Are towelettes effective for surface decontamination in healthcare settings?

Jean-Yves Maillard
Cardiff School of Pharmacy and Pharmaceutical Sciences
Cardiff University

Hosted by Dr. Lynne Sehulster
Prevention and Response Branch
Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

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OBJECTIVES

- Review the usage of towelettes in healthcare settings, particularly pre-wetted towelettes
- Discuss the role of pre-wetted towelettes in healthcare settings
- Consider the claims made by pre-wetted towelettes’ manufacturers in relation to the efficacy tests performed
- Review the efficacy of antimicrobial and detergent pre-wetted towelettes against bacteria, spores (Clostridium difficile) and viruses
- Reflect on the appropriate usage of pre-wetted towelettes and evidence that need to be provided by manufacturers to make an meaningful and practical claim
- Discuss potential new practical and regulatory challenges for pre-wetted towelettes
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SOME NUMBERS…

• HCAIs cost the NHS: £1 billion annually (£3,154 per patient)
  HPA 2012
  IFIC 2011

• 20-30% of HCAIs could be avoided with better application of existing knowledge and realistic infection control practices
  National Audit Office 2009

• Enhanced cleaning practices are reported to save hospitals between £30,000–£70,000

SURFACES AT RISK

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What is the evidence that environmental surface are involved in the transmission of pathogens?

ROLE OF SURFACES IN MICROBIAL TRANSMISSION

• 1970s - 1990s: THE DARK AGES: AN ALMOST COMPLETE DENIAL!

EVIDENCE

• Microorganisms survival on surfaces proximal to patients (high-touch surfaces)

• Pathogens survival on surfaces at concentrations sufficient for transmission and transference to the hands of healthcare workers (inc. MRSA, C. difficile, norovirus, VRE...)

• Low infectious dose for some pathogens
  Lawley et al. AEM 2010;76L6895-900.

• Ample evidence of the genotypic link between bacteria isolated from patients and surfaces proximal to patients
ROLE OF SURFACES IN MICROBIAL TRANSMISSION

MRSA

- Link between inanimate environmental contamination and infected or colonized individuals

- 65% of nursing staff that had directly treated an infected individual contaminated their gowns/uniforms with MRSA

- MRSA contamination of gloves was also observed in 42% of personnel who had no direct contact with the patient, but had touched surfaces in infected patient's rooms. Boyce et al. ICHE 1997; 18:622–7.


Prevalence of Clostridium difficile


- C. difficile incidence data correlated with the prevalence of environmental spores in 1 ward (out of 2). Fawley et al. Epidemiol Infect 2001; 126: 343-50.
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ROLE OF SURFACES IN MICROBIAL TRANSMISSION

<table>
<thead>
<tr>
<th>Observations</th>
<th>Hospital 1</th>
<th>Hospital 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% observations where staff washed hands</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>% observations where staff used alcoholic hand rub</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>Of those incidences where no gloves worn, % incidences where staff used alcoholic hand rub</td>
<td>41</td>
<td>14</td>
</tr>
<tr>
<td>% staff wearing no gloves and used no AHR, but washed hands</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>% staff using no protection/skin sanitisation</td>
<td>19</td>
<td>46</td>
</tr>
<tr>
<td>% potential staff to object cross-contamination</td>
<td>30</td>
<td>59</td>
</tr>
<tr>
<td>% potential staff to patient cross-contamination</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>% potential object to object cross-contamination</td>
<td>70</td>
<td>88</td>
</tr>
<tr>
<td>% potential object to patient cross-contamination</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>% potential patient to object cross-contamination</td>
<td>17</td>
<td>9</td>
</tr>
</tbody>
</table>

Low frequency of hand sanitisation, particularly with use of AHR lead to high incidence of potential cross contamination

How can decontamination of environmental surfaces be achieved?

