

## Behavioral faecal exposure pathways in nomadic community of Turbi ward in Marsabit county, Kenya

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### ARTICLE INFO

### ABSTRACT

#### KEYWORDS

Sanitation  
Behavioral change  
Pastoralism  
WASH

**Background:** Water, sanitation and hygiene (WASH) is the cornerstone for health and growth at all stages of life in helping to maintain health and to increase in life span. Poor sanitation has led in disease causing microorganisms such as *Escherichia coli* to be on the rise. Sanitation is influenced in a community by factors such as perception, behavioral and practices involved in defecation and disposal of these waste. This study aimed to identify behavioral faecal exposure pathways in the nomadic community of Turbi ward.

**Methods:** Mixed method approach using qualitative and quantitative research methods was applied in this study to assess exposure pathways and related behavior among the nomadic community of Turbi ward. Thematic data analysis was used to analyze data generated from behavioural observations. Data was presented using graphs and pie charts. **Results:** A total of 100 households were sampled and about 68% (n=100) of population used surface water for domestic. Turbi manyatta had the highest with number of households that use surface water at 30% (n=100), followed by Kambi Nyoka at 16%(n=100) and the least was Shurr manyatta at 2% (n=100). Surface water was the dominant source of water for the community. About 76% (n=100) of the households did not treat their water before use for domestic purposes and due to scarcity of water the community stored water in jerrycans for more than one week. About 87% of the residents reported not washing hands before milking animals. Open defecation was the predominant method of waste disposal among the five selected Manyattas, accounting for 95% (n= 100). There was significant relationship between practicing open defecation and using surface water without treatment for domestic purpose at p-value 0.032 (95% CI), using Wilcoxon Signed-Rank test.

**Conclusions:** The study revealed that the community have behavioral practice that exposes them to faecal exposure due to habitual practice of open defecation, throwing waste to the bush, open burning, drinking untreated surface water and not washing hands before milking animals. There is need for advocacy on social behavior change, and strategies on health promotion targeting Water, Sanitation and Hygiene (WASH)

#### Introduction.

Sanitation and water management is one of the ways to reduce the spread of enteric pathogens in the urban, peri -urban and rural environmental set up. The most affected are children, women and elderly people especially in a rural set

up(WHO JPM,2010). The goal of SDG 6.2 is to provide access to adequate, equitable sanitation and hygiene for all and put an end to open defecation especially for girls, women and the vulnerable in the society by 2030.(Word Bank,2016).The approach of a community to sanitation includes fac-

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Randomly Selected Villages	Proportionally Selected Households
Manyatta A = 30 households	$30/220 \times 100 = 13.75 \sim 13$ households (Dekuku)
Manyatta B = 60 households	$60/220 \times 100 = 27.2 \sim 27$ households (Shurr)
Manyatta C = 10 households	$10/220 \times 100 = 4.5$ 6 households (Manyatta Okolla)
Manyatta D = 40 households	$40/220 \times 100 = 18$ 18 household (Kambi Nyoka)
Manyatta E = 80 households	$80/220 \times 100 = 36.36$ 36 households (Turbi)
Total = 220 households	Total=100 Households

**Table 1:** Sample size formula. (Sample size/population size) x stratum size). formula by Schoeder (1969)

tors such as the perception, feelings and practices involved in defecation and the disposal of this waste. Their attitude is a result of interconnected factors of cognition as a result of knowledge, perception together with feeling and behaviour that leads to action. (Mustafa et al, 2020)

Water, Sanitation and Hygiene (WASH) is the cornerstone for health and growth at all stages of life in helping to maintain health and increase in life span. Epidemiological studies have associated poor hygiene practices and lack of water with adverse health outcomes that includes diarrheal diseases, enteric malfunctions that leads to stunted growth. (Pruss-Ustun et al., 2014).

These exposure pathways can be through water bodies, food, utensils, storage tanks, sewerage system, open drains galleys or seepage. Tens of millions of people across the world, most of them children, die of sanitation related illness (UNICEF, 2019). It is demand driven and gives importance to the empowerment and participation of local communities in the implementation of sanitation schemes (MoEF, 2004). Pathogens can be spread through skin contact, body fluids, airborne particles touching surface touched by an infected person or contacting contaminated surfaces or contact with faecal matter (Vazquez-Pertejo, 2020).

