Strategies for Documenting Water & Sanitation Coverage and Numbers of Beneficiaries

Final Draft
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Guidelines for quantitatively assessing and evaluating program requirements and accomplishments

Refugee Relief, Respect, Renewal

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Forward

"You get what you inspect, not what you expect." Stan Foster, Professor Emeritus, Emory University, Fellow IRC co-worker.

For nearly half a century, IRC has run effective and inspired programs providing services to some of the world's least fortunate people. Since the late 1960's, water and sanitation provision have been a major part of those services. Until 1999, IRC has not had health, water & sanitation, or shelter technical support based at headquarters. New York based staff has supported specific areas, such as reproductive health, in recent years and, it is not surprising that IRC's reproductive health programs have flourished in the field.

In 1999, with funding from the Gates Foundation, IRC has started a health unit. This unit will eventually house technical staff in water & sanitation, public health and medicine, epidemiology, and shelter. The goals of this unit are four fold: to better prepare IRC workers before they arrive at their posts, to better support staff technically while they are in the field, to help develop best practices through research and training, and to standardize IRC's operating procedures to the extent possible in our volatile and varied fields of work. The document that follows is the first in a series of technical manuals designed to achieve this fourth goal of standardizing practices.

There may be some who feel that the need to standardize technical procedures is an unwarranted intrusion by the central office on operations, which have historically been efficient and successful. Unfortunately, the changing circumstances demand a change in operations. The amount of funding spent on programs by IRC technical operations in recent years increased dramatically. We now have donors who each place millions, or even tens of millions of dollars into focused technical areas via IRC. They expect IRC as an organization to explain and justify those programs on a global scale. Moreover, as addressed in the introduction, our need to achieve quantifiable results has arisen from a general elevation of expectations within the relief community.

We hope that this manual, and those that follow will help you to advocate well, and assist expeditiously those who we serve. All of these manuals should be seen as works in progress and as IRC's experiences and competencies grow, so will the basic tools that make-up the set of abilities which will define IRC. We hope that you will feel free to provide feedback or additional techniques for future revisions.

Good luck and God's speed.

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Table of Contents

Introduction

The climate in which IRC operates is changing. Donors are being pressured to demonstrate the effectiveness of the projects they fund. Moreover, a rising level of professionalism among relief workers has created the expectation of reliable and high quality service, even under the most trying of circumstances. Not only are the increasing expectations focused on the quality of the service provided, but also on the ability to document the services provided. The recently established SPHERE Standards, a set of minimum expectations for humanitarian relief programs, have placed these increased expectations directly in the hands of workers in the field. The expectation now exists that relief workers in the water supply arena for example, will not only be able to lay pipe and install handpumps, but will be able to say how many people use those sources, how much water they receive on average, and how far the recipients live from their water supply.

This document grew from an attempt by the IRC Central & East African Regional Program to, in a systematic and reproducible way, to quantify the level of service and the number of people served by water and sanitation projects. The strategies set forth here are not always ideal and may not be applicable to all situations. Nonetheless, these approaches will enable the estimation of populations, water consumption, and latrine coverage in the majority of settings in which IRC works. Most of the techniques suggested have not been developed by IRC, but rather have been taken from other organizations such as MSF France and the CDC.

1) POPULATION ESTIMATION

One of the most common obstacles to the establishment of good program planning and management is the difficulty of estimating populations during crises. Not only can the population be moving or steadily increasing, but also people are often scared of strangers making lists or may attempt to double register in order to gain extra rations. In many stable refugee populations, survey estimates have been far lower than official registration figures. For example, Nyamithuthu Camp in southern Malawi had an estimated camp population of > 100,000 in late 1992 and yet a camp based survey by MSF-France estimated the actual resident population to be 62,000. Thus, in the refugee context, methods for quickly monitoring populations without biases from political interests or population fears can be valuable.

Several rapid methods for enumerating large populations have been developed with varying degrees of precision. When possible, a census is the best method of measuring a population and a registration or census process should eventually confirm rapid methods. Choosing among the various methods depends upon the information available, the size and dispersion of the population, and the amount of time available to the investigators.

