



A Review of the Evidence Base for WASH interventions in Emergency Responses

Discussion document

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Executive summary

Inadequate sanitation, inadequate water supplies and poor hygiene are critical determinants for survival of victims of natural disasters and conflict situations, especially in the initial stages of a disaster. The most significant are diarrheal diseases and infectious diseases transmitted by the faeco-oral route and a combination of these factors means that people affected by disasters are also generally much more susceptible to illness and death from disease.

The traditional response by relief agencies in emergency situations has been to install water supply points and latrines. But experiences have clearly demonstrated the limitations of this approach. More recently hygiene promotion has taken increasingly greater predominance as an integral part of relief agency operations. However, these experiences are diverse and this has led to questions about which type of hygiene promotion activity is most effective and how.

Consequently, in the course of the extensive inter-agency consultation, it has emerged that much of the existing evidence base which underpins decision-making for WASH interventions in relief operations is extrapolated from the development sector. It is unclear to the extent to which it is appropriate and relevant in emergency contexts. The primary aim of this assignment was therefore to explore whether it is considered appropriate to apply the existing evidence base for WASH interventions to support emergency operations as it stands and, if not, to consider what activities may be required to improve the evidence base.

The aim of the assignment was to review and assess the existing evidence that supports WASH interventions in the emergency context – namely those related to water supply, sanitation and hygiene promotion. For this purpose, a wide range of papers and reports, both published and unpublished were reviewed. Parallel to this, we contacted various relief agencies and leading academics working on various research activities related to the epidemiological aspects of WASH. The consultation involves telephone interviews and responses to a set of questions designed to promote further discussion on key issues.

There are a number of key papers written by researchers who have carried out a meta-analysis of other studies with the aim to collate and synthesize the existing knowledge base. These aggregate the results from other studies but the majority of studies have been undertaken in the development context and the division between the two is fuzzy and this has implications on the types of intervention that are most appropriate.

Although there is some expected variability in the results, on the whole these studies pronounce hygiene promotion as the most favorable intervention in terms of its effectiveness to reduce the incidence of diarrheal disease. The second most favorable is treatment of water at point of use followed by sanitation and finally water supply systems with treatment prior to distribution.

Although the results of these meta-analyses are indicators of the relative merits of different types of intervention, there are some limitations which confound the interpretation of the results especially for the emergency situation. The interventions themselves and the context in which these were implemented vary enormously and this may mean that a direct comparison between the two is not necessarily appropriate. The lack of blinding and randomness within the selected sample individuals mean that the measure of effectiveness is more akin to efficaciousness – i.e. the capacity or power to

produce a desired effect. This means that although the studies serve an important purpose i.e. to highlight the potential of hygiene promotion and treatment at point of water use, the actual values should be treated with caution within the context of WASH programming.

These observed weaknesses in the evidence base for WASH interventions are notably apparent within the context of emergency responses due to wide variety of social, physical and environmental contexts and the rapidly changing conditions associated with these factors. Thus, we conclude that although the evidence base serves to highlight the importance of hygiene promotion and treatment of water at point of use, there is a danger that this may detract attention away from the need to install water supplies and basic sanitation facilities.

It is important to note that the priorities from the perspective of affected populations will invariably be water supply and sanitation as these are required for other reasons other than health and hygiene. As in the more stable, development context, the interrelation between the facilities and behavior combine to result in ensuring that the disease transmission pathways are broken. Although there are some contradictory results from the evidence base about the benefits of combining interventions, intuition suggests that there is a need for water supply, sanitation, and hygiene promotion and where quality of water is compromised by contamination between the point of collection and consumption, there is a need to consider treatment at point of use.

Most of the specific evidence (quantative epidemiological evidence that forms the basis of the meta-analyses) is from development settings although there are some emergency studies that inform the conclusions and highlight key areas for further research – such as distribution of soap (without hygiene promotion), chlorination of water at source, CLTS and packet latrines.

In addition to looking at some specific interventions, given the lack of consistency in the results when multiple –interventions, we propose looking at various permutations of interventions rather than questioning whether we need to do hygiene promotion OR sanitation. Although there is not conclusive evidence, various studies combined with responses to the consultation back up the conclusion that an integrated approach is required.

A key finding on the household water treatment is that they are options that are technically feasible but their success depends on their uptake and use. This leads on to another key finding that there needs to be more focus on sanitation promotion, better use of technologies and ensuring effective management operations are established (and thinking about how these are going to be sustainable - different types of management arrangement are going to be more appropriate in different settings - evidently a key problem is transferring the responsibility of management through the phases of emergency response. Some of this (such as Community Led Total Sanitation) tends to fall under the umbrella of hygiene promotion but it is not really hygiene promotion - it is more social mobilization.

We conclude that the way forward is to take an approach which considers disease pathways in specific social and environmental contexts and assesses risks accordingly. One of the other advantages of this approach is that it also encourages agencies themselves to ground their decisions more firmly in the existing situation where they are working based upon an informed opinion about epidemiology and health risks.

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Abbreviations and Acronyms

CBO	Community-based Organisation
CDC	Centers for Disease Control and Prevention
CLTS	Community Led Total Sanitation
HWWS	Handwashing with soap
ICRC	International Committee of the Red Cross
IDP	Internally Displaced Persons
IFRC	International Federation of the Red Cross
IRC	International Relief Committee
MSF	Médecins Sans Frontières
NGO	Non-governmental Organisation
PHAST	Participatory Hygiene and Sanitation Transformation
PoUWT	Point of Use Water Treatment
QRCT\	Quasi-randomized controlled trial
RCT	Randomized controlled trial
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children’s Emergency Fund
USAID	United States Agency for International Development
WASH	Water, Sanitation and Hygiene
WatSan	Water Supply and Sanitation
WHO	World Health Organization

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1.0 BACKGROUND AND OBJECTIVES OF THE ASSIGNMENT

1.1 Background

Diarrhoea is one of the five major causes of death in an emergency setting and one of the three main causes of death in children (Curtis and Cairncross, 2003). The traditional response by relief agencies in emergency situations has been to install water supply points and latrines. But experiences have clearly demonstrated the limitations of this approach. More recently hygiene promotion has taken increasingly greater predominance as an integral part of relief agency operations. However, these experiences are diverse and this has led to questions about which type of hygiene promotion activity is most effective and how.

Consequently, in the course of the extensive inter-agency consultation, it has emerged that much of the existing evidence base which underpins decision-making for WASH interventions in relief operations is extrapolated from the development sector. It is unclear to the extent to which it is appropriate and relevant in emergency contexts. The primary aim of this assignment was therefore to explore whether it is considered appropriate to apply the existing evidence base for WASH interventions to support emergency operations as it stands and, if not, to consider what activities may be required to improve the evidence base.

1.2 Key objectives and activities

1. Carry out a brief review of the existing evidence for WASH interventions, distinguishing between evidence extrapolated from development and emergency contexts and confirm its relevance and appropriateness for emergency contexts.
2. Consult with key stakeholders to elicit their views as to its relevance and appropriateness for WASH programme planning and advocacy and to explore the available evidence underpinning decision-making in emergency WASH programmes.
2. Identify WASH research which is planned or in progress which may be relevant. In consultation with key stakeholders identify gaps in the existing evidence base and propose ways of addressing them through research.

1.3 Methodology

This report presents the main findings from a 10-day assignment undertaken by Jonathan Parkinson (Atkins). For the most part the study involved review of relevant literature (both published and grey literature), discussions with various practitioners and researchers (see Annex 1) and email based questionnaires (see Annex 2).

2.0 EXCRETA AND WATER RELATED DISEASES IN EMERGENCY SITUATIONS AND WASH RESPONSES

There is a wide range of different types of emergency situations, which influence environmental health conditions and consequently the incidence of disease. Floods and conflicts resulting in displaced populations are recognized as being situations where diarrheal diseases are particularly prevalent (Noji, 1997). It is widely recognized that these diseases are associated strongly with a lack of water supply, inadequate sanitation and poor hygiene behaviors.

2.1 Epidemiological issues in emergency situations

Emergency situations are rapidly changing situations both in terms of the physical environment as well as the social environment – either as populations temporarily “settle” or due to the influx of new displaced peoples. However, there has been a tendency to delineate environmental changes into those that are social and those that are related to the environment¹, but in actuality any process affecting human health has both social and ecologic components that are inextricably linked (Eisenberg 2007b).

Though epidemic diarrhoea such as cholera and shigellosis (bacillary dysentery) are well-known risks, particularly in emergency settings, their global health significance is small compared to endemic diarrhoea (Hunter 1997). Disease burden is determined by incidence and severity of infection, which is in part a function of the transmission cycle. The impact of proximal environmental characteristics on disease burden is mediated through transmission cycle dynamics. These changing environmental processes may affect the transmission cycles of infectious pathogens which consequently impact upon populations.

Emergency situations frequently force populations into closer proximity either due to loss of land due to flooding, or due to conflict, which forces people to evacuate areas where they are at risk. At the same time they are drawn towards (and often guided towards) locations, which are havens of safety where there is provision of food and shelter and other basic needs including water and sanitation. In emergency situations, close living proximity and shared facilities can more easily result in the spread of contaminable diseases.

The displacement of populations from different communities often brings people into proximity either due to increased concentrations of displaced populations and also increased density in terms of the living environment. If one group is a carrier of illness, disease outbreaks reflecting endemic pathogens circulating within the community may occur (Watson *et al* 2007).

A combination of these factors means that people affected by disasters are also generally much more susceptible to illness and death from disease (Sphere Project). Consequently, communicable diseases, primarily diarrhea, pneumonia, malaria and measles, contribute to substantially higher mortality rates in refugee populations compared to similar non-displaced populations (Peterson *et al* 1998).

¹ Eisenberg referred to these as “ecologic” in his papers but we refer to them in this report as environmental

Other factors such as the changes in the climate may also play a decisive role in changes in epidemiological risks. For instance, the onset of rainy season often introduces additional environmental health implications. Related to this, climate change is likely to be increasingly important as natural disasters resulting in flooding/drought and tsunamis cause more emergencies. Climate change-induced droughts, flooding and other extreme weather events degrade and reduce potable water supplies and increase water-associated diseases such as cholera and diarrhea, particularly in areas with inadequate sanitary infrastructure.

2.2 Types of excreta related diseases in emergency situations

Inadequate sanitation, inadequate water supplies and poor hygiene are critical determinants for survival of victims of natural disasters and conflict situations, especially in the initial stages of a disaster (Sphere Handbook). The most significant are diarrheal diseases and infectious diseases transmitted by the faeco-oral route, but there are a wide range of other health related problems including other water- and sanitation-related diseases such as those related to insect vectors (flies, mosquitoes) and those related to washing (e.g. trachoma) that are also important.

One of major cause of mortality and morbidity in emergencies is diarrhea. Unlike cholera, which results from infection with a single type of bacteria, a wide variety of pathogens (rotavirus, astrovirus, cryptosporidium, etc.) are responsible for diarrhea (Gundry *et al* 2004). Studies have shown that they contribute 25-50 per cent of all deaths (Baghri and Reed 1998) based upon CDC Morbidity and Mortality Weekly Reports between 1980 and 1991 from refugee camps in Eastern Sudan, Ethiopia, Kenya, Malawi and Somalia.

According to Baghri and Reed (1998), poor sanitation in refugee camps is not given as high a priority as other emergency interventions such as health care, food and water supply. This is despite the fact that many of the diseases common amongst refugees are caused by inadequate sanitary facilities such as excreta disposal, solid waste management, domestic wastewater management, vectors and pest control and a poor understanding of hygiene practices.

Based upon experiences from several humanitarian interventions in Africa, Indian Ocean and Central America, Piarroux (2002) explores epidemiology and modes of transmission of Cholera and the links between cholera and humanitarian disasters (refugee settlements, cyclones and volcanic eruptions) and highlights the role of water and the lack of hygiene.

