WHO Guideline and systematic review on hand hygiene and the use of chlorine in the context of Ebola

J.Hopman, Z.Kubilay, H.Edrees, T. Allen, B.Allegranzi
Service Delivery Safety, WHO, Geneva, HQ

Sponsored by WHO Patient Safety Challenge
Clean Care is Safer Care

Hosted by Claire Kilpatrick
World Health Organization

www.webbertraining.com

February 25, 2015
Presentation Outline

• Introduction
• PPE and Hand hygiene in the context of Ebola
• Current WHO recommendations for hand hygiene best practices in health care
• Systematic reviews on use of chlorine solutions; efficacy for hand hygiene and adverse events
  Search Strategy
  Outline of the Studies
  Summary of the Studies
• Conclusions
Ebola Virus Disease in West Africa —
No Early End to the Outbreak
Margaret Chan, M.D.

Many people have asked me why the outbreak of Ebola virus disease in West Africa is so large, so severe, and so difficult to contain. These questions can be answered with a single word: poverty.

The needs are enormous; the prospects for rapid containment are slim. The outbreak, in all its unprecedented dimensions, is an emergency of international concern and a medical and public health crisis of international proportions.
“Ebola threatens everything that makes us human,” says Bruce Aylward of the World Health Organization. With calm measure, he walks us through how the Ebola epidemic exploded — and how international alarm only fed the exponential growth of the problem. He shares four strategies critical to beating Ebola — and how they are succeeding, starting in Lofa County,
Enveloped RNA virus
Geographical distribution of Ebola and Marburg (1967-2014)
Situation February 2015

Ebola Situation Report - 4 February 2015
(Data up to 1 February 2015)

<table>
<thead>
<tr>
<th>Country</th>
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<td>Guinea</td>
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Ebola virus disease

Ebola in West Africa: 12-months on
15 January 2015 -- One year after the first Ebola cases started to surface in Guinea, WHO is publishing this series of 14 papers that take an in-depth look at West Africa’s first epidemic of Ebola virus disease. The papers explore reasons why the disease evaded detection for several months and the factors, many specific to West Africa, that fueled its subsequent spread.

One year into the Ebola epidemic: a deadly, tenacious and unforgiving virus

Read the note for media
Document with essential IPC components

- Interim manual - Ebola and Marburg virus disease epidemics: preparedness, alert, control, and evaluation
- This document describes preparedness, prevention, and control measures that have been implemented successfully during previous epidemics

Interim
Infection Prevention and Control Guidance for Care of Patients with Suspected or Confirmed Filovirus Haemorrhagic Fever in Health-Care Settings, with Focus on Ebola

December 2014

Principles of infection control

1. Procedures and protocols referred to as “controls”.
2. Standard precautions
3. Health and wellbeing of workforce
4. Implementation.
5. Resource management.
Procedures and protocols referred to as “controls”

In order of Infection Prevention and Control (IPC) effectiveness:

1. administrative controls
2. environmental and engineering controls
3. personal protective equipment (PPE)
Standard Precautions

1. Hand hygiene
2. Point-of-care risk assessment for appropriate selection and use of PPE to avoid direct contact with patients’ body fluids
3. Respiratory hygiene (cough etiquette)
4. Prevention of needle-stick or sharps injuries
5. Safe waste management
6. Cleaning, disinfection (and sterilization, where applicable) of patient-care equipment and linen cleaning and disinfection of the environment.
Standard Precautions

• Routine precautions to be applied in **ALL** situations for **ALL** patients — whether or not they appear infectious or symptomatic — especially important for EVD because the initial manifestations are non-specific
Ebola virus spreads through:

- **direct** contact with body fluids (stool, vomit, blood, urine, saliva, semen, breast milk) of a sick person with EVD
- by contact with surfaces or equipment contaminated by body fluids of an infected person
- Through mucous membranes or non-intact skin (e.g. cuts or abrasions)

• Transmission through intact skin has not been documented
Facts about Ebola

You can’t get Ebola through air

You can’t get Ebola through water

You can’t get Ebola through food
New WHO Guidelines on Personal Protective Equipment (PPE)

Guideline development process
- Development of key research questions
- Systematic literature reviews
- Literature review and an online survey on values and preferences of health workers
- Evidence-to-recommendations exercise using the GRADE framework
- Expert consultation
- WHO Guideline Review Committee

What are the benefits and harms of double gloves, full face protection, head cover, impermeable coveralls, particulate respirators, and rubber boots as PPE when compared with alternative less robust PPE for HCWs caring for patients with filovirus disease?

Issued on 31 October 2014
Personal Protective Equipment (PPE)
Need training and correct PPE!

Approximately 3-4% of infected patients are HCW
IPC training and reinforcement after training

- Importance of standard precautions in all outpatient and inpatient care
  - Many HCW infections from failure to apply standard precautions, rather than PPE in treatment centre

- PPE - putting on and taking off is a skill
  - not just knowledge that can be conveyed by demonstration
  - needs practice
  - needs ongoing supervision by dedicated supervisor

- Importance of safe work set-up and consistent practices
Hand hygiene
Role of hands and hand hygiene

- Hands contaminated with blood or bodily fluids (including when not visible) play a crucial role in the transmission of filovirus through direct contact with mucous membranes or non-intact skin.

- As a consequence, hand hygiene best practices and appropriate use of gloves are essential, both to protect the health worker providing care and to prevent transmission to others.
Hand hygiene

The 5 Moments apply to any setting where health care involving direct contact with patients takes place.

