

36th WEDC International Conference, Nakuru, Kenya, 2013

**DELIVERING WATER, SANITATION AND HYGIENE SERVICES
IN AN UNCERTAIN ENVIRONMENT**

**Piloting a rapid participatory risk assessment methodology
of sanitation systems in Maputo, Mozambique**

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BRIEFING PAPER 1822

This paper describes the activities of Class-A, established as a platform for multi-stakeholder partnership and learning alliance in Maputo, Mozambique to develop and pilot a methodology to assess risks associated with sanitation. The Participatory Rapid Sanitation System Risk Assessment (PRSSRA) methodology uses local knowledge to prioritise areas where community members are most at risk and to identify parts of the sanitation chain to which high risk can be attributed. The participatory nature of the methodology also gives communities the opportunity to identify their needs and express their priorities to the municipality. This paper outlines the methodology, the challenges and successes of its application in two low income neighbourhoods of Maputo, Mozambique and the next step in refining the methodology.

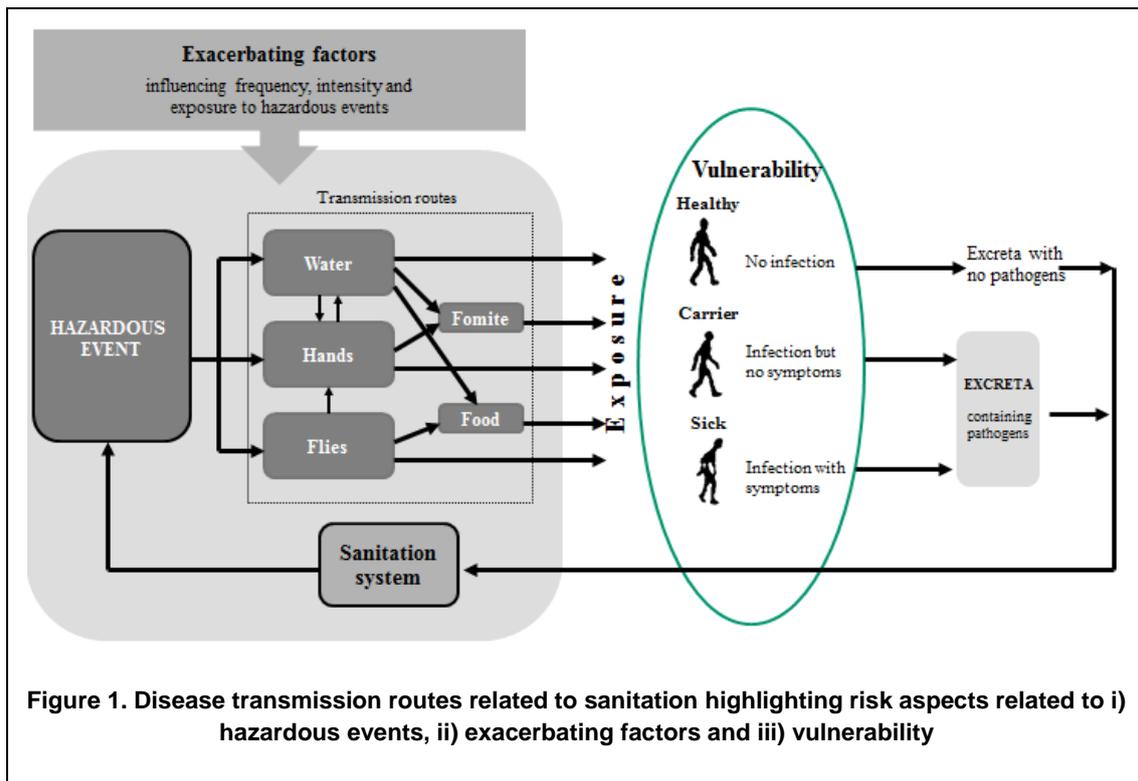
Definition of sanitation risks

Pathogens contained in faeces and to a lesser extent in urine, are widely recognized to be hazardous to human health. These range from various types of bacteria, virus and protozoa which, if ingested, can cause various ailments often resulting in diarrhoea. Sanitation related diseases are widely prevalent (endemic) in cities of developing countries particularly in poor communities and in informal settlements where infrastructure provision is poor. The paper starts with the premise that an improved understanding of risks associated with sanitation can help to target interventions and develop strategies to reduce risks where sanitation systems are most precarious and local residents are most at risk. Figure 1 (adapted from Carr, 2001) illustrates how the disease exposure pathways are affected by the type of sanitation system and how the resultant morbidity is dependent on the vulnerability of individuals to combat disease. What is clear from an inspection of this diagram is that there are three main elements that manifest to result in escalation/transmission of diarrheal disease: i) hazardous events ii) exacerbating factors and ii) vulnerability.

