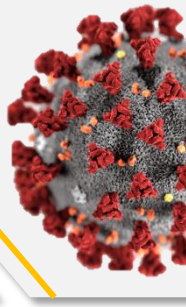
TITANIUM DIOXIDE NANOPARTICLE COATING

Based on available evidence up to 20 May 2020



INTRODUCTION

Decontamination of surfaces usually done using disinfectant solution which need to be applied repeatedly to reduce possibility of recontamination. Recent technology of photocatalytic antimicrobial coating was introduced as an alternative since it provides longer lasting effect compared to single use of disinfectant solution. Titanium dioxide (TiO_2 or 'Titania') a chemically inert, semiconducting material is material used as antimicrobial coating due to its photocatalytic properties. The mechanism of TiO_2 photocatalysis involves generation of electrons and valance holes pairs that diffuse and become trapped on or near the TiO2 surface with the presence of light. These electrons and holes have strong reducing and oxidizing activities and react with atmospheric water and oxygen, producing hydroxyl radicals (OH-) and superoxide anions (O_2-). These radicals are extremely reactive upon contact with organic compounds and bacterial cells in producing complete oxidation and destruction.[1, 2] It is used for disinfection of surfaces, air, water, production of antifogging and self-cleaning coatings on glass as well as food and pharmaceutical additive.[3]

Nano 223 is a water-based solution of Pure 2-3nm Titanium Dioxide (TiO2) that is colourless and odourless and claimed suitable to coat metal, timber, plastic and stone surfaces. Application method is by using spray can or spray gun. It was claimed that the product is Anti- Virus, Anti-Bacteria, Anti- Static, Anti- Odor, reduce VOCs and has UV Protection effect.

EVIDENCE ON EFFECTIVENESS AND SAFETY

Previous Technology Review (2012) conducted by the Malaysian Health Technology Assessment Section (MaHTAS), Medical Development Division reported that TiO_2 photocatalyst coatings demonstrated an antibacterial efficiency between 30% to 95% against certain types of bacteria such as *Escherichia coli* and *Staphylococcus aureus*. However, TiO_2 photocatalyst may not be effective against some spore forming bacteria such as *Bacillus atrophaeus* and fungal species

such as *Aspergillus Niger* and yeasts. There was also no retrievable scientific evidence with regards to its safety and cost-effectiveness. [4]

Besides, there were five Information Brief reports in 2009 on Nano TiO_2 Sol Coating Agent (SM1152) and ARC-FLASH Titanium Dioxide Photo Catalytic Solution, 2015 on Nanomax, 2016 on Smart Coat TiO2 photocatalyst, 2018 on Nano TiO2 that concluded there was limited retrievable evidence on the effectiveness, safety and cost-effectiveness.[5-9]

The systematic search for new evidence from the scientific databases such as Medline, EBM Reviews, EMBASE via OVID, PubMed and from the general search engines [Google Scholar and US Environmental Protection Agency (US EPA)], with the limits to year of publication from 2015 onward, yielded two articles to demonstrate the efficacy of TiO2 photocatalyst coatings in healthcare setting. However, there was no study retrieved on the safety and cost-effectiveness.

Min et. al (2018) conducted a prospective cohort study involving 621 patients in medical intensive unit. Titanium dioxide-based photocatalyst was coated on high touch surface and walls. Comparison of multidrug resistant organism incident rates, hospital-acquired blood stream infection, pneumonia, urinary tract infection, *Clostridium difficile*–associated diseases were done pre intervention and post intervention (five months of data each set). There was significant decrease in MRSA acquisition rate after photocatalyst coating (hazard ratio, 0.37; 95% confidence interval (CI): 0.14, 0.99; p = 0.04). However, clinical identification of vancomycin resistant *Enterococcus* spp. and multidrug-resistant *Acinetobacter baumannii* did not decrease significantly. The hazard of contracting hospital-acquired pneumonia during the intervention period compared to baseline period was 0.46 (95% CI: 0.23, 0.94; p = 0.03).[10]

Matthew et. al (2018) examine effectiveness of TiO2 coating (MVX, Hi-tech, Kitakyushu, Japan-doped with silver zeolite) in reducing bioburden of high risk surfaces in between two acute care wards. TiO2 coating was sprayed onto six surfaces and compared under normal illumination against the same surfaces in an untreated ward: right and left bed rails, bed control, bedside locker, overbed table, and bed footboard. Overall microbial burden and presence of an indicator pathogen (*Staphylococcus aureus*) were assessed biweekly for 12 weeks. Treated surfaces demonstrated significantly lower microbial burden than control sites, and the difference increased between treated and untreated surfaces during the study. Hygiene failures (>2.5 colony-forming units [CFU]/cm2) increased 2.6% per day for control surfaces (odds ratio [OR], 1.026; 95% CI: 1.009, 1.043; p=.003) but declined 2.5% per day for treated surfaces (OR, 0.95; 95% CI :0.925, 0.977; p<.001).[11]

In addition, document provided by the company mainly mentioned about:

a) Newspaper report, and narrative review regarding Nano223.

b) Test report : Indoor Air Quality report of single room before and after application of Titanium Dioxide coating (Nano Yo)

c) Laboratory report of antimicrobial activity from coated and uncoated sample.

d) Unpublished article: Laboratory experiment of Inactivation of SARS virus by Photocatalyst by Takatoshi et al. Study showed reduction of virus density was observed to less than detection limit (50pfu/ml) more than 15 minutes in irradiation time.

CONCLUSION

Based on the previous reports by MaHTAS and recent studies related to the efficacy of TiO_2 photocatalyst coatings, the scientific evidence of effectiveness is still limited and studies showed conflicting results. There was no retrievable evidence on its safety and cost effectiveness.

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Disclaimer: This rapid assessment was prepared to provide urgent evidence-based input during COVID-19 pandemic. The report is prepared based on information available at the time of research and a limited literature. It is not a definitive statement on the safety, effectiveness or cost effectiveness of the health technology covered. Additionally, other relevant scientific findings may have been reported since completion of this report.

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