The pathogens range from staphylococcus aureus to fungus. *E. coli* is predominantly found in human and animal intestines causing mild to fatal life-threatening infection. Contamination is normally through oral faecal route. *E. coli* from the poop of human and animals end up in water bodies like dams, pans, lakes, streams, and municipal water causing sickness if not treated before use for domestic purposes. The goal of SDG 6.2 is to provide access to adequate, equitable sanitation

and hygiene for all and put an end to open defecation especially for girls, women and the vulnerable in the society by 2030 (World Bank 2016).

## Methods

### Ethical considerations

Permission was sought through the board of post graduate studies of Meru University of science and technology, The Meru University of Science and Technology Institutional Research Ethics Review Committee (MIRERC) REF: MU/1/39/28 VOL2 (23) and County government of Marsabit.

### Study area

The study was carried out in the Turbi ward, North Sub- County of Marsabit County, Kenya, with a population of 23,978 (KPHC, 2019). The populations are mostly Cushitic community practicing a pure nomadic lifestyle. The area has land mass of 10, 8208 sqkm<sup>2</sup> and is located at longitude; 38°22'25"E latitude 3°20'51"N. Has tropical dry savanna climate. Map for Turbi ward in Northhor sub county.

### Study design and population

The study employed a cross-sectional study design with an aspect of laboratory analysis. Samples for analysis were collected from dams, pans, camel milk and swabs from milk holding containers. The samples were then transported to the laboratory for analysis. Consent to collect water samples from dams, pans and boreholes was obtained by village elders while milk and swabs from containers consent was given by household heads.

Codes	Themes
Rainwater is pure, we do not need to wash hands, personal hands have no germs; "once hand does not kill"	Lack of knowledge.
Only water available is surface water. Water scarcity.	Availability
Constructing toilet not their priority and not economical "We move from one place to another, there is enough space to defecate"	Lifestyle (Nomadic)
68% (n=100) reported use surface water for domestic use. The community experience scarcity of water for domestic use 79% (n=100) and finds a luxury to wash hands too frequent. They also believe that "one's hands does not kill" which is associated with lack of washing hands before milking. 86% (n=100) reported they do not wash hands before milking animals. "Water is not available to wash our hand often, Afterall one's hand does not kill"	Attitude and knowledge gap
The pastoralist community of Turbi finds it uneconomical 89% (n=100) and not their priority to construct toilets since they move from one place to another 93%(n=100), and there is enough space to defecate, justifying the practice of open defecation (95%, n=100), burning and throwing solid waste in the open field. "We have enough land to defaecate, why should we dig a toilet" Another one said "we move from one place to another, we don't need a toilet, it's an economical"	Attitude and knowledge gap
76% (n=100) did not treat their water before used for domestic purposes. 67% (n=100) stored water in jerrican for more than two weeks. 82% (n=100) report ground water is pure and do not need any treatment.	

**Table 2:** Behavioural themes that expose the adults and children to faecal contamination among the nomads.

### Sampling procedure

Simple random sampling was conducted to select one village from each center totaling to five villages. Water from dams, pans and boreholes were collected while milk samples were collected from the selected households.

### Sample size Determination.

Proportionate size sampling, (Sample size/ population size x stratum size), a total sample of 100 household from five (5) Manyattas using formula by Schoereder (1969) (see table 1).

Heads of the households were selected to respond to the interview within the household. Probability random sampling was used to select one child above six years within the household.

### Data collection method

Mixed method approach employing qualitative research methods and quantitative methods were used in this study to assess exposure pathways and related behaviour and dominant faecal exposure among the nomadic community of Turbi ward.

Preliminary assessment was conducted by the research team, elders and community members to identify the exposure pathways that have a probable risk of causing a condition associated with a

broken sanitation chain. The community under study are pure pastoralist moving from one place to another in search of pasture for their livestock, thus the identification and target neighborhood was excluded during preliminary assessment. The preliminary assessment involved key informants, transit walk, exposure behavioural surveys, environmental surveys and laboratory microbial sample collection and analysis.

Key informant interviews and transect walk in the five study sites (Manyattas/villages) were conducted, research assistants staff together with community, household heads, opinion leaders elders went through focus group discussion during this sessions. Environmental health officers were put to Checklist, structured observations and semi-structured questionnaires to gather information to identify critical sites that the community could come into contact with faecal contamination.

