 5).

Cairncross does allow for the **conditional use of subsidies** e.g. to offer low interest rate on loans, or to **temporarily attract attention** to the launch of a new marketing campaign, or to **subsidize businesses** that provide sanitation facilities and that wish to expend. "**Subsidies should [however] never be applied in a way which undermines the existing private providers in the market**". Nevertheless "constant monitoring of the working of the market is needed to ensure that public efforts and resources invested in the sector continue to benefit the unserved, and not only the privileged" (Cairncross 2004).

The evaluation of social marketing approaches to sanitation can provide insights in the feasibility of the above. Nevertheless, whether or not mechanisms are found that ensure the poorest of the poor will be served by the market; **if the market is able to sell** latrines to only 10% of the households that currently do not benefit from improved sanitation, **it should do so**. Box 7 illustrates the potential of a joint initiative between the public and private sector in Ghana could have to increase latrine demand.

Box 8: The New Role of the Public Sector in Promoting Sanitation:

The public sector must:

- Understand existing demand for sanitation, and what limits it;
- Overcome those limits, and promote additional demand;
- Stimulate development of the right products to meet that demand;
- Facilitate the development of a thriving sanitation industry; and
- Regulate and coordinate the transport and final disposal of wastes.

Source: Cairncross 2004

9. WASH and Primary School Education

Introduction

The consequences of poor water, sanitation and hygiene (WASH) on the primary education system go beyond the obvious health impact attributable to the WASH disease burden in the form of gastrointestinal infections. WHO has recently stipulated five positive effects of water supply, sanitation and hygiene in schools, namely (WHO 2009):

- The disease burden among children, staff and their families is reduced;
- Healthy children in healthy environments learn more effectively;
- There can be greater gender equity in access to education and meeting hygiene-related needs;
- Educational opportunities are created to promote safe environments at home and in the community; and
- School children can learn and practice life-long positive hygiene behaviors.

Below the evidence on the impact and importance of WASH on the primary education system is presented.

WASH Disease Burden and Education

Children who suffer from intestinal infections carry the disadvantage into school. 88% of diarrheal disease is caused by unsafe water supply, and inadequate sanitation and hygiene (WHO 2004). Subsequently, diarrhea contributes to absenteeism among school aged children.

- WHO has estimated that 1863 million school days would be gained due to less diarhoeal illness if everyone in the world had access to a regular piped water supply and sewage connection in their houses[3] (table 8).

In addition, infections with soil-transmitted helminthes (STH) (hookworm, roundworm, whipworm) directly reduce cognitive potential and indirectly undermines schooling through absenteeism, attention deficits and early dropout.

- The STH are one of the world's most important causes of physical and intellectual growth retardation (Lancet 2006).
- It is estimated that 47% of children in the developing world between the ages 5-9 are infected with any of the three main types of Soil Transmitted Helminthes: hookworm, or roundworm, or whipworm (Maternal and Child Nutrition 2008).
- Three hundred million people are severely ill due to worms and of those at least 50% are school-age children (AAW 2003).

Intervention attained	Annual number of schooldays gained [millions]
Water MDG	79
Sanitation MDG	193
Water and Sanitation MDG	272
Universal Improved Water and Sanitation	443
Universal Improved Water and Sanitation plus Point of Use Water Treatment	1431
Everyone has access to a regulated piped water supply & sewage connection in their house	1863

Children experiencing the debilitating effects of worm infections spend fewer days in school compared with those who are free from infection. For example:

- Children enduring intense infections with whipworm miss twice as many school days as their infection-free peers (WHO 2005).
- In children, chronic heavy-intensity hookworm infections are associated with growth retardation, as well as intellectual and cognitive impairments (Neglected Diseases 2005).

[3] The definition of infectious diarrhoea in the WHO 2004 study includes cholera, salmonellosis, shigellosis, amoebiasis, and other protozoal and viral intestinal infections

Table 8: Poor water and sanitation has a bearing on school attendance (Source: WHO 2004)

- As a result, the hookworm has been associated with impaired learning, increased absences from school, and decreased future economic productivity (Neglected Diseases 2005).
- Knowledge on disease transmission suggests that 100% of infections caused by these soil-transmitted helminthes can be prevented by adequate water, sanitation and hygiene (WHO 2007).

Tests have shown that a child's short-term memory, long-term memory, executive function, language, problem solving and attention respond positively to deworming. Interestingly, girls display greater improvements than boys (WHO 2005). Some facts on the burden of STH on education systems are:

- Estimates have been made of the quantitative costs of worm infections to cognition and education. The average IQ loss per worm infection is 3.75 points, amounting to a total IQ loss of 633 million points for the world's low-income countries (WHO 2005).
- A randomized study in India showed that addressing anemia (a symptom of worm infection) had important impacts on schooling and health (Policy Action Lab 2007).
- A recent randomized impact evaluation of a deworming program in western Kenya demonstrates that the worm burden in children attributed 25% of the overall absenteeism rates. School participation increased by 0.14 years of schooling per child treated with de-worming medication. This implies that eliminating the worm burden would add a year to the average child's education. Participation gains were especially large among the youngest pupils. (Policy Action Lab 2007).
- The total lost years of schooling due to worm associated absenteeism amounts to over 200 million years; almost all this loss occurs in low- and middle-income countries (WHO 2005).

Opportunity Costs of Children to Attend School

'Needed at home' and/or 'need to earn money' are major reasons why children, but especially poor girls, drop out of school in most countries (UNGEI 2003). Opportunity costs refer to labour time lost to the parent when the child goes to school. These opportunity costs of schooling are usually much higher for girls than for boys, since girls are expected to do more domestic work than boys (UNGEI 2003).