1. BEFORE TOUCHING A PATIENT
2. BEFORE CLEAN / ASEPTIC PROCEDURE
3. AFTER BODY FLUID EXPOSURE RISK
4. AFTER TOUCHING A PATIENT
5. AFTER TOUCHING PATIENT SURROUNDINGS
How to Handrub?

RUB HANDS FOR HAND HYGIENE! WASH HANDS WHEN VISIBLY SOILED

Duration of the entire procedure: 20-30 seconds

1a Apply a palmful of the product in a cupped hand, covering all surfaces;
1b Rub hands palm to palm;
2 Right palm over left dorsum with interlaced fingers and vice versa;
3 Palm to palm with fingers interlaced;
4 Backs of fingers to opposing palms with fingers interlocked;
5 Rotational rubbing of left thumb clapsed in right palm and vice versa;
6 Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;
7 Once dry, your hands are safe.
8 Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;
9 Dry hands thoroughly with a single use towel;
10 Use towel to turn off faucet;
11 Your hands are now safe.

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

0 Wet hands with water;
1 Apply enough soap to cover all hand surfaces;
2 Rub hands palm to palm;
3 Right palm over left dorsum with interlaced fingers and vice versa;
4 Palm to palm with fingers interlaced;
5 Backs of fingers to opposing palms with fingers interlocked;
6 Rotational rubbing of left thumb clapsed in right palm and vice versa;
7 Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;
8 Rinse hands with water;
9 Use towel to turn off faucet;
10 Your hands are now safe.
Hand hygiene and glove use

GLOVES PLUS
HAND HYGIENE
= CLEAN HANDS

GLOVES WITHOUT
HAND HYGIENE
= GERM TRANSMISSION

The use of gloves does not replace the need for cleaning your hands!
From sugar can, at low cost (0.30 $US) = 0.006% of the total annual hospital budget

Mali, Africa, 2007
System change made possible
WHO alcohol-based formulation local production
Global Survey 2012

39 sites in 28 countries

The use of Chlorine solutions for Hand hygiene

Liberians are Creative and Innovative

(Photo’s from Francis N. Kateh, MD, MHA, MPS/HSL, FLCP, *Medical Director/CEO*, Technical Assistant Margibi County Ebola response)
1. Are chlorine solutions effective for hand hygiene in health care?

2. Are chlorine solutions effective for disinfection of gloves?

3. Does the use of chlorine solutions for hand hygiene cause health workers’ skin irritation or lesions, respiratory side effects or any other adverse reactions?
PICO question 1

Are chlorine solutions effective for hand hygiene in health care?

- **P**: Health Workers (individuals who provide direct or indirect to patients, in particular affected by filovirus infection or pathogens with a similar route of transmission and infectivity)
- **I**: Hand hygiene with chlorine solutions,
- **C**: Hand hygiene with alcohol-based handrub or other agents including water and soap
- **O**: Primary outcome: Reduction of pathogen including Ebola virus, transmission to health workers or patients
  Secondary outcome: reduction of bacterial or viral load on hands
PICO question 2

Are chlorine solutions effective for disinfection of gloves?

- **P**: Health Workers
- **I**: Disinfection of gloves with chlorine solutions
- **C**: Disinfection with alcohol-based handrub or other agents including water and soap
- **O**: Primary outcome: Reduction of pathogen, including Ebola virus, transmission to patients
  - Secondary outcome: reduction of bacterial or viral load on hands
• Limited to PubMed (including MEDLINE) and Ovid EMBASE databases

• Performed on 26 September 2014

• No time, age, human, language limit or geographical restrictions.

• Refs of Retrieved papers
<table>
<thead>
<tr>
<th>Search strategy</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (“chlorine”[Mesh] OR “chlorine” OR “sodium hypochlorite” OR “calcium hypochlorite” OR “organic chloramines” OR “Chlorine Compounds”[Mesh] OR “chlorine dioxide” [Supplementary Concept]) OR chlorin* OR “Solvents”[Mesh] OR “bleach” OR “Dettol” OR “Chloramine” OR “Clorox”</td>
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<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
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<td>1</td>
<td>'hand hygiene'/exp OR 'hand hygiene' OR 'hand washing'/exp OR 'hand washing' OR 'handwashing'/exp OR 'handwashing' OR 'hand rubbing' OR 'handrubbing' OR 'hand disinfection'/exp OR 'hand disinfection' OR 'hand antisepsis' OR 'scrubbing' OR 'scrub'/exp OR 'scrub' OR 'hand preparation' OR 'alcohol based hand rub' OR 'alcohol based handrub' OR 'povidone iodine'/exp OR 'povidone iodine' OR 'povidone'/exp OR povidone OR 'iodophor'/exp OR 'iodophor' OR 'iodophor'/exp OR iodophor OR 'iodophors'/exp OR iodophors OR 'iodine'/exp OR 'iodine' OR 'iodine'/exp OR iodine OR 'betadine'/exp OR betadine OR 'triclosan'/exp OR 'triclosan' OR 'triclosan'/exp OR triclosan OR 'chlorhexidine'/exp OR 'chlorhexidine' OR 'chlorhexidine'/exp OR chlorhexidine OR 'hibiscrub'/exp OR hibiscrub OR 'hibisol'/exp OR hibisol OR 'alcohol'/exp OR alcohol OR 'alcohols'/exp OR alcohol OR 'gel'/exp OR gel OR 'soap'/exp OR 'soap' OR soap*:ab,ti AND ('hand'/exp OR hand) AND ('disinfectants'/exp OR disinfectants OR 'antisepsis'/exp OR 'antisepsis'/exp OR antisepsis OR antiseptics OR 'detergents'/exp OR detergents)) OR 'surgical glove'/exp OR 'surgical glove' OR glove:ab,ti OR gloves:ab,ti OR gloving:ab,ti OR handrub:ab,ti OR 'disinfectant agent'/exp OR 'disinfectant agent' OR 'disinfection'/exp OR 'disinfection' OR disinfection:ab,ti OR saturation:ab,ti OR microperforation:ab,ti OR handwash:ab,ti</td>
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<tr>
<td>4</td>
<td>#1 AND #2 AND #3</td>
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<td>5</td>
<td>waste water'/exp OR 'drinking water'/exp OR 'fluoridation'/exp</td>
</tr>
<tr>
<td>6</td>
<td>#4 NOT #5</td>
</tr>
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</table>
Inclusion criteria

