

# Practicing Prevention: Handwashing

R. A. Chotani ( Departments of Emergency Medicine and International Health, Schools of Medicine and Public Health, New York, USA. )

A. Shaukat ( Departments of Emergency, John Hopkins University, Baltimore and State University, New York at Buffalo, New York, USA. )

One hundred fifty-two years ago, Ignaz Semmelweis (1818-1865) introduced the concept of person-to-person transmission of microbes and the role of handwashing prior to examining patients by medical staff, as a barrier to such transmission.<sup>1,2</sup> Since then, it has been shown to be among the most important measures for preventing and controlling nosocomial infection<sup>3-11</sup>. Several articles in literature give ample evidence on multiple aspects of handwashing, such as health care worker (HCW) hands acting as vectors and transmitting pathogens from patient to patient, rates of nosocomial infection proportional to the lack of handwashing practices, review of handwashing techniques and materials used and suggestions on how the situations can be addressed and improved. This paper seeks to cover some of the salient points from several studies highlighting important issues linked with handwashing and its relationship to nosocomial infections with a special focus on the situation in Pakistan, an underdeveloped South-East Asian country of a population of about 135 million, which like most developing and under-developed countries sadly lacks the awareness of this issue.

## Historical Background

Historically the idea of handwashing has been handed down as a means for not only removing dirt, but also to symbolically protect people from physical and moral evils such as illness and sin. Once medicine began to adopt scientific ways of thinking, the idea to the role of hands in transmission of infectious diseases took its roots. Hands were recognized as transmitters of disease even at a time when microorganisms were not yet recognized as a source of infection. The first formal evidence however is the work of a Hungarian obstetrician Ignaz Semmelweis who made his analytical observations on the horrifying spread of puerperal fever that caused maternal mortality rates of up to 18% in some months at a Vienna Lying-in hospital in 1846<sup>2,12,13</sup>. Semmelweis applied epidemiological rather than microbiological methods to test the hypothesis and proved that preventing hands from introducing something fatal into the maternal birth canal during vaginal examination would also end the hyperendemic situation of puerperal fever in his hospital. A little later, Joseph Lister a Scottish surgeon, in 1860s tested and proved Louis Pasteur's hypothesis that microorganisms not only cause fermentation and putrefaction but may also initiate suppuration on living tissues<sup>14</sup>. By inactivating and keeping the causative organisms away from the surgical sites, he prevented postoperative infection. Among other vehicles and sources, he also recognized the importance of hands of the surgical team as carriers<sup>14</sup>. Between 1867 and 1881, he published 80 papers which coined the terms "Listerism" and "antisepsis". In the proceeding months, many authors attributed a dramatic reduction in post-surgical mortality to the development of antisepsis. Gakabin, between 1885-1890 demonstrated a decrease in rates of septic fever from 40% to 2.5% respectively, and attributed this to the introduction of antiseptic handwashing<sup>15</sup>. In the US, in 1898, Shoemaker also reported a steady decline in mortality due to puerperal fever<sup>16</sup>.

In the 1950s and 1960s antimicrobial agents were added to commercial hand and bath soaps. Their purpose was to inhibit odor-causing microorganisms on the skin<sup>17</sup>. A study by Larson examined 423 published articles specifically related to handwashing from 1879 to 1986 and demonstrated very elegantly the evidence of the causal link between handwashing and risk of infection<sup>18</sup>.

Table 1. Prospective studies of the influence of handwashing on infection.

Year published	Investigator	Setting	Results
1861	Semmelweis	Maternity Hospital, Vienna	Reduced mortality from puerperal fever
1977	Casewell	Critical care unit (U.K.)	Reduced nosocomial infection rates due to endemic klebsiella strains
1981	Black	Day care centers (U.S.)	Reduced incidence of diarrhea
1982	Khan	Village (Bangladesh)	Reduced incidence of Shigellosis
1982	Maki	Critical care unit (U.S.)	Reduced incidence of nosocomial infection
1984	Massanari	Critical care unit (U.S.)	Reduced incidence of nosocomial infection
Unpublished	Shahid	Village (Bangladesh)	Reduced incidence of diarrhea

Table 1 summarizes some of the studies and their respective findings.

