

# Hydrogen peroxide vapour Bio-decontamination

W T HUI

Senior Medical  
Technologist

Pathology / PMH



**BIOQUELL**  
Bio-decontamination solutions

# Hydrogen peroxide vapour Bio-decontamination

Bioquell Z Plus R20  
aeration Unit

~HK\$800,000



**BIOQUELL**  
Bio-decontamination solutions

# Hydrogen peroxide vapour

## Bio-decontamination

### Sectors

- ☐ Hospitals
- ☐ **Pharmaceutical**
- ☐ Biologics/ biotech
- ☐ Biomedical research
- ☐ Laboratory
- ☐ Hospital pharmacy
- ☐ Food processing



Broad Spectrum  
Environmental decontamination using  
hydrogen peroxide vapour

### Decontamination Solutions

Range of decontamination equipment and services for

- ☐ Rooms
- ☐ Material transfers
- ☐ Barrier systems
- ☐ Safety cabinets
- ☐ Process equipment



*Fast, efficient, environmentally friendly and safe*



*Industry standard 6-log sporicidal reduction achieved*



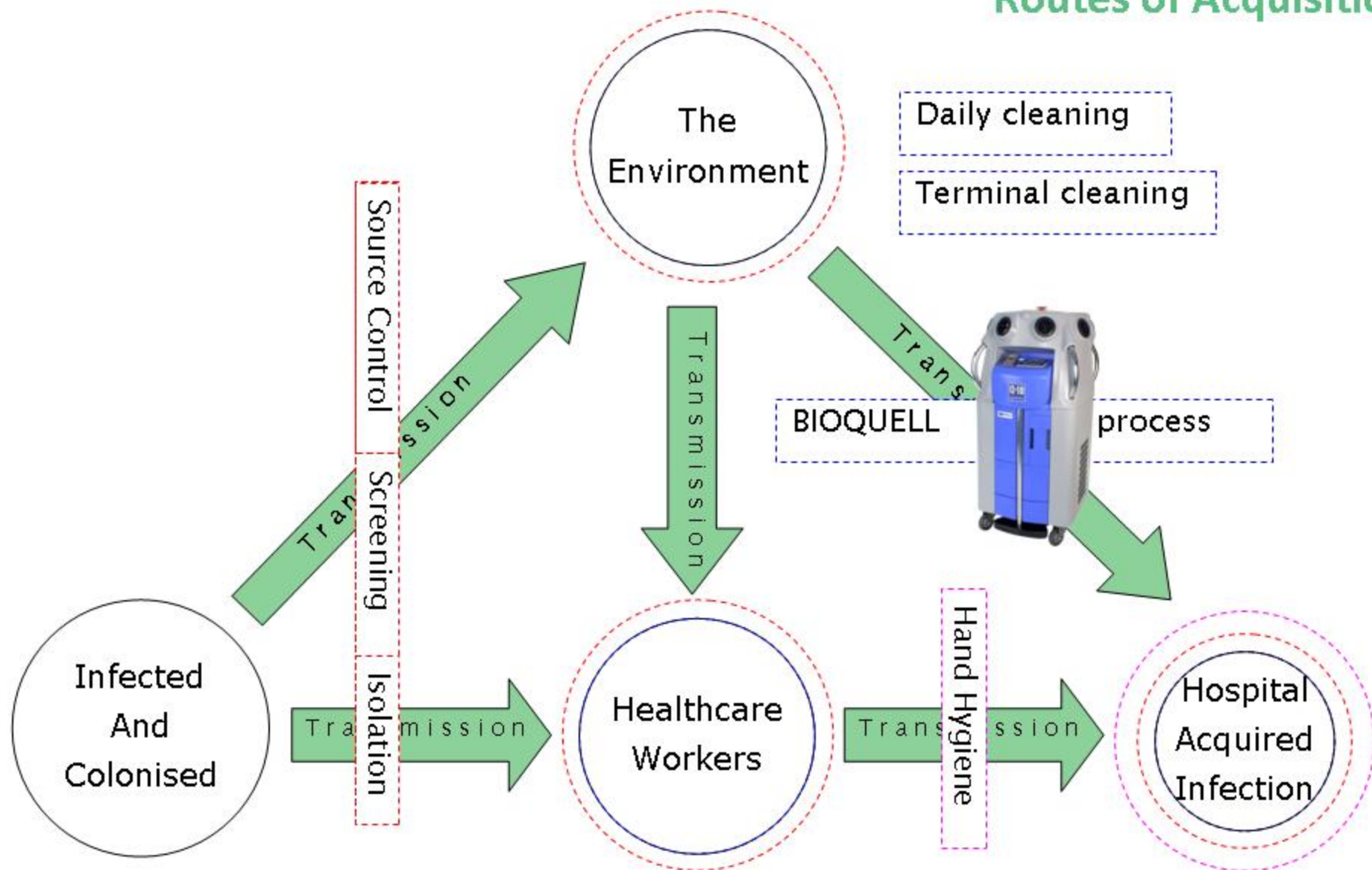
# HOSPITAL – ROOM BIO-DECONTAMINATION APPLICATIONS

- ❑ INTENSIVE CARE UNITS
- ❑ ISOLATION ROOMS
- ❑ PATIENT GENERAL WARDS
- ❑ CORRIDORS
- ❑ OPERATING THEATRES
- ❑ MORTUARIES
- ❑ PATHOLOGY LABORATORIES (BSL3)
- ❑ EQUIPMENT DECONTAMINATION ROOMS



# How HPV makes a difference

## Routes of Acquisition 3



# EMERGING NOSOCOMIAL INFECTIONS

## ❑ **CRE (*E. coli*, *Klebsiella* & *Enterobacter*), *Pseudomonas***

- Highly resistant Gram negative pathogens prevalent in the 1970's

## ❑ **MRSA *Methicillin Resistant Staphylococcus aureus***

- Dominant "super bug" over last decade

## ❑ **MDR *Acinetobacter***

- Could herald the "end of antibiotics"
- 21 deaths in Northern France in 2003
- Carbapenam strain is associated with significant mortality rates

## ❑ ***Clostridium difficile***

- Highly toxic and virulent strains causing increased deaths
- Bigger problem for the UK/USA than MRSA
- Incremental cost per C.diff infection has been calculated to circa £4k.

## ❑ ***Vancomycin-resistant enterococci (VRE)***

- Hard to treat due to high resistance
- Potential to transfer resistance to other gram positive pathogens



# Survival of Nosocomial Pathogens in the Environment

## Current position

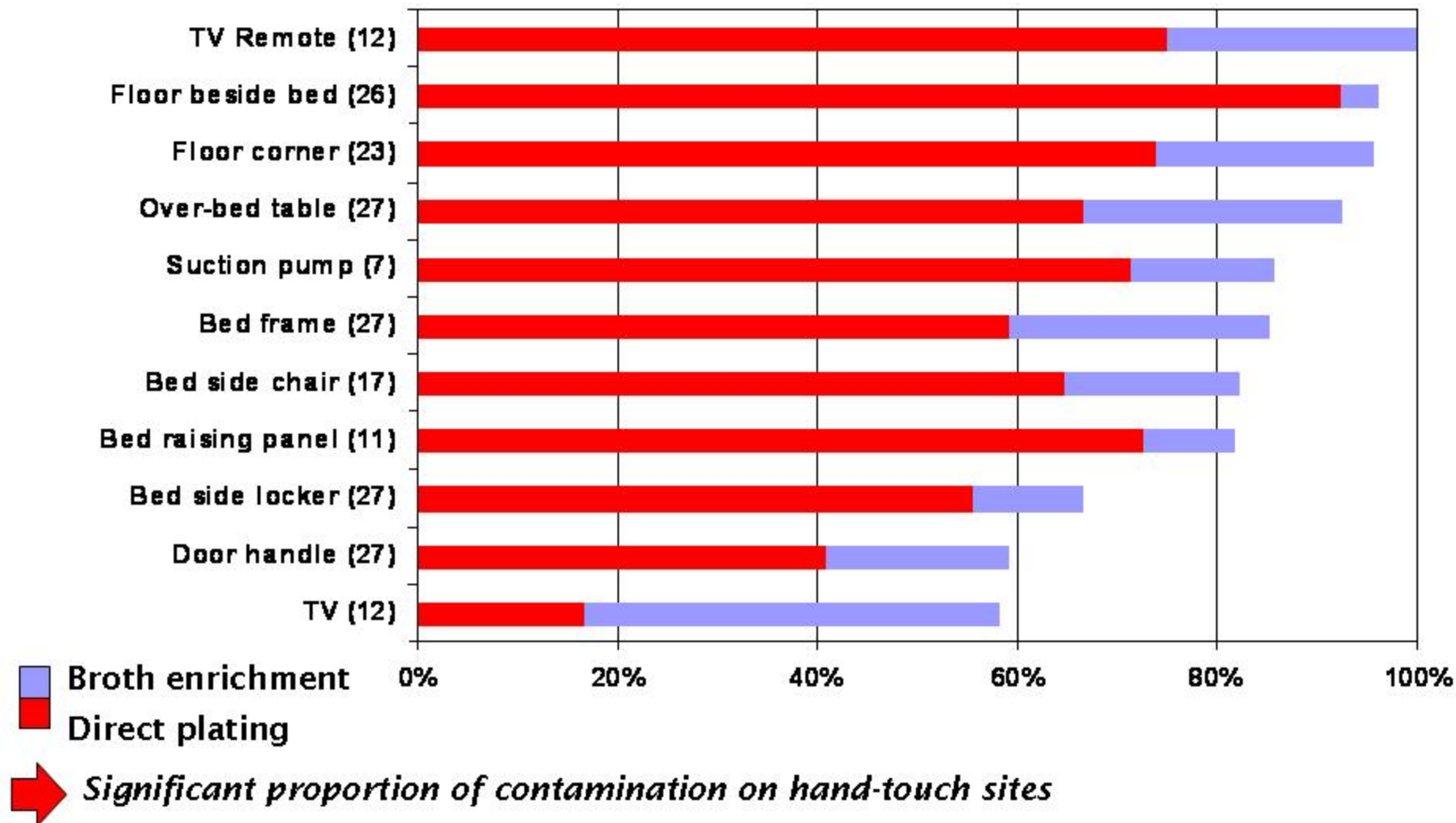
Recent research demonstrates that commonly found nosocomial bacteria can **survive for long periods**:

- MRSA : >300 days<sup>2</sup>
- VRE : 58 days<sup>3</sup>, >200 days<sup>4</sup>
- *C.diff* : >30 days<sup>5</sup>, >200 days<sup>4</sup>
- *Acinetobacter* : >300 days<sup>6</sup>
- *E.coli* : >150 days<sup>7</sup>
- *Klebsiella* : >10 days<sup>5</sup>

➔ **Recent research shows that vegetative organisms can survive for long periods dried in the hospital environment**

2. Wagenvoort JHT, et al. *J Hosp Infect* 2000;**45**:231-234.
3. Bonilla HF, et al. *Infect Cont Hosp Epidemiol* 1996;**17**:770-772.
4. BIOQUELL trials, unpublished data.
5. French GL, et al. 44<sup>th</sup> ICAAC, Washington DC, 2004.
6. Wagenvoort JHT, et al. *J Hosp Infect* 2002;**52**:226-227.
7. Smith SM, et al. *J Med* 1996; **27**: 293-302.