The three population estimation methods presented here are: spatial sampling, water production - water consumption comparison, and simple enumeration. When no surveys are going to occur for reasons other than population estimation, and water provision services are disorganized or non-existent, spatial sampling is the most appropriate method. Spatial sampling can also be effective in slums or shantytowns where population densities are high and conducting a census would be difficult. Where water production is less than demand and an estimate of the amount of water carried from water sources can be easily made, estimating the population based on water consumption can be very quick and fairly accurate. Where populations are small, a simple enumeration, or counting of huts is probably easiest and is normally the most accurate of the three techniques. A description of the basic techniques will be provided, but both judgment and modifications will need to be employed in many settings to obtain valid data.

1a) Population Estimation Based on Spatial Sampling

Where populations are in a defined area and are too large to count directly (e.g.> 30,000), spatial sampling is a useful tool. The method involves two phases; drawing a map of the population or at least defining its periphery, and estimating population density by counting people in squares or rectangles of a known surface area.

Mapping with GPS

If a population is in an area 1000 m X 1000 m or larger, mapping using a GPS (Global Positioning System) unit is probably the fastest and easiest way to create a map. Needed equipment include a GPS unit, a compass (optional), a ruler, a protractor, and a sheet of graph paper. GPS units have the ability to determine the latitude and longitude of any place on the surface of the earth, usually to within +/- 15 meters. They also have the ability to store positions in their memory (called waypoints) and determine the distance and direction from where the unit is being used to a stored waypoint. Most devices also have the ability to calculate the distance and direction between any two stored points. These units are typically about 150 gr., and can be held in the palm of the hand. The unit is a radio receiver, which is tuned into a network of satellites, which at the time of this writing are owned and controlled by the U.S. military. By triangulating between three satellites, the GPS receiver can estimate the position on the surface of the earth and the elevation. The unit has the ability to store points so that distances and directions to those points can be estimated from elsewhere.

The area to be mapped should be visually surveyed (walk around and look) and the crude geometric shape of the area should be estimated in the mind of the cartographer. The goal of the map is not to make a precise outline of the settlement, the goal is to create a simple geometric shape that is similar in shape and represents virtually an identical surface area as the settlement. Thus, the area should be represented by straight lines connecting between 4 and 10 points. Where settlement areas have curving edges, the straight lines symbolizing the edge of the area should be established so that areas within the line that are unpopulated are equal to the areas outside the line which are populated. (see Figure 1 on next page) At each corner where two straight edges meet, a waypoint should be established.

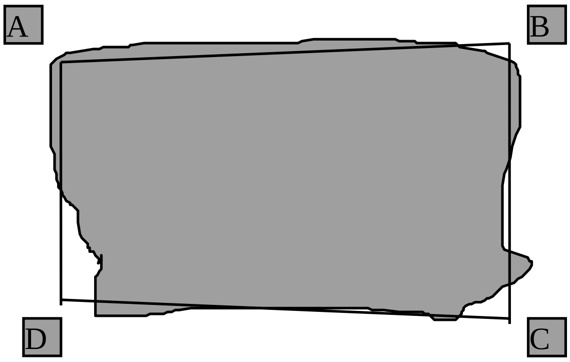

Figure 1: Simplified outline of a camp.

The mapping process will involve walking or driving around the periphery of the settlement and storing waypoints at each corner. The GPS unit should be used to measure the distances and directions to each of the waypoints. If this cannot be done at the end with the GPS units waypoint to waypoint measuring option, it should be done as one goes along. The directions and distances to each preceding waypoint should be recorded. The directions will be given with respect to north on a 360-degree compass. Table 1, which corresponds to Figure 1, shows the distances to the points before and after each waypoint and the angle formed by the two side which meet at that waypoint. Note, the angle made by two sides is determined by subtracting one direction from the next. While the purpose of this map is to estimate the population, it is wise to record the elevations at each waypoint also which can later help in planning water delivery or drainage improvements in the area.

Table 1: Distances and directions between hypothetical waypoints.

