Effectiveness Of Different House-Hold Hand Washing Agents On Hand Flora

A A Onifade, R R Cutler, A B Okesina, B H Oladeinde, O Tomori, A O Akpoka, O F Osiloglu, B I Adejumo & O A Alamu

1. Faculty of Health & Social Care Sciences, St George’s University of London & Kingston University, London
2. School of Health and Biologies, University of East London, London
3. College of Medicine, University of Ilorin, Kwara State, Nigeria
4. College of Health Sciences, Igbinedio University, Okada, Edo state, Nigeria
5. College of Medicine, University of Benin, Edo State, Nigeria
6. Anatomy department, College of Health Sciences, Ladoke Akintola University, Ogbomoso, Oyo State

Abstract

Hand hygiene is a very important procedure in infection control. Washing agents commonly in use were investigated for their effectiveness in reducing hand flora and cotton towel was used as drying agent. Agents studied include; water alone, carex soap, dettol, and imperial leather. The hands were inoculated (deliberate contamination) with nasal swab and glove put on to allow inoculums to be established. The test hand was washed with the selected washing agent and dried with cloth towel three times while the other hand serving as the reference (and control) remained gloved. Glove was later removed from the other hand and both hands (un-gloved) were inoculated on nutrient agar plates and incubated for 24 hours at 37°C. The colony forming units were counted for both treated (washed and dried) and untreated hands and percentage reduction was calculated. The procedure was repeated three times and average result with standard deviation presented for each washing agent.

All the hand washing agents showed significant difference between treated and untreated hands (P < 0.05). Imperial leather gave the highest reduction of 87.76%, followed by carex 71.05% then Dettol 53.58%. Water gave the average lowest in colony forming unit reduction of 15.08%. The study concluded that washing hand with any of the household soap washing agents is more effective as hand hygiene than water alone but Imperial leather showed the highest reduction in hand flora with cloth towel as drying agent.

Keyword: hand washing, hand flora, cloth towel

Introduction

Normal hand flora and contamination have been implicated in many diseases thus causing major problem to the world for a long time until the discovery of antibiotics (penicillin) in 1940’s. This brought relief until the development of beta-lactamase resistance and eventually the Methicillin resistant Staphylococcus aureus (MRSA) termed ‘superbug’. Because of the morbidity and mortality associated with resistance to antibacterial agents, prevention is better than cure which is the best golden rule to MRSA. Several measures have been put in place to reduce or eliminate this menace of which effective hand washing and drying plays a key role.

Hands are major part of human being and involved in many processes including contamination. There are normal resident organisms called normal hand flora which the nose had been a major source (sneezing, breathing, prickling etc). The organisms found as normal flora of hand differs from individual to individual but staphylococcus species especially Staphylococcus aureus are the most identified and pathogenic of all. Because hands are used for many things, they are prone to transfer of organism(s) from one part of the body to the other and from one individual to the other.

Hand hygiene to prevent infection by hand flora had been a vital role of life since a long period. The infections by hand flora can occur in the community or health care centres. The infection acquired in health care are termed nosocomial. The nosocomial infections had been a major concern and about 10% of hospital inpatients are affected. The nosocomial infections can be exogenous (30%) or endogenous (70%). About 20,000 deaths that occur annually in UK were associated with nosocomial infection. This accounts for 4% of total death of which 1% is directly linked and 3% indirectly linked to nosocomial infections respectively. The average patient that developed nosocomial infection in surgical ward spent average of £4,000 for the treatment. It was estimated that nosocomial infections gulped 1 billion pound annually in United Kingdom.

The most worrisome of the nosocomial infections is
Methicillin resistant *Staphylococcus aureus* which arose as a result of antibiotic resistance of *staphylococcus aureus*. After the advent of antibiotics (penicillins) in 1940s, there had been occurrences of antibiotic resistance by organisms. Methicillin resistant *Staphylococcus aureus* is resistant to beta-lactamase antibiotics which include major penicillins and cephalosporins. MRSA can be health acquired (HA-MRSA) or community acquired (CA-MRSA). It was estimated that about 2 billion people are affected by *staphylococcus aureus* and about 59 million (3%) are carriers of MRSA out of which 85% are community acquired. Because of intracellular infectivity of *staphylococcus aureus*, some strains of MRSA are now resistant to intracellular acting drugs like Erythromycin and Ciprofloxacin. MRSA causes different infections from cellulitis to life threatening systemic diseases syndrome like toxic shock.