### Pathogenesis

For simplicity purposes, three groups of microorganisms may be distinguished on the skin: organisms that reside on the skin or “resident flora”, those that happen to be there as contaminants or “transient flora” and pathogens that actually cause infections on the hands, which may be called “infectious flora”<sup>19</sup>. The resident flora reside mainly on the uppermost part of the stratum corneum, on corneocytes and is embedded in a mass of lipids and cell detritus of the pars disjuncta. They multiply in the upper regions of the hair follicle. The composition of the skin flora varies considerably with age, body site, sex, health condition, hospitalization and season. Except regions with large numbers of sebaceous glands where prionibacteria prevail, the main portion of the skin is made up of micrococcaceae, such as staphylococcal species (*S. epidermidis*., *S. hominis*, *S. capitis*, etc.) and micrococci. Although the ecological niche for *S. aureus* is the flares, it may temporarily colonize the skin, especially the perineal region, as well as the hands, face and neck. This happens often with children but HCW are more prone to it. Larson and colleagues reported the prevalence of colonization by *S. aureus* in HCW to be around 18% and Hofmann et al. demonstrated that 18.4% of the nurses and 36% of doctor’s hands were colonized by *S. aureus*<sup>20,1</sup>. Gram negative bacteria, such as *Acinetobacter* and *Enterobacter* spp. may be isolated mainly from moist skin areas and hands where they may be regarded as residents. Larson found 21% of hospital personnel persistently carried *Acinetobacter* and *KiebsiellaEnterobacter* group<sup>22</sup>. Male HCW compared to female HOW were more often carriers and washing hands less than 8 times per day was found to be a significant risk in terms of becoming a carrier.

The normal skin flora acts as a barrier and resists colonization by pathogenic microorganisms and unless introduced into body tissue by trauma or together with foreign bodies such as catheters or implants, their pathogenic potential is low. It is difficult to reduce resident flora by mechanical means as handwashing by soap and water only diminishes the release of skin bacteria every 5 minutes by only 50%<sup>23</sup>.

Transient flora is characterized by its inability to multiply on the skin and occurs as skin contaminants. Among transient flora, microorganisms with high pathogenic potential may also be found but usually do not survive for very long. Moreover, in contrast to resident flora, transient flora is removed rather easily by mechanical means such as handwashing. Just rubbing hands with water alone has shown to be effective and washing hands for 1 minute with soap and water has been demonstrated to reduce the bacterial release by two or three orders of magnitude<sup>24-26</sup>.

The third group referred to as infectious flora is associated with abscesses, paronychia, or infected eczema on the hands. The etiological agents are proven pathogens and the species most often

encountered are *S. aureus* and group B-hemolytic streptococci<sup>27</sup>.

### **Epidemiology**

Nosocomial infections result in substantial morbidity and are estimated to contribute to 80,000 deaths annually in the United States<sup>28</sup>. Evaluating the independent effects of handwashing alone is difficult because handwashing is one of the myriad practices that form the armamentarium of strategies to prevent the transmission of infection. However, several studies have shown an association, if not a causal link between handwashing and the rate and transmission of nosocomial infections. In a review done by Bryan and colleagues, 13 non-experimental studies between 1986 and 1995 established the link between handwashing and infection<sup>29</sup>. In two case-control studies conducted in rural Bangladesh and Senegal the incidence of neonatal tetanus was linked to the contaminated hands of the birth attendants<sup>30,31</sup>. In the Bangladesh study, the birth attendant washing hands and using a cleaned cord-cutting tool reduced the risk of neonatal tetanus. In Senegal, failure to wash hands with soap and water before cutting cord was associated significantly and independently with higher risk of neonatal tetanus (OR 5.22; p=0.0001). Rubio studied 3480 surgical cases over an 8-year period; his surgical team used an agent containing 0.23% hexachlorophene in a 46% ethyl alcohol base, the rate of postoperative infection was only 0.3%<sup>32</sup>. In an outbreak of Hepatitis A virus among neonatal intensive care unit staff, reviewing records and administering a questionnaire to the staff, ascertained infant-to-staff transmission. Among the staff exposed to the index infant, HAV occurred in 8 (57.1%) of the 14 NICU staff members. The risk of illness was greater for staff that did not routinely wash their hands after treating index infants (RR 4.9; p=0.02)<sup>33</sup>. Ehrenkranz and staff conducted a case-control study to determine the cause of an excess frequency of deep sternal wound infections. The rate in hospital A and B were 4% and 0.48% respectively. The same surgeons served the two hospitals over the same period of time. Inspection of the two hospitals showed important differences in handwashing sink locations, use of antimicrobial soap and isolation practices. Over the next 9 months, interventions were implemented which included enforcement of handwashing, use of alcohol antiseptics by the surgical ICU personnel before manipulation of catheters and other infection control practices. Results showed that post intervention rates of deep sternal wound infections were equally low at both the hospitals. The authors attributed this result to improved infection control practices, especially handwashing<sup>34</sup>. Until now we have been broadly using the term 'healthcare workers'. The frequency of handwashing varies between different categories of HCW. A one-year prospective study in a pediatric ICU to determine whether the rate of breaks in handwashing was different between medical professional found that physicians did not wash their hands in 79%, nurses 63%, occupational therapists 62%, respirator therapists 78% and radiology technicians 78% of the time after contact with a patient. Nurses used notably better techniques than physicians. Also, gown usage did not affect the overall breaks in handwashing. This study demonstrated how handwashing continues to be a neglected method of disrupting nosocomial transmission<sup>35</sup>.

