

# Comparison of Handwashing Methods in Uganda : Is using a Tippy Tap better than washing hands using a basin?

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## 1. Introduction

Washing hands with soap is considered to be one of the most powerful measures to prevent communicable diseases, especially diarrheal diseases (Curtis and Cairncross, 2003). In areas where a handwashing facility that provides running water is not available, a simple device called a Tippy Tap (see Figure 1) has been promoted to enable handwashing with running water (tippytap. org, 2013).

In this paper, we will examine the effectiveness of using a Tippy Tap in comparison to using a basin for washing hands. It is a common practice among the children of our research area in Uganda to put water in a basin and use the water to wash hands together with other children. We used Lumitester, a rapid hygiene monitoring device, to measure the cleanliness of 60 children in a primary school. Our hypothesis was that the hands washed using Tippy Taps would be cleaner than the hands washed using a basin.

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Figure 1. Tippy Tap (source: photographed by author)

## 2. Background of the Research

Diarrheal diseases remain the second leading cause of death among children under five globally. Nearly one in five child deaths –about 1.5 million each year – is due to diarrhea. Particularly in Africa, it is the cause of the highest rate of child deaths, at 46%. Nearly three quarters of child deaths due to diarrhea occur in just 15 countries including 10 countries in Africa (UNICEF and WHO, 2009)

The key primary barriers to the transmission of enteric pathogens are safe stool disposal and adequate hand washing, especially after contact with fecal material during anal cleaning of adults and children (Bateman, 1994). The effectiveness of washing hands with soap has been depicted widely since the meta-analysis by Curtis and Cairncross (2003) showing that it can reduce the risk of diarrheal diseases by 42-47 %.

Considering the magnitude of the burden of diarrheal diseases on children in developing countries, handwashing promotion should be a high priority. In 2008, the International Year of Sanitation, October 15<sup>th</sup> was designated as Global Handwashing Day (PPPHW 2008). This helped the promotion of handwashing through campaigns organized by national governments together with donors such as UNICEF, WHO or WaterAid. These campaigns emphasized the use of soap because it is much more effective in reducing pathogens on the hands compared to washing hands with water alone (ditto 2008).

One of the barriers for hand washing has been the lack of access to water itself (USAID, 2013). In remote areas, a piped water supply or any other hand washing facilities are often not available. To solve this problem, a low-cost, low-tech hand washing device called a Tippy Tap was contrived and diffused (tippytap.org, 2013). It can be made of locally available materials, such as wood, string and a 5 to 10 liter jerry can. A Tippy Tap is operated by a

foot lever so one does not have to touch the device with their hands in order to release water. This reduces the possibility of pathogen transmission. Foremost, a Tippy Tap facilitates running water. The proper way of handwashing requires running water for rinsing hands (CDC, 2013).

Tippy Taps have also been promoted by different agencies in Uganda. For example, UNICEF launched a Hand Washing Campaign and appointed Hand Washing Ambassadors (local mother volunteers) who would raise awareness on hygiene and give instruction on how to build Tippy Taps where necessary (UNICEF, 2013a). One of the Hand Washing Ambassadors notes that using a jerry can for handwashing was unhygienic since whoever used it would have to touch it, which meant leaving germs on the jerry can (ditto; Brian 2011).

Zhang et al. (2013) studying an intervention in Uganda suggests that education alone is insufficient to induce short-term behavior change such as handwashing behavior. They identified that after introducing tippy-taps, both handwashing at school and after using the toilet increased. Brain's study (2009) also matches this result; post-latrine handwashing rates increased as a result of Tippy Tap provision. Tippy tap also becomes a salient cue for handwashing (Brian, 2011).

### **3. Research Area**

#### **(1) Bugobero Sub-county, Manafwa District**

The research was conducted in Bugobero Sub-county of Manafwa District in eastern Uganda. Uganda's under-5 mortality rate was 90, while the GNI per capita was US\$510 in 2011 (UNICEF, 2013b). According to the JMP statistics (UNICEF & WHO 2013), access to safe water in rural Uganda is 72%, while access to basic sanitation is 35%. At primary schools, the national average of pupil to latrine stance (stall) ratio is 42 pupils per 1 stance. In Manafwa district, however, the stance ratio is 82 pupils per stance (UBOS, 2009).

