Alcohol Sanitizers and Their Effect on Viruses
Didier Pittet, MD, MS,
Professor of Medicine
Chair, Infection Control Program
University of Geneva Hospitals - Switzerland
Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
A Webber Training Teleclass www.webbertraining.com

Slide 2

Slide 3

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 4

- Adherence with the recommendations for hand hygiene practices remains extremely low in most healthcare settings
- Some of the key parameters for noncompliance have been clearly identified and corrective actions proposed
- New guidelines for hand hygiene have been published
  Boyce and Pittet, MMWR 2002; 51:1-44

Slide 5

Today's objectives

- To review some of the implications of the new hand hygiene guidelines
- To discuss the importance of viruses as human and nosocomial pathogens
- To review whether hands play a role in the spread of viral infections
- To discuss whether alcohol sanitizers have an effect on viruses
- Virucidal activity of antiseptics
- Selecting a hygiene agent

Slide 6

Non-Compliance with hand hygiene,
HUG 1994

- Time constraint is the main explanatory factor
- When the number of opp > 10 per h, compliance decreases on average by 5% (± 2%) per 10 opps per hour of care

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Observed reasons for not washing hands

Time and system constraints

- High demand for hand hygiene is associated with low compliance
- Full compliance with conventional guidelines may be unrealistic

Voss and Widmer - Inf Control Hosp Epidemiol 1997; 18:205
Pittet et al, Annals Intern Med 1999; 130:126

Advantages of alcohol-based hand antisepsis vs. handwashing

- Faster and of greater efficacy than soap & water handwashing
- Improved accessibility
  - No sinks (plumbing) required
  - In rooms, corridors, nursing stations
  - As a pocket container
- Effective against a wide array of organisms, including multi-drug resistant pathogens


Handwashing ... an action of the past
(even when hands are soiled)

Alcohol-based handrubbing is standard of care

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 10

Time constraint is currently a major obstacle for hand hygiene

Solution:
Handrubbing is standard of care

Implication:
A system change is required

Slide 11

Implications of hand hygiene guidelines

A system change is required

• Provide easy access to hand hygiene materials
  • Handrub solution
    • at the patient's bedside
    • eventually at the patient's room entrance
    • in convenient locations
    • in individual pocket-sized containers
  • Dispenser
    • conveniently located
    • working appropriately

Boyce & Pittet, MMWR 2002; 51:1-44

Slide 12

Efficacy of hand hygiene products

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 13

Efficacy of hand hygiene products
Log reduction in bacterial counts after 30 sec

Soap  Iodophor  4% CHG  70% Alcohol


Slide 14

Time constraint = major obstacle for hand hygiene

1 to 1.5 min
15 to 20 sec

Slide 15

Time course of efficacy of unmedicated soap and water
and alcohol-based handrub in reducing hand contamination

Pittet and Boyce, Lancet Infectious Diseases 2001, April 9-20

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 16

Implications of hand hygiene guidelines

Handrubbing efficacious

- Handrubbing is more efficacious than handwashing with soap and water
- Some agents are more efficacious than others
- Time spent handrubbing is critical
  - agent must be applied on dry hands and allow to dry
  - education is critical
- The clinical effectiveness (i.e., impact on nosocomial transmission) of the use of different agents remains to be tested prospectively

Boyce & Pittet, MMWR 2002; 51:1-44

Slide 18

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Slide 19

Should we consider viruses?

- Viruses are important nosocomial pathogens, but mostly underecognized and undereported
- Some viruses are foodborne pathogens
- Hand transmission is significant in the spread of viruses
- Appropriate hand hygiene action can stop viral cross-transmission

Slide 20

Basic structure of a viral particle (virion)

<table>
<thead>
<tr>
<th>Protein shell (capsid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein-lipid envelope</td>
</tr>
<tr>
<td>Nucleic acid (DNA or RNA) genome</td>
</tr>
</tbody>
</table>

20-300 nanometers

Slide 21

Important human viruses

Non-enveloped
- Adenoviruses (conjunctivitis, diarrhea, respiratory tract infections)
- Astroviruses (diarrhea)
- Caliciviruses (diarrhea, outbreaks in geriatrics)
- Enteroviruses (fever, rash, diarrhea, encephalitis)
- Hepatitis A
- Papillomaviruses (warts, cancers)
- Parvovirus (B19)
- Rhinoviruses (cold)
- Rotaviruses (diarrhea, outbreaks in pediatrics)
Important human viruses (2)

- Enveloped
- HIV
- Herpes
- Hepatitis B
- Hepatitis C
- RSV
- Influenza
- Vaccinia

