STUDY OF DISINFECTION AT THE HOUSEHOLD LEVEL

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ABSTRACT

To assess the reduction of waterborne diseases in populations with precarious water supply systems, a Study of Disinfection of Water and Food Eaten Raw at the Household Level was carried out in Peru based on three elements: (a) the adoption of adequate habits of hygiene; (b) the organization of the community and its management unit; and (c) continuous monitoring of the disinfection systems to achieve sustainability.

1. Introduction

In places where there is no continuous water supply or where the water is obtained directly from surface sources, the inhabitants store it in their homes in any type of container to cover their basic drinking, cooking, washing, and other needs. The main criterion used in selecting the container is that it should be practical for extracting and carrying water, rather than being the best type of recipient to protect the bacteriological quality of the water.

Several studies show that the bacteriological quality of water at its source is not usually such that the water is fit for drinking, and that the continual handling of the water in the home, passing it from one recipient to another, exposes it to even more contamination, with the consequent further deterioration of its bacteriological quality. This increases the likelihood that the water will trigger an outbreak of some kind of gastrointestinal disease, mainly among the population lacking adequate excreta disposal services.

In light of this situation, so common in low-income areas, one of the most important ways of stopping the transmission of gastrointestinal diseases among the population is to make sure that they drink water of good bacteriological quality.

Although it is evident that the installation of public water systems that provide a continuous supply of water of good bacteriological quality is the most effective way of controlling gastrointestinal diseases, it is unrealistic to expect that the communities which do not have those services today will gain access to them in the immediate future.
Other important risk factors, within the multiple causes of gastrointestinal diseases, are foods that are eaten raw, and the lack of adequate habits of hygiene.

Diarrhoeal diseases usually exacerbate malnutrition, since they affect the organism’s capacity to digest and absorb an often inadequate diet, and cause metabolic disorders. Malnutrition, alone or in combination with a water- or food-borne disease, considerably lowers the life quality of the affected individual.

For these reasons, water and food disinfection at the household level is an alternative for communities that do not have access to a public water supply system or, if such a system is available, it does not operate continuously. The objective is to provide good quality water for drinking, cooking, washing dishes and oral hygiene, as well as for disinfecting food that is to be eaten raw, thus contributing to the control of waterborne diseases.

2. Background

On March 31, 1995, the Ministry of Health of Peru and the Pan American Health Organization (PAHO/WHO) signed a Technical Cooperation Agreement to conduct the Pre-evaluation of the Water and Food Disinfection Study through the Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS). This study is part of the Program for the Strengthening of Health Care Services, carried out by the Ministry of Health of Peru with Inter-American Development Bank (IDB) funds.

The Pre-evaluation sought to “review the appropriateness of conducting the Study of Disinfection of Water and Food at the Household Level within the current terms of reference and, if its conclusions were positive, to propose the best way of performing said Study”.

The Pre-evaluation made it possible to identify, evaluate and select alternative systems for household water and food disinfection that could be used in low-income areas without a water supply system, or where such a system was available, but did not work continuously. The evaluation concluded that the success of the proposed disinfection systems would depend basically on the combination of three components: (a) the application of household disinfection techniques; (b) the use of suitable containers to store water; and (c) the practice of habits of hygiene in the home.

In addition, the Pre-evaluation determined that in water and food disinfecting systems at the household level, self-sustainability should be sought, by: (a) using methods that would be generally accepted by the community; (b) inserting disinfection procedures into the economic and cultural context of the beneficiary population; and (c) ensuring easy operation and maintenance, to minimize the need for outside participation.
3. Objectives

The objectives of the Study of Disinfection of Water and Food at the Household Level were:

3.1 Overall goal

To help reduce the risk of intestinal diseases associated with the consumption of contaminated water and raw food.

3.2 General objective

To establish the most adequate means by which the beneficiary communities without drinking water systems or with an intermittent service only may have safe water at home and disinfect the food that they eat raw.

3.3 Specific objectives

(a) To implement self-sustainable systems for household water and food disinfection in rural and urban-marginal communities that do not have a water supply of good bacteriological quality.

(b) To assess the operation and self-sustainability of the systems installed in different areas of the country, considering the geographic and sociocultural conditions, and the quality of water sources, and identifying the characteristics and conditions conducive to the required operation and self-sustainability.

