Household Water Treatment and Safe Storage in Emergencies

Emergency WASH in Asia Pacific
Today’s agenda

- What is household water treatment and safe storage (HWTS)
- What is multi-barrier approach
- What different methods are available for HWTS
- How and when to roll out a HWTS programme
- Further resources
What is household water treatment?

Household water treatment is any activity to improve water quality undertaken at the household level.
What is safe water storage?

Safe water storage is the use of clean containers with covers AND good hygiene behaviour that prevent contamination during water collection, transport and storage in the home.
## Point-of-use vs. semi-centralised water supply and purification

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<thead>
<tr>
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<th>Point-of-use water supply and purification</th>
<th>Semi-centralised supply and purification</th>
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<tbody>
<tr>
<td><strong>Principles</strong></td>
<td>End-users (households and communities) are trained to apply simple multi-barrier methods based on the HWTS approach.</td>
<td>After and during an emergency, a mobile water treatment unit is brought close to the water source and installed and operated by trained staff.</td>
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<tr>
<td><strong>Technologies</strong></td>
<td>Sedimentation, coagulation, disinfection, boiling, SODIS</td>
<td>Treatment units</td>
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<tr>
<td><strong>Advantages</strong></td>
<td>Low-cost</td>
<td>Ready-to-use, very effective</td>
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<tr>
<td><strong>Disadvantages</strong></td>
<td>High responsibility of end users</td>
<td>Expensive, knowhow for O&amp;M</td>
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## Pros and cons of HWTS

<table>
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<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Relatively inexpensive</td>
<td>High self-responsibility required from households</td>
</tr>
<tr>
<td>Independent from institutional set-up or centralised systems</td>
<td>Difficult to monitor correct O&amp;M of technologies</td>
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<tr>
<td>Can be rapidly deployed and taken up by vulnerable populations</td>
<td>Each households should be provided with knowledge on O&amp;M of the system</td>
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<tr>
<td>Improves microbial water quality and reduces contamination risk</td>
<td>Treated water may be lower quality than that offered by a well-designed, operated and maintained community system</td>
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<tr>
<td>between treatment and use</td>
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<td>Wide range of simple, low-cost technologies available</td>
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When do we roll out HHWT

- **Pre-event**
  - Event: Building awareness on HWTS
  - First response: HWTS – not encouraged

- **Initial relief**
  - ~10 days: Priority is large quantities of water

- **Transitional phase**
  - Best time to for introducing HWTS

- **Reconstruction phase**
  - 6 weeks: Another feasible entry point for HWTS
**HWTS and Sphere**

### Water supply standard

- **Access and water quantity**
  - ≥ 15 litre/p/d
  - Queuing time ≤30 minutes

- **Water quality**
  - No faecal (thermotolerant) coliforms
  - No negative effect on health
  - No outbreak of water-borne or water-related diseases
  - Water treatment options used are effective in improving water quality, accompanied by appropriate training, promotion and monitoring
  - All affected people drink water from a protected or treated source
**HWTS and Sphere**

**Water supply standard**

- ≥ 2 clean water collecting containers; 10–20 L/HH (storage & transportation)
- Narrow necks and/or covers for buckets or other safe means of storage
- ≥ 1 washing basin per 100 people and private laundering and bathing areas available for women with enough water

- Water at household level is free from contamination at all times
- All people are satisfied with the adequate facilities they have for water collection, storage, bathing, hand washing and laundry
- Regular maintenance of the installed systems and facilities is ensured and users are involved in this where possible
NO DISTRIBUTION WITHOUT TRAINING!!!!!!!
Movement of pathogens from faeces of a sick person to where they are ingested by somebody else can take many pathways.

Main pathways:
- fluids (drinking water)
- fingers
- flies
- fields (crops and soil)
- floods (and surface water generally)

Barriers can stop transmission of disease:
- primary
- secondary
Why more than one barrier for the transmission of faeces to new host?

