

# Using Vaporised Hydrogen Peroxide in Disinfection

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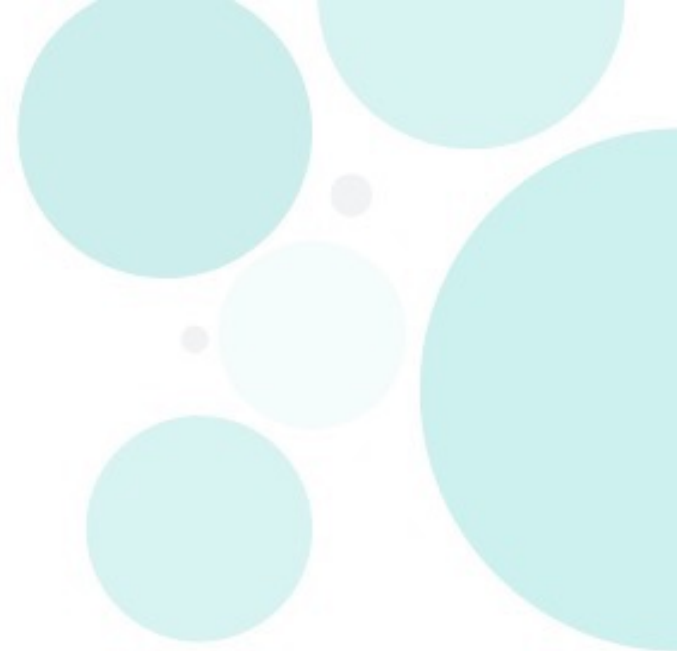
Hilton Hotel, Brussels, September 2016

Dr J-M Hubrechts



# PERSONALIA

- Hubrechts Jean-Marie Hubert Sebille
- Nationality : Belgian
- Born in Hasselt (Belgium) 11.08.1947



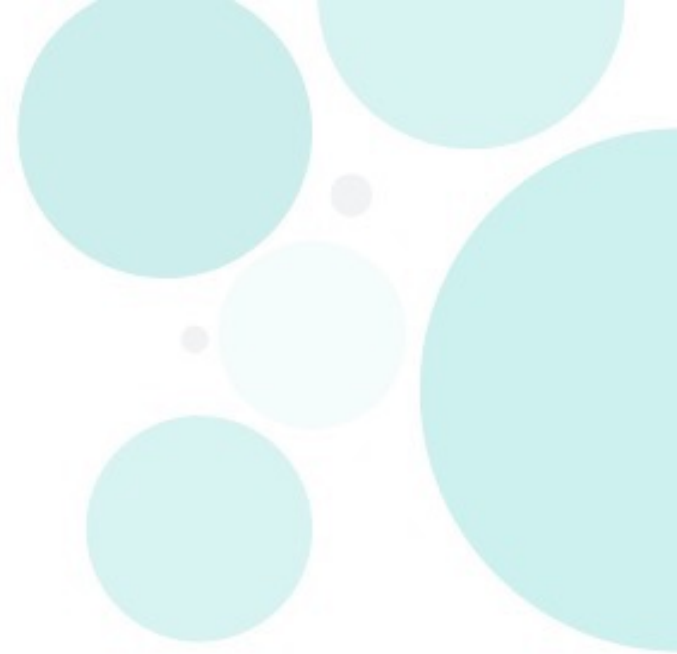
# C.V.

- 1974: Medecine (RUCA-VUB)
- 1977: Postgraduate Humane Ecology (WHO)
- 1979: Specialist in Clinical Biology (Microbiology)
- 1988: PHD (VUB) Thesis: Chlamydial Infection
- 1991: Postgraduate Hospital Hygiene (ULB)
- 1992-93: University Professor Microbiology (U.Liège)



# Professional activity

- Director of Labax laboratory in Brussels.(1987-1993)
- Director of MedicLab in Aalst.(1995-2006)
- Chief of the Laboratory of the Hospital chain Iris-South. Brussels (retired in 2011) and
- Infectiologist (1986-2007)



# Hospital Hygiene

- Hospital Hygienist in Bracops Hospital (Anderlecht Brussels) (1986-2009)
- Hospital Hygienist in the Medico-Geriatric Center of Woluwe St.Lambert (Brussels) (2008-2015)
- Almost 10 years experience in Peroxide Vapour Disinfection



# Biodecontamination by HPV (Hydrogen Peroxide Vapour)

Agricultural applications



# Greenhouse vegetables: cucumber, tomato and pepper



# Powdery Mildew infestation of cucumber





When the plants are infected start spraying 2% to 4% “Peroxide solution” each day as long as the infection is present, after that the spraying frequency can be reduced to one time a week



## New bio tomato plants

After disinfection of the area, before planting, dip the young plants in a dilution of 2% "Peroxide solution".