## Proportion of sites yielding MRSA before cleaning





# Manual Disinfection



Tradition Cleanroom with 'Gowned operator'

There has been development in disinfectant validation but no real improvement in the disinfection process –

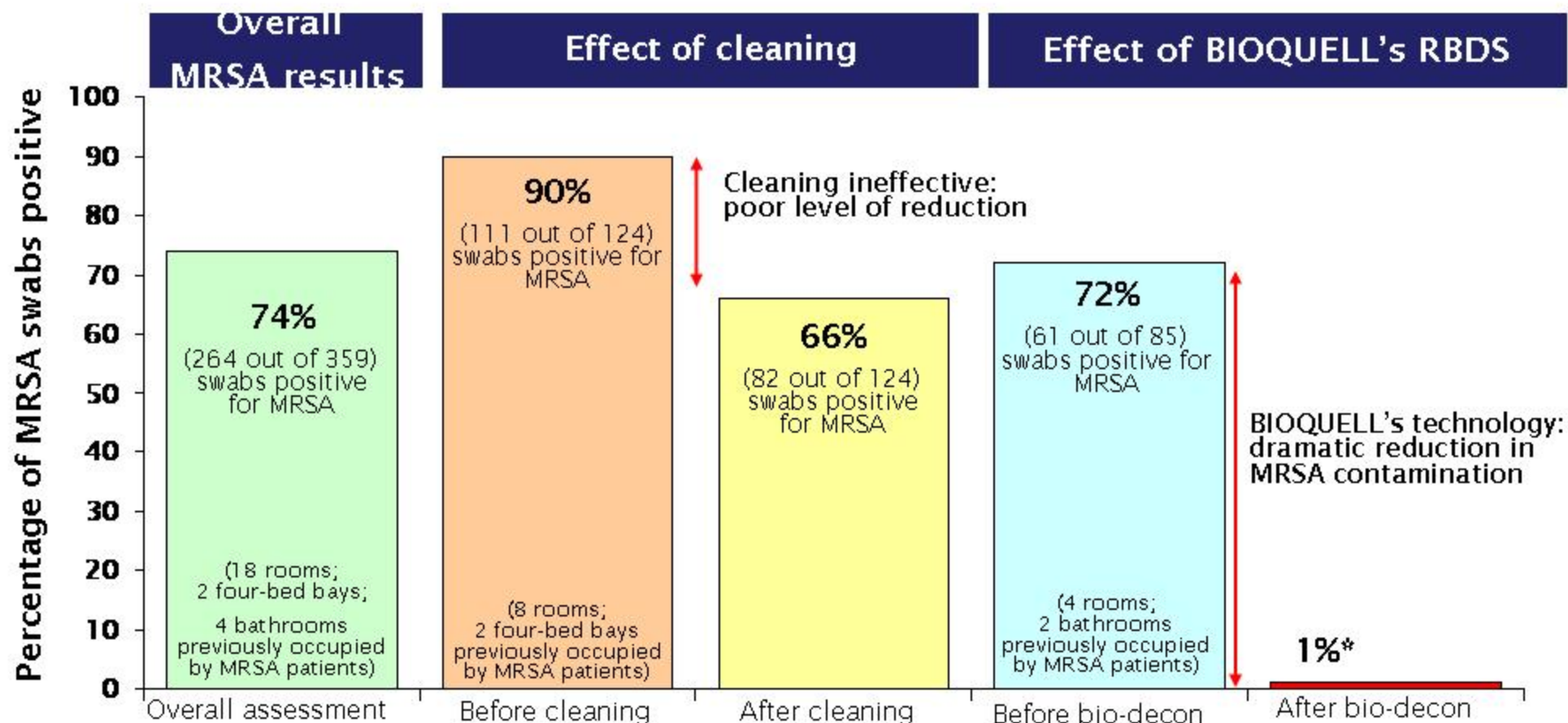
Except moving from a one bucket system to a three bucket system

Many variables including:

- Dilution coefficients
- Application
- HVAC drying times

**Time and labour intensive with potential impact on efficacy**

## Study: Conventional cleaning versus HPV



\* 1 swab out of 85 on enrichment only

**Collaborative trial led by Dr John M. Boyce with CDC and BIOQUELL**

	Standard swabs: post treatment		CDC specialised sponges: post treatment	
Post:	Bleach cleaning	BIOQUELL	Bleach cleaning	BIOQUELL
C.diff	5%	0%	24%	0%
MRSA	6%	0%	n/a	n/a
VRE	14%	0%	n/a	n/a

# Range of Decontamination Equipment



**BIOQUELL Z**  
Room  
Decontamination  
System



**CLARUS C**  
Multi  
Purpose  
generator



**CLARUS L2**  
Lab  
Scale  
generator



**CLARUS S**  
Enclosure  
Decon  
System



**Q10**  
Room  
Decontamination  
System



Configured for maximum efficiency, compliant with regulations

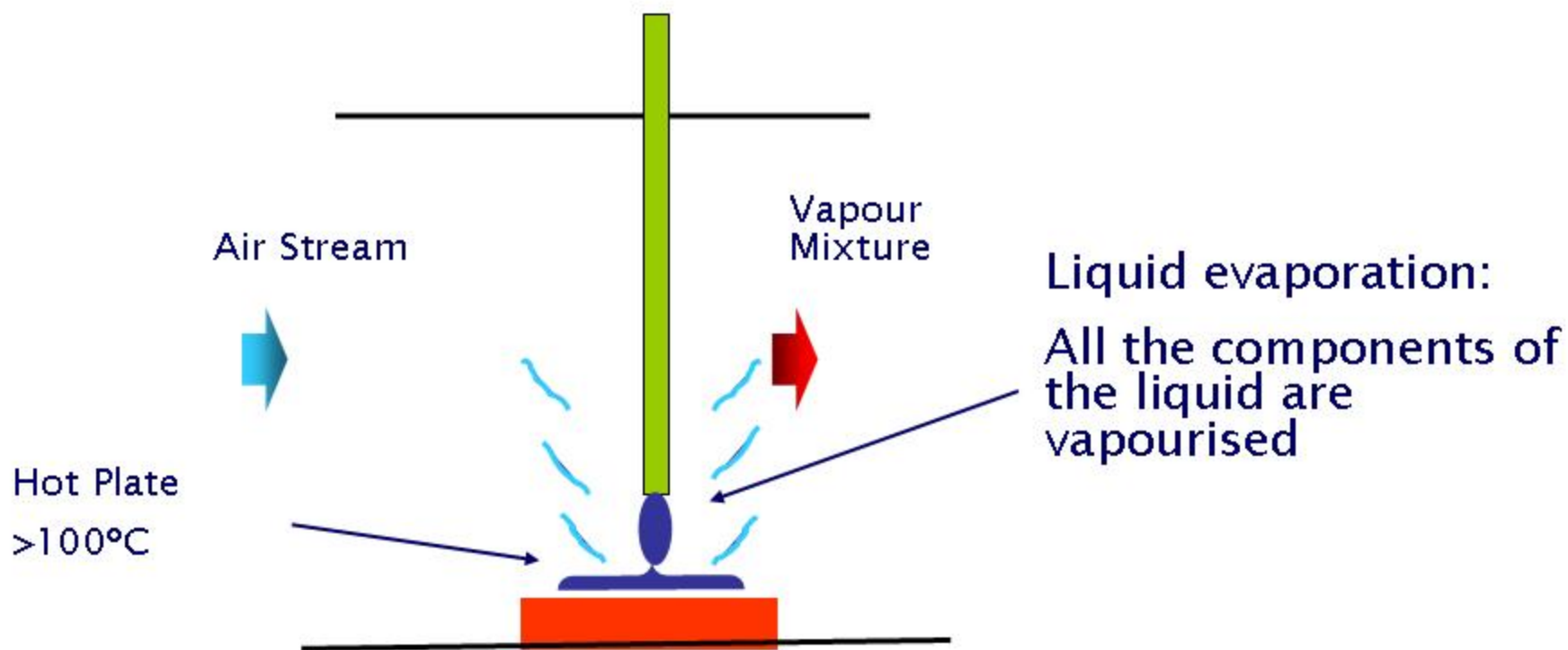


# BIOQUELL Z

- ❑ INTRODUCED IN MARCH 2007
- ❑ DESIGNED TO DECONTAMINATE HOSPITAL ROOMS UP TO 500M<sup>3</sup>
- ❑ SUPPLIED TO HOSPITALS FOR THEIR OWN USE
- ❑ MOBILE, "PLUG & PLAY" PRODUCT
- ❑ PARAMETRIC CONTROLS
- ❑ OPERATES WITHIN THE ROOM AND CONTROLLED FROM OUTSIDE



