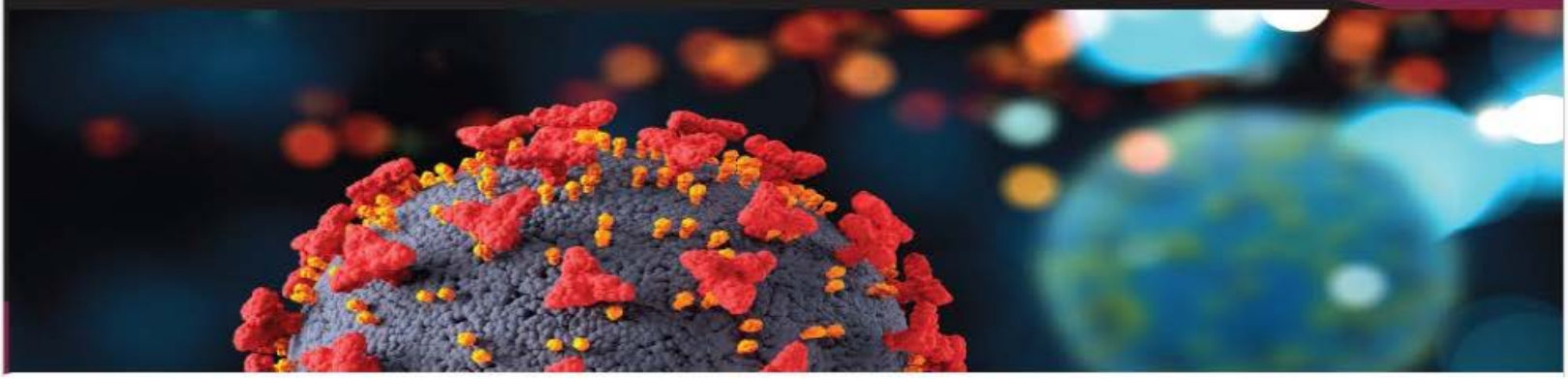
Microbiome Includes Difficult to Remove Biofilms on Dry Surfaces

PCS
PROCESS CLEANING SOLUTIONS
Bringing Science to the Art of Cleaning™



Did you know the vast majority of bacteria in the world live as a part of biofilm communities.

Most 50 to 70 % of hospital aquired infections are caused by biofilm forming bacteria including Methicillin Resistant Staphylococcus aureus (MRSA),Vancomycin Resistant Enterococci (VRE), Extended Spectrum Beta-Lactamase (ESBL), Carbapenemase Producing Enterobacteriaceae (CPE), Candida auras to mention just a few (Roy et al., 2018).

Hard surface disinfectants registered for use in Canada do not require testing against biofilms. Biofilms are divided into two groups ,traditional biofilms that are mostly found in wet areas and dry surface biofilms.
Dry surface biofilms are a relatively new science that challenges our current understanding of surface cleaning and disinfecting. Current cleaning and disinfecting techniques less effective against biofilms.

A few recent clinical studies have developed testing protocols testing MIC Minimum Inhibitory Concentration (planktonic bacteria) and MBEC Minimum Biofilm Eradication Concentration. The majority of pathogens are biofilm formers and are more resistant to many disinfectants.

Look for products in peer reviewed clinical studies. Containing disinfectants that have demonstrated similar MIC Minimum Inhibitory Concentrations and MBEC Minimum Biofilm Eradication Concentrations.

Sodium hypochlorite is one such chemical the most trusted disinfectant for the last 200 hundred years. PCS is dedicated to finding safer concentrations and ways of cleaning to Protect the most sensitive amongst us.

Current cleaning chemicals and Hydrogen Peroxide disinfectants less effective against Dry Surface Biofilms.

According to the National Institutes of Health (NIH), up to 80% of human bacterial infections are caused by bacterial biofilms, which are difficult to cure.

PROCESS CLEANING SOLUTIONS
Bringing Science to the Art of Cleaning®

1 Minute Disinfectant

PROCESS CLEANING SOLUTIONS PROUDLY CANADIAN.

PCS 1000 Plus Oxidizing Disinfectant Cleaner Active
Sodium hypochlorite - 0.13%
Hypochlorous acid - 0.01%
Oxidizing Cleaner
Oxidizing Hospital Grade Disinfectant
Oxidizing broad spectrum virucide
DIN: 02521431

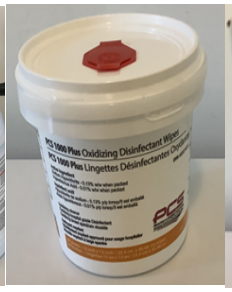
PCS 1000 Plus Oxidizing Cleaning Process to Prevent Spreading Pathogens and for Removal of Dry Surface Biofilm Matrix and C. difficile Spores.

(1) **Apply PCS 1000 Plus Oxidizing Disinfectant Cleaner to surface with coarse spray or moistened wipe. Allow 1 minute contact.**

(2) **Wipe dry with PCS Hygienic Microfibre cloth.**

APPLY AND DRY
PCS PROCESS CLEANING SOLUTIONS
CLEANING TO PROTECT PUBLIC HEALTH

SAFE • EFFECTIVE CLEANING
ENVIRONMENTALLY RESPONSIBLE
CLEANING WITHOUT TRANSFERRING PATHOGENS



PCS 1000 Plus Oxidizing Disinfectant/Cleaner

5906-6 • 6 x 946 ml flip top lids
5906-4 • 4 x3.78 liters

PCS-TRG-12 Hypochlorous acid Comp sprayers 12 pkg Use Squirt Setting Apply and Wipe Surface Dry

PCS-PS PCS pressure sprayer 1.5L

Now Available
PCS Hygienic Microfibre cloths use with PCS 1000 Plus to add friction to remove Biofilm Matrix

10-inch x 10 inch 18 grams per cloth • 6 x 50: 300 cs MF300- Blue, MF300- Green, MF300 -Yellow
MF300 – Pink Cost effective and durable

Surfactant Free Formulation Ingredients Sodium hypochlorite, Hypochlorous acid, Sodium carbonates , Acetic acid, Sodium hydroxide and Sodium chloride

NEW

PCS 1000 Plus Oxidizing Disinfectant Cleaner Wiper Kit - 6186-2

Carton contents 2 x 946 mL PCS 1000 Plus Oxidizing Disinfectant Cleaner 2 x PCS 1000 Plus Oxidizing Disinfectant Cleaner wiper bucket.

Each bucket contains 1 roll of wipes • 80 sheets 10” x 12”/25.4 cm x 30.48 cm

PCS 1000 Plus process, provides Oxidation and **FRICTION, KEY TO REMOVING DRY SURFACE BIOFILMS**. and C. difficile spores.

1. PCS 1000 Plus efficacy on bacteria removed from 12-day old biofilm.

2. C. difficile spores removing activity using PCS 1000 Plus OxidizingDisinfectant Cleaner wiping with PCS microfiber cloth and positive control Hydrogen Peroxide Disinfecting Wipe.

3. PHAC C. Difficile Acute Care

THINK GLOBALLY BUT BUY LOCAL. PROCESS CLEANING SOLUTIONS PROUDLY CANADIAN.

Oxidizing Cleaner Oxidizing Hospital Grade Disinfectant Oxidizing Broad Spectrum Virucide

APPLY AND DRY

PCS PROCESS CLEANING SOLUTIONS

CLEANING TO PROTECT PUBLIC HEALTH

PCS 1000 Plus Oxidizing Disinfectant Wipe Kit

Apply moistened wiper and wipe dry with PCS Hygienic microfibre cloth.

PCS 1000 Plus Oxidizing Disinfectant Wipes - DIN: 02521431

Active Ingredient - Sodium Hypochlorite - 0.13% w/w when packed • Hypochlorous Acid - 0.01% w/w when packed

Oxidizing cleaner • Oxidizing hospital grade Disinfectant • Oxidizing broad spectrum virucide
80 sheets • 10 inch x 12 inch / 25.4 cm x 30.48 cm wipes

PCS 1000 Plus Oxidizing Disinfectant Cleaner Wiper Kit - 6186-2 • DIN: 02521431

Carton contents
2 x 946 mL PCS 1000 Plus Oxidizing Disinfectant Cleaner
2 x PCS 1000 Plus Oxidizing Disinfectant Cleaner wiper bucket.
Each bucket contains 1 roll of wipes • 80 sheets 10” x 12”/25.4 cm x 30.48 cm

SAFE

PCS non-hazardous category four disinfectant meaning no cautionary symbols are required, neutral pH sodium hypochlorite - Hypochlorous acid solution.

EFFECTIVE CLEANING

Broad spectrum hospital disinfectant, Broad spectrum virucide and Oxidizing Cleaner. When using PCS patented Apply and Dry-cleaning process PCS 1000 Plus Oxidizing Disinfectant Cleaner removes and prevents transferring bacteria, viruses, mold and C. difficile spores.

Ideal cleaning process for use in critical areas and to replace alkali bleach disinfectants.

ENVIRONMENTALLY RESPONSIBLE

PCS Apply and Dry-Cleaning Leaves no toxic residue on surfaces or in the environment. Natural formulation contains no synthetic chemicals. Endorsed and certified by the Envirodesic™ Certification Program for Maximum Indoor Air Quality TM and minimum environmental health impact.

