

## VII. ABSTRACTS OF THE SELECTED PROJECTS

I1

### EVALUATION OF THE PERFORMANCE OF A CHLORHEXIDINE GEL CONTAINING CVC DRESSING IN A CLINICAL ENVIRONMENT

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**Introduction:** Although infection risk associated with central venous catheters (CVC) has reduced in recent years, the use of CVC are still associated with relatively large number of infections, leading to increased patient morbidity and healthcare costs. A major source of microbial colonisation and infection of short term CVC is the patients' endogenous skin microorganisms located at the catheter insertion site.

**Objectives:** To evaluate the introduction and performance of a chlorhexidine (CHG) gel CVC dressing in a critical care environment.

**Methods:** Following Ethical committee and Trust approvals and staff training, a transparent film-dressing incorporating an aqueous CHG gel was introduced to critical care patients over a 9 month period. Skin reactions to the dressings and performance characteristics of the dressings were monitored. Any adverse events were determined as per standard clinical practice. Healthcare workers' perceptions of the performance of the dressing were evaluated at the end of the study period.

**Results:** There were no reports of severe contact dermatitis associated with the CHG or standard dressings. Close assessment of skin condition at the CVC site was evaluated in 273 patients who had given their consent. Following dressing removal, mild redness under the adhesive was reported in one standard dressing group patient (0.7%, n=137) and in seven CHG dressing group patients (5.1%, n=136). Only one patient presented with mild redness under the CHG gel part of the dressing (0.7%, n=136). All the above symptoms resolved within 24 h following dressing removal.

A questionnaire was distributed to critical care nursing staff and clinicians in theatres, who had experience handling and observing both the standard CVC (Tegaderm IV dressing) and CHG gel containing CVC dressing (CHG Tegaderm). In total, 71 nurses and 10 clinicians responded to the survey. Staff was satisfied with the performance of the CHG dressing, with 97.5% of the respondents rating the overall performance of the CHG gel dressing as: the same as (11.1%), better (35.8%) or much better (50.6%) than the standard CVC dressing.

**Conclusion:** The CHG gel CVC dressing was well tolerated by patients and performed effectively in the critical care environment.

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I2

### STRUCTURE-BASED OPTIMIZATION AND DISCOVERY OF NOVEL 1,3,5-TRIAZINE DERIVATIVES AS BACTERIAL TRANSLATION INHIBITOR WITH FAVOURABLE METABOLIC FATE

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**Introduction:** We have recently moved into an era not just of multiple resistant bacteria but of totally resistant pathogens, which now include vancomycin-resistant *enterococci*, carbapenem-resistant *Acinetobacter baumannii*, vancomycin-resistant MRSA and, very recently, NDM-1. Thus, increased incidence of bacterial resistance to currently available antibiotics necessitates the discovery and introduction of new and effective drugs. In our earlier studies, we have discovered a potent antibacterial lead molecule from 1,3,5-triazine (first generation) and its subsequent optimization till its tenth generation results much more advanced analogue with enhanced activity and less toxicity.<sup>1</sup>

**Objectives:** Present study deals with the advancement of novel derivatives of 1,3,5-triazines to increase its efficacy and potency to make them viable drug candidate (eleventh generation).

**Methods:** The synthesis of analogues was achieved by means of S<sub>N</sub>Ar reaction utilizing distinguished amines. These molecules were then subjected to antibacterial screening against pathogenic Gram-positive and Gram-

negative micro-organisms. MetaPrint2D-React from University of Cambridge, UK was utilized for the prediction of metabolites of the compounds.

**Results:** Entire set of derivatives demonstrated excellent antibacterial activity ( $1.56 - 25 \mu\text{g ml}^{-1}$ ), and in some instance found equipotent to cefixime as standard. The molecular docking study on eubacterial ribosomal decoding A site (Escherichia coli 16S rRNA A site) confirmed the stability of target compounds into the inner groove of active site by making close H-bonds with highly conserved residues, e.g. Ade38, Gua37, Ade39, and Gua40. Moreover, the most active compound 7e, in MetaPrint2D-React study was not found to be deactivated by human metabolic process, which conform the utility of designed molecules.