Manafwa District is located on the eastern end of the country bordering Kenya. Agriculture is the main economic activity with an emphasis on food crops, as well as coffee and cotton (Fountain Publisher, 2011). Electrification has proceeded within Manafwa in recent years, and it was in 2012 when Electricity came to Bugobero Sub-county. The area is inhabited mostly by the Bagisu people, one of the Bantu ethnic groups. Most children in Manafwa district enter primary school as the Net Intake Rate of 96% shows, but the completion rate is at 70% (UBOS, 2009).

In terms of handwashing, a study conducted in Uganda shows that 46% of children in

schools washed their hands in some way after going to a latrine, but only 5% washed their hands with soap (Steadman Group, 2007 p33). Adults seemed to have better behavior, where 57% of observed caregivers washed their hands after going to a toilet, while 14 % used soap to wash their hands (ditto). An earlier study in Bugobero Sub-county of Manafwa district shows a lower rate. Only 35% of the caregivers washed their hands in some way after defecation, and only 5% used soap (Sugita, 2004). Handwashing before eating was performed at a better rate; 70% of the caregivers washed their hands in some ways. The usage of soap was still low where only 5% of the caregivers used it before eating (ditto).

## **(2) New Hope Primary School**

The sample children were selected from a primary school called the New Hope Primary School in Bugobero Sub-county. The school was established in 2012 by a local NGO and it had in total 501 students enrolled as of September 2013 (Interview with New Hope Primary School staff members, 2013). The water source for the school is a borehole (deep well) with a hand pump which is located about 300 meters from the school compound. We tested the water with a quick test kit and found no evidence of E-coli nor coliform bacteria contamination.

The school has one latrine with two stances and two separate urinal spaces. The latrine was located closer to the main building for the administration and nursery classes. No handwashing facility (including a Tippy Tap) was found on the school compound.

The school provides the pupils with lunch, unlike government schools around this area. The school director told us that providing lunch is important for the improvement of students' performance (interview, 2012). According to school staff members, students wash their hands before eating lunch. The school provides basins filled with water for the students to wash their hands (interview, 2013).

During our visit, we constructed four Tippy Tap stands, two near the school kitchen where lunch is provided and two between the latrine and classrooms on the school playground.

## **4. Research Method**

In order to compare the effectiveness of two different handwashing methods, we compared two groups of school students, 30 students in each group. Group A was assigned to wash their hands using soap and running water poured from a Tippy-Tap (see Figure 2). Group B was assigned to wash their hands using soap and water filled in a basin (see Figure 3).



Figure 2. Using Tippy-Tap (Group A)



Figure 3. Using Basin (Group B)

(source: both photographed by author)

Five students shared the water to clean their hands. We chose Group B to do this, because in their daily life, children often share water in a basin to wash their hands, especially before eating a meal.

At first, we conducted an educational class on sanitation and hygiene using a drama method and demonstration at the above mentioned school. During the session, we demonstrated the proper way of hand washing by using the lyrics and music of a song called “Washy Washy Clean” (Health Promotion Board, 2009). The target of the hygiene education class was third and fourth year students (namely P3 and P4). In total, 74 students participated in the class, all of the P3 and P4 students who were attending school that day.

Among the 74 students, we selected 60 excluding the ones who looked obviously older than the rest. Then we further divided them into two groups, A and B. In dividing the students into two groups, we tried to have a similar ratio of boys and girls for both groups, and similar approximate average ages (to avoid sex and age bias).

The students were tested for their hand hygiene before and after their designated method of handwashing. The basic procedure is described in Figure 4. Group A washed their hands using a Tippy Tap and Group B washed their hands with water in a basin together with other children. Six students shared one basin. Both groups used bar soap and washed their hands in a “proper way” as they just learned in the hygiene education class. Water for the

Tippy Taps and for the basins both came from the nearby borehole.

Group A (using a Tippy-Tap)	Group B (using a Basin)
Measure the hand cleanliness	Measure the hand cleanliness
↓	↓
Wash hands with soap using a Tippy-Tap	Wash hands with soap using water in a basin
↓	↓
Measure the hand cleanliness	Measure the hand cleanliness

Figure 4. Procedure of the experiment

For measuring the cleanliness of hands, a device called Lumitester PD-20 was utilized. Lumitesters measures the amount of ATP (adenosine triphosphate), and AMP (adenosine monophosphate). ATP acts as a "proof of life" for all living organisms, and AMP is derived from ATP during the processing, such as heat treatment and fermentation (Kikkoman Corporation, 2013). Using a swab, we wiped the right hand of each student and put the swab into a reagent kit. It only takes about 10 seconds for the analysis; and the degree of contamination is shown as a numerical value.