Viral shedding and transmission

- Human pathogenic viruses are not part of the normal microflora
- Viruses are shed by infected host for varying periods
- A large proportion of infected individuals/animals remains asymptomatic and discharges viruses into surroundings
- Hospitals, nursing homes, daycare centers
- The longer a virus can survive outside the body host, the higher its spreading potential

Viral shedding and transmission (continued)

- Hands can become contaminated by viruses either:
  - DIRECTLY, by contact with any virus-containing body fluid from self or others
  - INDIRECTLY, by touching or handling virus-contaminated surfaces or objects
- Fingers (in particular pads and tips) are the most likely to come in contact with infected individuals/animals, their body substances or other contaminated materials
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 25

**Do viruses survive on hands?**

**If yes, how long can they survive?**

Slide 26

**Virus acquisition, and survival on hands**

- Many viruses survive long enough on both hands and inanimate surfaces to permit transfer and cross-transmission
- Viruses are particularly sensitive to drying, thus can survive better on skin than onto dry surfaces, dependent on ambient humidity
  - **ex:** all non-enveloped viruses survive as well as, if not better than *S. aureus*
  - **ex:** enveloped viruses survive less longer, but somewhat similar to *E. coli*

Slide 27

**Survival of selected viruses and bacteria on the fingerpads of adult subjects**

(1 hour after artificial contamination)

Sponsored by Deb Medical Hand Hygiene [www.deb.co.uk](http://www.deb.co.uk)
Hosted by Paul Webber paul@webbertraining.com
[www.webbertraining.com](http://www.webbertraining.com)
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 28
Do hands play a role in the spread of viral infections?

Slide 29
Rhinoviruses
- Responsible for most upper respiratory tract infections
- Can survive on hands for hours
- Hands clearly implicated in human cross-transmission
  - Reed SE. J Hyg 1975;75:249
  - Ability of hand hygiene to stop cross-transmission is shown

Adenoviruses
- Responsible for conjunctivitis, cystitis, pneumonia and gastroenteritis
- Outbreaks in hospitals and daycare centers
- Outbreaks of ketaoconjunctivitis in ophthalmology
- Can survive on hands for many hours
- Hands clearly implicated in human cross-transmission and persistent carriage after handwashing with soap and water
  - Jernigan JA et al. J Hosp Infect 1993;26:399

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Caliciviruses
(SMRS, small round structured viruses)

- Norwalk outbreaks of gastroenteritis and diarrheal diseases in community and hospitals
  Kaplan NC et al. J Infect Dis 1990;162:1357
- Most common cause of foodborne disease in US
  Parashar UD et al. Zoonosis Infect 1998;12:121
- Can probably survive on hands for hours

Hepatitis A virus

- Infection is common worldwide
- Foodborne disease and outbreaks
- Endemic in developing countries (children)
- Frequently asymptomatic among young children, but transmission to older age groups is frequent
- Uncooked food and hand cross-transmission
- Can survive on hands for several hours
- Hands clearly implicated in human cross-transmission: 10 sec contact is enough
- Associated with high morbidity and societal costs

Rotaviruses

- Leading cause of gastroenteritis in infants worldwide
  Dennehy PH. Pediatr Infect Dis 2000;19:S103
- Outbreaks in hospitals, daycare centers, schools
  Dennehy PH. Pediatr Infect Dis 2000;19:S103
- Asymptomatic infection is common, but clinical cases excrete large amounts of viruses in feces
- Can survive on hands for many hours (~5 hours)
- Hands clearly implicated in human cross-transmission: hands of care givers play an important role in virus spread

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Slide 34

**Respiratory syncytial virus (RSV)**

- Most frequent cause of serious upper respiratory tract infection in children
- Outbreaks in hospitals and daycare centers
- Can survive on hands
- Hands clearly play a role in cross-transmission
  - More frequent handwashing by HCWs reduces transmission
  - Cohorting of RSV patients reduces spread

Hall CB. *Clin Infect Dis* 2000;31:590
Ruuskanen O. *J Hosp Infect* 1995;30 Suppl:494

---

Slide 35

**Hands and spread of viral infections**

- Hands could act as vehicles for many viruses
- Proper hand hygiene action could reduce the spread of viruses
- The lack of direct evidence for the relation between improved hand hygiene and reduced viral spread is due to the difficulty in working with viruses, our inability to discriminate between simultaneous spread by hands and other vehicles in a given condition, and diagnosis difficulties for viral infections
- Hands clearly play a role in cross-transmission