Although there are uncertainties about the adequacy of the disease surveillance and the lack of reported outbreaks (Clasen and Smith 2005), the two situations in which natural disasters have been shown to lead to increased diarrheal disease burden are flooding events or where a disaster or conflict leads to large-scale population displacement (Noji 1997).

The health effects of floods include those related to injuries, fecal-oral diseases, vector-borne diseases and rodent-borne diseases. In particular, there is evidence of increased transmission of fecal-oral transmission of infectious diseases following flooding (WHO 1998). Common waterborne disease outbreaks include cholera, typhoid fever, shigellosis, dysentery, and hepatitis A and E. Published studies have also reported post-flood

increases in cryptosporidiosis, non-specific diarrhea, poliomyelitis, rotavirus and a variety of vector-borne diseases (Ahern, 2005 from Clasen and Smith 2005).

For example, after the flight of 0.5 – 0.8 million Rwandan refugees into the North Kivu region of Zaire in July 1994, which overwhelmed the world's response capacity. During the first month after the influx, almost 50,000 refugees died, an average crude mortality rate of 20-35 per 10,000 per day. This death rate was associated with explosive epidemics of diarrheal disease caused by *Vibrio cholerae* 01 and *Shigella dysenteriae* type 1 (Goma Epidemiology Group 1995).

Another example was reported after the Tsunami, significantly higher cases of acute diarrheal disease were reported in Thailand in the six provinces affected by the disaster (CDC 2005). One month after the disaster, the annualized rate was already 1.7 times that of the previous year. In Indonesia, a survey of 400 households in IDP settlements in Aceh found 25.3% (54 of 214) children under 5 years of age reported having diarrhea during the two weeks prior to the interview, with 2.4% reporting an episode of bloody diarrhea during this period (Handzel 2006).

However, according to Clasen and Smith (2005), although there was evidence of increased levels of diarrheal disease in certain areas affected by the tsunami, most reports concluded there was no outbreak. This was credited to the resilience of the public health systems and response capabilities of the affected countries, the hard work by local communities as well as national and international support. While cases of malaria, measles, watery diarrhea and hepatitis were reported, the WHO and others concluded that there was no evidence that these were above normal background levels in countries in which these diseases are endemic and, in respect of waterborne diseases such as cholera, shigellosis and dysentery, no serious outbreaks were reported (WHO 2005).

In fact, the increased occurrence of outbreaks of infectious diseases following natural disasters may be exaggerated (Seaman *et al* 1984) and (Clasen and Smith 2005). state the inevitability of epidemics following natural disasters is a myth. A review of 38 natural disasters around the world between 1970 and 1992 (including at least 10 floods), only six were accompanied by outbreaks, and only two of those was a potentially waterborne agent (typhoid fever in Mauritius in 1980 following a cyclone, and diarrheal disease in the Sudan in 1988 following a flood (Toole 1997).

More than twenty years ago, Seaman *et al* (1984) questioned this widespread belief, noting that it probably evolved from the historical association of war, famine and social upheavals with epidemics of smallpox, typhus, plague and dysentery. The myth may also attributable to less than optimal surveillance. In some instances, it is observed that health workers from outside the area could not say with certainty what number of cases represented normal endemic levels of common diseases such as diarrhea. It may also be influenced by the willingness of local health officials to tolerate some increase in incidence of disease without characterizing it officially as an outbreak. Also, even if epidemics following floods have been largely averted in the past, it cannot be ruled out that this was the result of active steps in disease prevention such as the provision of safe drinking water (Clasen and Smith 2005).

Therefore, there is no reason for complacency and it remains important to maintain good disease surveillance and continue efforts to minimize the risk of infectious diseases in the aftermath of a natural disaster. Epidemics are not to be expected but remains a significant risk of their occurrence, especially related to the transmission of the virus, *Vibrio cholerae*.

According to Brown *et al* (2002) cholera epidemics in refugee camps represent a major public health emergency. In camps, precarious living conditions contribute to the transmission of the vibrio. Epidemics are characterized by high attack rates and high case fatality ratios. Attack rates in refugee camps can exceed 5%.

Maes (2008) states that initially the transmission route of cholera is mainly from polluted water or contaminated food associated with the primary transmission route in the F-diagram (Wagner and Lanoix 1958). But, once people are infected, and depending on prevailing conditions of crowding, behavioral practices, water supply, hygiene and sanitation, *V.cholerae* enters “secondary” transmission cycle that gradually becomes the most important pattern.

To illustrate the importance of the situation is an example from Rwanda where, as part of a cholera prevention project implemented in Cyangugu province since 2002, MSF carried out an epidemiological study of the repeated cholera outbreaks, which have been centred amongst rural communities living on the shores of Lake Kivu. The study showed that as well as the factors relating to access to potable water, inadequate water collection and storage containers, poor hygiene in latrines (despite high latrine coverage) and lack of toilets at schools influence the transmission of cholera among the exposed population but in addition, the proximity to the lake (use of the lake for fishing, bathing and drinking) was identified as a key risk factor.

2.3 Types of WASH intervention

Humanitarian agencies responding to emergency situations invariably focus resources for the provision of basic water and sanitation facilities for affected communities. The rationale for these components within relief efforts is to ensure that transmission routes of fecal-oral diseases (and other transmission routes) are broken and the health of those being served is protected.

Thus, the main objective of water supply and sanitation programs in disasters is to reduce the transmission of feco-oral diseases and exposure to disease-bearing vectors through the promotion of good hygiene practices, the provision of safe drinking water and the reduction of environmental health risks (Sphere).

The microbial contamination of drinking water is implicated in the prevalence of various diseases (Carncross 2009); both those related to quantity and those related to the quality of water. In the former case, waterborne diseases, whereas in the later water washed diseases. However, it is important to recognize that provision of safe water is essential for drinking but also for cooking, personal hygiene *etc.*, and in the case of sanitation, latrines provide a convenient and private place for defecation. Thus, water and sanitation facilities should establish conditions that allow people to live with good health, dignity, comfort and security (Sphere).

It is imperative to ensure the proper supply of water, the control of excreta, and the improvement of general sanitary conditions and individual hygiene. According to the Goma Epidemiology Group. (1995), the prevention of high mortality due to diarrheal disease epidemics in displaced populations relies primarily on the prompt provision of adequate quantities of disinfected water, basic sanitation, community outreach, and effective identification and treatment of ill patients.

Table 1 : Summary of types of WASH interventions

Water supply	Sanitation / excreta	Hygiene promotion
<ul style="list-style-type: none"> • Rehabilitation of existing systems • Boreholes • Private or communal improved supply or distribution (e.g. hand pump or household connection). • Water source protection and treatment. • Point-of-use water treatment (solar disinfection, chlorination, boiling, safe storage, and simple filtration) • Rainwater harvesting 	<ul style="list-style-type: none"> • Communal latrines • Defecation fields • Borehole latrines • Trenches • Private latrines • Packet latrines 	<ul style="list-style-type: none"> • PHAST • CLTS • Social marketing

2.3.1 Water supply

There are a range of options for water supply depending on the existing environment, the populations and what they had before. Rehabilitation of new wells and equipping them with a new type of hand pumps is one scenario. Supply may be increased with an increase in pumping and distribution timing, but often structural rehabilitation is required. There is often a need to rehabilitate and/or extend water supply in urban centers which may receive a large influx of IDPs.

Leakages in the distribution pipes may lead to the fecal contamination from close-by latrines, could be avoided (Shapkota and Lee 2006). In rural areas, drilling of new wells / digging of boreholes equipped with electrical pump and connected to tap stands is a common requirement. Rainwater harvesting is potentially a solution, but not likely to be an immediate solution. For example, a rainwater harvesting project began as a pilot project in 2002 and continues on a reduced scale due to the expected repatriation of Rwandan refugees by UNHCR in 2004.

Surface-water sources (e.g.ponds) are particularly sensitive to surface pollution, particularly bacteriological pollution, but are often used for abstraction of drinking water because there is a great demand for surface water in contexts where no other water source exists.

One approach towards supply of water (and probably the most widely recognized and practiced) is to treat water close to source prior to distribution. However, water can become contaminated after treatment but more importantly it is only one of the transmission routes in the F-diagram and there remain considerable opportunities for disease transmission from excreta related diseases where water is the mechanism of transport i.e. fingers and flies.

One major advantage of treating water in the home is that this reduces the risk of contamination after treatment by bringing the treatment process closer to the point of consumption. As well as the technologies described below, other such interventions include the use of ground seeds from the Moringa tree, which can be used to clarify water. Similarly, the 'three pot' system, as promoted by Skinner and Shaw (1998) allows stored water to settle for 48 h before consumption, thus reducing pathogens in the water through sedimentation and die-off. However, to date there has been no peer reviewed evaluation of this system (Lantagne 2008).

2.3.2 Sanitation

Excreta disposal is a major concern during the emergency phase of refugee rehabilitation particularly due to widespread practice of open defecation. Open defecation poses a serious health problem with incidences of diarrhea diseases and cholera. Thus, sanitation interventions are those that are aimed at the disposal of human excreta in a manner designed to reduce direct or indirect human contact. However, there is an ongoing debate about the relative importance of sanitation in terms of health benefits relation to other considerations related to dignity (including privacy, convenience and safety).

There is a wide range of sanitation technologies (predominantly types of pit latrine) that may be promoted in emergency responses. It is not possible within the context of this study to go through each individually but there are some fundamental distinct differences that need to be taken into consideration during emergency response planning.

Tearfund recommend that it is important to consider carefully whether latrines should be based on a communal or individual approach. In some emergency settings, notably refugee and displaced persons camps, the communal latrine approach is often the standard approach of UN and NGOs – often because of the urgent need to provide latrine facilities in a short period of time, or the transient nature of the camp. However, with communal latrines, there are often major problems with ownership and therefore cleaning and maintaining of hygiene standards. There can also be problems of accessibility and safety if people have to walk long distances to use the communal site.

As a result of the problems with communal latrines, as a rule Tearfund encourages the promotion of individual latrines wherever possible, in order to promote better hygiene standards and a clearer sense of ownership. In the case of Darfur, projects often started with latrine coverage which emphasized the sharing of one latrine between four households, and then as time and coverage permitted, the project moved towards having one latrine per household. This has been preferred to communal blocks, particularly in camps and settlements where the displaced people are scattered over a large area or integrated with host population (Tearfund).

In some emergency situations relief agencies may provide disposable packet latrines, which may provide an immediate response to sanitation problems². However, users still need somewhere private for defecation and provision for collection and safe disposal is required. These are plastic bags in which the user defecates which contain a blend of enzymes which assists the breakdown of the excreta and must be disposed of in a safe

² in urban squatter settlements, informal packet latrines are described as 'flying latrines' – where the user defecates in a plastic bag and throws it to dispose of it.

place. The most recent development is the PeePoo bag (www.peepoople.com) but older versions consisted of Pooh powder in WAG bags.

Packets are lightweight and easy to transport; and may be used where space is severely limited or in flooded areas. The *Peepoo* is a temporary sanitation solution that may work well in some emergency situations. But the method may not be acceptable to affected population; and final disposal site must be clearly marked, accessible and used (WEDC 2003). According to Ben Harvey (IRC), these have been discussed for years but never really used in earnest in any emergency, which suggests a need to evaluate potential in more detail. Discussions are underway to pilot the *Peepoo* bag in Bihar, India where there are many floodings, but to date there is no results. In particular it may offer an immediate solution to the problem of abuse of women who visit latrines, or for women who choose to wait until darkness to relieve themselves. However, it will be important that users practice good hygiene behaviors and wash their hands after using the Peepoo bag. In addition there is a need for a site where the waste can be disposed of.

2.3.3 Hygiene promotion

Hygiene promotion is one of the important aspects of environmental health in the camps to avoid any health risks. Hygiene practices promote proper use and maintenance of sanitation facilities (Shapkota and Lee 2006). According to Reed (personal communication) the majority of relief agencies place insufficient attention to the important of hygiene promotion and *there is general agreement with Harvey's statement that there is need for greater emphasis on hygiene promotion as part of a holistic emergency public health response* (personal communication).