### **Strategies of Hand Hygiene**

Strategies for prevention of hand associated microbial transfer must take into consideration that it is easier to reduce the release of transient flora from the hands than resident flora and infectious lesions must heal before hands are regarded safe. If contamination is expected, the strategy to keep hands clean is much easier than to make them clean. If used intelligently, the no-touch technique (use instruments only) and protective gloves are suitable remedies, provided they are discarded after use. Unfortunately this might not be a practical undertaking.

If hands are known to be or suspected of being contaminated, the undesired microflora must be eliminated to render the hands safe for the next patient. Washing or disinfecting the hands may achieve this. Furthermore, in contrast to ordinary handwashing, post-contamination treatment of hands involves the application of antimicrobial preparations. Different methods of rendering hands clean are discussed

below.

### **Type of Handwashing Agent**

For ideal post-contamination treatment, the detergent and technique used should be safe and effective. “Effective” refers to efficiently reducing the release of transient flora and “safe” means that treatment should not disseminate pathogens to be eliminated onto other sites. Often, the choice is made, not for any specific reason but for practical purposes, such as availability, cost and the simplicity of their application<sup>36</sup>. Moreover, the antimicrobial spectrum necessary for hygienic hand rubs depends on intended use. Commonly, the antimicrobial spectrum required includes bacterial and fungal pathogens. There is no need for sporicidal activity in hand disinfectants. Activity against mycobacterium is required while dealing with immunocompromised patients, such as those with tuberculosis, AIDS, transplanted and on chemotherapy.

In theory, possible agents for hand rubs are alcohol, used alone or mixed with other antiseptics; aqueous solutions containing halogens such as chlorine or iodine; chlorhexidine; quaternary ammonium compounds; phenolics; triclosan; aldehydes; metal lo-organic compounds and oxidizing agents such as peracetic acid. There is no doubt that alcohols are much more comfortable to rub onto skin than aqueous solutions because of specific features such as excellent spreading and quick evaporation.

Agents most commonly employed today for general antibacterial efficacy<sup>37,38</sup> are summarized in Table 2.

**Table 2. Hygienic handwash: efficacy of various antiseptic detergents in reducing the release of test bacteria from artificially contaminated hands.**

Detergent	Concentration (%)	Mean log reduction
Povidine-iodine	0.75	3.5
Chlorhexidine gluconate	4.0	3.1
Triclosan	0.1	2.8
2-Biphenylol	2.0	2.6
Octenidine	0.5	2.5
Soft Soap	20.0	2.7

Although not significant, chlorhexidine has shown to be better than soap. In a study by Wade et al, an outbreak strain of enterococcus faecium bearing plasmid mediated vancomycin resistance, and an epidemic multi drug resistant strain of Enterobacter cloacea were inoculated on fingertips of three volunteers and tested with different handwashing agents. Hand disinfection with 60% isopropyl alcohol or with alcoholic chlorhexidine was found to be most effective, giving a 4-log<sub>10</sub> reduction of both test organisms followed by chlorhexidine digluconate and povidine-iodine solutions<sup>39</sup>. This study demonstrates that alcoholic hand rubs are, at present, the most effective measure to quickly reduce the release of transient flora from the hands. Washing hands with ordinary soap and water was the least reliable method.

### **Technique**

The efficacy of the handwashing depends on the time taken and the technique used. Unfortunately, this period is too short in normal hospital setting. The average duration reported by several authors to be

between 8 and 20 seconds, whereas experiments show that the greatest reduction is achieved in the first 30 seconds<sup>20,40</sup>, as shown in Table 3.

**Table 3. Reduction of the release of test bacteria from artificially contaminated hands by washing with soap and water.**

Duration	Mean Log <sup>10</sup> reduction
15 seconds	0.6-1.1
30 seconds	1.8
	2.3-2.5
	2.5-2.8
1 minute	2.7
2 minutes	3.0
	3.3
4 minutes	3.7

**Table 4. Handwashing recommendations.**

---

**Handwashing should take place:**

1. When coming on duty
  2. Before all patient contact
  3. Before doing invasive procedures
  4. Before taking care of a particularly susceptible patient, e.g. immunocompromised
  5. Before and after touching wound
  6. After removal of gloves
  7. After contact with blood, mucus membranes or body fluids, secretions or excretions
  8. After touching inanimate sources likely to be contaminated, e.g. urine measuring devices
  9. After taking care of an infected patient or one who is likely to be colonized with micro organisms of special clinical or epidemiological significance, e.g. MRSA or VRE
  10. Before eating
  11. Before medication preparation
  12. After personal use of toilet
  13. When hands are soiled, including after sneezing, coughing or blowing of nose
- 

Extending it to 1 minute further reduces the release of bacteria from hand. Hands should be first properly soaked with water and then soap or disinfectant applied which should be rubbed properly and evenly on both hand surfaces followed by proper rinsing and drying to get the best results.

