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LHTIO Project No: EDM-STGEM-01

Date: 05/05/2022
Report No: EDM-STGEM-01

Lightico were asked to carry out an air quality audit to determine if CleanLight could provide additional infection control from airborne pathogens at St Gemma's Hospice in Leeds. The area of concern was the ward office.

Summary:

Lightico Limited supplies Titanium Dioxide (TiO_2) photocatalytic LED light panels that are designed to produce antimicrobial activity in the area around the light panel during operation.

St Gemma's provide support for people with cancer and other life-threatening illnesses from their Leeds based hospice. The area of the site Lightico visited provide in-patient care. The office surveyed is an administrative space where staff can conduct private meetings and work on patient care. It is often necessary for the door to be closed so that patient privacy can be maintained. Fixed CO2 monitoring is in place within the office but no mitigation actions, other than increasing ventilation from opening the door or window are available to address air quality in these cases.

The objective of the Lightico Air Quality Audit is to identify areas within an environment where the potential risk of onwards transmission of disease is greater and/or where the quality of air, due to potentially raised level of pollution and pollutants is poor, leading to negative consequences for staff and visitors.

Measurements:

To establish air quality Lightico's audit measures the following:

- Background airborne bacteria – Total Viable Count (TVC)
- CO2 levels throughout the testing period
- A final overall Air Quality Index is provided at the end of the test period

Methodology:

The standard index of microbial air contamination (IMA) for the measurement of microbial air contamination in environments at risk is determined using the 1/1/1 scheme. This method quantifies the microbial flow directly related to the contamination of surfaces coming from microbes that reach critical points by falling on to them. The index of microbial air contamination is based on the count of the microbial fallout on to Petri dishes left open to the air according to the 1/1/1 scheme (for 1h, 1m from the floor, at least 1m away from walls or any obstacle). The index of microbial air contamination has been tested in many different places: in hospitals, in food industries, in art galleries, aboard the MIR space station and also in the open air. It has proved to be a reliable and useful tool for monitoring the microbial surface contamination settling from the air in any environment. For more information reference The index of microbial air contamination by C Pasquarella, O Pitzurra and A Savino

Lightico use of the 1/1/1 scheme refers to the exposure of 18ml of nutrient agar contained in a 100mm diameter petri dish, 15mm deep for 1 hour. The dish is suspended 1m from the floor on a stand positioned 1m from the wall. 1 hour, 1m from the floor, 1m from the wall.

This ensures that whatever settles onto the plate during the 1-hour exposure period is from the air not contamination from surfaces or people. Lightico sample up to 3 separate locations with a room so that an average or total can be provided.

Once the plate has been exposed for 1 hour it is sealed and then incubated for 72 hours before a Total viable count (TVC) is made of the bacteria identified. This gives a quantitative estimate of the concentration of microorganisms such as bacteria, yeast, or mould spores in a sample. The count represents the number of colonies forming units per g of the sample.

The remaining measurement is conducted using the fixed CO2 monitor installed in the office together with a handheld CO2 monitor for comparison. After allowing the monitor to calibrate itself to the environment (taking approximately 5-10 mins) a numerical reading is taken for each of the measurements at 15 min intervals at each of the sample locations. At the end of the test period a handheld air quality meter is used to provide an Air Quality Index (AQI).

Environmental observations including air handling and ventilation:

The requirement for any organisation responsible for the health, safety, and wellbeing in a building under the law is clear and has not changed due to the recent COVID-19 pandemic. The following statements are set out by the Health and Safety Executive and UK Health Security Agency.

- All workers have a right to work in places where risks to their health and safety are properly controlled.
- The law says employers must make sure there's an adequate supply of fresh air (ventilation) in enclosed areas of the workplace. **This has not changed during the pandemic.**
- **Let fresh air in if you meet indoors.** Meeting outdoors is safer
- Control measures such as avoiding certain activities or gatherings, restricting, or reducing the duration of activities, providing ventilation breaks during or between room usage should be considered alongside ventilation for reducing the risk of airborne transmission.

It was noted that no fresh air ventilation or mechanical air handling was provided to the room other than the ability to open the external windows. These windows open into the car park and were not open at the time of Lightico's visit.

The lighting in the office is via 4 LED 600 x 600 flat luminaire and seemed adequate, although no lux readings were taken. The room appeared well lit with plenty of natural light.