CLEANING WITHOUT TRANSFERRING PATHOGENS•

PCS Apply and Dry-cleaning results demonstrated significantly better removal of pathogens and prevention of transfer of pathogens to adjacent surfaces. Previous QCT-3 studies demonstrated wiping high touch surfaces with pre-moistened wipes or cloths transferred Muri ne norovirus and C. difficile spores to clean surfaces, this occurred with all major classes of disinfectants

C. difficile spores removing activity using PCS 1000 Plus wiping with PCS Microfibre cloth and positive control Hydrogen Peroxide Disinfecting Wipe

	CFU/cm2			Percent	
Product	Control	After Wiping	Transfer	Reduction	Transfer
PCS microfibre cloth	7.67×10^6	0	0	100*	0*
HPW	6.67×10^5	~6.67×10^5	2.50×10^5	0**	37.5

C. difficile Cleaning Process

1. Apply **PCS 1000 Plus Oxidizing Disinfectant Cleaner** to the surface to be decontaminated with a **PCS Four Sided Single Use Wiper** or **PCS Microfibre Cloth** or **PCS Toraysee™ Cloth.**
2. Wipe the surface twice in the same direction. This will remove 99.9% of C. difficile spores.
3. Wipe surface dry with PCS microfiber cloth This will remove any organic soils that may have been left after step 2.

PROCESS CLEANING SOLUTIONS
Bringing Science to the Art of Cleaning

PCS 1000 Plus Oxidizing Disinfectant Cleaner

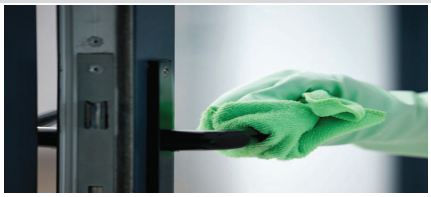
Powerful disinfectant that is gentle on staff, surfaces and the environment.

Health Canada list of disinfectants likely to be effective against Covid 19, of the more than 700 products listed only Neutral pH PCS 1000 Plus Oxidizing Disinfectant Cleaner list sodium hypochlorite and hypochlorous acid as the active ingredients. The formulation is a very mild category four disinfectant that does not require caution or warning symbols/statements on the label.

PCS Neutral pH products are a combination of hypochlorous acid and sodium hypochlorite that oxidize organic soils, then decompose upon drying leaving no residual disinfectant on surfaces. PCS Buffered pH products form an equilibrium of hypochlorous acid and sodium hypochlorite. The sodium hypochlorite provides cleaning and stability, the hypochlorous acid provides milder solutions with increased disinfection. Sodium hypochlorite oxidizes bacteria from the outer cell surface. Hypochlorous acid penetrates through the bacterial cell wall allowing for cell oxidation to occur simultaneously from the inside and outside of the cell.

C. difficile Cleaning Process

1. Apply **PCS 1000 Plus Oxidizing Disinfectant Cleaner** to the surface to be decontaminated with a **PCS Four Sided Single Use Wiper** or **PCS Microfibre Cloth** or **PCS Toraysee™ Cloth.**
2. Wipe the surface twice in the same direction. This will remove 99.9% of C. difficile spores.
3. Wipe surface dry with PCS Hygienic Microfiber cloth to remove biofilm matrix and remaining C. difficile spores.



Mechanical Wiping Increases the Efficacy of Liquid Disinfectants. Adding wiping reduced the time to kill 6 logs of SARS-CoV-2 to 5 seconds from 5 minutes.

Angela Sloan,Samantha B. Karsloff and Todd Curtis
Mechanical Wiping Increases the Efficacy of liquid Disinfectants on SARS-CoV-2
National Microbiology Laboratory, Applied Biosafety Research Program ,Safety and Environmental Services.

Public Health Agency of Canada, Winnipeg, MB

PCS 1000 Plus Oxidizing Disinfectant Cleaner
This product is a broad-spectrum virucidal hard surface disinfectant that is expected to inactivate the SARS-CoV-2 (the virus that causes COVID-19) Kills 99.99% of bacteria and viruses, Kills 99.99% of germs, Kills Staphylococcus aureus, Pseudomonas aeruginosa, Human Coronavirus, and Adenovirus Type 5 Broad Spectrum Virucide, Bactericide/Virucide
PCS 1000 Plus pH 6.5 to 8.5 oxidizing disinfectant available in ready to use formats.

DIN 02521431 New contact times

Oxidizing Cleaner	Contact Time
Oxidizing Hospital Grade Disinfectant	1 minute
Oxidizing Broad spectrum Virucide	1 minute

Use to to remove C. dificille spores
Use for discharge deep cleans of patient rooms
Use to deep clean food preparation areas
Use to clean during viral outbreaks
Use to clean mold stains

"Disinfectants, household cleaners, and bleach are meant to be used to clean surfaces." Quote from Health Canada

C. difficile spores removing activity using PCS 1000 Plus wiping with PCS Microfiber cloth and positive control Hydrogen Peroxide Disinfecting Wipe

	CFU/cm2			Percent	
Product	Control	After Wiping	Transfer	Reduction	Transfer
PCS Microfiber cloth	7.67×10^6	0	0	100*	0*
HPW	6.67×10^5	~6.67×10^5	2.50×10^5	0**	37.5

HOCL Versus H2O2 for biofim removal

Antibiofilm Efficiency of PCS Sodium Hypochlorite/ Hypochlorous Acid pH 6.5 to 8.5 Products.

Evaluation of the effectiveness of hydrogen-peroxide-based disinfectants on biofilms formed by Gram-negative pathogens

In Vitro Antibacterial Activity of Hydrogen Peroxide and Hypochlorous Acid, Including That Generated by Electrochemical Scaffolds

Effect of disinfectant formulation and organic soil on the efficacy of oxidizing disinfectants against biofilms

STUDY TITLE

Assessment of PCS APH 1000 Plus as a Hard Surface Disinfectant against Bacteria Isolated from Dry Biofilms using AOAC Germicidal Spray Test (GSPT): Testing against *Staphylococcus aureus* and *Pseudomonas aeruginosa*

TEST ORGANISM

Staphylococcus aureus (ATCC # 6538)
&
Pseudomonas aeruginosa (ATCC 15442)

TEST SAMPLE IDENTITY

PCS APH 1000 PLUS
Lot No: 3108L004

TEST STANDARD

AOAC International's Official Method 961.02[1]

AUTHOR/STUDY DIRECTOR

Dr. Farhad Karbassi

STUDY COMPLETION DATE

August/17/23

TEST FACILITY

CREM Co. Labs. Units 1-2, 3403 American Dr., Mississauga, Ontario, Canada L4V 1T4

SPONSOR

Process Cleaning Solutions, Ltd.,
2060 Fisher Drive, Peterborough, ON, Canada, K9J 8N4

STUDY NUMBER

PCS-230418-01

CREM Co Labs, Units 1-2, 3403 American Dr., Mississauga, ON, Canada L4V 1T4; Tel: 289-315-3639 Fax: 289-315-3631.
http://www.cremco.ca

Table 6: Results of efficacy test as + (growth), or - (no growth) tested by the GSPT method using biofilm isolated *P. aeruginosa*, for Test item PCS APH 1000 PLUS Lot# 3108L004

Sample ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Sample ID	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Sample ID	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Sample ID	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Sample ID	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Sample ID	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Growth/ No Growth	-	-	-	-	-	-	-	-	-	-
Total Number of negative Test Sample tubes:60 Total Number of positive Test Sample tubes: 00										
Pass/fail (the performance standard): **Pass**										

14. CONCLUSION

Under the test conditions specified in the protocol, the test substance PCS APH 1000 PLUS Lot# 3108L004 met the acceptance criterion against the dry biofilm-isolated *S. aureus* and *P. aeruginosa*.

The performance standard for *S. aureus* and *P. aeruginosa* is 0-1 positive (growth) carriers out of 60 tested. Based on the acceptance criterion, the test sample passed the test against both types of biofilm isolated bacteria. The test substance similarly passed the test against planktonic form of *S. aureus* and *P. aeruginosa* with the similar result. This shows the performance of the test substance against both planktonic and biofilm-related forms of the bacteria remain the same.

In the opinion of the Study Director, there were no circumstances that may have adversely affected the quality or integrity of the data.

CREM Co Labs, Units 1-2, 3403 American Dr., Mississauga, ON, Canada L4V 1T4; Tel: 289-315-3639 Fax: 289-315-3631.
http://www.cremco.ca

STUDY TITLE

Activity of PCS 1000 Plus against representative Healthcare-Associated Pathogens: Testing against the Spores of *Clostrioides difficile* (ATCC 43598) using a Suspension Test Protocol.

TEST ORGANISM

Clostrioides difficile spores (ATCC 43598)

TEST SAMPLE IDENTITY

PCS 1000 Plus
Lot #21342032

TEST Method

Suspension Test (ASTM E2315)

AUTHOR

Bahram Zargar, PhD
Study Director

STUDY COMPLETION DATE

Feb/24/21

PERFORMING LABORATORY

CREM Co. Labs. Units 1-2, 3403 American Dr., Mississauga, Ontario, Canada L4V 1T4

SPONSOR

Process Cleaning Solutions, Ltd.
2060 Fisher Drive, Peterborough, ON, Canada, K9J 8N4

STUDY NUMBER

PCS220210-01

This was done to take into the account the changes in the input level of the test organisms during the experiment.

DATA ANALYSIS

Calculation of Percent Reduction

$$Percent\ Reduction = \left(1 - \frac{\frac{\text{CFU or PFU}_{contaminated}}{\text{A}_{disk}}}{\frac{\text{CFU or PFU}_{initial}}{\text{A}_{platform}}}\right) x100$$

$$Percent\ Transfer = \left(\frac{\frac{\text{CFU or PFU}_{\ transfer}}{\text{A}_{disk}}}{\frac{\text{CFU or PFU}_{initial}}{\text{A}_{platform}}}\right) x100$$

Where

$\text{CFU or PFU}_{\ initial}$= average of CFU or PFU on the two control disks

$\text{CFU or PFU}_{\ contaminated}$= average of CFU or PFU on the five disks retrieved from contaminated platform

$\text{CFU}_{\ or\ PFU\ transfer}$= average of CFU or PFU on the five disks retrieved from transfer platform

$\text{A}_{platform}$= Area of the platform (cm^2)

A_{disk}= Area of the disk (cm^2)

STUDY ACCEPTANCE CRITERIA

No product acceptance criterion was specified for this range-finding study.