Girls often have to walk long distances to fetch water and firewood as well as look after young siblings.

- In India, for example, girls reported that before and after school they are always required to fetch water and often have to walk long distances to do so (UNGEI 2003).
- Project evaluations and research has found a 15% increase in school attendance in Bangladesh, when water was available within a fifteen minute walk compared to one of an hour or more. Similarly, a study in Tanzania showed a 12% increase in school attendance when

Box 9: Soil transmitted Helminthes and School Performance

Despite their educational, economic, and public-health importance soil transmitted helminthes remain largely neglected by the medical and international community. Over the past 5 years, however, the worldwide community has begun to recognize the importance of these infections after revised estimates showed that their combined disease burden might be as great as those of malaria or tuberculosis. Studies have also highlighted the profound effect of soil-transmitted helminth infection on school performance and attendance and future economic productivity. Such infections might also increase host susceptibility to other important illnesses such as malaria, tuberculosis, and HIV infection.

Lancet 2006

Box 10: Diarrhea and Cognitive Development

Most alarmingly of all—an even more serious consequence than the loss of physical stature and fitness—may be the association of early childhood diarrhoea and stunting with long-term decrements incognitive development and school performance.

The mechanisms that relate poor water and sanitation and early childhood diarrhoea to impaired physical and cognitive development probably involve impaired absorption of key nutrients or micronutrients, because of intestinal infection or inflammation during the critical period of early childhood development. Early childhood diarrhoea is the best single predictor of Test of Nonverbal Intelligence scores and even school performance at 6–12 years of age. Indeed the best surrogate predictor of cognitive development and school performance is height-for-age *Z* score at 2 years old (HAZ-2), the anthropometric measure that also best correlates with burdens of diarrhoea at 0–2 years old.

Lancet 2004

water was available within 15 minutes instead of being more than an hour away (Redhouse 2004 in IRC 2007).

WASH *in* Schools

Schools with poor water, sanitation and hygiene conditions, and intense levels of person-to-person contact are high-risk environments for children and staff, and exacerbate children's particular susceptibility to environmental health hazards (WHO 2009). The Centers for Disease Control and Prevention's recommendation (CDC 2007) of early closure of schools as a community mitigation measure in the event of a severe pandemic is a case in point. The extent to which schools embody effective hubs of feacal-oral disease transmission is a function of their level of adequate WASH facilities. The below chart (Koopman 1978).

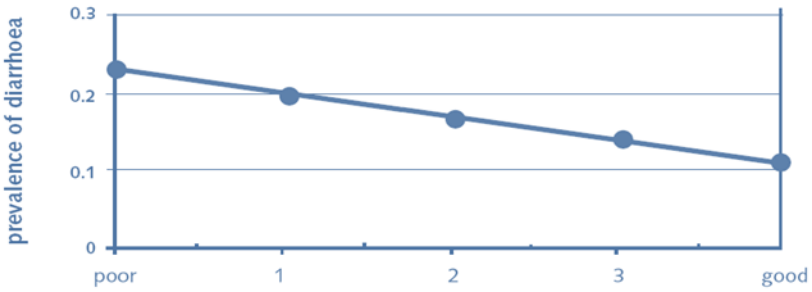


Chart 4. The association between level of water and sanitation conditions in primary schools and the prevalence of diarrhoea among primary school children.

Chart 4 shows the association between the prevalence of diarrhea (y-axis) and the level[4] of sanitation and water facilities in schools (x-axis) in Cali, Columbia[5].

In the above study, more than 40% of the cases of diarrhea in school children were attributed to **school transmissions** rather than transmission in homes.

Handwashing in primary schools

- A test on the presence of faecal pathogens in primary schools in Greece showed that on 52.9% of pupils' hands and on 16.7% of other school surfaces faecal pathogens were present (Kyriacou et al 2009)[6].
- A rigorous review shows that handwashing in institutions such as primary schools and daycare centers reduces the incidence of diarrhea by 30%[7] (Cochrane 2008).

Box 11: School Latrines and Diarrhea

In a 4-week period In early 1976 in a poor, working class area of Call, Colombia, the prevalence of diarrhea, vomiting, common cold, and head lice in schoolchildren were measured In relation to classroom size and to the condition of the school toilets. The study found that unhygienic toilet conditions were related to diarrhea, and it was estimated that if all schools could reach the modest level of hygiene of the two schools with the relatively best facilities, diarrhea would be reduced by 44% and vomiting by 34% (Koopman 1978).

Box 12: Lack of Handwashing in Primary Schools

- In Kenya an evaluation a WASH in schools evaluation reports that only 5 out of 100 schools had soap available for children. Less than 2% (only 21 out of 951 of the children) were observed to wash their hands with soap (IRC Kenya).
- An evaluation conducted in India shows that handwashing before eating in the school was far more frequent in districts with UNICEF WASH supported WASH in School programmes than in control districts. However soap was very seldom used when washing hands (2% or less of the children), which seriously compromises the effectiveness of handwashing (IRC India).
- A 6 country evaluation of SSHE pilot programs in Burkina Faso, Colombia, Nepal, Nicaragua, Vietnam and Zambia the availability of soap was a major problem in most of the schools. "This jeopardizes the educational effort promoting the use of soap and results in a low proportion of students washing hands with soap. Soap is not available for various reasons such as for fear of it getting stolen or because it is too expensive for the school to buy. This is an area of great concern" (IRC 2006).

[4] Level is defined by the functionality of latrines, cleanliness of latrines and the number of water outlets near to latrines per 100 students

[5] Sample of 9.800 primary school children in Cali, Columbia.

[6] Boys exhibited higher levels of contamination. The educational level of parents correlated well with the contamination of children's hands.