Hygiene promotion is defined as the mix between the population's knowledge, practice and resources and agency knowledge and resources, which together enable risky hygiene behaviors to be avoided (Sphere 2004). Hygiene education needs to be promoted in a manner that enables beneficiaries to understand the risks, and then to empower them to alter their hygiene behaviors as necessary. The limited available data does suggest that sustainability of changes in behavior require a minimum of 1 year's intervention (Shordt (2003) in Biran and Haggard 2003).

Communications is critical for promoting good hygiene practices. The concept of social marketing is becoming increasingly popular for sanitation and hygiene promotion as it requires a period of formative research to identify which messages people respond to. There is a need to explore more how this applies in the case of emergency response operations.

Whilst the data indicates that hygiene promotion and interventions to encourage hand washing seem to have an important effect on diarrheal rates, it does not *tell us much about the type of hygiene promotion required or if this can be effective outside of the research setting* (Fewtrell and Colford 2004).

Probably the most well known approach is the Participatory Hygiene and Sanitation Transformation (PHAST) which has a process of 7 steps, with each step based on a set of activities that lead communities through an analysis of hygiene problems to proposals for hygiene promotion, improvement of sanitation through community action, and management of water and sanitation facilities through user committees.

3.0 EXPLORING THE EVIDENCE BASE FOR WASH INTERVENTIONS

3.1 Water supply

Development context

There is evidence to demonstrate that both improved volumes of water supplied to populations as well as its quality provide health benefits, but it is difficult to disaggregate improved water supply from efforts to promote better hygiene behavior. For instance access to plentiful supplies of water may facilitate and encourage better hygiene in general, and in particular more hand-washing (Curtis *et al* 2000). However, although it is recognized that water supply interventions reduce incidence of diarrhea, according to Fewtrell and Colford (2004) it is not possible to distinguish between health benefits resulting from water quality and those from water quantity. Consequently, they recommend that more rigorous research is needed to disaggregate between benefits associated with quantity and those associated with quality.

According to Peterson-Zwane and Kremer (2007), evidence from randomized evaluations provides little evidence for substantial effects of communal water infrastructure on diarrheal disease when carried out in isolation, in fighting diarrheal disease. Communal water infrastructure may be effective in fighting diarrhea in certain environments, but unless this is demonstrated, other approaches appear to be a higher priority for reducing the burden of diarrheal disease. Therefore, although investments in communal water infrastructure may not be a priority for fighting diarrheal diseases, these projects may be justified on other grounds and other forms of intervention are deemed to be more effective to reduce diarrhea morbidity than improving water supplies.

The decline in water quality between source and point-of-use measured in terms of fecal and total coliforms is proportionately greater where source water is largely uncontaminated (*ibid.*). The large discrepancy between the effect of source and household water treatment presented in the results of the meta-analysis of Wright *et al* (2003) supports that source water is often not the primary origin of diarrheal diseases, but does stress water is nonetheless a significant transmitter of diarrheal diseases. The above supports the argument for (and effectiveness of) point-of-use water treatment (Clasen *et al* 2003).

An example offered by Bob Read (WECC) is from Bihar during the floods which suggest that quality not quantity is not a problem. PUR tablets were distributed but not everybody knew what they were and there were instances of people eating them. Even though many had not used a latrine before, the women used it as it offered privacy, but after the floods subsided, they reverted to open defecation. There has been no serious outbreak of disease and Bob attributes the success to the fact that relief agencies sorted out the feeding.

Point of Use Water Treatment

Interventions involving water treatment or improved storage at household level have successfully prevented cholera and therefore interventions to improve water quality are an important for reducing the risk of cholera outbreak. However, for general diarrhea, although interventions may significantly reduce diarrheal incidence, no clear relationship was found with point-of-use water quality. Reasons for these apparently contradictory results concerning general diarrhea are mentioned below.

Gundry *et al* (2004) carried out a systematic review concerned with two health outcomes; general diarrhea and cholera, and their relationship with water quality at point-of-use. For cholera, a clear relationship was found with contaminated water and household level water treatment and storage interventions were also found to reduce cholera.

Bacteriological evidence suggests that improved water vessels may be effective at reducing coliform counts in stored water where sources are well protected and consistently uncontaminated (Hammad and Dirar 1982; Pinfold 1990; Chidavaenzi *et al.* 1998). As an aspect of promoting the availability of potable water, health messages often need to include water storage in the home. Therefore, projects may need to ensure that water containers are available to support the health messages that are being given. (Ref : Tearfund). However the effectiveness of water treatment and storage interventions in combating diarrhea and/or cholera has never been demonstrated through community-based trials and the impact of improved container designs on diarrhea outcomes needs to be determined.

A reason for the relative low effectiveness of source water treatment interventions (11%) is the risk of microbiological contamination of drinking water during collection and storage in the home. A systematic meta-analysis by Wright *et al* (2003) of 22 studies measuring bacteria counts for source water and stored water in the home concluded that approximately half of the included studies identified significant contamination after water collection (Clasen *et al* 2003).

An increasing amount of research focuses on Point of Use Water Treatment (PoUWT) confirms that household level water quality interventions are more important than previously thought (Fewtrell and Colford 2004) and household-based interventions are more effective than those at the source. In terms of general diarrhea, the role of point-of-use water quality appears more complex. For instance, whilst most of the water treatment and storage interventions in the studies were seen to be effective, high indicator bacteria counts were seldom associated with diarrhea among subjects (Gundry *et al* 2004).

Fewtrell and Colford (2004) concluded that point-of-use water treatment reduces diarrhea by 39%. This figure is lower than the result of the Cochrane review which estimated that point-of-use water treatment is as effective as HWWS (Clasen *et al* 2006). Randomized impact evaluations of point-of-use water treatment systems observe statistically significant reductions of 20–30 percent in diarrheal incidence at the household level (Quick *et al* 1999; Reller *et al* 2003).

Despite these large reported gains, many of the same studies also find that the observed reductions in diarrhea incidence associated with the intervention are concentrated among children under age one and over age five. Surprisingly, the age group with the highest rate of diarrhea incidence, children ages 1–5, may be least affected by this intervention (Quick *et al* 1999; Reller *et al* 2003; Sobsey *et al* 2003) although these results were not

found to be the case in all cases such as Uzbekistan or Bolivia (Peterson-Zwane and Kremer 2007).

Household filters

High quality ceramic candle filters have long been known for their efficacy in removing bacteria and protozoon cysts, and there is some indication of efficacy in virus removal. Like the chlorine-based PoUWT options, ceramic filters have been shown to be effective in the development context (Lantagne 2008).

Field trials of a number of different proprietary ceramic candle filters were carried out in Cambodia, Sierra Leone, Burundi, South Africa and Bolivia. As summarized by Lantagne (2008), the results of the field trials suggest the following:

- *Effectiveness*: bacterial reduction is effective in the home.
- *Health impact*: use of the filters is associated with significant diarrhea reduction in a case-control study in Bolivia.
- *Acceptability*: users widely report they appreciate the filters and are willing to pay for them.
- *Technical issues*: breakages, quality of filters, capacity of filters, raw water turbidity, and filter cleaning and replacement need attention for consistent and sustainable good results.

Chlorination

Sobsey *et al.* (2003) refer to a significant reduction in diarrhea prevalence following a chlorination and safe storage intervention, despite the absence of any hygiene education.

Semenza *et al.* (1998) conducted a randomized intervention study to provide epidemiologic data for water policy decisions in Nukus, Uzbekistan, where drinking water quality is suboptimal. Households without access to municipal piped water were trained to chlorinate their drinking water at home in a narrow-necked water container with a spout and monitored biweekly for self-reported diarrheal illness over a period of 9.5 weeks. The home chlorination intervention group had the lowest diarrheal rate despite lack of access to piped water in their homes, which was one-sixth that of the group with no piped water and one-third that of the households with piped water.

Wang provides details of chlorination of water at source and the use of Chlorine dispensers as a means to overcoming some of the problems of household water disinfection. Since 2002, the Kenya Rural Water Project (RWP), a collaboration between Innovations for Poverty Action (www.poverty-action.org) and researchers at Harvard University and the University of California, Berkeley, have been conducting randomized controlled trials to investigate how to provide safe drinking water to rural populations in western Kenya. Guided by these studies, RWP developed an innovative technology for providing communities with dilute chlorine using a chlorine dispenser (similar to a liquid hand soap dispenser) located at pre-existing communal water sources. Feedback from communities about dispensers has been overwhelmingly positive. Not only did 69% of study households with access to a dispenser have detectable chlorine in their drinking water during an unannounced visit (compared to only 5% of households without access to a dispenser), but the percentage of the population using the dispenser has consistently increased over time (Wang 2008).

Emergency context

Probably the most researched response is the use of different types of Point of Use Water Treatment (PoUWT), which have been extensively reviewed by Lantagne (2008). PoUWT can be an appropriate intervention in emergencies that reduces diarrheal disease and improves microbiological quality (Lantagne 2008). According to Lantagne (2008), there is now substantial evidence of the benefits of household water treatment for disease reduction, and a number of studies indicate that some methods may be appropriate for specific disasters, such as flooding, or for scattered populations that are hard to serve with conventional water treatment methods.

According to Lantagne (2008), the lessons learned from the literature review include:

- High levels of uptake of PoUWT can occur in emergencies, and with some options that has been seen short-term during the emergency and in the longer term recovery phase.
- PoUWT programmes have documented more success in stable emergency as opposed to immediate response in acute emergencies.
- For all PoUWT options, training has been identified as crucial to programme success. Different options may require different amounts of training and follow-up.
- The standard interventions – chlorine tablets, mother solution, and boiling promotion – are severely under-researched.

Not all studies have been so favorable. For example, results from a study on use of HWT after the Asian Tsunami were not encouraging (Clasen *et al* 2006). Nonetheless, Schmidt and Cairncross (unpublished) concluded that given the current available evidence, there may be a case for implementing HWT as a preliminary method in emergency settings, or temporarily during an epidemic of water-borne diseases. Under these circumstances issues of sustainability, diverting funds and lack of non-health benefits may be less of a problem, while the potential effect size of HWT may be large.

In Aceh, CARE coordinated a pilot survey of 48 households four weeks after the tsunami which raised questions about the adequacy of the boiling approach being promoted in the region as an alternative to household chlorination, especially since the only samples free of the fecal indicator at source or household were those found to contain residual chlorine (Albert 2005).

Flocculant/disinfectant powder (PuR)

PuR is the most researched PoUWT option in emergencies. Three targeted emergency response projects that using PuR distribute to flood affected communities in Haiti, and distribution in a feeding project in Ethiopia – have been well evaluated. Samaritan's Purse attributed the success of the project in meeting its goals – education, introduction of PuR, and reduction of waterborne disease – in part to the PSI training curriculum and trainings, which were “highly recommended” to other agencies. According to Lantagne (2008), many of the same factors for project success (as in the Doocy Liberia trial), appropriate selection of intervention site, free distribution of all materials needed to treat water, and adequate training and follow-up – were also present in this intervention (Allgood 2008) (Doocy and Burnham 2006).

An emergency response project with PuR in Ethiopia which was very successful (CARE, Undated) involved the appropriate hardware to use PuR, including jerry cans, buckets, and filter cloths, as purchased, and a monitoring and evaluation project planned. Training demonstrations were given to beneficiary families at the clinics, and seven PuR sachets were distributed to the family each week when the child came in for their CTC visit Lantagne (2008).

In contrast to the successes from refugee camp situations as detailed above, two separate evaluations of a hurricane response project in Haiti demonstrate significant challenges implementing PuR in an acute emergency situation. One hundred households that received PuR in these community demonstrations were interviewed two weeks after the distribution. Although 92% of households reported using PuR sometime during the previous week, and 78% correctly answered all five knowledge questions about how to use PuR, only 22 (22%) households reported using PuR at the time of the unannounced visit, and only 10 (10%) of households had correct chlorine residual levels in their stored drinking water.