Point	Distance to next pt.	Direction to next pt.	Distance to last pt.	Direction to last pt.	Angle made
A	800 m	320°	500 m	52°	92°
B	520 m	54°	800 m	140°	86°
C	810 m	142°	520 m	234°	92°
D	500 m	232°	810 m	322°	90°

A scale needs to be established for drawing the map so that it will fit entirely onto the page. Do not concern oneself with the top of the page being north. To draw the map:

I) Draw one side (preferably the longest) in such a way as to permit the rest of the area to be drawn on the page. Measure its length with the ruler to precisely correspond with the distance of the side estimated by the GPS unit.

II) Determine the angle between the first and the second side by subtracting the directions between them. Lay the protractor along the first line with the center point over the end of the line. With a pencil, mark a dot at the appropriate angle from the end of the first line. Place the ruler with the 0 point at the end of the first line and the edge on the dot which you have drawn. Draw the second side to the proper length to correspond to the GPS distance estimate.

III) Repeat this process for each of the sides. The precision of your estimates and GPS error will determine how close the lines come to forming a closed polygon when the last side is drawn.

IV) Estimate the area on the map. This can be done by dividing the area into triangles and rectangles. The area of a triangle is 1/2 the base X height. The area of a rectangle is the average width X the average height. Sum up the areas of all of the triangles and rectangles. Other methods for estimating the area from the map may be more precise. A tool called a plenimeter can be used to trace the outline of the mapped area and it will report the area inside the perimeter. Many computer programs are available which allow for areas to be calculated give the latitudes and longitudes of the corner points. Some advanced GPS units can be downloaded into a computer directly.

Estimating Water Service Areas Without Mapping
Sometimes, workers want to roughly (+/- 30%) estimate a population using a specific water source. It may be that these people are not geographically distinguishable from people using other water sources. This often the case in large refugee camps and slums with multiple water sources. It can also occur that the population using a source can change over time. In these circumstances, one can begin at the water source and move in 4 directions (North, South, East, and West are obvious choices) and ask people where they get their water. The distance to where most people begin using another source should be measured, either by pacing or by GPS. When the distance to the 4 extremes of the service area have been measured, multiply the North- South span by the East - West span. This is approximately the area of the service area given the assumption that the area is a rectangle.

Estimating Population Density
Estimating the population density can be difficult but must be done in conjunction with any mapping technique in order to obtain an accurate population estimate. If a camp is of relatively homogeneous density, one-hectare sample areas should be used which together include at least 1% of the camp area and at least three locations. If a camp or slum is not always 100 meters or more across, smaller sampling areas can be utilized. In order to do estimate the population:

I) Mentally super-impose a grid on the map that begins or ends at a waypoint or a known location in the camp. The grid system must include all of the settlement and may include areas outside the settlement. Typically, the grid is in meters along and perpendicular to one axis or a grid running north, south, east and west.

II) Choose random combinations of numbers that correspond to the span of the grid. Any pairs of numbers that identify an area outside of the settlement should be discarded (do not keep one of the numbers and re-pick the second!). Numbers beginning at the right side of currency bills are generally a good source of random numbers.

III) By pacing or measurement, go to those randomly chosen spots. Pace out an area from that spot which covers 100 meters to the north and west (other directions can be chosen if it is done before the survey begins and the directions are not altered during the enumeration process).

IV) Once the one-hectare square has been defined, the number of people living in that area should be counted. If it is a stable situation where families have shelters and defined areas, one can ask people how many people live in each specific household. If the situation is in flux and with no shelters, the population would best be measured very early in the morning or extensive inquiries will have to be made about the numbers of people who slept in each spot the night before. This is because entire families may not be present at the time of the enumeration. Thus, the people who are there will have to be relied upon to recall how many people were within your chosen area on the preceding night.

The values of population density should be averaged (arithmetic mean) and the average density multiplied by the area of the settlement. This is the estimated camp population. In camps where certain areas seem to be high in density and other areas are of low density, these differing zones should be drawn in on the map or mapped separately and the spatial sampling process repeated for each type of area.

Spatial Sampling from Aerial Photographs

The same technique of estimating the population density and multiplying it by the area of the population can be used utilizing aerial photographs in lieu of drawing a map. This was done by MSF International during the 1994 exodus of Rwandan refugees into Goma Zaire. The MSF estimates for Katale Camp and Kibumba Camps (combined population of approximately 260,000) were almost identical to, and preceded by weeks official registration / census numbers. At the time, these estimates were far lower than press and unofficial estimates had reported. This technique only requires a compass and an aerial photograph.

