

A dynamic background of water splashing and bubbling, with a central blue sphere. The water is captured in various stages of motion, creating a sense of energy and freshness. The colors range from light blue to a deeper blue in the center where the sphere is located.

# ***Clostridium difficile*** **spores & latest** **information from USA**

**Michael Gately, B Soc. Sci., MBA**

# Presentation objectives

- Outline current situation with *Clostridium difficile* spores
- Discuss international best practice
- Advise on emerging research on hospital surface biofilm
- Indicate some important issues for your families

# Sub-segment of healthcare biocide market

		Application Area		
		Human Body*	Surface	Instrument
Degree of kill of bugs	Low	Antiseptic (for body) Sanitizer (for surface)		
	Almost complete	Disinfectant		
	Complete	Steriliser		

**Area of discussion, Operating rooms & General wards**

\*Skin disinfection: <http://www.cdc.gov/media/releases/2013/p0529-mrsa-study.html>

# From the Director General of The World Health Organization

**“The emergence and spread of drug-resistant pathogens has accelerated. More and more essential medicines are failing. The therapeutic arsenal is shrinking. The speed with which these drugs are being lost far outpaces the development of replacement drugs. In fact, the R&D pipeline for new antimicrobials has practically run dry”**

**“The threat of untreatable infections is real. Although previously unthinkable, the day when antibiotics don’t work is upon us. We are already seeing germs that are stronger than any antibiotics we have to treat them.”**

*- Arjun Srinivasan, MD, associate director for healthcare-associated infection prevention programs, Division of Healthcare Quality Promotion, Center for Disease Control and Prevention*



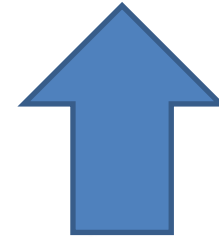
# The top 4 = 60% of outbreaks

**Norovirus 18.2%**

**Staphylococcus aureus 17.5%**

**Acinetobacter spp 13.7%**

***Clostridium difficile* 10.3%**



# *Clostridium difficile*

- ***Clostridium difficile*** – *C. difficile* is a gram-positive, anaerobic bacillus spore forming organism from the gut.
- When ingested it migrates to colon where it produces toxins
- Symptoms such as such as diarrhoea, abdominal pain, fever and increased white blood cell count
- 14,000 Hospital acquired infection deaths per annum in USA (despite 45% of all disinfectant used there)
- Thrives in situations where competing gut bacteria are reduced by antibiotics
- Low dose (100) enough to cause severe illness



**Now a greater threat than MRSA!**

# Decreasing Order of resistance to disinfectant

Most resistant

Prions

Spores (*C. diff*)

Mycobacteria

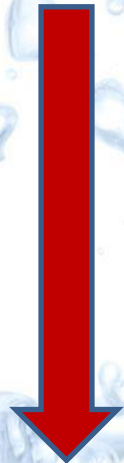
Non-enveloped viruses (Norovirus)

Fungi

Bacteria (MRSA, VRE, Acinetobacter)

Enveloped Viruses

Least resistant



# Mutation by *Clostridium difficile*

BI/NAP1/027

The epidemiology of *Clostridium difficile* infections (CDIs) has dramatically changed over the last decade in both North America and Europe, and it has become more frequent, more severe, more refractory to standard therapy, and more likely to relapse.

[http://apic.org/Resource/\\_EliminationGuideForm/59397fc6-3f90-43d1-9325-e8be75d86888/File/2013CDiffFinal.pdf](http://apic.org/Resource/_EliminationGuideForm/59397fc6-3f90-43d1-9325-e8be75d86888/File/2013CDiffFinal.pdf)

By Rodriguez-Pardo Dolors; Mirelis Beatriz; Navarro Ferran

From Enfermedades infecciosas y microbiología clínica (2013). Language: Spanish, Database: MEDLINE

*C.diff* as primary cause of death increased almost 10 fold (in USA) between 1999 & 2008.