## An overview of the different diseases of tomatoes:

- Grey mould (*Botrytis cinerea*)
- Septoria leaf spot (*Septoria lycopersici*)
- Late blight (*Phytophthora infestans*)
- Powdery mildew (*Oidium lycopersici*)



An overview of the different diseases :

- Powdery mildew (*Oidium lycopersici*)
- Powdery mildew on stem



# New bio pepper plants



# ***Fruit & vegetables***

- Peroxide diluted in water for better conservation and protection against moulds***



# Selection of pears



# Protection during quality selection of apples





# Bio-potatoes

Protection against Phytophthora with 2% peroxide vaporisation.



# Veterinary Applications



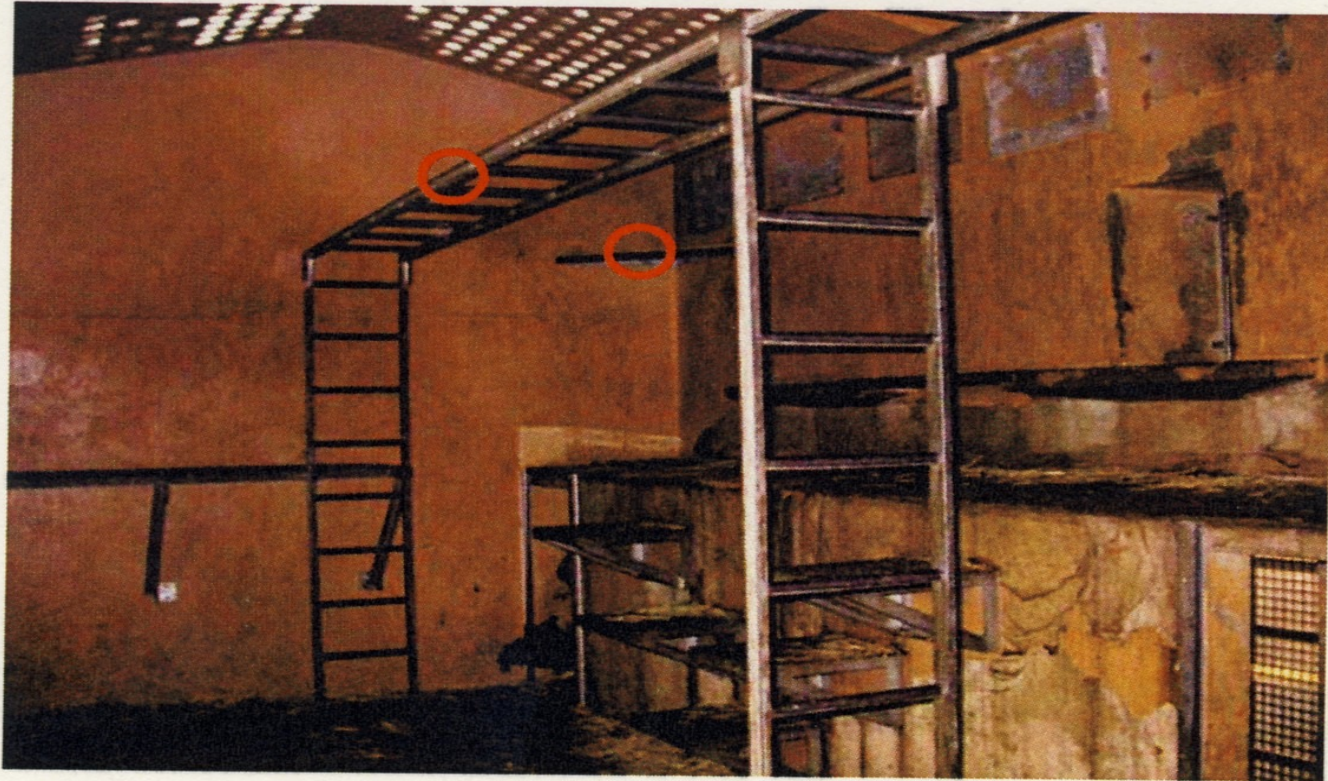
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Paris Zoo : Baboon Cage

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# Paris - Zoo Babooncage – ladder