[7] These are results of a rigorous Cochrane review of 8 trials in institutions (primary schools, day care centers, or classrooms in day care centers). The incidence of diarrhoea was assessed in 7711 children aged less than seven years in 161 day-care centres and 87 schools in the eight trials. All but one trial were conducted in high income countries. Although this review shows that hand washing can be effective, most of the trials should be regarded as 'efficacy' trials in the sense that they include intense follow up and monitoring (all contacted intervention communities at least fortnightly, some more often to ascertain diarrhoea episodes and reinforce the hygiene promotion messages);many also provided handwashing materials and replenished supplies regularly (Cochrane 200*)).

- Expanding a standard handwashing promotion programme in Chinese primary schools by the continuous provision of soap in schools and the recruitment of a *"student handwashing champion"* in each school reportedly resulted in 42% lower absence incidence, and 54% fewer days of absence compared to schools without such an intervention (Bowen et al 2007).
- Children in primary schools in Bogota Columbia who reported proper handwashing behaviors in schools were 20% less likely to report absenteeism (Lopez-Quintero et al 2009).

Sanitation, Menstruation, and Attendance

For girls sitting in class all day without the facilities to clean themselves and their rags in privacy, menstruation can lead to extreme discomfort and embarrassment.

- The average woman menstruates once every four weeks for three to five days. Using the average of four days per period, most girls bleed 52 days every year - almost two months cumulatively, or 14 percent of the year. This means that each year, a girl having reached puberty, has her cycle thirteen times.
- WHO writes that up to 12% of the school year missed by girls is during their menstruation (WHO 2009).
- No systematic or rigorous research has been conducted on the relationship between the lack of appropriate sanitary facilities and the drop-out rate of adolescent girls. And although data on the topic is scarce and from a limited number of countries, the association between sanitation and attendance is likely to exist globally (Kirk and Sommer 2006).

This section looks at the evidence that supports such claims. None of the results are published in peer reviewed articles, and not all have statistically significant outcomes. The various factors affecting school attendance are too numerous to make a claim for a causal relation between school sanitation and attendance rates. Yet, the studies do suggest that the absence of sanitation facilities and water in schools does play a role in girls dropping out of school.

- A study undertaken in Bangladesh revealed an 11% increase in girls' enrolment mainly due to the provision of sanitary latrines. (IRC 2007). In fact, a key factor in the rapid expansion of female enrolments in secondary schools in Bangladesh since the early 1990s has been the provision of a healthier and safer setting for girls by improving standards of water supply and sanitation (UNGEI 2003).
- One study in Uganda found that 1 in 3 girls missed all or part of a school day during their menstrual cycle (Kirk and Sommer 2006).
- In Alwar District, India, school sanitation increased girl's enrolment by one-third, and improved academic performance for boys and girls by 25% (UN-Water 2008).
- A WASH in Schools evaluation in Kenya indicated that girls were absent less in schools where there was more handwashing and a very high toilet use. The association suggests that in one way or another, the successful implementation of the WASH package in a school can significantly reduce girls' absenteeism, a substantial and highly desirable impact from the project[8] (IRC 2009a).

Water Supply in School

No evidence on the importance of water in schools has been found, most likely because its importance is evident. Comment 15 on the right to water under the International Covenant of Economic Social, and Cultural Rights underscores the importance and urgency of adequate water supply in schools:

[8] The same was not true for boys which might imply that in schools where toilets are not available, convenient, private and hygienic and where handwashing is not practicable, it is more likely that girls will stay at home during menstruation; it has often been claimed that this occurs, but until now most of the evidence has been anecdotal.

State parties should take steps to ensure that children are not prevented from enjoying their human rights due to the lack of water in educational institutions and household or through the burden of collecting water. Provision of adequate water to education institutions currently without adequate drinking water should be addressed as matter of urgency General Comment No. 15 (2002).

	Proportion of primary schools with adequate sanitation facilities for girls?	Proportion of primary schools with adequate sanitation facilities for boys?	Proportion of primary schools with adequate water supply?
Central African Rep	8%	8%	15%
Guinea-Bissau	10%	10%	10%
Togo	10%	10%	10%
Mali	14%	14%	45%
Chad	14%	14%	17%
Zambia	15%	27%	59%
Tajikistan	17%	17%	55%
Ethiopia	20%	20%	33%
Niger	22%	25%	5%
Madagascar	24%	24%	13%
Kenya	25%	30%	20%
Nicaragua	28%	28%	48%
Sudan	38%	38%	58%

Table 9: This table illustrates the urgency of WASH in school facilities in selected countries. Source: UNICEF WASH Section

Box 13: Data on Sanitation in Schools

- Interestingly, studies in the United Kingdom and Sweden indicate that 72% and 28% of school children respectively avoid defecating at school (Lopez-Quintero et al 2009).
- An evaluation of WASH and school facilities in carried out in 100 schools spread over 3 districts in Kenya shows that less than one in three of the flush toilets are working as flush toilets. In schools where children found toilets were clean, a higher proportion of the children reported using them. Similarly, for both boys and girls, toilets that afforded more privacy were used more. About two out of three girls and also boys in Nairobi school classes indicated that they were afraid of teasing or bullying when they were near or in the toilets (IRC 2009a).
- An evaluation of the sustainability of WASH in School interventions in 300 upper primary schools (for children aged 6 to 13) in the southern Indian state of Kerala only 7% to 10% of the children said, in the anonymous voting, that they used the school toilet over the past week. Attendance records of the children for the preceding month were compared between the intervention and control schools. These did not show significant differences among the three districts. (Furthermore, there was no evidence in the data to suggest that the cleanliness of toilets led to better school attendance by children) (IRC 2009b).