---

Slide 36

**Hands and spread of viral infections**

- Hands could act as vehicles for many viruses
- Proper hand hygiene action could reduce the spread of viruses
- The lack of direct evidence for the relation between improved hand hygiene and reduced viral spread is due to the difficulty in working with viruses, our inability to discriminate between simultaneous spread by hands and other vehicles in a given condition, and diagnosis difficulties for viral infections
- Hands clearly play a role in cross-transmission


---

Sponsored by Deb Medical Hand Hygiene [www.deb.co.uk](http://www.deb.co.uk)
Hosted by Paul Webber [paul@webbertraining.com](mailto:paul@webbertraining.com)
[www.webbertraining.com](http://www.webbertraining.com)
Hands and spread of viral infections ....

THUS:

Proper hand hygiene action and optimal hand hygiene formulations should include agents active against viruses at least in conditions where viruses of significance for humans are expected.

Important questions

1. Does hand hygiene agents' activity against bacteria equal activity against viruses?
2. Are there relevant methods to test hand antisepsis agents against viruses?
3. Is there a framework to allow label claims against viruses?
**Slide 40**

**Differences between viruses and bacteria toward hand hygiene action**

- Viruses are much smaller than bacteria
- Viruses are compact in nature
- Viruses (like bacteria) have ability to survive on hands
- Viruses can « hide » within skin surface crevices
- Viruses are more difficult to dislodge by simple handwashing than bacteria

---

**Slide 41**

**Virucidal activity of antiseptic agents against viruses**

- Enveloped viruses are easy to kill
  - HIV
  - HBV
  - RSV
  - Influenza
  - Vaccinia
- Log reductions obtained in the range of 2.5 to 6 using ethanol/isopropanol (30 sec to 2 min testing)
- Some activity of CHLX – Benzalkonium / detergent

Boyce & Pittet, AMAR 2002; 51:1-44

---

**Slide 42**

**Virucidal activity of antiseptic agents against viruses**

- Non-enveloped viruses are more difficult to kill
  - Alcohol, ethanol and isopropanol are more effective than medicated or nonmedicated soaps
  - Rotavirus, adenovirus, rhinovirus : 60% ethanol (> 3 log R)
  - Coronavirus / ECHO
  - Hepatitis A and enteroviruses may require 70-80% alcohol
  - Polio : 70% ethanol
  - Ethanol > isopropanol
  - Log reductions obtained in the range of 0.4 to 3 using ethanol/isopropanol (30 sec to 2 min testing)
- Efficacy is influenced by temperature, virus/antiseptic ratio, and protein load
- Poor/no activity of other antiseptics

Boyce & Pittet, AMAR 2002; 51:1-44

---

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 43

Activity of antiseptics used for hand hygiene against non-enveloped viruses

- Active
  - Alcohol, 60 to 95 %
    (ethanol > isopropanol)

- Poorly active
  - Benzalkonium chloride
  - Chlorhexidine gluconate
  - Triclocarban
  - Triclosan
  - PCMX

Slide 44

Important questions

THUS,
hand hygiene agents’ activity against bacteria does not mean activity against viruses

1) most antiseptics are inactive against non-enveloped viruses
2) alcohols (60 to 90%) :
  - reduce bacteria log_{10} counts by 4 to 6
  - reduce viruses log_{10} counts by 0.4 to 3

Slide 45

Important questions

- Does hand hygiene agents’ activity against bacteria equal activity against viruses?
- Are there relevant methods to test hand antiseptic agents against viruses?
- Is there a framework to allow label claims against viruses?

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Are there methods available to test hand antiseptics against viruses?

Types of tests against viruses

**In Vitro**
- Suspension Tests
- Carrier Tests

**In Vivo**
- Human Subjects (Whole Hands, Fingertips, Fingerpads)
- Animal Models
- Ex Vivo
  - Human Tissue (Skin, Umbilical Cord, Cornea)
  - Animal Tissue (Rat, Guinea Pig)

In vivo tests against viruses

- The fingerpad method for virucidal activity is an ASTM standard (E-1838)
- A similar method has been proposed to ASTM for working with bacteria fungi
- A whole-hand method also is now an ASTM standard (E-2011)
- European methods

See also: Sattar S et al, Am J Infect Control 2002;30:355
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 49

<table>
<thead>
<tr>
<th>Virus tested</th>
<th>Baseline control (PFU)</th>
<th>Reduction with handrub</th>
<th>Reduction with water</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotavirus strain WA</td>
<td>0.23 x 10⁵</td>
<td>&gt;99.99%</td>
<td>99.0</td>
<td>0.0001</td>
</tr>
<tr>
<td>Rhinovirus type 14</td>
<td>0.95 x 10⁵</td>
<td>&gt;99.90%</td>
<td>94.0</td>
<td>0.0004</td>
</tr>
<tr>
<td>Adenovirus type 4</td>
<td>0.33 x 10⁵</td>
<td>99.96%</td>
<td>88.0</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

Fingertip method with 12 volunteers for each virus. 10 µL of virus with soil load on each digit. Exposed to 1 mL of handrub with 60% ethanol vs. water.