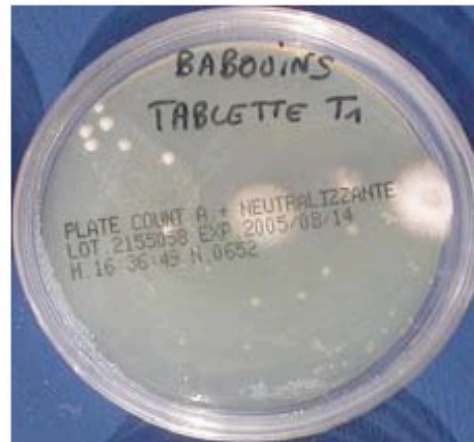
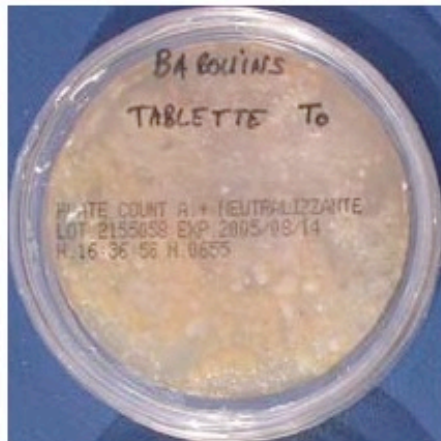
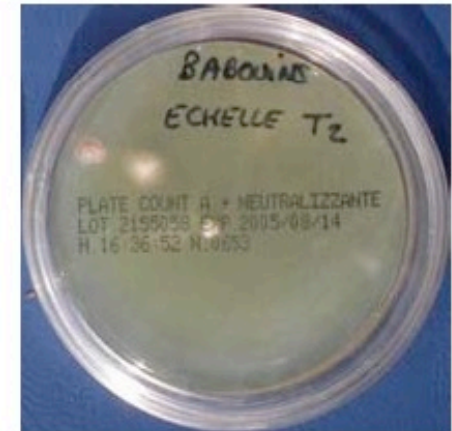
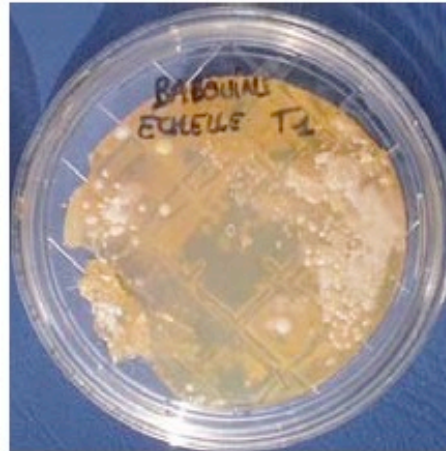
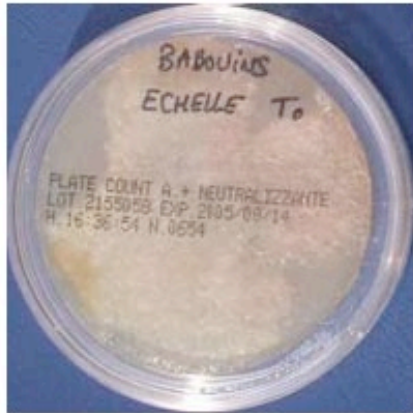
**Loges des babouins :**



# Paris - Zoo Babooncage - shelves



# Bacteriologische controles



# Biodecontamination by HPV (Hydrogen Peroxide Vapour)

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Medical applications

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# HPV for disinfection. Why ?



- Safe : decomposes in  $H_2O$  and  $O_2$
- Ecological: respects the environment
- No danger for the users
- Large spectrum of activity
- Rapid action
- No deposits on surfaces, no remnants