Lantagne (2008) summarize the reasons to be associated with the fact that NGOs had competing demands and different water supply strategies, as well as no training in the use of PuR, chose not to distribute the PuR, and sachets were warehoused until the non-emergency response NGO PSI worked with local communities leaders to conduct community demonstrations of PuR three to six weeks after the emergency.

Experiences from the Gonaives emergency provide additional reasons which highlight the limited usefulness of PuR in the specific circumstances during the emergency response to hurricane Jeanne. These also included the lack of knowledge of NGOs and governmental agencies about PuR prior to the emergency, including how to use it, and answers to technical questions about product safety; the fact the sachets were labeled in Spanish, a language the population could not read, and were about to expire; the fact many households had lost all their possessions and did not have the materials to use PuR; the degrading security situation; and, the fact many NGOs distributed bottled water and bladdered water to the population as the first-line water supply intervention (CARE, Undated). The report concludes *"It should not be assumed that PuR is appropriate to all emergencies where safe drinking-water is required."*

In conclusion, although PUR is evidently effective from a scientific perspective, if it is not administered correctly, then inevitably its effectiveness will be undermined.

Despite the fact that distribution of chlorine tablets (AquaTabs) is considered a standard intervention in emergency response, Lantagne (2008) has not identified a single peer-reviewed article or project report on tablet usage in emergencies. There are no specific reports evaluating a chlorine tablet project in an emergency identified (Edmondson, 2008) However, P&G/UNICEF undertook a study in Bangladesh amongst households who were effectively treating the water as measured by presence of free chlorine residual and absence of thermotolerant coliform in both the flood-affected areas and the Cyclone response. It was noted that there were extensive problems with the bulk distribution of AquaTabs in response to Cyclone Sidr, including the fact that no training was provided, people did not like the smell and taste of the treated water, and there were problems with dosage because different size tablets were distributed (Johnston 2008).

According to Lantagne, ceramic filters have not been as widely evaluated in emergencies (three Oxfam evaluations were identified : Sri Lanka post-tsunami, a peer-reviewed

journal article from a Dominican Republic project after flooding, and a report from a Haiti project after flooding).

The efficacy of ceramic filtration in improving water quality and reducing diarrheal disease is well established in the literature and the development context. However, user training is identified as a factor contributing to higher usage of ceramic filtration in both the Sri Lanka tsunami response and the Dominican Republic flooding response. Although trainings were not extensive, and follow-up visits were not needed to ensure continued usage, some training at the outset on care and maintenance of the filter was identified as “vital”.

In the Sri Lanka tsunami response project, lack of living space was identified as a barrier to use and being in an emergency shelter type was associated with having a greater number of problems with the filter. However, studies show that a significant number of families who continue to use the filter after the end of the emergency situation. However, ceramic filters appear to be a more appropriate intervention after the acute emergency has passed, for when recipients are moving from transitional into more permanent living structures and there is time for user training on the care and maintenance of the filter.

3.2 Sanitation

There is a strong argument that there is a need to isolate and contain feces in order to break the primary transmission route of fecal-oral diseases and many studies refer to the fact that that basic excreta disposal facilities are effective in preventing diarrhea disease, trachoma, cholera and infection with *Ascaris*, hookworm as well as other enteric helminths. This understanding is ubiquitous in the literature that applies to the development setting as well as published and unpublished literature related to emergency relief. However, there is little reported data that supports this understanding in the development context and even less in the emergency context.

According to Fewtrell *et al*'s meta-analysis (2004, 2005) sanitation interventions are recognized to be 32% effective, which implies that sanitation is less important than hygiene behavior and water quality and point of use to prevent the transmission of fecal-oral disease. However, a more detailed assessment of the data that supports these conclusions indicates that the methodological basis for many of these studies that supports the evidence base are fairly poor.

Clasen *et al* in their unpublished review of sanitation for WaterAid, found that sanitation improvements are frequently accompanied by other WASH related interventions and in fact only two trials of sanitation (Azurin and Alvero 1974; Emerson 2004) consist solely of improvements in excreta disposal. In all the other studies included in their review, the sanitation intervention was accompanied at least by improvements in drinking water supply. And in some studies, there were hygiene promotion or other components to the intervention.

Azurin *et al* (1974) reported a protective effect solely from improved latrines. However, the outcome was clinically confirmed cholera—a typically epidemic disease against which environmental interventions should normally be more effective against than endemic disorders. Considering endemic diarrhoea, there appears to be only study that shows categorically that the provision of sewerage infrastructure in a large Brazilian city results in positive epidemiological effects in terms of diarrhoea morbidity in children less than 3 years of age of a city-wide sanitation program (Barreto *et al* 2007).

Following on from these meta-analysis, LSTHM did a detailed assessment of a larger range of studies to assess the evidence base for sanitation and identified some additional studies to include in the analysis. They concluded that there is evidence that interventions to improve excreta disposal facilities are effective in reducing the risk of diarrhoea. The pooled risk ratio of all such studies is 0.67, corresponding to a 33% reduction in risk. The 95% confidence interval around such pooled estimate is 0.50 to 0.88, suggesting it would be unlikely that such effect would be attributable to chance if there were no other factors that could explain the effect (i.e. baseline differences between communities, observer / responder bias). However, in this review undertaken for the NGO WaterAid, Clasen *et al* (unpublished) concluded that the amount of literature that provides us with any in-depth quantitative evidence is very limited.

Sanitation as a means of breaking pathogen transmission from flies

Domestic flies are accepted vectors of diarrhea, but the role of flies in the transmission of infection remains unclear (Clasen *et al* unpublished). The most detailed work on disease transmission by flies and the role of sanitation has been undertaken by Emerson and colleagues. Emerson (2000) demonstrated that *M.sorbens* are important vectors of both trachoma and childhood diarrhea. He also identifies that the flies breed mainly in solid human feces present in the environment and not in latrines. This leads to the conclusion that safe excreta disposal plays an important role in reducing trachoma transmission. However, there is also a need for more effective fly controls (e.g. through the use of Deltamethrin spray) which may provide an alternative or a complimentary intervention to improved excreta disposal.

Emerson *et al* (2002, 2004)'s report on a community-based, cluster-randomised, intervention trial based in a rural Gambia which was designed to quantify the relative importance of flies as vectors of trachoma and to test the effectiveness of insecticide spraying and the provision of latrines in trachoma control. They concluded that the development and assessment of sustainable and cost-effective methods for the control of muscid flies, such as the provision of latrines, identification and clearance of breeding sites, and assessment of the feasibility of locally made traps should be a research priority.

Chavasse *et al* (1999) also highlight that the fact that control of flies can be improved by the provision of pit latrines but such an approach could be combined with targeted chemical and non-chemical fly control methods and behavioral promotion to restrict fly access to stored food and to children (for example, by covering sleeping babies during the day¹⁵) which can reduce the importance of flies as a transmission route.

Previously, Emerson (1999) stated that there does not appear to be any comprehensive evidence base to support this in emergency contexts.

3.3 Hygiene Promotion

Development context

Breaking down the different barriers in the F-diagram into primary and secondary barriers shows that among the behavioral change alternatives, to prevent stool pathogens from gaining access to the domestic environment, efforts that focus on hand-washing after stool contact are most effective, especially after defecation and after cleaning a baby/young child after defecation (Curtis *et al* 2000).

The relevance of HWWS stands out with regard to its effectiveness to reduce the disease burden of the world's top two causes of Under 5 mortality, diarrhea and pneumonia, which, together account for almost 3.5 million child deaths annually (UNICEF SOWC 2008). The results of three well known systematic reviews on the impact of HWWS to decrease diarrhea morbidity concluded that this behavioral change measure can reduce diarrhea incidence by as much as 31%, 44% and 42% respectively (Eljemot *et al* 2008, Fewtrell and colleagues 2005, and Curtis and Cairncross 2003). Targeting of other hygiene practices are estimated to be less effective (only 25% compared to 44%). These figures support a recent systematic review focused on the effect of HWWS (42%) (Curtis and Cairncross 2003).

The Cochrane Review carried out by Clasen (2008) evaluated the effects of interventions to promote hand washing on diarrheal episodes in children in low- and middle-income countries pooled that data of five cluster-randomized controlled trials. The overall results show the intervention reduced the incidence of diarrhea by 31%. This corresponds to the results of a concurrent Cochrane review (8 trials) on handwashing in institutional environments (schools, day-care centers etc.) in non-developing countries (29%).

The effectiveness of hand washing is said to be attribute to the fact that most endemic diarrheal disease is not waterborne (but transmitted from person to person on hands, food and other *fomites*³ because of poor hygiene (Cairncross 2003). This is also noted by Vanderslice and Briscoe (1995) who note that other fecal-oral pathways (e.g. food, hands, etc.) and therefore hand washing may be more important than water.

Two well designed randomized controlled trials showed that home HWWS interventions in Karachi, Pakistan, where diarrhea is the leading cause of childhood death reduced the incidence of diarrhea in households by 53% and 51% (Luby 2005 and Luby 2006 respectively). The Luby (2005) study also 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.

The magnitude of HWWS is further explored in, first of all, a review on the effectiveness of hand washing in preventing skin infections as implied by the Luby (2005) study where HWWS was found to have a significant effect on reducing incidence of impetigo by 34% (a superficial bacterial skin infection most common among children 2 to 6 years old). There is also some evidence that suggests that HWWS potentially reduces intestinal nematode and eye infections (conjunctivitis), but these both need to be studied further (WELL 2007).

³ A *fomite* is any inanimate object or substance capable of carrying infectious organisms (such as germs or parasites) and hence transferring them from one individual to another.

In addition, in terms of costs, Cairncross and Valdmanis (2004) highlight that compared to any other intervention, hygiene promotion (including HWWS) is the most cost effective measure to avert diarrhea morbidity and mortality (US\$3.35 per DALY averted).

Various studies suggest that the effectiveness of handwashing and point-of-use water treatment has been well established and that attention should now be given to efforts to understand effective promotion strategies and how to sustain behavior change. The health benefits of this class of interventions depend on individual decisions to adopt and consistently adhere to certain behaviors. For both types of behavior the observed impacts were generated in settings where high uptake (around 70 percent in the case of point-of-use water treatment) was supported by weekly or daily reminders by fieldworkers. Such extremely high-intensity contact with fieldworkers is prohibitively expensive to provide on a large-scale basis.

Emergency context

Peterson *et al* (1998) carried out a systematic sample of 402 households in one portion of a refugee camp in Malawi which housed 64 000 Mozambican refugees. The population were surveyed for diarrheal risk factors, and then interviewed twice weekly for 4 months regarding new diarrhea episodes and the presence of soap in the household. The findings suggest that the provision of regular and adequate soap rations, even in the absence of a behavior modification or education program, can play an important role in reducing diarrhea in refugee populations. If subsequent study confirms the soap as a cheap and effective measure to reduce diarrhea, its provision in adequate amounts should be a high priority in refugee settings.

In IFRC's experience in 8 countries in Eastern Africa, PHAST has proven to be a useful hygiene promotion tool for development work and in long-term refugee settings. It is also potentially useful in emergency contexts in order to help rapidly identify key hygiene risks and risk groups, and involve the affected population in developing strategies for reducing risk. However, as it normally takes around 6 months, there is a need to shorten the process and it is possible to shorten the process by cutting it from 17 to 7 core steps. In 2003, the first PHAST review in Kampala, Uganda, examined whether PHAST could successfully be shortened in emergency without losing its impact and the community 'buy-in' seen to be so essential to its successful implementation. New guidelines have been produced for shortening the PHAST process during an emergency and also specifically during a cholera epidemic and research is underway to assess the effectiveness of the faster PHAST approach.