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LIMITATIONS OF CURRENT SURFACE INTERVENTIONS

Increasing body of knowledge which highlights improved infection control practices can help break the chain of transmission


BREAKING THE CHAIN OF TRANSMISSION

Staff compliance
Factors affecting efficacy
Product efficacy
Product usage

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BREAKING THE CHAIN OF TRANSMISSION

Possible scenarios for decontaminating high-touch environmental surfaces by wiping

Sattar and Maillard AJIC 2013;41:S97-S104.

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Can manufacturers and end users rely on standard efficacy tests (product claim)?

HOW TO DETERMINE WIPE EFFICACY?

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HOW TO DETERMINE WIPE EFFICACY?

“How the main purpose of wipes is to remove contamination from surfaces. Additionally, some wipes may provide some antimicrobial activity by the inclusion of a disinfectant although this activity might be limited based on contact time, type of surface and contamination present.”

“There are currently no accepted standards to support the selection and purchase of disinfectant wipes in health care.”

Support the use of surface test rather than suspension test.

HOW TO DETERMINE WIPE EFFICACY?

Phase 2, step 2 tests: surface tests

- Determine bactericidal, fungicidal, virucidal or sporidical activity under laboratory conditions that simulate practical conditions.
- Can be used to make a claim (liquid expressed from wipes)
- Application for surface disinfection

*E.g.* EN14561: Quantitative carrier test for the evaluation of bactericidal activity for instruments used in the medical area
Temperature: 20°C(4-40°C); contact time: 5 min (1-60 min) + soiling

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HOW TO DETERMINE WIPE EFFICACY?

**Phase 1, step 1 tests: basic activity (suspension test)**

- Does my product show some antimicrobial activity (yes/no)
- Not to be used to make a claim

**e.g.** (BS)EN14347: Basic sporicidal activity
  Temperature: 20°C; contact time one of the following 30, 60, 120 min; no soiling (no C. difficile)

**Phase 2, step 1 tests: suspension test**

- Determine bactericidal, fungicidal, virucidal or sporicidal activity under laboratory conditions that simulate practical conditions.

**e.g.** EN 13727: Bactericidal suspension test
  Temperature: 20°C(4-40°C); contact time: 5 min (1-60 min) + soiling

Efficacy of “antimicrobial” wipes

Qualitative – agar diffusion test (ISO 20645)

<table>
<thead>
<tr>
<th>ISO 20645</th>
<th>CONTROL</th>
<th>TEST</th>
</tr>
</thead>
</table>

Test interpretation: “good antimicrobial effect”

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**WIPE USAGE IN PRACTICE**

Antimicrobial wipe usage

Observation of usage in practice – cleaning staff in ITUs
- use of wipes – surface area
- contact
- rotation

<table>
<thead>
<tr>
<th>Wipe Number</th>
<th>Surface initially wiped</th>
<th>Time applied (seconds)</th>
<th>Number of consecutive surfaces wiped (other surfaces)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bed Rail</td>
<td>4</td>
<td>5 (bedside table, monitor X2, monitor stand)</td>
</tr>
<tr>
<td>2</td>
<td>Steel Trolley</td>
<td>6</td>
<td>2 (both shelves on the trolley wiped)</td>
</tr>
<tr>
<td>1</td>
<td>Monitor</td>
<td>4</td>
<td>5 (monitors, two keypads, monitor stand)</td>
</tr>
<tr>
<td>2</td>
<td>Bed rail</td>
<td>7</td>
<td>4 (table, monitor, keypad)</td>
</tr>
<tr>
<td>3</td>
<td>Bedside table</td>
<td>10</td>
<td>4 (folder, two bed rails)</td>
</tr>
</tbody>
</table>

Sources:
- Sattar and Maillard AJIC 2013;41:S97-S104.

**WIPE USAGE IN PRACTICE**

Factors impacting on the efficacy of wipes.