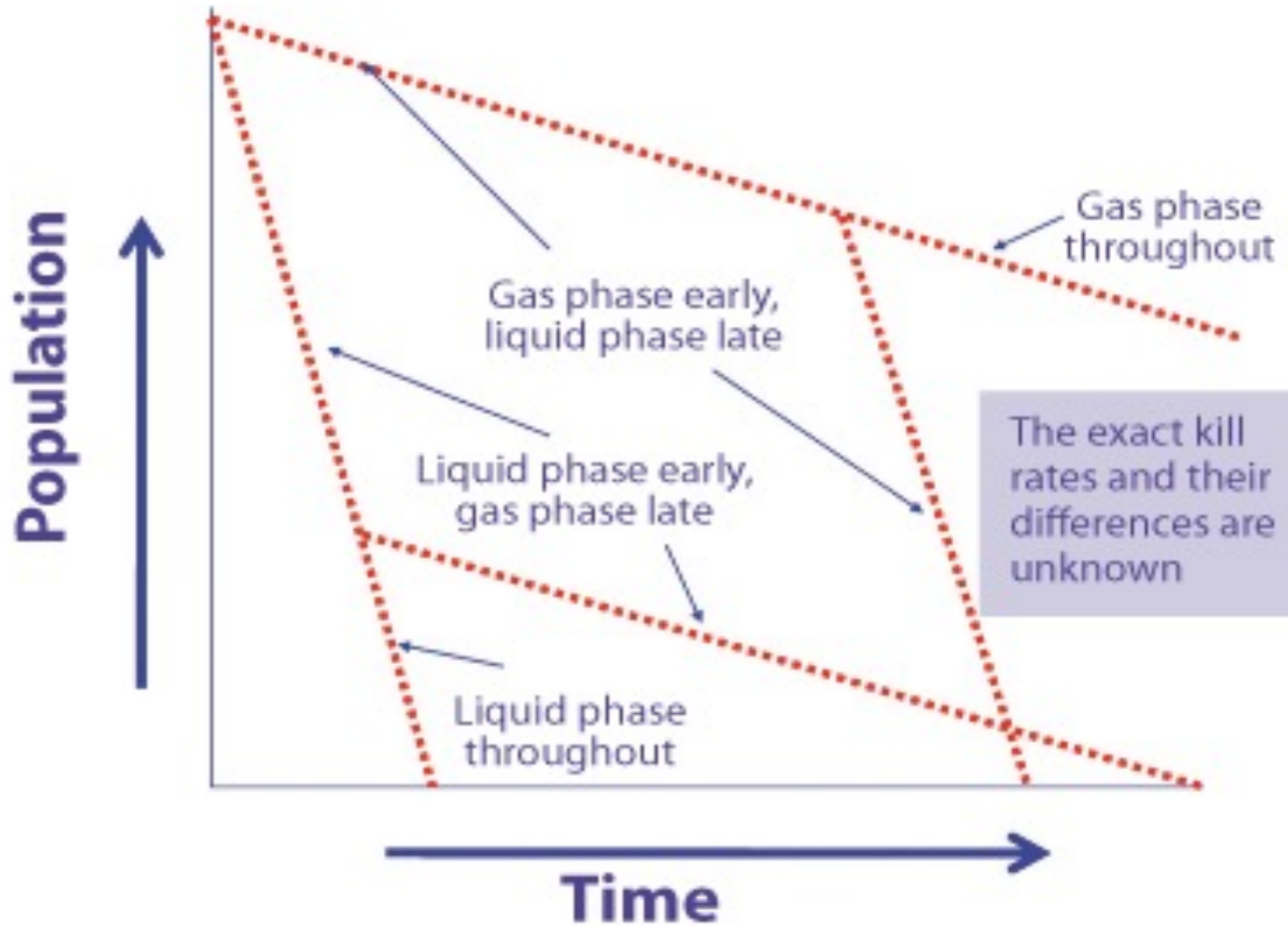


# How?

Liquid misting system for liquid peroxide distribution within an area: The vaporizer produces a disinfecting mist (aerosol), with small droplets that condense without causing humidity nor corrosion.







# Killing potential or biocidal activity



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Hydrogen peroxide generates **hydroxyl radicals** that initiate lethal reactions within exposed cells .

The cell membranes of the microorganismen are damaged: interference with proteins, lipids and amino acids .

The exact fine mechanisms are complex and poorly understood.

**There is no induction of resistance.**

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# Overall evaluation



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- Hydrogen peroxide generates hydroxyl radicals that initiate lipid peroxidation chain reactions within exposed cells and can lead to **DNA damage** and cell death in cultured mammalian cells.
  - Hydrogen peroxide is *not classifiable as to its carcinogenicity to humans*
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- Activity on nosocomial pathogens

Staphylococcus (MRSA)

Enterococci (VRE)

C.Difficile

Acinetobacter sp.

*Can contaminate hospital surfaces and are not eradicated by conventional cleaning.*

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# Hospital rooms



- Allows rapid disinfection of surfaces and rooms
- Generates no humidity.
- Completes the mechanical cleaning.
- Autonomous, portable, rapid , no extra work-load