A pre-prepared kit of materials and equipment may help to implement the process rapidly, and as preparedness is essential for enabling PHAST to be fast trained staff can be deployed at short notice to help implement PHAST in an emergency. This approach was adopted by IFRC by the Uganda Red Cross emergency response during the Cholera outbreak in 1979 Cholera in Hoima, Bundibugyo and Kibale Districts in Western Uganda and also in Pakistan after the South Asia earthquake.

4.0 INTEGRATED APPROACHES TOWARDS WASH INTERVENTIONS

4.1 Single or multiple interventions ?

The evidence suggests that there is a stronger base from an epidemiological perspective for some types of WASH intervention than others. However, there is potentially a danger that interpretation of the data may lead to too much emphasis on single interventions, claims that may overstate the importance of one type of intervention as oppose to anything else.

This suggests that the results should highlight the fact that they should be used to help inform our decisions but not to overstate the importance of one type of intervention to the detriment of the others. In particular, the importance of improved hygiene behavior is noted but it remains open to debate and further research how much emphasis should be placed on hygiene behavior compared with

To some extent it will depend on the type of water supply and the type and the design of of sanitation facility as both the type and design may influence behavior itself. Therefore potentially an important area for further research both within the development and emergency setting is ergonomics of water supply and sanitation and the impact of different designs on result behavior with and without complimentary hygiene behavior campaigns.

It is intuitive that an integrated approach towards WASH interventions is inherently beneficial and as a result of this, the majority of interventions are manifold i.e. a combination of improvements to water supply, sanitation and hygiene promotion. The success of other WASH interventions may be dependent on hygiene education, e.g. effective excreta disposal does not usually depend on the provision of a toilet alone and intervention will be needed to make sure that people buy, construct, maintain and use the facility (Fewtrell and Colford 2004).

However, in addition to reviewing the impact of individual interventions, Fewtrell *et al* (2005) also looked into the impact of multiple intervention and, perhaps surprisingly found no evidence for their effect to be additive (33%). Various other researchers have published papers that support this conclusion.

For instance Luby (2006) assessed the impacts of a combined programme of soap (HWWS) and point of use (POU) water treatment to see what would be the impact on diarrhea 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 observed 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 (Luby *et al* 2006).

Two studies have been designed to compare the effects of hygiene education alone against hygiene education and water treatment (Wilson and Neveu 1995; Luby *et al*. 1998). These studies suggest that whilst additional the water treatment intervention undoubtedly improves water quality more than hygiene education alone, there may only

be a slight reduction in diarrhea associated with water treatment and education compared with hygiene education alone (Gundry *et al* 2004).

The following plausible grounds for the effects of multiple interventions not to be cumulative are brought forward by (Clasen *et al*, *unpublished*):

- The piecemeal implementation of more ambitious programs resulting in an overall lack of focus or attention (typically for sanitation and hygiene education).
- The primary motivation of recipients (e.g. the desire to obtain a more reliable water supply).
- None of the multiple programmes in the review involved point-of-use water treatment, which might have affected the accumulative value of the water component.

On the other hand, the meta-regression suggests that point-of-use interventions have a greater impact on general diarrhea where a high proportion of households had adequate sanitation. This may be because household sanitation has restricted the fecal-oral pathways associated with fecal matter around the household compound and in communal defecation areas, so reducing diarrhea morbidity, with the consequence that an additional intervention has a proportionately greater effect (Clasen *et al*, *unpublished*).

In addition, although the results of the meta-analysis demonstrate some consistency in demonstrating that hygiene behavior based interventions and POWUT are more effective than water supply, this data does highlight the potential health benefits that can be achieved and the need to focus more attention on these areas.

4.2 Limitations of epidemiological approaches

Given the apparent variations in the evidence base and the outstanding deliberations relating to the perceived benefits (or otherwise) of multiple interventions, it is perhaps important to review some of the factors that may limit the application of traditional epidemiological approaches. This is not to diminish the importance of work in this area but to highlight some of the inherent weakness associated with the methods applied to collect rigorous epidemiological data.

Walden *et al* (2005) refer to the fact that it is extremely difficult to obtain good and statistically rigorous data in an emergency setting, the priority being to intervene rapidly to prevent further cases of diarrhoea. Problems also relate to the fact that people outside of camps and the chaotic situation on the ground where local staff on the ground do not have the specialist knowledge / skills (Bob Reed, WEDC).

This is notably the case for sanitation. Schmidt and Cairncross (2009) concluded that there is a paucity of evidence in support of health outcomes from interventions to improve excreta disposal and this does not allow quantification of such an effect if it exists. This is due to the limitations of the studies and shortcomings in the magnitude and rigor of the evidence concerning the effectiveness of interventions to improve excreta disposal facilities for preventing disease and infection. These limitations are considered to be greater than those related to water supply and in particular hygiene promotion.

One of the fundamental issues related to the epidemiological approach towards demonstrating the evidence base is that they were developed for the clinical medical environment and in many instances this does not easily apply within the context of WASH interventions. The following reasons are mentioned by Clasen, Cairncross and others may limit the meaningfulness of the results:

1. *Methodological shortcomings of study designs and substantial differences in the methods.* For instance, interventions may not be randomly allocated to intervention and control.
2. *Randomized Controlled Trials (RCTs)* are generally considered the gold standard of epidemiological evidence because they reduce or eliminate the effect of confounders (even those that cannot be identified). But, RCTs require the intervention to be randomly assigned to a portion of the study population, while the remaining population serves as controls (Clasen, undated). This is difficult to achieve and there are ethical issues to consider relating to the need to have a control group who do not receive assistance.
3. *Blinding* – it is not possible to effectively blind a portion of the group from the fact that they are benefiting from a WASH intervention.
4. *Potential for observer and responder bias in assessing the disease outcomes.* For instance, reported diarrhea rates are known to be reduced by recall periods greater than 48 h (Blum and Feachem 1983 see Gundry *et al* 2004).
5. *Heterogeneity in the study populations.* Certain studies reported adjusting for age variances in the study population (Emerson 2004, Garrett 2008, Huttly 1990), while others reported no such adjustment. As age is an important risk factor among these outcomes, failure to adjust or control for age could represent a source of bias particularly in smaller study populations.
6. *Heterogeneity in the interventions* - for example, studies tend to use a wide range of definitions of 'high' and 'low' water quality. No attempt is made to adjust the analysis for the inconsistency in these definitions, since this would entail obtaining the raw water quality data sets which is generally not feasible.
7. *Projects often contain a mixture of WASH interventions* making it difficult to disaggregate the benefits and thus to identify which type of intervention is the most effective. Interventions involving some form of hygiene education or otherwise may raise awareness of water handling and its importance. The education component — rather than better water quality per se— may reduce diarrhea (Gundry *et al* 2004).
8. *Cholera and helminth infections are easier to verify by medical diagnosis using laboratory analysis but there are other problems for studies that involve water quality testing.* For instance, counts of indicator bacteria such as thermotolerant coliforms may not be a good proxy measure of these pathogens (rotavirus, astrovirus, cryptosporidium, etc.), thus accounting for the apparent absence of a relationship between point-of-use water quality and diarrhea (Gleeson and Gray 1997; Hamer *et al.* 1998).

On this basis, if proving the evidence base in non-emergency situations is problematic, then it is invariably more problematic in the emergency context. Part of the reason why there is limited literature from emergencies is due to the fact that the environments in which agencies operate are not conducive for systematic research and documentation and a focus on saving lives rightfully predominates rather than investing limited resources to carry out a scientific experiment. Reasons for this may include population movements, problems related to insecurity, lack of time, and/or lack of qualified people (Ben Harvey). James Kahia (IFRC) also recognizes that data is confounded due to the fact that many actors with varied and often uncoordinated actions based on their 'mandates' and beneficiaries have unacknowledged/undetected inherent coping mechanisms.

4.3 Arguments for an integrated approach

Fewtrell *et al* (2005)'s systematic review and meta-analysis found a strong consistency in the effectiveness of WASH interventions. Data are comparable to results of an earlier review done by Esrey *et al* (1991) and the results on these are also supported by reviews of Clasen *et al* (2007) and Curtis and Cairncross (2003). But it is important to note that the meta-analyses tend to obscure the types of intervention and therefore suggests that all types of water supply, sanitation and hygiene promotions activities will result in the same result, which is clearly not the case.

Gundry *et al* (2004) concluded that water supply, sanitation and hygiene promotion interventions should be implemented as a package and cannot be disaggregated. Various others have also suggested that a 'holistic' approach to community water, sanitation and hygiene may produce better health outcomes than water source improvements alone. Previously, Hoque (2000) stated that water, sanitation and health are inseparably linked and there is general consensus that for various reasons (health and otherwise) there will invariably be a need for interventions in all 3 areas.

Eisenberg states 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 amount of water contamination. If each transmission pathway alone is sufficient to maintain diarrheal disease, single-pathway interventions will have minimal benefit, and ultimately an intervention will be successful only if all sufficient pathways are eliminated. However, where one pathway is critical to maintaining the disease, public health efforts should focus on this critical pathway.

Eisenberg *et al* (2007) 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. The argument of critical pathways relates to the primary and secondary barriers as brought forward by Curtis *et al* (2000) where primary barriers are viewed as high potential pathogen blockers. Curtis argues there are two principal interventions⁴ that establish the primary barrier for preventing stool pathogens to enter the domestic environment: namely safe excreta disposal and hand washing.

On the other hand, IRC (unpublished) argues that there is a need for much greater emphasis on the secondary transmission routes, stating that *in an environment where*

⁴ amongst transmissions through food-borne, flies, bottle-feeding, animal feces, water, hand washing and excreta disposal

there is open defecation or a lack of handwashing after defecation, it is still possible for a single family to protect itself by carrying out the practices that constitute the second barrier to diarrheal disease transmission.

Based upon this argument Harvey stresses the greater importance of handwashing before eating as opposed to handwashing after defecation to avoid post-handwashing contamination and bring hygiene practices closer to the POU. However, the question arises whether there is a need to disaggregate the two from each other especially considering the potential confusion that may arise if members of the displaced community have encountered hygiene promotion elsewhere. If individuals are to be reached by the right hygiene promotion messages, then it may come across as contradictory and confusing if the communications team inform them that handwashing is a priority but less so after defecation.

The pro and cons of these arguments are debatable but clearly the dominant pathogens that are able to exploit the transmission pathways that leave the human hosts most susceptible are most likely to predominate and result in illness. Eisenberg *et al* (2007) argue that when sanitation conditions are poor, water quality improvements may have minimal impact regardless of the amount of water contamination, thereby subscribing to the importance of ensuring safe hygiene and excreta disposal.

As Luby and others discuss, their findings are consistent with an epidemiological model in which disease thresholds are qualitatively important. If a large proportion of diarrhea incidence is caused by pathogens that must be present in large doses to cause disease, substantially reducing the organisms ingested may reduce diarrhea incidence, but further marginal reductions could be much less important.

A key issue is therefore the fact that the incidence of disease is determined by the frequency and severity of infection, and therefore concentrations of pathogens in the environment are of critical concern. Peter Van Maanen from UNICEF supports this by saying that we should keep in mind that the effectiveness of various WASH interventions, changes according to pathogen loads, critical pathways and the degree of measure adoption among the community members (personal communication).

It is apparent that the physical, environmental and social environment combined with an individuals' susceptibility to disease (often with a weakened immune system caused by fatigue and lack of food), are considered to be important factors that offer pathogens many opportunities in the emergency situation. WASH interventions need to be targeted towards these transmission routes and the effectiveness of WASH interventions in emergency contexts may potentially differ from those in the non-emergency contexts, but we do not currently have a good understanding of how these may differ and this is an area for further research.

4.4 Alternative approaches for assessing effectiveness

A wide variety of bacterial, viral, and protozoan pathogens excreted in the feces of humans and animals are known to cause diarrhea, but the importance of individual pathogens varies between settings, seasons, and conditions. Eisenberg *et al* (2007b) concluded that the inherent multidimensionality of epidemiological problems precludes the use of standard analytic approaches. As public health moves more toward examining how both environmental and social processes affect disease transmission, and more specifically toward examining the fundamental role of environmental change in creating

the landscape of human disease, a systems theory framework is needed from which to integrate and analyze data obtained from the disparate but relevant fields of study involved.