If the aerial photograph displays a range of population densities (as is usually the case) zones of relatively high density should be identified and distinguished from zones of lower density. The areas of different density need to be sampled separately. As with the GPS based mapping, one hectare areas are randomly selected, paced out, and the average population density estimated. If there is no scale built into the photograph, the distance between two objects on the photo and in the field must be measured to establish the scale of the image. If the photograph has a scale built in, the areas can be estimated by breaking the zones into rectangles and triangles that approximate the same area as the populated portion of the picture. If the populated zones are not easily broken into geometric shapes, there are three other rapid options;

I) superimpose a grid on the picture and count the square of each zone.

II) cut out a square from an empty portion of the photograph that represents a known area. Weigh the piece of photo paper on an accurate scale. Carefully cut out the zones of high and low density on the image and weigh them separately. The ratio of the weight of the initial square to its representative area will equal the ratio of the different zones weight to their different areas.

III) if available, a plenimeter can be used to trace the outlines of the zones and it will calculate the areas inside the tracing.

As with the GPS method, the overall population equals the average human density of the sampled areas times the area of the settlement. If sampling and area estimation was done for high and lower density zones, the population of each zone should be calculated and the two populations should be added together.

1b) Population Estimation from Water Consumption or Sanitation Coverage

There are times when a population is dispersed, or only a few hours are available for estimating a population, and the mapping process is not practical. There are also times when a population is well established and services are already well monitored and one wants to quickly confirm the population estimates. In these circumstances, estimating numbers of people can sometimes be done through water use surveys or sanitation coverage surveys. Compared to food and medical services, fewer incentives exist to inflate populations in the water and sanitation sector and inquiries into the levels of services in this arena are less likely to be met with hostility than most other sectors. The precision of each of these methods depends on the size of the samples taken and the validity of the underlying assumptions.

A method for estimating water consumption administratively is presented in Section 2 as is a method for estimating water consumption from rapid surveys at locations such as ration queues. The administrative estimate of water consumption is the total water produced or transported into the population area divided by the population. This should be the same as the survey based water consumption estimates. In locations where total water production is known, a survey of water consumption can be used to estimate the population.

Assuming:

The sample frame for the survey is valid.

All of the water produced in the community is for personal uses or public/commercial/agricultural and waste related consumption can be subtracted.

The estimate of water production is accurate.

Est. water production / population = per capita consumption = survey est. of consumption

Thus:

Est. water production / survey est. of consumption = population

For example:

A camp is receiving 800,000 liters/day (l/d).

A survey in a ration queue estimates per capita consumption to be 10 l/p/d.

Population = 800,000 l/d / 10 l/p/d = 80,000 persons

Estimates of population based on water consumption are generally crude compared to a census. Yet, particularly during assessments of populations in established camps or small villages, where overall water production is known, this method can be very rapid.

Likewise, when specific items for latrines, such and concrete slabs or sanplats are provided for each latrine in a population, the number of people in the community can sometimes be estimated from a quick sanitation survey. This is most often the situation in a camp with an organized latrine program. This method has three requirements:

1. The number of latrine slabs provided to the community is known.
2. One can visit every 10th or 20th hut / household in the community and determine if they have a latrine slab.
3. One can acquire the average number of people per household or per hut either by interviewing households during the visits or because this number is already known.

Latrine coverage (for this population estimation purpose) should be defined as the number of households with the latrine slab divided by the total number of households visited.

The estimated population = (# slabs distributed / latrine coverage) X the average household size.

For example:

A sanitation program in a camp has passed out 3000 latrines.
The average household has 7 people.
75% of visited households have a latrine slab.

Population = (3000 / .75) X 7 = 28,000 people

Not only can this method be used to estimate population but also it can often quickly enable the confirmation of official camp figures. During a major population influx to Lisungwe Camp in Malawi during 1993, a survey found that over 90% of households had a latrine from the camp program while the estimated coverage based on the number of official residents divided by the sanplats distributed was about 5% lower. This enabled a quick estimate of the over-registration within the camp.