## **Discussion**

### **Corn pliance**

In spite of the emphasis on the importance of handwashing, compliance with the practice remains low. In 1980s, the U.S. Centers for Disease Control published guidelines that included recommendations on handwashing, which are seldom followed in practice. Educational programs and persuasion have not shown to lead to sustained improvement<sup>41</sup>. Physicians have been particularly refractory. In a recent observational study, 230 staff-resident interactions were recorded and evaluated for compliance with handwashing recommendations. Results showed that hands were washed when needed before an interaction in 27%, during an interaction in 0% and after an interaction in 63%. Gloves were worn in 82% interactions where indicated and changed appropriately in 16% of the interactions<sup>42</sup>. Attempts to improve compliance, e.g., by in-service education, distribution of leaflets, lectures, automated

dispensers and feedback on handwashing rates have been associated at best with transient improvement<sup>43-45</sup>. The most effective measure has been routine observation and feedback, but no intervention has had a long-term impact on handwashing practice. Reasons for the poor compliance have been excuses such as being too busy, skin irritation, wearing gloves, or not thinking about it<sup>43</sup>. Experts in infection continue to cajole, plead and threaten, but their colleagues still neglect to wash their hands. Multi-resistant pathogens are increasing in frequency and are now a threat to public health. These organisms have been isolated from the environment around the infected patient and from the hands of health care personnel looking after them.

### **Handwashing Facilities**

Kesavan and colleagues in an elegant study looked at the adequacy of handwashing facilities on elderly care wards in seven hospitals of UK. They found 10.9% of the sinks were inaccessible, 12% of sinks did not have any cleansing agent, and 9.3% of ward sinks and 79% of treatment room sinks did not have any antiseptic solution. These results show the inadequacy of the facilities and the need to develop a standard checklist for hospital sinks<sup>46</sup>.

### **Recommendations**

It is essential that all hospitals be aware of handwashing recommendations listed in Table 4 and develop a standardized checklist for each ward, unit or facility in their hospital, such as the one presented in Table 5.

**Table 5. Standards for handwashing facilities on hospital wards.**

1. Handwashing facilities should be conveniently placed throughout the hospital. A sink should be placed in or just outside every patient's room. More than one sink may be necessary if a large room is used for several patients.
2. There should be suitable cleansing agent in every sink.
3. Taps should be elbow operated to prevent recontamination during or after handwashing.
4. Paper towels should be provided for hand drying being more effective than electric hand-dryers.
5. There should be adequate facilities of disposal of used paper towels without recontamination of hands.

Other solutions to the problem include education in the form of "performance feedback", as suggested by Tibballs<sup>47</sup>. In this study 939 patients contacts were observed. After overt observation, the rates of handwashing before patient encounter rose from 12.4% to 32.7% and after patient encounter rose from 10.6% to 33.3%. These rates increased further to 68.3% and 64.8% during the period of performance feedback. The residual rate seven weeks after cessation of the program were 54.6% before and 54.9% after patient encounter, showing the moderate effectiveness of this technique<sup>47</sup>.

After tolerating poor handwash-ing compliance for 150 years, it is time for hospitals and health care professionals to get serious about improving hand hygiene in hospitals. If this trend of non-compliance with handwashing practices does not change over the next few years, we could be considering teaching patients the importance of handwashing and the techniques, so that before or after a medical personnel

sees them, they ask them to wash their hands first!

### **Situation in Pakistan**

In terms of awareness, implementation and action on the message of Semmeiweis, Pakistan is several decades behind. There are several issues it faces. According to the World Development Report, in 1999, Pakistan had a total population of 134,790,000, with an average per capita yearly income equivalent to US\$470. In 1991, the infant mortality rate was 97 per 1,000 live births and roughly 57% of children under the age of 5 years were malnourished by World Health Organization (WHO) standards. With one of the highest growth rates in the world of around 3% per year, it is estimated that Pakistan's population by the year 2025 will be 244 million. The life expectancy at birth for both men and women was 59 years<sup>48</sup>.

Being a country with a GNP of around 67 billion dollars per year, between 1-2% of its GDP is spent on health. Perhaps the first and foremost issue is the allocation of funds for public health. The country is unable to provide enough hospitals and health care facilities to meet the need of its burgeoning population, let alone control the quality of the ones that exist. The significant cost of installing sinks, water supply, soap dispensers and paper towels does not make it a priority with decision makers in the face of other serious health care issues. Moreover, the feasibility of installing sinks is compromised in places where water supply is limited.