Guide to Elimination of *Clostridium difficile* in Healthcare settings APIC



# Hypersporulation

- Sporulation is where bacterium move from vegetative form to protected spore state. ( *C.diff* )
- Spores are hard waterproof membranes which prevent drying out
- *C diff.* spores are difficult to kill and highly infectious
- Many disinfectants actually encourage sporulation as they stress the vegetative form of the bacterium
- Only chlorine based disinfectants and maybe some very high-concentrations of H<sub>2</sub>O<sub>2</sub> kill spores

A dynamic background image showing a large splash of water with many bubbles and droplets, creating a sense of movement and freshness. The water is clear and bright, with some darker blue tones in the splash.

**Hydrogen peroxide, bleach or even detergent  
can cause very significant increases in *C. diff*  
sporulation.**

**This is a particular danger where sanitation level  
of dosages are used in home**

# Characteristics

- **Very low inoculation dose – just 100 spores**
- **Symptom is diarrhoea**
- **Spread by faeces**
- **Acquisition by ingestion**
- **1 gram of faeces contains more germs than all humans who have ever lived**
- **Faecal shedding**
- **Survives 6 days on skin**
- **Survives 5 months on surfaces**

# High Cost of Hospital Acquired Infections

- Cost to the hospital of extra bed days
- Cost to the hospital of extra drugs, bandages etc.
- Cost to the patient & patient's family of death or work time lost
- Emotional cost to patient and family
- Loss of hospital staff due to sickness
- Risk to the families of hospital staff sickness
- Opportunity for pathogens to mutate or strengthen



## ***C. diff*- dramatic reduction by proper disinfection**

**C. Diff incidence reduced from 16.6 per 1000 patient days to 3.7 by proper environmental disinfection & maintained for 2 years.\***

\* <http://journal.publications.chestnet.org/article.aspx?articleid=1086038>

# Effective disinfectants – US EPA

## Three part soil test

- Bleach
- ‘Improved Hydrogen Peroxide is not effective against spores’ *Rutala W et al, Infection Control Hospital Epidemiol 2013;33; 1159-61*
- Klorsept & Klorkleen

# Your Challenges

A dynamic background image showing a large splash of water with many bubbles and droplets, creating a sense of movement and freshness. The water is light blue and white, set against a white background.

- **50% of surfaces not properly cleaned**
- ***C.diff* requires physical removal & disinfection**
- **Very few (3) chemicals approved in USA for *C.diff***
- **Illegal in US to use non effective disinfectant in OR**

# PEOPLE PEOPLE PEOPLE

The background of the slide features a dynamic splash of water in shades of light blue and white. In the center of the splash, a small, semi-transparent globe of the Earth is visible, showing continents and oceans. The water droplets and splashes are scattered across the frame, creating a sense of movement and freshness.

**R**e-educate & Explain regularly

**E**mpower

**P**rioritize

**E**xamine

**L**isten



# The patient is your partner

- **Educate the patient & family about infection safety**
- **Educate about self infection**
- **Educate about infecting others**
- **Educate about washing hands with soap regularly**
- **Empower them to ask health care providers to wash-in and wash out**
- **Help high risk patients care for themselves**

# Hand washing & *C. diff*

## Common antimicrobial agents not effective

Alcohol – not effective

Chlorhexidine – not effective

Idophors – not effective

Triclosan – not effective

Hexachlorophene – not effective

**Proper hand washing with soap & water is effective**

# Best practice

## Contact precautions for patients with diarrhoea

Prior room occupant = high next-patient rate

62.2% of bath basins used in ICUs to wash patients were found to be contaminated.

(American Journal of infection control 40 (2012) 562-4)

## Privacy curtains

Disinfect up to 1 meter in from leading edge on both sides. Use a “Palm to Palm” action.

(\*American Journal of Infection Control 40 -2012 904-6).

**Remote control for TV remains infected after most cleaning regimes**

# Checklists (especially for CDI / diarrhoea prior occupant)


**The use of checklists combined with monthly reports is associated with a significant decrease in Nosocomial infections. (150 item list, hands procedures, cultures)**

Yinnon Et Al J Hosp Infect. 2012 Jul;81(3):169-76. Epub 2012 May 23

**SMART - specific, measurable, achievable, relevant, and time bound approach**

<http://journal.publications.chestnet.org/article.aspx?articleid=1086038>



A dynamic background of water splashing and bubbling, with a prominent blue sphere in the center. The water is rendered in various shades of light blue and white, creating a sense of movement and freshness.