(c) To propose strategies and programs for large-scale application of these disinfection systems.
4. Household water and food disinfection systems

4.1 General

The Pre-evaluation of the Study pointed out the need for dealing systemically with household water and food disinfection, that is, the need for a set of inter-related elements that would work together to improve the life quality of the population covered by the Study; an effective solution implies far more than merely installing equipment for the production of disinfectants.

4.2 Definition

The Water and Food Disinfection System is a set of inter-related elements that enable a community lacking in safe water to disinfect at home the water to be used for drinking and washing the food that is eaten raw, mainly vegetables.

As indicated above, the Study considers that a community does not have safe water when a drinking water supply system is not available or when such a system exists, but operates intermittently.

4.3 Components

The Water and Food Disinfection System at the Household Level is shown in Figure 1. It has the following components:

(a) Supply source. Intake where the population collects water for domestic consumption.

(b) Water-carrying. Water is carried in containers from the source to the household.

(c) Production of disinfectant. Process of manufacturing the disinfectant. This is undertaken by the community, using portable disinfectant-producing kits. There can be several variables here: for example, one community can produce disinfectant for other communities.

(d) Distribution of disinfectant. Marketing of the disinfectant produced locally or acquired outside the community. This process takes into account the community's capacity for organization. The disinfectant is sold in bottles with caps to be used as feeders.

(e) Storage and disinfection of water. Household water supply is kept in a large can that facilitates the introduction of the disinfectant, protects its content from inadequate handling and assures its prompt discharge. In some communities,
Table filters have to be used for storage and disinfection because of the source characteristics and difficulties in producing or acquiring the disinfectant.

(f) Consumption of the disinfected water. Drinking the disinfected water from containers or filters. This action demands changes in family habits that should be taken into account in the system implementation process.

(g) Disinfection of food. Action of disinfecting food which is eaten raw, mainly vegetables, by using disinfected water or diluted disinfectant.

(h) Adequate hygiene practices. Set of habits and customs geared to improving household sanitary conditions through protection of the disinfected water and its use; as well as ensuring that the food eaten raw is disinfected; and seeing to cleanliness in the house, and hygienic disposal of excreta, wastewater, and solid waste.
Figure 1. Water and Food Disinfection System
Community management. Administrative management of the water and food disinfection system by the organized community. The introduction and operation of the system demand that the community assume a series of responsibilities to ensure self-sustainability.

Control. Ongoing control process on a regular basis to determine the level of operation of the system with regard to maintenance of source conditions, production and use of disinfectant, and adoption of adequate habits of hygiene; resulting, if necessary, in the application of corrective measures to ensure self-sustainability. In the systems provided with chlorine production equipment, control includes the verification of residual chlorine at household level through the use of chlorine comparators.

Monitoring. A process similar to control, but which does not include the adoption of corrective measures. It is usually carried out by an external agent and includes epidemiological impact assessment.

5. Beneficiary population

The application of this study has benefited approximately two hundred thousand (200,000) individuals in low-income areas that do not have safe water, in different geographic and sociocultural sectors of Peru with the following characteristics:

- high incidence of acute diarrhoeal diseases (ADD), including cholera;
- lack of water supply systems with a good bacteriological quality;
- easy access;
- existence of health care posts or sanitary posts in the locality or vicinity; and
- location in a single district or adjacent districts.

To ensure the future self-sustainability of the disinfection systems, the following criteria were also considered:

- sufficient degree of sensitization and interest of the communities to participate in the study;
- extreme poverty (measured with regard to the unmet basic needs - UBN);
- sufficient operating capacity of the support institution; and
- the support institution’s having worked for no less than three years in the Study area

The geographical areas covered are shown in Figure 2 and described in Table 1.
6. Implementation strategies

The implementation of water and food disinfection systems at the household level adopted the following strategies:

• The setting up of a multidisciplinary work team in Lima to manage the project.

