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WASH interventions – going beyond direct health impacts

Recommendations for improving and monitoring the health impacts of water, sanitation and hygiene (WASH) interventions.

Key messages:

- *There is inadequate evidence for the health impacts of WASH due to limitations of available and realistic research methodologies. However, the important role of WASH as a determinant of public health, including nutrition, has widespread recognition.*
- *The social, psychological, gender-related, educational, economic and environmental benefits of water and sanitation are considerable enough to merit investment and can be equally or even more important than direct health benefits, depending on the context.*
- *The effectiveness of WASH programs can be improved through template tools to develop context-specific programs which incorporate baseline assessment, combine WASH interventions, and have a greater focus on including hygiene behavior change.*

Summary

It is widely accepted that water, sanitation and hygiene are necessary foundations for public health. For this reason, the WASH sector, which includes the German development actors (GIZ, 2011)[1], have traditionally based their justification for WASH interventions on the hypothesis that the health status of the target groups will improve. Despite the fact that these impacts are in general not questioned, it is costly and difficult to provide proof. There are methodological and practical difficulties with generating evidence and isolating the direct intervention effects. These challenges include confounding factors such as seasonal interferences, local economic developments and parallel interventions that affect the health status of the local population at the same time.

In accordance with Schmidt (2014),[20] this paper makes the case that even if the health impacts of WASH are limited or non-existent, the numerous additional social, psychological, gender-related, educational, economic and environmental impacts and benefits of effective water and sanitation are alone considerable enough to merit investment. Additional non-health-related impacts of WASH include: keeping children in school, which leads to better educational status; higher productivity due to time savings and less absence from work; improving dignity; and positive environmental effects like keeping eco-systems and water sources clean.

This paper also outlines the available knowledge, monitoring methods and evidence on health impacts of WASH interventions which was gathered from the desk study conducted by Mosler et al. (2014)[2] and consultations with international WASH and health experts which accompanied the desk study. This paper draws from those discussions to develop recommendations on how WASH interventions could be improved in the German development sector and beyond, particularly in the context of improving health impacts, thereby improving the effectiveness of WASH interventions.

Basics of WASH and health impacts

What is WASH?

WASH stands for the triangular connection of **WA**ter, **S**anitation and **H**ygiene. It represents the basic human need to drink clean water and release body waste in a safe and dignified way in which diseases originating from human waste are prevented from re-entering the human body. WASH aims at promoting and strengthening individual and public health and relieving pressure from the healthcare system as a whole. Besides health, WASH is crucial for general well-being and good outcomes in nutrition, education and livelihoods.

Both water and sanitation are internationally proclaimed human rights. The water component includes providing a water supply with sufficient quality* and quantity for drinking and hygiene purposes. Sanitation provides facilities that serve the daily need to release body waste and act as a physical barrier to keep human waste (primarily urine and faeces) and containing pathogens separated from humans. This way, the water and food chain is protected from pathogen contamination. Hygiene is the interlinking element of water and sanitation that aims for body and household hygiene behaviours that ensure safe handling of water, adequate preparation of food, washing hands at critical times and avoiding skin contact with contaminated soil and water-ways among other things.

Scale: Disease burden of inadequate WASH

According to the WHO (2008)[3] 10% of the total burden of disease (measured in Disability-Adjusted Life Years, DALYs) and 6% of all deaths are associated with diseases related to unimproved WASH. Within the WASH disease burden, diarrhoeal diseases are the main cause (40%), followed by malnutrition (25%), parasitic worms (6%) and trachoma (1%). Estimates put the death toll attributed to unsafe water, sanitation and hygiene at 2.4 million people per year. (Prüss-Üstün, Bos et al. 2008).[4]

Among children, the burden is even higher: 22% of the disease burden among children and 25% of child deaths are attributable to WASH-related diseases. This does not include respiratory infections that are also often linked to insufficient hygiene, but cannot be quantitatively linked to WASH (Prüss-Üstün, Bos et al. 2008).[4] Diarrhoeal disease is the second leading cause of death in children under five years old and it is the leading cause of malnutrition. A significant proportion of the annual deaths of 760 000 children under five from diarrhoeal disease can be prevented through safe drinking-water and adequate sanitation and hygiene (WHO, 2013).[5] Health consequences of diarrhoea and malnutrition include reduction of children's growth (stunting), cognitive underdevelopment, and death. Of the 555 million preschool children in developing countries, 32% are stunted and 20% are underweight (Humphrey, 2009).[6]