TEST RESULTS

Table 1 summarizes the result of efficacy tests on *C. difficile* spores.

Table 1: C. difficile spores inactivating activity using PCS 1000 PCS Plus in suspension test.

	Average of the Total CFU/tube		Log_{10} reduction	Percent Reduction
	Control	Test		
5-minute Contact Time	5.86×10^5	2.06×10^3	2.45	99.65
10-minute Contact Time	5.86×10^5	20.2	4.46	99.997

Conclusions

The results of this study showed that, under the test conditions specified, PCS 1000 Plus efficiently inactivated the spores in suspension. Such test shows that the reusable wipes can be decontaminated efficiently in a bucket of PCS 1000 Plus even if it is contaminated with highly disinfectant-resistant spores of *C. difficile*.

STUDY TITLE

Assessment of the Bactericidal Stability of PCS 1000 Plus Oxidizing Formulation Over 16 Month Period Using a Suspension Test Protocol: Testing with *Staphylococcus aureus* as a Healthcare-Associated Pathogen

TEST ORGANISM

Staphylococcus aureus (ATCC 6538)

TEST SAMPLE IDENTITY

PCS 1000 Plus Oxidizing Formulation
Lot: #23016045

TEST Method

ASTM E2315: Assessment of Antimicrobial Activity Using a Time-Kill

AUTHOR

Dr. Syed A. Sattar
Study Director

STUDY COMPLETION DATE

March/4/24

PERFORMING LABORATORY

CREM Co. Labs. Units 1-2, 3403 American Dr., Mississauga, Ontario, Canada L4V 1T4

SPONSOR

Process Cleaning Solutions
2060 Fisher Drive, Peterborough, ON, Canada, K9J 8N4

STUDY NUMBER

PCS230115-SA

2. Test Procedure

Three 10-mL Falcon tubes were used for control and three others for the test substance. 0.5 mL of a working culture was added to each test or control tube. 9.5 mL of the test substance was added to each of test tubes 10 sec before finishing the contact time was mixed and 1 mL of it was transferred to another tube containing 9 mL neutralizer, vortex-mixed and 10-fold serial dilutions were prepared using phosphate buffered saline (PBS; pH 7.2-7.4) as the diluent. For controls, a similar procedure was used except 9.5 mL PBS was used instead of test substance. 100 µL of each dilution were spread plated on a TSA plate. The plates were incubated for 24 to 48 hours, CFU on them counted and the plates reintubated for an additional three days for any late-growers to manifest themselves.

Experimental Design

a) Efficacy Test

1. The efficacy tests were performed every three months over a 16-months period on the same lot of the test substance.
2. Three control tubes and three efficacy tubes were used during each test.

DATA ANALYSIS

Calculation of Total CFU per Carrier

$$C_{carrier} = \left[\left[\frac{\sum_{i=1}^{n}(C_i * Di * 10)}{n}\right] * V_n\right] * 10$$

Where

$C_{carrier}$= Total CFU per carrier (tube)

V_n= Volume of neutralized disinfectant

Di= 10^(-i) dilution

i= dilution factor

n= number of dilution

C_i= number of CFU on the plate of i_{th} dilution

STUDY ACCEPTANCE CRITERION

The microbicidal activity of the test substance is not considered stable if it shows a greater than 0.5 $\log_{10}$ reduction difference in its activity against the test organism over 16 months.

TEST RESULTS

Table 1 shows the results of the testing performed on *S. aureus* every three months over a 12-months period using a suspension test protocol.

Table 1: The result of efficacy tests on PCS 1000 Plus over a 16-months period

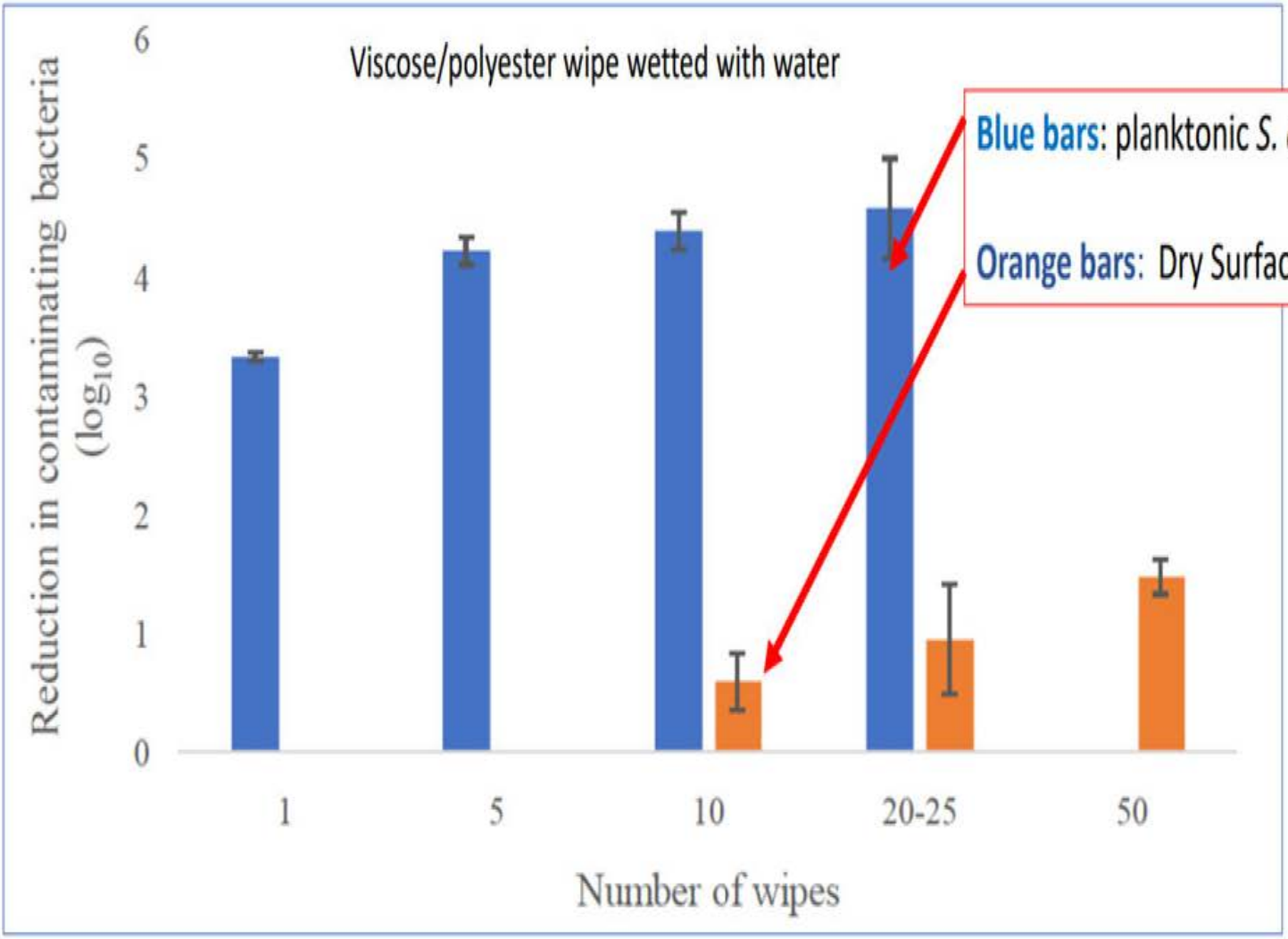
Test Number	Test Date	(CFU/mL) in Neutralizer		(CFU/carrier)		Reduction	
		Control	test	Control	test	log_{10}	Percent
Test #1	Feb/05/2023	4.83E+06	0	4.83E+08	0*	8.68	99.9999998
Test #2	May/05/2023	3.02E+06	0	3.02E+08	0*	8.48	99.9999997
Test #3	Aug/06/23	5.40E+06	0	5.40E+08	0*	8.73	99.9999998
Test #4	Nov/06/23	3.65E+06	0	3.65E+08	0*	8.56	99.9999997
Test #5	Feb/05/24	4.82E+06	0	4.82E+08	0*	8.68	99.9999998
Test #6	June/07/24	7.67E+06	0	7.67E+08	0	8.88	99.9999999
Average Log reduction						8.67±0.14	99.9999998±0.00000008

*No of CFU recovered from each test plate

Conclusions

The test substance was able to bring the viability of the test organism to an undetectable level in all the efficacy tests even after aging under ambient conditions for a period of 16 months, thus meetings its stability criterion. Log_{10} reductions of 8.67±0.14 was achieved by all three lots of the test substance.

Impact of linear wiping action on different growth cultures of *Staphylococcus aureus*



Parvin F et al., Difficulty in removing biofilm from dry surfaces, Journal of Hospital Infection, https://doi.org/10.1016/j.jhin.2019.07.005

ipac Infection Prevention and Control Canada

pci Prévention et contrôle des infections Canada

1 minute

CRITICAL HEALTH CARE

Oxidizing Cleaner
Oxidizing Hospital Grade Disinfectant
Oxidizing Broad Spectrum Virucide

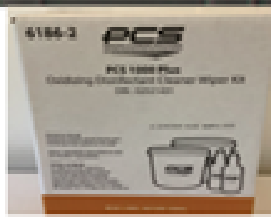
APPLY AND DRY
PCS
PROCESS CLEANING SOLUTIONS
CLEANING TO PROTECT PUBLIC HEALTH

PCS 1000 Plus Oxidizing Disinfectant Wipe Kit
Apply moistened wiper and wipe dry with PCS Hygienic microfibre cloth.

