



DISINFECTION AGENT

**HEALTH TECHNOLOGY ASSESSMENT SECTION
MEDICAL DEVELOPMENT DIVISION
MINISTRY OF HEALTH MALAYSIA
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DISCLOSURE

The author of this report has no competing interest in this subject and the preparation of this report is totally funded by the Ministry of Health, Malaysia

EXECUTIVE SUMMARY

Introduction

██████ is claimed to be highly effective, water-soluble disinfection agent based on polyhexamethylene guanidine hydrochloride (PHMG), which is an antimicrobial biocide of the guanidine family. PHMG is a type of newly developed multipurpose cation polymer used as a disinfection agent and contains no toxic substances. It is also nonirritating. It is claimed to be successfully used in healthcare, the textile industry, the food industry and, in treating as well as making water and surface hygienic.

██████ is a cation polymer in an aqueous solution and positively electrically charged. When in contact with negatively charged cell membrane of a microorganism, the cell wall is electrically disrupted and the cell dies. It is claimed that ██████ has been tested with both pathogenic and nonpathogenic bacteria, viruses, fungi and algae. The company claimed that disinfectant capabilities of ██████ have been tested on prescribed coated viruses such as influenza viruses – Influenza A, Influenza B and Influenza C and fulfilled the conditions for reducing initial virus values by 4 logarithmic orders.

Objective / Aim

The objective of this technology review was to assess the safety, efficacy and cost-effectiveness of ██████ disinfection agent for disinfecting healthcare facilities.

Results and Conclusions

No retrievable evidence and information on US FDA approval or CE mark for ██████ disinfection agent for disinfecting healthcare facilities. However, PHMG is listed in the EU biocide directive (98/8/EC) in the annexes I and II for human hygiene biocidal products. There was also no evidence in adverse events on the use of this technology.

There was insufficient and poor level of evidence to show the efficacy of the ██████ disinfection agent for disinfecting healthcare facilities although it contained PHMG which is listed as biocidal product. There was also limited evidence on PHMG to determine its efficacy.

There was no retrievable evidence on the cost-effectiveness of ██████ disinfection agent for disinfecting healthcare facilities. However, the cost of PHMG is approximately between USD \$ ██████ depending on package (25 kg/plastic drum, 25 kg/carton, 1000 kg/cubic drum with frame).

Methods

Electronic databases were searched, which included PubMed, Medline, Journal @ Ovid full text via OVID, OVID EBM Reviews - Cochrane central register of controlled trials, EBM Reviews - Cochrane database of systematic review, Horizon scanning databases - Centre, Birmingham, Australia and New Zealand Horizon scanning (ANZHSN), FDA website, MHRA website and from non scientific database - Google search engine. In addition, a cross-referencing of the articles retrieved was also carried out accordingly to the topic. Relevant articles were critically appraised and evidence graded using US / Canadian Preventive Services Task Force.

GUAA DISINFECTION AGENT

1.0 INTRODUCTION

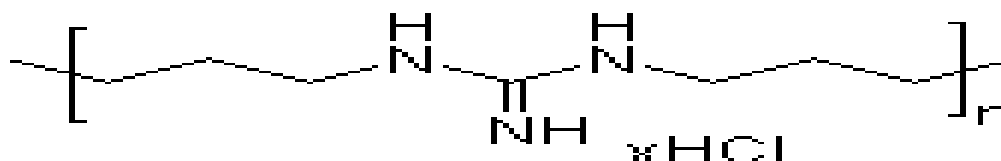
Antiseptic and disinfectants are used extensively in hospitals and other health care settings for a variety of topical and hard-surface applications. In particular, they are an essential part of infection control practices and aid in the prevention of nosocomial infections. “Biocide” is a general term describing a chemical agent, usually broad spectrum that inactivates microorganisms. Because biocides range in antimicrobial activity, other terms may be more specific, including “static,” referring to agents which inhibit growth (e.g., bacteriostatic, fungistatic, and sporistatic) and “cidal,” referring to agents which kill the target organism (e.g., sporicidal, virucidal, and bactericidal).¹ The company claimed that [REDACTED] may be used for disinfecting the interiors of hospitals, surgeries and other healthcare facilities, including their equipment.²

This technology review was conducted following a letter from Deputy Director General of Health (Public Health), Ministry of Health Malaysia, who received proposal from Embassy of Malaysia in Czech Republic to promote the usage of [REDACTED] disinfection agent in Ministry of Health facilities.