Diarrhoeal diseases and malnutrition are highly correlated and influence each other. In this context, the condition of *environmental (or tropical) enteropathy* plays a key role - young children living in conditions of poor sanitation and hygiene who experience frequent ingestion of faecal bacteria leads, on one hand, to diarrhoea episodes which result in decreased food and nutrient intake, and on the other, to a subclinical disorder of the small intestine which reduces absorption of nutrients, thus causing malnutrition (Humphrey, 2009).[6]

* Safe drinking water is defined in the Human Right to safe drinking water as "*water free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health*" (UNGA, 2010).

Moreover, WASH-related diseases disproportionally affect the poor in developing countries, as monitored by the ongoing WHO/ UNICEF Joint Monitoring Programme (JMP). Insufficient access to WASH, health care services and education creates of vicious cycle of disease and poverty.

Cause: Casual chain – transmission routes of pathogens

Diseases linked to inadequate WASH are caused by infectious agents called pathogens, which are primarily microorganisms including viruses, bacteria, protozoa and intestinal worms (parasites).

Pathogens are mainly present in faeces, and to a smaller extent also in urine, dependent on whether the person is infected with or is a carrier of the pathogen in question. Pathogens can cause a variety of diseases, including diarrhoea, typhoid fever, cholera and parasitic infections. Some pathogens do not originate from human waste but from infected insects that breed in or near stagnant water, like malaria, or in faeces, like trachoma.

There are many different transmission routes for pathogens, depicted in various "f-diagrams", diagrams which depict the movement of pathogens from faecal matter, including through fluids, food, flies, fields, floors, fingers and floods (WEDC, 2012).[7] Many pathogens are easily transmitted via the *faecal-oral route*, either directly, through contact of contaminated hands to mouth, or indirectly, through ingestion of faecal-contaminated food (fields and flies) and water (while drinking or bathing). This is mostly due to inadequate hygiene conditions when people do not wash their hands before preparing food, or due to untreated sewage contaminating drinking water supply. Other pathogens are transmitted by touching soil that is contaminated with soil-transmitted helminths (parasites) originating from untreated human faeces disposed on and in soil. For WASH-related diseases unrelated to direct contact with human waste, the pathogen transmission is commonly mosquito-borne, causing malaria, dengue fever and trachoma. The latter is an eye-infection that is further spread by direct or indirect body contact, which can be a sign of insufficient face and hand washing and hence inadequate hygiene conditions.

WASH interventions can interrupt these transmission routes and lead to the reduction of disease burden, based on logic-based cause-and-effect models. The causal model in Figure 1 is one of the main justifications for WASH interventions.

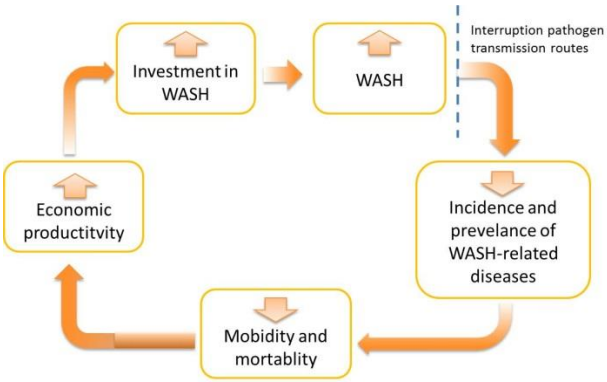

***Figure 1**. Logic framework of WASH interventions based on health impacts (adopted from Solomon, 2014)*[24]

Measures: Interventions and their evidence base of direct WASH health impacts

Measures preventing pathogen transmission comprise: interventions in sanitation; at water source and point of use (POU); and of hygiene improvements that intervene at different points along the transmission routes.