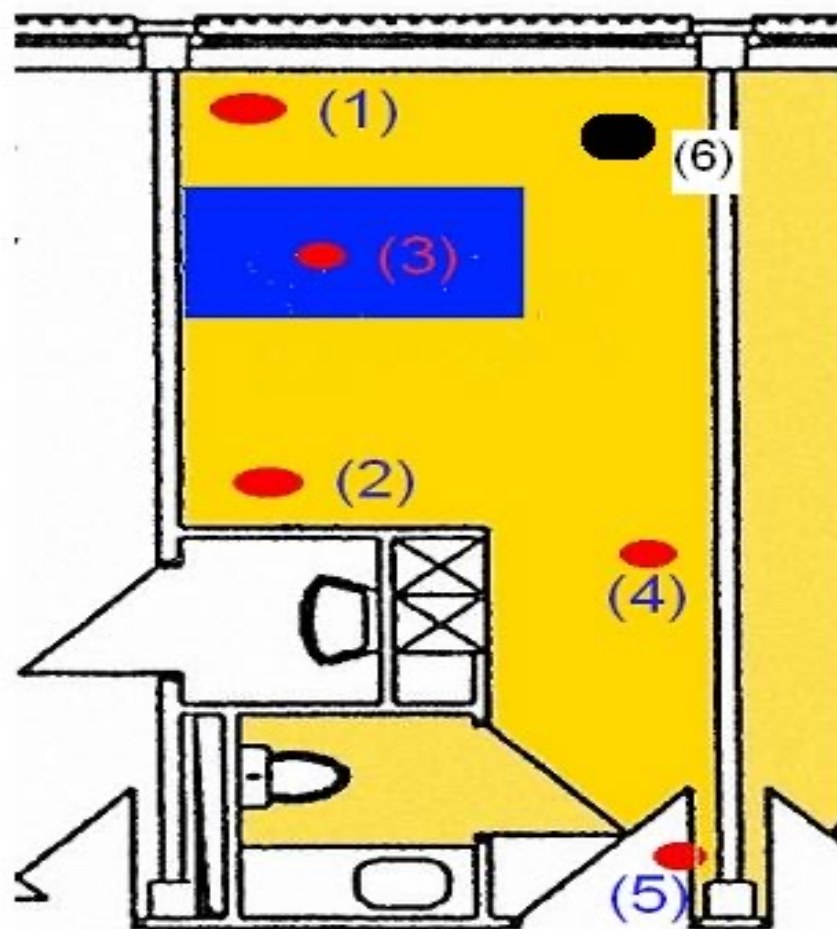








310



# References

## 1) Virucidal activity NFT 72180

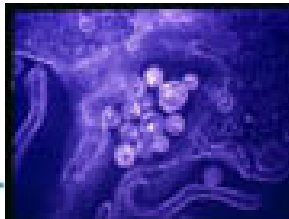
(Institut Pasteur de Lille)

strains of

enterovirus Polio 1; orthopoxvirus (vaccinia); human adenovirus type V

It has been approved for decontamination of ANTHRAX spores from contaminated buildings.

It has proven effective in removing animal viruses (avian influenza= orthomyxovirus), Newcastle disease =paramyxovirus /birdplague) from surfaces.

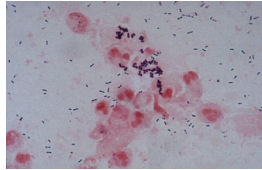


## References

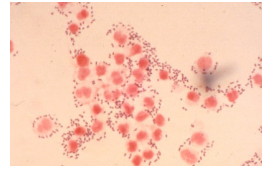
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### 3) Bactericidal activity NFT 72281 :

(Institut Pasteur de Lille)

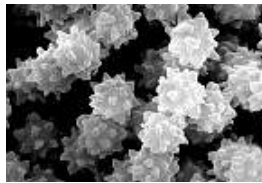


Legionella pneumophila strains

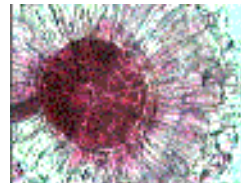


### 4) Fungicidal activity NF EN 1275 :

(Fonderphar de Toulouse)



Candida Albicans et Aspergillus Niger



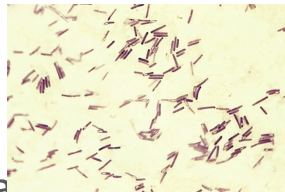
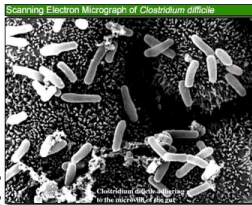
# References

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## 5) Sporicidal activity :

(Clinique universitaire St Luc Bruxelles)

Clostridium difficile; Clostridium difficile NAP 1/027




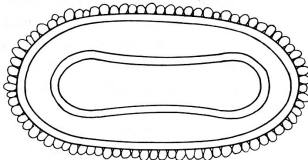




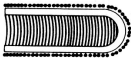

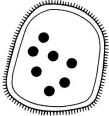







## 6) Miscellaneous (Rouleau de Stryphann) :

Meningococcus; Koch bacilli; H5 N1

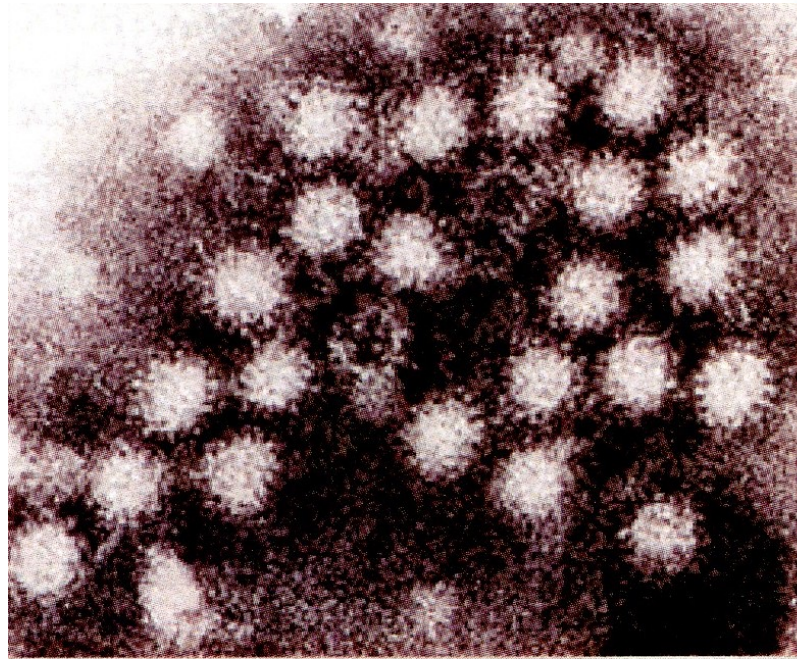
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# Virus