Unsafe behaviours
Insufficient training/knowledge on HWTS
Unsafe containers for water
Lack of self-responsibility

Diarrhoea!!!
Transmission of faecal matter to new host
**Multi-barrier approach**

Pathogen removal at every stage:

- **Sedimentation**
  - Example: slow sand filter
  - 80% removal

- **Filtration**
  - Example: Chlorination
  - Increase in removal

- **Disinfection**
  - 99.99% removal
  - 100% removal

Source: RedR
Multi-barrier approach

Source protection → Sedimentation → Filtration → Disinfection → Safe storage

Straining

Source: CAWST (2009)
**HWTS decision tree**

**Is the source contaminated?**

- **YES**
  - **Are products from outside the community available in the market or through humanitarian response?**
    - **NO**
      - **Is water muddy?**
        - **NO**
          - **Is wood or another heat source readily available?**
            - **NO**
              - Promote straining, SODIS, three pot method or basic filtration
            - **YES**
              - Strain water and use double dose of chemical disinfection
        - **YES**
          - Promote straining, three pot method, chemical sedimentation or filtration
    - **YES**
      - **Is water cloudy?**
        - **NO**
          - Promote straining, boiling and safe water storage and handling
        - **YES**
          - Use normal doses of chemical disinfection
Multi-barrier approach

Source protection → Sedimentation → Filtration → Disinfection → Safe storage

Source: CAWST(2009)
Sedimentation is a physical treatment process allowing dirt (impurity) to fall to the bottom of the water container over time or can also be achieved through the addition of chemicals.

Option 1: Settling

Three pot method

TIP

- Strain water before carrying out other treatment options
- Use clean, fine cotton cloth
- Wash the cloth in between uses
**Sedimentation**

Option 2: Chemical sedimentation

- **Chemical coagulants**
  - Watermaker/PuR sachets: coagulation + chlorination
  - Alum (aluminium sulphate)
  - Poly aluminium chloride – liquid alum
  - Aluminium/iron salts i.e. ferric sulphate

- **Natural/plant coagulants**
  - Moringa seeds (*Moringa oleifera*)
  - Prickly pear cactus (*Cactus opuntia*)
# Comparison between three pot method and combined chemical sedimentation & disinfection

<table>
<thead>
<tr>
<th>Method</th>
<th>thumbs up</th>
<th>thumbs down</th>
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<tr>
<td>Three pot method</td>
<td>• Greatly reduces dirt and disease-causing germs in water.</td>
<td>• Does not totally remove disease-causing germs.</td>
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<td>• Boiling, chemical or solar disinfection is still needed to completely remove disease risk.</td>
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<tr>
<td>Chemical sedimentation plus disinfection</td>
<td>• Can make muddy water safe to drink.</td>
<td>• More complicated to use and requires more training and follow-up.</td>
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<td></td>
<td>• The disinfection aspect of chemical sedimentation has a residual effect, which gives some protection against contamination post treatment.</td>
<td>• Some chemicals may not be available everywhere.</td>
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</table>
Coagulants: how does it work?

TIP

- Use clear buckets for demonstrations
- Use straining cloth when pouring into containers

Source: chemistry.tutorvista.com
Filtration

- Cloth filter
- Sand filter
- Biosand filter
- Ceramic pot filter
Filtration

Ceramic candle filter

Membrane filter
# Comparison between filtration types

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<tr>
<th>Filtration Type</th>
<th>Pros</th>
<th>Cons</th>
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</table>
| **Cloth filter** | - Low cost  
- Minimal time required  
- Simple and easy to reduce turbidity  
- Known to reduce risk of cholera | - Require diligent washing of cloth after use  
- Fibres may loosen significantly over time  
- Cannot remove all bacteria and viruses |
| **Sand filter** | - Simple and fast to use  
- Effective at removing dirt and some disease-causing germs  
- Inexpensive if sand and containers are available locally | - Requires 3 containers (1 of which must have a spigot) |
| **Biosand filter** | - High removal of pathogens  
- Removal of turbidity, colour, odour and iron  
- Relatively high flow-rates (>30 L/hour)  
- One-time installation with few maintenance requirements and negligible operation costs  
- Long life  
- Can be fabricated from locally available materials  
- Easy to operate and maintain | - Biological layer takes 20-30 days to develop to maturity  
- Low rate of virus inactivation  
- High turbidity (> 50 NTU) will cause filter to clog and requires more maintenance  
- Requires that the filter be used on a regular basis  
- Cannot remove dissolved compounds  
- Can be difficult to move or transport (due to weight)  
- Lack of residual protection (risk of re-contamination)  
- Requires that the filter be used on a regular basis |
## Comparison between filtration types