German Cooperation measures. Typical German Cooperation WASH interventions are water supply programmes with combined hygiene promotion and sanitation secondary infrastructure like sewerage systems. Combined measures of all three WASH components are rare and on a piloting scale only. Studies on health impacts are only available for water

supply, most of them not complying with high-level evaluation methodologies. The lack of an adequate baseline analysis, monitoring, record keeping and archiving (in projects, water institutions or health centres) has hindered evaluation procedures. One exemption is a longitudinal health study on the school hygiene programme 'Fit for School' which is mentioned below.

The analysis of water supply programs of German Development Aid undertaken by the Mosler et al. (2014)[2] desk study shows that for most cases, water supply programs are not clearly designed for health impacts (indicated also by the lack of health indicators). The programs instead focused on improving water sources by improving water quantity and quality at the point of source (mostly water kiosks and stand pipes) and at the point of use (household connections) with the main objective of time savings for fetching water, gender aspects and cost savings.

Nearly all the analysed projects in Mosler et al. concentrate on source water interventions like water kiosks or yard taps, thus neglecting that drinking water has to be collected, transported, stored and drunk with specific vessels which are all prone to re-contamination. In general, projects showed weaknesses on hygiene training and awareness campaigns. From the evaluated projects in Mosler et al. in Tanzania, Yemen and Benin, delivered water was often chemically or microbially unsafe at the point of consumption. In regards to piped household water supply, the available project evaluation in Yemen also showed contaminated water supply. This was due either to poor construction of pipes or, more likely, poor operation and maintenance with supply interruptions causing contamination of water in the piping networks.

Therefore projects with a water supply component should ensure water safety up to the point of consumption.

Moreover, in terms of accessibility, the achieved coverage rates were often too low (e.g. below 50%) to impact the general community health status or did not reach the right areas e.g. in Benin, 38% of water points that were implemented had been allocated to localities which already had adequate service. In addition, the costs of water with project-supported cost recovery systems is a typical reason why the very poorest may be excluded from the use of improved water facilities and continue to use unimproved water sources for drinking after project implementation, for example, in rural Benin and Tanzania (Mosler et al., 2014).[2]

Evidence base: water interventions. Safe drinking water is defined in the 'Human Right to Safe Drinking Water' as "water free from micro-organisms, chemical substances and radiological hazards that constitute a threat to a person's health" (UNGA, 2010).[8] However, the WHO (2011)[9] acknowledges that "100% free" is not achievable, and that it is most effective to define the public health targets by applying a multiple-barrier-principle that increases water safety through measures at several steps of water supply.

Studies at the different steps of water supply include randomized trials with large samples, which found health impacts of *improved communal water sources* in most, but not all cases (Waddington and Snilstveit et al., 2009).[10] The risk of re-contamination at the point of consumption in the household is largely dependent on household hygiene behaviours. For *water quality interventions at point of use,* most studies suggest that interventions like SODIS or water filters are more effective in reducing diarrhoea risk than water supply interventions, irrespective of the evaluation quality (Waddington, Snilstveit et al. 2009).[10] Nevertheless, behaviour change techniques that maintain new behaviours over time are not available yet and are currently being researched (Sonego and Mosler, 2014).[12]

Some evidence was found indicating that more significant health impacts occur from

improved private piped water supply than from communal water supply (Günter and Schipper 2013).[13] Additionally, as traditional water handling and treatment, such as boiling water, decreases among users after installation of modern privately piped water infrastructure, it is important to ensure continuous safe water quality at the point of tap.

Evidence base: sanitation interventions. In contrast to water supply, few studies exist which discuss the impact of sanitation infrastructure on health, and those that exist are primarily for rural contexts. Günther and Fink (2013)[14] found that access to improved sanitation was associated with lower mortality, lower risk of childhood diarrhoea, and a lower risk of mild or severe stunting, with the highest health benefits coming from private sewer connections. A meta-analysis from Waddington, Snilstveit et al. (2009)[11] found that effective sewer connection and latrine provision led to a 37% reduction of child diarrhoea morbidity.