Although Lumitester cannot measure E-coli or coliform bacteria specifically, we decided to use this device because it runs on dry cell batteries and results are shown very quickly. In Bugobero, stable electricity is not available. So it is difficult to secure 15 to 24 hours of electricity required for an incubator that enables analyzing a large number of bacteria test papers.

We conducted a quick test of water also. We tested ①the borehole water that was used for both handwashing methods, as well as ②water poured out from a tippy tap and ③water in a basin after it was used. We used Suncoli test paper which allows a simple test for the existence of E-coli and coliform bacteria after 15to 20 hours of incubation at 36 to 37 centigrade. We took sample waters of the above ①, ② and ③, and the 10 fold dilution sample of each. Since we were not able to use an electric incubator, we incubated the test paper, which was put in a sealed bag, with our body temperature. Thus we were able to take only a small sample size; we took one sample each, six in total.

## 5. Results

### (1) Attributes of the Participants

Table 1 shows the school year, age, and sex of the test subjects. We selected 60 subjects

from two classes to participate in our experiment, and they were 27 boys and 33 girls. There were 37 students in P3 and 23 students in P4, and their average age was about 11.8 years old.

Table1. Grades, age and sex of the test subjects

	A. Tippy Tap (n=30)	B. Basin (n=30)	Total (n=60)
<b>Grades</b>			
P3	20	17	37
P4	10	13	23
<b>Age</b>			
14	3	3	6
13	1	10	11
12	9	7	16
11	12	6	18
10	5	3	8
9	0	1	1
<b>Average of age</b>	11.5	12.0	11.8
<b>Sex</b>			
Boy	14	13	27
Girl	16	17	33

## (2) Results of ATP test

Their average values of ATP on students' hands before handwashing were 21202 RUL (Relative Light Unit) for Group A and 25953 RUL for Group B (Table 2). After handwashing, they decreased to 8160 RUL and 8411 RUL, respectively. Mean values of reduction rates were 56.7 and 54.7 %, and these data suggested there were no significant differences ( $p > 0.05$ , n.s.) between the two methods for handwashing.

Table2. ATP values before and after two handwashing methods

Methods	Before handwashing (RUL)	After handwashing (RUL)	Reduction rates (%)
<b>Tippy Tap</b> (n=30)	21202	8160	56.7
<b>Basin</b> (n=30)	25953	8411	54.7

When we looked at the value of all subjects, there was some variability (Figure 5). In Figure 5, we indicate the data of ATP values on their hands before and after handwashing of Group A and B. In Group A, ATP values of 29 subjects decreased after handwashing, and only one subject's ATP value increased. In Group B, ATP values of 27 subjects decreased, and 3 subjects' ATP values increased. Their reduction rates ranged from 26.1 to 92.1% and