# **Hospital Surface Biofilms**

**New research**



Review

## Surface-attached cells, biofilms and biocide susceptibility: implications for hospital cleaning and disinfection

J.A. Otter<sup>a, b, \*</sup>, K. Vickery<sup>c</sup>, J.T. Walker<sup>d</sup>, E. deLancey Pulcini<sup>e</sup>, P. Stoodley<sup>f, g</sup>, S.D. Goldenberg<sup>a</sup>, J.A.G. Salkeld<sup>b</sup>, J. Chewins<sup>b</sup>, S. Yezli<sup>b</sup>, J.D. Edgeworth<sup>a</sup>

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### SUMMARY

Microbes tend to attach to available surfaces and readily form biofilms, which is problematic in healthcare settings. Biofilms are traditionally associated with wet or damp surfaces such as indwelling medical devices and tubing on medical equipment. However, microbes can survive for extended periods in a desiccated state on dry hospital surfaces, and biofilms have recently been discovered on dry hospital surfaces. Microbes attached to surfaces and in biofilms are less susceptible to biocides, antibiotics and physical stress. Thus, surface attachment and/or biofilm formation may explain how vegetative bacteria can survive on surfaces for weeks to months (or more), interfere with attempts to recover microbes through environmental sampling, and provide a mixed bacterial population for the horizontal transfer of resistance genes. The capacity of existing detergent formulations and disinfectants to disrupt biofilms may have an important and previously unrecognized role in determining their effectiveness in the field, which should be reflected in testing standards. There is a need for further research to elucidate the nature and physiology of microbes on dry hospital surfaces, specifically the prevalence and composition of biofilms. This will inform new approaches to hospital cleaning and disinfection, including novel surfaces that reduce microbial attachment and improve microbial detachment, and methods to augment the activity of biocides against surface-attached microbes such as bacteriophages and antimicrobial peptides. Future strategies to address environmental contamination on hospital surfaces should consider the presence of microbes attached to surfaces, including biofilms.

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E-mail address: [jonathan.otter@kcl.ac.uk](mailto:jonathan.otter@kcl.ac.uk) (J.A. Otter).

# Biofilms new research

- **Vegetative germs are surviving on dry hospital surfaces for months**
- **Biofilms protect against disinfection 100- 1000 times more difficult to kill**
- **Low pH & Oxidizing disinfectants are best**



# Biofilms

**60% of human infection arise from biofilm formation**

*( mainly in wounds)*

<http://www.infectioncontrolday.com/webinars/2011/12/biofilms-in-medicine--patients-threatened-by-highly-organized-militant-pathogens.aspx>

**Biofilms can act as a reservoir of pathogens in the hospital and offer favorable environment for pathogens to persist over extended periods.**