**Conclusion:** We have discovered an another novel 1,3,5-triazine analogs as potent antibacterial agent through structure-based optimization of our defined lead.

**References:** 1. Singh B, Bhat HR, Kumawat MK, Singh UP. Structure-guided discovery of 1,3,5-triazine-pyrazole conjugates as antibacterial and antibiofilm agents against pathogens causing human diseases with favourable metabolic fate. *Bioorganic & Medicinal Chemistry Letters*, 2014, 24, 3321-3325.

**Disclosure of Interest:** None Declared

### I3

#### IN VITRO EVIDENCE FOR THE ANTI-STAPHYLOCOCCAL ACTIVITY OF A CATIONIC POLYMER COMPOUND—PRELIMINARY RESULTS

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**Introduction:** In the context of a clinical trial, we observed a surprisingly high methicillin resistant *S. aureus* (MRSA) eradication rate of a placebo solution containing a cationic polymeric compound (CPC). The most active compound altering bacterial growth was identified by testing individually all molecules entering the composition of the commercial solution

**Objectives:** To assess the inhibitory capacity of a decolonisation solution and determine the *in vitro* time kill curves of Prontoderm® (containing polyhexanide plus CPC) *versus* CPC alone and versus a control solution containing only excipients and emollients

**Methods:** Minimal inhibitory concentrations (MIC) of all compounds entering in the composition of a decolonization solution were assessed by a macro-method in liquid medium, on MRSA strains from the prevalent lineage isolated in our institution. A constant and calibrated inoculum of MRSA was exposed to adapted concentrations (4-fold MIC) of inhibitory compounds in liquid medium. Aliquots were sampled serially at time 15 to 240 min and diluted before plating on nutrient agar medium. Survival cells were enumerated after 20 h incubation at 37°C

**Results:** In addition to polyhexanide, the decolonisation solution contained another compound showing activity on MRSA growth. Polyhexanide was rapidly bactericidal for all tested MRSA strains; a rapid decrease of >5 logs in 15 min was generally observed. CPC showed also a significant effect on MRSA development. The killing was slower than that observed with polyhexanide but reached 4 to 5 logs after 2 h exposure

**Conclusion:** In addition to the active bactericidal compound, decolonization solution contains additives altering bacterial growth. The choice of a reliable placebo solution for comparison purposes in clinical trials should be adapted. Susceptibility of other relevant bacterial species, particularly multi-resistant pathogens, to the CPC should be evaluated

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### I4

#### DEVELOPMENT OF ANTIMICROBIAL PEPTIDES FOR CATHETER-RELATED BLOODSTREAM INFECTION PREVENTION

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**Introduction:** Central venous catheters are used in many medical procedures to deliver critical and lifesaving treatments, such as antibiotics and chemotherapy agents. However, central line-associated bloodstream infections (CLABSI) associated with these devices negatively impact over 100,000 patients per year and are extremely expensive to treat.

When infections arise on implanted biomaterials, they are treated with systemic antibiotics, debridement, and implant removal. Unfortunately, the high local antibiotic concentrations needed to kill colonized bacteria are only

achieved over a short time, cause cytotoxicity, and can promote antibacterial resistance. Therefore, it is currently believed that proactive methods of infection management will be superior to reactive methods.

As an alternative to traditional antibiotics or to device removal, antimicrobial peptides (AMPs) represent a novel way to prevent and treat infections. AMPs are short, cationic molecules found naturally in the innate immune systems of many species, and they have broad spectrum antimicrobial activity. AMPs use fundamentally different mechanisms to kill bacteria than conventional antibiotics, reducing the threat of bacterial resistance.

**Objectives:** The objective of our overall research program is to improve biomedical devices using a therapy based on surface-tethered AMPs. Although AMPs are highly active against bacteria when free in solution, immobilization of AMPs to a surface significantly reduces antimicrobial activity.

**Methods:** Antimicrobial peptides are tethered to biomaterial surfaces using flexible chemical linkers. We are currently investigating the role of the linker size in influencing the efficacy of the antimicrobial peptide. Activity against Gram-negative and Gram-positive bacteria is being quantified. We are also studying the cytotoxicity and long-term stability of the tethered peptides.