PCS 1000 Plus Oxidizing Disinfectant Wipes - DIN: 02521431
Active Ingredient - Sodium Hypochlorite - 0.13% w/w when packed • Hypochlorous Acid - 0.01% w/w when packed

Oxidizing cleaner • Oxidizing hospital grade Disinfectant • Oxidizing broad spectrum virucide
80 sheets • 10 inch x 12 inch / 25.4 cm x 30.48 cm wipes

PCS 1000 Plus Oxidizing Disinfectant Cleaner Wiper Kit - 6186-2 - DIN: 02521431
Carton contents
2 x 946 mL PCS 1000 Plus Oxidizing Disinfectant Cleaner
2 x PCS 1000 Plus Oxidizing Disinfectant Cleaner wiper bucket.
Each bucket contains 1 roll of wipes • 80 sheets 10" x 12"/25.4 cm x 30.48 cm



SAFE
PCS non-hazardous category four disinfectant meaning no cautionary symbols are required, neutral pH sodium hypochlorite - Hypochlorous acid solution.

EFFECTIVE CLEANING
Broad spectrum hospital disinfectant, Broad spectrum virucide and Oxidizing Cleaner. When using PCS patented Apply and Dry-cleaning process PCS 1000 Plus Oxidizing Disinfectant Cleaner removes and prevents transferring bacteria, viruses, mold and C. difficile spores.
Ideal cleaning process for use in critical areas and to replace alkali bleach disinfectants.

ENVIRONMENTALLY RESPONSIBLE
PCS Apply and Dry-Cleaning Leaves no toxic residue on surfaces or in the environment. Natural formulation contains no synthetic chemicals. Endorsed and certified by the Envirodesic™ Certification Program for Maximum Indoor Air Quality TM and minimum environmental health impact.

CLEANING WITHOUT TRANSFERRING PATHOGENS-
PCS Apply and Dry-cleaning results demonstrated significantly better removal of pathogens and prevention of transfer of pathogens to adjacent surfaces. Previous QCT-3 studies demonstrated wiping high touch surfaces with pre-moistened wipes or cloths transferred Murine norovirus and C. difficile spores to clean surfaces, this occurred with all major classes of disinfectants

CREM CO
For a Safer Tomorrow

CREM Co Labs.
3403 American Dr.
Mississauga L4V 1T4
Phone : +1 (289) 315-3639 +1 (905) 510-0111
E-mail : bzargar@cremco.ca

Test Report #241017-01
Date of Issue: Oct/17/24
WO# WO-1-241011-1

Test certificate

Customer Name and Address:	**Test Item :**
Name: St. John's Hospital Address: Hamilton	Received Items: 2 Samples of CREM Co's Audit Kit Date of Receipt: Oct/11/24

Sl#	Sample name	Date of test	Test	Result
1	Emergency Room 9 HALL	Oct/11/24	Detection of *Pseudomonas aeruginosa*	Detected (Present)
			Total aerobic Microbial Count per cm^2	489 CFU/cm^2
2	Emergency Room 9 CART	Oct/11/24	Detection of *Pseudomonas aeruginosa*	Detected (Present)
			Total aerobic Microbial Count per cm^2	3429 CFU/cm^2

Pre-Cleaning Audit with PCS dry sterilized microfiber cloth. 2500 square centimeters dampened by spraying small quantity of disinfectant neutralizing solution. Surface wiped dry with PCS autoclaved Microfiber cloth. Cloth placed in sterile pack and sent to CREMCO for incubation and analysis .

Target level of cleanliness after cleaning in health care is less than 1 CFU per square centimeter and 2.5 CFU after cleaning in institutions and commercial settings.

These studies highlight PCS Apply and Dry Hygienic Microfiber cloths ability to remove,hold and prevent transfer of a very large numbers of pathogens. Even without the use of detergents or disinfectants

Cleaning to a Scientifically Validated Standard

Testing PCS Apply and Dry cleaning process with CREM CO labs newly developed third tier of Quantitative Carrier Test Method(QCT-3)to asses decontamination of high touch environmental surfaces(HITES) with the incorporation of field –relevant wiping.

PCS Apply and Dry results demonstrated significantly better removal of pathogens and prevention of transfer of pathogens to adjacent surfaces . Previous QCT-3 studies demonstrated wiping high touch surfaces with pre moistened wipes or cloths transferred Murine norovirus and C.difficile spores to clean surfaces , this occurred with all major classes of disinfectants.

QCT-3 Field relevant laboratory testing data needed to be confirmed under actual use conditions in the patient care environment.PCS contracted NSF International to do microbial audits pre and post cleaning in three separate health care facilities. A large teaching facility in Michigan, a new teaching hospital and a community hospital in Montreal Quebec .

Microbial auditing of the environment pre and post cleaning provides a very accurate measurement of the effectiveness of hospital cleaning practices.

Previous studies have recommended that cleaning should reduce aerobic plate counts to below 2.5 Colony forming units (CFU) per square centimetre for cleaned surfaces.

However many professionals currently recommend that cleaned surfaces should have less than 1 colony forming unit per square centimetre after cleaning.

In all three facilities surfaces where sampled pre and post cleaning and two of the three hospitals in addition to aerobic plate counts samples were also analysed for presence of C.difficile spores.

Samples were taken in multiple rooms for multiple days with hospitals current cleaning process. Staff where then trained on how to clean using PCS Apply and Dry process. Testing pre and post cleaning were again taken in multiple rooms and days.

PCS Apply and Dry Process

PCS low concentration, of non caustic, non toxic, neutral ph sodium hypochlorite solution Applied to surface by spray, pre moistened wiper or microfibre cloth and immediately wiped dry with PCS microfibre cloth.

Cleaning to a scientifically validated standard of less than 1 CFU per square centimetre on average is possible using PCS Apply and Dry process. Better cleaning equals fewer outbreaks. The use of disinfectants potent enough to kill spores like C. difficile should be limited to outbreaks and discharge cleaning of special pathogens, they are no longer needed for everyday cleaning of the health care environment.

Cleaning to Protect Public Health.

Vegetative Bacteria (S. aureus and S. marcescens)
Average CFU per square centimetre

	CFU/cm2			Percent		Average Percent	
Product	Control	AfterWiping	Transfer	Reduction	Transfer	Reduction	Transfer
Apply & Dry Test 1	**27,000**	**0**	**0**	**100**	**0**	**100**	**0**
Apply & Dry Test 2	**35,000**	**0**	**0**	**100**	**0**		

C. difficile spores
Average CFU per square centimetre

	CFU/cm2			Percent		Average Percent	
Product	Control	AfterWiping	Transfer	Reduction	Transfer	Reduction	Transfer
Apply & Dry Test 1	**27,000**	**3.57**	**0**	**99.99**	**0**	**99.95**	**0**
Apply & Dry Test 2	**9,240**	**8.15**	**0**	**99.91**	**0**		

Murine Norovirus
Average PFU per square centimetre

	PFU/cm2			Percent		Average Percent	
Product	Control	AfterWiping	Transfer	Reduction	Transfer	Reduction	Transfer
Apply & Dry Test 1	**4,333**	**0**	**0**	**100**	**0**	**100**	**0**
Apply & Dry Test 2	**18,386**	**0**	**0**	**100**	**0**		

Human Respitory Coronavirus 229E (ATCC- VR-740)

	Total PFU per platform			Percent		Average Percent	
Product	Control	Contaminated	Transfer	Reduction	Transfer	Reduction	Transfer
Apply & Dry Test 1	**13,778**	**0**	**0**	**100**	**0**	**100**	**0**
Apply & Dry Test 2	**127,777**	**0**	**0**	**100**	**0**		

Results
Average hospital colony forming units (CFU) Pre and Post cleaning existing processes

	Pre CFU	Post CFU
1. Community Hospital medical ward 60% isolation patients Daily cleaning with hydrogen peroxide disinfectant cleaner	**6.33**	**3.18**
2. Michigan Teaching Hospital daily sporicidal cleaning	**10.9**	**4.61**
3. New teaching hospital daily cleaning with Quaternary disinfectant cleaner	**4.12**	**0.601**

Results
Average hospital colony forming units (CFU) Pre and Post cleaning
PCS Apply and Wipe Dry Process

	Pre CFU	Post CFU
1. Montreal Community Hospital	**3.91**	**0.60**
2. Michigan Teaching Hospital	**10.9**	**1.53**
3. New Teaching Hospital Montreal	**7.84**	**0.263**

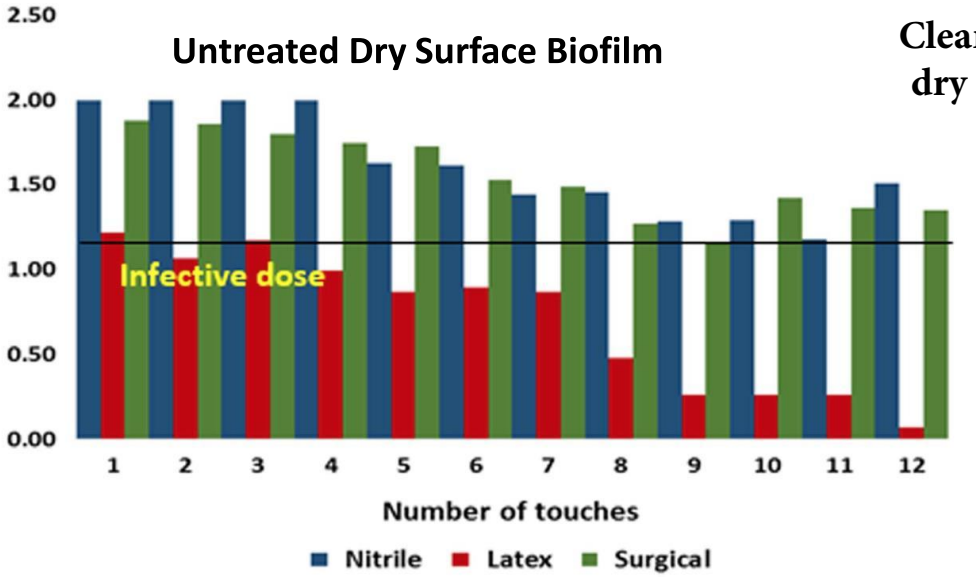
	Pre CFU	Post CFU
AVERAGE OF THE THREE HOSPITALS CURRENT CLEANING PROCESESS	**5.01**	**2.797**
AVERAGE OF THE THREE HOSPITALS PCS Apply and Dry Process	**7.55**	**0.798**

No C. difficile spores where detected in any of the samples tested.