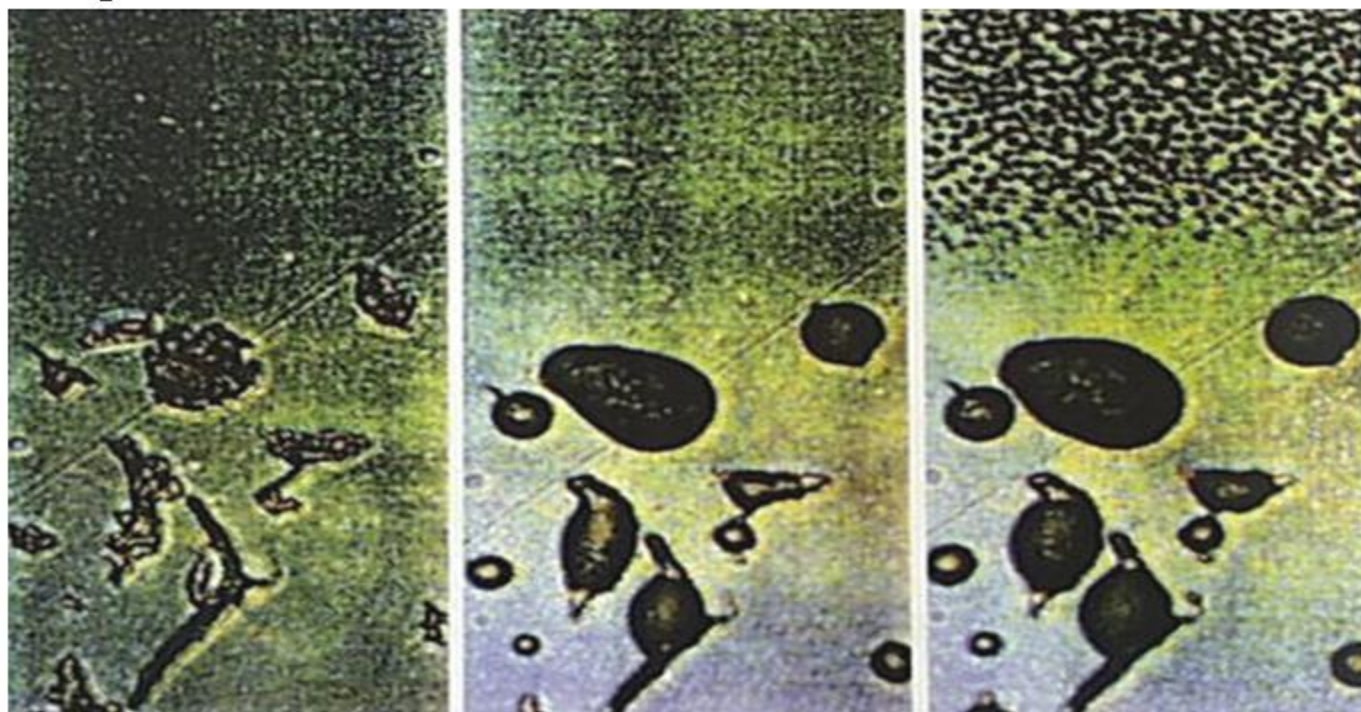
# Liquid Forced Evaporation



Higher concentration of  $\text{H}_2\text{O}_2$  vapour achieved than the equilibrium state

# Vapour Micro-Condensation

Micro-condensation of vapour on lyophilised spores of *Bacillus macerans* on silanized glass



Time = 0 sec

Time = 0.5 sec

Time = 3 sec

From "Sterilization by Vapour Condensation" Pharmaceutical Technology Europe Feb 1996 Vol.. 8 No. 2

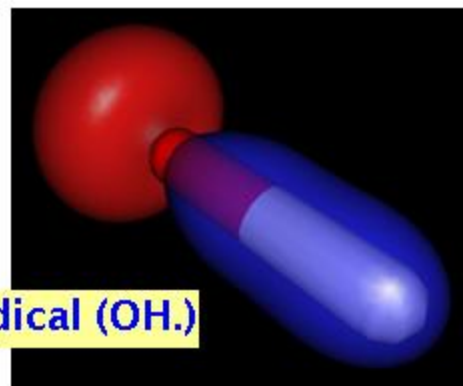
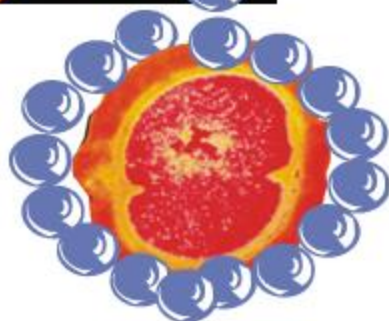
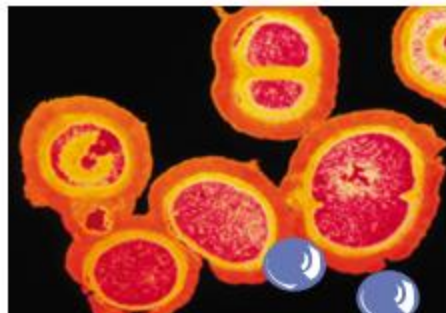
by M.-A. Marcos, A.Bardat, R. Schmitthaeusler, and D. Beysens.

Information from PMH HPV Lecture March 2010



# HYDROGEN PEROXIDE – THE PROCESS

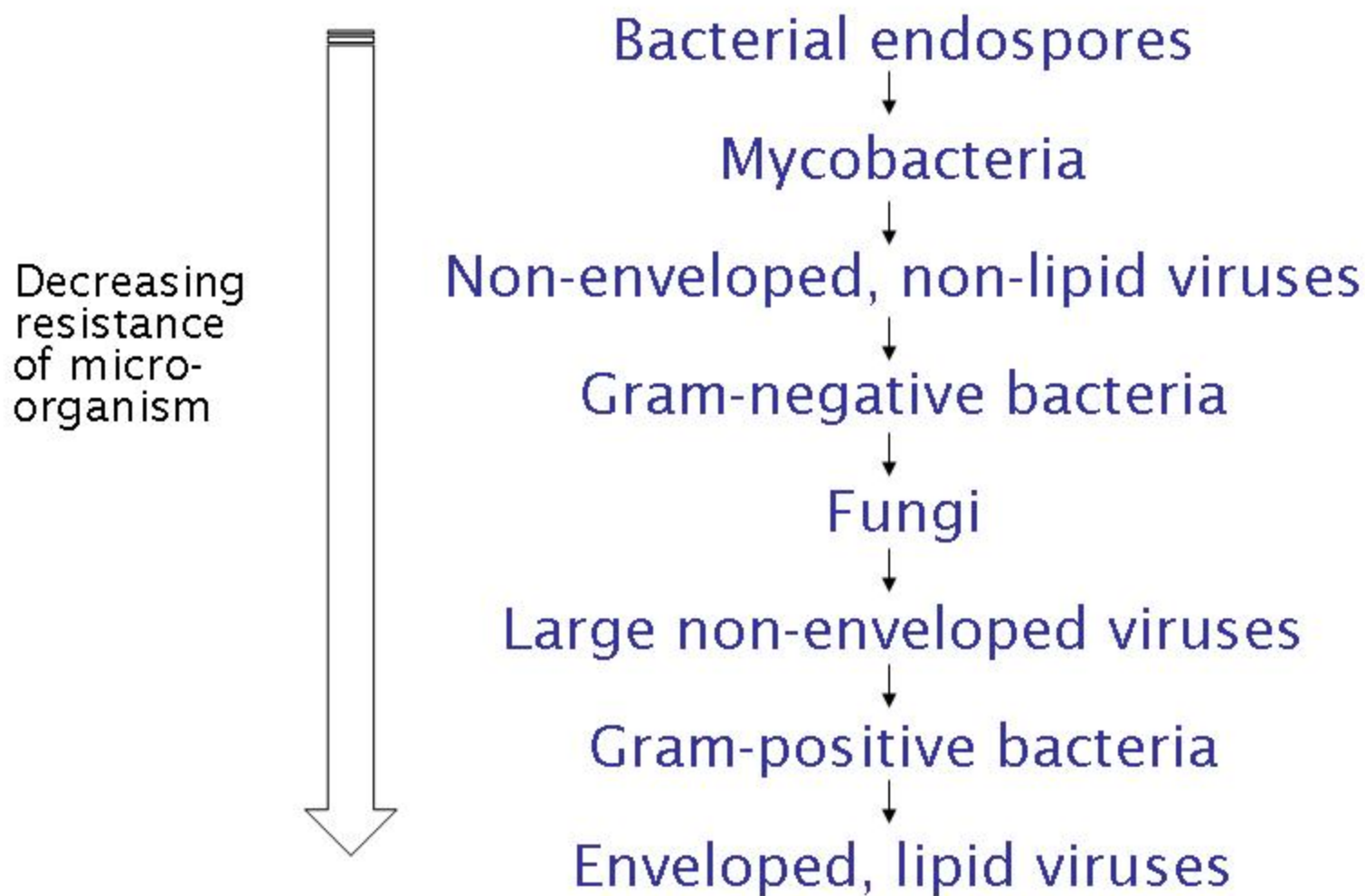
- ❑ HPV is injected until micro-condensation is achieved
  - ❑ A MICRON LAYER OF DISINFECTANT APPEARS ON ALL EXPOSED SURFACES AND **OXIDATION** OCCURS
  - ❑ **FREE RADICALS** ARE RELEASED, ONE OF WHICH IS THE HIGH OXIDISING **RADICAL HYDROXYL** THAT BECOMES HIGHLY DESTRUCTIVE, AS IT COMES INTO CONTACT WITH CELLS.
  - ❑ FREE RADICALS PROVIDE MICRO-ORGANISM DEACTIVATION WITH A MINIMUM HIGH LEVEL (6log) REDUCTION OF BIO-CONTAMINATION.



hydroxyl radical (OH.)