**Results:** We have shown that modified antimicrobial peptide, chrysopsin-1, can be chemically tethered to a biomaterial surface using polyethylene glycol as a spacer. Killing was observed for *Staphylococcus aureus* and *Escherichia coli*.

**Conclusion:** The expected outcome of this project is a surface modification on catheters can be used to help mitigate catheter-related bloodstream infections.

**Disclosure of Interest:** None Declared

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### INVESTIGATION INTO COMBINATION OF AN ANTIMICROBIAL PEPTIDE WITH EXISTING ANTIBIOTICS AGAINST ANTIBIOTIC RESISTANT CLINICAL ISOLATES OF ESCHERICHIA COLI

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#### Introduction:

Bacterial infections remain the leading killer worldwide which is worsened by the continuous emergence of antibiotic resistance. In particular, antibiotic resistant Gram-negative bacteria are prevalent and extremely difficult to treat. Therefore, rejuvenating the therapeutic potentials of existing antibiotics represents an attractive novel strategy. Antimicrobial peptides have been of great focus recently. Newly derived synthetic lipopeptides have been shown to exhibit antimicrobial activity against bacteria and fungi.

**Objectives:** In this study, we investigated the ability of an antimicrobial peptide, PA-KKKK, to enhance the potency of currently used antibiotics against antibiotic-resistant clinical isolates of *Escherichia coli* and a NDM-1 producing strain.

**Methods:** Antibiotic susceptibility was investigated by determining the minimal inhibitory concentration (MIC) using a broth dilution method. To study the combined interactions between PA-KKKK and the antibiotics, checkerboard titrations were performed. Time-kill assays were then carried out to prove the effect of synergistic activity against the tested bacterial strains. Transmembrane potential depolarisation assays and ATP levels were determined to understand the mechanism of action of PA-KKKK.

**Results:** NDM-1 producing strain was extremely resistant to all antibiotics tested. The fractional inhibitory concentration index (FICI) was calculated to show the peptide synergised with rifampicin against the NDM-1 strain, while it synergised with rifampicin, colistin, ceftazidime and aztreonam against antibiotic-resistant clinical isolate of *E. coli*. Time-kill analysis demonstrated significant synergistic activities when a low level of PA-KKKK was combined with rifampicin and colistin. PA-KKKK had a membranolytic effect on cytoplasmic membrane and in combination, decreased ATP levels of cells in a dose-dependent manner.

**Conclusion:** We have demonstrated that PA-KKKK acts as an antibiotic enhancer and therefore accelerates the bactericidal activity of drugs against antibiotic-resistant *E. coli*. This novel treatment regimen can have major clinical implications in our fight against Gram-negative bacterial infections.

**Disclosure of Interest:** None Declared

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## INACTIVATION OF PSEUDOMONAS AERUGINOSA BY ZINC OXIDE NANOPARTICLES IN AQUEOUS SOLUTION

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**Introduction:** Since ZnO nanoparticles (ZnO-NPs) exhibit strong antibacterial activities on a broad spectrum of bacteria the aim of this study was to evaluate the antimicrobial activity of ZnO-NPs against *pseudomonas aeruginosa* as a model for gram-negative bacteria.

**Methods:** The average size of ZnO-NPs was 20 nm, as determined through scanning electron microscopy. Muller Hinton broth was used as a growing medium for *pseudomonas aeruginosa*. Photocatalytic experiment was carried out in a laboratory-scale batch reactor with low pressure ultraviolet irradiation (380 nm). Different experimental parameters such as amount of ZnO-NPs, contact time, inorganic and organic substances and pH on photocatalytic inactivation of *pseudomonas aeruginosa* cells have been studied. An initial *pseudomonas aeruginosa* concentration of  $10^8$  CFU/mL was used for all experiments.

**Results:** Result showed that, almost all the initial *pseudomonas aeruginosa* cell ( $10^8$  CFU/ml) was inactivated in 60 min in the presence of 2 g/l ZnO-NPs. Photocatalytic inactivation of bacteria was found to follow first order kinetics. The initial pH of the water did not play an important role on the inactivation rate within a range of 6–8 pH units. The amount of photocatalyst also plays an important role in photocatalytic inactivation rate. As the result showed increasing the photocatalyst amount provided more rapid inactivation.