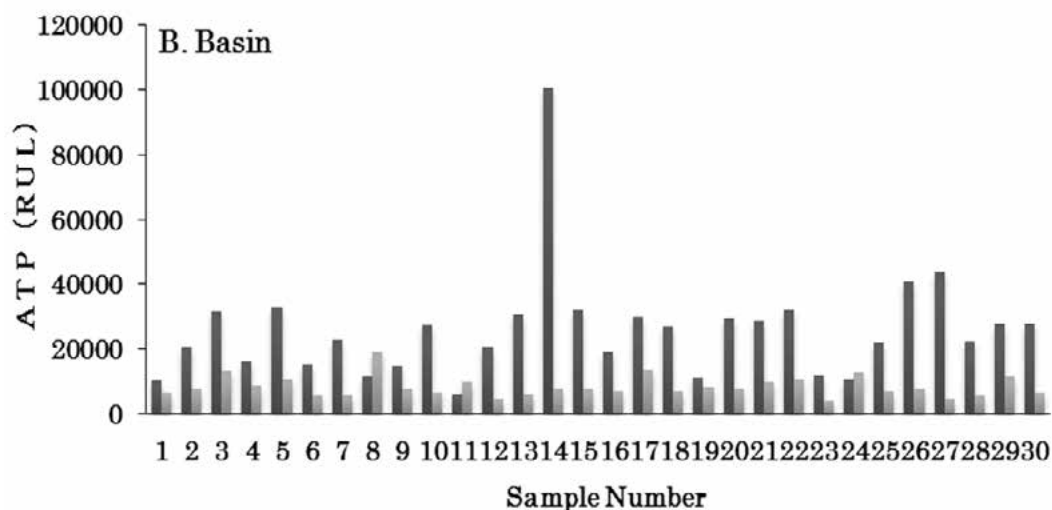
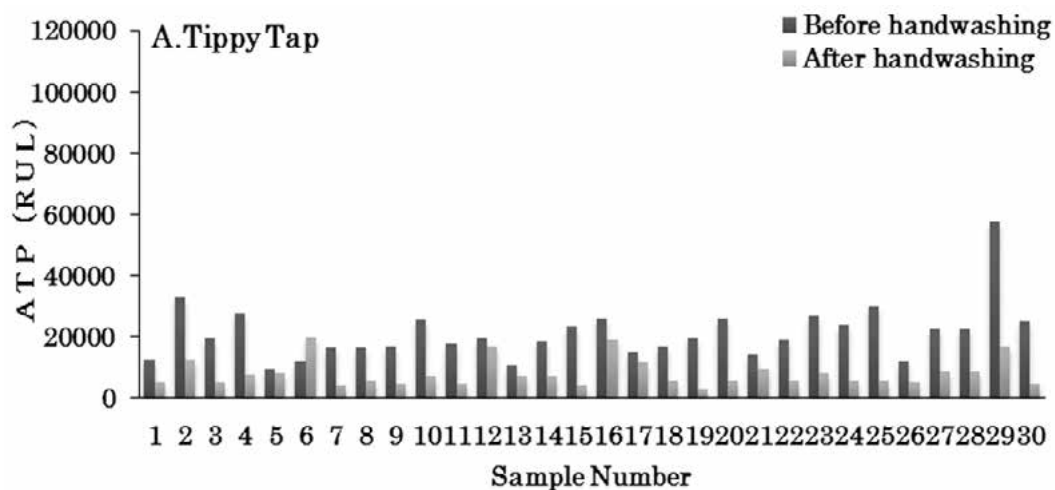


Figure5. the ATP values of Group A and B

from 20.8 to 85.1 %, respectively.

We analyzed the data of Group B removing No.14 which was an outlier, and still there was no significant difference ( $p > 0.05$ , n.s.) between Group A and B.

### (3) Results of the Water test

With the Suncoli test paper, none of the six water samples below showed the existence of E-coli nor coliform bacteria:

- ① the borehole water that was used for both handwashing methods  
(an undiluted solution sample and a 10 fold dilution sample)
- ② water poured out from a tippy tap



(an undiluted solution sample and a 10 fold dilution sample)

③ water in basin after it was used

(an undiluted solution sample and a 10 fold dilution sample)

We expected ③ to show some contamination. The negative result can be due to the small sample size, in other words, the part of water we tested happened to be uncontaminated but if we had taken more samples they may have shown the contamination. When we inquired the manufacturer of Suncoli, the staff member suggested that the other possibility can be some substance in the bar soap used for this experiment was preventing the reaction of the test paper.

## 6. Discussion

The hands of both Group A and Group B, namely the students who washed their hands using a Tippy Tap and those who washed their hands with water in a basin, became substantially cleaner after washing their hands with soap. The mean reduction rates of the ATP values were 56.7 % for Group A and 54.7 % for Group B.

This data, in addition, suggested that there was no statistically significant difference between the two methods for handwashing in terms of ATP value reduction rates. This means our hypothesis — hands washed using Tippy Taps would be cleaner than hands washed using a basin — was negated.

Then, is using a Tippy Tap not better than using a basin when washing hands? The Planner's Guide for the Global Handwashing Day advises to “rinse well with running water (rather than rinsing in still water)” as the correct way to wash hands (PPPHW, 2008). On the other hand, CDC (2013) recommends “If clean, running water is not accessible, as is common in many parts of the world, use soap and available water” (underline by author).

