

## **Project Title**

UVC Germbuster

## **Project Lead and Members**

Project Lead: Dr Willis George Christopher, Senior Consultant, Khoo Teck Puat Hospital

Project Members:

- Professor Tambyah, Senior Consultant, KTPH Infection Control Committee Adviser, National University Hospital
- Dr Ooi Say Tat, Senior Consultant, Khoo Teck Puat Hospital
- Mr Hong Lim Tim, Principal Lecturer, Republic Polytechnic
- Mr Stewart Tai, Facilitator/Engineer, Khoo Teck Puat Hospital
- Ms Foo Meow Ling, Senior Nurse Clinician, Khoo Teck Puat Hospital
- Ms Priscilla Chen, Senior Staff Nurse, Khoo Teck Puat Hospital
- Mr Tony Yang, Assistant Director, Khoo Teck Puat Hospital
- Mr Keegan Lim, Intern, Singapore Polytechnic
- Mr Syafiq Yeoh, Intern, Singapore Polytechnic
- Ms Edgina Winartio, Intern, Singapore Polytechnic
- Mr Kannan, Intern, Singapore Polytechnic

## **Organisation(s) Involved**

Khoo Teck Puat Hospital, National University Hospital, Republic Polytechnic, Singapore Polytechnic

## **Healthcare Family Group(s) Involved in this Project**

Medical, Nursing, Facilities engineering

## **Applicable Specialty or Discipline**

Infection Control

## **Aim(s)**

To interrupt the chain of transmission of microorganisms among patients

## **Background**

See poster appended/ below

## **Methods**

See poster appended/ below

## **Results**

See poster appended/ below

## **Lessons Learnt**

- This innovation is a simple and very effective way to reduce the spread of multi-drug resistant organisms (MDRO) between patients who share the same toilet facilities. It is also very cheap and cost-effective. The UVC system operates 24/7 except when the toilet is being used. This means bacteria have no opportunity to multiply. All these features make this system very attractive. Furthermore, our innovation is easily accepted and implemented since it does not add to the workload of staff. In fact, it reduces their workload and assures greater safety for both patients and staff.
- The first prototype had two safety features to protect patients and staff from exposure to UVC light. The first feature is an automatic shut-off of the UVC lights whenever the toilet door is opened. The second feature is a motion detector within the toilet facility that prevents the UVC from turning on until no motion has been detected for 15 minutes. In consideration of the unusual situation in which a patient was to faint in the toilet, the third safety feature was added. The in/out counter prevents the UVC light from turning on unless the counter determines that any person(s) who entered have exited the toilet.

- Once the system is rolled out across the hospital, there is plan to implement an additional feature which is a central fault detection system. This will expedite detection and repair of any system fault that may occur in any of the toilets.

## **Conclusion**

See poster appended/ below

## **Additional Information**

This innovation has so far been set up in one ward using initial grant funding. It has been operational for about one year. This period has allowed us to observe and perfect the system. We are requesting budgeting from the hospital so this system can be set up in 72 toilets in Tower B of KTPH.

## **Project Category)**

Technology

Product development

Care & Process Redesign

Valued Based Care, Safe Care (Reduce The Risk of Healthcare Associated Infections), Risk Management, Build Environment, Facilities Management Improvements, Facilities Engineering

## **Keywords**

Infection control, UVC light system, reduce bacterial count

## **Name and Email of Project Contact Person(s)**

Name: Dr Willis George Christopher

Email: [Willis.george@ktph.com.sg](mailto:Willis.george@ktph.com.sg)