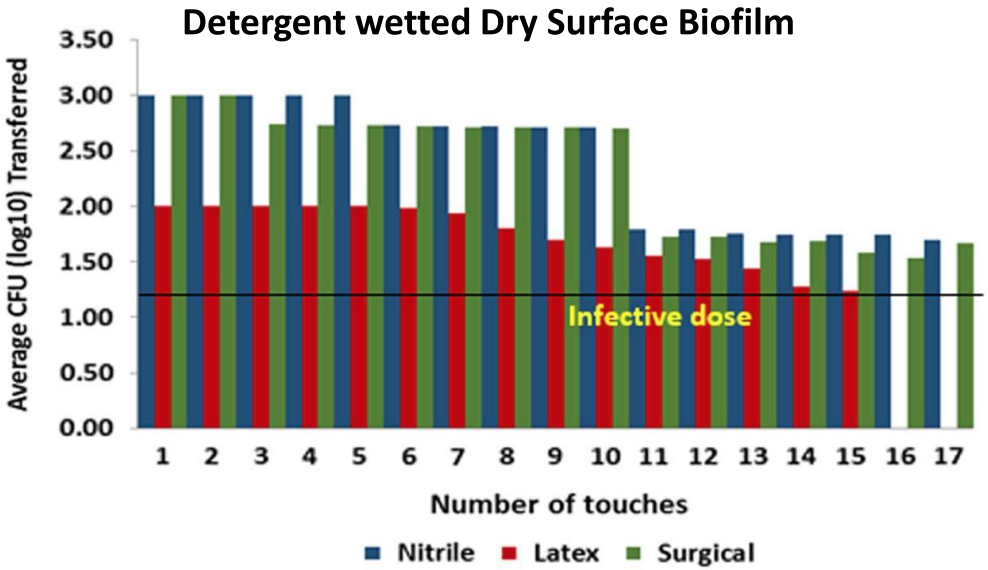
Reports - Download PDF to access hyperlinks

Assessment of the Combined Activity of Spray and Wiping for Decontaminating Hard, Non-Porous Environmental Surfaces: Testing with Coronavirus 229E (ATCC VR-740)
Assessment of the Combined Activity of Spray and Wiping for Decontaminating Hard, Non-Porous Environmental Surfaces: Testing with Healthcare-Associated Pathogens
Assessment of the Combined Activity of Spray and Wiping for Decontaminating Hard, Non-Porous Environmental Surfaces: Testing with Mouse Norovirus (MNV) as a representative Healthcare- Associated Pathogen
ACC Analysis of 146 samples C. difficile analysis of 72 post-cleaning samples
ACC Analysis of 111 samples with NSF International
ACC and Clostridium difficile Analysis of 195 total samples evaluating University Hospital's current Sporicidal Disinfection Procedure and PCS' Cleaning Process with NSF International
Approved Hard Surface Disinfectants and Hand Sanitizers

Transmission of *S. aureus* from Dry Surface Biofilm by gloved hand contact



Clean and Disinfect Apply PCS 1000 Plus wait 1 minute and wipe dry to prevent spreading Dry Surface Biofilm pathogens.



Tahir S et. al. Transmission of *Staphylococcus aureus* from dry surface biofilm (DSB) via different types of gloves. Infection Control & Hospital Epidemiology 2019, 40, 60–64. doi: 10.1017/ice.2018.285

ipac Infection Prevention and Control Canada

pci Prévention et contrôle des infections Canada

Journal of Hospital Infection 100 (2018) e85–e90

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin

Transfer of dry surface biofilm in the healthcare environment: the role of healthcare workers' hands as vehicles

D. Chowdhury [a], S. Tahir [a], M. Legge [a], H. Hu [a], T. Prvan [b], K. Johani [a,c], G.S. Whiteley [d,e], T.O. Glasbey [a,e], A.K. Deva [a], K. Vickery [a,*]

[a] Surgical Infection Research Group, Faculty of Medicine and Health Sciences, Macquarie University, New South Wales, Australia
[b] Department of Statistics, Macquarie University, New South Wales, Australia
[c] Central Military Laboratories and Blood Bank, Prince Sultan Military Medical City, Riyadh, Saudi Arabia
[d] Western Sydney University, School of Medicine, Campbelltown, Australia
[e] Whiteley Corporation Pty Ltd, North Sydney, New South Wales, Australia

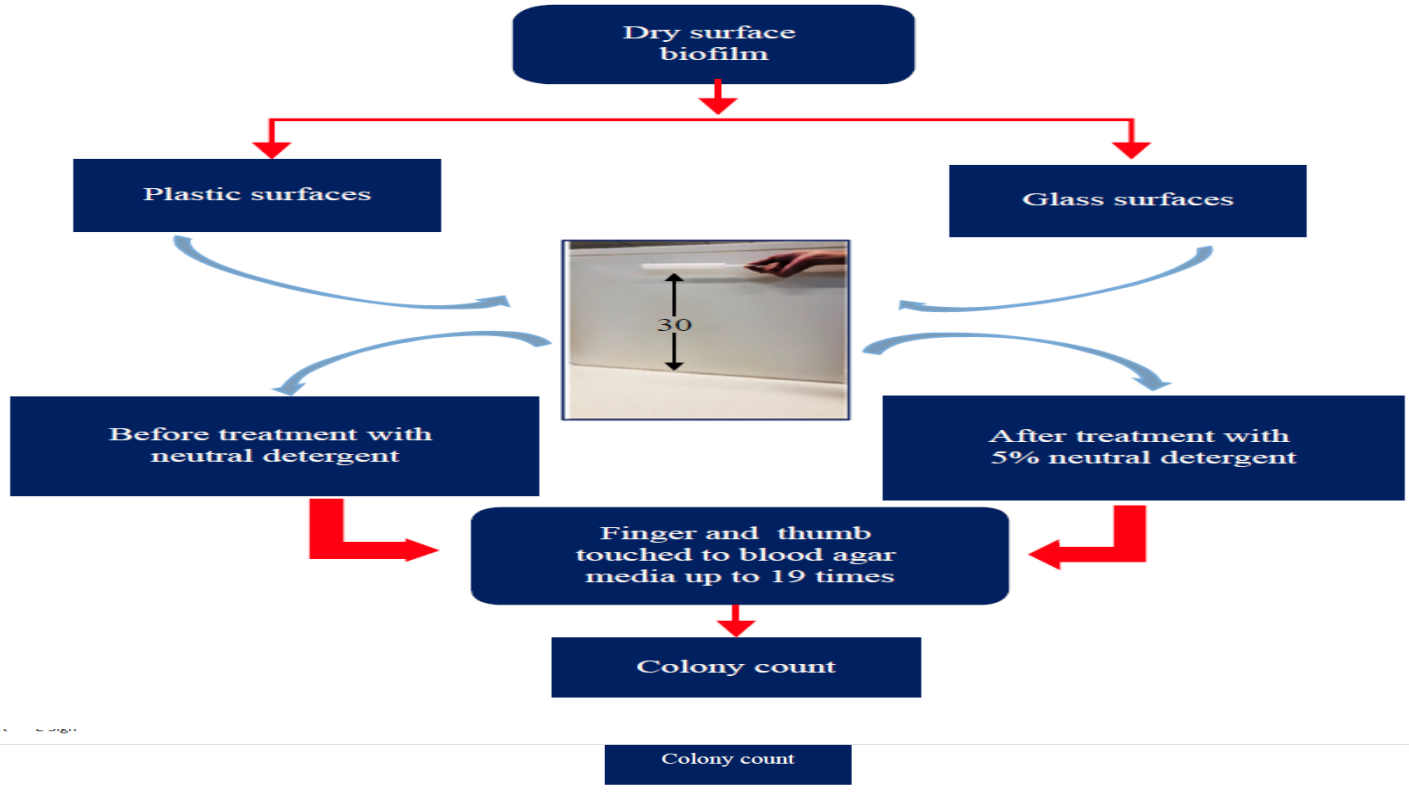


Figure 1. Schematic presentation of transfer testing procedure.

The transfer rate of bacteria from DSB to the hands and thence to HBA plates on the first touch was calculated using the following formula:

$$\text{Transfer rate of DSB (\%)} = \frac{\text{cfu transferred to HBA plate} \times 100}{\text{cfu on control coupons}}$$

Transfer of DSB to multiple surfaces following one touch

The number of surfaces that could be contaminated following touching DSB once was determined by touching the biofilm-covered coupon as described above and then pressing the thumb and the forefinger on to the surface of different HBA plates up to 19 times as detailed in Figure 2 and counting the number bacteria transferred. The protocol was repeated 18 times for both glass and polycarbonate coupons.