Figure 2. Areas for the initial implementation of water and food disinfection
Table 1. Implementation areas and beneficiary population

<table>
<thead>
<tr>
<th>Areas</th>
<th>Provinces</th>
<th>Districts</th>
<th>Beneficiary population</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Lima</td>
<td>Lima</td>
<td>Comas, Carabayllo, and Independencia</td>
<td>75,000</td>
<td>Urban-marginal communities of the coastal region</td>
</tr>
<tr>
<td>Provinces of Lima</td>
<td>Cajatambo, Huaura, and Barranca</td>
<td>Cajatambo, Manas, Huancapón, Huaura, Santa María, Sayán, Vegueta, Barranca, Paramonga, Pativilca, Supe Puerto and Supe Pueblo</td>
<td>25,000</td>
<td>Rural communities of coastal region and Andean highlands</td>
</tr>
<tr>
<td>Huánuco</td>
<td>Huánuco, Ambo, and La Unión</td>
<td>Amarilis, Cayrán, Huánuco, Santa María del Valle, Ambo, Conchamarca, Huácar, La Unión and Ripán, San Rafael</td>
<td>40,000</td>
<td>Urban marginal and rural communities of the Andean highlands</td>
</tr>
<tr>
<td>Pucallpa</td>
<td>Coronel Portillo</td>
<td>Callería, Masisea y Yarinacocha</td>
<td>55,000</td>
<td>Urban-marginal and rural communities of the jungle region</td>
</tr>
<tr>
<td>Andahuaylas</td>
<td>Andahuaylas</td>
<td>Andarapa, Huancaray, Pacucha, San Jerónimo, Santa María de Chicmo and Talavera</td>
<td>15,000</td>
<td>Rural Andean highland communities in extreme poverty</td>
</tr>
</tbody>
</table>

- Implementation of technical-administrative support teams in each area, to be responsible for the preparation and execution of local projects.
- Identification of public or private support institutions, to be responsible for the preparation and implementation of local projects, as well as the supervision of the management, operation, and maintenance of the disinfection systems and assessment of the impact of the Study.
- Evaluation of the sociocultural aspects of the selected communities to determine their culture, conflicts, degree of acceptability of incorporation of the disinfection system and of the disinfected water and food in their daily life, as
well as the practice of adequate habits of hygiene conducive to improved sanitary conditions in the community.

- Promotion of the study among prioritized communities and their commitment to participate in its implementation.

- Active involvement of the community at all stages of the process, from diagnosis to management, so that the community will perceive the project as its own, thus ensuring self-sustainability.

- Sensitization, mobilization and training of the staff belonging to regional public and private institutions willing to support the project at the local level.

- Sensitization, mobilization, and organization of the members of the unit in charge of managing the disinfection systems, and of the beneficiary population as they get involved in the project expansion at the local level.

- Training of management units for sound management of the system and operation of the disinfectant production equipment.

- Allocation of equipment for disinfectant production, large cans in which to keep water, and other accessories provided by the Ministry of Health through the Study; and laying down of the organization and management conditions in terms of the community’s commitment to finance the operation of the system and keep it in good working condition, guaranteeing the protection and conservation of the equipment, large cans and accessories, as well as their replacement at the end of their useful life.

- The setting up of a computerized information system to record, control and assess the Study development in each local project.

6. Activities performed in stages

6.1 Direction, organization and planning

This stage included the following activities:

(a) Designation of the Study coordinators, one from PAHO/WHO, and one from the Ministry of Health.

(b) Designation of the support team to work with the Study coordinators at the central level, made up of specialists in the fields of sanitary engineering, management and social sciences.
(c) Allocation of physical space, fixtures, and office equipment for the Study coordinators and support team.

(d) Review of the information obtained in the previous evaluation, data kept on the Study implementation file, and other relevant sources.

(e) Co-ordination with other institutions that may contribute to the implementation of the Study.

(f) Pre-selection of the communities where disinfection systems would be installed.

(g) Drafting of agreement models.

(h) Assigning of priorities to localities and preparation of the methodology for the situational diagnosis.

(i) Performance of the diagnosis in the prioritized communities.

(j) Preparation of guidelines on how to identify and select technological alternatives for water and food disinfection systems.

(k) Preparation of guidelines on how to write up technical files for the projects.

(l) Procurement and distribution of equipment, containers, tools, and supplies.

(m) Preparation of guidelines on how to identify and select organization models for the management of water and food disinfection systems.

(n) Preparation of guidelines for the installation, management, operation and maintenance of water and food disinfection systems.

(o) Preparation of teaching material and guidelines for sensitization and mobilization.

(p) Preparation of teaching material and guidelines for training.

(q) Updating of the working program.
6.2 System implementation

The implementation of the disinfection systems demanded the following:

(a) Designation of support teams to the Study coordinators at the subregional level, made up of technical and administrative personnel.