• All chlorine compounds
• Stated population
• In-vivo experiments on hands
• In-vivo experiments on gloves

Based on consultation with the WHO Steering Group, we modified the inclusion criteria for the rapid review so that only manuscripts that addressed sodium or calcium hypochlorite solutions were included.
Exclusion criteria

• Animal studies

• In-vitro studies

• Environmental studies

• Studies addressing therapy
Search performed on September 26th, 2014

No Human, Age, Language or Time Limits applied

Records identified through the Pubmed n=1172
Embase n=2805
(Total after duplicates removed n = 1931)

EXCLUDED:
Titles not relevant to the study question based on exclusion criteria: n=1909

Titles selected n = 22

EXCLUDED:
- Chloramine T (incl. Chlorine covers) (n=4)
- 4-chloro-3,5 methylphenol (Dettol) (n=3)
- Electrolized acid water (n=5)
- In-vitro study (n=6)

ABSTRACTS SELECTED FOR DETAILED REVIEW:
N= 22

Full text included from above list n=2
Full text included after screening reference lists of selected articles n=0
Full text included from "others" list n=2
Total n=4
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<th>First Author</th>
<th>Year</th>
<th>Compounds</th>
<th>Contact time</th>
<th>Comparator</th>
<th>Contact time</th>
<th>Sample Size</th>
<th>Hands or gloves</th>
<th>Microbiological Test Used</th>
<th>Microorganism</th>
<th>Results</th>
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<tbody>
<tr>
<td>Lowbury, E</td>
<td>1964</td>
<td>Sodium hypochlorite (Milton 1:80)</td>
<td>30 seconds</td>
<td>Chlorhexidine solutions</td>
<td>30 seconds</td>
<td>4 volunteers</td>
<td>hands</td>
<td>Bacterial cell count</td>
<td>Staphylococcus aureus</td>
<td>Chlorhexidine significantly higher bacterial reduction than hypochlorite (p&lt;0.001)</td>
</tr>
<tr>
<td>Rotter, M</td>
<td>1998</td>
<td>Sodium hypochlorite (4%=40000ppm)</td>
<td>5 minutes</td>
<td>Isopropanol 60% and water/soap</td>
<td>1 minute</td>
<td>15 volunteers</td>
<td>hands</td>
<td>Bacterial cell count</td>
<td>Escherichia coli K12</td>
<td>Sodium hypochlorite significantly higher bacterial reduction than isopropanol 60% or water and soap (p&lt;0.001)</td>
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<tr>
<td>Edmonds, S</td>
<td>2013</td>
<td>Bleach (0.5%) and surfactant (Triton-X) prototype</td>
<td>Not specifically mentioned</td>
<td>Tap water, 4% chlorhexidine gluconate, Nonantimicrobial hand wash, Nonantimicrobial body wash, 0.3% triclosan hand wash, 8% hydrogen peroxide and surfactant (Triton-X) prototype, Peracetic acid wipe, Sodium tetraborate decahydrate, Ink and stain remover, Ink and stain remover with brush, 2000 ppm peracetic acid and surfactant (Triton-X) prototype</td>
<td>tap water 2 minutes, other agents not specifically mentioned</td>
<td>6 volunteers</td>
<td>hands</td>
<td>Bacterial cell count</td>
<td>Clostridium difficile spores, Bacillus atrophaeus, Clostridium sporogenes</td>
<td>Peracid and surfactant formulation significantly superior compared to bleach 0.5% (p&lt;0.05). Bleach 0.5% non-significant with tap water and other agents</td>
</tr>
<tr>
<td>Weber, D</td>
<td>2003</td>
<td>Antibacterial microfiber towel (400ppm sodium hypochlorite)</td>
<td>10-30-60 seconds</td>
<td>61% ethyl alcohol, a 2% chlorhexidine gluconate preparation, and a non antimicrobial soap (control).</td>
<td>10-30-60 seconds</td>
<td>6 volunteers</td>
<td>hands</td>
<td>Bacterial cell count</td>
<td>Bacillus atrophaeus</td>
<td>At 60 seconds, chlorine-towels significantly superior effect compared to chlorhexidine (p=0.008) and NS with non antimicrobial soap and water. At 10 seconds, both soap and chlorhexidine were significantly better than chlorine-towels.</td>
</tr>
</tbody>
</table>
Summary