According to Emerson, the challenge for future studies on the environmental determinants of disease is to develop new approaches for thinking about processes at the system level to take into account these complexities. In theory these should elicit new study designs and data analysis to take into account the increasingly explicit nature of the connections between proximal environmental change and health—for example, the SARS epidemic in 2003, the Indian Ocean tsunami in 2004, Hurricane Katrina in 2005, and the recent focus on avian influenza (Emerson 2004).

To determine the most effective intervention in each context (or combination of interventions) to curb the prevalence of diarrheal diseases in a community the context's critical paths of pathogens demands consideration. To assist with this analysis, Eisenberg *et al* (2007) present a dynamic version of the F-diagram in order to simulate the different pathways enteric pathogens may opportunistically 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.

Considering critical pathways requires a consideration of the locus of environmental health hazards – whether they are in the public domain (such as problems with a water treatment works), or the domestic domain (such as contamination of water in the home). This analysis may subsequently be used to determine the control measures required, and the likely benefits of interventions. A major challenge for emergency responses is to develop and implement interventions that encompass both public and domestic domains (Cairncross 2004) and the key issue is which combination of hardware and software will be most effective in which circumstances and it is this area where further research is request.

There are still many opportunities for improving the evidence base with carefully designed intervention trials to improve comparison and transferability. Although there is value to embark upon a concentrated piece of research to derive the evidence for different interventions quantitatively based upon strict epidemiological evidence using RCTs at best or otherwise QRCTs, there is a danger that the results may not provide the conclusive evidence that is required to support programming. It is important to consider the limitation of these approaches in the more stable development setting and the fact that in the emergency setting the limitations are inherently greater. Therefore, notwithstanding the importance of intervention trials, as stated by Schmidt and Cairncross (undated) accepting the lack of good evidence may be preferable to deciding on the basis of misleading evidence.

For relief responses, to be successfully, there is a need to take into account the heterogeneity of different communities/cultures and this there is a need for categorization of different emergency populations and their likely responses. This suggests the need for integrated approach for the epidemiological diagnosis of an endemic situation at local level. Epidemiological methods can be used to detect the dependent variables (those related to the human infection) and the independent variables (demographic, economic, sanitary and social). A methodological approach of anthropological /ethnographic nature

can be conducted in order to make an articulation of the knowledge on the various dimensions or determinant levels of the disease (Barbosa 1998).

Clearly, given the limitations of the traditional epidemiological approach and the problems setting up robust epidemiological studies in the emergency context, there is a need for a consideration of alternative approaches. Fundamentally, agencies themselves to gain a better understanding of the nature of disease transmission for them to be able to plan accordingly. Potentially the way forward is to develop a risk based approach towards the research which assesses different behaviors within different environments and ascribes a factor of risk to these in health terms.

According to Checchi *et al* (2007), crises bring about or exacerbate certain risk factors. These operate at different levels of causality, i.e. more or less remotely from the outcome, which we can roughly categorise as distal, intermediate and proximate. For example, proximate factors causing higher diarrhoeal incidence among babies in eastern DRC could be poor water and sanitation and high malnutrition prevalence; however, looking more broadly, we might identify intermediate factors such as food insecurity due to militia attacks. Further, we might conclude that, ultimately, underlying distal factors such as regional instability are to blame.

The objective should be to define which interventions are likely to be most effective in which context. To be overly prescriptive about this may be counterproductive as this may lead to important interventions being overlooked. What is required is a methodology through which an agencies to systematically assess the environment in which they intend to intervene.

A process of risk assessment may then be used to help inform decisions and programming for emergency relief operations. This approach can also help relief workers understand in more detail disease transmission pathways so that they can also understand the potential impacts of interventions and to understand better the potential synergies associated with different permutations of intervention in different environments. To achieve this goal there is a need for a decision-support system to help a systematic assessment of different technologies and software interventions within different situations. Eisenberg *et al* (2007b) provide a framework to conduct a systematic review of how the environment may affects a representative pathogen for different transmission groups. The same framework can then be used to look at different scenarios and evaluate different types of interventions and to enable programmers to assess different environmental health hazards related to WASH related diseases.

Related to the emphasis of good hygiene, it is important to note that good hygiene practices are inevitably compromised by inadequate facilities and therefore these is a need to focus more on sanitation promotion to a) encourage use of facilities and b) good use of facilities.

4.5 Views on the need for more research

Various respondents thought that the evidence base for WASH interventions in emergency situations it is generally acknowledged, even though as J-F Pineira from MSF Holland points out WASH does not always get the attention it deserves. Pineira also questions if distinguishing between 'development' and 'relief' work in this case is relevant, especially as WASH interventions are generally a matter of survival in emergency situation. He doesn't see the merits of further efforts to strengthen the evidence base to

support programming in this area. He believes that improved well-being resulting from better access is what recipient community value most because this is what they can understand and the benefits from improvements are quite obvious. However, subsequently he makes the important point that there is a need to clarify and quantify the effects of the various types of intervention which is a key point to discuss further.

Various respondents raised the issue that doing research in a emergency setting may be seen to be difficult from a perspective of the message that it portrays. It may even be seen to be unethical if the intervention trials propose to deny certain groups access to some facilities. As stated by Ben Harvey (IRC), the gold standard of a blinded, truly randomized controlled trial is unethical in emergency settings and a need to focus on saving lives rather than carrying out research. However, it should be noted that it is potentially more acceptable to 'deny' people of interventions that they don't express a demand for (e.g. hygiene promotion) than it would be to deny them of water supply.

The limitations of the existing evidence base are generally recognised by those leading research working in this field. Eisenberg, Cairncross, Biran and Luby are amongst those who were consulted who raised various concerns with the use of results of meta-analyses without taking into consideration the methodological limitations and taking the results out of context. Cairncross highlighted the fact that even the most rigorous studies may have weakness in terms of a strict epidemiological perspective.

In response the question, *do you see a need to improve the evidence base (focusing specially on demonstrating the health benefit of WASH interventions on an epidemiological basis)?* there is a mixed set of opinions. Ben Harvey firmly believes that without investing in the evidence base we will never know which interventions are best to focus our limited resources on. JK also believes that an improve evidence base would improve the effectiveness of response especially to the diseases outbreak emergencies e.g. cholera, hepatitis E virus, avian flu etc. There is the possibility that we can have significantly greater impacts on health in emergency settings than in development settings, but at present we do not know the answer to this question.

However, others such as Jean Francois remain of the believe that more research to improve the evidence base is not needed *per se* but in fact is needed maintain WASH as a priority. The basis for his arguments is that it the evidence base is sufficient from the perspective of WASH professionals but enough to persuade decision makers of aid agencies responsible for granting funding.

Related to this point, Miriam Aschkenasy (Oxfam America) also believes that greater attention will be required to demonstrated the effectiveness for the purpose of either persuading donors to make funding available or to demonstrate to the funding agencies that the money is being well spend. Therefore, she advocates strongly that there are considerable merits of collecting a limited data set provided the right questions are asked and the relief organizations dedicate sufficient resources to enable staff in the field to be able to administer the task necessary to collect this data.

Miriam Aschkenasy argues that these questions don't need to be overly complex, listing some fundamental questions that provide a good basis for understand the existing health risks which can then be used to inform the decisions about which types of intervention are likely to be most beneficial. Some agencies such as MSF and Tearfund are already strong in collecting data which can then be used to support the evidence base. Tearfund us typical/classical log-frame indicators (such as the incidence of diarrhoea in under fives, or

the incidence of acute WASH-related diseases, such as cholera and typhoid). This data is gathered through HH/beneficiary survey, or from existing health structures and is appropriate for the task but Tearfund would welcome ways of speeding up gathering of this data.

Mechanism for achieving research goals

In response to the question, how would it be possible to obtain a strong evidence base through a concerted research effort and who would need to be involved, there appears to be consensus for the need for a consortia of interested NGOs, WASH Cluster, Academics Institutions and Donors. As mentioned by Jean Francois Pineira from MSF Holland, there must be funds to carry out this kind of research and this is probably the main obstacle. In addition there is a need for a number of agencies to collaborate which may potentially be problematic.

Andy Bastible from Oxfam supports this idea highlighting the need to utilize academic institutions such as CDC, Epi Centre and London School of Hygiene to undertake the research and advise the agencies accordingly. James Kahia (IFRC) also sees a need for a similar arrangement with the involvement of key stakeholders/actors: including public health agents/institutions (Govt., WHO, INGOs CDC etc) providing epidemiological data and agencies providing WASH services providing data on service levels. One long-term partnership that has already been established is between Oxfam USA and the Harvard Humanitarian Initiative via Miriam Aschkenasy.

According to Bob Read from WEDC, most agencies are not good at the software due to lack of expertise. Many enlist the support of specialists such as UNICEF during emergency relief work. For example, in Bihar, the Government is doing the hardware and UNICEF's local staff are responsible for the complementary software component. Thus, forming partnerships and collaboration/cooperation is vital.

5.0 PROGRAMMING / IMPLEMENTATION ISSUES THAT INFLUENCE EFFECTIVENESS

5.1 Priorities and Planning objectives

Of key concern to humanitarian organizations / relief agencies is the need to ensure that their interventions are effective in terms of meeting the basic needs of the populations that they are mandated to serve. The issues are related to limited time and resources and therefore the need to be able to identify which WASH interventions are a priority to achieve the maximum benefits.

Although health is evidently critical important to the well-being of populations it is important to consider the effectiveness from other viewpoints in the realization that a) the success of an intervention from a health perspective may be supported by/or otherwise undermined by other user considerations (a good example is latrines in which usage is determined by the need for privacy, safety convenience). Sanitation is not likely to be a primary driver under any situation and displaced populations are unlikely to respond to hygiene promotion campaigns when their other more important basic needs have not already been met.

In terms of epidemiological perspective, the issue has been raised that many of the studies that inform the evidence base do not conclusively demonstrate the effectiveness but in fact only provide an indication of their effectiveness in terms of their efficacy. The distinction appears subtle but in epidemiological terms is significant.

Clearly one of the key basic needs is health but in terms of WASH interventions, many of the immediate basic needs are not health related. Broadly speaking, 'drinkable' (although not necessarily potable) water in sufficient volume is generally the primary requirement, followed by somewhere to defecate, then water quality (of a quality that is determined by WHO), followed finally by hygiene promotion (of which there is rarely an expressed demand from populations).

Of importance, but not apparently clearly stated in the literature is the fact that those interventions that are generally recognized to have greater health benefits (namely hygiene promotion and Point of Water Use Treatment) are those that are least in demand. This is a consideration when agencies are planning their interventions, as there would appear to be less justification to initiate in a hygiene promotion exercise in the immediate aftermath of an emergency until the emergency survival needs for water supply have been met.

Sanitation is unlikely to be a primary driver under any situation and displaced populations are unlikely to respond to hygiene promotion campaigns when their other more important basic needs have not already been met. Aim-on Pruksuriya (2006) explored the impacts of the Tsunami on WSS system in Phang-Nga province on the Andaman coastline and, based upon interviews and consultation recommended that during emergencies, water the priority and should come first and foremost prior to improvements in sanitation facilities. The study also concluded that it is likely that demand for hygiene promotion is of very low priority.

In terms of emergency responses, water comes first and then sanitation and then HP last and this is the focus of investments. Provision of facilities is the primary preoccupation.

But sanitation is not all about health; it is also just as much to do with privacy and convenience. Thus, maintaining dignity may be more of a concern than maintaining health.

Although effectiveness in health terms is predominantly measured in health terms, the preoccupation with health means that we may overlook other important aspects of sanitation that may be more important from the users' perspective. Bob Reed from WEDC asks *what type of evidence are we looking for*? He feels that we are overly preoccupied with health at the detriment to other benefits related to sanitation. He suggested a need to measure other benefits from sanitation such as convenience, privacy as these are much bigger drivers than health for use of latrines.