2.0 OBJECTIVE /AIM

The objective of this technology review was to assess the safety, efficacy and cost-effectiveness of [REDACTED] disinfection agent for disinfecting healthcare facilities.

3.0 TECHNICAL FEATURES



Scheme 1: Molecular Structure of PHMG

[REDACTED] is claimed to be highly effective, water-soluble disinfection agent based on polyhexamethylene guanidine hydrochloride (PHMG), which is an antimicrobial biocide of the guanidine family. PHMG is a type of newly developed multipurpose cation polymer used as a disinfection agent and contains no toxic substances. It is also nonirritating. It is claimed to be successfully used in healthcare, the textile industry, the food industry and, in treating as well as making water and surface hygienic.²

[REDACTED] is a cation polymer in an aqueous solution and positively electrically charged. When in contact with negatively charged cell membrane of a microorganism, the cell wall is electrically disrupted and the cell dies. It is claimed that [REDACTED] has been tested with both pathogenic and nonpathogenic bacteria, viruses, fungi and algae. The company claimed that disinfectant capabilities of [REDACTED] have been tested on prescribed coated viruses such as influenza viruses – Influenza A, Influenza B and Influenza C and fulfilled the conditions for reducing initial virus values by 4 logarithmic orders.²

The bactericidal effect of the molecule is based on the positive charge of the guanidine group located in each monomer. The mechanism of action involve following steps:-³

- i. Adsorption: The negative charge on the bacterial cell wall attracts the positively charged N^+ ion of the PHMG molecule.
- ii. On the surface of the bacterial cell, PHMG forms a molecular net that inhibits the proteins of the cellular membrane changing the osmotic pressure and stability of the cell.
- iii. PHMG diffuses through the cellular membrane and binds to the cytoplasmic membrane forming a complex with the phospholipid molecules of the lipid bilayer that is more stable than the structure of the membrane.
- iv. The structure of the membrane is broken, the cytoplasmic components are released to the environment and the cell dies.
- v. In any time of the mechanism of action PHMG does not come in contact with the genetic material, DNA or RNA, therefore it is very hard for the bacterial cells to generate any resistance to the molecule.

4.0 METHODOLOGY

4.1. Searching

Scientific databases such as PubMed, Medline, OVID EBM Reviews - Cochrane central register of controlled trials, EBM Reviews - Cochrane database of systematic review, EBM Reviews - HTA databases, Horizon scanning databases - Centre, Birmingham, Australia and New Zealand Horizon scanning (ANZHSN), FDA website, MHRA website and from non scientific database - Google search engine were searched for evidence of safety, efficacy and cost-effectiveness of [REDACTED] disinfection agent for disinfecting healthcare facilities.

The following keywords were used either singly or in combinations: GUAA, [REDACTED] disinfection agent, and polyhexamethylene guanidine hydrochloride (PHMG).

4.2. Selection

All published articles related to safety, efficacy and cost-effectiveness of [REDACTED] disinfection agent for disinfecting healthcare facilities were included. Relevant articles were critically appraised using Critical Appraisal Skills Programme (CASP) and evidence was graded according to US/Canadian Preventive Services Task Force (Appendix 1).

5.0 RESULTS AND DISCUSSION

No relevant articles were retrieved on [REDACTED] disinfection agent from the scientific databases. However, the search strategies yielded one article on the efficacy using PHMG

as a disinfectant. There was no retrievable evidence on the safety and cost-effectiveness of this technology.

5.1 Safety

No retrievable evidence and information on US FDA approval or CE mark for [REDACTED] disinfection agent for disinfecting healthcare facilities. However, PHMG is listed in the EU biocide directive (98/8/EC) in the annexes I and II for human hygiene biocidal products.⁴ There was also no evidence in adverse events on the use of this technology.