Prior to the sampling period the office was in use for a meeting with 2 occupants and the door closed.

No mechanical air handling, windows were closed at time of visit

Background airborne bacteria – Total Viable Count (TVC) Sampling Results:

1. GENERAL INFORMATION

1.1 Test Laboratory

Lightico Ltd
Y Tyddyn Teg Heol Y Nant,
Llannon, Llanelli,
Wales, SA14 6AE

Telephone: 0113 4607102

Client
St Gemma's Hospice
C/O Edmundson Electrical - Leicester
22 Euston Street,
Freemans Common
Leicester
Leicestershire,
LE2 7ST

Telephone: 1006 2557441

1.2 Test Schedule

	Before CleanLight Installation	After CleanLight Installation
Sample Collection	8th April 2022	29th April 2022
Incubation of plates	8th – 12th April 2022	29th April – 3rd May 2022
Plate reading (colony counting)	13th April 2022	4th May 2022

2. MATERIALS AND METHODS

2.1 Culture media and other consumables

The following commercial culture medium was used:

Tryptone Soya Agar (LabM; LAB011) – TSA

TSA plates were prepared in accordance with the manufacturer's instructions and the DWS Media Preparation Manual.

2.2 Sampling procedures (settle plates)

2.2.1 Prepared 100 mm plates of sterile TSA were supplied by Darwin Biological to Lightico.

2.2.2 Lightico's representatives were responsible for the exposure of agar plates to monitor airborne bacteria.

2.2.3 All samples were collected in the putting on nurses office at the St Gemma's Hospice in Leeds

2.2.4 In each area selected for sampling, corresponding settle plate samples were collected as follows:

Before installation - 8 April 2022
After installation – 29th April 2022

2.2.5 In each area, airborne bacteria were collected using TSA settle plates: lids were removed, and the agar surface was exposed for 60 minutes.

2.2.6 Following sampling, plates were returned to the Test Laboratory on 8 April 2022 and 29th April 2022

2.2.7 Incubation and evaluation of agar plates

2.3.1 At the Test Laboratory, all returned TSA plates were placed in an incubator at 30°C ±1°C for 72 hours.

2.3.2 After incubation, bacterial colonies on each TSA plate were photographed and enumerated.

3. RESULTS AND DISCUSSION

3.1 Sample descriptions provided by Lightico, and the corresponding colony counts on each agar plate are presented in Table 1.

3.2 Photographs of the agar plates are presented in appendix A

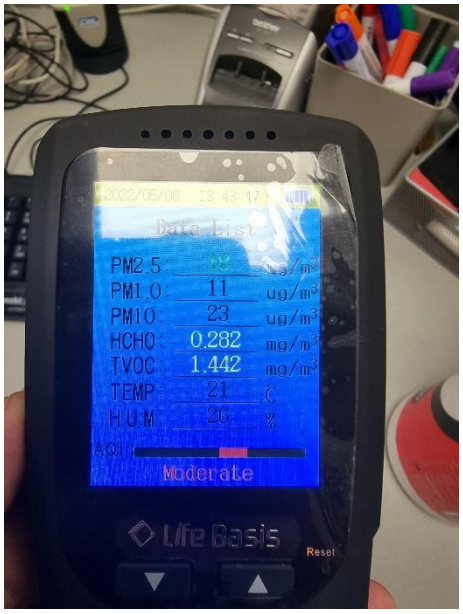
Table 1 Bacterial colony counts on settle plates at each location

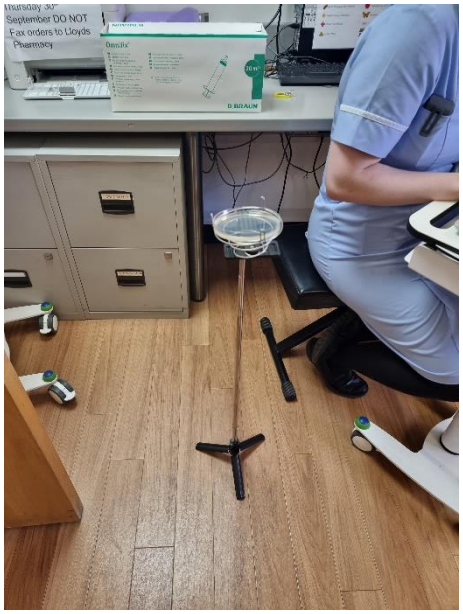
Plate location	Bacterial colony count (per plate) - TVC		
	Before Cleanlight	After CleanLight	% Diff
Office Position 1	30	11	-63%
Office Position 2	32	22	-31%
Office Position 3	33	15	-55%
Total	95	48	-49%