**The biofilm structure protects embedded pathogens against biocides**

**Biofilms increase patient exposure and provide higher infectious dose**



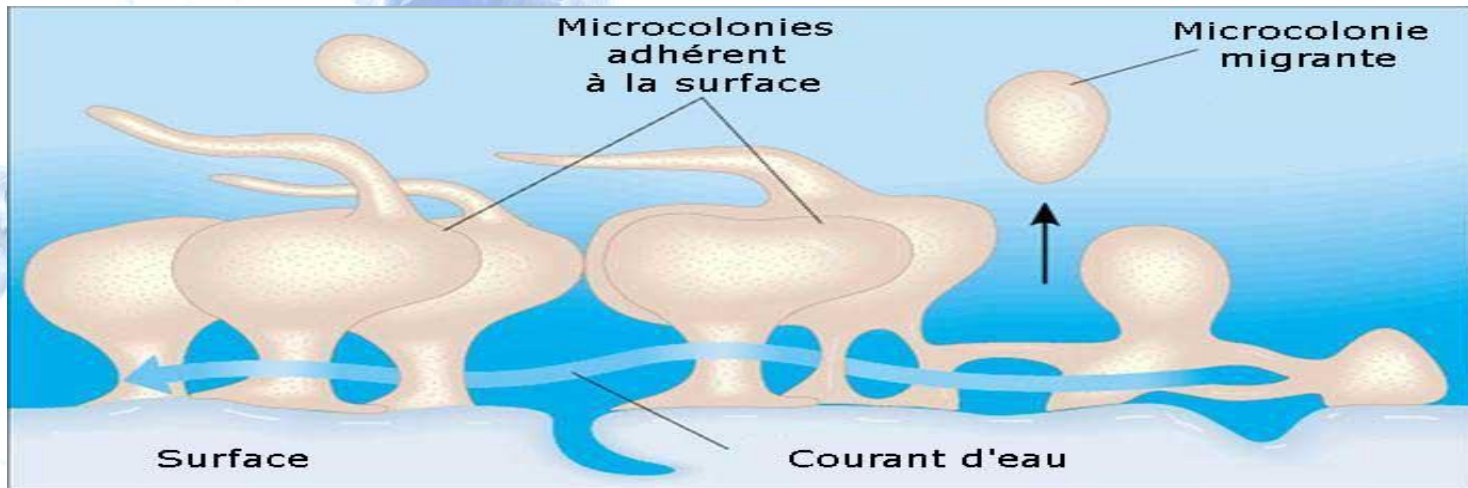
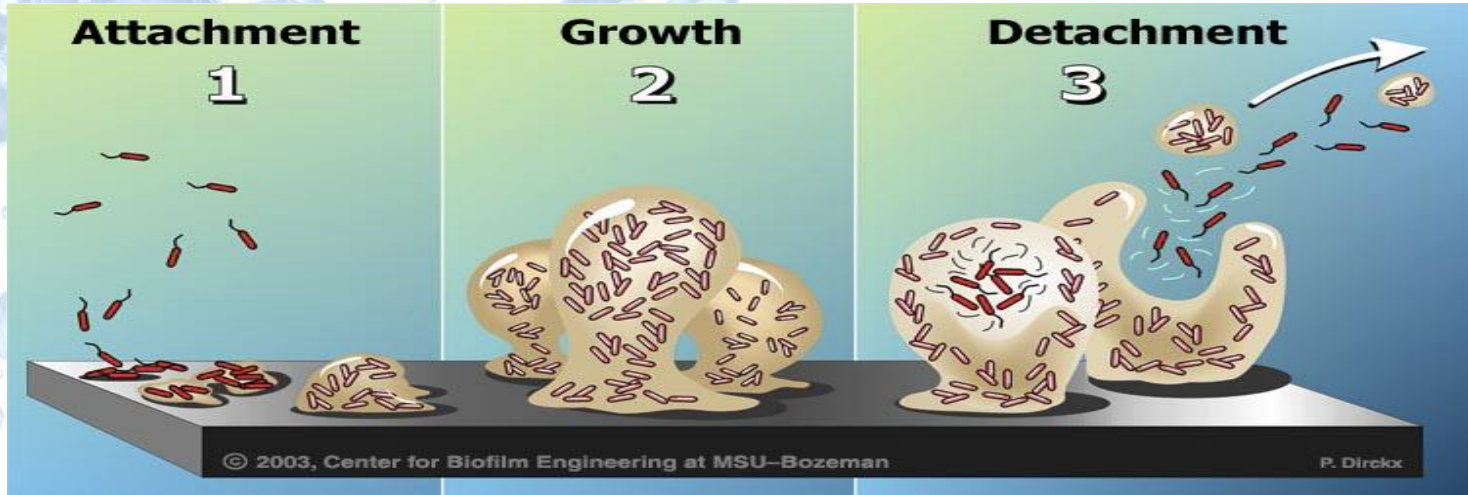
# What are Bio-films?