1c) Simple Enumeration

Perhaps little needs to be said about registering or counting populations. Situations vary from place to place and the level to which populations cooperate can range from large numbers of residents avoiding detection to people attempting to double register in order to gain extra food rations. An entire science has arisen around registering populations. Dyes, electronic fingerprint scans, and bar coded wrist bands have all been used to assign specific individuals to food distribution rations.

For most situations, counting huts or households, and visiting every 10th or 20th household to determine the average household size is the easiest way to measure a population. In this case, *Population = Households X Average Household Size*. When determining household size, a systematic sample which spreads over all of the different areas (new versus late arrivals, with cattle versus without cattle, etc.) is best. During the crisis in Somalia in 1993, CDC staff enumerated a group of several thousand people and a crowded and chaotic spontaneous settlement by estimating the average number of residents per hut and counting huts from atop of a nearby water tower.

2) ESTIMATING WATER CONSUMPTION

Estimating the amount of water that either is being produced or which needs to be produced is one of the easiest of the monitoring tasks which relief workers have, and yet it is rarely done. Many programs have gone through the embarrassment of having outsiders come and document that they are supplying one-half or one-third of the water that they thought that they were. In a camp setting or with a geographically focused client population, water supply workers should publicly display a graph of monthly water consumption among their beneficiaries. Where IRC workers are serving a large stable area through many different projects, ongoing monitoring may not be feasible. In this case, at least estimates of water consumption among the target population before and after the projects completion should be obtained. While many engineers feel that their job is to supply water, the SPHERE standards and the expectations of the humanitarian community focus on how much water people actually take. Thus factors such as, crowding at water points, a lack of buckets, the unwillingness of people to carry water great distances, all need to be included into the program design in order to assure a reasonable level of service. Moreover, regular monitoring of water consumption can help identify unseen changes, such as new influxes of population or changing circumstances at distant water points causing greater numbers of people to utilize points within one's project.

Presented below are three rapid techniques for estimating water consumption. A variation of one of these techniques will enable an estimation of water consumption in almost any setting.

2a) Administrative Estimate

The simplest and fastest way to estimate water consumption within a population is to divide the total water production by the total number of beneficiaries. Where water is metered or brought by tanker, with a small effort to estimate water wastage, the amount given to people can easily be estimated. Unfortunately, this is rarely the case. Usually, water is provided to people either through wells or tap stands. To estimate water production, each well or tap stands' productivity must be established.

Estimating Water Production at a Specific Water Point

If a well or spring has a relatively constant rate of water production, estimating water production can be quite easy. One should time the filling of either a set number of containers of a known volume, or estimate the amount of water removed from a point over a fixed period, such as 10 minutes. Time spent rinsing off buckets or between people in the queue is an inevitable part of utilizing that site and should not be subtracted.

The rate of water flow from the site should be calculated in liters per hour. People at the point should be asked about the numbers of hours per day that the source is in use. In most places in the tropics, the sites are in use between 12 to 13 hours during daylight. The total production at this point is: *Flow Per Hour* ***X*** *Number of Hours of Use Per Day*.

There are many settings where utilization of water at a point is not constant throughout the day. This can be because there are no queues at certain times of the day, or, as with a river or lake, production per unit time is practically unlimited and people get the water primarily at certain times of the day. In these cases, water production at each point must be measured at many different times of the day and the estimated production per hour summed-up over the day. It is particularly important to measure the rates at which people are removing water first thing in the morning and also in the evening, when water source utilization is usually at its peak. (That is, a 10% error in hourly production when 1000 l/hr. are being taken will have far more influence on your daily production figure than will a 10% error when 100 l/hr. are being removed.) If the evaluator themselves cannot go to each site for 10 minutes per one-hour or two-hour period, they should train someone locally to estimate water consumption rates at a point.

In a camp setting, if people use a lake or a stream for a water supply, they usually walk back to the settlement on one of a few paths. The flow rate on the paths can be measured over several 10 minute periods throughout the day, a flow rate in liters per hour can be calculated, and the average or cumulative inflow of water down each path can be calculated.