# UVC Germbuster

Author: Christopher Willis

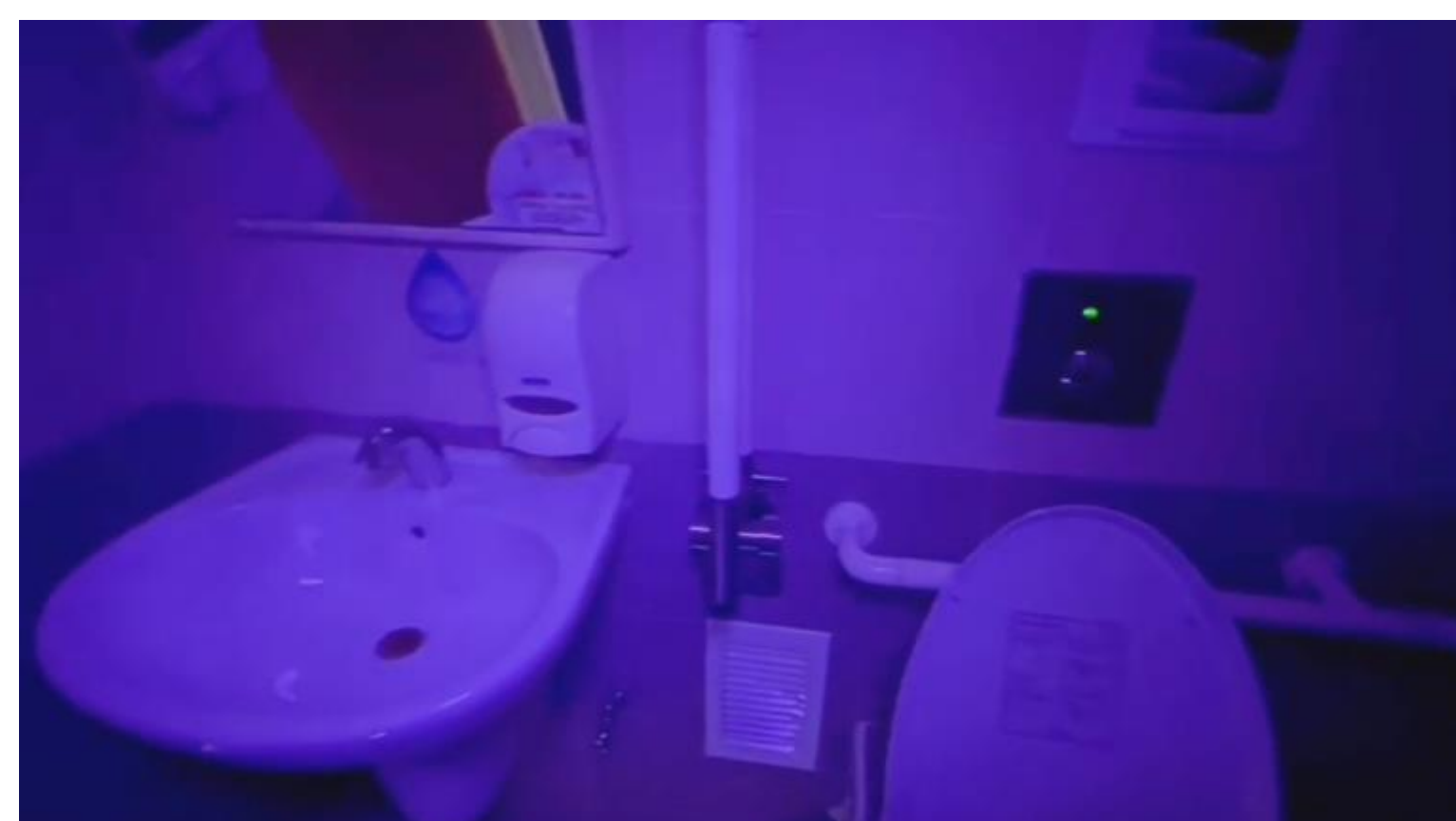
