

Lufuno Muleba,¹ Renay Van-Wyk,² Jennifer Pienaar,³ Tanusha Singh^{1,2,4}

¹ National Institute for Occupational Health, National Health Laboratory Services, Johannesburg, South Africa

² Department of Environmental Health, University of Johannesburg, South Africa

³ Department of Biomedical Technology, University of Johannesburg, South Africa

⁴ Department of Clinical Microbiology and Infectious Diseases, University of Witwatersrand, Johannesburg, South Africa

Introduction

Hand hygiene plays a vital role in reducing infections in various settings, particularly in hospitals and can be achieved through hand washing or hand sanitising when washing facilities is unavailable. Hand sanitiser is a solution designed for application to the hands for reducing the number of viable microorganisms. It is used as an alternative to hand washing in reducing the number of viable microorganisms when soap and water is not readily available; but it is only effective if hands are not heavily soiled or greasy. The aim is to investigate the anti-bacterial effectiveness of hand sanitisers commonly used in hospital settings and commercially available.

Methods

Mapping exercise to procure hand Sanitisers

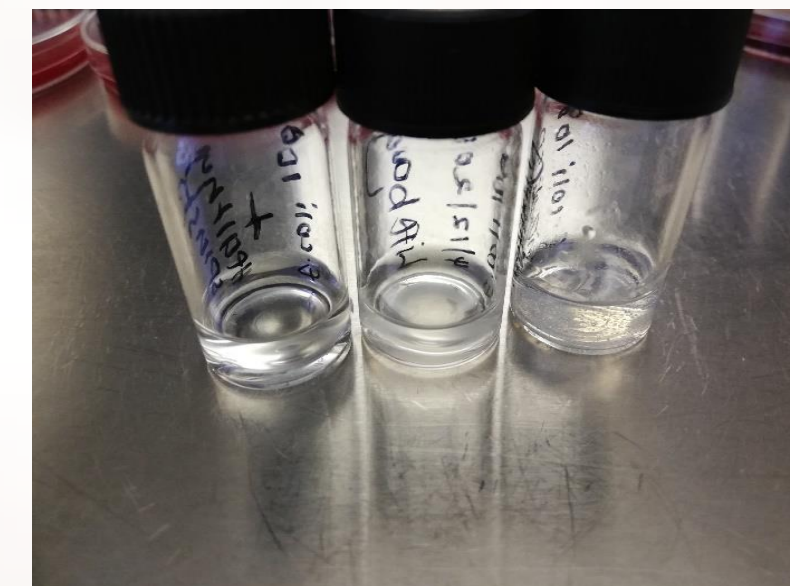
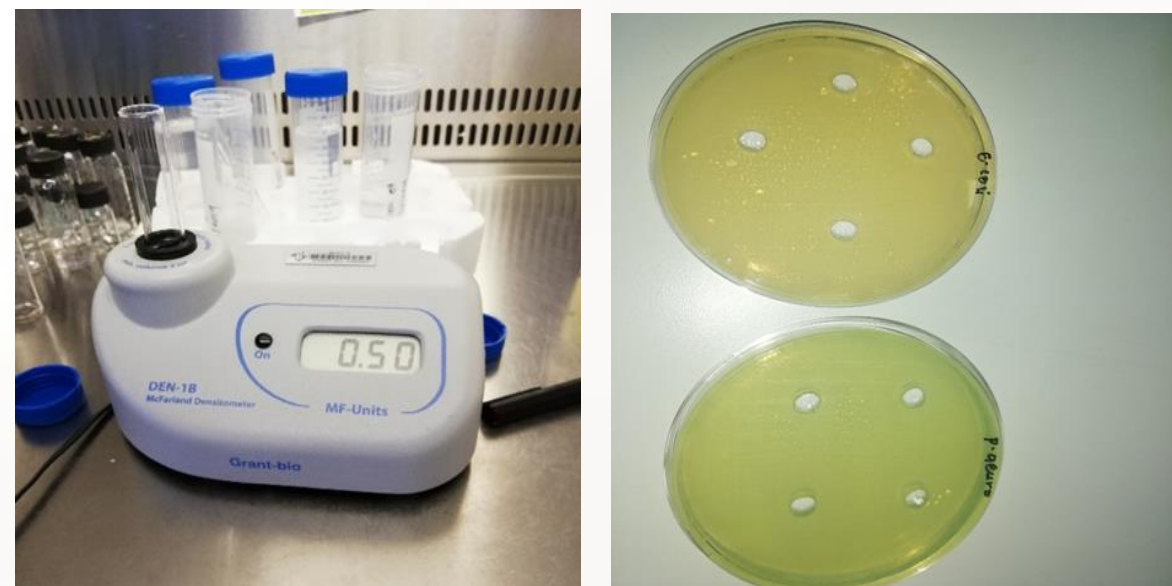
N=18