Statistical analysis

Data were analysed using SPSS Statistics 23 (IBM, Portsmouth, UK) and Minitab version 17 (Minitab, Inc., Sydney, NSW, Australia). Hierarchical log-linear modelling using backward

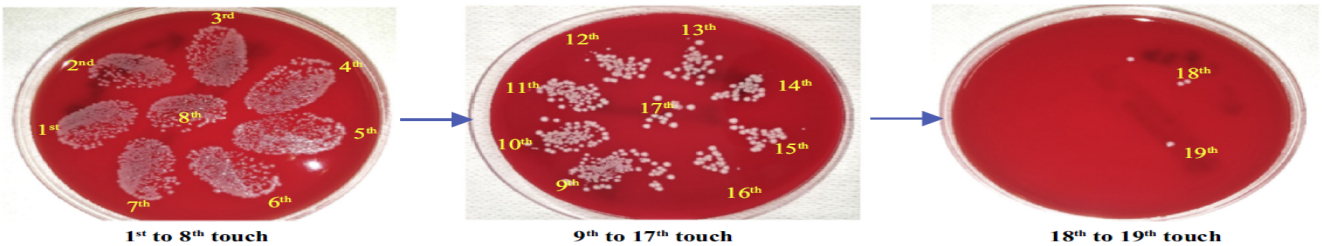


Figure 2. Transfer frequency of biofilm bacteria from 1st to 19th touch on the horse blood agar plate (1st to 19th are touch number).

Journal of Hospital Infection 150 (2024) 34—39

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin

Transfer of micro-organisms from dry surface biofilms and the influence of long survival under conditions of poor nutrition and moisture on the virulence of *Staphylococcus aureus*

N.J. Amaeze [a], A.B. Akinbobola [b], R. Kean [c], G. Ramage [c], C. Williams [d], W. Mackay [a,*]

[a] School of Health and Life Sciences, University of West of Scotland, Lanarkshire Campus, South Lanarkshire, UK
[b] Department of Microbiology, Adekunle Ajasin University, Akungba-Akoko, Nigeria
[c] School of Health and Life Sciences, Glasgow Caledonian University, Glasgow, UK

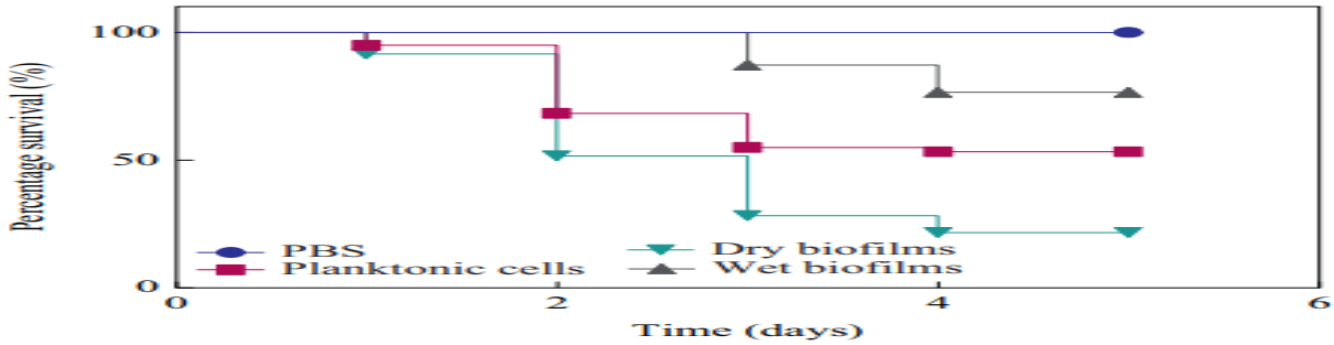


Figure 3. Kaplan—Meier survival curves of the percentage survival of *Galleria mellonella* larvae inoculated with cells recovered from dry biofilms, wet biofilms or planktonic cultures of *Staphylococcus aureus* ATCC 25923 and phosphate-buffered saline (PBS). Dry biofilms caused highest mortality of 60%; planktonic and standard biofilms followed with 53 and 21%, respectively (P=0.0008, <0.0001).

The number of S. aureus cells transferred from the dry biofilms grown in vitro reduced with an increase in the number of touches. A similar observation was reported by Tahir et al.

However, intermittent wetting of the dry biofilms in their experiment to mimic detergent application on hospital surfaces increased the number of cells transferable from dry biofilms. Thus, intermittent wetting of dry biofilms on surfaces during cleaning can result in an increase in the number of cells transferable from dry biofilms on surfaces through touching with gloves. The number of cells transferable from the dry biofilms of S. aureus ATCC 25925 and S. aureus 1132 are shown in Figure 2.

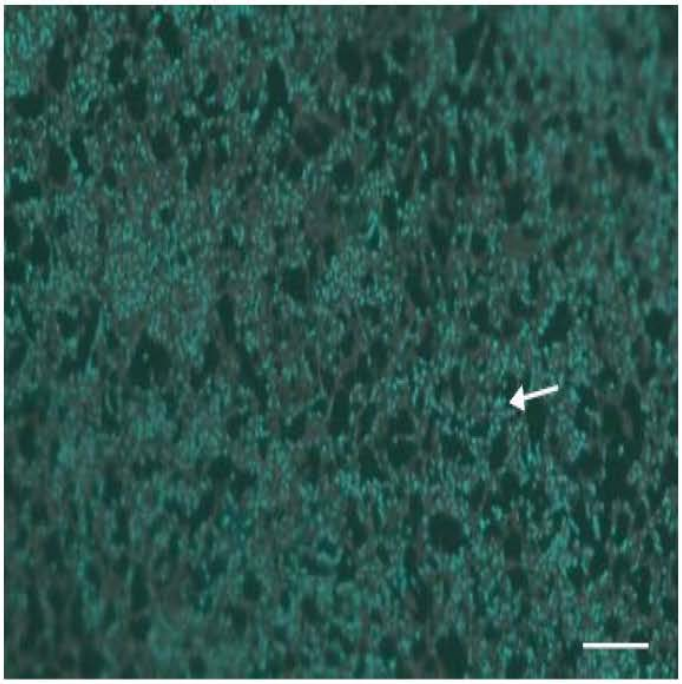
The average number of cells deposited on nutrient agar at the first touch for S. aureus ATCC 25925 and S. aureus 1132 were 22 and 19, respectively. The transfer rates were higher when the seeded biofilm surfaces were wet than when dry. The numbers of cells deposited on nutrient agar plates were too numerous to count, with >1000 cfu all through the 24 touches tested.

Detergent treatment control. Contact time ten minutes for all test. Green dye visualizes live bacteria. No visible reduction in biofilm.

Dual Species biofilm

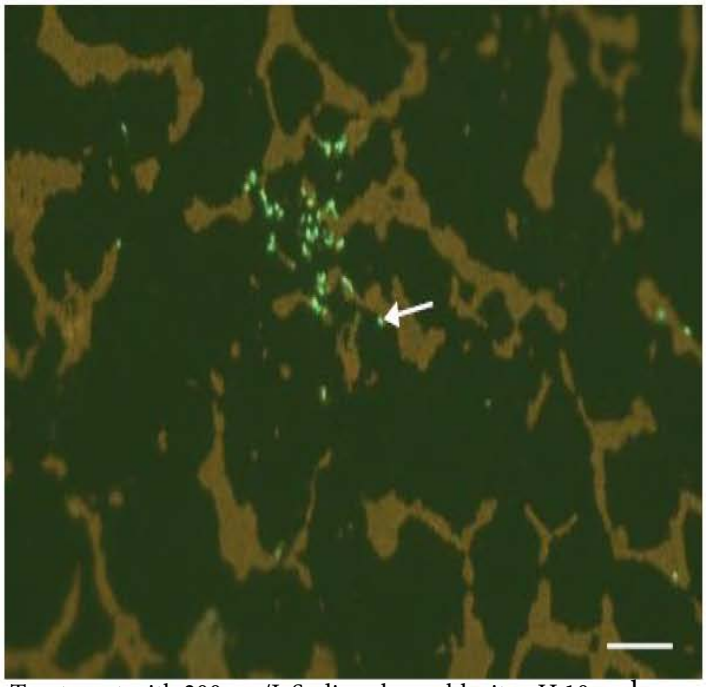
Treatment with 40 mg/l SAHW only a few cells remain.

3A



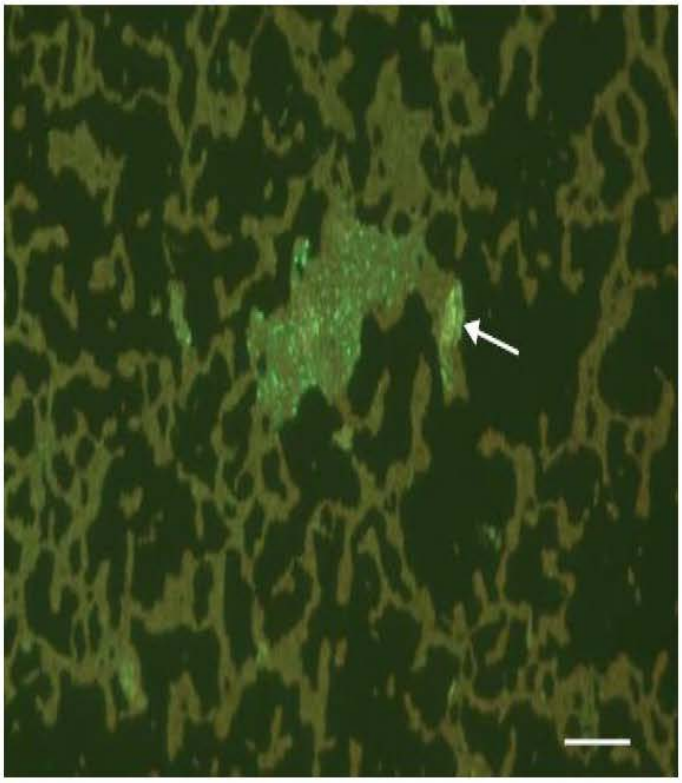
Treament with 100 mg/L Sodium hypochlorite pH10 only a few cells remain.