(b) Allocation of physical space, fixtures, office equipment, vehicle, electromechanical tools, and basic laboratory equipment for the subregional support team.

(c) Sensitization and mobilization of institutions and communities.

(d) Identification and selection of support institutions.

(e) Signing of agreements with support institutions.

(f) Training of support staff for the implementation of disinfection systems.

(g) Assigning of priorities to localities.

(h) Identification of the disinfection technology to be applied in each system.

(i) Preparation of the project file for each locality.

(j) Allocation and distribution of equipment, containers, tools, and supplies at the local level.

(k) Implementation of the project in each locality.

6.3 Monitoring and evaluation

The monitoring and evaluation of the water and food disinfection systems at the household level included the following activities:

(a) Design of the methodology and identification of indicators for the monitoring and assessment of disinfection systems in their different aspects: installation, operation, use, and impact, including the epidemiological aspect.

(b) Scheduling and execution of the monitoring and assessment of the operating systems according to the methodology designed.

(c) Preparation of periodic reports for the monitoring and assessment of the disinfection systems.

(d) Scheduling of ongoing monitoring and assessment of the Study.
6.4 Proposal for large-scale replication

The strategies and programs for large-scale replication of water and food disinfection within a systemic approach, included the following activities:

(a) Preparation of strategies and program proposals to replicate in communities lacking safe water the use of water and food disinfection systems at the household level.

(b) Analysis and approval by the Ministry of Health of the identified strategy and program proposals.

6.5 Progress and final report

Periodically, progress reports were prepared, as well as the preliminary final report, and the definitive final report of the Study.

7. Organization for the Study

For the implementation of the Study, an organization was set up to facilitate its management and operation, and to co-ordinate the participation of Ministry of Health institutions and non-governmental organizations. Figure 3 shows the basic scheme of this organization and Table 2 shows the responsibilities of each of the participating institutions. The organization of the Study at each level included:
Figure 3. Basic organization scheme for the implementation of the Study
Table 2. Responsibility of the participants in the Study

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>TECHNICAL AND ADMINISTRATIVE TEAM</th>
<th>SUPPORT INSTITUTIONS</th>
<th>HEALTH SUBREGIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization and planning</td>
<td>• To co-ordinate and schedule Study activities.</td>
<td>• To co-operate in the Study scheduling.</td>
<td>• To supervise and support.</td>
</tr>
<tr>
<td></td>
<td>• To promote water disinfection systems.</td>
<td>• To co-operate in the promotion of disinfection systems in the localities.</td>
<td></td>
</tr>
<tr>
<td>Identification</td>
<td>• To identify public and private institutions at the local level.</td>
<td>• To co-operate in sensitization of the local inhabitants.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To raise awareness among the beneficiary populations.</td>
<td>• To co-operate in the selection and prioritization of localities.</td>
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</tr>
<tr>
<td></td>
<td>• To select and prioritize localities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To promote the disinfection study among institutions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td>• To carry out the situational diagnosis in prioritized localities.</td>
<td></td>
<td>• To co-operate in the situational diagnosis.</td>
</tr>
<tr>
<td>Implementation</td>
<td>• To prepare and implement local projects.</td>
<td>• To co-operate in the preparation of projects; installation of the equipment; training of community promoters and beneficiary population; and organization of communities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To train personnel of support institutions; health workers who participate in the Study; community promoters; and beneficiary population.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• To supervise the installation of disinfection equipment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>• To perform the monitoring of the Study.</td>
<td>• To supervise the management of the water disinfection systems by the community.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To supervise the operation and maintenance of the systems.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To monitor the disinfection systems: epidemiology of diarrhoeal diseases; changes in hygiene practices; sustainability of the installations.</td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>• To conduct the Study assessment.</td>
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</tbody>
</table>

7.1 **Central level**

- The Study is coordinated by one PAHO/WHO representative and one representative from the Ministry of Health, both responsible for the programming and correct management of the Study. The PAHO/WHO coordinator reports to the Director of CEPIS and the Ministry of Health Coordinator reports to the Program Coordinating Unit.
A technical and administrative team supports the Study Coordinators at the central level. It is responsible for preparing the methodological documents; training regional coordinators and personnel of the support institutions, including the Ministry of Health personnel participating in the Study; supervision of diagnoses; preparation of executive projects; supervision of project execution; control and monitoring at the local level, and monitoring and assessment of the Study. This team was composed of specialists in sanitary engineering, management, community participation, and health education.