There are many hand washing agents. Water is the oldest of the washing agents and had been recognized in health care system before 1840 when health practitioners were encouraged to wash their hands after touching dead persons. However, water alone as a hand washing agent is not enough in infection control of many organisms led to the incorporation of soap into hand hygiene. Soap is made from salt of sodium (Na) and potassium (K) with stearic or fatty acids. It removes loose bacteria and has been less effective when compared with other agents like alcohol-propanol (60% v/v) log kill 4.6 while soap is log2.8.

Hand drying helps to make the care delivery to be comfortable especially it is easier to wear gloves with dry hands than wet thus wearing gloves with wet hand has been associated with high risk of skin allergic reactions to washing agents. Effective hand drying also reduces the hand bacterial load flora. The commonly adopted mode of hand drying in health care are: hand cloth or paper towels, air drying and automatic hand air drying machine. There are different variations of reduction in hand flora reduction.

**Materials**

**Nutrient agar** - Nutrient agar was used to for identification of flora in the hand through colony formation.

**Carex soap** - It contains saqua, sodium laureth sulphate, glicer, lauramidopropyl betaine, laureth-4, cocamidopropyl PG-Dimonomium chloride phosphate, polyquaternium-39, sodium lactate, parfum, Hexylene Glycol, sodium chloride, sodium benzoate, citric acid, laetic acid, sodium citrate, tetrasodium, EDTA sodium benzoate, methyl butylphenol sulphonate, but-3, tributyl citrate, methyparaben, propylparaben, citronellol, linoene, alpha-isomethyl ionone, Hexyl cinnamal, Butylphenyl, methylpropiol and linalool (Manufacturer’s declaration).

**Imperial leather soap** - contains sodiumtallowate, sodium palmate, sodium palm kernelate, aqua, glycerine, parfum, sodium chloride, coconut acid, tocopheryl acetate, hydrolysed milk protein, disodium phosphate, pentasodium pentate, tetrasodium edisolate, disodium distyrylphenyl disulphonate, BHT, Methylchloroisothiazolinone, methyl isothiazolinone, magnesium nitrate, magnesium chloride, butylphenyl methylpropiol, hexylnnual, linalo, geraniol, citronellol, linoene, alphaisomethyl ionone (Manufacturer’s declaration).

**Dettol soap** - Chloroxyleneol is the main antiseptic agent and accounts for 4.8% of the contents. Others are: isopropanol, castor oil soap, ceramal and water (Manufacturer’s declaration).

**Drying agent** - Cloth towel - This a rolling cloth made of cotton.

**Method**

The following steps were followed in carry out the study. 1. Swab from both nostrils was inoculated into both left and right hands (left as test and right as control respectively). 2. Sterile latex gloves were put on for one hour for the inoculums to be established on both left and right hands. 3. The left hand (test) glove was removed with the aid of forceps and the hand washed under running water alone or appropriate washing agent (Carex soap, Dettol soap and Imperial leather soap) for 60s. 4. The washed hand (left) was dried using rolling cloth towel which serves as drying agent for 25s. 5. Thenafter, the right hand (control) glove was removed with forceps but neither washed nor dried. 6. Both left (washed and dried) and right (neither washed nor dried) hands (test and control respectively) were placed on nutrient agar plate and was incubated at 37°C for 24 hours. 7. The colonies formed were identified and counted manually as colony forming unit. The finger colonies were counted separately.

The procedure was repeated three times for each washing agent (water alone, Carex soap, Dettol soap and Imperial leather soap) and average with standard deviation recorded.

**Result**

The result of colony forming unit was tabulated below for each hand washing agent in Table I.