3B



Treatment with 200 mg/L Sodium hypochlorite pH 10 only a few cells remain.

3C



3D

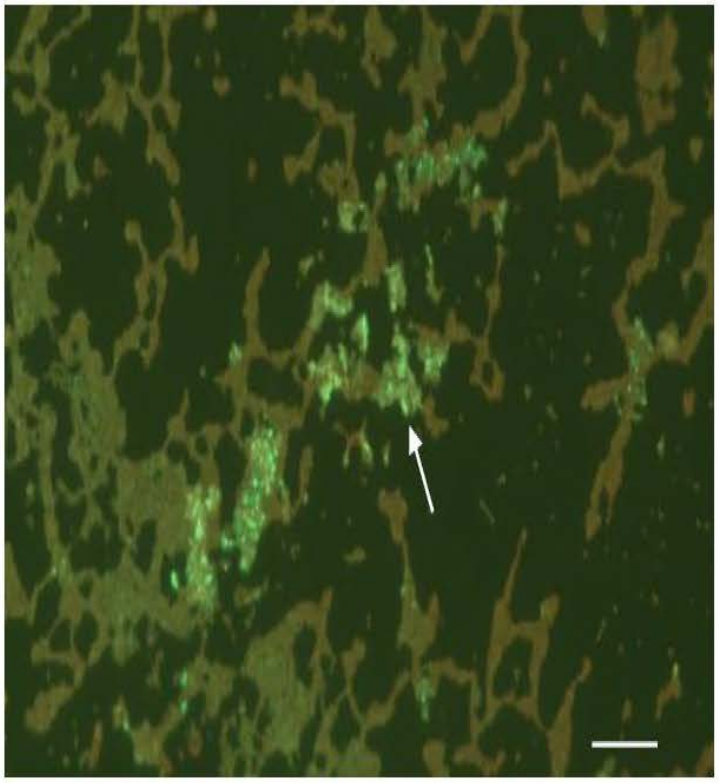


Fig. 3. Fluorescence microscopy images of dual species biofilm by *L.monocytogenes* and *E.coli* after different treatments.

3A, control sample; 3B, treatment with 40 mg/L SAHW; 3C, treatment with 100 mg/L NaOCl; 3D, treatment with 200 mg/L NaOCl. Scale bars correspond to 50 μm. Arrows show living cells.

Check for updates

OPEN ACCESS

EDITED BY
Axel Cloeckaert,
Institut National de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE), France

REVIEWED BY
Kurt Henry Piepenbrink,
University of Nebraska-Lincoln, United States
Carolina Muñoz-Camargo,
University of Los Andes, Colombia

*CORRESPONDENCE
Enea Gino Di Domenico
enea.didomenico@uniroma1.it
Fulvia Pimpinelli
fulvia.pimpinelli@ifo.it

RECEIVED 14 May 2024
ACCEPTED 25 June 2024
PUBLISHED 10 July 2024

CITATION
Fabrizio G, Sivori F, Cavallo I, Truglio M, Toma L, Sperati F, Francalancia M, Obregon F, Pamparau L, Kovacs D, Pimpinelli F and Di Domenico EG (2024) Efficacy of sodium hypochlorite in overcoming antimicrobial resistance and eradicating biofilms in clinical pathogens from pressure ulcers. *Front. Microbiol.* 15:1432883. doi: 10.3389/fmicb.2024.1432883

COPYRIGHT
© 2024 Fabrizio, Sivori, Cavallo, Truglio, Toma, Sperati, Francalancia, Obregon, Pamparau, Kovacs, Pimpinelli and Di Domenico. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Efficacy of sodium hypochlorite in overcoming antimicrobial resistance and eradicating biofilms in clinical pathogens from pressure ulcers

Giorgia Fabrizio[1], Francesca Sivori[2], Ilaria Cavallo[2], Mauro Truglio[2], Luigi Toma[3], Francesca Sperati[4], Massimo Francalancia[2], Francisco Obregon[2], Luisa Pamparau[2], Daniela Kovacs[5], Fulvia Pimpinelli[2]*and Enea Gino Di Domenico[3]*

[1]Department of Biology and Biotechnology "C. Darwin", Sapienza University of Rome, Rome, Italy, [2]Microbiology and Virology, San Gallicano Dermatological Institute, IRCCS, Rome, Italy, [3]Medical Directorate, IRCCS Regina Elena National Cancer Institute, Rome, Italy, [4]UOSD Clinical Trial Center, Biostatistics and Bioinformatics, IRCCS San Gallicano Dermatological Institute, Rome, Italy, [5]Cutaneous Physiopathology, San Gallicano Dermatological Institute, IRCCS, Rome, Italy

Sodium hypochlorite (NaOCl) is widely recognized for its broad-spectrum antimicrobial efficacy in skin wound care. This study investigates the effectiveness of NaOCl against a range of bacterial and fungal isolates from pressure ulcer (PU) patients.

We analyzed 20 bacterial isolates from PU patients, comprising carbapenem-resistant *Klebsiella pneumoniae* (CRKP), multidrug-resistant Acinetobacter baumannii (MDRAB), methicillin-resistant *Staphylococcus aureus* (MRSA), methicillin-susceptible *Staphylococcus aureus* (MSSA), along with 5 *Candida albicans* isolates. Antibiotic resistance profiles were determined using standard susceptibility testing. Whole-genome sequencing (WGS) was employed to identify antimicrobial resistance genes (ARGs) and disinfectant resistance genes (DRGs). Genetic determinants of biofilm formation were also assessed. The antimicrobial activity of NaOCl was evaluated by determining the minimum inhibitory concentration (MIC) and the minimal biofilm eradication concentration (MBEC) for both planktonic and biofilm-associated cells.

Check for updates

OPEN ACCESS

EDITED BY
Axel Cloeckaert,
Institut National de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE), France

REVIEWED BY
Kurt Henry Piepenbrink,
University of Nebraska-Lincoln, United States
Carolina Muñoz-Camargo,
University of Los Andes, Colombia

*CORRESPONDENCE
Enea Gino Di Domenico
✉ enea.didomenico@uniroma1.it
Fulvia Pimpinelli
✉ fulvia.pimpinelli@ifo.it

RECEIVED 14 May 2024
ACCEPTED 25 June 2024
PUBLISHED 10 July 2024

CITATION
Fabrizio G, Sivori F, Cavallo I, Truglio M, Toma L, Sperati F, Francalancia M, Obregon F, Pamparau L, Kovacs D, Pimpinelli F and Di

Efficacy of sodium hypochlorite in overcoming antimicrobial resistance and eradicating biofilms in clinical pathogens from pressure ulcers

Giorgia Fabrizio[1], Francesca Sivori[2], Ilaria Cavallo[2], Mauro Truglio[2], Luigi Toma[3], Francesca Sperati[4], Massimo Francalancia[2], Francisco Obregon[2], Luisa Pamparau[2], Daniela Kovacs[5], Fulvia Pimpinelli[2]* and Enea Gino Di Domenico[1]*

[1]Department of Biology and Biotechnology "C. Darwin", Sapienza University of Rome, Rome, Italy, [2]Microbiology and Virology, San Gallicano Dermatological Institute, IRCCS, Rome, Italy, [3]Medical Directorate, IRCCS Regina Elena National Cancer Institute, Rome, Italy, [4]UOSD Clinical Trial Center, Biostatistics and Bioinformatics, IRCCS San Gallicano Dermatological Institute, Rome, Italy, [5]Cutaneous Physiopathology, San Gallicano Dermatological Institute, IRCCS, Rome, Italy