Respondents who participated in the consultation (see Appendix 1) highlighted the fact that many studies and in focus group discussions – convenience, comfort, aesthetics often rank higher than diseases. Security is an important concern for weather. This discussion raises the fact that health is the agencies' priority, but from a perspective of promoting use of latrines, then it is probably wellbeing and dignity that comes first, but evidently this is a contentious issue that requires more discussion.

Given this context and the myriad of logistical issues, Bob questions if there is a need for a research programme to find out what to do on and to justify interventions on an evidence basis. Thus, a greater need to focus on communication and co-ordination – although this is easier said than done.

5.2 Community mobilization and sanitation promotion

According to Taylor 1979, to provide a latrine is one thing, to get the people to use it is more complicated. If people have a clean spot to go to which offers privacy, is easy to get to at night and is within easy water carrying distance, then they will use the latrine. In some situations, the pressing need for somewhere to private to defecate may be sufficient but not in all cases.

One potential way forward might be to adopt a similar approach as advocated by Community Led Total Sanitation (CLTS), which suggests that children with whistles can signal when they see someone defecating in the open. CLTS is Tearfund's main approach in Afghanistan. Tearfund recognise the superiority of demand-led approaches to sanitation (particularly sanitation marketing, or livelihood approaches) for greater sustainability and replicability of sanitation interventions. Of course, in front-line emergency response (e.g. refugee/IDP camps) this is unlikely to be appropriate. But since Tearfund's strength is more in the rehabilitation phase of an emergency, it is very applicable and is may ork in camps, as long as there is strong community coherence (even if it was in clusters, or camp "neighborhoods"), and that guidance was available to build elementary latrines.

This is supported by results from a review of CLTS in Bangladesh by LSTHM which suggested that a bigger driver for using sanitary latrines was a positive one rather than the negative on that they would be named and shamed. However, experiences from CLTS are only just emerging and there would need to be a more detailed assessment to consider whether this approach would be effective in the emergency environment and specifically what physical and social environment.

According to Ben Harvey, shame is a big motivating force – however there has to be social will – and James Kahia (ICRC), community sanction for non-compliance may work where awareness and promotion has advanced to a level that the community decides to implement hygiene improvement actions. In Burundi in 2001 in the IDP camps in Bujumbura Rurale, IRC hygiene promoters encouraged children to go around the camps and put small red flags in people's feces in an effort to draw attention to open defecation (in a similar vein to the CLTS 'walk of shame' that draws attention to where people defecate and the issue of open defecation). It reportedly had a marked effect on improving excreta disposal behavior in the camps.

There is clearly a distinction between the types of intervention that are required in different contexts, but less clear in the literature is the decisions that are made in different stages in emergency response with regard to WASH interventions. A critical stage is the transition from immediate relief in crisis situation to the livelihood rehabilitation phase that are more akin to the development sector, which is characterized by a more stable social and physical environment and longer-term planning objectives.

According to Minnigh (2001), only in camps where there are concentrated groups of people can specialized, standardized but costly (imported) equipment be used. In all other situations, WASH interventions require a long-term commitment which requires a need to consider the continuation once the emergency relief operations are winding down.

Clasen and Smith (2005) refer to the following 4 stages in emergency response:

1. Immediate Emergency Phase.
2. Stabilization Phase.
3. Recovery Phase.
4. Resettlement Phase.

These are important when we consider the types of intervention and their effectiveness. The majority of technical guidance documents do not describe in much detail the specific context in which they should be applied, although Chalinder (1994) provides an overview of what may be considered 'good practice' in the field of emergency water and sanitation and indicates the particular considerations that need to be taken into account in these situations.

As long ago as 1952, the Ross Institute Industrial Advisory Committee identified the key to success to be cleaning, good maintenance and proper lighting. Baghri and Reed (1998) note that providing sanitation facilities alone does not, in itself, guarantee health improvements, they must also be used effectively. They identify the fact that there are other causes of poor sanitation, which include lack of expertise and trained people, lack of time, and a low level of interest in the subject by camp managers and refugees. The result is that a proper sanitation assessment does not take place leading to poor choice of technology.

Goma Epidemiology Group (1995) stress the need for relief agencies must place increased emphasis on training personnel in relevant skills to address major public health emergencies caused by population displacement and a well-coordinated relief program is based on rapidly acquired health data and effective interventions. Bob Reed (WEDC) thinks that emergencies can't be managed like a project. People and knowledge should be the focus, not on one answer / type of intervention. He also stressed the fact that

individuals collaborate; not organisations. He highlighted the fact that WASH works at field level but to get the organisations to work together is inherently complicated.

According to Tearfund, when considering latrine design, it is important to consider issues of sustainability and hygiene standards against replicability and cost. Tearfund Disaster Management Team (DMT) projects have seen a wide range of approaches taken on this issue – in some countries such as Afghanistan; projects have constructed latrines to a high standard of construction, using concrete slabs and solid super structure. While these are effective in maintaining good hygiene levels in a community, they are very difficult to replicate by other community members, due to the high costs of inputs involved.

In the other extremes, projects such as that in Democratic Republic Congo (DRC) have focused on replicability of the latrines, aiming to model latrine design which any community member could build in their own compound – hence the use of wooden slabs and simple super structure. The drawback of such an approach could be the difficulties of maintaining cleanliness or the sense of pride and ownership in the latrine. Each context where DMT operates is likely to be different, but this is a critical issue of project design to think through from the start.

5.3 Planning and timing of interventions

Harvey from IRC (unpublished) raises the important issue that of the time it takes to install sanitary facilities. He states that emergency latrine construction programs typically require movement of large quantities of earth (in the form of pits or trenches) and can take several months to achieve the minimum of humanitarian standards. He states that even if sufficient latrines are constructed to meet coverage standards it can take time to sufficiently change adult and child excreta disposal behaviors. He doubts that in most acute emergencies it is possible to achieve the total usage required for establishing the primary barrier to diarrhoeal disease transmission.

Taylor (1979) concluded that it is doubtful whether there is any one sanitary solution that is universally applicable in all refugee camps. There are some other technologies such as borehole latrines that should be much quicker to install. Both military engineering and the experience of the relief agencies confirm that the bore-hole latrine, together with the more temporary trench, are likely to be much more successful in providing emergency sanitation (especially in developing countries) than more sophisticated techniques which depend for materials and know-how on outside aid organizations. The simpler methods - which require an investment in hand tools rather than in capital items, can be useful over a period well beyond the duration of the immediate crisis.

In some projects, Tearfund has found that latrines have been very poorly maintained, because there has been either inadequate ownership identified or inadequate hygiene education to ensure standards of cleanliness and hygiene are maintained around the latrine. In the extreme, such latrines are a worse health hazard than having no latrine at all. It is therefore essential to always accompany latrine construction projects with comprehensive hygiene education and design, which incorporates clear ownership and promotes operational sustainability.

Also according to Tearfund, it is important to consider children's perspectives when designing latrines. Some projects have been criticized for having drop-holes, which are too wide, and children have been scared of using the latrine for fear of falling into the pit. It is important, therefore, that there is proper consideration of children's needs.

Although coverage is important, there are other important considerations that affect their usage (which is the critical factor). Firstly latrines need to be accessible and they need to be clean and well maintained. Other issues related to use of facilities include privacy and safety. Latrine design technologies influence both usage and behavior and consequently this has implications on health benefits.

5.4 Sustainable use of facilities

Another aspect less explored is the role of local watsan institutions in emergency and post-emergency. Jean Francois has researched this aspect (Pineira 2009). In post-conflict areas, the strategy of encouragement to 'link' relief and development recognizes this fact but funding patterns do not seem to have been adapted to this approach. For most donors, 'emergencies' and 'development' remain totally disconnected and this may lead to absurd situations.

The European Commission Humanitarian Office (ECHO), one of the major funding agencies for emergencies, funds operations over six months, with possible extensions, but without any mechanism for allowing a continuity of funding that would ensure the consolidations of outputs (European Commission, 1996:Article 13). ECHO may object to initiatives as important as cost-recovery in certain projects arguing that this kind of initiative has a 'long-term approach' character and is not required in an emergency.

This happened in Port-de-Paix in relation with the construction of water-kiosks by ACF. Likewise, ECHO-funded 'Solidarités' emergency operation in Kabul, which extended over three years without any impact on cost recovery. Addressing this problem requires a reform of donorship, which would allow greater flexibility in terms of objectives and ensure funding over longer periods. Aid agencies may stay for decades implementing 'emergency projects' in certain countries. In recent years, this happened in Afghanistan, Angola and Sudan, to cite only a few. This contributes to the blur of the limits between relief and development and if a link must be established in strategies, this link must be reflected in funding patterns (Pineira 2009).

5.5 Hardware vs software interventions

Various respondees agree that the provision of hardware is a way in which relief agencies can be seen to be taking action which would be less evident if their focus was primarily on hygiene promotion. Ben Harvey supports this statement and says that there is definitely an emphasis on agencies to quickly show that they are providing 'concrete' assistance. Hard numbers of family hygiene kits distributed, water purification tablets distributed, jerry cans distributed, latrines constructed etc. are easier to measure and may sound much better than number of people who received hygiene messages.

Although the community may benefit just as much from hygiene promotion activities they see this as less tangible compared with the construction of sanitation hardware which is seen as a greater investment (Tearfund). James Kahia from ICRC also agrees that it is easier for relief agencies to concentrate on provision of latrines because the availability of local masons means that this is easier than resourcing the relief effort with suitable qualified staff with the right set of skills to promote better hygiene behaviors.

However in Darfur Tearfund found it easier to find people who are teachers/trainers who are suited to hygiene promotion activities at a lower implementation level. These are often

women because, in a conflict situation the men are often fewer as they are involved in fighting and therefore skilled masons are harder to come by.

One of the arguments against undertaking hygiene promotion in acute humanitarian emergencies is that adult behavioral change is a slow process that can take a long time. The challenges of changing the behaviors of communities that may not have been using good hygiene practices in their places of origin can be particularly difficult.

The Health Belief model (Becker *et al* 1994) suggests that people may be more willing to change when they feel themselves to be more susceptible to risk e.g. at the time of a cholera outbreak. In an emergency people are often forced to change and adapt anyway and they may be more willing to do things differently or question how things are done. But on the other hand they may be overloaded with changes that they may find it hard to concentrate on or adapt to hygiene promotion campaigns that suggest that they should make additional changes to their behaviors.

Whilst some so called 'emergencies' such as long term refugee camps may resemble urban public health contexts and suffer from inadequate funding, the acute stages of a large scale emergency are often (but not always) characterized by the initial capacity to provide WASH facilities (e.g. soap, toilets, water supply) thus making change much more likely to happen. Initial higher funding levels may also ensure higher staffing levels – increasing the capacity to undertake more effective interactive hygiene education.

The conventional approach to health and hygiene promotion is based upon the behavior change paradigm in which 'knowledge' and 'attitudes' are believed to be the most important factors that influence behavior change. Although the relationship between these factors may appear to be a straightforward causal chain, the supporting evidence is equivocal and there is research, which suggests that there is too much emphasis on this causal chain (Williams 1995).

Models of social change challenge the individual behavior change paradigm; stressing the importance of groups working together to achieve changes in health or hygiene. In addition, Becker *et al* 1994) suggest that people may be more willing to change when they feel themselves to be more susceptible to risk.

According to Harvey, during acute emergencies where diarrheal epidemics are manifest and the threat of sickness and possibly death is evident, communities have been shown to seek out advice and radically alter hygiene behaviors. This hypothesis is supported by experience from El Salvador, where refugees arriving in Honduras in 1981–1982, quickly set up camp committees responsible for ensuring that their concerns were represented before the United Nations High Commissioner for Refugees and the nongovernmental organizations that became involved. In time, subcommittees were formed to deal with specific issues, such as public health, sanitation, hygiene and education. Refugees who had arrived as illiterate farmers soon acquired effective skills in management, administration and negotiation, and built up a sustainable social structure on which they would build on their return to El Salvador (Oxfam 1995 - quoted in Wisner and Adams 2002).