<table>
<thead>
<tr>
<th>Total</th>
<th>Colony forming units on finger + colony forming units on palm + finger tips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Percent change in finger</td>
<td>Percent change in palm</td>
</tr>
</tbody>
</table>

The percentage change in finger, palm and total were calculated as follows:

Percent change in finger = untreated finger – treated finger tips colony forming units/untreated + treated
Table I showing the colony forming units of hand washing agents with % reduction with average and standard deviation

<table>
<thead>
<tr>
<th>Washing Agent</th>
<th>UNTREATED HAND</th>
<th>TREATED HAND</th>
<th>% change colony</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Finger</td>
<td>Palm</td>
<td>Total</td>
</tr>
<tr>
<td>Water</td>
<td>212±56</td>
<td>650±99</td>
<td>862±108</td>
</tr>
<tr>
<td>Carex</td>
<td>149±34</td>
<td>856±125</td>
<td>1005±345</td>
</tr>
<tr>
<td>Dettol</td>
<td>239±79</td>
<td>487±101</td>
<td>726±134</td>
</tr>
<tr>
<td>Imperial</td>
<td>250±56</td>
<td>1082±234</td>
<td>1332±345</td>
</tr>
</tbody>
</table>

Percentage change in palm = untreated palm and fingers- treated palm and fingern colony forming units/untreated + treated palm and fingern colonies x 100

Percentage change in total colony forming units = 100 - (treated total/total untreated x 100)

Table I showed the result of colony forming units in untreated (right) hand (i.e control) and treated (left) hand (i.e test). It is obvious that the entire colony forming units in test (treated hand) is lesser than control (untreated) hand in all the washing agents. However, water showed the least in reduction in colony forming units while imperial leather soap showed the highest reduction.

Discussion

This study simulated the normal way of contamination at home and health care centres. Nose has been the major source of hand flora. The contamination procedure which occurs by contact from nose as primary source to hand through aerosol, e.g. sneezing or nose pricking gave direct inoculation like nose swab. This led to the used of common hand washing agents in community and hospitals. The hand washing is usually combined with hand drying for the effectiveness and comfortability - wet hand appeared not comfortable for working.

Water is the most common and available of the hand washing agents. Likewise, soaps (carex, dettol and Imperial leather) are common washing agents at both phases: health and community. However, carex soap is widely available at home in some countries but are out of reach of common man in third world countries as household washing agents but Imperial leather and dettol are generally available in all households and health centres as hand washing agent. There are many hand drying agents in use. Towel is available generally as drying agent at home and hospital including the developing countries. The incorporation of the clean rolling cotton towel in this study gave an indication of the effectiveness of major hand drying agent acceptable and available to all.

From the above result, it was evident that water removed only small percentage of the hand flora which accounted for 15.08%. However, the presence of the chemical agents in soap showed the efficacy in removing organisms and dirt. The difference in chemical composition of soap determines the efficacy. Imperial leather showed highest number of colonies of organism removal from the hand in this study. The lower percentage colony change in Dettol soap compared with carex and imperial leather could be attributed to its oily constituents as shown in manufacturer’s declaration and evidenced in the result above.

The effective hand washing agent should be able to remove both the transient and resident flora of the hand. Hand drying agents apart from removing moisture also removed or killed organisms. It was concluded in earlier study that hand drying agent removed bacteria if the procedure is properly done. Water can reduce the hand flora but may not be able to remove the most adherent organisms like staphylococcus species as seen in the result above. Water does not have any chemical constituents that can kill bacteria organisms but may act by reducing the attachment of organisms to each other. This may be the advantage for the drying agent to act. Towels act as drying agent by absorbing moisture and remove the loosely transient flora by physical activities—mechanical abrasion. This might accounted for the significant percentage change in colony of the hand washed with water and dried with cloth towel and untreated hand in the above result.

From this study result above, it was found that there was no significant difference between the colony forming units of the finger tips and palm (>0.05), which is in contrary to the early documentation by some researchers. This might be due to direct inoculation of nasal swab thus inadequate spreading of the inoculums to the finger tips. It was observed in earlier study that the finger tips harbour more organisms than palm.

The presence of microorganisms in the skin and their potential threats to infection was enumerated in many studies. Thus the significant reduction in bacterial load of hand flora with hand hygiene using any of the house-hold hand washing agents and cloth towel as drying agent will reduce spread of microorganisms. This was evidenced by significance...
difference of P<0.05 was observed for treated and untreated finger tips, palm and total in the colony forming units in the result of this study. However, the presence of antibiotic agents in soap showed drastic reduction in bacterial load when used with cloth towel.

Conclusion
This study concluded that hand washing with any of the house - hold agents (water, Dettol, carex or imperial leather soap) and drying with cloth towel improved hand hygiene significantly thus reducing the spread of micro - organisms that could lead to infection.

References