- Chlorhexidine significantly higher bacterial reduction than hypochlorite (p<0.001) (Lowbury)
- Bleach 0.5% non-significant difference compared with tap water and other agents (Edmonds)
- Peracid and surfactant formulation significantly superior compared to bleach 0.5% (p<0.05) (Edmonds)
- At 60 seconds, chlorine-towels NS higher effect compared to non antimicrobial soap and water (Weber)
  
- Sodium hypochlorite significantly higher bacterial reduction than isopropanol 60% or water and soap (p<0.001) (Rotter)
- At 60 seconds, chlorine-towels significantly superior effect compared to chlorhexidine (p=0.008) (Weber)
Summary

• **Different concentrations of chlorine** solution were used
  – aqueous sodium hypochlorite solution (Milton 1:80, 125ppm)
  – sodium hypochlorite solution 4% (40000ppm)
  – bleach 0.5% (5000ppm)
  – microfiber releasing 400 ppm bleach.

• **Variability in the applied contact time** for both the chlorine compound and the comparators.
  – Contact time ranged from 10 seconds up to 5 minutes.
Sodium hypochlorite concentration dependent

Effect Contact time and concentration

Bacterial reduction

Lowbury  Weber  Edmonds

125ppm  400ppm  5000ppm  40000ppm

Sodium hypochlorite Concentration
Sodium hypochlorite efficacy contact time dependent

Contact time (seconds)

Bacterial reduction

- Weber
- Lowbury
- Edmonds
- Rotter
Conclusion

- No evidence about efficacy of sodium hypochlorite used for hand hygiene to prevent filovirus transmission in health care.
- No evidence about efficacy to reduce or eliminate filovirus or other (enveloped) viruses on hands in laboratory studies.
- Limited evidence about the efficacy of sodium hypochlorite in comparison to other agents to reduce or eliminate other microorganisms in laboratory studies.
- Very limited number of manuscripts and the quality of the performed comparative studies.
- Differences in sodium hypochlorite concentrations, contact time and microorganisms were observed.
- No evidence that the advocated concentration of 500ppm sodium hypochlorite has a sufficient efficacy for hand hygiene with the current advocated contact time of 30 sec.
Adverse events related to use of chlorine solutions for hand hygiene

Z. Kubilay, J. Hopman, H. Edrees, T. Allen, B. Allegranzi
Service Delivery Safety
Geneva, WHO HQ
Does the use of chlorine solutions for hand hygiene cause health workers’ skin irritation or lesions, respiratory side effects or any other adverse reactions?

- **P**: Any person who performs the hand hygiene with chlorine solutions
- **I**: Hand hygiene or glove disinfection with chlorine solutions
- **C**: Hand hygiene or glove disinfection with alcohol-based handrub or other agents including water and soap
- **O**: Skin irritation or other skin lesions, respiratory adverse events or any other adverse reactions
Search methods

- PubMed (including MEDLINE) and Ovid EMBASE databases
- Performed on 26 September 2014
- No time, age, human, language limit or geographical restrictions.
- References of retrieved papers
- Contact Dermatitis Journal using the terms "sodium hypochlorite" and "chlorine".
## Pubmed search strategy

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<tr>
<th>#</th>
<th>Searches</th>
<th>Results</th>
</tr>
</thead>
<tbody>
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<td>(&quot;chlorine&quot;[Mesh] OR &quot;chlorine&quot; OR &quot;sodium hypochlorite&quot; OR &quot;calcium hypochlorite&quot; OR &quot;organic chloramines&quot; OR &quot;Chlorine Compounds&quot;[Mesh] OR &quot;chlorine dioxide&quot; [Supplementary Concept]) OR chlorin* OR &quot;Solvents&quot;[Mesh] OR &quot;bleach&quot; OR &quot;Dettol&quot; OR &quot;Chloramine&quot; OR &quot;Clorox&quot;</td>
<td>256196</td>
</tr>
<tr>
<td>3</td>
<td>#1 AND #2</td>
<td>2598</td>
</tr>
</tbody>
</table>
Inclusion criteria

**Initial inclusion criteria**
Comparative studies on adverse events due to use of chlorine solutions for hand hygiene or glove disinfection compared to use of alcohol-based handrubs or other agents incl. water and soap

**Revised inclusion criteria**
- Any kind of population
  - exposed to sodium hypochlorite
  - developed any kind of reaction, mostly skin or respiratory side effects

regardless of the concentration of the product, type of the setting or the method of exposure.
Exclusion criteria

- Studies about swimmers or chlorination of swimming pools,
- Chlorine use for therapeutic purposes,
- Chlorine gas/vapor exposures,
- Products used other than sodium and/or calcium hypochlorite i.e. chloramine, benzalkonyum chloride,
- Animal studies
Records identified through the Pubmed n = 2598
   Embase n=698
   (Total after duplicates removed n = 3241)

EXCLUDED:
   Titles not relevant to the study question: n=2952

Titles selected n = 320

EXCLUDED:
   Chlorine used for therapy n= 25
   Chloramine or other products n=16
   Reviews n=4
   Irrelevant n=3

ABSTRACTS SELECTED FOR DETAILED REVIEW:
   Respiratory Side effects : 163
   Skin Side Effects:71
   Miscellaneous:38
For SKIN Side Effects
n=71

EXCLUDED
Irrelevant or only background information n=49
Swimmer studies n=2
Review/editorial/meeting abstract n=6
Chloramine n=3
Animal Study n=1
Languages cannot be read: 1 +1*