zonder envelop	met envelop
<b>dubbelstrengs DNA</b>  Papovaviridae  Adenoviridae	<b>dubbelstrengs DNA</b> Herpesviridae   Poxviridae
<b>enkelstrengs DNA</b> Parvoviridae 	<b>enkelstrengs RNA</b> Paramyxoviridae  Orthomyxoviridae 
<b>dubbelstrengs RNA</b> Reoviridae 	Rhabdoviridae  Retroviridae  Arenaviridae 
<b>enkelstrengs RNA</b> Picornaviridae 	Coronaviridae  Bunyaviridae  Togaviridae 
	

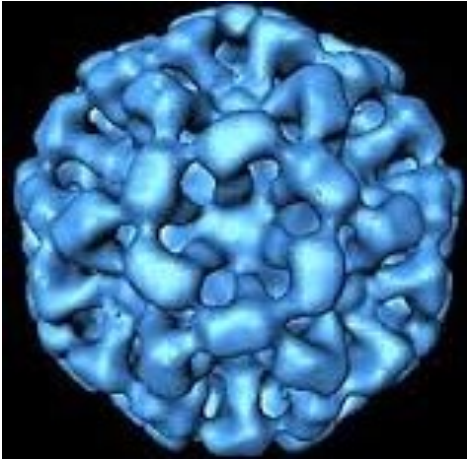
# NOROVIRUS

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Transmission electron micrograph of  
Norovirus particles in faeces

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## Norovirus a danger for the Cruise Ships : New disinfection approaches based on Hydrogen Peroxide





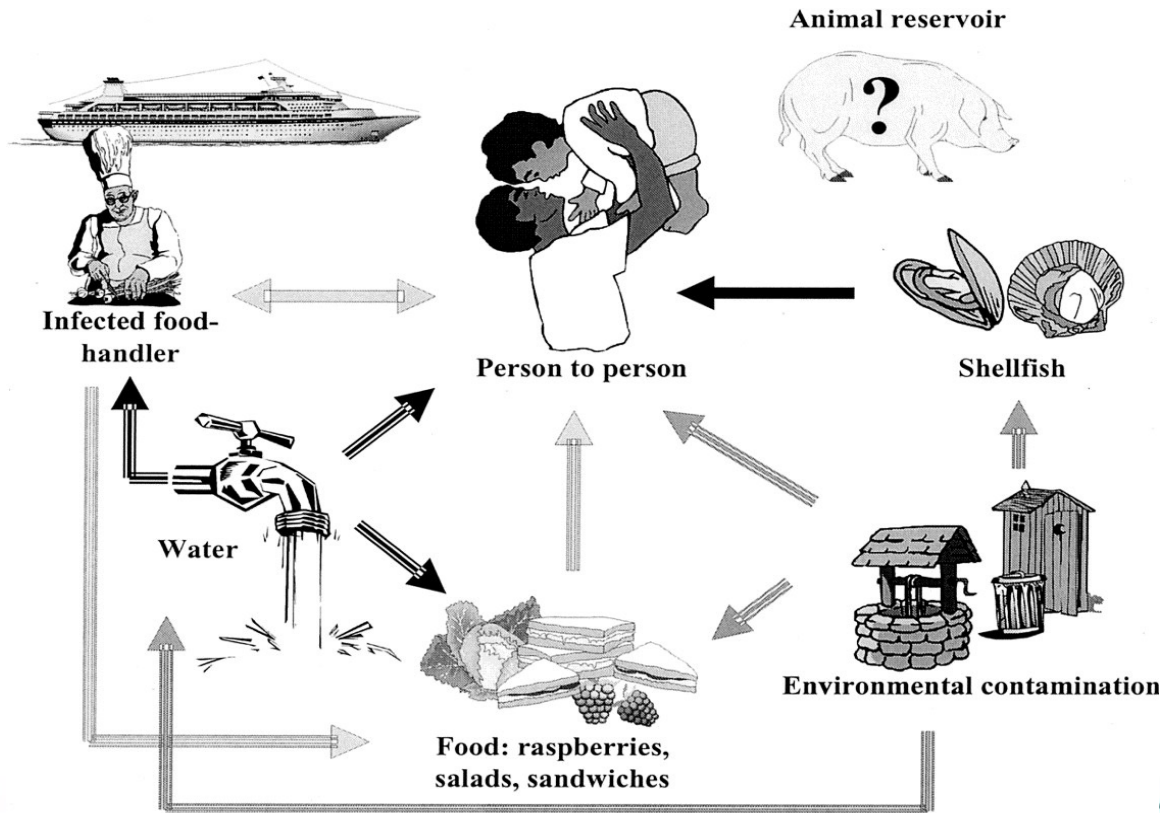
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Queen Victoria