- Usage
- Formulation (product)
- Pathogen

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WIPE TESTS

Wiping Not Controlled
AOAC International 961.02
EN 4-Field test (phase 2, step 2)
ASTM International E2362
US EPA (virucidal efficacy, mycobactericidal efficacy)
US EPA; Draft Interim Guidance for Non-Residual
Sanitization of Hard Inanimate Food Contact Surfaces Using Pre-Saturated Towelettes
US EPA Method for Disinfection Using Pre-Saturated Towelettes

Contact Time Inappropriate
AOAC International 961.02
US EPA Method for Disinfection Using Pre-Saturated wipes

Do Not Reflect Product Usage

3-Step Test – A New ASTM Intl. Standard (04-15)

✓ Remove bioburden from a surface
   Stage 1 – Bacterial Removal
   How good are the wipes in removing microbial contaminants? (not killing effect)

✓ Prevent transfer of bioburden from the wipe to other surfaces
   Stage 2 – Bacterial Transfer “Adpression Tests”
   Can the wipes transfer survivors to other surfaces (i.e. cross-contaminate)?

✓ Where antimicrobial is present – kill the microbial bioburden
   Stage 3 – Antimicrobial Activity
   Can the wipes kill the bacteria they remove?

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EVIDENCE THAT PRE-WETTED ANTIMICROBIAL/DETERGENT WIPES WORK

LITERATURE USING THE 3-STEP TEST

- S. aureus and methicillin-resistant S. aureus: one wipe

- methicillin-resistant S. aureus, B. subtilis, S. epidermidis: alcohol impregnated vs. alcohol spray on wipe

Williams GJ, Denyer SP, Hosein IK, Hill DW and Maillard J-Y. (2009) Limitations of the efficacy of surface disinfection in the healthcare settings. Infection Control and Hospital Epidemiology, 30(6); 570-573.
- S. aureus and methicillin-resistant S. aureus: multiple wipes

- C. difficile: multiple wipes


- S. aureus, A. baumanii, C. difficile (spores): multiple wipes

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DO ANTIMICROBIAL WIPES WORK?  

REMOVAL
Log_{10} number of S. aureus cells remaining on surfaces following 10 s applications of control and test wipes. Striped bars: inocula; grey bars: control wipes; white bars: test wipe

(a) Dirty  
1 log_{10} reduction (90%)

(b) clean  
3 log_{10} reduction (99.9%)  
4 log_{10} reduction (99.99%)

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**DO ANTIMICROBIAL WIPES WORK?**


**REMOVAL**

Log_{10} number of *S. aureus* cells remaining on surfaces following 10 s applications of control and test wipes. Striped bars: inocula; grey bars: control wipes; white bars: test wipe.

(a) Dirty

(b) Clean

5 log_{10} reduction (99.999%)

6 log_{10} reduction (99.9999%)

**KILLING**

The bactericidal effect of 10 s exposures of *S. aureus* strains to a grapefruit extract containing wipe.

1 log_{10} reduction (90%)

**Table 1**: A summary of the results obtained using the ISO 20145 agar diffusion test and the novel three-step method

<table>
<thead>
<tr>
<th>Method</th>
<th>Organic load</th>
<th>Antimicrobial wipes</th>
<th>Control wipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 20145 method</td>
<td>NA</td>
<td>Good effect</td>
<td>Low effect</td>
</tr>
<tr>
<td>The three-step method:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bacterial removal</td>
<td>Present</td>
<td>2.05 – 4.66</td>
<td>1.25 – 1.74</td>
</tr>
<tr>
<td>2. Bacterial transfer</td>
<td>Present</td>
<td>1 – 4.71</td>
<td>1.28 – 2.10</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>8 consecutive transfers</td>
<td>8 consecutive transfers</td>
</tr>
<tr>
<td>3. Bacterial effect</td>
<td>Present</td>
<td>0.66 ± 0.07</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Absent</td>
<td>5.58 ± 0.11</td>
<td>NA</td>
</tr>
</tbody>
</table>

Do antimicrobial wipes work?

