AiroCide®

A NASA DEVELOPED TECHNOLOGY

Confidential

Air Quality Test Report

Test Authorized By: Managing Director- RAK Hospital, Ras Al Khaimah.
Test Location: RAK Hospital
Country: Ras Al Khaimah, United Arab Emirates (UAE)
Test Area: Operating Theater(s), ICU, CSSD, Emergency Area, OPD
Test Dates: November 18th-21st, 2009

Contents

RAK Hospital

Ras Al Khaimah – UAE
Date: 18th-21st November 2009

AiroCide® Photocatalytic Air Purification Technology

Report includes the CFUs/m3 findings for both bacteria and fungi from air sampling pre and post AiroCide use in various areas as identified and approved by the hospital management team.

***Confidential Research* prepared at the request of Dr. Marc Gauer Head of RAK Hospital.**

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Air Testing Protocol & Procedures

The following procedures are strictly followed when initiating and/or performing any and all air testing of AiroCide®

1 Project Initiation

Plates can only be shipped to an out of town location if it is certain they will be placed in a refrigerated environment upon receipt.

Plates must be stored in a refrigerator or in a thermal container with an ice pack prior to testing and following testing. Alternately, after sealing the exposed plates, store them in a refrigerated environment until they are ready to ship.

Before shipping, ensure the completed COC (chain of custody document) and all of the properly identified plates are in the insulated box.

Ensure that the cold packs that will be sent with the exposed plates.

If multi-day tests are conducted, it is best to send all of the plates on the last day of the test by FedEx in an insulated container containing an adequate number of frozen cold packs to ensure proper temperature during shipping.

Plates must be shipped **only** Monday through Thursday, as there is no weekend delivery possible. Arrangements for the proper cold storage of the plates over the Friday-Sunday time period must be made for the Monday FedEx pick up.

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2.1 Single Stage Air Sampler

The Aerotech 6® is a single stage microbial bioaerosol impaction sampler designed to test for viable fungi and bacteria. It is comparable to the Anderson N6 sampler. The Aerotech 6® is constructed of aircraft-grade aluminum. It is held together by 3 spring clamps and sealed with 2 o-ring gaskets. The unit consists of an inlet-cone, a jet classification stage and base plate. The impactor stage contains 400 precision-cut holes. When air is drawn through the sampler, multiple jets of air direct airborne particles toward the surface of the agar collection media. The Aerotech 6® meets NIOSH method 0800 and 0801 specifications. *This equipment meets IESO standards for sampling.

2.2 Sample Media. The following media in a 15 x 100 mm plastic Petri-dish are used with the Aerotech 6®. (Important: Glass Petri dishes will not fit inside the Aerotech 6® air sampler.

Bacteria: Tryptic Soy Agar with 5% Sheep Blood, Incubated at 25^{o} C

Fungi: Potato Dextrose Agar (PDA), Incubated at 28^{o} C

3.0 Preliminary Data

(Record and verify the following BEFORE any air sampling is conducted, and for every repetition of procedures.) Note ï this part of the protocol directs you to make enough notes about the environment that you have information to discuss unexpected variations in the sample results.

3.1 Describe the room and the roomôs contents. Record the temperature, the general appearance, the size and the type of HVAC System Filtering System that is being used in this room, to include:

3.1.1 Any Type of filter (HEPA or other) that is in use

3.1.2 Filtration percentage (%) of HEPA or MERV if available

3.1.3 Filter change schedule if known

3.2 If available: note the number of air turns the HVAC system makes per hour in the chosen test site.

3.3 Does the test site have its own separate HVAC system? If not what other zones, if any, does it share air with?

3.4 Verify the maintenance schedule of both the HVAC filter element change if one exists and the room-cleaning schedule to insure that the air sampling will be conducted in the timeline of what can be established as the **"steady state"** of the room.

3.5 Verify that there has been NO construction within the last 30 days, and there will be NO new construction during the air sampling time period.

3.6 Make sure that there has been no water damage or structural damage to the facility

3.7 Make sure that the sampling media (Petri dishes) have come to room temperature before air sampling begins.

3.8 The agar plates should not be exposed to freezing cold temperature or extreme heat above 85^{o} F

3.9 **Important -** It is extremely important that the number of staff in the room be noted as well as the frequency of entry and departure from the room. If any ñewòequipment is brought into the room this also should be noted.

4.0 Sampling Locations

Sampling should be taken in the selected locations in the range of 36ò and 72ò above the floor. The tripod should **NOT** be readjusted during air sampling. The air sampler should always face in an upward direction for **ALL** air samples.