Risk assessment framework and risk indicators

The risk assessment is based on the assumption that in situations where excreta are not safely contained, local residents are at risk of exposure to faecal matter containing pathogens, which may lead to illness and further propagation of disease. Sanitation systems are frequently inadequate in performing this function resulting in hazardous events which may result in exposure of the population to the hazard (faeces). The level of risk depends on i) the coverage and quality of the sanitation systems, ii) the factors that exacerbate exposure through transmission routes for faecal contamination and, iii) the vulnerability of populations to disease. As described below, the risk framework considers these three main components of risk.

- 1) **Sanitation systems:** the primary element of risk is posed by the *hazards* related to excreta (mainly contained in faeces) that harbour different types of pathogen and resulting in disease in the local population. Although the most important sources of hazards are household facilities/communal latrines and infrastructure for excreta and wastewater management, solid waste is widely considered to be part of sanitation and is part of municipal environmental health services.



- 2) **Exacerbating factors:** the incidence of and exposure to hazardous events are often exacerbated by additional factors and circumstances that, although not directly related to sanitation systems, impact upon these systems resulting in an increased frequency, intensity, and/or duration of exposure to hazards. The following risk indicators are considered to be of primary importance: i) availability of water for maintaining hygienic conditions ii) flooding which causes dispersion of hazards iii) hygiene behaviours (particularly hand washing) iv) flooring in housing which can increase disease transmission when not lined v) groundwater levels vi) domestic livestock and vii) wastewater reuse.
- 3) **Vulnerability:** The third element of the risk framework refers to vulnerability or susceptibility to disease. This takes into account aspects related to exposure (i.e. some social groups within communities are more prone to exposure to others due to their types of activity) and their physical resistance to disease. Taking into account both of these factors, it is clear that children are highly vulnerable. Other factors include nutrition, access to health care and weight for age, which can be attributed to socio-economic status or poverty level (Rheingans *et al.* 2012). The number of children per household and type of house are considered to be suitable risk indicators.

Participatory Rapid Sanitation System Risk Assessment (PRSSRA)

As in many cities in sub-Saharan Africa, there is limited information about the current sanitary situation in different areas of Maputo, Mozambique. Information on type and quality of facilities and infrastructure can be collected by house to house sanitary surveys, questionnaires or a mixture of both, but these are time and resource consuming and are therefore not considered an appropriate tool to be practical for application at a city scale. In contrast, the workshop methodology presented in this paper aims to collect information in half a day for each neighbourhood.

The rest of the paper firstly describes the translation of the conceptual risk framework described above into a methodology that has practical application and secondly the initial experiences from the application of the methodology as part of workshops in two *bairros* (neighbourhoods) of Maputo called Maxaquene-A and Chamanculo D. These are both typical low-income settlements which are poorly serviced by municipal infrastructure and services and therefore local residents suffer health problems related to poor water and sanitation.

There are three main parts to these workshops which firstly introduce the concept of risk and how this relates sanitation systems and health. Participants then estimate the numbers of different types of latrine in

the *bairro* and finally they are asked to assess the level of risk in different parts of the *bairro* using the risk framework and indicators introduced above. The workshops are conducted in half a day with 20 -25 participants from different parts of the *bairro* with a mix of genders and ages groups. Further information about the methodology adopted for the participatory workshop is provided below.

As the participants enter the workshop room they are greeted by a handshake from the facilitators who have glitter on their hands. During the workshop when people touch other parts of their body, e.g. scratching or wiping ones face, then the glitter is transferred. The glitter provides a didactic illustration (and also amusing) to highlight to participants how easy it is for pathogens to be transmitted from hand to mouth. This is followed by an interactive session in which participants explore the other primary transmission routes of excreta-related disease using cards and arrows representing different parts of the F-diagram (see Figure 2).