Health and hygiene education in schools

Any action to address health issues at the school level needs to be designed according to what is known to work. [9] Evidence shows that school health programming is most effective when a coordinated "combination prevention" approach is planned and implemented. This requires the design of activities across biomedical, legislative, structural and behavioural measures. The key to the effectiveness of combined approaches lies in the reinforcing effect of activities across each of the measures. De-worming services are supported by hygiene education that helps children prevent re-infection, and by water and sanitation facilities that prevent re-exposure. Policies guaranteeing gender equity become more than paper promises when girls have access to appropriate water and toilet facilities at school, and when they are supported by education that addresses the way boys and girls define themselves and each other. In a nutshell, programmes that include activities across biomedical, legislative, structural and behavioural measures are simply more effective than piecemeal, single-strategy approaches (all from WHO/UNICEF/World Bank/UNFPA 2004).

[9] WHO, UNICEF, UNESCO, World Bank, UNFPA, Education Development Center, Education International, Partnership for Child Development, *Skills for health: An important entrypoint for health promoting/child-friendly schools*. WHO, Geneva, 2004.

10. WASH and People Living with HIV/AIDS (PLHA)[10]

Health Burden

Diarrhea is a very common symptom of HIV and AIDS, it affects 90 percent of PLHA, it becomes more frequent and severe as the immune system deteriorates, and results in significant morbidity and mortality (Katabira 1999; Monkemuller and Wilcox 2000). In a study in India, PLHA reported 20% higher levels of diarrhea than the general public (WSP 2007). Further, diarrheal illness in PLHA can interfere with and compromise the absorption of antiretroviral (ARV) drugs and can even contribute to developing HIV strains that are resistant to antiviral agents (Bushen et al 2004). The consequences are even more severe in children with HIV and AIDS. A study of HIV-positive infants in the Democratic Republic of Congo found that the risk of dying from diarrhea is 11 times greater than for infants who were HIV-negative (Thea et al. 1993). Another study found that HIV-positive babies with acute diarrhea were six times more likely to develop persistent diarrhea. HIV-negative babies born to HIV-positive mothers were also at 3.5 times greater risk of developing recurrent bouts of diarrhea than babies born to HIV-negative mothers (Keuch et al. 1992). Gastrointestinal infections are the predominant cause of diarrhea in PLHA (Katabira 1999).

Box 14: Opportunistic Infections

Diarrheal diseases are the most common opportunistic infections (OIs) experienced by people living with HIV and AIDS (PLHA) in Africa and elsewhere.An opportunistic infection is an infection caused by pathogens that usually do not cause disease in a healthy immune system. A compromised immune system, however, presents an "opportunity" for the pathogen to infect.

Quality of Life

The negative impact of low access to necessary quantities of water, to water of reasonable quality, to basic sanitation and hygiene are magnified for HIV-infected individuals. Ensuring proper WASH practices benefits those infected with HIV and AIDS by keeping them stronger, well nourished, and can prolong life and improve the quality of life for PLHA - and can also protect family members and caregivers from contracting diarrhea. This, in turn, helps to keep households economically viable and generally resilient for longer periods of time.

Bathing and proper hygiene at end-stage has two clear benefits: preserving the dignity of the PLHA and protecting caregivers and household members from infection with other disease-causing pathogens.

Box 15: HIV and Feces

Feces itself presents little risk of HIV infection though great risk of transmitting diarrhea causing pathogens. HIV has never been isolated in urine or feces, and international guidelines all rate the risk of HIV infection from feces itself to be low to none, although blood and pus in stools can present some risk so universal precautions are recommended for handling feces. Nonetheless, other infectious agents that cause diarrhea are easily transmitted to caregivers and other household members unless fecal matter is cleared away quickly and thoroughly with water and a cleaning agent. (USAID 2008)

Access to Water

Accessible, plentiful supplies of water facilitate and encourage better hygiene in general, and more hand-washing in particular (Curtis et al 2000). But if the total time taken per water collection round trip exceeds 30 minutes, people tend to collect significantly less water, thus compromising their basic water needs (Carincross and Feachem 1993). Evidence indicates that HIV affected households require more than the basic 20 liters of water per capita daily (WSP 2007). For end-stage bed-ridden PLHA in Botswana for example, caregivers reported requiring 20 to 80 additional liters of water per day, depending upon the severity of the patient's symptoms, especially diarrhea. (Ngwengya 2006). Other more anecdotal accounts refer to an average reported water need for home-based care of 100L for laundry and 100L for cooking, bathing, and drinking (Molose et al 2007). Women in southern Africa required 24 buckets of water a day to wash PLHA as well as the clothing and bedding and the house, especially during bouts of extreme diarrhea (Kamminga 2006).

[10] This complete section is basically a summary of evidence mentioned in the following three documents: USAID 2007, USAID 2008, WSP 2007

Water Quality

A study conducted in Uganda showed that the use of a simple, home-based safe water system consisting of a chlorine solution to disinfect water and storage in a container with a narrow mouth, lid, and a spigot reduced the frequency (by over 30 percent) and severity of diarrhea in PLHA (Lule et al. 2005). Safe water in combination with a locally available preventive antibiotic (Cotrimoxazole) reduced diarrhea episodes by 67%, days with diarrhea by 54% and days of work or school lost due to diarrhea by 47%.

Further, when infants are weaned from HIV positive mothers, a safe water source must be used to mix formula or the babies will be at greater risk for dying from diarrheal diseases. In the first two months, a child who receives replacement feeding is six times more likely to die than a breastfed child (UNICEF 2002). However, the official recommendation from the Inter-Agency Task Team on Feeding and HIV/AIDS is that exclusive breastfeeding is recommended for HIV-infected mothers for the first six months of life unless replacement feeding is acceptable, feasible, affordable and sustainable and safe for them and their infants before that time (WHO 2006).