5.0 Sampling Methods

5.1 Sanitation. The air samplerôs bottom fixed aluminum plate; middle section (top and bottom) and top cap should be lightly swabbed with alcohol to sanitize between air samples.

Important: Excess alcohol left within or on the metal surfaces will potentially KILL bacteria or fungi that have been collected on the agarôs surface thereby negatively affecting the air-sampling test. Be certain alcohol has **completely** evaporated before sampling.

5.2 Air Sampler Operation

5.2.1 Clean hands with a hands with an alcohol swap (and at any point where cross contamination is possible.) or wear throwaway gloves.

5.2.2 Connect the flexible tubing from the pump to the male connector on the sampler. Turn in the pump and verify that the flow rate is at 28.3 l/min.

5.2.3 Allow enough time for all of the alcohol to evaporate from the metal surfaces before sampling. You also can look at the metal surfaces and see if there are any alcohol-wet spots. In high humidity environments it may take 2 to 4 minutes for the surface to dry.

5.2.4 With the sampler sanitized and the inlet cone and jet classification stage removed, place an agar plate with its lid removed on the base of the sampler so the plate rests on the three raised metal pins. Immediately cover the plate with the jet classification stage and the inlet cone. Secure the device with the three spring clamps and visually check to be sure of a good seal.

Note: Take sampling media out of refrigerator (do not freeze) and let rise to room temperature before air sampling begins.

5.2.5 Using a stop watch turn on the vacuum pump for **exactly 3 minutes**. Air is drawn through the cone at 28 l/m and passes into the jet classification stage where it is accelerated and passes through small openings and is then impacted onto the agar plate. The exhaust air is then carried through the outlet on the base and into the vacuum hose attached to the pump.

5.2.6 After sampling, unhook the three clamps and remove the agar plate. Quickly replace the agar plate cover and label the back of the plate with the appropriate

sample identification information. Seal the plate with standard laboratory wax or wide Teflon tape and place in a zip lock bag inside an ice chest with blue ice*.

*There is no need to further refrigerate the plates if they will be delivered within 24 hours to the appropriate laboratory that will be conducting the analysis.

5.2.7 Before taking another sample, be sure that your hands and the sampling device have again been sanitized.

Note: There should be hundreds of small ñdimples,ò or indents, the sampling media from the impact of the air. If there are no indents, this means that the air sampler was not sealed properly. The plate without the indents should be discarded and the procedure repeated with a new agar plate.

5.2.8 When transporting or storing sampling media plates, keep the media side up so excess moisture does not adversely affect the integrity of the media or the test.

5.3 Sampling Intervals

Because different areas of the test site will be sampled there is no reason to have a time delay between air-sampling specimens. In fact, since what we are testing how the AiroCide® system(s) assists and/or aids the existing HVAC systems filtering system in removing CFUs, it is important to conduct the air sampling in different areas of the test site as quickly as is reasonable.

5.4 Labeling Samples

All sample petri dishes must be labeled with a number corresponding to its location in the test site per your COC time/location/data sheet, use a wax pencil. (See Attachment A.)

6.0 Sampling Procedures

The Test Protocol should be conducted as follows:

6.1 Baseline

Samples are taken at a test site on one (1) day with NO AiroCide® units operating. If you are testing an Operating Room (OR) the **base line** is the time just before the operation, begins meaning before the equipment, staff, doctor and patient arrive (an empty room).

6.2 Active Samples – AiroCide ON

Samples are taken at a test site on consecutive days while AiroCide® unit(s) have been OPERATING. If an (OR) after the equipment, staff, doctor and patient arrive and during the **"prep"** time which will vary. You should take several samples at the same locations as you took at the base line. Suggested areas of air sampling are the head, foot and each side of the patient

Purpose of the Study

Evaluate and quantify the affect of the installation of AiroCide devices in the Operating Theater (#5), ICU, CSSD, Emergency Area & OPD (Waiting Area) sections of the RAK hospital. The study counted the microbial baseline levels for both bacteria and fungi/mold.

The expected performance outcome was a significant reduction of microorganisms responsible for the airborne transmitted Nosocomial diseases.

Therefore, AiroCideôs objective value for the RAK Hospital system is to minimize the risk of nosocomial infections achieving 4 primary outcomes.

- Improve the healthcare services provided by the hospital.
- Reduce the morbidity and mortality due to this cause.
- Enhance ôbest practicesôfor infection control.
- Cut down the healthcare costs generated by such diseases.