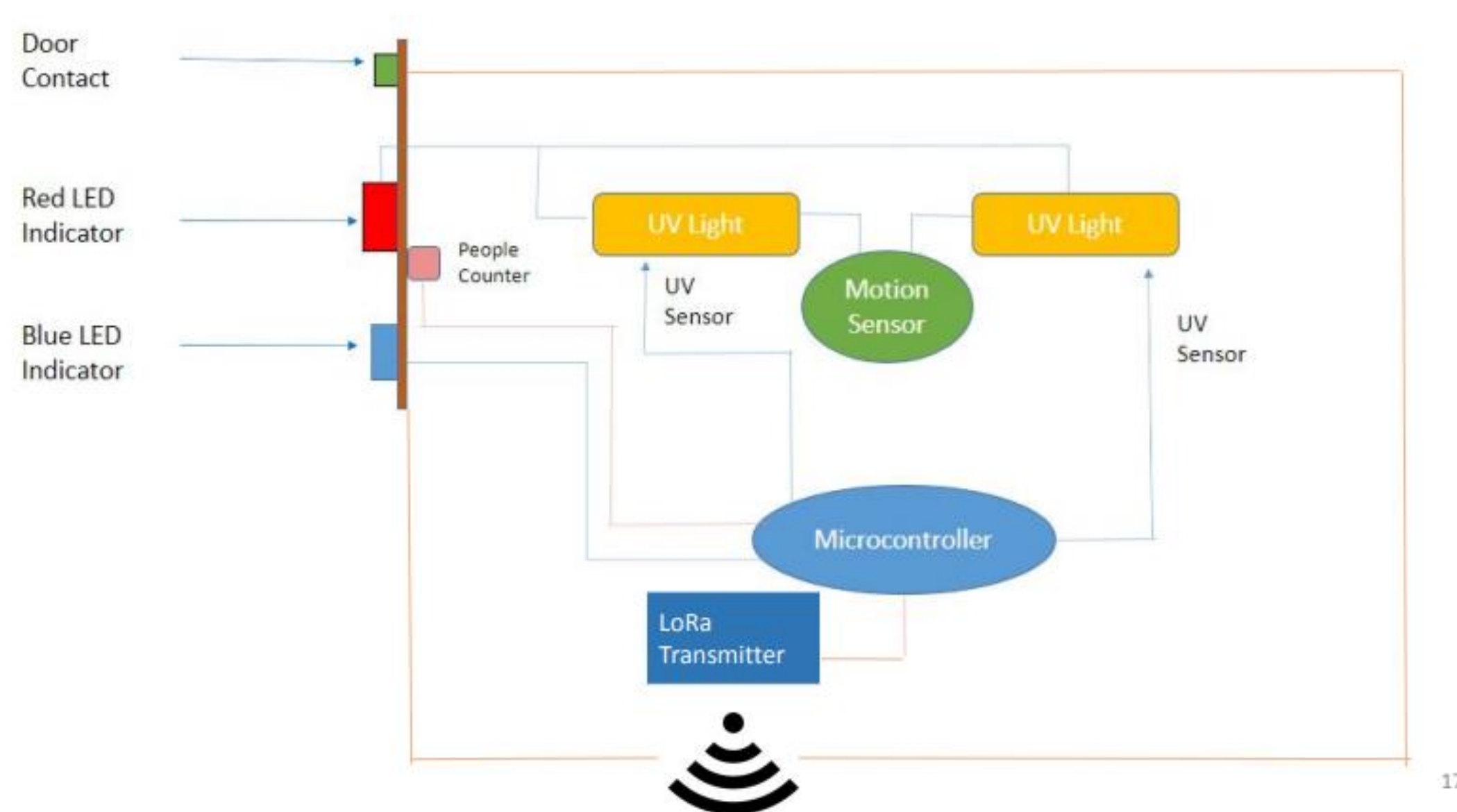
Co-Author: Stewart Tai & Syafiq Yeoh & Keegan Lim & Edgina Winartio