Full text included from above list n=9
Full text included after screening reference lists of selected articles n=3
Full text included from "miscellaneous" list n=2
Total n=14
- Case report on HANDWASHING n=1
- Other Case reports n=9
- 1 comparative, 3 survey studies

*One possible article found for other side effects had to be excluded because in language cannot be read. (Lithuanian)
### 1 CASE REPORT – Veterinary surgeon handwashing w/ 4-6% sodium hypochlorite

<table>
<thead>
<tr>
<th>Article Title, Author, Year</th>
<th>Type of Participants</th>
<th>Sodium Hypochlorite (NaOCl) - INTERVENTION</th>
<th>COMPARATOR</th>
<th>Description of Skin reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium hypochlorite dermatitis Eun et.al, 1984</td>
<td>Veterinary Surgeon</td>
<td>Hand washing</td>
<td>4-6% sodium hypochlorite (Halasol®) used for handwashing</td>
<td>Iodine and antibiotics</td>
</tr>
<tr>
<td>[3 healthy volunteers]</td>
<td>Patch test as described</td>
<td>Patch test: Halasol® (undiluted, 1 in 10, and 1 in 100), Sodium hypochlorite (2% ag, 1% ag, 0.5% ag, 0.25% ag)</td>
<td>N/A</td>
<td>all negative patch test results except to undiluted 4-6% NaOCl</td>
</tr>
</tbody>
</table>
### Other CASE REPORTS COMBINED WITH EXPERIMENTAL CONTROLS n=5 (1)

<table>
<thead>
<tr>
<th>Sensitization to sodium hypochlorite causing hand dermatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habets, et.al 1986</td>
</tr>
<tr>
<td>2 housewives</td>
</tr>
<tr>
<td>Domestic cleaning w/o gloves</td>
</tr>
<tr>
<td>Kristal product: 10% sodium hypochlorite (bleach)</td>
</tr>
<tr>
<td>Both patients had positive patch test Kristal 1% aq, Kristal 0.5% aq, NaOCl 2% aq, NaOCl 1% aq, NaOCl 0.5% aq, NaOCl 0.1% aq</td>
</tr>
<tr>
<td>N/A</td>
</tr>
<tr>
<td>chronic itchy dermatitis on the dorsum of the fingers for 9 months (case 1); chronic hand eczema for more than 15 years-sym. dermatitis of the palms, periungual areas and dorsa of the fingers (case 2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>69 control patients, randomly selected with suspect allergic contact dermatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch Test</td>
</tr>
<tr>
<td>sodium hypochlorite 2% in aq. (for 69 patients); sodium hypochlorite 1% and 0.5% in aq (for 20/69 patients)</td>
</tr>
<tr>
<td>N/A</td>
</tr>
<tr>
<td>15/69 a weak or moderate irritant reaction</td>
</tr>
<tr>
<td>20/20 no reaction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact dermatitis due to sodium hypochlorite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmundsen et.al, 1989</td>
</tr>
<tr>
<td>1 patient developed dermatitis after chloramine was used for disinfection in the genital area</td>
</tr>
<tr>
<td>Chloramine use for disinfection purposes</td>
</tr>
<tr>
<td>Patch test positive to sodium hypochlorite 0.5% aq and chloramine 0.5% aq (Extreme reaction to NaOCl)</td>
</tr>
<tr>
<td>N/A</td>
</tr>
<tr>
<td>Extreme reaction to NaOCl patch test characterized by palm sized, red grossly edematous and infiltrated reaction</td>
</tr>
</tbody>
</table>

| 225 patients with dermatitis                |
| Patch test as described                    |
| N/A                                         |
| 3/225 positive reaction - 1 patient with history of eczema, 2 with contact dermatitis |
Other CASE REPORTS COMBINED WITH EXPERIMENTAL CONTROLS n=5 (1)

<table>
<thead>
<tr>
<th>Sensitization to sodium hypochlorite causing hand dermatitis Habets, et.al 1986</th>
<th>2 housewives</th>
<th>Domestic cleaning w/o gloves</th>
<th>Kristal product: 10% sodium hypochlorite (bleach)</th>
<th>N/A</th>
<th>chronic itchy dermatitis on the dorsum of the fingers for 9 months (case 1); chronic hand dermatitis of the palms, fingers and dorsa of the hands (case 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/ 69 weak or moderate irritant reaction- 2% Sodium hypochlorite</td>
<td>20/20 no reaction 0.5-1 %</td>
<td>3/225 positive reaction 0.5%</td>
<td>2/40 positive reaction 1%</td>
<td>20/20 negative reaction to 0.3%</td>
<td>4/10 + low intensity reaction 6%</td>
</tr>
<tr>
<td>Contact dermatitis due to hypochlorite Osmundsen et.al, 1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pandemic and Epidemic Diseases department
4 additional case reports with severe reaction

• Two case reports from the ‘30s severe dermatitis following use of bleach (reported concentration 1:10) for environmental cleaning; the patch test was positive in both cases.