## Biological efficacy of HPV



# MRSA at University Hospital Lewisham, London



- ❑ BIOQUELL asked to bio-decontaminate the ward using RBDS
- ❑ adjacent ward and public areas monitored for HPV – no leakage
- ❑ RBDS completed in 12 hours
- ❑ ward available for re-occupation immediately after RBDS
- ❑ no new acquisition of MRSA following RBDS
- ❑ *'Decontamination using HPV provides a rapid and cost-effective method for the eradication of environmental MRSA.'*

# *Serratia* at the Royal Hallamshire Hospital, Sheffield



- Independent research supporting the use of BIOQUELL's technology for environmental control of *Serratia marcescens* in a NICU
- 12-bed NICU experienced an outbreak of *S. marcescens*, which complicated the care of 4 neonates
- Evidence of cross-transmission and the *S. marcescens* was indistinguishable by PFGE (conducted by the HPA)
- *S. marcescens* cultured from 8% of 24 sites on the unit, including one of the cots



# *Serratia* at NICU of the Royal Hallamshire Hospital, Sheffield



- ❑ Unit decontaminated using RBDS in conjunction with standard detergent-based cleaning.
- ❑ Sensitive medical equipment (pictures, left) decontaminated *in situ* without damage.
- ❑ No *S. marcescens* cultured after RBDS and outbreak ceased.
- ❑ '*...HPV provided a safe and effective means for the eradication of environmental S. marcescens from our NICU, which may otherwise have resulted in a continuation of the outbreak.*'



## *Enterobacter* in ICU at Gelderse Vallei, Ede, Holland



- 12-bed ICU experienced an outbreak of MDR-*Enterobacter* sp., which proved to be clonal by PFGE
- The ICU also had ongoing problems with MDR-*Acinetobacter*
- Several patients were infected and transmission on the unit continued despite an emphasis on hand hygiene and environmental cleanliness
- The unit was closed and decontaminated using HPV
- Microbiological swabbing using gauzes was conducted before and after HPV



# *Enterobacter* in ICU at Gelderse Vallei, Ede, Holland



❑ Cultures taken after cleaning (which included sodium hypochlorite for surfaces and alcohol for equipment) grew MDR-*Acinetobacter*.

❑ Cultures taken after HPV did not grow any Gram-negatives. However some *Bacillus* species did grow on the culture media. (NB. large surface area covered by the gauzes.)

❑ No transmission was noted on the unit for over three months after HPV

❑ HPV broke the cycle of transmission

❑ The outbreak strain has recently been detected in the ICU; the source is unknown



# Safety Issues

- Safety in Design – alarms and interlocks
- HPV diffuses **slowly** so does not leak readily
- HPV dilutes and **breaks down in air**
- Process operates at neutral or negative pressure to minimise risk of leakage
- Sensitive **HPV sensors** are available to monitor for leakage
- Material **compatibility** is good
- **No residues**
- Simple recovery procedures



# Equipment Examples



Gambro® Dialysis  
Machines



Siemens® Servo 300  
Ventilator



Tyco® Puritan Bennett  
800 Ventilator



Siemens® Servo  
900C Ventilator



Siemens® Patient Monitor Systems



Philips® Defibrillators



Dinamap® NIBP



# Instrument Testing



A range of instruments including **computers** have been tested both dormant and powered without any failures

## HPV – Members of PMH HPV Decontamination working groups

- Infection Control Team (Officers & Nurses)
- Infectious Disease Center
- Facility Management
- EMSD
- Pathology (Initial – SOP, machine operation, Documentation & Risk assessment, later – provide culture of biological indicator)



# HPV Bio-decontamination Request Form

Infection Control Team



## Section 1 (To be completed by requesting department)

Please **FAX** the form with completed Section 1 to ICT at ext. **XXXX** or **EMAIL** to **'PMH Infection Control Team'**

1. Requested By: \_\_\_\_\_ Dept.: \_\_\_\_\_ Post: \_\_\_\_\_

Hospital: \_\_\_\_\_ Email: \_\_\_\_\_ Ext.: \_\_\_\_\_

2. Location of the requested works: Floor: \_\_\_\_\_ Block: \_\_\_\_\_

3. Reason for requesting HPV:

- ☐ Interim disinfection for cubicles or rooms with uncontrolled spread of MDRO (e.g. MRSA, MRAB) and problematic pathogens (e.g. C. difficile, Norovirus). State the pathogen(s): \_\_\_\_\_
- ☐ Terminal disinfection for cubicles or rooms with highly pathogenic or bioterror agents (e.g. smallpox, plague). State the pathogen(s): \_\_\_\_\_
- ☐ Post-renovation (with much dust generation) disinfection for wards housing immunocompromised or highly susceptible in-patients or with high prevalence of MDRO
- ☐ Disinfection of the autopsy room (Room 2) during overhaul and after completion of autopsy on a case with highly pathogenic or routine maintenance
- ☐ Disinfection of the BSL3 laboratory of S16
- ☐ Other: \_\_\_\_\_

4. Target Completion Date: \_\_\_\_\_

5. Cost of the works request could be absorbed by Departmental Budget

☐ Yes (Please specify COA): \_\_\_\_\_ ☐ No

Head of Unit/Dept: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Section 2 (To be completed by ICT)

Approved (funded by departmental/maintenance budget)

- ☐ Supported – by departmental budget
- ☐ Supported – by maintenance budget
- ☐ Rejected with reason(s): \_\_\_\_\_

Name: \_\_\_\_\_ Post: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



# HPV Bio-decontamination Request Form

Infection Control Team



## Section 1 (To be completed by requesting department)

Please **FAX** the form with completed Section 1 to ICT at ext. **XXXX** or **EMAIL** to **‘PMH Infection Control Team’**

1. Requested By: \_\_\_\_\_ Dept.: \_\_\_\_\_ Post: \_\_\_\_\_

Hospital: \_\_\_\_\_ Email: \_\_\_\_\_ Ext.: \_\_\_\_\_

2. Location of the requested works: Floor: \_\_\_\_\_ Block: \_\_\_\_\_



### 3. Reason for requesting HPV:

- ☐ Interim disinfection for cubicles or rooms with uncontrolled spread of MDRO (e.g. MRSA, MRAB) and problematic pathogens (e.g. C. difficile, Norovirus), State the pathogen(s): \_\_\_\_\_
- ☐ Terminal disinfection for cubicles or rooms with highly pathogenic or bioterror agents (e.g. smallpox, plague), State the pathogen(s): \_\_\_\_\_
- ☐ Post-renovation (with much dust generation) disinfection for wards housing immunocompromised or highly susceptible in-patients or with high prevalence of MDRO
- ☐ Disinfection of the autopsy room (Room 2) during overhaul and after completion of autopsy on a case with highly pathogenic or routine maintenance
- ☐ Disinfection of the BSL3 laboratory of S16
- ☐ Other: \_\_\_\_\_

4. Target Completion Date: \_\_\_\_\_

5. Cost of the works request could be absorbed by Departmental Budget

☐ Yes (Please specify COA): \_\_\_\_\_ ☐ No

Head of Unit/Dept: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Section 2 (To be completed by ICT)**

Approved (funded by departmental/maintenance budget)

☐ Supported – by departmental budget

☐ Supported – by maintenance budget

☐ Rejected with reason(s):

Name: \_\_\_\_\_ Post: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_



# HPV Bio-decontamination Pre-assessment Report

Infection Control Team



(To be completed by ICT)

1. Requested By: \_\_\_\_\_ Dept.: \_\_\_\_\_ Post: \_\_\_\_\_

Hospital: \_\_\_\_\_ Email: \_\_\_\_\_ Ext.: \_\_\_\_\_

2. Location of the requested works: Floor: \_\_\_\_\_ Block: \_\_\_\_\_

3. Date: \_\_\_\_\_ Assessed by:  
\_\_\_\_\_  
(ICT) \_\_\_\_\_ (Signed)  
\_\_\_\_\_  
(EMSD) \_\_\_\_\_ (Signed)

3. Reason for requesting HPV:

(A) Pathogen(s) concerned : \_\_\_\_\_

(B) **PPE required for EMSD staffs**

- ☐ Regular PPE – surgical mask, disposed gloves, regular EMSD working cloth
- ☐ Highly containment PPE – N95 mask (fit test required), disposal gown (e.g. water repellent gown, Tyvek® suit), disposal gloves, face shield, Don up & down procedures, PPE disposal procedure

(C) **A/C system**

- ☐ With remote individual damper
- ☐ Without remote individual damper

(D) Room Size

Room No	H2O2 required (mL)	Height	Width	Length

(E) Sealing of room (photo) ☐ Yes ☐ No

(F) Placement of biological indicators (photo) ☐ Yes ☐ No

(G) Suggest to evacuate the adjacent room ☐ No ☐ Yes, Room No \_\_\_\_\_

(H) Any leakage of the room ☐ No ☐ Yes, \_\_\_\_\_

☐ Others: \_\_\_\_\_

4. Proposed Completion Date: \_\_\_\_\_



# HPV Bio-decontamination Pre-assessment Report

Infection Control Team



**(To be completed by ICT)**

1. Requested By: \_\_\_\_\_ Dept.: \_\_\_\_\_ Post: \_\_\_\_\_

Hospital: \_\_\_\_\_ Email: \_\_\_\_\_ Ext.: \_\_\_\_\_

2. Location of the requested works: Floor: \_\_\_\_\_ Block: \_\_\_\_\_

3. Date: \_\_\_\_\_ Assessed by:

\_\_\_\_\_ (ICT) \_\_\_\_\_ (Signed)

\_\_\_\_\_ (EMSD) \_\_\_\_\_ (Signed)