## Background & Aims

- Hospital bathrooms are known to contain a high number of microorganisms, including multi-drug resistant organisms (MDRO). This reservoir of pathogens can spread among patients and lead to serious infections.
- Blind spots which are left untouched by Environment Service Associates are optimal spots for bacteria to grow.
- Improvement of hospital hygiene is needed for patient safety.
- Aim – To find an effective way to reduce bacterial counts in the washrooms without the use of manpower.

## Results & Project Impact

- Since implementing the UVC light system, the number of harmful microorganisms have significantly decreased. This has been confirmed by an accredited laboratory which tested before-after swab tests from a ward toilet. This UVC system can reduce bacterial counts to extremely low levels..
- This project will enhance patient and nurses' safety and instill a better safety awareness culture.
- Staff ratio is maintained as this system does not require extra manpower to operate, nor would extra staff be necessary to clean the ward toilets.



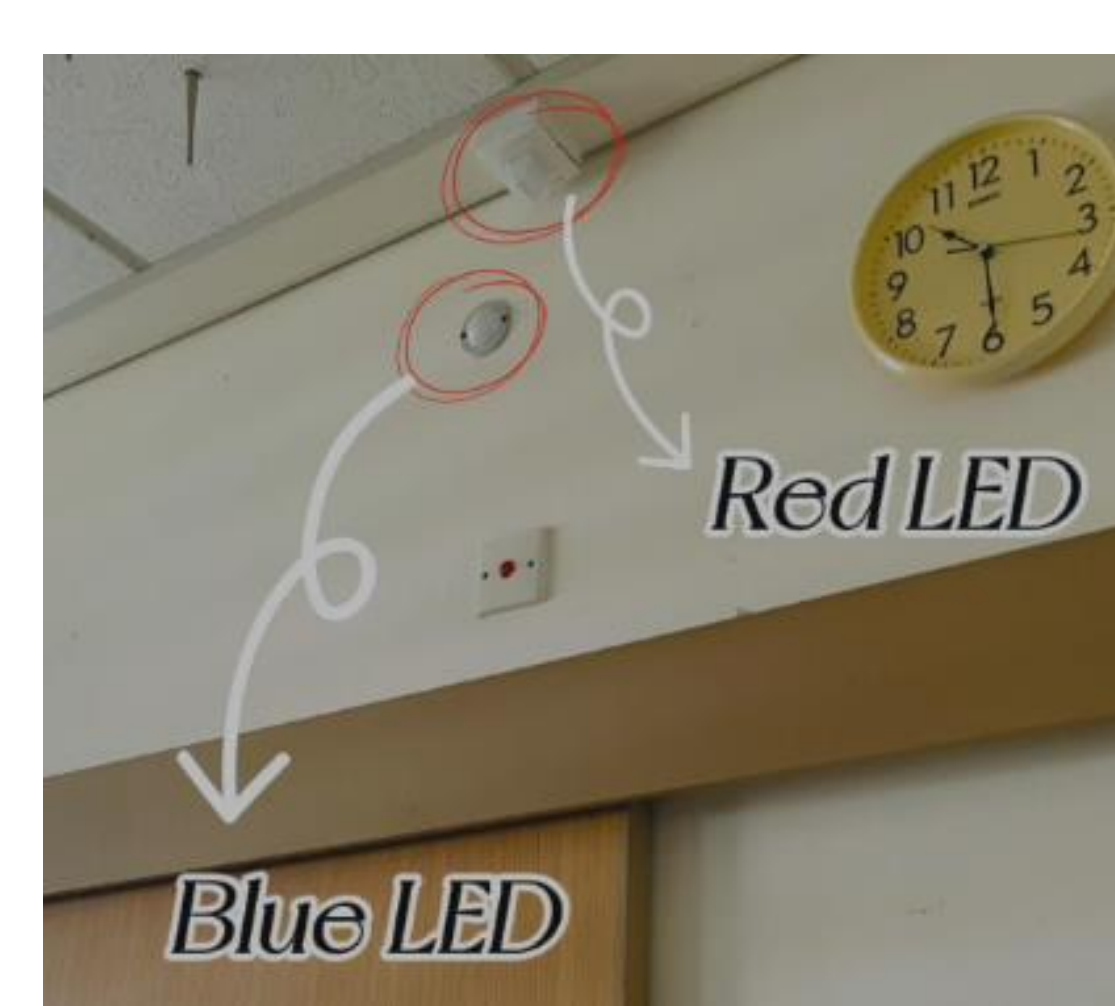
	Grab Bar in Toilet	Inner Door Handle & Lock	Sink	Soap Dispenser	Shower Handle	Shower Chair	Grab Bar At Shower Area	Shower Control Water Knob	Cloth Hanger	Toilet Cover
0 Min	50	40	6,400	380	880	14,000	17,000	7,600	<10	12,000
5 Mins	<10	<10	190	<10	300	12,000	1,500	210	<10	30,000
10 Mins	60	<10	9,000	<10	<10	520	3,200	300	<10	6,200
15 Mins	<10	<10	140	<10	<10	1,200	800	200	<10	2,000
Effect by 15 Mins	↓ 5	↓ 4	↓ 46	↓ 38	↓ 88	↓ 12	↓ 21	↓ 38	-	↓ 6
Effect by 10 Mins	↓ 1	↓ 4	↑ 1	↓ 38	↓ 88	↓ 27	↓ 5	↓ 25	-	↓ 2

## Methodology

- In response to an increase in antibiotic-resistant hospital-acquired infections, the Infection Control Committee and Team explored methods to break the chain of microorganism transmission among patients. Shared toilets/showers are reservoirs of bacteria in view of high humidity
- UVC light is a potent germicidal for bacteria, viruses, fungi, and parasites. We designed a simple and low-cost system to be installed in shared patient toilets. After Senior Management approval, and after obtaining grant funding for our prototype, we installed the system in two toilets/shower areas on ward B65 at KTPH. It employs two ceiling-mounted UVC light tubes which turn on when the toilet door is closed and nobody is inside. The toilet door is spring-loaded so that it always closes fully after entry or exit.
- Three safety features ensure patients and staff will not be inadvertently exposed to UVC light. 1. Spring-loaded door closure with automatic turnoff of UVC whenever the door is opened. 2. A motion detector prevents the UVC from turning on whenever someone is inside. There must be no motion detected for 15 minutes before the UVC turns on. 3. An entry/exit person counter ensures the UVC will not turn on in the unusual situation where a patient was to lose consciousness in the toilet.
- An LED light on the outside of the toilet shows the UVC light is on.
- Swabs of high-touch points were taken before UVC activation and repeatedly for three times after every 5 minutes of activation (ie. 5,10,15 minutes UVC exposure). These were sent to an accredited lab to determine colony counts. Results are shown. Colony counts can be expected to be even lower when the system is operating 24/7 because bacteria and other germs have no time to multiply.

## Sustainability & Follow-Up

- New nurses will be briefed on the UVC system by the nurse in-charge.
- Pictorial guides are pasted on the door for staff and patients to understand the system.
- The UVC Germbuster system is entirely automated. It will include a fault-detection system which allows central monitoring and prompt rectification of any problem by Facilities Management.



## Conclusion

- This automated, low-cost, effective and reliable system will greatly enhance patient and staff safety. Environment Service Associates will be able to focus on other things than cleaning the toilet. It will limit the need for more manpower.