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DO ANTIMICROBIAL WIPES WORK?

REMOVAL

Log_{10} number of S. aureus cells removed from surfaces following 10 s applications of two disinfectant wipes.

(a) Dirty

(b) Clean

KILLING

The bactericidal effect of 10 s exposures of S. aureus to a disinfectant wipe. Inocula were prepared to simulate dirty (grey bars) and clean (white bars) conditions.
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### DO ANTIMICROBIAL WIPES WORK?


Comparison of efficacy between an alcohol impregnated wipe and a non-impregnated sprayed with ethanol 70% v/v wipe.

<table>
<thead>
<tr>
<th></th>
<th>Impregnated wipe</th>
<th>Non-impregnated wipe sprayed with ethanol 70% v/v</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spores of B. subtilis</td>
<td>Staph. epidermidis</td>
</tr>
<tr>
<td>Efficacy to remove bio burden from surfaces</td>
<td>1.92 ± 0.01</td>
<td>1.96 ± 0.01</td>
</tr>
<tr>
<td></td>
<td>0.00 ± 0.00</td>
<td>1.77 ± 0.03</td>
</tr>
<tr>
<td>Efficacy of wipes to kill inoculum</td>
<td>1.05 ± 0.01</td>
<td>0.78 ± 0.10</td>
</tr>
<tr>
<td>Ability of wipes to transfer bio burden</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

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### Do Antimicrobial Wipes Work?

**Removal**

**SPORICIDAL CLAIM — efficacy testing against C. difficile NCTC12727**


<table>
<thead>
<tr>
<th>Wipes</th>
<th>Bacterial Removal (log₁₀ cfu/disk ± SD)</th>
<th>Bacterial transfer following 10 s wiping time at 500 g surface pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td>1.13 (± 0.36)</td>
<td>5 consecutive transfers. TNTC</td>
</tr>
<tr>
<td>Hypochlorite soaked wipe</td>
<td>2.02 (± 0.21)</td>
<td>5 consecutive transfers. TNTC</td>
</tr>
<tr>
<td>Clinell® sporicidal wipe</td>
<td>4.09 (± 0.79)</td>
<td>No spore transferred</td>
</tr>
<tr>
<td>TriGene Advance</td>
<td>0.22 (± 0.07)</td>
<td>5 consecutive transfers. From 0 to TNTC</td>
</tr>
<tr>
<td>AzoMaxActive™</td>
<td>1.30 (± 0.33)</td>
<td>5 consecutive transfers. From 0 to TNTC</td>
</tr>
<tr>
<td>Sani-Cloth® Rapid</td>
<td>0.57 (± 0.07)</td>
<td>5 consecutive transfers. From 1 to TNTC</td>
</tr>
<tr>
<td>Activ8™</td>
<td>+0.08 (± 0.08)</td>
<td>5 consecutive transfers. From 0 to TNTC</td>
</tr>
<tr>
<td>SuperNova®</td>
<td>1.14 (± 0.65)</td>
<td>5 consecutive transfers. From 0 to TNTC</td>
</tr>
<tr>
<td>Tuffie</td>
<td>0.67 (± 0.11)</td>
<td>5 consecutive transfers of ≤ 43 bacteria</td>
</tr>
<tr>
<td>Enduro Patient wipes</td>
<td>0.88 (± 0.13)</td>
<td>5 consecutive transfers. From 2 to TNTC</td>
</tr>
<tr>
<td>NewGenn</td>
<td>0.84 (± 0.66)</td>
<td>5 consecutive transfers. From 40 to TNTC</td>
</tr>
</tbody>
</table>