The Technology

AiroCide is a unique airborne pathogen killing technology that was funded, developed and used by NASA. It uses a patented combination of ultraviolet light and a proprietary titanium based photo catalyst that is capable of killing a wide range of airborne pathogens including bacteria, viruses, and molds, and is adept at promoting the breakdown of volatile organic compounds (VOCôs). This study expands upon earlier documented proof that this technology has a direct application in all medical healthcare environments as it addresses the elimination of airborne infectious disease and improves overall patient care.

Testing Background and Expectations

In hospitals, it is important to keep in mind that there is a high population of immune-compromised patients. These infection susceptible patients include AIDS patients, geriatrics, neonatal patients, recent surgery patients (especially organ transplant recipients), Tuberculoses patients, chemotherapy and radiation therapy patients, cystic fibrosis and diabetics and the chronically ill and others whose immune system is suppressed or under stress. For these individuals, even low levels of pathogenic spores can be potentially fatal.

Therefore, air sampling tests were taken for both bacteria and mold/fungi in the TB Ward to prove the efficacy of the AiroCide system in removing airborne bacteria and fungi colony forming units (CFUôs).

Despite sound cleaning practices witnessed within the TB WARD including surface disinfecting, entry precautions, including clothing coverage and

gloves, and continual surveillance for cross contamination relatively high baseline levels were measured. Our initial speculation for likely sources for ongoing generation of contamination would be air communication from the outer entry hallway and the cycling of the dedicated HVAC air handling system which may introduce bio burden.

It is important to keep in mind that any environment is continually faced with pathogen spikes occurring at irregular intervals as new contamination is introduced. Meaning, at any singular point in time, the graphical analysis of the environment could show a higher or similar level of contamination than that of a sample taken just a few minutes prior. For example, what happens to a room when a medical staff of two (2) are present versus the same room when seven (7) are present? Clearly, the opportunity for increased contamination exists when more people enter a room - which could result - in an upward or similar contaminate reading even though the AiroCide unit had been working. For clarification, the point here is not to focus on any singular sample ï good or bad ï but rather particular attention should be focused on the longer-term trend.

Note: Baseline samples revealed a great variety of both bacteria and fungi. Please, refer to the laboratory testing reports in the Appendix for details of bacteria and fungi/mold identification. Each plate analysis included total CFU/m3 level. Specific Colony counts for the top 5 microorganisms were cultured.

HAI – Background, Transmission & Annihilation with AiroCide

Background
Hospital-acquired infections (HAIs), also known as health-careï associated infections, encompass almost all clinically evident infections that do not originate from a patient's original admitting diagnosis. Within hours after admission, a patient's flora begins to acquire characteristics of the surrounding bacterial pool. Most infections that become clinically evident after 48 hours of hospitalization are considered hospital-acquired. Infections that occur after the patient's discharge from the hospital can be considered to have a nosocomial origin if the organisms were acquired during the hospital stay.

Pathophysiology
Within hours of admission, colonies of hospital strains of bacteria develop in the patient's skin, respiratory tract, and genitourinary tract. Risks factors for the invasion of colonizing pathogens can be categorized into 3 areas: iatrogenic, organizational, and patient-related.

- Iatrogenic risk factors include pathogens on the hands of medical personnel, invasive procedures (eg, intubation and extended ventilation, indwelling vascular lines, urine catheterization), and antibiotic use and prophylaxis.
- Organizational risk factors include contaminated air-conditioning systems, contaminated water systems, and staffing and physical layout of the facility (eg, nurse-to-patient ratio, open beds close together).
- Patient risk factors include the severity of illness, underlying immunocompromised state, and length of stay.

Frequency United States
The National Nosocomial Infections Surveillance (NNIS) System of the Centers for Disease Control and Prevention (CDC) performed a survey from October 1986 to April 1998.[1] They ranked hospital wards according to their association with central-line bloodstream infections. The highest rates of infection occurred in the burn ICU, the neonatal ICU, and the pediatric ICU.

Nosocomial infections are estimated to occur in 5% of all acute-care hospitalizations; the incidence rate is 5 infections per 1,000 patient-days. Based on the 35 million patients admitted to 7,000 acute-care institutions in the United States, the incidence of HAIs is more than 2 million cases per year. HAIs result in an additional 26,250 deaths (range 17,500-70,000) and an added expenditure in excess of $4.5 billion.

International
The impact of HAIs on the health care systems of developed countries is significant and is proportionate to that of the United States.

Mortality/Morbidity
Nosocomial infections are estimated to more than double the mortality and morbidity risks of any admitted patient and probably result in as many as 70,000 deaths per year in the United States. This is the equivalent of 350,000 years of life lost in the United States.