Figure 2. Participants from Maxaquene A discuss disease transmission routes



Figure 3. Results of participatory exercise to identify the proportion of toilet types

The whole *bairro* is divided into smaller areas (6 for Maxaquene A and 4 for Chamanculo C) and each of these areas is assessed separately. In the second part of the workshop, participants are asked to indicate which types of toilet are most prevalent in the different areas of the *bairro*. Participants are grouped into the area of the *bairro* in which they reside. The groups are given ten counters which they proportion to indicate which types of toilet are predominant in their area. The final part of the workshop is based on the conceptual framework for risk assessment described above which has been translated into a rapid participatory process for community engagement to score the perceived risk. Each indicator is scored based on a simple traffic light system:

- Score 1 *Green* indicating low level of risk
- Score 2 *Orange* indicating medium level of risk
- Score 3 *Red* indicating high level of risk

Definitions for each level of risk and for each factor have been developed but due to space limitations, these have not been included in this paper. For example, for desludging services, households that manually empty latrines and waste are dumped in the *bairro* or latrines that are never emptied are considered to be high risk.

Results and observations from the workshop in Maxaquene A

Around thirty participants took part in the Maxaquene workshop. The results shown in Table 1 present the estimates the types of toilet in Maxaquene A according to community perceptions. Participants easily understood how to proportion the ten counters and there were some good discussions around the topic. Results from the workshop indicated that most people in Maxaquene A have a toilet with no water (58%) while a significant number of people still have no toilet (15%), with most people with no toilet residing in Area 1 of the *bairro*. Table 1 also compares the results from this activity with data from the Centre for Population Studies (CEP) in Maputo which has also undertaken a survey of toilet types for the *bairro* of Maxaquene A. The biggest difference between the results of the participatory assessment and the CEP data relates to households without a toilet, in which the community perceive a far greater amount of people without a toilet than is recorded by the CEP data. Further investigation is required to explore this finding.

	Proportion (out of 10) of people with different types of toilet split by Area of the <i>Bairro</i>					% of type	Data from CEP	Difference
	1	2	3	4	5			
Sewerage	0	0	0	0	0	0%	0%	0%
Toilet with water	3	3	2	1	4	27%	30%	- 3%
Toilet without water	4	5	7	9	6	58%	68.6%	- 10.3%
No toilet	3	2	1	0	0	15%	1.4%	13.6%

The risk assessment in Maxaquene A was based on blind voting. Each participant initially placed a coloured token of their choice, representing high, medium or low risk in a voting box for each of the areas in the *bairro*. This process was then repeated for each indicator. This approach was time consuming, and the act of getting up and voting distracted participants and it was hard to hold their attention again. People did not understand that they were assessing all areas of the *barrio* in turn and often voted according to their own situation. An interesting observation was, when blind voting, people seemed not to consider the situation and just picked any colour and voted. Discussion was needed to get people to actually think about why they were choosing a particular level of risk. As a result of these problems, only two indicators were assessed using the voting approach in Maxaquene A. The remainder were assessed through discussion and assigning a level of risk through consensus.

Modifications to the methodology and results from the workshop in Chamanculo D

Based on the experiences from the workshop in Maxaquene A, the methodology for the risk assessment used for the Chamanculo D was modified in a number of ways as described below:

1. An equal number of participants from each area in the *bairro* were invited.
2. Participants were asked to form small groups and asked to evaluate the situation in their own area. They used the ten counter method to allocate proportions of households in each block that relate to the low, medium, high risk indicator definitions.
3. Once each area group had assessed all indicators, the whole group commented on and discussed the individual area assessments to confirm that the scores allocated by the different groups were considered reasonable to their peers.

This new system was found to work well and the results from the exercise can be found in Tables 2, 3 and 4. In these tables the values for each indicator for each block were calculated according to the following equation:

(No. of counters for low risk * Risk factor of 1) *

(No. of counters for medium risk * Risk factor of 2) *

(No. of counters for high risk risk * Risk factor of 3) / Total number of counters

For example, for the quality of household toilets in Block 1 the 10 counters were allocated by the participants as 1, 7 and 2 for low, medium and high risks. Therefore, the score was calculated as $((1*1) + (7*2) + (2*3)) / 10 = 2.1$. The values are ranked to show which indicator was perceived to be of highest risk and then the following risk ranges were then applied to the scores to convert the aggregate score back to numerical value of 1, 2 or 3 to indicate low, medium or high risk for each block.