*SPORICIDAL CLAIM — efficacy testing against C. difficile NCTC12727*


**Killing**

**SPORICIDAL CLAIM — efficacy testing against C. difficile NCTC12727**


<table>
<thead>
<tr>
<th>Wipes</th>
<th>Claim on label</th>
<th>Sporicidal effect (log₁₀ reduction ±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10 s contact time</td>
</tr>
<tr>
<td>Clinell® sporicidal wipe</td>
<td>Sporicidal</td>
<td>0.11 (± 0.15)</td>
</tr>
<tr>
<td>TriGene Advance</td>
<td>Sporicidal</td>
<td>0.04 (± 0.05)</td>
</tr>
<tr>
<td>AzoMaxActive™</td>
<td>Bactericidal claim and claim against Clostridium difficile on label</td>
<td>1.41 (± 0.14)</td>
</tr>
<tr>
<td>Sani-Cloth® Rapid</td>
<td>Sporicidal</td>
<td>1.77 (± 0.27)</td>
</tr>
<tr>
<td>Activ8™</td>
<td>Sporicidal</td>
<td>0.99 (± 0.14)</td>
</tr>
<tr>
<td>SuperNova®</td>
<td>Sporicidal</td>
<td>1.96 (± 0.09)</td>
</tr>
<tr>
<td>Tuffie</td>
<td>Sporicidal</td>
<td>0.37 (± 0.23)</td>
</tr>
<tr>
<td>Enduro Patient wipes</td>
<td>Sporicidal</td>
<td>0.41 (± 0.10)</td>
</tr>
<tr>
<td>NewGenn</td>
<td>No sporicidal claim on label</td>
<td>0.31 (± 0.15)</td>
</tr>
<tr>
<td>Hypochlorite soaked wipe</td>
<td>5000 ppm</td>
<td>+0.14 (± 0.49)</td>
</tr>
</tbody>
</table>
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**DO ANTIMICROBIAL WIPES WORK?**

**EFFICACY OF ANTIMICROBIAL WIPES AGAINST VIRUSES**

Remove, transfer and kill MS2 phage, a surrogate virus for small non-enveloped mammalian viruses.

<table>
<thead>
<tr>
<th>Wipe</th>
<th>Mean removal</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Universal’ wipes</td>
<td>1.68 log(_{10})</td>
<td>1.37-1.87 log(_{10})</td>
</tr>
<tr>
<td>Sporicidal wipes</td>
<td>3.13 log(_{10})</td>
<td>2.61-3.65 log(_{10})</td>
</tr>
<tr>
<td>Detergent wipes</td>
<td>2.11 log(_{10})</td>
<td>0.36-3.85 log(_{10})</td>
</tr>
</tbody>
</table>

**EFFICACY OF DETERGENT WIPES**

Bacterial/spore removal from surface
- *S. aureus*
- *A. baumannii*
- *C. difficile*

**DO DETERGENT WIPES WORK?**

**REMOVAL**

**Wesgate et al. AJIC; in press**

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DO DETERGENT WIPES WORK?

TRANSFER

EFFICACY OF

DETERGENT WIPES

Wesgate et al. AJIC; in press

<table>
<thead>
<tr>
<th>Wipes</th>
<th>CFU/spores on wipes*</th>
<th>% microba/spore transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>66969</td>
<td>66.43</td>
</tr>
<tr>
<td>B</td>
<td>3633292</td>
<td>11.01</td>
</tr>
<tr>
<td>C</td>
<td>5076282</td>
<td>8.58</td>
</tr>
<tr>
<td>D</td>
<td>4941786</td>
<td>0.04</td>
</tr>
<tr>
<td>E</td>
<td>14557759</td>
<td>0.43</td>
</tr>
<tr>
<td>F</td>
<td>13368894</td>
<td>0.09</td>
</tr>
<tr>
<td>G</td>
<td>16705056</td>
<td>0.00</td>
</tr>
</tbody>
</table>

CFU and % transfer in S. aureus, A. baumannii and C. difficile onto three consecutive surfaces.

DO ANTIMICROBIAL WIPES WORK?