There seems to be a paradox review of medical literature shows that there is a dearth of research and data on issues of quality control and compliance with infectious disease guidelines in Pakistan, whereas several studies indirectly point towards the fact that infectious diseases are the major source of morbidity and mortality and need to be controlled through education, awareness and better practices and policies. In a literature search to identify the priority health problems in Pakistan, those with high disease burden and with cost effective interventions. Khan found the major causes of sickness to be communicable diseases (diarrhea, respiratory infections, malaria, tuberculosis) and pregnancy related problems<sup>49</sup>. Factors contributing to these were malnutrition, poor sanitation and water supply, low level of education and poverty. Maternal mortality remains high and its main cause is infection<sup>50</sup>. During a one-year review of 377 obstetric cases at the Jinnah Postgraduate Medical Center maternal morbidity was 4.4% of total deliveries and infections was its major attribute<sup>51</sup>. Another study reported maternal mortality ratio, combining data from different sites, to be 433 (range 281-673) per 100,000 live births, hemorrhage (52.9%) and puerperal sepsis (16.3%) were the leading causes<sup>52</sup>. Perinatal mortality in Pakistan is estimated to be between 60-90 per thousand births, virtually 60% of which occurs in the neonatal period, this is mainly attributed to inadequate attention to programs of maternal and newborn care<sup>53</sup>.

The health care practices in Pakistan need much revamping. Indeed, more money needs to be spent on public health. Still, research has demonstrated that even in environment lacking in general hygiene practices handwashing reduces infections and helps reduce nosocomial infections among the high-risk population, such as the critically ill and the neonates. Indeed, if one takes into account some of the direct and indirect costs associated with nosocomial infections, such as number and the cost of extra hospitalized days; cost of additional medications; number of patients requiring critical care; grave prognosis associated with prolonged hospital and critical care unit stay, dearth of critical care units, inability of the common man to afford stay in critical care and mortality from uncontrolled sepsis; even a token contribution from hand washing can have a tremendous impact in a country with limited resources like Pakistan.

The collective evidence of years of research has beyond doubt demonstrated a very strong association between handwashing and infections and evidence suggests a strong link between handwashing as the most important practice among all personal practices for a positive patient outcome. In terms of type of hand washing agents particularly in developing and under-developed countries, evidence suggests that handwashing using plain soap and an adequate volume of water reduces fecal-oral transmission in turn



reducing diarrheal disease mortality by 30-50%<sup>54-56</sup>.

In summary, as infectious diseases remain the major challenge particularly in developing countries such as Pakistan; implementation and compliance with infection control guidelines should be a high priority. When Semmelweis died clinicians disregarded his beliefs. We are still not wiser about infection. For the safety of patients as well as HCW it is pertinent that handwashing is practiced with rigor. Improved hygiene, including handwashing, is the main available mode of preventing spread of the disease. Handwashing is the simplest, most cost-effective and efficacious preventive measure that can make a significant difference against the challenge of infectious diseases faced by the country.

## **Discussion**

### **Compliance**

In spite of the emphasis on the importance of handwashing, compliance with the practice remains low. In 1980s, the U.S. Centers for Disease Control published guidelines that included recommendations on handwashing, which are seldom followed in practice. Educational programs and persuasion have not shown to lead to sustained improvement<sup>41</sup>. Physicians have been particularly refractory. In a recent observational study, 230 staff-resident interactions were recorded and evaluated for compliance with handwashing recommendations. Results showed that hands were washed when needed before an interaction in 27%, during an interaction in 0% and after an interaction in 63%. Gloves were worn in 82% interactions where indicated and changed appropriately in 16% of the interactions<sup>42</sup>. Attempts to improve compliance, e.g., by in-service education, distribution of leaflets, lectures, automated dispensers and feedback on handwashing rates have been associated at best with transient improvement<sup>43-45</sup>. The most effective measure has been routine observation and feedback, but no intervention has had a long-term impact on handwashing practice. Reasons for the poor compliance have been excuses such as being too busy, skin irritation, wearing gloves, or not thinking about it<sup>43</sup>. Experts in infection continue to cajole, plead and threaten, but their colleagues still neglect to wash their hands. Multi-resistant pathogens are increasing in frequency and are now a threat to public health. These organisms have been isolated from the environment around the infected patient and from the hands of health care personnel looking after them.

### **Handwashing Facilities**

Kesavan and colleagues in an elegant study looked at the adequacy of handwashing facilities on elderly care wards in seven hospitals of UK. They found 10.9% of the sinks were inaccessible, 12% of sinks did not have any cleansing agent, and 9.3% of ward sinks and 79% of treatment room sinks did not have any antiseptic solution. These results show the inadequacy of the facilities and the need to develop a standard checklist for hospital sinks<sup>46</sup>.

### **Recommendations**

It is essential that all hospitals be aware of handwashing recommendations listed in Table 4 and develop a standardized checklist for each ward, unit or facility in their hospital, such as the one presented in Table 5.

**Table 5. Standards for handwashing facilities on hospital wards.**

1. Handwashing facilities should be conveniently placed throughout the hospital. A sink should be placed in or just outside every patient's room. More than one sink may be necessary if a large room is used for several patients.
2. There should be suitable cleansing agent in every sink.
3. Taps should be elbow operated to prevent recontamination during or after handwashing.
4. Paper towels should be provided for hand drying being more effective than electric hand-dryers.
5. There should be adequate facilities of disposal of used paper towels without recontamination of hands.