**Conclusion:** Addition of some inorganic ions to the suspension affects the sensitivity of *pseudomonas aeruginosa* and caused to retard the inactivation rates. Since the sensitivity of *pseudomonas aeruginosa* to photocatalytic treatment was fairly good, it is therefore, recommended to use this nano-particle for water treatment.

**Disclosure of Interest:** None Declared

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## QED DISINFECTION OF EBOLA AND DRINKING WATER IN THE DEVELOPING WORLD

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**Introduction:** The UV disinfection protocol for Ebola and drinking water in the West [1] is not only too complex and expensive to be used in the developing world but requires sources of electricity usually not available.

**Objectives:** To provide people in the developing world with a means to disinfect both the Ebola virus and drinking water themselves using UV-C radiation from hand-held nano-coated bowls powered only by body heat.

**Methods:** QED induced EM radiation [2] from body heat in hand-held nano-coated bowls is proposed to disinfect the Ebola virus and drinking water. QED stands for quantum electrodynamics and EM for electromagnetic. By this theory, heat from the hand cannot increase the coating temperature because its heat capacity vanishes by quantum mechanics. Instead, body heat is conserved in the nano-coating by QED inducing the creation of EM radiation having wavelength  $\lambda$  depending on the coating thickness  $d$  and refractive index  $n$ , i.e.,  $\lambda = 2nd$ . For example, a bowl comprising a thin-walled aluminum half-sphere (100 mm diameter x 50 mm high) that fits in the palm of one hand is provided on the inside surface with a 53 nm zinc-oxide coating having  $n = 2.4$  to produce the UV-C. Humans produce body heat of about 6 mW/cm<sup>2</sup>. Since the UV-C intensity necessary to disinfect [3] the Ebola virus is 0.4 mJ/cm<sup>2</sup>, the protocol is to move an empty inverted hand-held bowl over the area to be disinfected in < 1 second scans. Water disinfection requiring 16-38 mJ/cm<sup>2</sup> of UV-C [4] means filling the bowl with water and waiting 3 to 6 seconds before drinking.

**Results:** Preliminary results expected for the ICPIIC conference.

**Conclusion:** QED induced UV-C radiation from hand-held nano-coated bowls allows people in the developing world to rely on themselves to disinfect the Ebola virus and drinking water. Costs of the bowls are minimal and may be distributed freely by West African governments to their people. Support and funding in the development and testing of UV-C disinfection of Ebola and drinking water by the Innovation Academy is requested

### References:

[1] Ferrero G. UV disinfection in developing Countries. UNESCO IHE, Delft, The Netherlands, November 6, 2014.

[2] Prevenslik, T. See diverse QED applications at <http://www.nanoqed.org>

[3] Vatansever F, et al., Can biowarfare agents be defeated with light? Virulence 2013;4:796–825.

[4] Ultraviolet Disinfection, National drinking water clearinghouse fact sheet, Tech Brief

**Disclosure of Interest:** None Declared

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## INFECTION PREVENTION AND PATIENT SAFETY IMPROVEMENT IN DEVELOPING COUNTRIES THANKS TO SODIUM HYPOCHLORITE PRODUCTION DEVICES

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**Introduction:** The technology developed by Antenna Technologies has allowed reaching some promising results. In **Guinea Conakry**, The sales of Sodium Hypochlorite (SH) flasks in a limited zone (target population for 2014: 7'218'882) represent a calculated coverage ratio of 27,5% (2014: 3'390'637 flasks sold at very low price to lowest income group). In **Burkina Faso**, the excellent results obtained by a pilot study under the auspices of the Health Ministry suggests that a scaling-up phase with the ambition to equip 63 health districts and 9 regional hospitals should be undertaken in a close future.

**Objectives:** To demonstrate that devices, through the electrolysis of saltwater, can locally produce high-standard quality SH at a very low cost and without prior scientific knowledge. This SH allows to significantly improve public health and patient safety (disinfection) particularly in developing countries.

**Methods:** Antenna Technologies (AT) assesses, through experiences and data from the field, the usefulness of its devices (WATA) and chemical reagents (WataTest, WataBlue) by considering growing demand for its technology and its demonstrated substitutive capacity.