Source: Sattar et al., Infect Control Hosp Epidemiol 2000; 21: 516

Slide 50

Important questions
- Does hand hygiene agents’ activity against bacteria equal activity against viruses?
- Are there relevant methods to test hand antiseptic agents against viruses?
- Is there a framework to allow label claims against viruses?

Source: Sattar S et al. Hygienic hand antiseptics: should they not have activity and label claims against virus. Am J Infect Control 2002;30:355

Slide 51

Is there a framework to allow label claims against viruses?
- The lack of recognized surrogates/standards for testing agents against viruses:
  - makes the development of products expensive and time consuming
  - results in the listing of easy-to-kill (enveloped) viruses on product labels conferring them an unjustified advantage
  - encourages label claims against viruses
  - makes product comparisons difficult

Source: Sattar S et al. Hygienic hand antiseptics: should they not have activity and label claims against virus. Am J Infect Control 2002;30:355

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Is there a framework to allow label claims against viruses? (2)

- Testing should be conducted with proper surrogates using rigorous test conditions
- in vitro, alcohol-based products reach a 2 to 3 log reduction in virus infectivity (in contrast to soap and water that hardly reach a 1 log reduction)
- possible surrogate for testing activity against viruses include: adeno-, rhino-, rota-, and enteroviruses, and Hepatitis A virus
- fingertip or fingerpad methods are more appropriate
- ultimate testing is the demonstration of viral cross-transmission and infection

Satar S et al. Hygienic hand antiseptics: should they not have activity and label claims against virus. Am J Infect Control 2002;30:345

Alcohol-based handrubbing is standard of care

... viruses will suffer

Alcohol-based handrubbing is standard of care

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Alcohol Hand Sanitizers and Their Effect on Viruses
A Webber Training Teleclass with Dr. Didier Pittet
June 24, 2003

Slide 55

Alcohol-based hand rub solutions

- Increasing acceptance - even in the USA
- Formulations with ≥60% alcohol have broad spectrum activity, including activity against enveloped as well as most non-enveloped viruses
- Hepatitis A virus, caliciviruses, and paroviruses might be more resistant
- There is a need for a regulatory framework for virus testing
- Hand hygiene major concern remains compliance

Boyce & Pittet, MMWR 2002; 51:1-44

Slide 56

Conclusions (1)

- Viruses are important nosocomial pathogens
- Hands play a key role in viral spread
- Virucidal activity is needed in formulations
- Alcohol-based products are the best choice
- There is a need for viral surrogates for testing agents
- Label claims against HIV, HBV, HCV, and influenza are useless
- Regulatory framework for label claims is needed
- Clinical effectiveness of hand hygiene products with virucidal activity should be demonstrated

Slide 57

Selecting a hand hygiene agent

- Handrubs contain 60-95% of alcohol
- Ethanol is the commonly used alcohol but propanol and mixtures are also available
- Handrubs are available as rinses (low viscosity), gels, and foams
- The higher the content in alcohol (max 90%), the higher the wider the spectrum of efficacy against viruses
- Agent selection is a difficult task

Sponsored by Deb Medical Hand Hygiene www.deb.co.uk
Hosted by Paul Webber paul@webbertraining.com
www.webbertraining.com
Implications of hand hygiene guidelines

Selecting a hand hygiene agent

1. Form a multidisciplinary team to establish criteria for product selection; consider:
   - fragrance
   - skin tolerance
   - costs
   - antimicrobial properties
   - accompanying dispenser(s)

2. Evaluate several products in clinical settings

3. Project resources and costs

4. Perform a pilot test with the selected product(s)

   • Major determinants of product selection are: user acceptance and antimicrobial profile

CONCLUSIONS (2)

• A system change must be addressed in most HCF
• Introduce/promote hand rubs hospital-wide
• Promote/facilitate skin care
• Monitor and feedback performance regularly
• Secure active participation at both individual and institutional level
• Implement a product selection process
• HCW education and motivation is fundamental
• Multivariate promotion strategies
• Successful campaign will reduce infection rates and antimicrobial resistance spread, and enhance patient safety