It is important when using administrative estimates that: the population estimate is correct, and that there are no major non-domestic uses occurring in the camp. The making of bricks, the watering of livestock and gardening, all can cause people to carry significant amounts of water away from sources for reasons other than domestic consumption. A quick walk around the camp is perhaps the best way to assess if there are major non-domestic water consuming activities occurring.

2b) Spatial Assessment of Water Consumption

The number of people utilizing a water point is usually limited by the flow rate at the source or the distance people have to go to acquire water. Thus, the population using a water point is usually the population living closest to that water point. By assessing water consumption among those residents around the source, the average water consumption rate can usually be estimated. The following steps are recommended:

I) One chooses three or four directions away from the water source, preferably with paths, but certainly with 90° or greater difference in compass heading.

II) Walk in the chosen direction stopping at intervals of 20 to 100 meters. One should plan to visit 10 to 20 households. (Most productive water points serve 300 to 1000 people. If the average household size is 5-7 people, you will be sampling from a total of 50 to 200 households. Thus, your sample should end up being 10 to 20% of the client population.) Judgment will have to be used to guess how large the interval between houses needs to be in order to end with 10 to 20 interviewed houses. But, once an interval is chosen and the second house is interviewed, the interval should not be changed.

III) Ask households if they collected water at the source yesterday. If they did, inquire about the quantity collected and how many people are in the household. If the number in the household varies or some family members are away, ask how many people used the water which was brought home yesterday.

IV) Continue interviewing the houses separated approximately by your sampling interval until houses (three in a row ideally) report that they go to a different water source. If possible, measure the distance from the source to each interviewed house using a GPS unit. While not needed to estimate water consumption, it will enable a characterization of the service provided by this point with respect to the distance people need to go to collect water. Moreover, the GPS can be used to confirm that one is moving away from the source in a constant direction.

V) When a series of houses in each direction have been visited, sum the total water collected the day before at each house and sum the number of occupants from each house. The estimation of average water consumption among the beneficiaries of that point is the total water collected divided by the total number of people in those houses interviewed.

2c) Estimating Water Consumption through Surveys

Method 2b) is in essence a spatial survey around a water point. Many times, populations are mobile, use a variety of water sources, or are mixed in with another population and are difficult to identify. In these circumstances, a survey may be the easiest way to assess water consumption. Surveys are often very easy to conduct - although finding a way to sample a population that represents them well can be exceedingly difficult. Therefore, if another survey is being conducted to assess vaccine coverage, or attitudes about repatriation, or most anything else, it is often best to add on a couple of questions about water consumption rather than conduct an independent survey.

The people who collect water (usually women) generally have a very clear recollection of how much water was collected the day before. In settings where most people are using buckets or jerry-cans of fixed size, it will be easy to establish how much water was collected just by conversation. If the interviewing is being done at homes, people can actually display the vessels. Otherwise, it is prudent to take a range of the most common vessels or pictures of vessels to assist people in estimating the amount of water that they collected.

The survey should always ask about water collection during the preceding day. In many cultures, asking about the past 24 hours is confusing since people may not keep tract of the hour during the day. If something occurs, such as rainfall or a ration distribution which is likely to disrupt the normal water collection habits, delay the survey until a day which follows a more typical day.

The easiest way to obtain a rapid and representative sample in a camp setting, is to go to a ration distribution or a registration site, where all households are represented. In this situation, a rapid and representative survey can be done by going through the queue and asking every 10th or 20th person about water collection the preceding day and how many people were in the household on that preceding day. At the end of the interviewing, the total amount of water collected in the interviewee families should be divided by the total number of people in those families.

If finding people at a common place is not possible, visiting every 10th or 20th family systematically over space is also a reasonably rapid and usually representative way to determine water consumption. A systematic spatial sample also has the advantage of identifying areas where there are particularly acute water shortage problems.

3) ESTIMATING SANITATION COVERAGE

Sanitation coverage is generally easier than estimating water access or use. Latrines are highly visible objects and can usually be counted while walking around, avoiding the time consuming act of stopping at each house to introduce oneself and explain what you are doing. Nonetheless, verbal interviews can also be used to assess sanitation coverage.