- A biofilm is an aggregate (group) of germs in which cells adhere to each other on a surface.
- **Listeria, Salmonella, Psudomonas, Campobacteria**
- **Aerobic on top & anaerobic underneath**
- **Intercellular communication**
- **Resistance increase by 100 – 1000%**

# Biofilm

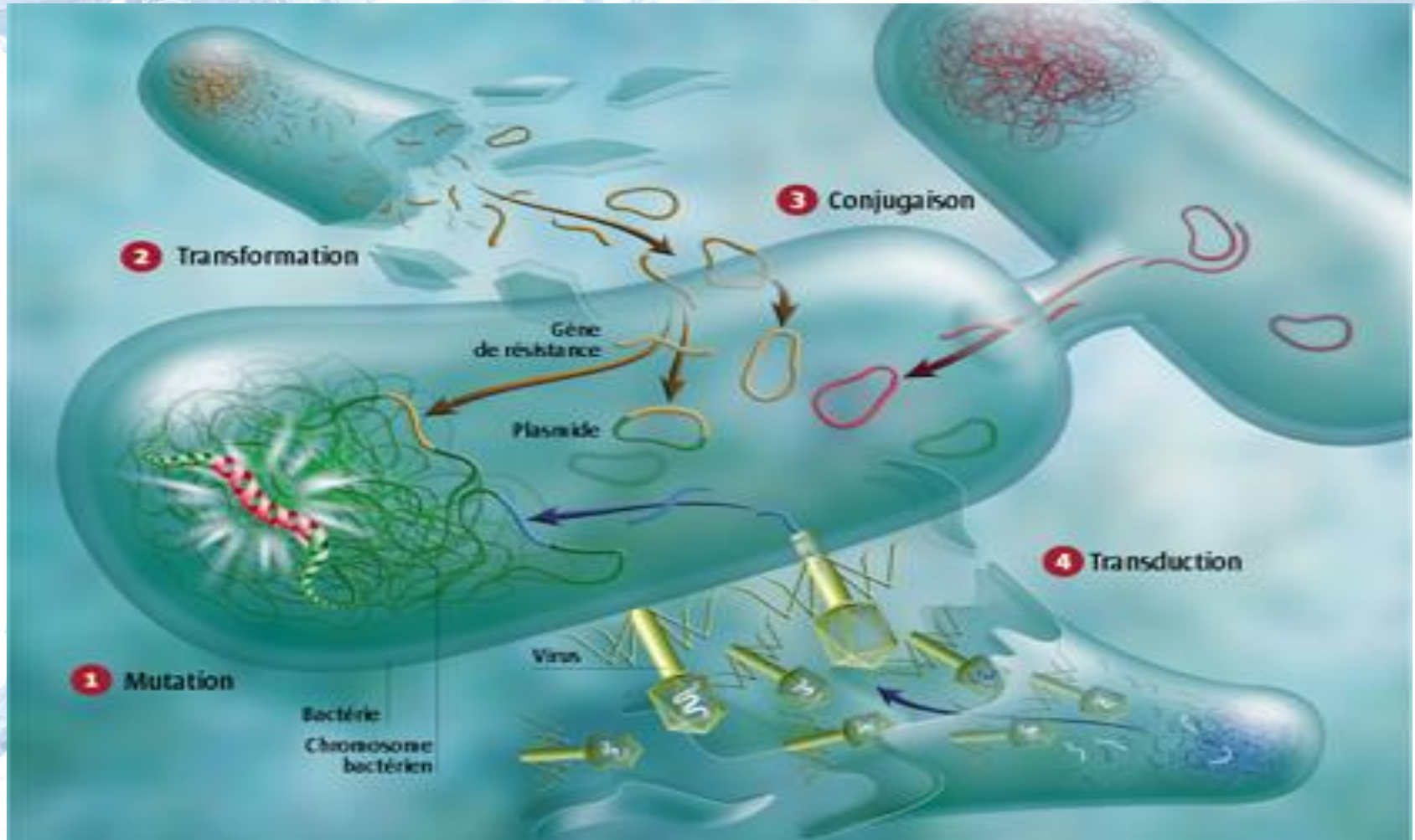
- **Dirt provides nutrients (protein) = biofilm grows.**
- **Aerobic & anaerobic cooperate in single mass barrier – 100 – 1000% increase in resistance**
- **Self protecting – inter organism communication**
- **(division of labour)**
- **“Seeding” then can occur**
- **Increase in antibiotic resistance**
- **The infection pressure may become sufficient to overflow the physiological immune response especially in immuno-compromised patients**