**Results:** AT's devices are now used in thirty countries. Laboratory empirical studies and data gathered on the field have shown that such devices are able to produce on a regular basis a SH equivalent to 6g/L of active chlorine. This concentration is in line with recommendations of CDC for the disinfection in health centers in the Ebola context (CDC, 2015) and with the recommendations of the WHO regarding infection control in health care facilities (WHO, 2004). HS is also recognized as an efficient disinfectant for drinkable water. Water quality is expected to have a huge influence on the prevalence of waterborne diseases. Chlorination is identified as the most cost-effective disinfection solution.

**Conclusion:** SH production process is very low-cost and easy to learn/train. The produced SH meets high-quality standards. According to CDC and WHO, the SH is an efficient and convenient disinfectant/antiseptic for health facilities and water, especially in developing countries. SH is also relevant for the washing and disinfection of the wounds (Dakin solution).

**Disclosure of Interest:** None Declared

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## USE OF AN INNOVATIVE COLOUR-BASED PERSONALITY-PROFILING (PP) TOOL TO GUIDE CULTURE-CHANGE STRATEGIES AMONG DIFFERENT HEALTHCARE WORKER (HCW) GROUPS

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**Introduction:** Most current infection control (IC) culture-change programs are standardised and do not take into account possible differences between HCWs.

**Objectives:** 1. Identify PP features among various HCW categories to inform the development of a personality-based educational culture-change "blueprint" to improve uptake of IC initiatives.

2. Compare the accuracy of PPs derived from the Human Resources (HR) database at 5 Australian hospitals (HR-Ps) with those derived from direct participant surveys (PS-Ps) from these sites

3. Use findings to develop targeted marketing strategies for each HCW group.

**Methods:** We used an innovative colour-based PP tool (ColourGrid; framework based on Hofstede's Cultural Dimensions Theory) to identify PPs using: Basic HR data (gender, age, home postcode and suburb, employment status, HCW category) and ColourGrid surveys completed by HCWs at the 5 sites. HR-Ps and PS-Ps were compared for 3 HCW categories – Doctors (D), Nurses/Allied (N-A) and Support staff (SS). Among Ds, PS-Ps were compared for senior hospital clinicians (full-time [SMO] vs part-time [VMO]) and junior staff (interns/fellows [HMO]).

**Results:** HR data was obtained for 34 243 HCWs, with 1045 completing a ColourGrid survey. HR-Ps suggested that HCWs are substantially different to the general Australian population, being more affluent; established; well informed; likely to adopt new technology and new experiences; often cynical about advertising messages; challenging to others who do not share their interests or concerns; want to make a difference and leave a heritage of success. HR-Ps and PS-Ps were highly concordant for all 3 HCW categories (D, N-A, SS) – with both suggesting a need for messaging differences. Overall, Ds exhibited more individualism, lower power distance and less uncertainty avoidance, but PS-Ps were different for SMO vs VMO vs HMO suggesting targeted messaging strategies are critical.



**Conclusion:** PP identified major differences among D, N-A and SS; and a need for targeted marketing strategies. Among Ds, subtle but important, differences also exist that need consideration if culture-change initiatives are to be successful.

**Disclosure of Interest:** None Declared

I10

#### TEACHING GOOD INFECTION CONTROL PRACTICES WITH FUN: IMPACT OF THE SERIOUS GAME FLU.0

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**Introduction:** Flu outbreaks usually reveal that practices and knowledge about the diagnosis of influenza, its treatment and infection control measures must be improved. A serious game, "Flu.0", was created to teach the 8 key points to know and do when facing one or more patient infected by influenza.

**Objectives:** To evaluate the impact of playing to 'Flu.0' on the knowledge and practices of nurses and physicians.

**Methods:** Flu.0 is free and can be played online or downloaded; A call for participation to play and evaluate the game was performed. Players were asked to complete a questionnaire before and after the game to give their opinion on sentences about flu, to write what they learned with the game and the main thing they would do differently. A descriptive analysis was performed and the evolution of the answers was analysed.