### 3. Reason for requesting HPV:

(A) Pathogen(s) concerned : \_\_\_\_\_

(B) **PPE required for EMSD staffs**

- ☐ **Regular PPE** – surgical mask, disposed gloves, regular EMSD working cloth
- ☐ **Highly containment PPE** – N95 mask (fit test required), disposal gown (e.g. water repellant gown, Tyvek® suit), disposal gloves, face shield, Don up & down procedures, PPE disposal procedure

(C) **A/C system**

- ☐ With remote individual damper
- ☐ Without remote individual damper

# HPV – Initial Assessment **PPE required**



**Tradition Cleanroom with ‘Gowned operator’**



(D) Room Size

Room No	H <sub>2</sub> O <sub>2</sub> required (mL)	Height	Width	Length

(E) Sealing of room (photo) ☐ Yes ☐ No

(F) Placement of biological indicators (photo) ☐ Yes ☐ No

(G) Suggest to evacuate the adjacent room ☐ No ☐ Yes, Room No \_\_\_\_\_

(H) Any leakage of the room ☐ No ☐ Yes, \_\_\_\_\_

☐ Others: \_\_\_\_\_

4. Proposed Completion Date: \_\_\_\_\_

# HPV – Initial Assessment





# HPV – Bioquell Z Instrument Set Up



- Unhook the lectern from the main unit and place outside the enclosure to be gassed. This will be the controlling and monitoring location during the gassing cycle. This must be **outside** a door or other point to which the cable to the main unit can be passed



# HPV – Bioquell Z Instrument Set

**U** Open the back of the lectern where the following items should be stored: The mains power cable for the main Bioquell Z unit, Electronic Measuring Device, PAC III Gas Monitor, Safety Glasses, Sealing Tape and Disposable Gloves.

**Safety Glasses**

**Electronic Measuring Device**

**PAC III Gas Monitor**

**Sealing Tape**

**Disposable Gloves**

**Printer Paper**

**Mains Power Cable**



# HPV – Bioquell Z Instrument Set Up



- Remove the **control cable** from its location immediately beneath the hydrogen peroxide bottle location in the main Bioquell Z unit.





# HPV – Bioquell Z Instrument Set Up



Plug the free end of this cable into the main Bioquell Z unit and use the retention clips to secure in place



Reel out the cable back to the lectern, connect to the short **flat cable** fitted to the lectern and use the retention clips to secure in place.



# HPV – Bioquell Z Instrument Set Up



Plug the unit into a mains power socket and turn the unit on at the mains switch. The switch will now illuminate



# HPV – Bioquell Z Instrument Set Up



- Plug the **mains power cable** into the main Bioquell Z unit next to the control cable and use the retention clip to hold it in position.





# HPV – R20 Aeration Unit Instrument Set Up



- Connect the Aeration Unit to the mains power and power on





# HPV – Instrument Set Up

Connect signal communication cables from the Bioquell Z unit to the R20 Aeration Unit.



# HPV – Instrument Set Up

Areas which consist of more than one room, non-rectangular rooms, or large areas (more than 200 m<sup>3</sup>) may require **fans**.



# HPV – Prepare the Room

Seal off the **supply** and ventilation grills in the room (or shut down the ventilation system if possible).

Piece of Perspex





# HPV – Prepare the Room

- Secure PVC sheet in place with adhesive tape to seal all **exhaust** grills





# HPV – Prepare the Room

- Use PVC tape to seal up any **large openings** in the fabric of the building.



# HPV – Prepare the Room

- Isolate **fire sensors** or cover them with gloves to prevent accidental false alarms during fumigation.



# HPV – Prepare the Room

- Open **drawers** and **doors** of cupboards
- Prop up **mattresses** if present to ensure that HPV can contact all sides.



# HPV – Prepare the Room

Put **biological indicators** to the places which you think that are **difficult** to bio-decontaminate.





# HPV – Prepare the Room

Pour the water to drains of **wash basin** and **floor drains**



# HPV – Starting Decontamination Cycle

If any Aeration Units are to be used, press the '**Aeration Unit Test**' button. Then press '**Test R2**' button to check that the Aeration

PRESS LOGO TO START



PLEASE PRESS REQUIRED OPTION

AERATION  
UNIT  
TEST

STORED  
CYCLES

NEW  
CYCLE

ADMIN  
MENU

AERATION  
ONLY  
CYCLE

Connect R2/R20 unit/s if required,  
then click on "TEST R2" button.  
Click on "OK" button if unit/s start  
or are not required

TEST R2

OK

# HPV – Starting Decontamination Cycle

Choose '**New Cycle**' button.

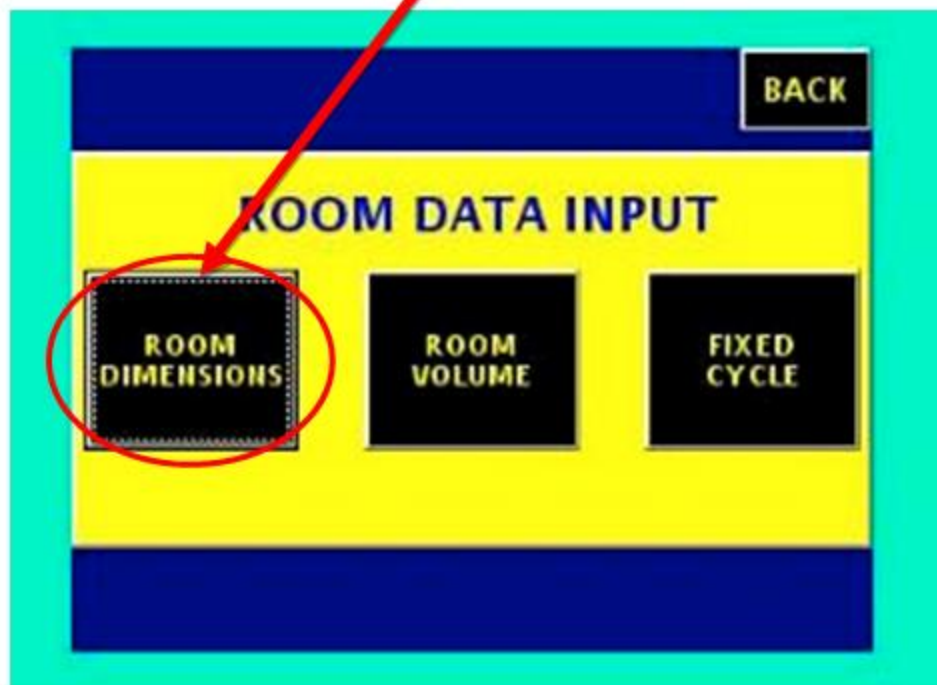


User Name: ADMINISTRATOR  
Password: ADMIN



# HPV – Starting Decontamination Cycle

Choose '**Room Dimensions**'



Use **Electronic Measuring Device** to measure room dimensions





# HPV – Starting Decontamination Cycle

Enter the room dimensions in the white boxes, by pressing the box and then using the keypad which will appear to enter the number

BACK

Please enter room dimensions in metres.  
Press value box for each measurement,  
then use on-screen keyboard to enter new values

**2.0** 5.0 5.0 50.0  
LENGTH (m) WIDTH (m) HEIGHT (m) VOLUME (m³)

REMOTE START/STOP OFF  
INJECTION IN DWELL ON  
DWELL INJ. RATE 4.0

OK

LIGHT LOAD MEDIUM LOAD HEAVY LOAD

MAIN GASSING ROOM

A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z	/	*	-	+
.	:	,	=	_	{	}	@	"	
0	1	2	3	4	5	6	7	8	9
Shift	←	→	BSP			ESC	↵		

# HPV – Starting Decontamination Cycle

Set the **load** to Light, Medium or Heavy, this defaults to Light, and press OK

BACK

Please enter room dimensions in metres.  
Press value box for each measurement,  
then use on-screen keyboard to enter new values

2.0 5.0 5.0 50.0  
LENGTH (m) WIDTH (m) HEIGHT (m) VOLUME (m³)

REMOTE START/STOP OFF  
INJECTION IN DWELL ON  
DWELL INJ. RATE 4.0

OK

LIGHT LOAD MEDIUM LOAD HEAVY LOAD

Enter the **cycle name** where there are a number of similar sized rooms, and press OK.

Light - Dwell period 15 minutes  
Medium - Dwell period 20 minutes  
Heavy - Dwell period 25 minutes

## HPV – Prepare the Room

- Light - Dwell period 15 minutes
- Medium - Dwell period 20 minutes
- Heavy - Dwell period 25 minutes

# HPV – Starting Decontamination Cycle

Press '**Stored Cycles**'



Press '**Parametric Cycles**'





# HPV – Starting Decontamination Cycle

Scroll up and down the list of stored cycles and **highlight the cycle** that is to be run

The required **quantity** of hydrogen peroxide



A screenshot of the HPV control interface. At the top, there are four buttons: '22.0' (Ambient °C), '50.0' (RH%), 'LIGHT' (Room Load), and 'CONFIRM CYCLE'. Below these is a 'Stored Cycle Name:' label and a dropdown menu currently showing 'TEST'. A red arrow points from the text 'highlight the cycle' to this dropdown. To the right of the dropdown is a 'No.:' label and a button showing '1'. Below the dropdown, a list of cycles is visible: 'TEST', 'TEST 2', and 'TEST 3'. At the bottom, there are several labels and values: 'SURFACE AREA (m²)', 'H2O2 REQ'D (m³)', 'REMOTE START/STOP', 'INJECTION IN DWELL', 'BATCH', 'H2O2 BATCH', and '4.0' (Dwell Inj. Rate).



A screenshot of the HPV control interface showing the required quantity of hydrogen peroxide. The top buttons are the same as in the previous screenshot. Below them is a 'Ready' status bar. The main display area shows four large numbers: '2.0' (Length m), '5.0' (Width m), '5.0' (Height m), and '50.0' (Volume m³). Below these are four smaller numbers: '90.0' (Surface Area m²), '992' (H2O2 REQ'D m³), 'OFF' (Remote Start/Stop), and 'ON' (Injection in Dwell). The '992' value is highlighted with a red circle. At the bottom, there are labels for 'BATCH', 'H2O2 BATCH', and '4.0' (Dwell Inj. Rate).