# How Biofilms disperse





# Mutation of pathogens with increased resistance





# What disinfectant is needed

- **Broad spectrum ( Bacteria, Mycobacteria, Fungai, Spores, Viruses & biofilms)**
- **High level – 6 log**
- **Fast acting (under 5 minutes)**
- **What is the secret hidden by your disinfectant?**

# Ideal Disinfectant

- Proven High-Level activity against microorganisms of concern
- Effective against a Broad Spectrum of germs & Biofilm
- Rapid activity < 5 minutes
- Compatible with environment - plastics, stainless steel, soap etc.
- Non-toxic, non-irritating, non-corrosive at in-use dilutions
- Reliable quality and extended shelf-life
- Cost-effective in-use
- Easy to use, and easy to understand and obtain in-use dilutions
- Safe to store and handle



# What Are Klorsept & Klorkleen Tablets?

**They are a broad spectrum biocide in effervescent tablet form**

**In water, Klorsept Tablets provide disinfectant solutions of known and accurate strength**

**Available in two tablet sizes for convenient application - Klorsept 17 & 87**

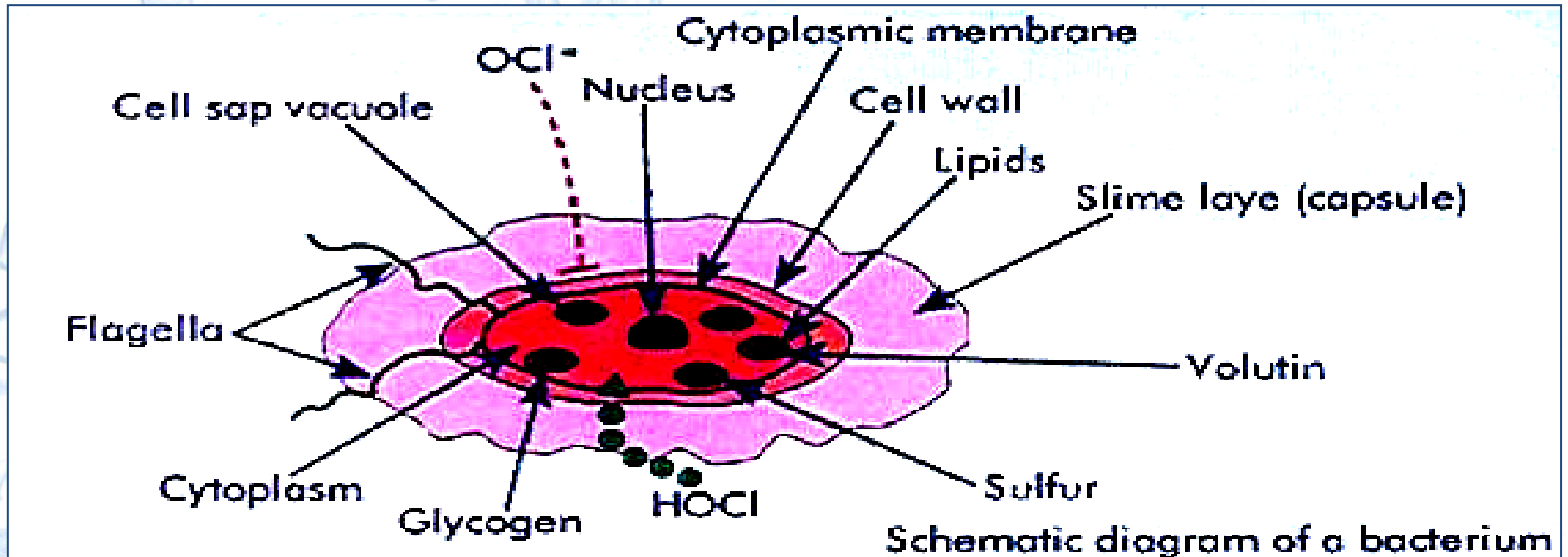


# Why Is HOCl 100 Times More Powerful?

HOCl has a similar chemical structure to water (HOH)