**Results:** Physicians were 264 to participate (including 213 fellows), senior nurses 62 and nurses students 577; 95% learnt at least something. The main knowledge acquired was about rapid test for influenza (32%) and additional precautions (19%). Significantly, players agreed more after the game that seasonal flu is a not benign disease, that flu vaccination of health care workers is useful, knew more about antiviral treatment and felt better prepared to face a flu case ( $p < 0.001$ ). Thanks to the game 47% of physician/senior nurses and 80% of nurses students declared they would perform better additional precautions.

**Conclusion:** A serious game is an innovative quick and efficient tool for infection control team to improve patient safety.

**Disclosure of Interest:** None Declared

I11

#### NURSES' SELF-IMPROVEMENT HAND-HYGIENE COMPLIANCE IN A HOSPITAL WARD: COMBINING INDOOR LOCATION WITH GAMIFICATION DATA PRESENTATION

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**Introduction:** Healthcare acquired infections can be prevented by means of hand hygiene (HH) compliance. Nonetheless, leading busy healthcare workers to comply with HH remains puzzling. Recognized hurdles are lack of time, forgetfulness, wrong technique, lack of motivation and awareness about compliance.

**Objectives:** This study aims at exploring the use of gamification to promote nurses' HH compliance self-awareness and action. Real-time data collected from an indoor location systems will provide feed-back information to nurses working in a ward.

**Methods:** A design science approach is used to design and test a solution[1]. Gamification was selected as the solution (Osyrih) to the compliance problem to engage and motivate people to achieve specific goals.[2] An innovative indoor system, based on Beacons (iBeacon™), is used to collect data on nurses' position (and time) to enable both the detection of HH moments and its validation. Each nurse carry a device running an application that use the received signals to detect its proximity to the beacons, being able to know to which one it is closest to, thus knowing its relative position in the room. After this, data is collected to display, in anonymous way, nurses' compliance in real-time. Changes in behavior were measured

**Results:** The compliance of HH in the ward was studied before and after the intervention. The system was installed and tested with significant precision. 35 Beacons were placed in the ward (in the room's doors, in each alcohol-based hand rub container, in each sink and in each side of the bed). Even though times aren't totally accurate, we are able to detect nurses' movements using proximity and quantify compliance. Participant nurses approved the measure as an opportunity to improve their performance.

**Conclusion:** The impact of gamification on HH compliance is still under evaluation. So far the results show significant improvements in nurses' awareness. The nurses participated from the beginning enabled a higher sense of ownership in the process, recognized as a performance enabler.

**References:** 1. Peffers et al. (2008) Design Science Research Methodology..., *J. Manag. Inf. Syst.* 24(3), 45–77  
2 King et al. (2013) Gamification, *J. Royal Soc. Medicine*, 106(3), 76–78

**Disclosure of Interest:** None Declared

**THE USE OF CREATIVE AND HUMOROUS DESIGNS AS VEHICLES FOR HEALTH EDUCATION AND INFECTION CONTROL**S. W. L. Soh <sup>1,\*</sup><sup>1</sup>*K Ventures, Singapore*

**Introduction:** ilovemicrobes.com™ was started in late 2014 by a microbiologist cum ex-lecturer at a Singapore institute of higher learning. The concept was to incorporate humour and creative designs to give a glimpse of the world of microbes and their impacts in human health and disease.

**Objectives:** The concept was to incorporate humour and creative designs to give a glimpse of the world of microbes and their impacts in human health and disease.

**Methods:**

Each design is scientifically-based on microscopic or macroscopic attributes of the real image of the actual microbes magnified up thousands if not millions times over.

The uniqueness of these microbes' designs are not only to generate curiosity but also to demystify the diseases caused in a fun and approachable manner.

Microbes are known to cause disease. However, there is still a sense of complacency and resignations when it comes to infectious disease. The failure of people to exercise appropriate precaution and infection control processes are most likely due to ignorance and the lack of awareness.

Thus, the importance of a vehicle, which can capture the attention of people, especially children to be aware of the existence of these infectious agents, and to understand the way they caused infections; and finally as to how we can performance interventions to reduce the risk of infections are of significance.

**Results:** For viewing of the characters designed, please go to [www.ilovemicrobes.com](http://www.ilovemicrobes.com)

**Conclusion:** It is the vision of ilovemicrobes.com™ to promote Health Education and Infection Control in a fun and exciting way!

**Disclosure of Interest:** None Declared