Access to Sanitation

Only one study is available that found improved sanitation can improve the health of PLHA. The 2005 Lule study did not have sanitation as an intervention, however, researchers recorded the latrine access of all participants in the study and found that the presence of a latrine in the family compound was associated with fewer episodes of diarrhea (31%), fewer days with diarrhea (27%), and fewer days of work or school lost due to diarrhea (27%).
Kangamba (2006) and Lockwood (2006) found in Zambia and Malawi respectively that most home-based care clients had a latrine, but in many cases lack of water rendered these (flush) latrines unusable. Further, at least 20 percent of the latrines in both studies were poorly maintained, with fecal matter around them indicating prime transmission sites for water-borne pathogens. Barriers to improved sanitation were evident in both countries: inhospitable soils often led to latrine collapse; cultural beliefs prevented use; and cost, lack of donor interest, and fewer adult male headed households prevented new latrine construction.

Hygiene Practices

In a study on the effects of hand washing with soap on diarrhea rates in PLHA in the United States, Huang and Zhou found a 58 percent reduction in diarrheal incidence (Huang 2007). In a study of male sexual partners of Kenyan women with genital symptoms, Meier et al (Meier 2006) found that men with reported lower hygiene behaviors were more likely to be HIV positive than the women's other sexual partners. It has also been suggested (Short 2006) that post-coital penile hygiene can reduce HIV transmission in men. This supports evidence that circumcision protects men from HIV infection, presumably because, in part, circumcision makes penile hygiene easier. It should be noted that post-coital douching in women is not recommended (CDC 2007) as it dilutes the anti-viral properties of the acidic vaginal secretions and can flush vaginal pathogens up through the cervical os.

Although solid field research provides evidence that hand washing can decrease respiratory infections in people with full immune systems (Luby 2005), no similar research has been done on PLHA. Additionally, ample evidence exists that improved body hygiene (daily bathing) and regular laundering of clothing and bed linen decrease skin infections and skin parasites (scabies, lice, bed bugs, etc) in people with full immune systems and is also considered to be such a basic part of human dignity, that no other research is needed to justify their integration into HIV/AIDS programming (USAID 2007)

Resources on HIV/AIDS and WASH
A useful resource for programme guidance is: **USAID 2008**: http://www.hip.watsan.net/page/2458
More information on PLWA and WASH can be found in **WSP 2007**: http://www-wds.worldbank.org/servlet/main?menuPK=64187510&pagePK=64193027&piPK=64187937&theSitePK=523679&entityID=000310607_20071003160417.

10. WASH and Nutritional Status

Introduction

Gastro-intestinal infections can affect nutritional status, and on the other hand, malnutrition can predispose to infection (see fig. 1). Water, sanitation and hygiene are closely linked to childhood malnutrition (WHO 2007). A lot of valuable applied research published since 1968 has confirmed the deleterious effect of diarrhea on children's nutritional status and has produced new evidence in support of revised approaches to prevent and treat these illnesses (promotion of breastfeeding, supplementation of micronutrients) (Brown 2003). Nevertheless, knowing that

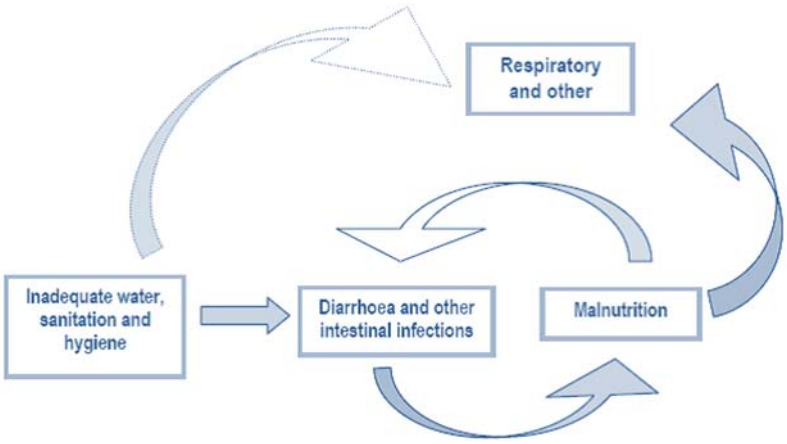


Chart 5: The synergistic interaction of intestinal infections, malnutrition, and others. Source: WHO 2007

- **88%** of all cases of diarrhoea globally are attributable to water, sanitation and hygiene (WHO 2002, PFC 2005).
- **100%** of all the annual cases worldwide of Ascaris (**roundworm**), Trichuris (**whipworm**) and **hookworm** infestation are attributable to inadequate sanitation and hygiene (Prüss-Üstün et al., 2004).

…it is more than sensible to argue that interventions aimed to reduce the burden of intestinal infections should be accompanied by measures that **tackle the root cause** of the problem. This section focuses on the evidence that reducing diarrhea in general and intestinal worms through improved WASH (especially sanitation) positively affects nutritional status.

Box 16: Malnutrition

Malnutrition is both a health outcome and a risk factor for infections and exacerbated malnutrition, and it can increase the risk of morbidity and mortality of many infectious diseases. Infectious diseases are the main killers of children under the age of five years in developing countries, and malnutrition is the underlying cause of about half of these deaths.

WHO 2007

Diarrhoea and nutritional status

The synergistic relationship between malnutrition and infection is clearly exacerbated in diarrhoeal episodes as children tend to eat less during episodes and their ability to absorb nutrients is reduced. Each episode contributes to malnutrition, reduced resistance to infections and when prolonged, to impaired growth and development (Ejemot et al., 2008). And although there can be contributions to growth faltering from respiratory illnesses, or malaria, the role of diarrhea seems to be particularly important, perhaps because of its association with mal-absorption of nutrients, as well as anorexia and catabolism (Black et al., 2008).