• Accidental contact exposure to unknown concentrations of bleach- linear IgA bullous dermatosis with systemic reaction

• The use of diluted Clorox® (one part of 6% NaOCl to five parts of water) for bathing the foot to treat an infected big toe for several weeks- severe allergic contact dermatitis characterized by diffuse swelling, scalling, vesiculation of the foot and hands.
### Comparative study *(Tupker, 1997)*

<table>
<thead>
<tr>
<th>Article Title, Author, Year</th>
<th>Type of Participants</th>
<th>Sodium Hypochlorite (NaOCl) - Intervention</th>
<th>Comparator</th>
<th>Outcome</th>
<th>Description of Skin Reaction</th>
</tr>
</thead>
</table>
| Irritancy of antiseptics tested by repeated open exposures on the human skin, evaluated by non-invasive methods Tupker et al. 1997 | 20 subjects without any skin disease Experimental study open exposure model for all products | Open exposure model of 30 mins duration x2 (3h in between) on daily on 4 consecutive days. With a plastic strip 0.8 ml of solution applied thru 20 mm diameter. | Sodium Hypochlorite (SH) (0.25%) ag | **Sodium Hypochlorite (SH) (0.25%) ag** | **Visual scoring for erythema, scaling, and fissures**  
**Subjective score of burning, stinging**  
**Stratum corneum hydration**  
**Transepidermal water loss**  
**Cutaneous blood flow** | **5/20 erythamous reaction + after 1 exposure to SH**  
**In majority SH had to be stopped after 4 applications because of subjective irritation sensation.**  
**For all the outcomes SH was significantly the worst, followed by IE.** |
One survey on occupational skin diseases in nurses

- 62.5% of nurses who worked with chemical disinfecting materials for more than 9 hours were suffering from skin damage and 33.5% of cases induced by chlorine.

- The risk of developing occupational skin disease is higher for chlorine than alcohol. (OR – 3.6; CI = 2.1–6.2; 1.85 CI=0.9-3.9 respectively) Highest with aldehydes and H2O2
2 surveys among cleaners

• 818 professional cleaners in Spain (Mirabelli, 2012)
  – did not show significantly higher prevalence rate of hand dermatitis in health care settings,
  – Significantly higher prevalence rate of hand dermatitis among all cleaning workers who reported frequent use of bleach (≥4 days per week)

• 25 day care workers – (Sheretz, 1992)
  – used 1:1000 dilution of sodium hypochlorite-50 ppm chlorine for disinfection purposes
  – 13/25 workers who had hand dermatitis were exposed to wet work and latex gloves along with sodium hypochlorite.
CONCLUSION - Skin Side Effects

- Extremely limited evidence related to contact dermatitis following sodium hypochlorite use for hand hygiene purposes (only one case report but using high concentrations)
- Other studies - exposure to sodium hypochlorite as a disinfectant for other uses
- The quality of the studies was low or very low
- Great variability was found in the type of setting, concentrations used (high in most of these studies), study designs and exposure methods

- Overall, low or very low quality evidence shows that sodium hypochlorite can cause skin irritations even at low concentrations with bare skin exposure
For RESPIRATORY Side Effects
n=163

EXCLUDED
Swimmer studies n=57
Irrelevant or only background information n=67
Chlorine gas /vapour exposure n=20
Review/editorial/meeting abstract n=8
Chloramine n=4

Full text included from above list n=7
Full text included after screening reference lists of selected articles and SR  n=4

Total n=11
- NONE ON HAND HYGIENE
- Low concentration chlorine compounds n=3
- General Bleach studies n=8
HCW Survey study (Glumbakaite, 2003)

- 314 medical personnel surveyed in 9 different hospitals in Lithuania
- 0.02 or 0.1% chlorine solutions and a 3% chloramine solution, glutaraldehyde, hydrogen peroxide, isopropyl and ethyl alcohol
- Significantly more frequent skin reddening, itching symptoms and chronic bronchitis when using chlorine compounds,

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Prevalence n (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reddening and itching of skin</td>
<td>80(58.4)*</td>
<td>49.67–66.74</td>
</tr>
<tr>
<td>Allergic conjunctivitis</td>
<td>57(41.6)</td>
<td>33.25–50.33</td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>51(37.2)</td>
<td>29.12–45.89</td>
</tr>
<tr>
<td>Weakness</td>
<td>39(28.5)</td>
<td>21.09–36.80</td>
</tr>
<tr>
<td>Headache</td>
<td>38(27.7)</td>
<td>20.43–36.03</td>
</tr>
<tr>
<td>Dizziness</td>
<td>31(22.6)</td>
<td>15.92–30.55</td>
</tr>
<tr>
<td>Cough</td>
<td>28(20.4)</td>
<td>14.03–28.16</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>21(15.3)</td>
<td>9.74–22.47</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>15(10.9)</td>
<td>6.26–17.41</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>13(9.5)</td>
<td>5.15–15.68</td>
</tr>
<tr>
<td>Difficulty in breathing</td>
<td>8(5.8)</td>
<td>2.55–11.18</td>
</tr>
<tr>
<td>Wheeze</td>
<td>5(3.6)</td>
<td>1.19–8.31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Prevalence n (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic bronchitis</td>
<td>17(12.4)**</td>
<td>7.39–19.12</td>
</tr>
<tr>
<td>Allergic contact dermatitis</td>
<td>10(7.3)</td>
<td>3.55–13.01</td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>10(7.3)</td>
<td>3.55–13.01</td>
</tr>
<tr>
<td>Allergic conjunctivitis</td>
<td>10(7.3)</td>
<td>3.55–13.01</td>
</tr>
<tr>
<td>Contact dermatitis</td>
<td>7(5.1)</td>
<td>2.08–10.24</td>
</tr>
<tr>
<td>Chronic laryngitis</td>
<td>6(4.4)</td>
<td>1.62–9.29</td>
</tr>
<tr>
<td>Chronic rhinitis</td>
<td>5(3.6)</td>
<td>1.19–8.31</td>
</tr>
<tr>
<td>Contact urticaria</td>
<td>4(2.9)</td>
<td>0.80–7.30</td>
</tr>
<tr>
<td>Asthma</td>
<td>4(2.9)</td>
<td>0.80–7.30</td>
</tr>
</tbody>
</table>