Other solutions to the problem include education in the form of “performance feedback”, as suggested by Tibballs<sup>47</sup>. In this study 939 patients contacts were observed. After overt observation, the rates of handwashing before patient encounter rose from 12.4% to 32.7% and after patient encounter rose from 10.6% to 33.3%. These rates increased further to 68.3% and 64.8% during the period of performance feedback. The residual rate seven weeks after cessation of the program were 54.6% before and 54.9% after patient encounter, showing the moderate effectiveness of this technique<sup>47</sup>.

After tolerating poor handwashing compliance for 150 years, it is time for hospitals and health care professionals to get serious about improving hand hygiene in hospitals. If this trend of non-compliance with handwashing practices does not change over the next few years, we could be considering teaching patients the importance of handwashing and the techniques, so that before or after a medical personnel sees them, they ask them to wash their hands first!

#### **Situation in Pakistan**

In terms of awareness, implementation and action on the message of Semmeiweis, Pakistan is several decades behind. There are several issues it faces. According to the World Development Report, in 1999, Pakistan had a total population of 134,790,000, with an average per capita yearly income equivalent to US\$470. In 1991, the infant mortality rate was 97 per 1,000 live births and roughly 57% of children under the age of 5 years were malnourished by World Health Organization (WHO) standards. With one of the highest growth rates in the world of around 3% per year, it is estimated that Pakistan's population by the year 2025 will be 244 million. The life expectancy at birth for both men and women was 59 years<sup>48</sup>.

Being a country with a GNP of around 67 billion dollars per year, between 1-2% of its GDP is spent on health. Perhaps the first and foremost issue is the allocation of funds for public health. The country is unable to provide enough hospitals and health care facilities to meet the need of its burgeoning population, let alone control the quality of the ones that exist. The significant cost of installing sinks, water supply, soap dispensers and paper towels does not make it a priority with decision makers in the face of other serious health care issues. Moreover, the feasibility of installing sinks is compromised in places where water supply is limited.

There seems to be a paradox review of medical literature shows that there is a dearth of research and

data on issues of quality control and compliance with infectious disease guidelines in Pakistan, whereas several studies indirectly point towards the fact that infectious diseases are the major source of morbidity and mortality and need to be controlled through education, awareness and better practices and policies. In a literature search to identify the priority health problems in Pakistan, those with high disease burden and with cost effective interventions. Khan found the major causes of sickness to be communicable diseases (diarrhea, respiratory infections, malaria, tuberculosis) and pregnancy related problems<sup>49</sup>. Factors contributing to these were malnutrition, poor sanitation and water supply, low level of education and poverty. Maternal mortality remains high and its main cause is infection<sup>50</sup>. During a one-year review of 377 obstetric cases at the Jinnah Postgraduate Medical Center maternal morbidity was 4.4% of total deliveries and infections was its major attribute<sup>51</sup>. Another study reported maternal mortality ratio, combining data from different sites, to be 433 (range 281-673) per 100,000 live births, hemorrhage (52.9%) and puerperal sepsis (16.3%) were the leading causes<sup>52</sup>. Perinatal mortality in Pakistan is estimated to be between 60-90 per thousand births, virtually 60% of which occurs in the neonatal period, this is mainly attributed to inadequate attention to programs of maternal and newborn care<sup>53</sup>.

The health care practices in Pakistan need much revamping. Indeed, more money needs to be spent on public health. Still, research has demonstrated that even in environment lacking in general hygiene practices handwashing reduces infections and helps reduce nosocomial infections among the high-risk population, such as the critically ill and the neonates. Indeed, if one takes into account some of the direct and indirect costs associated with nosocomial infections, such as number and the cost of extra hospitalized days; cost of additional medications; number of patients requiring critical care; grave prognosis associated with prolonged hospital and critical care unit stay, dearth of critical care units, inability of the common man to afford stay in critical care and mortality from uncontrolled sepsis; even a token contribution from hand washing can have a tremendous impact in a country with limited resources like Pakistan.

The collective evidence of years of research has beyond doubt demonstrated a very strong association between handwashing and infections and evidence suggests a strong link between handwashing as the most important practice among all personal practices for a positive patient outcome. In terms of type of hand washing agents particularly in developing and under-developed countries, evidence suggests that handwashing using plain soap and an adequate volume of water reduces fecal-oral transmission in turn reducing diarrheal disease mortality by 30-50%<sup>54-56</sup>.

In summary, as infectious diseases remain the major challenge particularly in developing countries such as Pakistan; implementation and compliance with infection control guidelines should be a high priority. When Semmelweis died clinicians disregarded his beliefs. We are still not wiser about infection. For the safety of patients as well as HCW it is pertinent that handwashing is practiced with rigor. Improved hygiene, including handwashing, is the main available mode of preventing spread of the disease. Handwashing is the simplest, most cost-effective and efficacious preventive measure that can make a significant difference against the challenge of infectious diseases faced by the country.