Box 17: Stunting

Of an estimated 178 million children aged younger than 5 years who are stunted (ie, have a height-for-age Z score of less than −2) most live in sub-Saharan Africa and south-central Asia. 160 million (90%) stunted children live in just 36 countries, and make up 46% of the 348 million children in those countries.

Bhutta et al.2008. The Lancet

Reduced diarrhoea leads to reduced stunting:

- Data pooled from 9 longitudinal studies (Bangladesh 1, Brazil 2, Guinea-Bissau 2, Ghana 1, Peru 3), demonstrates that the adjusted **odds of stunting** at 24 months of age **multiplicatively increased by a factor of 1.05 with each episode of diarrhoea in the first 24 months of a child's life** (Black et al., 2008).

- As a consequence, in another paper of The Lancet Series on Maternal and Child Undernutrition (Bhutta et al., 2008), of several disease prevention strategies that reduce the burden of infections (and hence affect nutritional status), hygiene interventions (hand washing, water quality treatment, sanitation and hygiene) were selected among the **core interventions** to affect nutritional status.

Evidence of sanitation as a preventive intervention for stunting

- Children with **worst** WASH conditions (water source, water storage and sanitation) in Peru were **1.0cm** shorter in stature and had 54% more diarrhoeal episodes than did those with the **best** conditions. Water supply improvements did not have a profound impact on nutritional status when not accompanied by improvements in sanitation (Checkley et al., 2004. The Lancet).
- Data collected in the late 1980's from eight countries in Sub-Sahara Africa, Asia, North Africa, and the Americas were combined and analyzed (sample size almost 17.000). It showed that improvements in **sanitation** were associated with increases in height ranging from **0.8cm to 1.9cm**. Differences of such magnitude are not always found following nutritional interventions (Esrey 1996).

Intestinal worms – Sanitation as the Preventive Solution

The negative impact of worm infections on children's cognitive development was already discussed in section 9. This section presents the evidence worms have on childrens's nutritional status only.
Table 11 gives an overview of the prevalence of children under 5 infected with the main types of intestinal nematodes. The number of children between 5 and 10 years old that are infected with any of the three main types of nematodes are listed in table 10.

World Bank Regions	Infected [millions]	Infected [% of Population]
Asia and West Pacific	76.6	61.7
South-east Asia B	18.3	64.3
South-east Asia D	55.5	37.7
Americas B	15.8	35.2
Americas D	5.8	63.3
Middle east B	1.1	7.1
Middle east D	7.3	15.5
Africa D	24.4	54.7
Africa E	31.7	61.1
Total	**242.8**	**47.3**

Table 10: Number of children per region between 5 and 10 infected with any of the three common species of nematodes: Ascaris or Trichuris or hookworms. **Source:** Hall et al., 2008.

Regions	Population [millions]	Ascaris [millions]	Trichuris [millions]	Hookworm [millions]
Latin American and Carribean	530	8	10	1
Sub-Sahara Africa	683	28	26	9
Middle east and North Africa	313	3	1	0
South Asia	363	13	10	2
India	1027	15	8	2
East Asia and the Pacific	564	20	16	4
China	1295	35	15	3
Total	**4775**	**122**	**86**	**21**

Table 11. Number of children under 5 infected with the main types of nematodes. **Source**: Hall et al. 2008

The number of children carrying worms in their gut is astounding, but to what extent do worms affect a child's nutritional status? It has been reported that Ascaris diverts about one third of the nutritional intake of a child with a

typical worm burden. Hookworm is a major cause of anaemia. Trichuris is a serious cause of stunting in children, and of chronic colitis in toddlers, so long-lasting that their mothers rarely think of taking them for treatment as they tend to think that this diarrhoea is a normal condition for these children (Cairncross 1998).

A **Meta analysis** of the effects of de-worming studies on nutrition status of children was conducted by Hall et al (2008) and shows the burden of worms is significant. In the analysis it was not possible to say anything conclusive about the absolute magnitude of any effects of giving treatment, for a number of reasons (the initial degree of undernutrition, the age and current health of subjects, treatment duration and treatment dose, type of worms etc). Nevertheless, the meta-analysis indicates that if the prevalence of intestinal nematodes is 50% or more, then giving anthelmintic drugs leads to significant extra gains in weight, height, mid-upper arm circumference and skinfold thickness in comparison with untreated controls. The most striking outcome is that the pooled result of 11 de-worming studies with a total of 33,860 participants shows an average weight gain of **210 gram in children** (a considerable average impact in terms of nutritional status).

Yet, de-worming is essentially an end-of-pipe solution: *"Knowledge on disease transmission suggests that **100% of intestinal nematode infections** can be prevented by adequate **water, sanitation and hygiene**. Several studies on the reinfection by intestinal nematodes (Norhayati et al., 1995) show that reinfection rates are relatively high after treatment. For example, in a study of over 1800 children in Brazil, Moraes and Cairncross (2004) found that sewerage and drainage infrastructure could significantly reduce transmission (and reinfection**). This suggests that long-term strategies incorporating education on personal hygiene, provision of toilets and of access to safe water are important elements in strategies to sustainably reduce the disease**" (WHO 2007).*

Box 18: Worms and Hand Washing

A WELL Factsheet on hand washing brings to light that the association between hand washing with soap and reduced ingestion of Ascaris and Trichus eggs seems likely (Ascaris eggs have an especially 'sticky' nature and they have been found adhered to money, agricultural produce, cutlery, crockery and hands), but only one single study has investigated this. This study showed no difference both in intensity and prevalence of Ascaris infection between the two trial groups. The study was however a short trial which did not allow for sufficient time for reinfection, did not control for confounding variables, including household clustering and in general was (too) limited in size. Other studies have included hand washing and/or the availability of soap in the household in their risk factor analysis. The evidence of these studies again suggested a protective effect but were in most cases confounded by sanitation and socio-economic status of the households involved. There is no clear association between hookworm infection and hand washing with soap, as hookworm disease is caused by a larvae which penetrates the skin in contact with contaminated soil.