Open defecation in rural settings is often conducted at some distance from households (Cairncross and Valdmanis, 2006)[15] and often considered a health hazard. However, in rural settings, use of unclean and non-improved latrines close to the household may even increase disease burden compared to open defecation (Opryszko, Majeed et al., 2010).[16]

Evidence base: hygiene interventions. Hygiene interventions should focus on a substantial behavioural change among beneficiaries as WASH infrastructure needs to be used safely and continuously by target population to achieve health impacts (Waddington, Snilstveit et al., 2009).[11] Mere hygiene education efforts alone usually do not result in behaviour change and it has been difficult to identify health effects specifically from hygiene education (Fewtrell, Prüss-Üstün et al. 2007).[17] A large number of randomised trials were conducted to address promotion efforts for hand-washing with soap, which generally yielded high health impacts of a 30-50% reduction in self-reported diarrhoea (Ejemot, Ehiri et al., 2008)[18] or reduction of respiratory diseases (Luby, Halder et al., 2011)[19]. However, the validity of the evidence has been subject to scrutiny as it has been criticised as being 'all an illusion' as the combination of lack of blinding and use of a subjective outcome such as self-reported diarrhoea causes bias (Schmidt, 2014).[20]

A relatively well studied example of a hygiene behaviour change strategy with good evidence is the skills-based approach of the GIZ programme 'Fit for School' in the Philippines, where daily routines of hand-washing and tooth-brushing and bi-annual deworming have led to clear health benefits, including 20% less underweight children and encouraging the formation of life-long hygiene behaviours (Monse, Benzian et al., 2013).[21]

Evidence base: full WASH programmes (combined approaches). There is a scarse evidence base on the health impact of combined approaches. Despite this, combined interventions seem crucial in some contexts, for example, for sanitation, which only works well with the combined effects of hygiene and water supply as indispensable preconditions for hygienic use and operation of facilities.

Quality and validity of evidence

The Mosler et al. (2014)[2] desk-study and other sector documents confirm that there is a lack of relevant and valid scientific information about key aspects of WASH interventions and their health impact. In general, there are conceptual, methodological, and practical difficulties of generating sound and relevant evidence of health impacts from WASH interventions.

Research trials are very difficult to implement in the settings where they are most needed, such as in densely populated urban areas for sanitation and in remote rural areas for water supply. The

challenge is to compare intervention areas with control areas (with no intervention) as it is unacceptable to delay the access for water or sanitation for people in need just for the sake of science. Therefore valid data is scarce.

There are issues with isolating the direct intervention effects from confounding factors that are unrelated to the original intervention. Parallel changes in the setting like socio-economic developments and improved health and solid waste services or changes in the environment like seasonal interferences and less flooding and pollution due to a concurrent drainage intervention can affect the health status of the target population and thus make it difficult to measure or capture.

There are also challenges with the widely-used self-reported diarrhoea as a key indicator for health impacts of WASH interventions. Most research trials base their results on self-reported diarrhoea, which normally leads to bias by either the observer and/or the respondents who (intentionally or unintentionally) under-report disease. More accurate alternative indicators and methodologies are not, however, available. Statistical data from the health sector also does not provide sufficient information as most episodes of diarrhoea and other WASH-related diseases are treated at home and not at a local hospital or health centre.

Furthermore, the evidence presented in the previous section of this paper shows scientific constraints for most meta-analyses by comparing evidence from very different settings using different methodologies for research and monitoring.

Given the severe constraints in implementing water and sanitation trials and generating valid evidence, especially in settings where they would be most informative, it seems unlikely that useful health impact estimates will be available in the near future (Schmidt, 2014).[20] Nevertheless, although research methods fail to demonstrate clear and plausible relationships between causes of diseases, interventions and health status, it is important to continue to invest in WASH interventions and related research, especially by taking into account other significant outcomes and impacts of WASH interventions.

Recognition and inclusion of indirect- and non-health impacts of WASH

Significant health problems are often the starting point of WASH interventions. Based on an evidence-based assessment of health impact alone, some of the interventions described would have to be reconsidered or justified. However, besides direct health impacts of WASH interventions, there is clearer evidence on a broad scope of other impacts. Depending on the local context, some of them are equally or possibly more important than *direct* health impacts.