It is similar in size and it is electrically neutral

These factors enable it to penetrate the cell wall in a similar way to water



$\text{OCl}^-$  is electrically charged, which makes it difficult to penetrate the cell wall



# Is Klorsept Trusted?

- **UNICEF**
- **World Health Organization**
- **Medecine Sans Frontieres**
- **“All” British Hospitals**
- **20% of Russian market**
- **US EPA tested and approved**
- **Used by NASA**



A dynamic background of water splashing and bubbling, with a large blue sphere in the center. The water is captured in mid-air, creating a sense of movement and energy. The overall color palette is light blue and white.

## Ask Yourself!

What are you bringing home to your most vulnerable family member and when are they more vulnerable?

# Immuno-compromised family members

People with primary immuno-deficiency conditions,

1. Elderly ( *C. diff* mostly effects elderly, white females)
2. Babies
3. People already ill or recovering from illness
4. People taking anti-acid tablets
5. People on antibiotics
6. AIDS
7. People undergoing treatment such as cancer or transplants
8. Dialysis
9. Children with open cuts or acne
10. Pregnant



# Do you infect your family?

- **Infection will hit immune-compromise people. Healthy people will act as reservoir and transmit the disease. (Mitsuda *et al.*, 1999)**
- **Authors identified 37 pathogens associated with 206 outbreaks at long-term care facilities, and HCW were infected in more than 50 % of the cases. There are likely to be carried back to their family. (Utsumi *et al.*, 2010)**



# The Facts

- Healthcare worker (HCW) are at higher risks of acquiring infections and transmitting the infections than non healthcare workers.
- Healthy HCW may also act as reservoir, transmitting the infections to their families without being sick themselves.
- Significantly higher infections were observed among family members of HCW than family members of patients (Lu *et al.*, 2008).
- Recent studies have identified that (HCW) household members are more likely to carry MRSA than general population and that different strains of MRSA may circulate within the household (Calfee *et al.*, 2014).
- Estimated approximately 9-42 HCW per million die annually from occupational death (Sepkowitz and Eisenberg, 2005). Does not include HCW families

# Face touching

- **Via video, researchers looked at the face-touching behaviour of medical students at the University of New South Wales in Sydney, Australia.**
- **On average, the students touched their face 23 times each hour. Of all of the face touches, 44 percent involved contact with a mucous membrane (36 percent involved the mouth, 31 percent involved the nose and 27 percent involved the eyes).**

# Phones

- **9-25% of the devices used by HCW were contaminated with pathogenic bacteria, and 95% of the mobile phones and hands of HCW working in the operating and intensive care rooms were contaminated with different bacteria**

<http://www.medscape.com/viewarticle/838295> Doctors electronic devices carry germs

# Advice

- Frequency of hand washing during day
- Stop touching hair, nose, mouth, eyes = the T Zone
- Personal terminal disinfection at end of shift
  - Full shower??
  - Surgery level of hand washing
  - Change of clothes
- Get ALL the vaccines
- Improve home disinfection – NOT sanitation



## Advice 2

- **Washing machines now was at low-temperatures.**
- **We love false nails but not for work**
- **Remain at home if you are ill – your are “The vulnerable”**
- **If family members say they feel unwell - listen**

# Home disinfection tips

- - cloth in dish washer then soak in bleach or clearon tabs
- - advise family against antibiotics
- - toothbrush in disinfectant ( close toilet lid)
- - spray bottle refill.
- - its the handle not in the toilet that's the problem.

Steam clean  
In dishwasher  
then soak in  
disinfectant



Make your  
own  
disposable  
wipes



# Key messages

- *Clostridium difficile* has mutated
- It is killing more people in USA than MRSA
- Very few disinfectants are effective
- Many disinfectants make things worse
- Wise to use a broad spectrum, high-level disinfectant
- Biofilms protect vegetative bacteria on dry hospital surfaces
- Protect your vulnerable family members
  
- Ask Quimca MediQ for a copy of their training program

A dynamic splash of water with a blue sphere in the center, set against a light blue background. The water is captured in mid-air, creating a sense of movement and energy. The sphere is a vibrant blue, contrasting with the lighter blue of the water and background. The overall composition is clean and modern.