WELL Factsheet on Hand Washing with Soap

11. Safe Disposal of Children's Feces

The handling and disposal of children's feces merits special attention.

In many cultures, the feces of children are regarded as less harmful than other feces, when in fact they are more likely to contain pathogens (USAID 2008)

Nevertheless, a review of 33 studies shows that 30% of the time children's feces are not discharged or removed from their original defecation site (EHP 2004).

The unhygienic disposal of children's feces is one of the key factors responsible for the high incidence of childhood diarrhea in developing countries (Lanata et al 1998).

Figure 6 illustrates that of all the feces not safely disposed of within a community, unsafe toddlers' feces disposal is probably the most important contamination in the household environment with the highest risk of exposure to young infants (EHP 2004). And it's the young infants in particular who need to be protected from contact with fecal matter (see box 19).

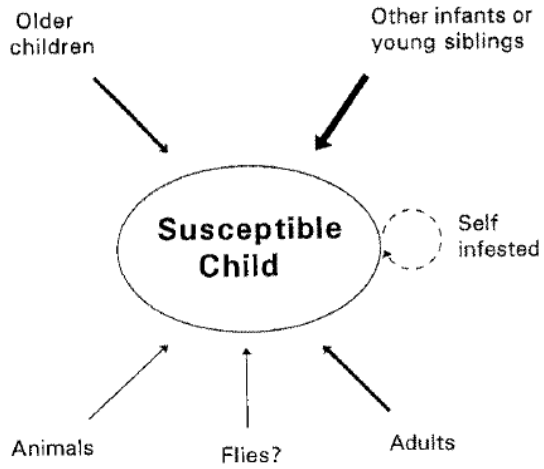


Chart 6. Of all feces those of other infants or young siblings pose the greatest threat to a young child

Are infant's feces a danger to themselves?

- Feces of children under 2 years of age, with few exceptions (e.g. shigellosis), are seldom a threat to themselves for the development of diarrheal diseases (Lanata et al 1998).

Box 19 The importance of protecting children under 2 from diarrheal diseases

Diarrhea morbidity and mortality rates are greatest in the first 2 years of children's lives, when they are more susceptible because of their lack of immunity (Black and Lanata 1995). Out of the 1.5 million children who died by diarrhoeal disease in 2004, 80% were under two years old (WHO/UNICEF 2009)

But young children are also at greater risk of the detrimental consequences than adults (life-threatening dehydration) since water constitutes a greater proportion of children's bodyweight (WHO/UNICEF 2009).

Besides death and disease, early childhood diarrhea has other significant consequences.

Cognitive Development:

- Early childhood diarrhea is the best single predictor of Test of Nonverbal Intelligence scores and even school performance at 6–12 years of age (Lancet 2004)

Growth

- 25% of all stunting in 24-month-old children is attributable to having five or more episodes of diarrhea a year (Checkley et al 2008).

What about feces from older children and adults?

- Feces from older children and adults also represent a low direct threat to a susceptible child, not only because they seldom develop diarrhea (therefore the concentration of a pathogenic organism in the stool is lower) but most importantly because they seldom defecate in an area where a susceptible child would be[11] (Lanata et al 1998).

In contrast, feces from young infants and toddlers, in particular when they have diarrhea, represent the greatest threat to a young child.

Incidence of diarrhea

In a meta analysis (EHP 2004) of 13 studies that measure to what extent unsafe disposal of children's feces in fact leads to increased incidence of diarrhea in children under 5 the authors found that:

> *When hygiene behaviors or defecation practices were classified either as protective (use of latrines, nappies, potties, toilets, washing diapers), or as risky (open defecation or stool disposal, stools not removed from soil or stools seen in household soil, child seen eating feces), in a meta-analysis of these studies risky behaviors were associated with a significantly increased risk (**23%**) of diarrheal diseases.*

Practices

The survey and structural observation data in the report (EHP 2004) evoke the differentiation between three stages in the disposal of children's feces:

1. Where the child defecates:
   Cloth diapers/nappies, potties, on household soil/yard, latrines, rivers or open fields
2. Final destination of the feces (disposal by caretaker)
   Washing cloth diapers, burying, disposed in latrine, discharged outside compound, disposed in rivers, or not disposed off at all
3. Hygiene practices after disposal
   Children's' handwashing (either by child or by caretaker), Child's bottom cleaning, handwashing of caretaker