1 No. of people tested = 137; *p < 0.001; **p < 0.05.
One patient survey study (Aronhalt 2012)

- USA hospital during the "*Wipe Out C. Difficile*" intervention
- 94 patients and 6 environmental cleaning staff
- Bleach wipes containing 0.55% sodium hypochlorite (5,200 ppm) while their rooms were cleaned.
- Only 7% of patients from the medical units \((n=2)\) but half of the patients from the hematology–oncology units \((n=50)\) noticed the odor of the bleach used for cleaning; 44% of them found it bothersome and either used a mask or left their room during cleaning.
- All participating cleaners \((n=6)\) reported respiratory irritation and less satisfaction from using the bleach wipes; however, later their satisfaction improved.
CONCLUSION - Respiratory side effects

• No evidence in the literature that shows that low level of sodium hypochlorite used for hand hygiene may cause respiratory irritation, other respiratory symptoms or asthma.

• However, respiratory symptoms are clearly reported in patients, health workers and other users as a consequence of exposure to chlorine solutions used for environmental decontamination also with low concentrations (0.02 or 0.1% chlorine solutions)
Other Side Effects

- No studies were identified addressing other possible side effects except the Glumbakaite, 2003, Lithuanian study.
• Any practice of **glove washing, decontamination or reprocessing is not recommended** as it may damage the material integrity and jeopardize the glove’s protective function.
• Although these practices are common in many health-care settings, essentially in developing countries, where glove supply is limited, **no recommendation exists concerning the washing and reuse of gloves, nor the washing or decontamination of gloved hands** followed by reuse on another patient.
• Although the antibacterial efficacy of glove washing and decontamination is demonstrated (1 study using 4% chlorhexidine + 7.5% povidone-iodine liquid soap, and 1 study using ABHR+ chlorhexidine), **the consequences of such processes on material integrity still remain unknown**.
Some evidence exists that cleansing latex-gloved hands using an alcohol-based handrub solution is effective in removing micro-organisms and shows increasing contamination rates of hands only after 9–10 cycles of cleansing.

However, cleansing plastic-gloved hands with an ABHR leads to early dissolving of the plastic material.

It should be noted that this process may be applied only in the framework of contact precautions implementation and as long as gloves are not soiled with blood and other body fluids.
Conclusions on glove reprocessing

- The opinion of international experts consulted by WHO is that **glove reprocessing must be strongly discouraged and avoided**, mainly because at present no standardized, validated, and affordable procedure for safe glove reprocessing exists.

- Every possible effort should be made to prevent glove reuse in health-care settings, and financial constraints in developing countries leading to such practices should be assessed and tackled. Institutions and health-care settings **should firmly avoid the reuse of gloves**.

- In circumstances **where the reprocessing of gloves has been carefully evaluated but cannot be avoided**, a clear policy should be in place to limit reprocessing and reuse of gloves until a budget is allocated to ensure a secure supply of single-use gloves.

- Policies for exceptional reprocessing should ensure **a process that follows strict procedures for collection, selection and reprocessing**, including instructions for quality/integrity control and discarding of unusable gloves.
Does glove disinfection with chlorine solutions cause damage to permeability or increased perforations?

Rapid review upon request by the WHO Guidelines Review Committee
Search Methods

- PubMed (including MEDLINE) and Ovid EMBASE databases
- Performed on 11 November 2014
- No time, age, human, language limit or geographical restrictions.
<table>
<thead>
<tr>
<th>#</th>
<th>Searches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(“chlorine”[Mesh] OR “chlorine” OR “sodium hypochlorite” OR “calcium hypochlorite” OR “organic chloramines” OR “Chlorine Compounds”[Mesh] OR “chlorine dioxide” [Supplementary Concept]) OR chlorin* OR &quot;Solvents&quot;[Mesh] OR &quot;bleach&quot; OR &quot;Dettol&quot; OR &quot;Chloramine&quot; OR &quot;Clorox&quot;</td>
</tr>
<tr>
<td>2</td>
<td>(((“Gloves, Protective”[Mesh] OR gloves [TW] OR glove [TW] OR gloving [TW]))</td>
</tr>
<tr>
<td>3</td>
<td>#1 AND #2</td>
</tr>
</tbody>
</table>
Records identified through the Pubmed n=159
Embase n=48
Total after duplicates removed n=141

EXCLUDED:
Titles not relevant to the study question based on exclusion criteria: n=98

Titles selected n=43

EXCLUDED:
- No abstract/Editorial n=4
- Irrelevant n=1
- Glove permeability studies not including chlorine compounds n=35

ABSTRACTS SELECTED FOR DETAILED REVIEW:
N=3

EXCLUDED:
- Irrelevant n=1
- Glove permeability studies not including chlorine compounds

Full text included n=1
• Seven brands of surgical gloves tested for permeation against seven chemicals according to the European and the American standards

• The gloves did not exhibit permeation of potassium hydroxide (45%), sodium hypochlorite (13%) or hydrogen peroxide (30%).