In our study, the water in the basin was drawn from a borehole, thus clean. However, in the course of sharing the water with other children (a common practice of children's hand washing method in this area), the water is believed to get less clean. To our surprise, the effect of water cleanliness did not show up on the hands in the Lumitester test results.

There are two possible explanations to this. One possibility can be explained by the children's skill of scooping water from a basin using hands. When you observe how Ugandan children wash their hands using water in a basin, we can see that they don't dip their hands very long but can scoop much water making the shape of a cup with one hand. It is actually surprising how well they can scoop and hold water using just one hand. This is an acquired skill and the older children can do this better. Our data showed that the older the subject

gets, the higher the APM value reduction rate (54% for 9 year old students; 79% for 14 year old students). With this skill, it may be that water in the basin does not get so dirty.

The other possible explanation is that the water actually gets dirty but the effect of water cleanliness on hand hygiene is relatively less when the absolute value of APM is very high, which may be common in a daily life setting in a rural environment. At health care facilities or food processing facilities, the recommended APM value for hands is much smaller (Kikkoman Corporation, 2013). If a stricter standard of hand hygiene is applied, clean running water would be required.

The limitation of our study is that we were not able to conduct a thorough test on the water we used. Even the water in the basin after it was used for handwashing did not show the existence of E-coli and coliform bacteria. We only took one sample each, so further study is required on the aspect of water cleanliness after use.

Going back to our question whether using a Tippy Tap is better than using a basin, we recognize there are other aspects besides the reduction of APM value after handwashing. The effect of Tippy Tap is not just the provision of running water. It will be a reminder of the necessity of handwashing if strategically located. Another study in Uganda also points out that Tippy Taps can provide a salient cue to handwashing (Brian, 2011). As Zhang et al. (2013) suggests, Tippy Tap can be fun to use especially for school-aged children. In our target school too, we felt that the students were having fun using the newly installed Tippy Taps.

As useful as a Tippy Tap can be, it is also necessary to understand that this low-tech and low-cost tech is not maintenance free. Somebody has to manage Tippy Tap stands since the water (5 liter) gets depleted rather quickly. In addition, the jerry cans themselves, as well as soaps, can get stolen if left during the night. Other reports show, Tippy Taps can break and need replacement after some years (tippy.org, 2013).

## 7. Conclusion

Testing with a Lumitester measuring AMP value, we found no statistically significant difference between the effectiveness of washing hands using a Tippy Tap and washing hands with water in a basin. It implies, in a rural setting like our study area in Manafwa district of Uganda, washing hands (with soap) is more important than whether they use running water or not. Further analysis is required for the effect of water cleanliness on the hand hygiene.

However, we infer that the effect of a Tippy Tap is not just facilitating clean water for

hand washing. If managed well, the presence of a Tippy Tap itself can be used as a tool for reminding and enhancing attitudes towards handwashing.

**Key Words:** Handwashing, Tippy Tap, running water, Uganda, Lumitester

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## ティッピータップによる手洗いはタライの利用より有効か ——ウガンダにおける手洗い方法の比較——

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本研究は、給水施設の整備されていない主に開発途上国で推進されている簡易手洗い器「ティッピータップ」を利用する手洗いの方法と、タライに水を溜めて数人でその水を使って手を洗う従来の方法と、どちらが有効か比較した。「ティッピータップ」は現地の物資で簡単に作ることができ、流水での手洗いを可能にする。調査は、ウガンダ国マナファ県ブゴベロ地区の小学校で行った。小学生（3、4年生）60名を対象に、30名ずつ2グループに分け、それぞれ異なる手洗い方法で手洗いを行ってもらった。手洗いの前後に、ルミテスターを用いた手指のATPふき取り検査を行った。それぞれの手洗い方法実施の際には、現地で一般的に使用されている固形石鹸を用いた。

その結果、2つの方法によるATP値の減少率に有意な差は見られなかった。つまり、一般的に「正しい手洗いの方法」として推奨されている流水による手洗いが、タライに溜めた水に比して必ずしも手の洗浄効果が高い訳ではないという結果になった。可能性として考えられる理由を本稿で論じている。ただし、「ティッピータップ」の効果は流水を給水できることのみならず、それが存在すること自体が意識向上や行動変容への誘因となると本稿では推察している。

キーワード：手洗い、ティッピータップ、流水、ウガンダ、ルミテスター