TESTING WIPES EFFICACY: FIELD TRIAL

- Cross-over study in two gastro/surgery wards (1 and 2) with similar patient mix, design and layout (number of bedded-bay and bedded-side room)
- Cleaned using the current wipe regimen (detergent and chlorine) ● or a sporicidal wipe ★ for a period of 9 months.

<table>
<thead>
<tr>
<th>Baseline data</th>
<th>Cross over study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Phase 2</td>
</tr>
<tr>
<td>Ward 1</td>
<td>★</td>
</tr>
<tr>
<td>Ward 2</td>
<td>★ ★ ★ ★ ★</td>
</tr>
<tr>
<td>Month</td>
<td>1</td>
</tr>
</tbody>
</table>

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**DO ANTIMICROBIAL WIPES WORK?**

TESTING WIPES EFFICACY: FIELD TRIAL

- LRU measurement – bioburden on surfaces
- Total aerobic counts
- Total anaerobic count

Siani et al. unpublished data.

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**Education & Training**

**EDUCATION AND TRAINING**

- **Integral to infection control and prevention**
  NHS personnel (medical and non-medical staff) and NHS users (patients and visitors).

- **Evidence that they can contribute to reductions in HCAIs.**

- **Disparity in training**
  Nurses and healthcare assistants were provided with induction training on infection control in 90% of NHS Trusts, whilst only 16% of senior doctors received training.

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EDUCATION AND TRAINING

From wipe manufacturers – Training tools & Audit

A way forward

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A WAY FORWARD

Auditing product efficacy and usage – manufacturers’ responsibility

• The choice of disinfectant will depend on its intended use, thus the manufacturer’s instructions should be followed to ensure correct application. Maillard & McDonald. In Pract 2012;34: 292-9.

• Procurement – include auditing as part of product package

Education of end users

• Joint manufacturers and NHS provider responsibilities

• Procurement - include product training, educational material (poster etc.)

BETTER UNDERSTANDING

Key criteria
- Mechanical effect
- Formulation: correct balance of surfactants

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Are Towelettes Effective for Surface Decontamination in Healthcare Settings?
Prof. Jean-Yves Maillard, Cardiff University, Wales
A Webber Training Teleclass

A WAY FORWARD

BIOCIDES ARE IMPORTANT!
PREVENTION, PREVENTION PREVENTION
COMPLIANCE (only 30% surface disinfected)

ANTIMICROBIAL WIPES
Removal of bioburden from surfaces

Added value – vegetative bacteria –
   kill within the contact time (10 sec)
   - spores - ? – wipes safe to dispose of.

BIOCIDES ARE IMPORTANT!
PREVENTION, PREVENTION PREVENTION
COMPLIANCE (only 30% surface disinfected)

BETTER PRODUCTS
Understanding formulation efficacy

APPROPRIATE EFFICACY TEST
   Product development
   Ensuring efficacy in real conditions

EDUCATION
   Better understanding
   Better usage
   Better information

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THANK YOU

May 5  (Free WHO Teleclass - Europe)
10 YEARS OF WHO CLEAN CARE IS SAFER CARE: WHY YOU SHOULD BE A PART OF THE SOCIAL PANDEMIC THAT IS SAVE LIVES: CLEAN YOUR HANDS
Prof. Didier Pittet, World Health Organization, Geneva

May 7  VACCINATION OF HEALTHCARE PROVIDERS: A CRITICAL STEP TOWARD PATIENT SAFETY
Dr. Helena Maltezou, Hellenic Center for Disease Control and Prevention, Greece

May 13  (Free WHO Teleclass – Europe)
UNDERSTANDING CONSUMER PERCEPTIONS OF HAI AND HAND HYGIENE THROUGH A GLOBAL SURVEY
Claire Kilpatrick, WHO, and Dr. Maryanne McGuckin, McGuckin Methods International

May 21  (Free Teleclass)
IS YOUR PHONE BUGGED? THE ROLE OF MOBILE TECHNOLOGY IN INFECTION CONTROL

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