Nosocomial infections Microorganisms

- *Escherichia coli*
- *Enterococcus faecalis*
- *Klebsiella pneumoniae*
- *Pseudomonas aeruginosa*
- *Staphylococcus aureus*

Agar diffusion method
(Measuring zone of inhibition)

Minimum Inhibitory Concentration
(turbidity test)



Measuring zone of inhibition using digital calliper

Minimum Bactericidal Concentration
(colony/ bacterial growth test)

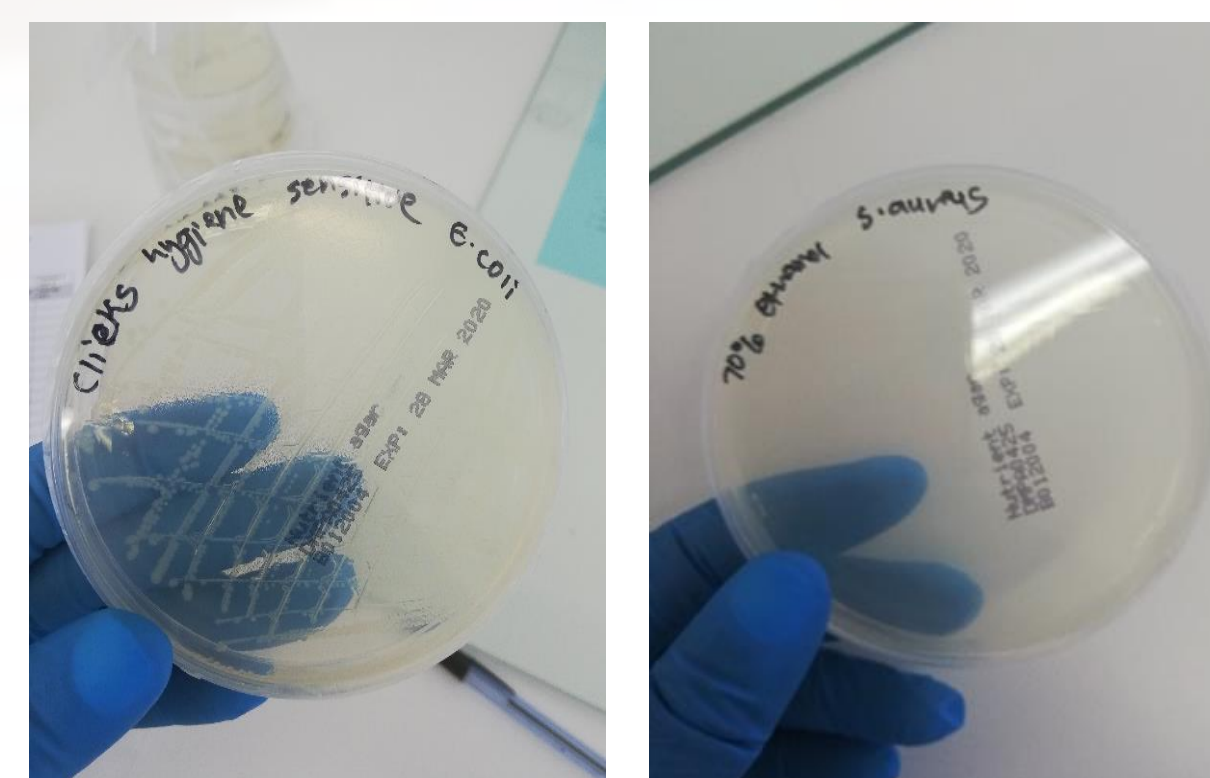
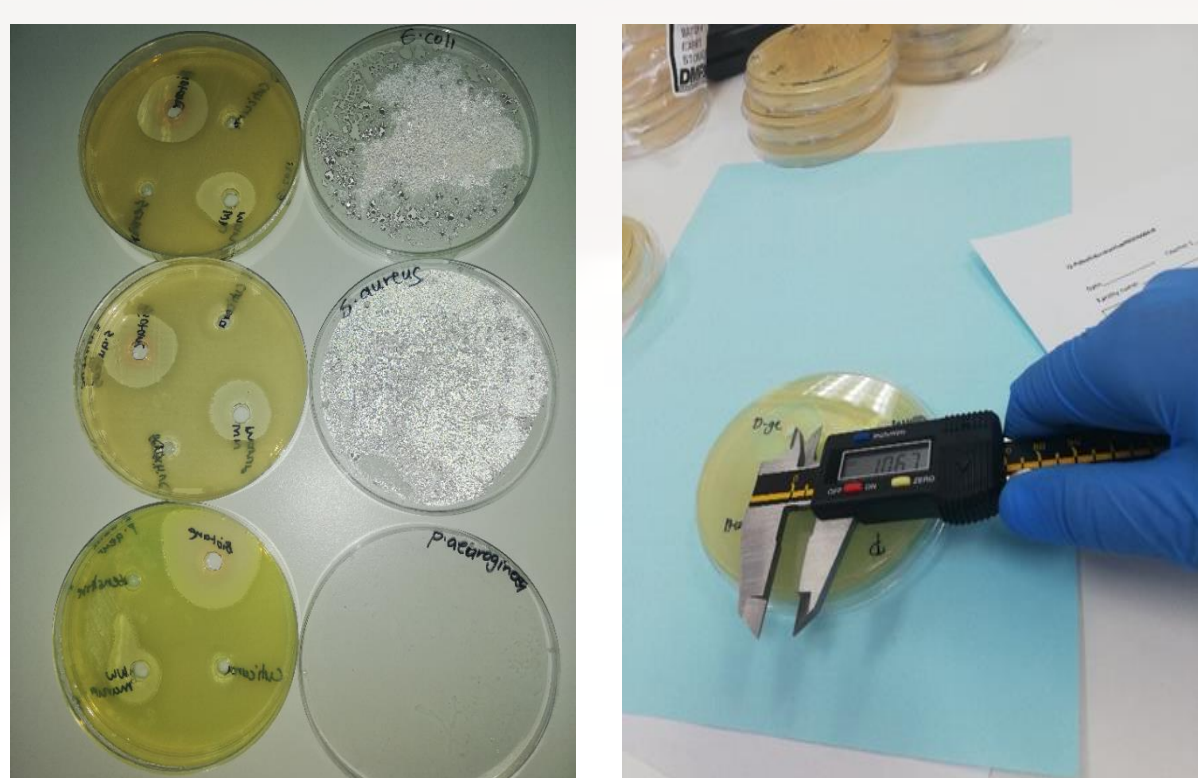


Figure 1 Flow diagram showing the laboratory methods for testing the effectiveness of hand sanitisers.