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| Ceramic pot filter   | - Proven reduction of bacteria and protozoa in water  
                       - Simple to use  
                       - Proven reduction of incidence diarrhea among users  
                       - Long life is filter remains unbroken | - Not as effective against viruses  
                       - Lack of residual protection (risk of re-contamination)  
                       - Variable QC for locally produced filters  
                       - Filters can break over time – need spare parts  
                       - Low flow rate of 1-3 L/hr for non-turbid water  
                       - Need to be cleaned regularly esp if water is turbid |
| Ceramic candle filter| - Cheap, simple and easy to use and clean  
                       - Removes pathogens, turbidity and suspended solids  
                       - Somewhat effective for removal of viruses and iron  
                       - Improves taste, smell and colour of water  
                       - Generally durable, easy to move and transport (except clay pot) | - Does not remove all pathogens  
                       - Does not remove chemical contaminants  
                       - Highly turbid/iron-containing water plugs candle pores  
                       - Low flow rate  
                       - Clay pot can be fragile and heavy  
                       - QC is difficult in local productions |
| Membrane filter      | - High performance  
                       - Simple operation  
                       - Able to separate different contaminants i.e. high selectivity  
                       - Disinfection can be performed without chemicals depending on pore size | - Equipment cost can be quite high  
                       - Membrane fouling which could lead to decrease of permeate flux  
                       - Production of polluted water from backwashing  
                       - Membranes have to be replaced on a regular basis |
Multi-barrier approach

Source protection → Sedimentation → Filtration → Disinfection → Safe storage

Source: CAWST(2009)
**Types of disinfection**

- Boiling
- Solar disinfection (SODIS)
- Chemical
Boiling

• For boiling water to work, water must be brought to a rolling, bubbling boil

TIP

Boiling will make water taste flat – this can be fixed with salt or shaking!
**Solar disinfection (SODIS)**

- Sunny - 6 hours
- Cloudy - 2 days

**TIP**
- Fill the bottle abt ¾ full – shake it vigorously – then fill the bottle and expose to the sun
- Sporadic shaking during exposure

Source: http://www.thescienceofcreativity.com/
**Chemical disinfection**

- Chlorine tablets

**TIP**
- Use double dose of chemical if water looks dirty or cloudy
- Talk to people about the product – ask for feedback
Safe water storage

- Water storage container
  - Tight fitting lid or cover
  - Tap or narrow opening
  - Stable base
  - Durable
  - Easy to clean
  - Locally available
Considerations for successful implementation of a HWTS in emergencies

HWTS should be targeted to the most vulnerable populations
Considerations for successful implementation of a HWTS in emergencies

Long term maintenance plan which supports effective exist strategy

Plan the source of financial support

User appropriateness & acceptability through community engagement

Creates ownership
What should be monitored

No. of products distributed
No. of people trained
No. of education materials distributed

These kinds of numbers are not enough!!

Household visits should also include checks of *proper use* of products distributed

No. of HHs visits conducted
Further resources

- **Household water treatment and safe storage in emergencies**
  A field manual for Red Cross/Red Crescent personnel and volunteers
  Download it at [www.watsanmissionassistant.org/water](http://www.watsanmissionassistant.org/water)

- **Public Health – Module 4: Household Water Treatment and Safe Storage**
  Available on IFRC Learning Platform [https://ifrc.csod.com](https://ifrc.csod.com)

- **Sphere handbook**
  Download it at [http://www.sphereproject.org/handbook/](http://www.sphereproject.org/handbook/)