# HPV – Starting Decontamination Cycle

Using appropriate PPE hydrogen peroxide bottle is loaded with at least this quantity of fresh hydrogen peroxide



Seal the area to be gassed by taping around doors and any other leak points





# HPV – Starting Decontamination Cycle

Enter the **Batch Number** for the hydrogen peroxide being used (if required)

Press '**Confirm Cycle**'

Press '**I Agree**'



The screenshot shows the HPV control interface with the following elements:

- Top row: 22.0 (AMBIENT °C), 50.0 (RH%), LIGHT (ROOM LOAD), CONFIRM CYCLE (highlighted with a red arrow), and BACK.
- Stored Cycle Name: TEST (dropdown menu), No.: 1.
- Ready status bar.
- Parameters: LENGTH (m) 2.0, WIDTH (m) 5.0, HEIGHT (m) 5.0, VOLUME (m³) 50.0.
- Parameters: SURFACE AREA (m²) 90.0, H2O2 REQ'D (m) 992 (highlighted with a red circle), REMOTE START/STOP OFF, INJECTION IN DWELL ON.
- Bottom row: BATCH (H2O2 BATCH) (highlighted with a red circle), 4.0 (DWELL INJ. RATE).



The screenshot shows a caution message on a red background:

CAUTION! DO NOT START THIS CYCLE UNLESS ABSOLUTELY CERTAIN THAT ALL PERSONNEL HAVE CLEARED THE AREA TO BE GASSED AND THAT ALL POTENTIAL LEAK PATHS HAVE BEEN PROPERLY SEALED.

BY CLICKING ON THE "I AGREE" BUTTON, YOU ARE ACKNOWLEDGING THAT YOU UNDERSTAND THIS STATEMENT AND HAVE CARRIED OUT THESE CHECKS

The "I AGREE" button is highlighted with a red circle.

# HPV – Starting Decontamination Cycle

Press '**Yes**' to confirm and start the cycle.

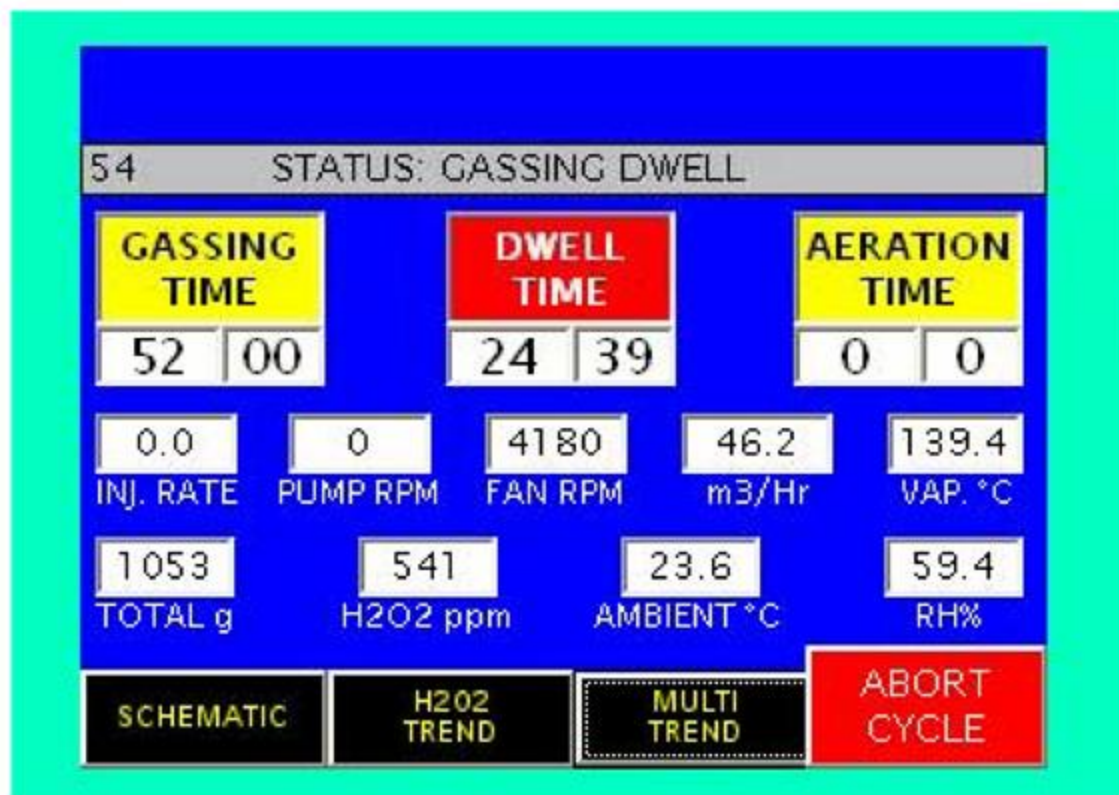
The printed report prints out



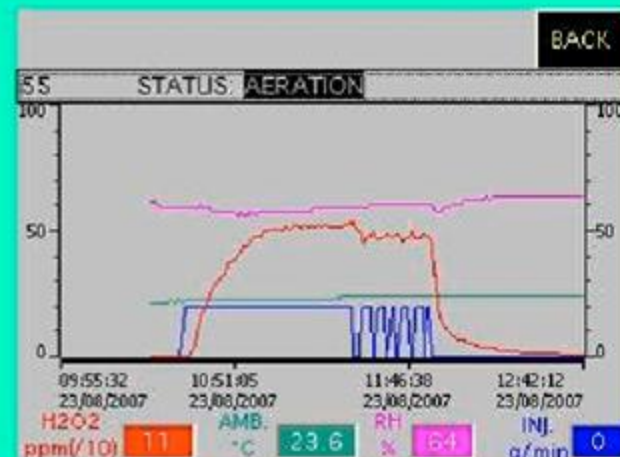
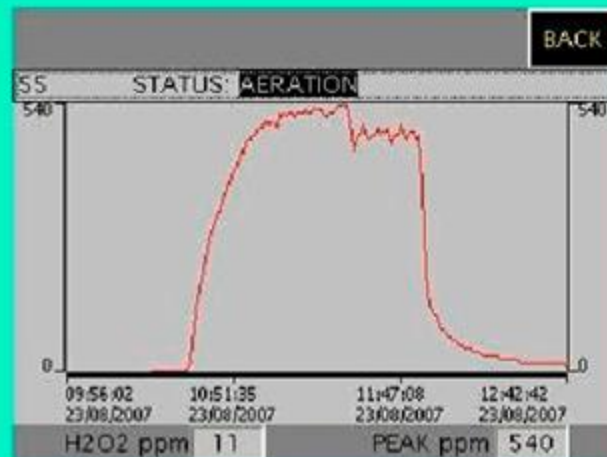


# HPV – During Decontamination Cycle

- During the cycle the default screen displays relevant information about the cycle



# HPV – During Decontamination Cycle



- Other screens may be viewed during the cycle

# HPV – During Decontamination Cycle

Monitor the area(s) using a handheld low-level gas sensor (PAC III) or Portasens for leaks of hydrogen peroxide gas

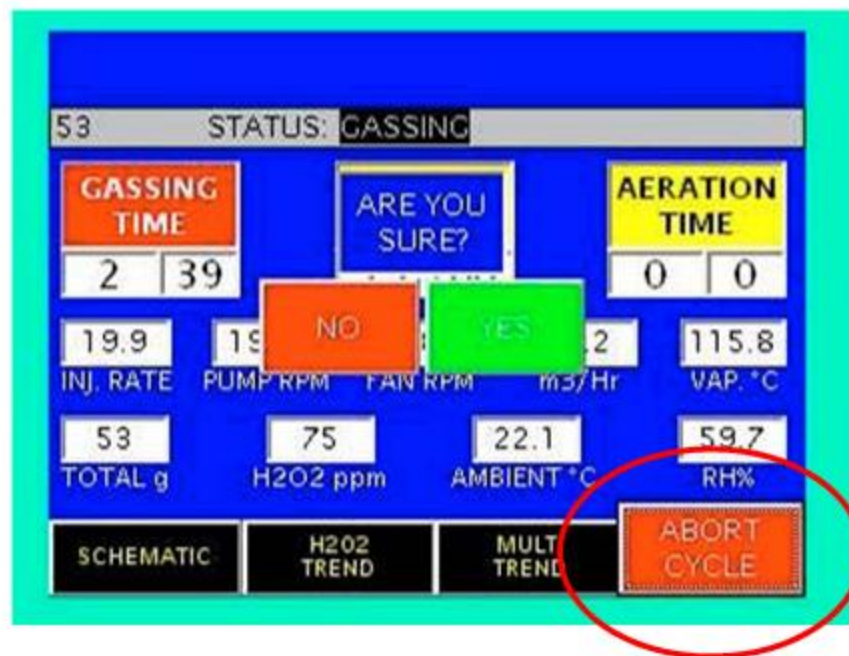
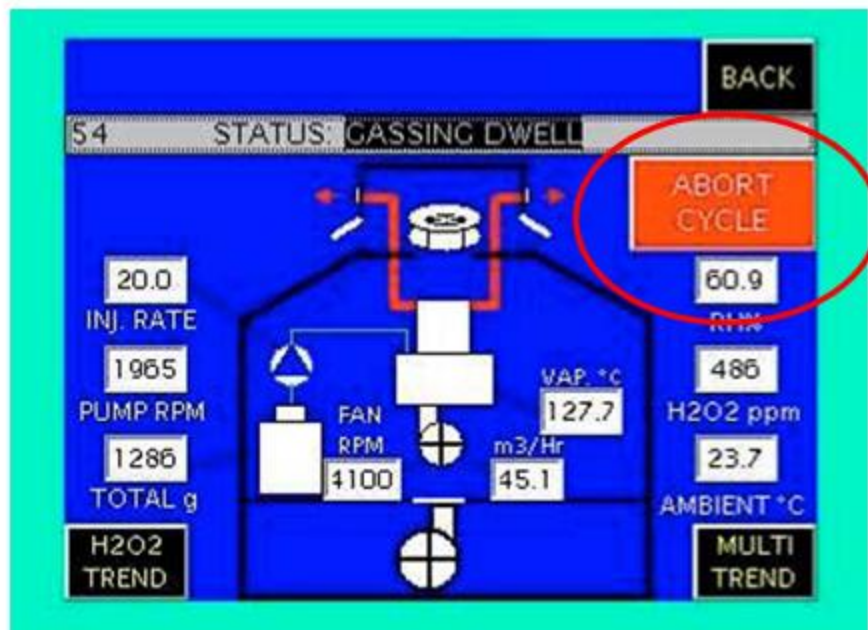