- i) Low 1 - 1.67
- ii) Medium 1.67 - 2.33
- iii) High 2.33 - 3

These resultant risk indices are shown in brackets.

	Block 1	Block 2	Block 3	Block 4	Average
Desludging	2.8 (3)	2.5 (3)	2.5 (3)	1.9 (2)	2.43 (3)
Toilets	2.1 (2)	1.9 (2)	1.9 (2)	1.4 (1)	1.83 (2)
Wastewater (blackwater/greywater) collection	1.8 (2)	1.0 (1)	2.2 (2)	1.0 (1)	1.50 (1)
Solid waste collection	1.4 (1)	1.0 (1)	1.2 (1)	1.0 (1)	1.15 (1)

	Block 1	Block 2	Block 3	Block 4	Average
Domestic animals	2.8 (3)	2.2 (2)	2.8(3)	2.3 (2)	2.53 (3)
Hygiene (handwashing facilities)	2.7 (3)	2.6 (3)	2.4 (3)	2.2 (2)	2.48 (3)
Density of settlement	2.7 (3)	2.3 (2)	2.6 (3)	2.2 (2)	2.45 (3)
Flooring in houses	2.4 (3)	2.1 (2)	2.2 (2)	1.9 (2)	2.15 (2)
Water supply	1.4 (1)	2.0 (2)	1.7 (2)	2.0 (2)	1.78 (2)
Stormwater drainage	1.5 (1)	2.0 (2)	2.4 (3)	1.1 (1)	1.75 (2)
Groundwater level	2.7 (3)	1.0 (1)	1.0 (1)	1.0 (1)	1.43 (1)

	Block 1	Block 2	Block 3	Block 4	Average
Type of housing	2.8 (3)	2.1(2)	2.7 (3)	1.9 (2)	2.38 (3)
Number of children per household	2.5 (3)	1.7(2)	2.0 (2)	1.9 (2)	2.03 (2)

Discussion

Overall, Block 1 has the highest risk but all blocks are categorised as medium risk overall. It was observed that general problem with de-sludging but latrines are also a problem. Hygiene and domestic animals are

perceived by the participants to be the biggest risk exacerbating factors. The reasons for this requires further investigation and we also intend to explore the application of weighting factors which can be applied to the risk indicators. Currently each factor is given the same weight when the risks are cumulated. In reality, there is limited scientific data which compare the impact on health of different types of sanitation intervention so the next part of the research will look into the weighting of the different systems, factors and vulnerabilities in more detail.

Further developments in the research

The Participatory Rapid Sanitation Systems Risk Assessment (PRSSRA) is risk mapping exercise which can be undertaken in half a day in one community and negates the need for detailed household surveys. The methodology will be applied in another five bairros. The results will be verified against household survey data, where available and from transect walks to visually compare risk within and between bairros. A mapping tool is being developed, based on the WaterAid's Sanitation mapper tool, to map the spatial distribution of risks, which will be used to present the results from the research to institutional stakeholders at a municipal level workshop. The results from the risk assessment will be used as the basis for discussion about the roles and responsibilities between the community and different institutions for managing risk in different parts of the sanitation service delivery chain. The risk assessment tool will also being used to prepare some training modules to be used as part of capacity building to promote greater understanding of diseases transmission pathways and sanitary risks.

Acknowledgements

CLASS-A are a learning alliance based in Maputo, Mozambique aiming to act as an interface between government agencies, private sector actors and poor communities that currently lack adequate sanitation services. The research is funded by SPLASH Sanitation Research Programme, jointly financed by ADA (Austria), DFID (UK), MAEE (France), SDC (Switzerland), SIDA (Sweden) and BMGF (Bill and Melinda Gates Foundation) and coordinated by the International Water Association. University College London Centre for Urban Sustainability and Resilience is playing a lead role in methodological development which forms the basis for an ESPRC and Atkins sponsored EngD of the lead author. The authors would like to extend thanks to members of Class-A, notably Moises Mabote, Patricilio Mucavele and Joao Manjate and also to Orlando Matendjua who is working closely with Class-A to support their activities. In addition the authors would like to thank Huw Taylor and Nasar, Zaheer for their help developing the methodology and Dr. Amaka Godfrey (WEDC) for her support to Class-A.

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