Structured observations were conducted by trained research assistants to identify exposure of adults and children to faecal contamination both at household level and at school. The observers recorded, source of contamination, the type of contact, frequency and duration. The structured observation information gave useful information on exposure behaviour and also a guide in envi-

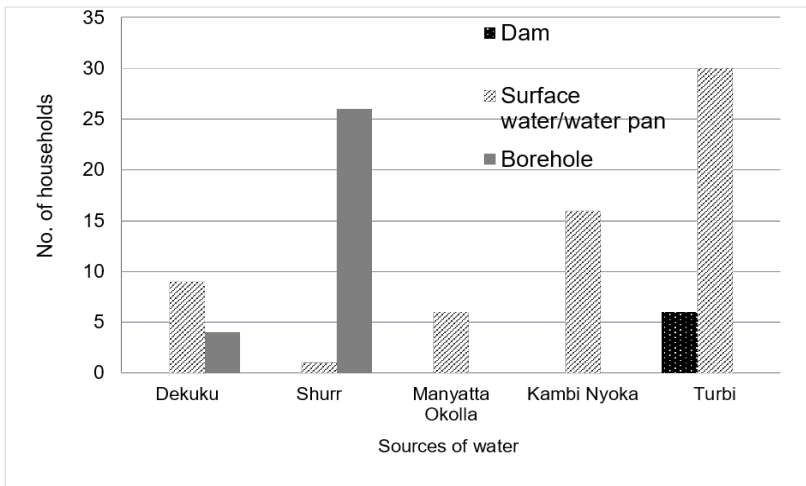


Figure 1: Water sources used by household in the Manyattas: source for Turbi Ward.

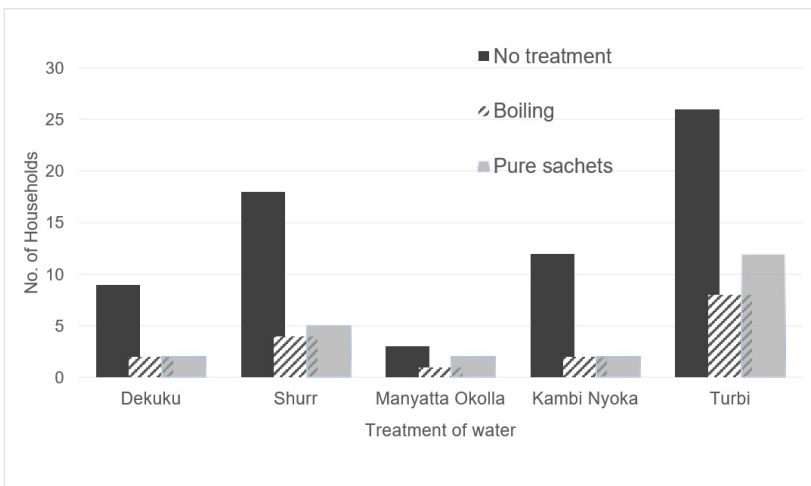


Figure 2: Mode of water treatment

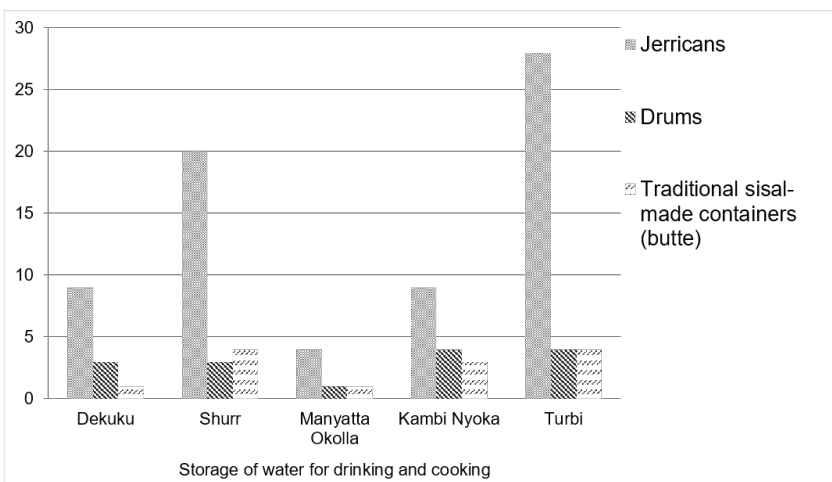


Figure 3: Water Storage facilities for domestic use in the Manyatta

ronmental sample for collection.100 households and two schools were conducted for structural observation for 3-4 hours.