# HPV – End of Decontamination Cycle

In the case of an emergency

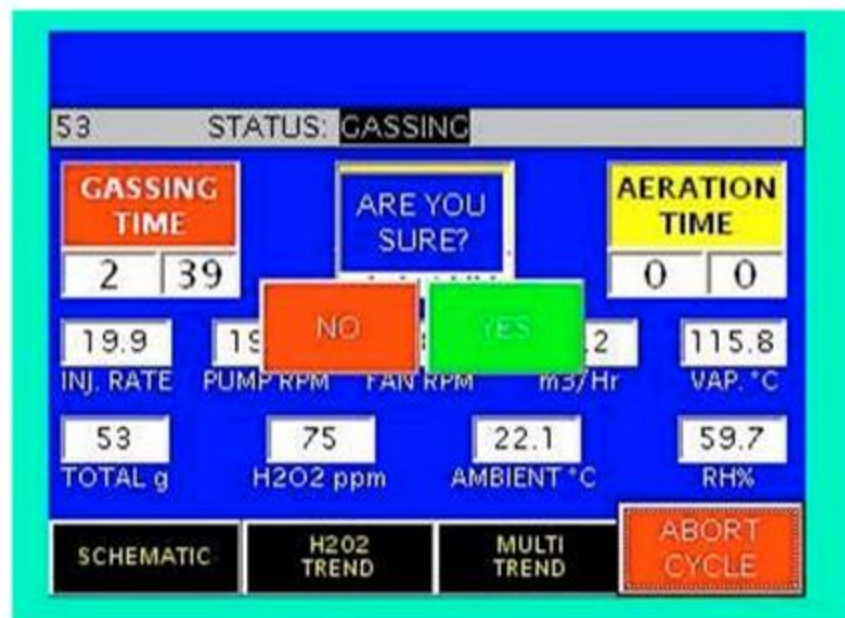
Press 'Abort Cycle' and then press 'Yes' to confirm





# HPV – End of Decontamination Cycle

Once the gas concentration inside the room has dropped below **1ppm**, press '**End Cycle**'



# HPV – End of Decontamination Cycle

Decant any residual peroxide back into its storage container and rinse H<sub>2</sub>O<sub>2</sub> bottle with clean water



# HPV – Bioquell Z Instrument

Open the back of the lectern where the following items should be stored: The mains power cable for the main Bioquell Z unit, Electronic Measuring Device, PAC III Gas Monitor, Safety Glasses, Sealing Tape and Disposable Gloves.

**Safety Glasses**

**Electronic Measuring Device**

**PAC III Gas Monitor**

**Sealing Tape**

**Disposable Gloves**

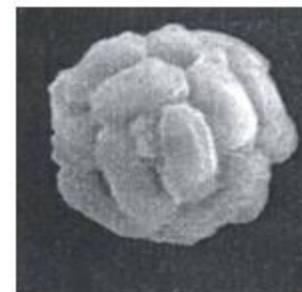
**Printer Paper**

**Mains Power Cable**





# Biological Indicators



❑ Biological indicators are a critical validation 'Tool' in the Pharmaceutical industry. It is important in any qualification to manage 'Rogue' BIs (poorly manufactured with spore clumps not possible to inactivate with HPV).

❑ Room disinfection standards are developing via the CEN groups (European standards). The current requirement is one type of spore challenge at 3log and other specific Isolates e.g. bacteria etc at 4log.

HVAC drying affects reducing contact time of disinfectants is a key issue giving problems to validate Manual disinfection processes.



# Biological Indicator

- 56 – 60°C Incubation
- Environmental bacteria not grow



## HPV Bio-decontamination Report

Bioquell Z (AMS: \_\_\_\_\_) H2O2 Sensor next calibration date: \_\_\_\_\_

Portasens II (AMS: \_\_\_\_\_) H2O2 Sensor next calibration date: \_\_\_\_\_

Hydrogen peroxide Batch No: 0624690 Exp Date: 28 Feb 2011

Biological indicator Lot No: H1459 Exp Date: 28 Feb 2011

Hospital: PMH Ward: EF4

Location	Date	Result <sup>@</sup>	Remarks
Bed 1&2	31/12/2010	Success / <del>Fail</del>	
Bed 3&4	31/12/2010	Success / <del>Fail</del>	
Bed 5&6	30/12/2010	Success / <del>Fail</del>	
Bed 7&8	29/12/2010	Success / <del>Fail</del>	
Bed 9&10	28/12/2010	Success / <del>Fail</del>	
Bed 11&12	29/12/2010	Success / <del>Fail</del>	
Bed 13&14	28/12/2010	Success / <del>Fail</del>	
Bed 15&16	30/12/2010	Success / <del>Fail</del>	
Bed 17&18	29/12/2010	Success / <del>Fail</del>	

@ Success – ≥90% of biological indicator killed;

Fail – <90% of biological indicator killed.

The details of the disinfection cycles (please refer to attached Bioquell X printouts)

Done By:

Ward Supervisor: Ms Tany KWONG, PMH WM(Paed&AM)

EMSD: Mr Roy Yam, Mr Lau, Mr Law & Mr Yip

ICT: Ms S S LAM, PMH NO(ICT)

Supervisor: Mr WT HUI (PATH) Sign: \_\_\_\_\_

ICO: Dr TK Ng Sign: \_\_\_\_\_ Date: \_\_\_\_\_

## **HPV Bio-decontamination Report**

**Bioquell Z (AMS: \_\_\_\_\_)H2O2 Sensor next calibration date: \_\_\_\_\_**

**Portasens II (AMS: \_\_\_\_\_)H2O2 Sensor next calibration date: \_\_\_\_\_**

**Hydrogen peroxide Batch No: 0624690 Exp Date: 28 Feb 2011**

**Biological indicator Lot No: H1459 Exp Date: 28 Feb 2011**



Hospital: PMHWard: EF4

Location	Date	Result <sup>@</sup>	Remarks
Bed 1&2	31/12/2010	Success / <del>Fail</del>	
Bed 3&4	31/12/2010	Success / <del>Fail</del>	
Bed 5&6	30/12/2010	Success / <del>Fail</del>	
Bed 7&8	29/12/2010	Success / <del>Fail</del>	
Bed 9&10	28/12/2010	Success / <del>Fail</del>	
Bed 11&12	29/12/2010	Success / <del>Fail</del>	
Bed 13&14	28/12/2010	Success / <del>Fail</del>	
Bed 15&16	30/12/2010	Success / <del>Fail</del>	
Bed 17&18	29/12/2010	Success / <del>Fail</del>	

<sup>@</sup> Success –  $\geq 90\%$  of biological indicator killed;

Fail –  $< 90\%$  of biological indicator killed.

The details of the disinfection cycles (please refer to attached Bioquell X printouts)

**Done By:**

**Ward Supervisor:** **Ms Tany KWONG, PMH WM(Paed&AM)**

**EMSD:** **Mr Roy Yam, Mr Lau, Mr Law & Mr Yip**

**ICT:** **Ms S S LAM, PMH NO(ICT)**

**Supervisor:** **Mr WT HUI (PATH)** **Sign:** \_\_\_\_\_

**ICO:** **Dr TK Ng** **Sign:** \_\_\_\_\_ **Date:** \_\_\_\_\_

## BIOQUELL Z

PLC Version: 2.04 OP Version: 2.04

Z Serial Number: 2007098200012

Hours Run: 144 Cycle Count: 153

Calibration Due: 21/09/08

Cycle Name: PMH WARD EF4 *Bed 182*

Room Parameters: L(m) W(m) H(m) VOL(m3)

8.0 3.0 2.5 60.0

Cycle Parameters: Gas(mins) Dwell(mins)

49 20

Room Loading: MEDIUM

H2O2 Batch No.: 0624690

Aeration Only Cycle: NO

Remote Start/Stop: NO

Minimum H2O2 in Bottle: 1653 ml

Dwell Injection Enabled: YES

Operator: ADMINISTRATOR

Signature:

31/12/10 11:24:24

CONDITIONING START

VAP °C: 29.1 Airflow m3/Hr: 16.0

RH: 31.4% Ambient Temperature: 26.1°C

31/12/10 11:30:30

GASSING START

VAP °C: 136.2 Airflow m3/Hr: 50.0

RH: 30.7% Ambient Temperature: 26.4°C

31/12/10 12:01:58

DWEILL START

VAP °C: 129.2 Airflow m3/Hr: 47.5

H2O2 ppm: 550 Peak ppm: 550 Total g: 629

DWEILL TRIGGERED BY: MINIMUM

31/12/10 12:21:57

AERATION START

VAP °C: 140.5 Airflow m3/Hr: 48.4

H2O2 ppm: 493 Peak ppm: 550 Total g: 807

31/12/10 14:23:30

ALARM: USER CYCLE ABORT

## BIOQUELL Z

PLC Version: 2.04 OP Version: 2.04

Z Serial Number: 2007098200012

Hours Run: 142 Cycle Count: 152

Calibration Due: 21/09/08

Cycle Name: PMH WARD EF4 *Bed 384*

Room Parameters: L(m) W(m) H(m) VOL(m3)