Determinants of health

The acknowledged concept of "determinants of health" underpins this assessment as it defines health not only based on the disease burden but in a much broader sense of human well-being. The health of a person depends not only on diseases and conditions which affect the health status but on other non-disease related factors like socio-economic, cultural and environmental conditions.

WASH is one out of many factors that determine health, as shown in the following graph by Dahlgren and Whitehead (1991).[22]

Figure 2. *Determinants of health (adopted from Dahlgren and Whitehead, 1991)*[22]

In addition to direct health impacts of WASH, improved WASH also has important non-disease related impacts. Such effects include, but are not limited to, social, psychological, educational, economic and environmental effects like:

- Improving dignity, privacy and better security related to sanitation, especially for women and girls
- Greater participation of girls in school
- Reduced cost for safe water sources and access to sanitation
- Time savings - more time for family, social interaction and productive activities
- Positive environmental effects

WASH associated impacts

In line with this concept there are three different types of associated health impacts of WASH:

Direct health impacts	reduced disease burden and health care costs
Indirect health impacts	reduced disease-related absenteeism from school or work and higher productivity, gender equality, privacy and dignity
Non-health related impacts	Non-disease related impact like time savings, environmental protection

Investing in water, sanitation and hygiene despite lack of evidence

The realisation that WASH-related health impacts are difficult to assess and generally modest if looked at in detail is not unique or new to German Development Aid and other development agencies. A recent review by the Institute of Development Studies (Loevinsohn, Mehta et al., 2014)[23] comes to similar conclusions and clearly recommends the inclusion of non-health impacts. Therefore, the described educational, developmental and gender-related benefits of water and sanitation access are in general significant enough to merit investment.

General recommendations for water, sanitation and hygiene interventions

The desk study conducted by Mosler et al. (2014)[2] provides a wealth of useful and relevant information on current evidence, relevant studies and approaches, different monitoring strategies, and key lessons from programme implementation. Summarised below is the reflection of this information during the consultations with international WASH and health experts which aimed at developing recommendations to improve the effectiveness of WASH programs on health impacts and the general value for money.

Role of hygiene behaviour change

A greater focus on hygiene behaviour change is necessary in order to ensure that existing or newly built infrastructure and services are actually used and operated in a safe manner and on a continuous basis. Existing behaviours like drinking inadequately stored water, using toilets but not cleaning them, washing hands only after eating but not in key situations (after going to the toilet, before eating) often foster inadequate use and counteract health impacts.

Implementers often assume that increasing knowledge through hygiene and awareness campaigns is enough to change behaviour, which in most cases is inappropriate and insufficient. However, before behaviour change can take place, behavioural determinants have to change. Behavioural determinants are, for example, knowledge, perceived health risks, costs and benefits, mind-sets of the people and social norms.

Since current behaviour change techniques are largely not evidence-based for a specific project context, there is need to generate evidence on the most effective hygiene intervention and develop useful planning templates from this evidence.

Focus on settings

It seems to be useful to focus on specific settings like schools and health care centres where; first of all, many people come together and secondly, people are a captive audience for a specific time span or on a routine basis. These situations help behaviour change techniques to work better. It is also important to form life skills on healthy behaviours like handwashing with soap at critical times or regularly cleaning toilets and water points. The Fit for School approach is a promising example for schools as it has achieved significant health impacts among school children (Monse, Benzian et al., 2013).[21]

WASH programming templates

The challenge of defining the right mix of water, sanitation and hygiene interventions in a specific project context needs to be addressed by developing context-specific WASH approaches. For this it is useful to develop modular and template-based tools for programme planning, implementation, monitoring, evaluation and research in order to reduce complexity and prioritise areas in need of improvement which are also realistic to implement and integrate into partner structures. As a part of these packages, programme planning needs to start with adequate baseline studies that provide an analysis on the locally relevant WASH diseases, transmission pathways, and current status of WASH infrastructure and services. Guidelines on a standardised methodology for WASH baselines need to be developed. An example of a useful tool for WASH baseline assessment is the WHO's Health Impact Assessment (HIA).

