UNDERSTANDING AND IMPROVING WATER SANITATION PRACTICES TO IMPROVE HEALTH OUTCOMES IN MALAWI, AFRICA

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INTRODUCTION

Sustainable Development Goals 2030 Prioritize Water and Sanitation

Goal # 6: Ensure availability and sustainable management of water and sanitation for all:
- Digging new wells
- Improving existing wells
- Connecting to municipal water through yard taps

Source water can still be contaminated during:
- Collection
- Transportation
- Storage

Increasing access to safe drinking water focuses on need for sustainable, effective household water treatment.
**Water Purification Interventions Research Supports Use of Household Filtration to Improve Health Outcomes**

### Table 18-3. Reduction in Diarrhea for All Age Groups Following Different Interventions to Improve Water Quality

<table>
<thead>
<tr>
<th>Intervention Type (No. Trials)</th>
<th>Relative Risk (RR) Estimate (Random)</th>
<th>Percentage Reduction (1–RR)</th>
<th>95% CI of Relative Risk Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (6)</td>
<td>0.73</td>
<td>27</td>
<td>0.53–1.01</td>
</tr>
<tr>
<td>Household total (32)</td>
<td>0.53</td>
<td>47</td>
<td>0.39–0.73</td>
</tr>
<tr>
<td>Household filtration (6)</td>
<td>0.37</td>
<td>63</td>
<td>0.28–0.49</td>
</tr>
<tr>
<td>Household chlorination (16)</td>
<td>0.63</td>
<td>37</td>
<td>0.52–0.75</td>
</tr>
<tr>
<td>Household solar disinfection (2)</td>
<td>0.69</td>
<td>31</td>
<td>0.63–0.74</td>
</tr>
<tr>
<td>Household flocculation and disinfection (7)</td>
<td>0.48</td>
<td>52</td>
<td>0.20–1.16</td>
</tr>
<tr>
<td>Household improved storage (1)</td>
<td>0.79</td>
<td>21</td>
<td>0.61–1.03</td>
</tr>
</tbody>
</table>

Note: Although all interventions resulted in reduced diarrhea, point-of-use treatment interventions generally had a greater effect. There was significant variation in the relative risk estimates among studies of the same intervention type, which the authors suggest resulted from a variety of conditions that would require further research to understand. Additionally, these studies only considered reduction in diarrhea; results might have been significantly different if water-washed diseases such as trachoma had been considered.

Source: Clasen et al. 2006.
PURPOSE OF STUDY

1. Understand baseline practices and knowledge related to:
   1. Water supply
   2. Safety of drinking water
   3. Hygiene/sanitation

2. Compare the efficacy and acceptance of three different point-of-use water purification interventions.
METHODS

• A field study of 30 households in a periurban neighborhood of Mzuzu, Malawi.

• Households were randomly assigned to one of three water purification interventions:
  a. Waterguard® Solution
  b. Boil water
  c. Table Top Tulip® Filter
METHODS

• 30 baseline and 30 follow up samples taken from a drinking water storage container in each household

• Samples cultured for total coliform and E. coli using **Hach mColiBlue24™** membrane filtration method.

• Initial structured questionnaire addressed water sources, sanitation, health, consumption patterns, and socioeconomics of each household.

• Follow up questionnaires, conducted at one and two weeks of the intervention, focused on use and acceptance of the assigned treatment modality.

• The WHO water quality standard, and health risks based upon levels of E. coli, were correlated with questionnaire responses.

• Data analysis: Fisher's Exact Test.
TABLE - TOP CERAMIC CANDLE FILTER

- Two bucket water filter and storage in one.

- Top bucket is filled with raw water, which is filtered through the Tulip candle filter into the lower bucket.

- The water in the lower bucket is safe for immediate consumption.

- The water is safe for storage in the lower bucket for longer periods.

- The Tulip Table Top lasts up to 7000 liters. After which the ceramic candle filter can be easily replaced.

FEATURES

- Bacteria removal: 99.995%
- Protozoa removal: >99,995%
- Flow-rate: 3 liters per hour
- Capacity: 7,000 liters
- Backwash: no
- Price per liter: $0.002-$0.005
- Applicability: household, schools
RESULTS

Final Analysis included 28 households:
- 9 Tulip filter
- 10 Waterguard
- 9 Boiled water

- Two excluded households were not included in data analysis.
- Pre-intervention 29/30 households were not treating their water.

Baseline questionnaire responses indicated that drinking water contamination may be related to sanitation/hygiene practices.
- Lack of good hand washing hygiene practices, with 18/30 failing to wash hands before eating
- Absence of soap for hand washing in 9/30 households
- No previous education about potential faecal contamination of drinking water in 2/3 of participant households
WATER QUALITY POST TREATMENT

WHO standard and water quality health risks are shown in the graph below.

No statistical differences were noted between the treatment methods (p=0.081), but there was a trend toward significance for the Tulip filter intervention.
RATING OF WATER QUALITY

After 2 weeks of intervention water was rated for appearance, smell, and taste as shown on figure below:

While the trend was for a preference for the Tulip Filter, the only significant difference was for smell. (Fisher’s Exact Test. $P=0.0127$)
RESULTS

Household Questions/Concerns/Comments

• Prior to randomization, all study participants were educated about the three different water treatment interventions. During the follow up survey at 2 weeks, Questions/Concerns/Comments were solicited:

  • 100% of households utilizing the Tulip filter intervention expressed satisfaction with and desire to continue to use the filter.

  • 67% of households using Waterguard, and 50% of households boiling water expressed interest in obtaining a Tulip filter after the study was completed.

  • 40% of household participants who boiled water, expressed concerns regarding time consumed, and cost of fuel.
CONCLUSIONS

• Household sanitation and hygiene practices were deficient.

• Education regarding faecal contamination of drinking water was lacking.

• Trend toward superior performance by the Tulip filter in effective treatment of household water.

• Subjective measures of water quality: appearance, smell, and taste, showed an overall preference: **Tulip filter > Waterguard > Boiling**

• Questions/Concerns/Comments revealed a strong preference for water treatment with the Tulip filter by the majority of households.

• Study provides evidence to inform the development of public health educational programs that:
  • Promote household drinking water treatment
  • Improve hygiene and sanitation
IMPLICATIONS FOR FUTURE RESEARCH

• Future comparison of interventions in a larger scale study would need to be performed to achieve the statistical power to detect a significant difference in the three household water treatment methods studied.

• Although each water treatment has been proven to effectively eliminate bacterial contamination; sustainability of a public health intervention requires acceptance and continued use by the participating population.

• Based upon quantitative & qualitative data, reasonable approach is introduction of Tulip filter as the household water treatment, while providing a strong educational component focusing on household sanitation and personal hygiene practices.
BURDEN OF DISEASE ALL CAUSES MORTALITY IN CHILDREN UNDER 5 YEARS MALAWI VS USA

International Health Metrics and Evaluation GBD Compare, 2013
BURDEN OF DISEASE FROM DIARRHEA MORTALITY IN CHILDREN UNDER 5 YEARS IN MALAWI

International Health Metrics and Evaluation GBD Compare, 2013
BURDEN OF DISEASE FROM DIARRHEA MORTALITY IN CHILDREN UNDER 5 YEARS IN MALAWI

International Health Metrics and Evaluation - Global Burden of Disease Compare, 2013