8.0 3.0 2.5 60.0

Cycle Parameters: Gas(mins) Dwell(mins)

46 20

Room Loading: MEDIUM

H2O2 Batch No.: 0624690

Aeration Only Cycle: NO

Remote Start/Stop: NO

Minimum H2O2 in Bottle: 1593 ml

Dwell Injection Enabled: YES

Operator: ADMINISTRATOR

Signature:

31/12/10 09:12:06

CONDITIONING START

VAP °C: 22.7 Airflow m3/Hr: 14.6

RH: 35.9% Ambient Temperature: 24.5°C

31/12/10 09:18:10

GASSING START

VAP °C: 135.8 Airflow m3/Hr: 50.0

RH: 34.8% Ambient Temperature: 25.6°C

31/12/10 09:47:52

DWEILL START

VAP °C: 129.2 Airflow m3/Hr: 47.8

H2O2 ppm: 513 Peak ppm: 513 Total g: 594

DWEILL TRIGGERED BY: MINIMUM

31/12/10 10:07:51

AERATION START

VAP °C: 138.3 Airflow m3/Hr: 50.1

H2O2 ppm: 466 Peak ppm: 513 Total g: 724

31/12/10 11:14:36

ALARM: USER CYCLE ABORT

EF4 *Bed 586*

BIOQUELL Z

PLC Version: 2.04 OP Version: 2.04

Z Serial Number: 2007098200012

Hours Run: 138 Cycle Count: 150

Calibration Due: 21/09/08

Cycle Name: PMH WARD EF4 *Bed 586*

Room Parameters: L(m) W(m) H(m) VOL(m3)

8.0 3.0 2.5 60.0

Cycle Parameters: Gas(mins) Dwell(mins)

40 20

Room Loading: MEDIUM

H2O2 Batch No.: 0624690

Aeration Only Cycle: NO

Remote Start/Stop: NO

Minimum H2O2 in Bottle: 1490 ml

Dwell Injection Enabled: YES

Operator: ADMINISTRATOR

Signature:

30/12/10 08:53:07

CONDITIONING START

VAP °C: 22.3 Airflow m3/Hr: 12.6

RH: 52.2% Ambient Temperature: 23.3°C

30/12/10 08:59:13

GASSING START

VAP °C: 135.5 Airflow m3/Hr: 49.1

RH: 50.8% Ambient Temperature: 24.2°C

30/12/10 09:24:41

DWEILL START

VAP °C: 128.6 Airflow m3/Hr: 46.8

H2O2 ppm: 355 Peak ppm: 355 Total g: 509

DWEILL TRIGGERED BY: MINIMUM

30/12/10 09:44:40

AERATION START

VAP °C: 140.2 Airflow m3/Hr: 49.7

H2O2 ppm: 326 Peak ppm: 355 Total g: 611

30/12/10 10:52:08

ALARM: USER CYCLE ABORT

30/12/10 11:02:33

ALARM: COMMUNICATIONS TIMEOUT

## Infectious Disease Center Princess Margaret Hospital

### Title: PMH Ward **EF4** Disinfection by Bioquell Z Vapourised Hydrogen Peroxide System

Document Type: Work Instructions

Document code: **WI-ICT-HPVXXX-01**

Number of copies and distribution

Location	# of copy		Location	# of copy
PMH S16 ICT	1 of copy 2			
<b>PMH Ward EF4</b>	2 of copy 2			



## 1. Important Notes & Quick Guides

### 1.1 PPE required for EMSD staffs (recommended by ICT)

1.1.1 Regular PPE – surgical mask, disposed gloves, regular EMSD working cloth

1.1.2 Highly containment PPE – N95 mask (fit test required), disposal gown (e.g. water repellant gown, Tyvek® suit), disposal gloves, face shield, Don up & down procedures, PPE disposal procedure

### 1.2 A/C system

1.2.1 **No remote individual damper** provided, the removal H<sub>2</sub>O<sub>2</sub> vapour can be done by the **Neutralizer, R20 Aeration Unit only**.

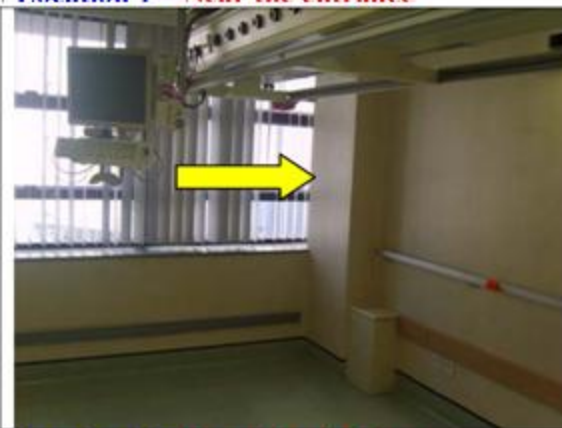
1.3 Room Size & Cycle name saved in the Bioquell Z ([Refer Section 4.5 to 4.11](#))

Room No	Cycle Name	H2O2 required (mL)	Length (M)	Width (M)	Height (M)
Bed 1 & 2	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 3 & 4	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 5 & 6	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 7 & 8	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 9 & 10	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 11 & 12	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 13 & 14	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 15 & 16	PMH Ward EF4	1.6	8.0	3.0	2.5
Bed 17 & 18	PMH Ward EF4	1.6	8.0	3.0	2.5

1.4 Placement of biological indicators (photo) (Refer to [Section 3.8](#))



**Location 1 – Near the entrance**

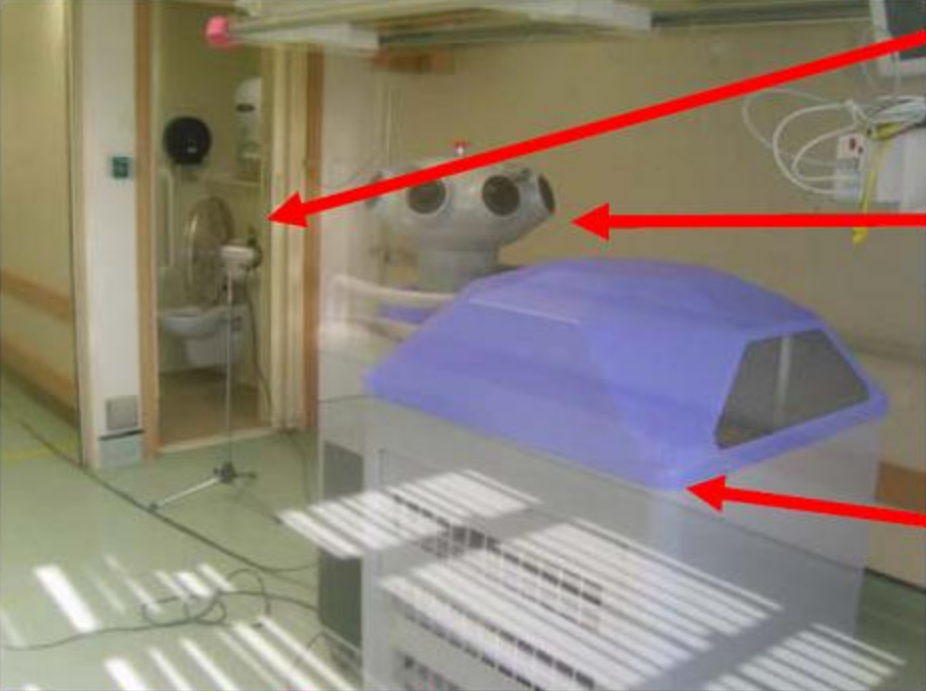


**Location 2 – Near the window**



**Location 3 – Near the Shower**

1.5 Placement of Circulating Fan, Bioquell Z, neutralizer, R20 Aeration Unit (photo)

	<p><b>Circulating Fan</b></p> <p><b>Bioquell Z</b></p> <p><b>neutralizer, R20 Aeration Unit</b></p>
<p><b>Location 1 – Near the entrance</b></p>	



1.6 Sealing of room (photo) (Refer to [Section 3](#))



Seal the inlet and outlet near the **entrance**



Seal the smoke detector near the **entrance**



Seal the outlet in the **toilet**



Seal the outlet & smoke detector in **the room**



Seal the visible big hole of the window frames, lower the Venetian Blinds(百頁簾)



seal all **exhaust grills** just above the floor



add water to the floor drain of the **shower**



add water to the floor drain of the **toilet**



add water to the drain of the **wash basin**



Seal the entrance with plastic sheet



Make a small opening for air sampling by the H<sub>2</sub>O<sub>2</sub> detector, Portasens





**Cannot seal by closing the door with the tape**



**Cannot seal by closing the door with the tape**



**Cannot seal by closing the door with the tape**

**Cannot seal by closing the door with the tape – there was a big leakage found in the door upper part!!!**



- 1.7 Post the **Warning sign** and check any leakage of the surrounding of the room (photo)



Post the **Warning sign**



Post the **Warning sign**



check any leakage of the **entrance**



check any leakage of the **glass window of adjacent room**



check any leakage of the **fall ceiling of adjacent room**

# Equipment Maintenance

- Bioquell Z HPV machines  
– Annual maintenance  
(done by UK staff)  
HK\$43,200.
- Portable sensor –  
PortaSens II H2O2 sensor  
calibration annually  
HK\$3,500
- Portable sensor –  
PortaSens II H2O2  
HK\$12,000



## HPV De-contamination Cost for Small room (half day work)

	Unit cost	Quantity	Subtotal
<b>Operation cost (done by PMH EMSD) including minor consumables for sealing</b>	<b>2000</b>	<b>1</b>	<b>2000</b>
<b>Consumables</b>			
<b>Hydrogen peroxide reagent (1 L)</b>	<b>400</b>	<b>1</b>	<b>400</b>
<b>Biological indicator</b>	<b>50.5</b>	<b>3</b>	<b>151.5</b>
<b>Chemical indicator</b>	<b>18</b>	<b>3</b>	<b>54</b>
		<b>Total</b>	<b>2605.5</b>