Fostering intersectoral approaches

Even though it is a challenge to work across sectors, it should be the objective to intensify intersectoral collaboration in order to utilise and benefit from the respective expertise, roles and responsibilities for better WASH services.

Standardising monitoring and evaluation of health-related impacts

More frequent evaluation could contribute to improved effectiveness by encouraging investors and implementers to focus on impacts rather than outputs (such as number of toilets constructed). Projects should follow systematic monitoring with standardised indicators across water, sanitation, and hygiene to allow for comparability of data, better adaption of interventions to the local context and better illustration of impacts.

Strengthening operational and implementation research to increase the evidence base

Given the significant persisting research gaps related to health impacts and other associated impacts of WASH interventions, it is important to improve the evidence base by research, particularly with inclusion of indicators other than diarrhoea incidence. Interdisciplinary operational and implementation research should be encouraged, to facilitate effective programme implementation and to make recommendations which should be as practical as possible.

Specific recommendations for water, sanitation and hygiene interventions

Water interventions

Use the Water Safety Plan (WSP) approach. *The development of a WSP for a given supply system provides a holistic approach of risk identification and continuous risk management, addressing the entire water supply chain from catchment to consumer.*

Use health-based water quality targets. *The WHO Guidelines for Drinking-water Quality emphasizes the benefits of using locally realistic health targets and setting drinking-water quality targets accordingly (allowing incremental improvement over time).*

Avoid faecal pollution of source water. *Focus on avoiding faecal pollution at the source water is an important, achievable, and necessary step to avoid water contamination.*

Apply behaviour change interventions *to prevent re-contamination of water at the point of use.*

Ensure quality for piped household supply. *Research results show that piped supply into the household has the highest potential to yield health impacts, but only if water quality – particularly microbial – at tap is continuously assured.*

Indicators for water. *No single indicator can capture 'water safety', rather it is important to select a set of indicators and make a multidimensional analysis. A good example is the combination of direct water quality measurements like 'Faecal indicator bacteria' (E.coli) and 'Geogenic chemicals', with water management indicators such as 'Sanitary inspection and risk score' and 'Household water storage practices and risk score'*

Sanitation interventions

Ensure water supply. *There is no safe sanitation without water supply, even for dry toilets, to enable cleaning of facilities and basic hygiene practices. Likewise, there is no safe water supply without sanitation.*

Stronger focus on hygiene and behaviour change. *Provision of sanitary facilities show health benefits only when continuously used and operated in a safe manner. This can only be achieved when hygiene behaviours are changed adequately by employing evidence-based behaviour change techniques. This includes the main personal hygiene behaviours such as handwashing with soap and activities related to toilet cleaning and maintenance.*

Address the entire sanitation chain. *Especially in urban areas, a supportive environment is required in order to provide the entire sanitation chain, starting from collection of faecal material to transport, treatment and safe disposal or reuse.*

Indicators for sanitation. *The aspects of sanitation which directly impact health are those specifically related to the separation of faeces from the environment like 'Cleanliness of the sanitation facility', 'Type of sanitation facility used', 'Faecal sludge management systems' and 'Management of child faeces'.*

Hygiene interventions

Behaviour change is key. *An evidence-based behaviour change intervention should always accompany the installation of WASH infrastructure and the introduction of water and sanitation services, to make sure that the target population uses them continuously and safely. Avoiding the use of unsafe water sources and facilities, which often still exist, also needs to be part of such interventions.*

Promotion of handwashing with soap *(with accompanying awareness of behavioural determinants) is a highly cost-effective intervention if the main objective is to reduce WASH-related diseases. In the specific setting of schools, the health impacts of handwashing have been clearly demonstrated with skill-based methods in the Fit for School approach.*

Indicators for hygiene. *The principal indicators for hygiene are use (or behaviour) indicators. Other aspects of hygiene (e.g. covering of food, menstrual hygiene management) should be considered if those behaviours are targeted by the intervention being monitored. Typical use indicators are 'Observed presence of soap by latrine or in yard', 'Spontaneous use of soap when asked to demonstrate handwashing' and 'Observed HWWS [handwashing with soap] after defecation (structured observation)'.*

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