Exposure behaviour surveys were conducted to gather information from the households community and the two (2) selected schools in the study area, using focus group discussion, interviews, observation and open-ended questions. Five samples per five pathways were collected (n=55). Frequency of contact with the dam, trough water and borehole feed tank water, by adults and children were observed. Animal milking habits, storage and utensils cleaning was observed. How the community disposes its human and garbage waste and the proximity to surface water source was also observed. Community norms were observed during application of each tool during the survey.

**Data analysis and presentation.**

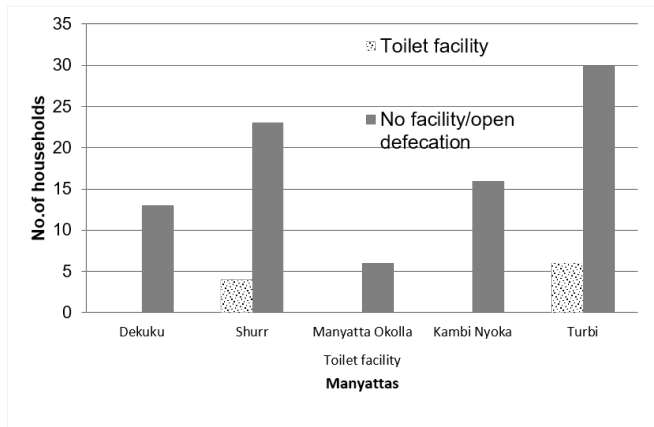
Thematic data analysis was used to analyze data generated from behavioural observations. Data were presented using tables, Pie charts bar, histograms and graphs

**Results.**

Behavioural factors that expose the adults and children to faecal contamination among the nomads Social behaviour of a community greatly influence exposure to the available contaminant. The community of Turbi ward had several behavioural factors that exposes them to faecal contaminates. This is summarized in Table 2.

Social behaviour of a community greatly influence exposure to the available contaminant. The community of Turbi ward had several behavioural factors that exposed them to faecal contaminates.

A total of 100 households were sampled and about 68% (n=100) of popula-



**Figure 4a:** Waste disposal mechanisms used in Manyatta

tion use surface water for domestic,(Figure 1). Turbi manyatta are the highest with 30% (n=100), followed by Kambi Nyoka at 16% (n=100) and the least was Shurr manyatta at 2% (n=100).

#### Mode of water treatment in the Manyattas

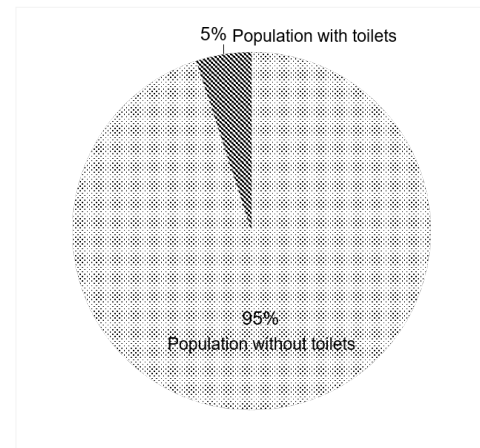
Surface water is the dominant source of water for this community. The highest number of households 76% (n=100) did not treat their water before used for domestic purposes. Due to scarcity of water the community store water in jerricans for more than one week. Storing contaminated water exposes the residents to bacterial infection, (Figure 2).

#### Sanitary facility/waste disposal mechanisms used in Manyatta.

Open defecation was the predominant method of waste disposal among the five selected Manyattas, accounting for 95% (n= 100), households with toilets accounted for 5% (n=100) of the total households in Manyatta. Turbi ward had significantly high number of households that practiced open defecation and using surface water without treating for domestic purpose at p-value 0.032 (95% CI), using Wilcoxon Signed-Rank test.( Figures 4 a & b)

#### Waste disposal in household

The primary methods of disposing waste were by throwing to the bush 86% (n=100) and open burning 19% (n=100), (Figure 5). Turbi had high



**Figure 4b:** Sanitary facility in the selected Manyattas

number of households that threw waste to the bush 26% (n=100) and open burning of the waste 8% (n=100), while the least Manyatta that practiced open defecation and open burning was Okolla 5% (n=100) and 1% (n=100) manyatta respectfully. Turbi had significantly high number of households that used open burning as disposal mechanism at p-value of 0.0246 (95% CI) Kruskal-Wallis test.