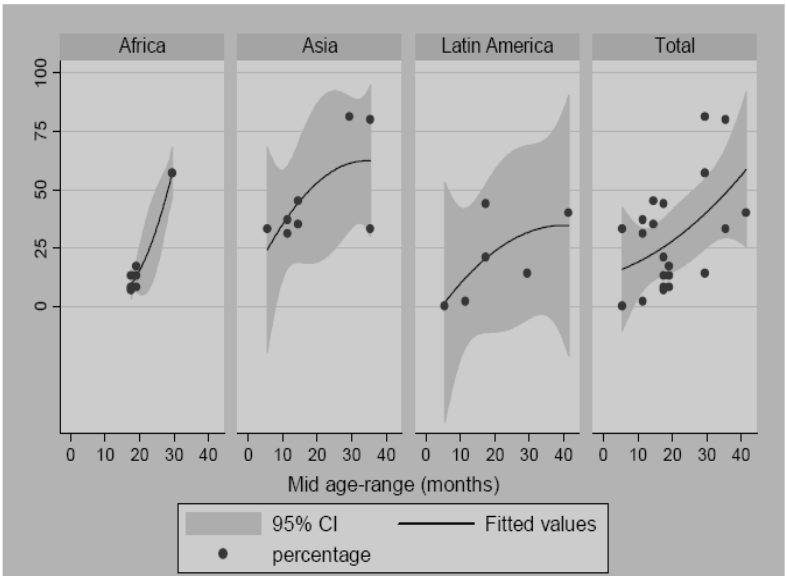


Chart 7 Prevalence of defecation in the household's soil or yard by children in developing countries, by age and region (Source: EHP 2004)

[11] In communities where adults and youth do not use latrines, it's safe to assume they at least do not practice open defecation within the household compound (while toddler's feces are often prevalent within the compound). Shoes, bicycle tires, animal hooves, rainwater runoff, however, may all transport feces of adults back towards the household compound.

From the above categorization must be inferred that the final destination of the feces and the hygiene practices are more critical than where the child defecates. For example: one cannot say that potty use is a hygienic practice, unless the caretaker empties the potty in a safe location (e.g latrine). And washing diapers is only safe when the grey water is disposed of safely and handwashing with soap is practices afterwards.

Other important conclusion are that all three practices within the above 3 categories are to a large degree a function of the age of the child. To some extent this is quite intuitive (e.g. caretakers do normally not prefer to use cloth diapers after the second birthday of a child). But age is an important factor for all practices (in place of disposal, final disposal and hygiene after disposal). Figure 2 is an example of the prevalence of a practice (defecation on household soil = y-axis) plotted against the age of a child (in months = x-axis), and shows that open defecation within the household increases as the child grows older.

Moreover practices differ per region and within countries. Figure 8 illustrates how handwashing rates after disposal in Africa and Latin America are a function of the age of the child, but the differences between the two continents is significant (NB, handwashing was largely done without soap).

The differences are linked to levels of socio-economic development but as well as cultural differences

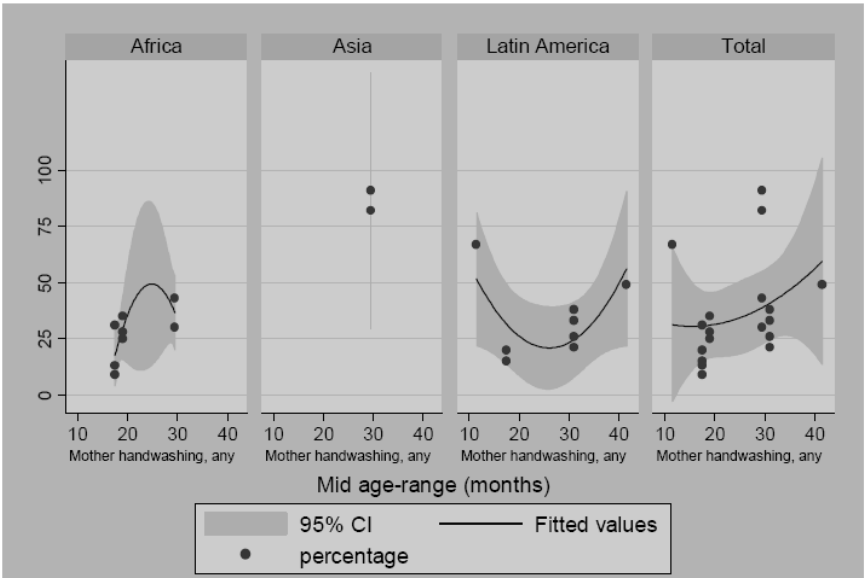


Figure 8 Prevalence of the mother/caretaker's handwashing after attending the child's defecation/cleaning, in developing countries, by age and region (Source: EHP 2004) NB, for this practice there wasn't any good data from Asia. NB handwashing was largely done without soap

Promotion of Children's feces

To acknowledge the above has implications for how safe disposal of children's feces is promoted.

- Promoting a single technology is not satisfactory, because any technology is age-dependant (e.g. diapers, potties, latrine usage), and secondly, because the final disposal of a child's feces is more critical.
- Hygiene practices after disposal are often inadequate. The limited prevalence of handwashing with soap after cleaning up a child requires attention.

The bottom line is that whichever type of technology is used, hygienic behaviors determine if feces are adequately removed from the environment.

Formative research in Peru (Yeager at al 1999) about the motivations of mothers to treat children's feces the way they do resulted in the following:

- The effort required by the method
- Perceptions of dirtiness of children's feces
- Availability of resources/facilities
- The age of the child

One interesting finding is that among caretakers latrines were not considered appropriate for children between 3-4 years old. Not acknowledging this, the author conclude, explains how efforts that have been concentrated on the promotion of latrines have failed to induce their utilization by children.

> *Instead, sanitation projects should incorporate interventions that will promote hygienic defecation and stool clearance practices for infants and small children. Such interventions should include the proper elimination of contaminated waste water from washing soiled diapers … and the elimination of open defecation in the household or nearby areas. (Yeager et al 1999).*

Implications for Sanitation Programming?

Both the importance and the limited use of the safe disposal of children's excreta invoke questions about the extent Community Approaches to Total Sanitation (e.g. TSC, SLTS, CLTS) in fact include the management of children's faces in the definition of "total sanitation". Secondly, if the management of children's feces is promoted it's interesting to know how that is done and how effective it has been.

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