## References

1. Weisse ER. Semmelweis. *Ann. Med. Hist.*, 1930;2:80-8.
2. Herdgen R, Semmelweis IP. A biographical sketch. *Am. J. Obstet.*, 1885;18:218-55.
3. Daschner FD. Useful and useless hygienic techniques in intensive care units. *Intensive Care Med.*, 1985;11:280-83.
4. Davies PA. Please wash your hands. *Arch. Dis. Child.*, 1982;57:647-8.
5. Steere AC, Mallison GF. Handwashing practices for the prevention of nosocomial infections. *Ann.*

- Intern.Med. 1975 ;83 :683-90.
- 6.Lilly HA, Lowbury EJL. Transient skin flora. *J.Clin.Pathol.*,1978;31:919-22.
  - 7.Larson E. Factors influencing handwashing behaviour of patient care personnel. *Am J.Infect.Control*, 1982;10:93-99.
  - 8.Gamer IS, Favero MS. Guideline for handwashing and hospital environmental control. Atlanta: Centers for Disease Control, 1985.
  - 9.Ayleff GAJ. Nosocomial infections - the irreducible minimum. *Infect.Control*, 1986;7:92-95.
  - 10.Larson EL, Early E, Cloonan P, et al. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. *Behav. Med.*, 2000;26:14-22.
  - 11.Bucher A. Hand hygiene - is hand disinfection the best solution? *Tidsskr Nor Laegeforen*, 2000; 120:472-75.
  - 12.Chotani RA, Roghmann MC, Perl T. Nosocomial infections. In: NW Graham (eds). *Infectious disease epidemiology: theory and practice*. Gaithersburg: Maryland. Aspen Publishers Inc., 2000, pp. 357-408.
  - 13.Semmelewis IP. The etiology, the concept and the prophylaxis of childbed fever. Pest WU, Leipzig. CA. Hartleben, 1861 (reprinted in translation by Murphy FP). *Med.Classics*, 1981 ;5:334-773.
  - 14.Lister J. On the effects of the antiseptic system of treatment upon the salubrity of a surgical hospital. *Lancet*, 1870;1:40; In vol. 2 *Collected Papers*, Oxford, 1909; republished, *Classics of Medicine Library*, Birmingham, 1979.
  - 15.Galain AI. The prevention and treatment of puerperal septicemia. *Clin.J.*, 1897;11:49-57.
  - 16.Shoemaker GE. The prevalence and the prevention of puerperal infection in private practice. *Therap. Gaz.*, 1898;22:809-13.
  - 17.Traub FF. The value of a new compound used in soap to reduce the bacterial flora of the human skin. *Surg. Gynaecol. Obstet.*, 1944;79:205-7.
  - 18.Laron E. A casual link between handwashing and risk of infection? Examination of the evidence. *Infect. Control*, 1988;9:28-36.
  - 19.Price PB. The bacteriology of normal skin: a new quantitative test applied to a study of the bacterial flora and the disinfectant action of mechanical cleansing. *J.Infect.Dis.*,1938;63:301-18.
  - 20.Larson E, McGinley KJ, Grove GL, et al. Physiologic microbiologic and seasonal effects of handwashing on the skin of health care personnel. *Am.J.Infect. Control*, 1986;14:51-59.
  - 21.Hoffmann E, Mlangeni D, Grundmann Hi, et al. Das Problem der infektiösen Enteritiden als Aufgabe für Klinikhygieniker und Betriebsarzt. In: Hoffman E (ed). *Infektiologie*. Landsberg: Ecomed Verlags gesmbH, 1991, pp. 20-25,
  - 22.Larson E. Persistent carriage of gram-negative bacteria on hands. *M.J.Infect.Control*, 1981 ;9: 112-19.
  - 23.Larson EL, Butz AM, Gullette DL, et al. Alcohol for surgical scrubbing? *Infect. Control Hosp. Epidemiol.*, 1990;11:139-43.
  - 24.Marples RR Towers AG. A laboratory model for the investigation of contact transfer of micro-organisms. *J.Hyg.*, 1979;82:237-48.
  - 25.Mittermayer H, Rotter M. Comparative investigations on the efficacy of tap water, some detergents and ethanol on the transient flora of the hands. *Zentralbl Bakteriol*
  - 26.Ayliffe GA, Babb JR, Quoraishi AH. A test for hygienic hand disinfection. *J. Clin.Pathol.*, 1978;31 : 923-28.
  - 27.Rotter ML. Handwashing and hand disinfection. In: Mayhall GC (ed). *Hospital epidemiology and infection control* (5th ed.). Baltimore: Williams and Wilkins, 1966, pp. 1052-68.
  - 28.Jarvis WR. Selected aspects of the socioeconomic impact of nosocomial infections: morbidity, mortality, cost and prevention. *Infect.Control Hosp. Epidemiol.*, 1996;17:552-57.
  - 29.Bryan JL, Cohran J, Larson EL. Handwashing: a ritual revisited, *Crit. Care Nurs. Clin. North Am.*, 1995;7:617-25.