7.2 **Subregional level**

There are technical and administrative teams to support the Study coordinators in every subregion participating in the Study, responsible for promoting and coordinating the implementation of local projects at the subregional level. Each team was made up of specialists in sanitary engineering and community participation.

Support institutions at the subregional level assumed the commitment to help with the diagnosis, scheduling, installation, management, control and monitoring of water and food disinfection systems at the household level in areas prioritized by the Study, as well as to carry out monitoring and assessment.

- Health Subregion Offices were in charge of the supervision and support of the Study activities in the prioritized localities of each subregion.

- Subregional coordinating committees, made up of representatives of the Health Subregions, support institutions, and regional coordinators of the Study, were responsible for coordinating the efforts carried out at the subregional level.

7.3 **Local level**

- Health care centers and health posts were placed in charge of supervising and supporting the implementation and operation of the systems at the local level (communities).

- Local administration units or community administration units were placed in charge of the implementation, management, monitoring, and assessment of the water and food disinfection systems at the household level in their communities.
8. **Self-sustainability**

It takes a long time for water and food disinfection systems to become self-sustainable of and requires follow-up and control by a specific organization and ongoing training and re-training of users. However, to set the basis for self-sustainability, the necessary organization and management conditions were put in place to ensure that the community would effectively use the disinfectant, finance the operation, and maintain the disinfection system in good working order. At the same time, the contractual procedures for using the equipment, water containers, and accessories supplied to the community by the Ministry of Health through the Study were identified to guarantee their protection and conservation, and their replacement at the end of their service life.

For that same purpose, the active participation of the community was sought in the installation and operation of the water and food disinfection systems. The community was encouraged to participate in all the project processes so that from the beginning they would consider it their own project, and the water and food disinfection processes would become a part of the daily habits and customs of the community.

Finally, long-term self-sustainability of the installed systems will depend largely on the efficiency of the Environmental Health offices in the Regional Departments of Health, and the local support institutions. However, to make the project sustainable in the long term, it is recommended that in a second stage an organizational development project be drawn up to connect this project for water and food disinfection at the household level with a national institution that will be responsible for the follow-up and support of projects already under way, and for linking future water and food disinfection projects with some kind of development project.

9. **Achievements of the Study**

The Study has obtained the following results:

- The implementation of water and food disinfection systems in the prioritized localities has been a valuable contribution to the improvement of drinking water quality and well-being of the beneficiary families.

- The use of disinfected water for drinking and for the washing of vegetables that are eaten raw has produced a change in hygiene-related behavior.

- Regional public authorities and community leaders have been sensitized about the need of improving health conditions among the population.

- Community organizations in charge of the self-management of water and food disinfection systems have been strengthened.
• In addition to these results, changes in food handling and home cleanliness have been observed as a consequence of educational activities.

The factors contributing to the Study achievements were:

• The participation of professionals and technical personnel from the Ministry of Health and support institutions, and their skill in working with the local population at the stage of the social insertion and implementation of the water and food disinfection systems at the household level.

• Sensitization of community leaders and authorities and their commitment to participate.

• Willingness to participate and be trained in self-management on the part of members of the beneficiary communities.

• Application of participation methodologies to the training process for the management units.

• Easy and simple operation and maintenance of the equipment for disinfectant production, and of the table filters.

10. Impact assessment

The indicators used to measure the impact of the Study on the different disinfection systems assessed the quality of the product and storage containers; habits and customs; community management; self-sustainability and health impact on children under five years of age.

Preliminary results indicate that the Study has had acceptance and that more than 80% of the participating families of rural communities use the disinfectant to improve the bacteriological quality of their drinking water. However, in localities supplied with very turbid waters, table filters have proved to be the best solution, and have been met with total acceptance on the part of the beneficiaries.

Although ancestral habits and customs are still observed, a small change in hygiene has been detected now that disinfected water is being used. The beneficiary populations will be able to improve their habits provided a continuous monitoring program is maintained for at least three years.

The equipment installed has been reliable and has been operating without major problems. The management units have been carrying out their tasks satisfactorily.
Finally, with respect to the prevalence of diarrhoeal diseases in children under five years of age, previous experiences have demonstrated a significant reduction (50 to 66%) in such diseases.

12. References