If this is true then this is a key issue because it challenges the paradigm that changing behavior takes a long time. The statement suggests that behavior can change almost immediately and it is logical to assume that this is the case where everything else has changed and therefore it is easier for the refugees to adapt to new – albeit on a temporary basis. This suggests that disaster victims are likely to be able to adopt new behaviors in the immediate – short-term basis (which may continue to the medium term) but in the longer term, once back in their abode they refer to their normal behavioral practices.

6.0 GAPS IN KNOWLEDGE AND POSSIBLE AREAS FOR FURTHER RESEARCH

6.1 General issues

- We know that in some situations epidemics occur and in others they don't. Do we have rationale basis for assessing these risks in order to help agencies estimate whether an epidemic (notably cholera) is expected and therefore plan accordingly?
- It is important to consider the effectiveness of interventions not just from a health perspective but also other perspectives such as user satisfaction which may influence level of use and hygiene behavior practiced which may have an impact on health.
- The effectiveness of interventions can be judged in different ways and thus there is a need to look at these issues from different stakeholder perspectives.
- The evidence base may point towards the need for certain types of intervention but if these are not to be sustained, then the effectiveness of the intervention will be compromised.
- It is important to consider children in emergency situations, although clearly the evidence base argues for the need to focus on children for various reasons, this does not appear to be an aspects which has been looked at in sufficient depth in shorter term relief efforts. Age is not taken into account sufficiently in the epidemiological studies in the literature.
- At present, there does not appear be a systematic review and assessment of pathogen pathways within different emergency contexts and how these are affected by the physical and social environment. This could be used as the basis for improving the understanding of health risks in these different environments and thus potentially improve decision-making and program planning.
- For intervention planning purposes - how much does the timing of the introduction of an intervention affect its uptake and therefore its success in terms of health benefits?
- Although the expected impacts of climate change (such as temperature rise) on pathogen transmission are recognized (notably those related to insect vectors), there is insufficient consideration to date as to what this is likely to mean for environmental health in emergency situations and how these may affect humanitarian aid responses.
- There is a general consensus that there is often too much overemphasis on the installation of sanitation facilities, without sufficient attention paid to management arrangements and sustainability.
- A description of the epidemiological conditions associated with these contexts and how the effectiveness of WASH intervention will be affected by the type of environment in which the relief organization is operating.

Primary barriers vs secondary barriers

What level of latrines use/safe excreta disposal (e.g. % of population using latrines or other safe excreta disposal methods) would result in a substantive health benefit as a primary barrier?

Is the household centered approach to diarrheal disease reduction the most effective way of reducing diarrheal disease?(Ben Harvey- IRC)

Individual vs combined interventions

Multiple intervention strategies

Clarify and quantify the effects of the various types of intervention (water supply, excreta disposal, drainage, wastewater, hygiene promotion) with a specific focus on sanitation and hygiene promotion (J-F Pineira).

Although there are some staunch advocates of hygiene promotion, there are others who believe that we have yet to demonstrate sufficiently that hygiene promotion really makes a difference (John Allen) Under which conditions is it better to focus more on hardware and increase coverage or on use of facilities and do more hygiene promotion (J-F Pineira) ?

A hierarchy of implementation versus health benefits would be useful e.g. improvements in hand washing reduces the risk of diarrhoea typically by 20% or provision of well used latrines cuts risk of cholera by 50% etc. These data would help to focus immediately on the appropriate intervention (hard or soft) depending on the risk factors in the specific location.

6.2 Water supply

More rigorous research is needed to disaggregate between benefits associated with quantity and those associated with quality - consider the curve that describes access to water in terms of time to reach the point of collection and the amount of water that is obtained) (Cairncross).

The effectiveness of POU interventions following distribution without any form of promotion (Ben Harvey).

6.3 Sanitation

Based upon the experience from Peterson, it is important to plan for additional research to evaluate whether the provision of soap can result in desirable health benefits without the focus on hygiene promotion.

Technology choice

Although there is literature about the types of sanitation technology that may be appropriate in the emergency context, there is not presently a framework to guide decision makers towards the identification of the most appropriate latrine. The phase of the emergency response is clearly a key factor in terms of the most appropriate technology.

Choice of sanitation technology is clearly a key factor for the achievement of health benefits. Simply put, getting the technology wrong may result in complete failure of the intervention. Therefore, data regarding the effectiveness of sanitation to achieve health benefits needs to be taken within the context of the type of latrine and how well it is maintained, which can subsequently influence hygiene behavior as well as the other way around.

In relation to use of sanitation facilities, there does not appear to be much in the way of sanitation promotion in emergency situations.

The effectiveness of packet latrine (Peepoo bag) technology needs a trial (BH) and also more research into communal versus individual latrines is required for different contexts

Time for implementation

Harvey (undated) raises the important issue that of the time it takes to install sanitary facilities and achieve sufficient levels of behavior change to ensure high levels of usage. He states that emergency latrine construction programs typically require movement of large quantities of earth (in the form of pits or trenches) and can take several months to achieve the minimum of humanitarian standards.

This raises the question, why should it take so long to install basic facilities and points to an area for further research to improve the timeliness and therefore the effectiveness of emergency response. At present it would appear that IFRC are the only organization who are considering the 'speed' issue with the emergency response 'mass sanitation module' which involves an option of flying small mechanical excavators into an emergency.

Usage versus access

Another issue for future research in sanitation is to understand better the correlations between access, usage and the result effectiveness. James Kahia (IFRC) stated the need for research in different emergency settings where coverage is varying i.e. at different levels of latrine use comparing with diarrhea diseases incidence rates over time.

In theory, there should be very little impact on reducing diarrhoeal transmission where access (and consequently usage) is low but at present we do not know at what stage the increasing access stimulate greater usage. But there are of course other factors that will play a key role in whether or not people use it. A specific question is the question *is total sanitation required?* (Ben Harvey- IRC), referring to the argument that even one of 2 people practicing open defecation creates a significant health risk the rest of the emergency community.

6.4 Hygiene promotion

It would be useful to assess the role of hygiene education alone compared to hygiene education and water treatment or storage improvements (as attempted by Wilson and Neveu 1995) to see how much hygiene education contributes to the apparent health benefits of such interventions. However, in most cases this is probably not a realistic proposition as it would be considered unethical to deny disaster affected populations access to basic water supply and sanitation.

What types of promotional activity are most effective and to whom ?

- Experiences from CLTS are only just emerging and there would need to be a more detailed assessment to consider whether this approach would be effective in the emergency environment and specifically what physical and social environment.
- How effective is the faster PHAST process and methodology (in an emergency (as opposed to use of participatory tools in isolation)?
- There is a need to explore in greater depth how social marketing may apply in the case of emergency response operations
- Is it beneficial to carry out one-to-one motivational interviewing for hygiene promotion in emergencies or will it suffice to work at the communal level ?
- Are the hygiene promotion activities influencing the behavior of children (either directly or indirectly) ?
- Provision of soap to refugees without emphasis on its promotion requires further investigation.
- Is it beneficial to carry out one-to-one motivational interviewing for hygiene promotion in emergencies or will it suffice to work at the communal level ?

What level of activity and what resources ?

- To ensure that hygiene promotion is effective, how much resources need to be put into it to ensure that the desired outcome is achieved.

Receptiveness of populations

- Does the acute emergency context predispose people to change their practices?
- A potential important area of research is the receptiveness of populations to different hygiene behavior promotional techniques and a focus on their ability to respond to these and adopted new behaviors.
- A key issue related to this that is especially relevant in the emergency context may be the psychological status of the population. For instance, if an individual is in a state of mental/emotional turmoil, they may not be in the right frame of mind to respond to behavioral change interventions.

6.5 Social mobilization

Sanitation promotion

What are the most effective behavior change methods for encouraging latrine use ?

Further evidence on water quality testing using existing and potential water resources (e.g. from Geographical Information System data, incorporating hydrogeological data), population movements, sanitation facilities, security issues,

Effectiveness of soap distribution without any form of promotion –

Impact of distributing massive quantities of soap alone without other hygiene items vs distributing family hygiene kits that contain soap (and the importance of soap is lost). (Ben Harvey)

6.6 Cost-effectiveness

Existing results indicates that hygiene promotion is the most cost effective but these results may not be relevant as most of the data is from development situation. Evidently if something has some impact and costs very little, then it is a potentially a more attractive options than one that only has a little additional benefit but costs a lot more.

The issue of costs seems to be factor that is not mentioned in the literature and there is a need for a concerted effort to collect and compare cost data. More research to assess the impacts of transitions from crisis emergency response to more stable “emergency”.

Cost effectiveness aspects should be considered. Meddings *et al* (2004) concluded that ICRC sanitation intervention in Kabul reduced the risk of diarrhoeal disease morbidity in children and that its cost effectiveness was comparable to other health case interventions. However, long term follow up is necessary to understand the full impact of the intervention

7.0 References

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Annex 1: Consultees

Organisation	Contact
UNICEF	Peter van Maanen
Teafund	Frank and others
IFRC	Libertad Gonzalez Emma Hernandez James Kahia
MSF Holland	Jean Pineira
Action Contra la Faim (Belgium)	Jean Lapegue
·Action Contra la Faim (Spain)	Karine Daniel
Oxfam America	Miriam Aschkenasy
Oxfam UK	Andy Bastable Marion O'Reilly
Academic Institutions	
WEDC	Bob Reed
LSTHM	Sandy Cairncross Adam Biran
University of Michigan	Joseph Eisenberg
University of Harvard	Michael Kramer Peter Wang
International Centre for Diarrheal Disease Research, Bangladesh (ICDDR,B)	Steve Luby
Independents	
	John Adams
	Mark Myatt

Annex 2: List of questions

Do you agree/disagree with the following statements / questions ?

- 1) There is no strong evidence base for WASH interventions in emergency situations. Is this simply because the data set is limited because it is so hard to collect or are there other reasons?
- 2) Do you see a need to improve the evidence base (focusing specially on demonstrating the health benefit of WASH interventions on an epidemiological basis?)
- 3) If you think that there is a need to improve the evidence base, what sort of evidence do we need and how do we get it?
- 4) How would you propose to achieve this objective ? Would it be possible to obtain a strong evidence base through a concerted research effort ?
- 5) It is not possible to achieve total sanitation in emergency relief operations and therefore there will always be those who practice open defecation which means that primary transmission routes can not be removed. Therefore there is a need to focus more on secondary barriers (in accordance with the F-diagram) to prevent transmission of disease.
- 6) There is a need to focus more on secondary barriers (in accordance with the F-diagram) to prevent transmission of disease.
- 7) There is too much focus on the installation of hardware (latrine facilities) and not enough on the software aspects?
- 8) Do you think this increased focus on hygiene promotion should be in addition to the provision of latrines or can we reduce the amount of resources to install latrines to enable greater efforts on hygiene promotion?
- 9) Is it easier for relief agencies to concentrate on provision of latrines because the availability of local masons means that this is easier than resourcing the relief effort with suitable qualified staff with the right set of skills to promote better hygiene behaviors.
- 10) Is the provision of hardware a way in which relief agencies can be seen to be taking action which would be less evident if there focus was primarily on hygiene promotion?
- 11) On the assumption that use of facilities is a better indicator than coverage, do you think that we should look at ways to promote use of latrines. For instance, the CLTS approach encourages children in communities who traditionally practice open defecation to blow whistles when they see someone defecating in the open. Would this approach work in emergency relief context (notable refugee camps)?
- 12) Do you think that the Peepoo bag (www.peepoople.com) which is akin to the PUR tables for water treatment offers an immediate response to sanitation problems if a) there is someone private for defecation b) provision is made for collection and safe disposal?