#### Disposal of child's stool/faeces.

Approximately 58% (n=100), of the Turbi ward residents reported disposing children's faeces by throwing to the bush. Only 42% (n=100) cover children's faeces with stone/soil/sand.

#### Discussion

##### Behavioural factors contributing to faecal exposure

Kenya is a water scarce country with its 13 million people struggling to access clean water and 19 million lacking access to basic sanitation (KDHS, 2014). The community members of Turbi ward use surface/pan/dam water for all their domestic purposes. A total of 100 households were sampled and about 68%(n=100) of population use surface water for domestic (figure 10). Surface water is the only available water to this community and there was lack of knowledge on consuming untreated surface water. The pastoralist community of Turbi finds it uneconomical and not their priority to construct toilets since they move from one place to another, and there is enough space to defecate, justifying the practice of open defecation, burning and throwing solid waste in

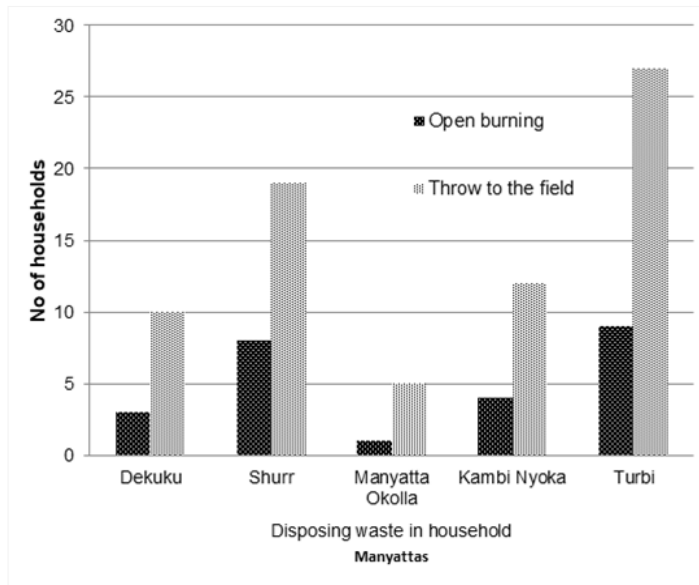


Figure 5: Waste disposal in household

the open field.

*“We have enough land to defecate, why should we dig a toilet” Another one said “we move from one place to another, we don’t need a toilet, it’s an economical”*

The community experience scarcity of water domestic use and finds a luxury to wash hands too frequent. They also believe that “one’s hands does not kill” which is associated with lack of washing hands before milking.

*“water is not available to wash our hand often, after all one’s hand does not kill”*

About 76% (n=100) did not treat their water before using for domestic use and they predominantly water stored water in jerrican 67% (n=100) for over week, this could be due to survival tactics to mitigate water shortage in the households.

*“The only available water is surface water, rain water is clean and pure”*

This study concurs with study conducted by Mohamed *et al.* (2013), who found out that 74% of SDukem town residents in Ethiopia, stored water in jerricans for safe storage. Safe water storage in households prevents contamination of water by disease causing microbials. Storing contaminated water for domestic purpose for long leads to multiplication of bacteria and hence infection to consumers. Poor hygiene is linked to under nutrition, child morbidity and mortality.

The surface water sampled had high positivity

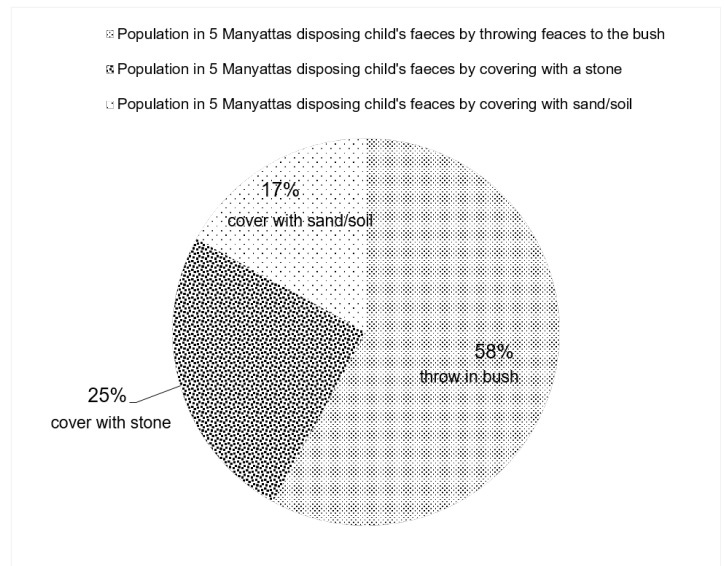


Figure 6: Waste disposal in household (child waste)