# The Transmission of the Norovirus

- Norovirus can be transmitted from person to person by eating or drinking foods and liquids infected with Norovirus OR, Indirectly from touching surfaces or objects infected with norovirus



# Importance of Norovirus in Cruise Ships (CDC registration)

## Overview 2001-2009

year	Number of registrations	Number of proven NORO-infections	Number of GI-episodes without diagnosis	Other diagnosis	Detail
2001	4	3	1	0	
2002	21	13	4	4	Salmonella:1 Shigella:1 Sappovirus <sup>3</sup> :1 ETEC:1
2003	27	15	12	0	
2004	36	17	18	1	ETEC:1
2005	19	14	5	1	Salmonella:1
2006	37	32	4	1	ETEC:1
2007	23	17	5	1	Shigella, salmonella:1 E. histolytica:1
2008	15	14	0	1	ETEC:1

2001-2009. (CDC)

Sappovirus (Norovirus-like virus)

# Importance of Norovirus in Cruise Ships

## Number of GI-registrations 2009-2011

year	Number of registrations	Number of proven NORO-infections	Number of GI-episodes without diagnosis	Other diagnosis	Detail
2009	15	9	4	2	S.sonnei:1 Cyclospora:1
2010	14	7	7	0	
2011	4	1	3	0	

(CDC)

## Number of GI-registrations 2012-2014

year	Number of registrations	Number of proven NORO-infections	Number of GI-episodes without diagnosis	Other diagnosis	Detail
2012	15	15	0	1	Mixt: Noro and ETEC
2013	9	9	0	1	Mixt: Noro and ETEC
2014 (3 months)	7	3	4	0	

(CDC) GI =gastro-intestinal infections

# Importance of Norovirus in Cruise Ships (CDC)

2010	Cruise Line	Cruise Ship	Period in 2010
	Holland America Line	<u>Nieuw Amsterdam</u>	9/10 – 16/10
		<u>Maasdam</u>	19/02 – 05/03
	Carnival Cruise Lines	Carnival Glory	09/10 – 16/10
	Celebrity Cruises	Mercury	15/02 – 26/02
			26/02 – 08/03
			08/03 – 19/03
<u>Millennium</u>	Queen Victoria	22/02 – 05/03	
		04/01 – 12/01	

(CDC). data



Queen Victoria



: Mercury – 3 outbreaks



MS Maasdam



Millennium

# Importance of Norovirus in Cruise Ships (CDC)

	Cruise Line	Cruise Ship	Period in 2012
2012	<i>Royal Caribbean Cruise Line</i>	<b>Voyager of the Seas</b>	28/01 – 04/02
	<i>P &amp; O Cruises</i>	<b>Aurora</b>	04/01 – 26/01
	<i>Princess Cruises</i>	<b>Crown Princess</b>	28/01-04/02
		<b>Ruby Princess</b>	04/02 – 09/02 26/02 – 04/03 28/01 – 11/02 28/10 – 09/10
	<i>Celebrity Cruises</i>	<b>Sun Princess</b>	08/07 - 21/07
		<b>Dawn Princess</b>	21/08 – 13/09
		<b>Emerald Princess</b>	17/12 – 27/12
	<i>Carnival Cruise Line</i>	<b>Celebrity Constellation Celebrity Silhouette</b>	28/01 – 04/02
			29/01 – 10/02
	<i>Carnival Cruise Line</i>	<b>Carnival Glory</b>	06/08 - -11/08
<i>Royal Caribbean</i>	<b>Rhapsody of the Seas</b>	24/08 – 31/08	
<i>Holland America Line</i>	<b>Amsterdam</b>	11/11 – 05/12	
<i>Prestige Cruise Holdings</i>	<b>Oceania Riviera</b>	15/11 – 29/11	
<i>Cunard Line</i>	<b>Queen Mary 2</b>	22/12 – 03/01	



# Disinfection attempt

(shortness of cleaning time : only 8-12 hours in the harbour)

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# Disinfection Attempt





# *What influences the proliferation and spreading of Norovirus ?*

- The number of passengers of the cruise in a confined environment – crowding effect
- The difficulties to isolate the contaminated passengers or crew members
- The poor knowledge of passengers regarding basic hygiene on board
- The humid environment
- **The short cleaning time on board (8-12hrs)**
- The use of inappropriate and inefficient products not adapted for disinfection as well as the **short contact time for disinfection**
- The personnel training not adapted to the norovirus
- The services which need to get in contact (hands, card games, buffets)