Causes

- Among 6,290 pediatric ICU patients surveyed in the last decade, the incidence of Nosocomial invasive bacterial and fungal infections were as follows:[3]
    - Bloodstream infections - 28%
    - Ventilator-associated pneumonia - 21%
    - Urinary tract infection (UTI) - 15%
    - Lower respiratory infection - 12%
    - Gastrointestinal, skin, soft tissue, and cardiovascular infections - 10%
    - Surgical-site infections - 7%
    - Ear, nose, and throat infections - 7%
- Nosocomial etiologies in bloodstream infections
    - Coagulase-negative staphylococci - 40%
    - Enterococci - 11.2%
    - Fungi - 9.65%
    - *Staphylococcus aureus* - 9.3%
    - *Enterobacter* species - 6.2%
    - Pseudomonads - 4.9%
    - *Acinetobacter baumannii* with substantial antimicrobial resistance - Reported with increasing frequency
- Nosocomial etiologies in UTI
    - Gram-negative enterics - 50%
    - Fungi - 25%
    - Enterococci - 10%
- Nosocomial etiologies in surgical-site infections
    - *S aureus* - 20%
    - Pseudomonads - 16%
    - Coagulase-negative staphylococci - 15%
    - Enterococci, fungi, *Enterobacter* species, and *Escherichia coli* - Less than 10% each
- Nosocomial etiologies in fever
    - Viral infections are most common causes of nosocomial fevers.
    - Phlebitis is the second most common cause of nosocomial fevers in the hospitalized child.
    - *Clostridium difficile colitis* is also a cause of Nosocomial fevers.

Since 14+ years AiroCide is clinically proven to kill/annihilate all type of airborne bacteria, yeast, mold & fungi by pulling the infected air through its reaction chamber and ensuring a collision with the hydroxyl radicals using the photo catalysis methodology;

Photo catalysis - A catalyst is a substance that accelerates or enhances a chemical reaction, or in AiroCide's case, a photoreaction. Titanium dioxide (Ti02) when irradiated by UV energy produces a strong catalytic reaction. This reaction lowers the intensity field required for UV light to break organic covalent bonds. Hydroxyl radicals are produced as the UV strikes the titanium oxide coating. However with AiroCide the OH-radicals are surface bound in a molecular structure to the catalytic layer. These free electrons from the hydroxyl molecule (and super-oxide ions) are extremely potent oxidizing agents. Hydroxyl radicals are often referred to as "toxic oxygen". AiroCide uses this oxidizing potential to react with airborne organic compounds such as but not

limited to Mycobacterium tuberculosis, it breaks organic bonds and creates a chemical oxidative reaction which eliminates the unwanted compound and produces trace amounts of water vapor and carbon dioxide.

There are numerous reasons as to why this particular NASA born technology or AiroCide has a significant advantage over other PCO and/or so-called Titanium dioxide catalytic systems.

Nano Particle Solution
The patented technique further refined by learned art in practice creates a nano solution which isolates a molecule in solution or substrate whereby no particle migration takes place. This process creates separate and multiple molecules that can be surface bound to generate optimum reactivity by orienting molecules for maximum angle access. Unlike naturally occurring TiO2 molecules closely packed together and with poor PCO characteristics and poor bonding compatibility, the NASA sol nanoparticles in solution can be properly aligned in a random membrane lattice maximizing the interactive surfaces.

Permanent Bonding
The above solution then can be bonded to a substrate or in the case of AiroCideôs catalytic rings a borosilicate cylinder which will not delaminate and have an indefinite functional life. The coating process limits the size of the bond contact point which facilitates more molecular surface area for more reactive collisions with organic compounds. The surfaces have more area and pores for creating surface bound hydroxyl radicals which interact with contaminants. The result of this high reactivity is the ability to kill viruses, bacteria, mold/fungi and oxidize volatile organic compounds or VOCs.

Air Sampling Protocol

Sampling points were selected after observing the each room layout and flow of staff and patients. 2 key points were selected in each patient room. Throughout the study when each sample was taken activities were noted like general activity in proximity to test site, whether the room/bed was occupied by patient and whether both nursing and MD presence was unusual. Notes were taken on cleaning schedules, food servings, patient/relative visits, patient movement, and other events which may cause or create the bio-burden to fluctuate.

Anderson Sampling

The air samples were accomplished using an Anderson-Type sampler set at the same flow rate. In addition, the samples were taken from the same floor height and air was drawn through and into the agar media for the same time duration to guarantee a constant volume of air for each and every sample taken regardless of day, time or

media type. This was essential to be able to render comparisons from different conditions and days of AiroCide purification of the space.