As with water assessments, there are three common methods for estimating sanitation coverage:

<u>Administrative estimate</u> - The population is divided by the number of latrine slabs or other latrine specific items distributed. Coverage in communal latrine programs is usually assessed by an administrative estimate.

<u>Spatial sample or census</u> - The number of households or huts are counted, a few are interviewed to determine the number of people per household or hut. The number of latrines is also counted. The household coverage is the number of latrines in the area divided by the number of households. The “people per latrine” is the number of people per household times the number of households, then divided by the number of latrines counted.

<u>Surveys</u> - People in a representative sample are asked if they have a latrine and if they share the latrine with any other families. If a family shares a latrine, they should only be given partial credit for latrine ownership. That is, if the family shares that latrine with 2 other families, they should be given credit for 1/3rd of a latrine. If the family has its own latrine, they should be given credit for one latrine. The sum of the latrines credited should be divided by the number of households interviewed to determine the fraction of households with a latrine. Unlike questions about water consumption, people often will not tell the truth about latrine ownership. Therefore, a rapid visual confirmation of a questionnaire based sanitation survey is desirable when possible.

While latrine coverage is important, having clean latrines is also important. Dirty latrines dissuade use, and there have been at least two outbreak investigations in Africa (Malawi, 1993 by Epi-Centre, Zambia, 1994 by CDC) which found that using latrines (presumably dirty) was a risk factor for acquiring shigella. Thus, programs need to have a systematic way to assess the cleanliness of latrines and to take corrective action when latrines become hazardous.

Finally, there are programs which supply household latrines and there are programs which supply communal latrines. Household latrine programs should be reported as the fraction of client households which have a latrine. For example, reporting that there is one latrine for nine people means very different things when the average household size is 8 people versus 5 people. Conversely, communal latrine programs should be reported as people per latrine.

4) **GUIDING PUBLIC HEALTH PRINCIPLES**

I) Reviews of epidemiological studies examining the effects of water and sanitation on both diarrhea and mortality have found that sanitation is more important than water, both in terms of water quality and water quantity. In general, the effect of improved sanitary facilities is twice as protective as water improvements against diarrhea and death in children under five years of age. (see Esrey et al. Bull. WHO, 1990)

II) The world over, a communal latrine is much more difficult to keep clean than a family latrine. Therefore, when a population is expected to be somewhere for more than a few weeks, getting people to construct their own latrines should be a high priority. While materials and tools may need to be provided, labor should generally not be paid for or supplied. It may be that special sub-populations (child headed households, wounded...) will need to have latrines built for them. Nonetheless, the contribution of labor by the owner will assure that the design is appropriate for that family, and will contribute to the sense of ownership and responsibility for maintenance.

III) Giving people enough water (15 liters / person / day or more) is more important than giving people the highest quality water.

IV) During cholera and typhoid outbreaks, assuring water quality becomes the highest environmental priority. It is probably prudent to chlorinate during outbreaks of shigella as well although shigella is not as water obligate as cholera and typhoid. Most contamination of water typically occurs after water is collected from the source - either through dirty hands or dirty objects. (See Mintz et al. JAMA 1996) Thus, the best way to assure high quality water is to chlorinate. During outbreaks, outreach groups can be mobilized to chlorinate buckets at water points or other collection sites. The goal should be to have 0.3 to 0.5 mg/l in the water at the time it is consumed. This may require adding a much higher dose at the source, especially in hot climates where chlorine volatilizes rapidly.

V) While not the job of most water and sanitation officers, assuring that people have access to soap is an important part of any diarrhea prevention program. The only study which examined soap access in a refugee population found a reduction in diarrhea of approximately 30% in houses with soap, compared to the same houses on different days without soap. (See Peterson et al. Int. J. of Epi., 1998.)

VI) Monitoring should be done primarily to improve the quality of programs rather than to document expenditures or placate donors. People who cannot measure the effect of their water or sanitation program are often running programs that provide no benefits. Monitoring is the tool by which efforts which are ineffective are identified and efforts which are particularly effective are appreciated. Thus, all water and sanitation programs should have publicly displayed graphs showing the progress of the program or the level of service among the client population.