for *E. coli* bacteria 86% (n=50). This could be attributed to surface water runoff into dams and pans that is predominately used by the respondents for domestic purposes since it’s the only water available to their reach. The surface water could be contaminated through environmental contamination by sanitation malpractice of open defecation and indiscreet waste disposal to the field by these community members.

This study contrast with study conducted by Wasongo, *et al.* (2014) who observed that the 37% of the residents owned dump compost site within their compound for waste disposal. In this research among nomadic community primary methods of disposing waste was by throwing to the bush 86% (n=100) and open burning 19% (n=100), (Figure 5). Unsafe waste disposal creates breeding sites for mosquitoes and flies and contaminates water bodies during rainy seasons through water run off leading to water born disease.

Utensils are used for essential purposes such as cooking, eating and milking animals, which is not exceptional to this nomadic community of Turbi ward. The community reported using plastic containers 85% (n=100) as the favourable utensils for milking and storage of milk. Approximately 77% (n=100) reported cleaning the milking utensils with water and 18% (n=100) reported cleaning with water and then fumigating with special fumes from a tree branch. Fumigation act

as sterilizer and providing good odour when milk is stored in those guards in older days and now plastic container. Despite those cleaning processes the milking containers sampled indicated high presence of *E. coli* in all households in all the manyattas. This could be due to significantly high presence of *E. coli* in water used for domestic purposes and poor hygiene practices of milking animals without washing hands. A study conducted in Bangladesh too revealed 43% , (58/136 ) swabs from drinking vessels were identified as major source of contamination Hossain et.al, (2021), Majalija,(2020) Aforementioned studies concurs with current study that drinking water and utensils can be a source of faecal exposure pathways.

A study conducted in Peru identified frequency of *E.coli* in drinking water was (48%) which was significantly higher than kitchen utensils (16%) (Gil, 2014).

In the current study behavioural change is a critical element in water, sanitation and hygiene. The provision of sanitation services alone will not improve health outcomes if WASH facilities are not utilized habitually and properly for all including the mobile communities like the ones of Turbi ward.

## Conclusion

Microbial contamination noted from this study indicates that there is poor sanitation in a nomadic lifestyle. The study revealed that the community have behavioural practice that exposes them to faecal exposure due to habitual practice of open defecation. Environmental contamination by faecal matter and garbage will lead to perennial cycle of environmental and water contamination .This study reaffirms the need for an elaborate sanitation model tailored to the need of pastoralist community to reduce perennial faecal contamination of water sources for the community of the Turbi ward.

## Recommendations

Health education on water, hygiene and sanitation needs concerted effort by all stakeholders, to improve environmental waste management and provision of safe water for domestic use at house-

hold level. There is need for protection of wells and management of water resources through community engagement at all levels.

## Data availability

### Underlying data

Figshare: Underlying data for “Behavioral faecal exposure pathways in nomadic community of Turbi ward in Marsabit County, Kenya.”. <https://doi.org/10.6084/m9.figshare.22357084.v1> (Batula et al. 2023)

The project contains the following underlying data: Data is about the behavioural survey of the pastoral community that exposes them to faecal contamination. The study was seeking to evaluate behavioural factors that exposes the pastoralist community to faecal exposure. contamination from human waste. Samples were analyzed by most probable number method where the indicator organism was confirmed using standard microbiological techniques.

## Grant information

The authors declared that no grants were involved in supporting this work

## Competing interests

No competing interests were disclosed

## Author’s contribution

**BJ:** Developed the concept, wrote the project proposal, collected the research data, analyzed the data, and wrote the thesis.

**SW:** Corrected the concept, provided necessary guidance, and corrections at the proposal writing, data analysis, and thesis writing.

**GK:** Corrected the concept, provided necessary guidance, and corrections at the proposal writing, data analysis, and thesis writing

**CK:** Mentorship guidance in writing and corrections

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- mental Compartments (Soil, Hands, Drinking Water, and Hand washing Water) in Urban Harare*