Table 1 Zone of inhibition

Hand sanitiser	<i>E.coli</i>	<i>E.Faecalis</i>	<i>K.pneumoniae</i>	<i>P.aeruginosa</i>	<i>S.aureus</i>
A	14.48	14.94	8.79	8.32	13.91
B	4.56	8.48	3.70	3.66	2.85
C	3.81	7.96	4.74	5.40	5.79
D	0	3.26	1.17	1.50	1.91
E	6.51	4.37	5.21	5.98	4.57
F	4.31	4.89	4.56	4.04	1.79
G	14.34	14.75	11.40	11.82	14.82
H	4.81	4.15	3.82	5.15	5.02
I	12.92	10.35	8.04	6.39	10.47
J	6.45	9.29	5.64	4.30	5.11
K	3.02	4.29	2.23	2.14	3.19
L	6.55	8.53	6.57	4.79	6.31
M	8.98	8.73	5.76	6.95	4.10
N	5.38	8.44	2.57	4.19	8.01
O	4.32	4.44	2.80	2.32	3.66
P	2.71	0	1.98	1.14	0
Q	2.99	4.89	4.68	3.66	2.65
R	13.09	12.29	8.92	7.45	12.05
Lab control 70%	7.06	6.46	1.83	7.05	0
Streptomycin	4.03	6.03	6.52	6.47	5.56

Table 2 Minimum inhibitory concentration

Hand sanitiser	<i>E.coli</i>	<i>E.Faecalis</i>	<i>K.pneumoniae</i>	<i>P.aeruginosa</i>	<i>S.aureus</i>
A	clear	clear	clear	clear	clear
B	clear	clear	clear	clear	clear
C	turbid	turbid	turbid	turbid	turbid
D	turbid	turbid	turbid	turbid	turbid
E	turbid	turbid	turbid	turbid	turbid
F	turbid	turbid	clear	turbid	turbid
G	clear	clear	clear	clear	clear
H	turbid	turbid	turbid	turbid	turbid
I	clear	clear	clear	clear	clear
J	turbid	turbid	turbid	turbid	turbid
K	turbid	turbid	clear	turbid	turbid
L	turbid	turbid	turbid	turbid	turbid
M	turbid	turbid	turbid	turbid	turbid
N	turbid	turbid	clear	turbid	turbid
O	turbid	turbid	turbid	turbid	turbid
P	clear	clear	clear	clear	clear
Q	turbid	turbid	clear	turbid	turbid
R	turbid	turbid	turbid	turbid	turbid
Positive control	turbid	turbid	turbid	turbid	turbid
Negative control	clear	clear	clear	clear	clear

Results

- All hand sanitisers passed the sterility test (non-contaminated)
- Four of eighteen (22 %) hand sanitisers were most effective against all tested bacterial species, and another four (22 %) was not effective at all
- The zone of inhibition was mainly observed on liquid form hand sanitisers (n = 5) than the gel sanitisers
- The minimum inhibitory concentration (MIC) was observed in almost all (n = 11) (61 %) hand sanitisers in gel form
- Only one hand sanitiser failed the minimum bactericidal concentration (MBC) test

Discussion

- Hand sanitisers (A,G, I, R) were the most effective against all species that were tested, whereas hand sanitiser (D, K, P, Q) were not effective against any of the species
- Four of five (80%) hand sanitisers that were tested contained (70 %) alcohol concentration as labelled on the containers and were observed to perform best compared to those that did not indicate alcohol content
- Hand sanitiser in liquid more are more viscous and have high zone of inhibition.
- Hand sanitisers (n=7) with a label claim of 99.99% were all effective against *Escherichia coli*.

Conclusion

Only a fifth of hand sanitisers were effective against selected microorganisms. Thus further investigations into labelling claims are warranted as those claiming 99.9 % effectiveness only inactivated one of the five microorganisms commonly reported in hospital acquired infections.

Acknowledgements: Sincere appreciation to the NHLS and NIOH for supporting and funding this study.