Table 2 CO2 levels recorded

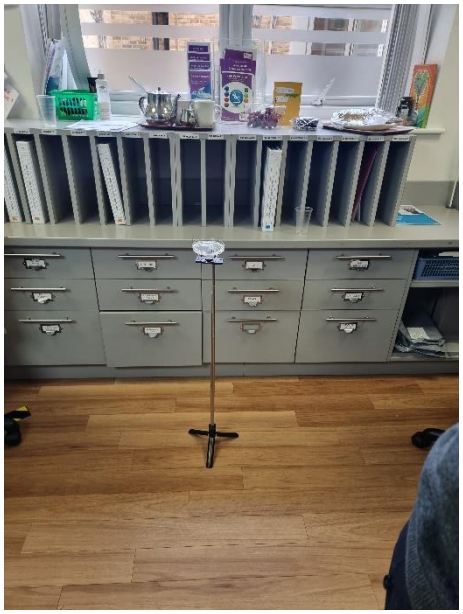
Time	Fixed CO2 Monitor	
	Before CleanLight	After CleanLight
Start	940ppm	870ppm
15 mins	677ppm	699ppm
30 mins	659ppm	587ppm
45 mins	565ppm	582ppm
60 mins	601ppm	679ppm

Reading 3 – Air Quality Index – **Moderate** (taken at the end of the 1-hour testing period)