30. Hlady WG, Bennett JV, Samadi AR, et al. Neonatal tetanus in rural Bangladesh: risk factors and toxoid efficacy. *Am.J. Public Health*, 1992;82: 1365-69.
31. Leroy O, Garenne M. Risk factors of neonatal tetanus in Senegal. *Int.J.Epidemiol.*, 1991 ;20:52 1-26.
32. Rubio PA. Septisol antiseptic foam: a sensible alternative to the conventional surgical scrub, *Int. Surg.*, 1987;72:243-46.
33. Watson JC, Fleming DW, Borella AJ et al. Vertical transmission of hepatitis A resulting in a outbreak in a neonatal intensive care unit. *J.Infect.Dis.*,1993;167:567-71.
34. Ehrenkranz NJ, Pfaff SJ. Mediastinitis complicating cardiac operations: evidence of postoperative causation. *Rev.Infect.Dis.*,1 991; 13:803-14.
35. Donowitz LG. Handwashing technique in a pediatric intensive care unit. *Am.J.Dis.Child.*, 1987; 141:683-85.
36. Meers PD, Yeo GA. Shedding of bacteria and skin squames after handwashing. *J. Hyg.*,1978;81 :99-105.
37. Rotter ML. An European test for the evaluation of the efficacy of procedures of the antiseptic handwash. *Hyg.Med.*, 1991 ;4- 12.
38. European Committee for standardization (CEN): Hygienic handwash, PrEN 1499, CEN/TC 216: Chemical disinfectants and antiseptics. Brussels: European Committee for Standardization, 1993.
39. Wade JJ, Desai N, Casewell MW. Hygienic hand disinfection for the removal of epidemic vancomycin-resistant enterococcus faecium and gentamycin-resistant enterobacter cloacae. *J. Hosp.Infect.*,1 991; 18:211-18.
40. Taylor LS. An evaluation of handwashing techniques. *Nurs. Times*, 1978;7:54-55.
41. Conly JM, Hill S, Ross J, et al. Handwashing practices in an intensive care unit: the effects of an educational program and its relationship to infection rates. *Am .J.Infect Control*, 1989; 17:330-39.
42. Thompson BL, Dwyer DM, Usseyi XT, et al. Handwashing and glove use in along term care facility. *Infect. Control Hosp. Epidemiol.*, 1997;18:97-103.
43. Graham M. Frequency and duration of handwashing in an intensive care unit. *Am.J,Infect. Control*, 1990; 18:78-81.
44. Dubbert PM, Dolce J, Richter W, et al. Increasing ICU staff handwashing: effects of education and group feedback. *Infect. Control Hosp. Epidemiol.*, 1990;11:191-93.
45. Simmons B, Bryant J, Neiman K, et al. The role of handwashing in prevention of endemic intensive care unit infections. *Infect. Control Hosp. Epidemiol.*, 1990;1 :589-94.
46. Kesavan S, Barodawala S, Mulley GP. Now wash your hands? A survey of hospital handwashing facilities. *J.Hosp.Infect.*,1998;40:29 1-93.
47. Tiballs J. Teaching hospital medical staff to handwash. *Med.J.Aust.*, 1 996;1 64:395-98.
48. World Development Report 1993. Investing in Health, World Development Indicators. New York, Oxford University Press, 1993, p. 288.
49. Khan KS. Setting health care priorities in Pakistan. *J.Pak.Med. Assoc.*, I 995;45:222-27.
50. Midhet F, Becker S, Berendes HW. Contextual determinants of maternal mortality in rural Pakistan. *Soc.Sci.Med.*, 1998;46:1587-98.
51. Hassan Ti, Baqai R, Jafarey SN, et al. Maternal morbidity in the Department of Obstetrics and Gynaecology, Jinnah Postgraduate Medical Centre, Karachi. *J.Pak.Med.Assoc.*,1991;41:223-25.
52. Fikree FF, Midhet F, Sadruddin S, et al. Maternal mortality in different Pakistani sites: ratio, clinical causes and determinants. *Acta.Obstet.Gynecol. Scand.*, 1997;76:637-45.
53. Bhutta ZA, Rehman S. Perinatal care in Pakistan: a situational analysis. *J. Perinatol.*, 1997;1 7:54-59.
54. Khan MU. Interruption of shigellosis by handwashing. *Trans. R. Soc. Trop. Med. Hyg.*,1982;76:164-68.
55. Clemens JD, Stanton BF. An educational intervention for altering water sanitation behaviours to reduce childhood diarrhea in urban Bangladesh. I. Application of the case-control method for

development of an intervention. *Am.J. Epidemiol.*, 1987;1 25:284-91.

56.Black RE, Dykes AC, Anderson KE, et al. Handwashing to prevent diarrhea in day-care centres. *Am.J. Epidemiol.* 1981;1 13:445-51.