• Neither glutaraldehyde (2%) nor chlorhexidine digluconate (4%) in the commercial disinfectant solutions studied exhibited permeation.

• The surgical gloves studied are able to protect against sodium hypochlorite 13% (available chlorine > 12%) in conventional hospital work where there is usually contact with less concentrated chemicals and where contact is for short periods of chemical usage. However, should this chemical be used in mixtures with highly glove-permeable or glove-degrading chemicals or the mechanical stress is greater than the gloves can stand, then the results will be not applicable.
1. Very limited evidence to evaluate the efficacy of sodium hypochlorite (bleach/chlorine solutions) compared with other agents when used for hand hygiene or glove disinfection.

2. Available data indicates that for hand hygiene efficacy there is a relation between bleach/chlorine concentration and contact time.

3. With regards to glove disinfection, no study on efficacy of chlorine solutions compared with alcohol-based hand rub or other antiseptics products, including water and soap was retrieved. Only one study assessed the permeability of surgical gloves to sodium hypochlorite 13% and showed no permeation or glove damage.
4. Limited evidence (only one case report) showing that sodium hypochlorite used for hand hygiene purposes can cause skin irritation or lesions; however, the concentration in this case was much higher than is currently used for hand hygiene.

5. No evidence that low concentrations of sodium hypochlorite used for hand hygiene cause respiratory irritation, other respiratory symptoms or asthma.

6. Risk for irritative conjunctivitis is noted.

7. The use of bleach/chlorine solutions at the concentrations currently used for hand hygiene (500 ppm sodium hypochlorite or a 0.05% chlorine solution) can be acceptable from the tolerability point of view, if other products are unavailable.
Hand hygiene in health care in the context of Filovirus disease outbreak response
Rapid advice guideline

Authors:
WHO

Publication details
Number of pages: 12
Publication date: November 2014
Languages: English
WHO reference number:
WHO/HIS/SDS/2014.15

Downloads
Guideline on hand hygiene in health care in the context of Filovirus disease outbreak response
pdf, 1.05 Mb

Overview
This document provides a summary of the recommendations for hand hygiene best practices to be performed by health workers providing care and/or support to patients with filovirus infection (Ebola and Marburg viruses).

The recommendations were developed in accordance with the WHO Rapid Advice Guideline procedures and are based on systematic reviews of the scientific evidence and the consensus of experts.

Related links
- Five moments for hand hygiene in health care - tools
- Ebola virus disease - website
• We recommend performing hand hygiene, by using either an alcohol-based hand rub or soap and running water applying the correct technique recommended by WHO.

• Alcohol-based hand rubs should be made available at every point of care (at the entrance and within the isolation rooms/areas) and are the standard of care.

• If alcohol-based hand rubs are unavailable, hand hygiene should be performed with soap and running water whenever necessary. When hands are visibly soiled, hand hygiene should always be performed with soap and running water.

*Strong recommendation, high-quality evidence for the effectiveness of alcohol-based handrub or soap and water.*

http://apps.who.int/iris/bitstream/10665/144578/1/WHO_HIS_SDS_2014.15_eng.pdf?ua=1
Recommendation 2

In settings where bleach/chlorine solutions are currently used for hand hygiene, we recommend implementing a strategy to change to alcohol-based hand rub or soap and water.

Strong recommendation, very strong evidence for the in-vivo effectiveness of alcohol-based hand rubs or soap and water.

http://apps.who.int/iris/bitstream/10665/144578/1/WHO_HIS_SDS_2014.15_eng.pdf?ua=1
Recommendation 3

• Bleach/chlorine solutions currently in use for hand hygiene and glove disinfection can be used in the interim period in emergency situations until alcohol-based hand rubs or soap and water become available.

*Conditional recommendation, very low-quality evidence for the comparative efficacy of bleach/chlorine solutions compared with alcohol-based handrub or soap and water, and very low-quality evidence about tolerance to bleach or chlorine solutions for hand hygiene and glove disinfection.*

http://apps.who.int/iris/bitstream/10665/144578/1/WHO_HIS_SDS_2014.15_eng.pdf?ua=1
Final conclusions

• Handwashing with soap and running water is effective

• Ideally, for hand hygiene an alcohol-based handrub should be used as it is highly effective

• On the medium-/long-term, procurement of alcohol based handrub in developing countries including Africa, should be increased (with associated price reduction) and local production should be strongly encouraged and supported
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Prof Folasade Ogunsola, Nigeria
Dr Benjamin Park USA
Prof Didier Pittet, Switzerland
Dr Diamantis Plachouras, Sweden
Prof Manfred Rotter, Austria
Dr Syed Sattar, Canada
Dr Wing Hong Seto, Hong Kong SAR
The next WHO teleclass ....

March 11, 2015

USING THE CORE COMPONENTS OF INFECTION CONTROL DURING THE EBOLA OUTBREAK

Dr. Sergey Eremin
Medical Officer, World Health Organization

Objectives ....
- To introduce the WHO concept of the core components of infection prevention and control programmes in health care.
- To understand the challenges and share the experience in implementing core components of IPC in the countries affected by the current EVD outbreak.
- To discuss minimum standards needed for health facilities in the EVD outbreak setting to operate and provide care in an environment that is safe for both patients and staff.
- To define strategy for building sustainable IPC capacity in the Ebola affected countries.

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