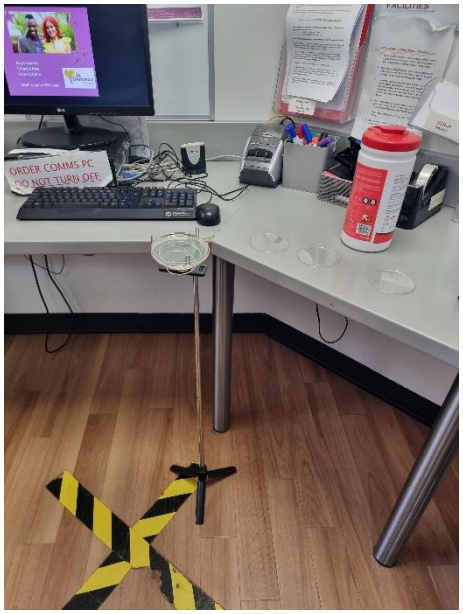




Office Position – 1

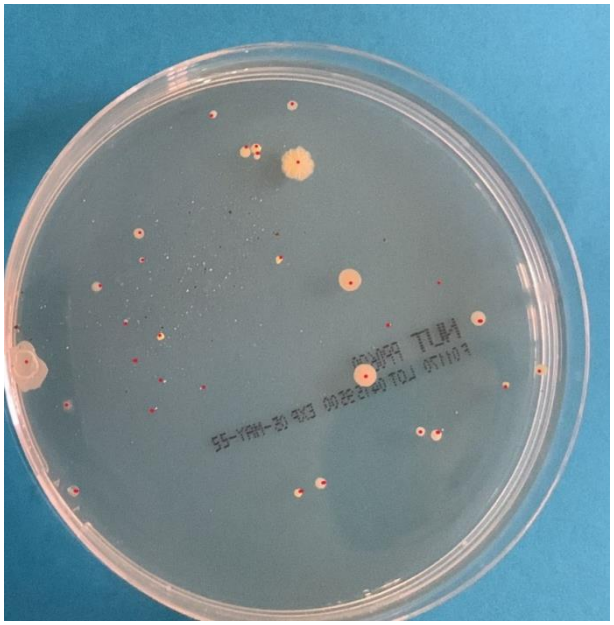


Office Position – 2

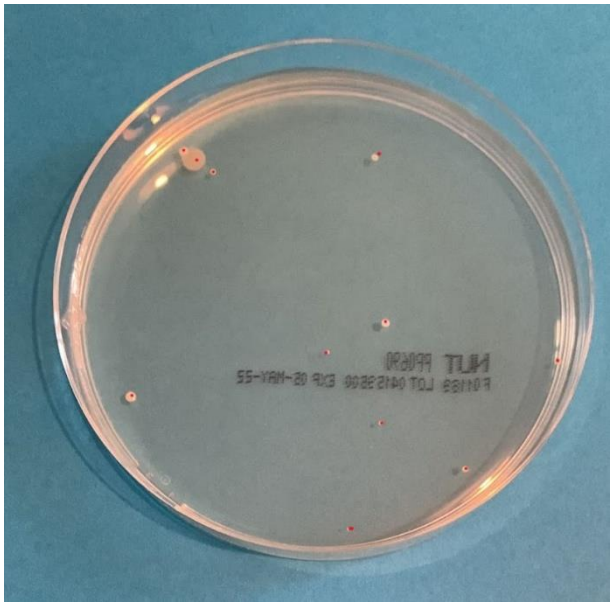


Office Position – 3

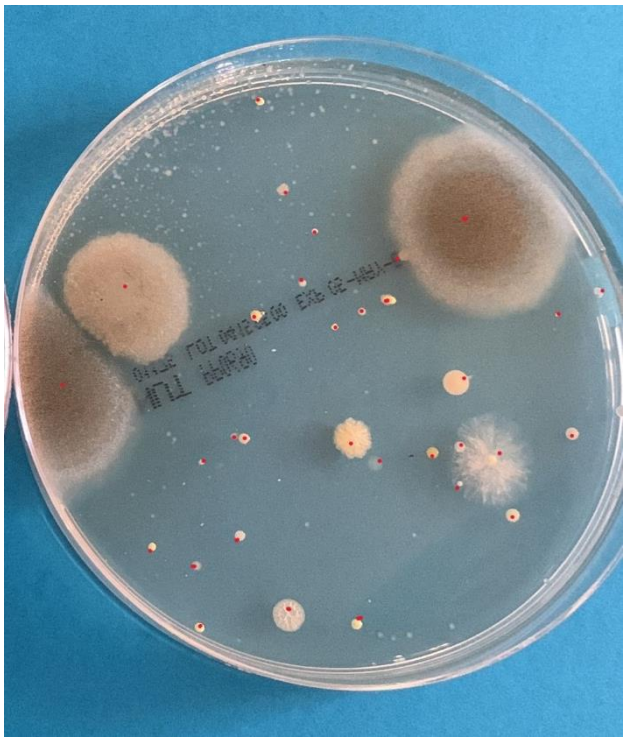
Appendix A - Photographs of the agar plates



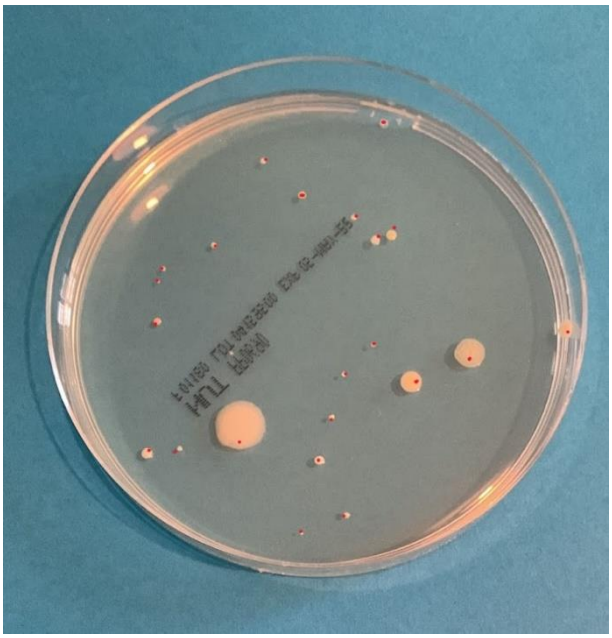
Office Position – 1 – BEFORE (30 TVC)