Find text

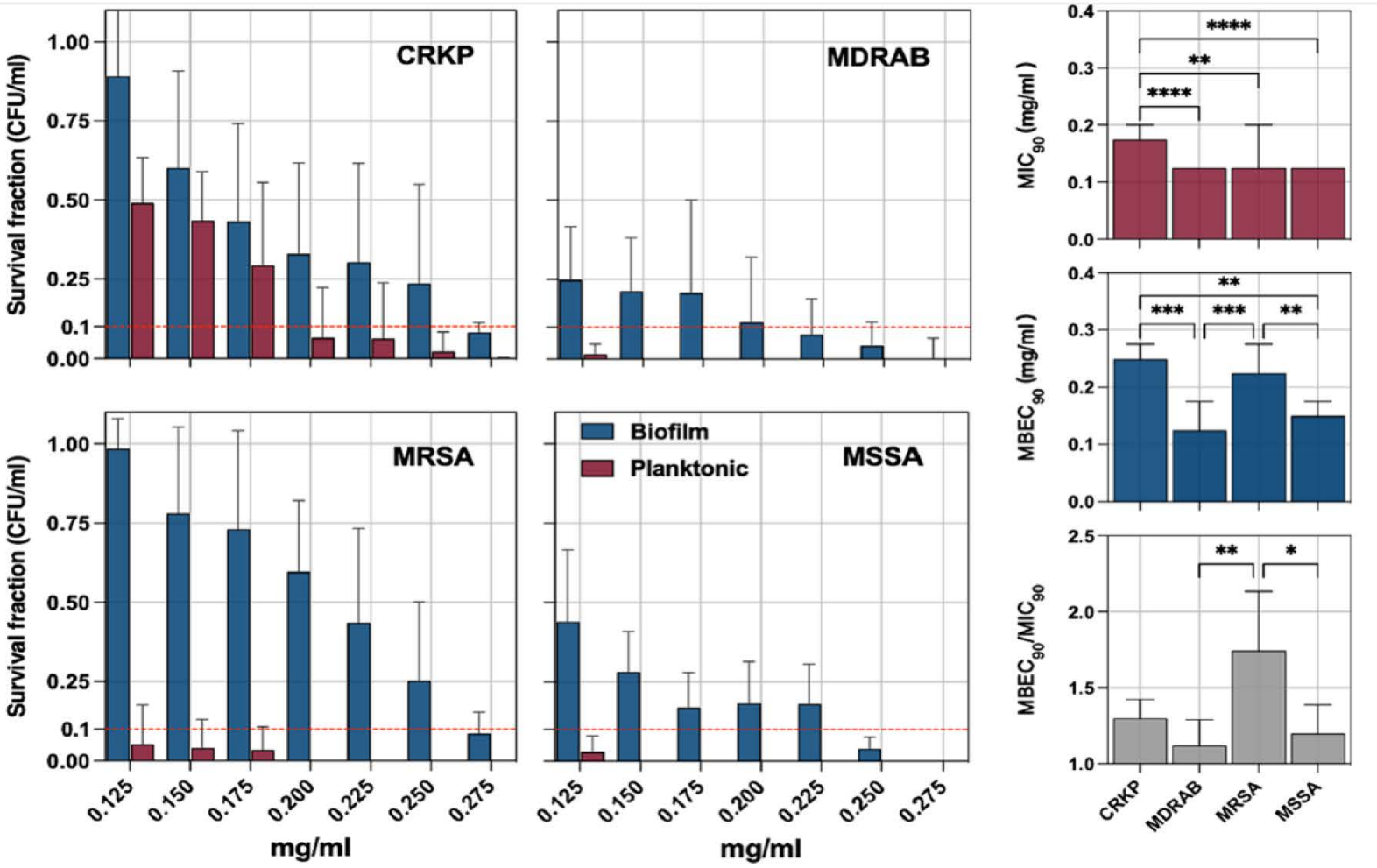
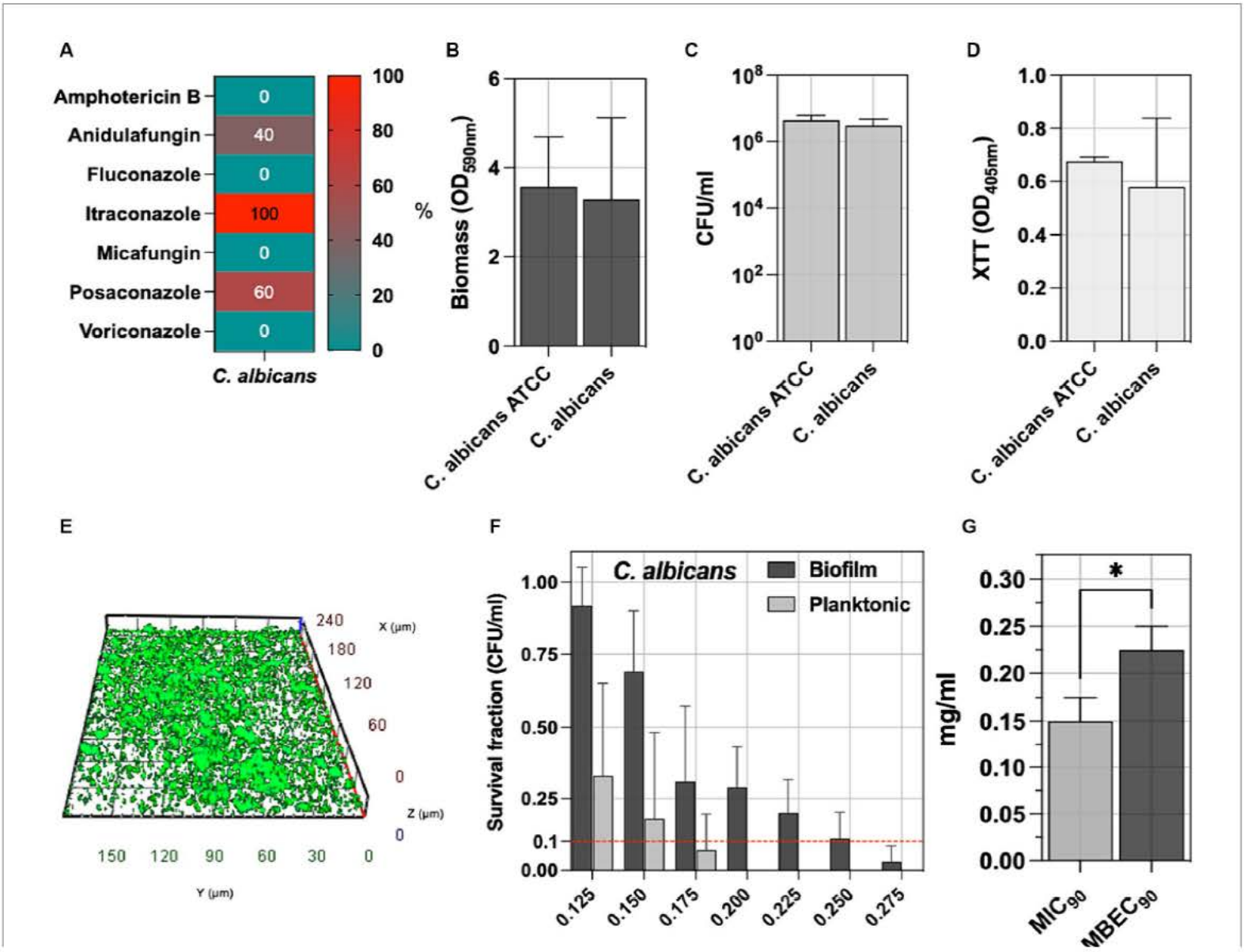


FIGURE 3
(A) The antimicrobial and antibiofilm activity of an electrolytic sodium hypochlorite solution (NaOCl) against carbapenem-resistant *Klebsiella pneumoniae* (CRKP), multidrug-resistant *Acinetobacter baumannii* (MDRAB), methicillin-resistant *Staphylococcus aureus* (MRSA), and methicillin-susceptible *S. aureus* (MSSA) is displayed through survival cell fractions compared to untreated control strains at concentrations ranging from 0.125 to 0.275 mg/mL. **(B)** The minimum inhibitory concentration (MIC_{90}) is the lowest concentration (mg/ml) needed to inhibit 90% of planktonic bacterial growth relative to controls and the minimum biofilm eradication concentration ($MBEC_{90}$). The antimicrobial and antibiofilm activity of NaOCl is demonstrated through the survival of bacterial cell fractions, compared to untreated control strains, at concentrations ranging from 0.125 to 0.275 mg/mL. The minimum inhibitory concentration (MIC_{90}) and the minimum biofilm eradication concentration ($MBEC_{90}$) are defined as the lowest NaOCl concentrations required to inhibit 90% of planktonic and biofilm bacterial growth, respectively, compared to untreated controls. The $MBEC_{90}/MIC_{90}$ ratio was used to quantify the biofilm tolerance to NaOCl for all tested strains. Significance was assessed by the Kruskal Wallis statistic test. *, $p < 0.05$;



5 Conclusion

The application of NaOCl demonstrated a potent antimicrobial and antibiofilm activity, though it was markedly more effective against planktonic than biofilm-embedded cells. The low MBEC90/MIC90 ratio suggests that the biofilm matrix is poorly effective in protecting the bacterial and C. albicans isolates from NaOCl.

The observed susceptibility of bacterial pathogens and C. albicans to NaOCl, both in planktonic and biofilm states, suggests that NaOCl could be a broad-spectrum agent applicable in a multi-pathogen context, reducing the microbial burden and promoting PU's healing (Serena et al., 2022). This distinction between MIC90 and MBEC90 values points to the resilience of biofilm architectures and emphasizes the need for higher concentrations of NaOCl for biofilm eradication of microbial isolates from PUs.

PROCESS CLEANING SOLUTIONS
Bringing Science to the Art of Cleaning®

Surfactants can cause Resistance

Reducing the development of antibiotic resistant bacterial populations is no longer just an issue for hospitals. We all need to do what we can, because the same conditions that promote resistance operate not only in hospitals but in other environments as well.

Microbiology 2023
Biological and synthetic surfactant exposure increases antimicrobial gene occurrence in a freshwater mixed microbial biofilm environment

Int. J. Environ. Res. Public Health 2023,
Organic Compounds and Antibiotic-Resistant Bacteria Behavior in Greywater Treated by a Constructed Wetland

Heliyon (2023)
Direct Environmental concentrations of surfactants as a trigger for climax of horizonal gene transfer of antibiotic resistance

Water Research Volume 236, 1 June 2023, 119944
Direct The structure of biodegradable surfactants shaped the microbial community, antimicrobial resistance, and potential for horizontal gene transfer

Environmental Science & Technology 2023 57 (20), 7645-7665 DOI: 10.1021/acs.est.2c08244
Quaternary Ammonium Compounds: A Chemical Class of Emerging Concern
Policy Recommendations - Immediately address the known threat of antimicrobial resistance. The medical field recommends that antibiotics be prescribed only when necessary and educate the public about proper use. Similar efforts to eliminate non-essential uses of antimicrobial QACs in consumer products are warranted. An example would be product labeling requirements such as

“To reduce the public health threat of antimicrobial resistance, use this product only when disinfection is necessary and not for general cleaning”.

Manufacturers should also be discouraged from implying a health benefit of QAC use in coatings durable product treatments without supporting evidence that these treatments are effective in reducing the transmission of infectious diseases.

2023 United Nations Environment Programme

The environmental dimensions of AMR include pollution from hospital and community wastewater, effluent from pharmaceutical production, run-off originating from plant and animal agriculture and other forms of waste and releases. These matrices may contain not only resistant microorganisms, but also antimicrobials, various pharmaceuticals, microplastics, metals and other chemicals, which all increase the risk of AMR in the environment.
Polluted waterways, particularly those that have been polluted for some time, are likely to harbour microorganisms that increase AMR development and distribution in the environment. With increasing pollution and lack of management of sources of pollution, combined with AMR in clinical and hospital settings and agriculture, risks are increasing.