5.2. Efficacy

Oule M.K *et al.* 2008 conducted a cross-sectional study to evaluate the efficacy of polyhexamethylene guanidine hydrochloride (PHMG) against quality-control strains of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella choleraesuis*, methicillin-resistant *S. aureus* (MRSA) and *Escherichia coli*. The ultimate aim of this study was to show that PHMG can be used as an odourless, colourless, non-corrosive and harmless disinfectant for hospital and household facilities. Bactericidal activity against *S. aureus*, *P. Aeruginosa* and *Salmonella choleraesuis* was determined using the official methods of analysis of the Association of Official Analytical Chemists, with modifications as recommended by the Canadian General Standards Board. For MRSA and *E. coli*, the MIC and minimal bactericidal concentration (MBC) were determined using the broth dilution technique. The experiments were carried out at 20°C under a range of conditions including varying PHMG concentration (0.001 – 0.1%), contact time (0.5 – 10 min) and water type (distilled, tap and hard water). The result indicated that the phenol coefficient values determined with *S. aureus*, *Salmonella choleraesuis* and *P. Aeruginosa* were 7.5, 6.1 and 5.0, respectively. No matter what type of water was used to make the dilutions, PHMG killed MRSA and *E. coli* at concentration as low as 0.04 and 0.005% (w/v), respectively, within 1.5 min. The mode of action of PHMG was elucidated by transmission electron microscopy: the cell envelope was broken, resulting in cell content leakage into the medium.^{5 Level III}

In addition, the document provided by the manufacturer were mainly claims of the [REDACTED] disinfectant capabilities in term of its bactericidal, virucidal, algicidal, mycobactericidal and tuberculocidal activity based on the testing performed by the European accredited Chemila Chemical and Microbiology Laboratory in Hodonin, Czech Republic. The results indicated that the product [REDACTED] fulfilled the conditions for reducing initial bacteria, viruses, fungi and algae values by 4 logarithmic orders.²

5.3. Cost-Effectiveness

There was no retrievable evidence on the cost-effectiveness of [REDACTED] disinfection agent for disinfecting healthcare facilities. However, the cost of PHMG is approximately between USD \$ 2,000 – 5,000 depending on package (25 kg/plastic drum, 25 kg/carton, 1000 kg/cubic drum with frame).⁶

6.0 CONCLUSION

6.1. Safety

No retrievable evidence and information on US FDA approval or CE mark for [REDACTED] disinfection agent for disinfecting healthcare facilities. However, PHMG is listed in the EU biocide directive (98/8/EC) in the annexes I and II for human hygiene biocidal products.⁴ There was also no evidence in adverse events on the use of this technology.

6.2. Efficacy

There was insufficient and poor level of evidence to show the efficacy of the GUAA disinfection agent for disinfecting healthcare facilities although it contained PHMG which is a biocidal product. There was also limited evidence on PHMG to determine its efficacy.

6.3. Cost- Effectiveness

There was no retrievable evidence on the cost-effectiveness of [REDACTED] disinfection agent for disinfecting healthcare facilities. However, the cost of PHMG is approximately between USD \$ [REDACTED]0 depending on package (25 kg/plastic drum, 25 kg/carton, 1000 kg/cubic drum with frame).⁶

7.0 REFERENCES

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3. Desisoft. Available at http://www.desisoft.eu/eng_mechanism.html
4. European Commission Environment – Biocidal Products. Available at <http://ec.europa.eu/environment/biocides/index.htm>
5. Oule M.K, Azinwi R, Bernier AM *et al.* Polyhexamethylene guanidine hydrochloride-based disinfectant: a novel tool to fight meticilin- resistant *Staphylococcus aureus* and nosocomial infections. Journal of medical Microbiology. 2008; 57: 1523-1528.
6. Polyhexamethylene guanidine hydrochloride (PHMG) 25% aqua-solution. Available at <http://www.alibaba.com>

8.0 APPENDIX

8.1 Appendix 1

DESIGNATION OF LEVELS OF EVIDENCE

- I Evidence obtained from at least one properly designed randomized controlled trial.
- II-I Evidence obtained from well-designed controlled trials without randomization.
- II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.
- II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.
- III Opinions or respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

SOURCE: *US/CANADIAN PREVENTIVE SERVICES TASK FORCE
(Harris 2001)*