**Thank you**

**Further reading & references below**



# Free training sites

- (1) <http://www.hhs.gov/ash/initiatives/hai/training/>
- (2) <http://www.webbertraining.com/recordingslibraryc4.php>
- (3) Guidelines: <http://www.cdc.gov/hicpac/pubs.html>  
<http://www.hhs.gov/ash/initiatives/hai/training/>

A dynamic background of water splashing and bubbling in shades of light blue and white. The water is captured in mid-air, creating a sense of movement and freshness. The splashes are concentrated in the upper and lower portions of the frame, with a large, central splash that appears to be the source of the water. The overall effect is clean and refreshing.

# Best Practice in Infection Control

<http://www.oahpp.ca/resources/documents/pidac/2011-01%20BP%20Infection%20Prevention%20Control.pdf>

The background of the slide features a dynamic splash of water in shades of light blue and white, with various droplets and bubbles scattered throughout. The water appears to be falling or splashing from the top, creating a sense of movement and freshness.

## **Suggested reading**

**“Guidelines for Environmental Infection Control”  
Centre for Disease Control USA 2003**

**“Control of Hospital Infection” Ayliffe 2000**

**Guidelines for Disinfection and Sterilization in  
healthcare facilities William A Rutala. CDC 2008**



# Links

**On demand Library:**

[www.apic.org/anywhere](http://www.apic.org/anywhere)

**APIC Lab Collaborative:**

[www.apic.org/labproject](http://www.apic.org/labproject)

**APIC – EVS:**

[www.apic.org/cleanspaces](http://www.apic.org/cleanspaces)

**Assoc for the healthcare Environment:**  
(free e-newsletter)

[www.ahe.org](http://www.ahe.org)

**Bundled Practices:** [www.shea-](http://www.shea-)

[online.org/guidelinesresources/compendiumofstrategiestopreventhais.aspx](http://online.org/guidelinesresources/compendiumofstrategiestopreventhais.aspx)

# Further resources

Association for Professionals in Infection Control and Epidemiology (APIC): Available at: <http://www.apic.org>

Best Practices for Infection Prevention and Control Programs in Ontario, September 2008.  
Available at: [http://www.health.gov.on.ca/english/providers/program/infectious/diseases/best\\_prac/bp\\_ipcp\\_20080908.pdf](http://www.health.gov.on.ca/english/providers/program/infectious/diseases/best_prac/bp_ipcp_20080908.pdf)

Centers for Disease Control and Prevention (CDC): Available at: <http://www.cdc.gov>

Certification Board of Infection Control and Epidemiology (CBIC): Available at: <http://www.cbic.org>

Institute for Healthcare Improvement (IHI): Available at: <http://www.ihl.org/ihl>

The CDC Hospital Infection Control Practices Advisory Committee (HICPAC):  
Available at: <http://www.cdc.gov/ncidod/dhqp/hicpac.html>

The Joint Commission (TJC): Available at: <http://www.jointcommission.org>

Society for Healthcare Epidemiology of America (SHEA): Available at: <http://www.shea-online.org>

# General Reading

<http://www.infectioncontrolday.com/articles/2012/08/environmental-hygiene-what-we-know-from-scientific-studies.aspx>

<http://www.infectioncontrolday.com/news/2013/07/ecdc-releases-first-point-prevalence-survey-on-hais.aspx>

<http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>



# General References

**(z – Favero, M.S. Chemical Disinfection of Medical and Surgical materials in disinfection, sterilization & preservation. 3<sup>rd</sup> edit. Ed. S.S. Block, Lea and Febiger, Philadelphia 1983 , 469 – 492**

**(Z) Disinfectants in Martindale: The Extra Pharmacopeia, 29<sup>th</sup> Edit. Ed. J.E.F. Reynolds, The Pharmaceutical Press, London 1989, 949-972**