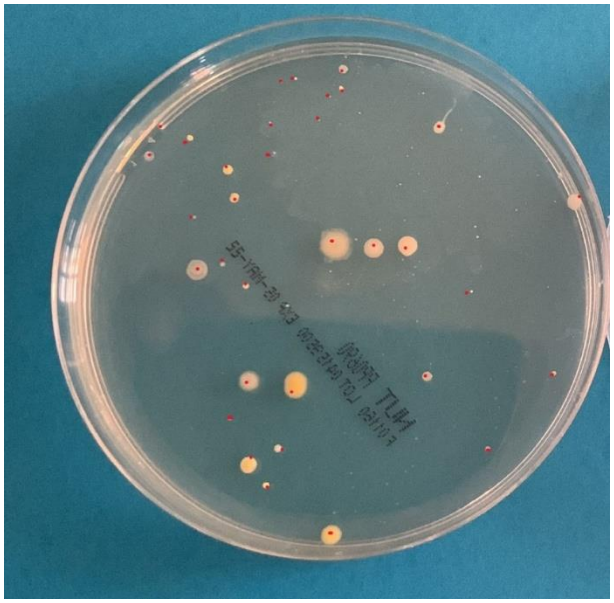
AFTER (11 TVC)



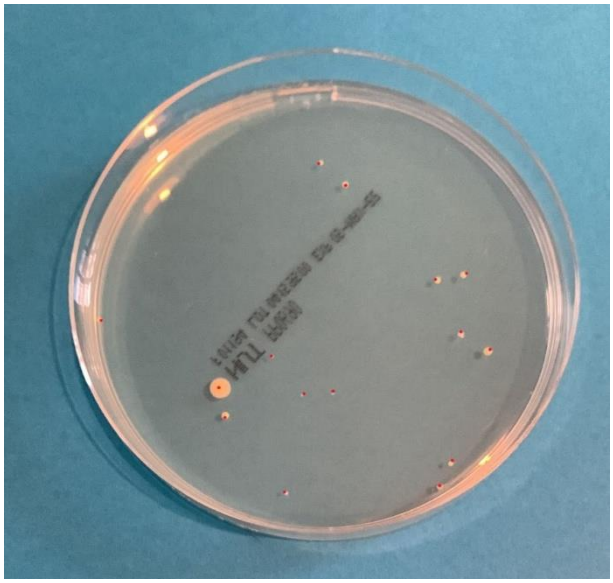
Office Position – 2– BEFORE (32 TVC)



AFTER (22 TVC)



Office Position – 3 – BEFORE (33 TVC)



AFTER (15 TVC)

Summary & Conclusions:

From our audit of the area and samples taken, the following conclusions may be drawn:

1. With the door closed and occupied by 2 people the levels of CO2 recorded in the office indicates poor ventilation in the space.
2. Keeping the door open allows for CO2 that has built up during the time to door was shut to dissipate and the CO2 concentration to return to safe indication levels.
3. Both tests were conducted following a meeting with 2 members of staff and the door closed. The levels of CO2 recorded post installation were lower than recorded prior to installation and the time it took for CO2 levels to return to a safe level was shorter.
4. The levels of bacteria collected during the test does indicate that full air changes are not being delivered within an hour. CIBSE (Charted Institution of Building Services Engineers) recommends between 5 and 15 air changes per hour in occupied spaces. Replacing the 4 existing panels with CleanLight would deliver the equivalent of 10 ACH.
5. Following installation, the lights were dimmed to approximately 70% due to natural light. The TVC counts were aggregated to provide an overall air quality level (given the size of the room). With the lights dimmed the level of bacteria collected was half that found in the same room during the previous test.
6. Using the open door to provide ventilation only disperses the air from inside the office to the corridor and wider ward area, without fresh air changes any pathogen (such as COVID-19) is simply moved to other parts of the building.
7. Users of the space were wearing masks throughout their time in the room which would reduce the level of airborne bacteria captured during testing. Reports indicate this would equate to an average reduction of 75% for surgical masks. Without proper addressing the lack of ventilation masks should not be removed, even with the door open.
8. The data recorded following the installation of CleanLight panels indicates a significant improvement of air quality.

Recommended CleanLight Installation:

There are currently 4 600 x 600 LED panels in place in the office which is 14.4m^2, replacing these with CleanLight panels would provide the following

1. Sufficient CleanLight coverage based on 7.5m^2 effective area from each panel
2. Minimum light levels of 644 lx which is well within CIBSE guidelines for the space and use type
3. The equivalent ACH (air changes per hour) of 9.99, again more than the minimum CIBSE guidance of 5 ACH.