# Centre Médico-Gériatrique de W-St-Lambert - Brussels

- 
- Geriatric institution with 100 beds for hospitalisation of elderly patients (3 floors).
  - Diagnosis of norovirus outbreak (acute gastro-enteritis): from march 17 till march 29 2013.(**12** days)
  - Number of cases :**48** cases out of 100 patients
  - + **5** members of nursing staff.
  - Cleaning and disinfection with hyspray (prototype)
  
  - *The outbreak was successfully stopped*
-

# Ebola Virus





# Wipes



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Efficacy of HyO2 medical on 5 types of surfaces, artificially contaminated by 4 different ATCC strains

J.M.Hubrechts M.D.,Ph.D

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# HyO2 medical, 3% peroxyde solution

– 5 types of surfaces : wood, glass, laminate, inox and vinyl

– 4 ATCC strains:

*Escherichia coli* ATCC25922

*Candida albicans* ATCC 10231

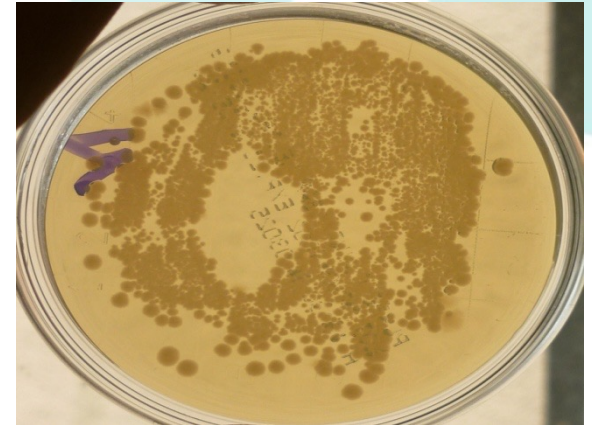
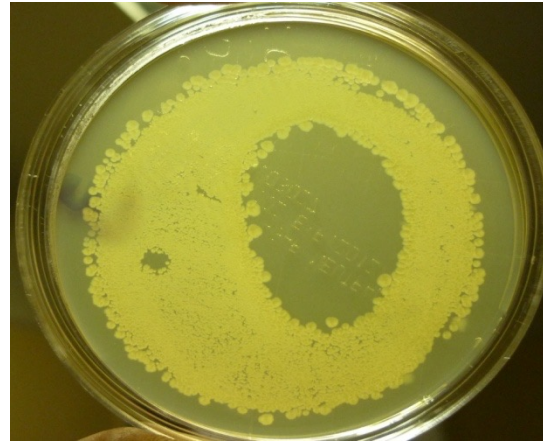
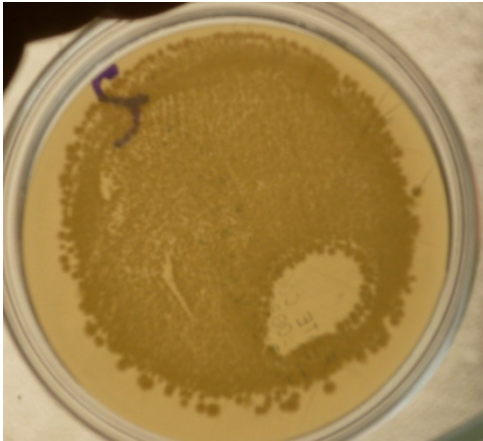
*Pseudomonas aeruginosa* ATCC 9027

*Staphylococcus aureus* ATCC25923



– After manual cleaning of 5 different artificially contaminated surfaces

# Controls : *E.coli* on 3 surfaces (lamininate, inox, wood)



(0.5 ml of a suspension of  $3 \cdot 10^8$  *E.coli*)

# Results

	<b>E.coli ATCC 25922</b>	<b>P. aeruginosa ATCC 9027</b>	<b>Staph. aureus ATCC 25923</b>	<b>C.albicans ATCC 10231</b>
<b>Nbres de germes au départ</b>	<b>3.10<sup>8</sup></b>	<b>3.10<sup>8</sup></b>	<b>3.10<sup>8</sup></b>	<b>3.10<sup>8</sup></b>
<b>Nettoyage mécanique des surfaces contaminées avec Hy02 medical (lingettes) 3 minutes de contact</b>				
<b>Nbres de germes après 24H</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Nbre de germes après 48H</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Nbres de germes après 72H</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Chaque test a été effectué sur 5 surfaces différentes (bois, verre, stratifié, inox, vinyle)</b>				

- After 24h and 48h : absence of growth on the 5 surfaces
  - The surfaces remained germfree for at least 72h after the wiping
-