Baselines were taken on day 1 after installation and before the units were powered on. Mold/fungi and bacteria plates were obtained, sealed, labeled packed at appropriate temperatures with cold packs. Units were then powered on and the samples repeated each day for 4 successive days at different times of day and in the same sequence for each of the testing points.

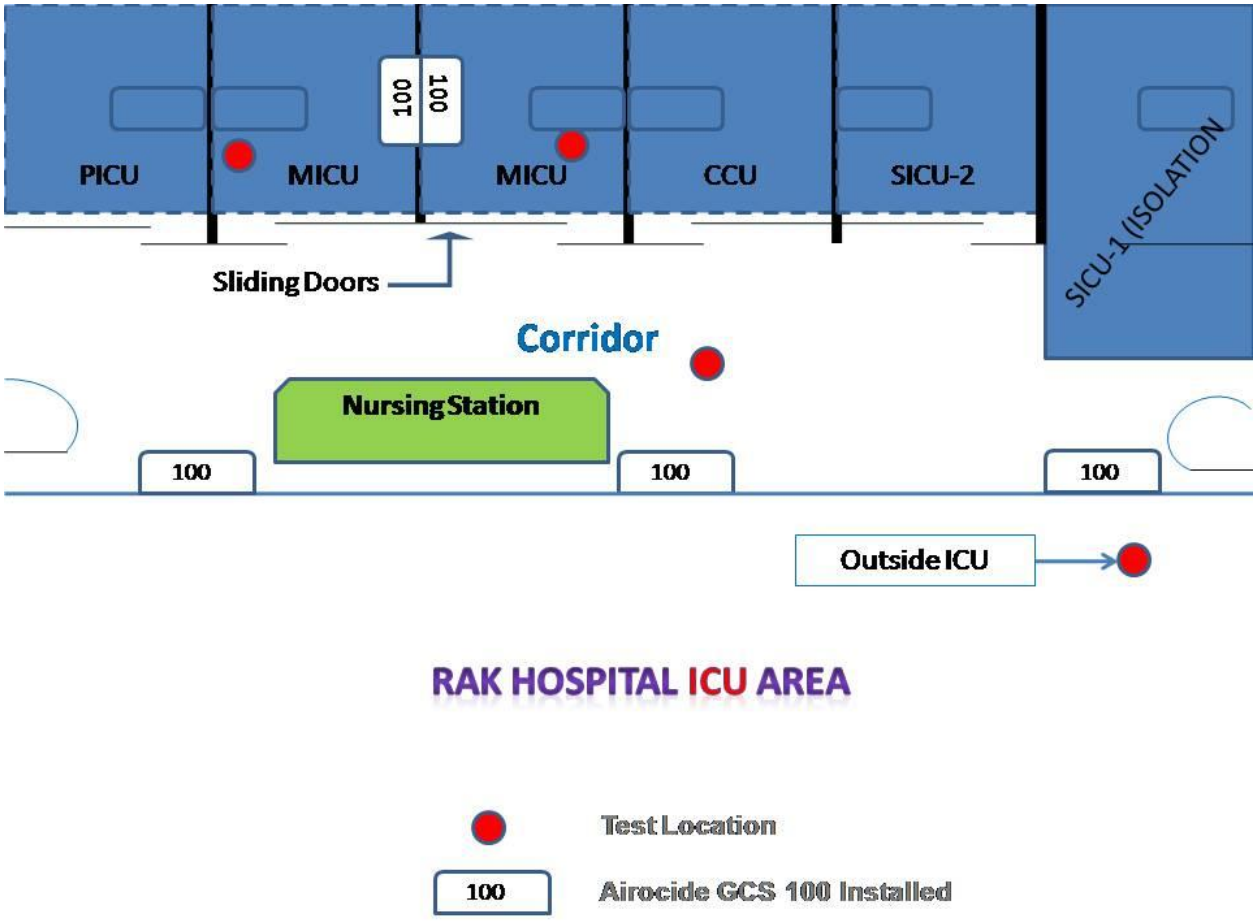
Each dayôs sampled plates were sent to a third party microbiology lab for preparation, incubation of contents and analysis. The reported results included a total CFU/m3 count as well as individual species count.

Following areas were chosen for the deployment of AiroCide Technology and thorough Air Quality samples were drawn as laid in the protocol for study.

- ✓ ICU (Two rooms & Nursing Stations)
- ✓ Operating Theater (#5)
- ✓ Emergency Areas
- ✓ Central Sterile Supply Department (CSSD)
- ✓ Out Patient Department (Waiting Area)

During the four (4) day regiment of testing, patient populations were relatively stable.

Intensive Care Unit (ICU)

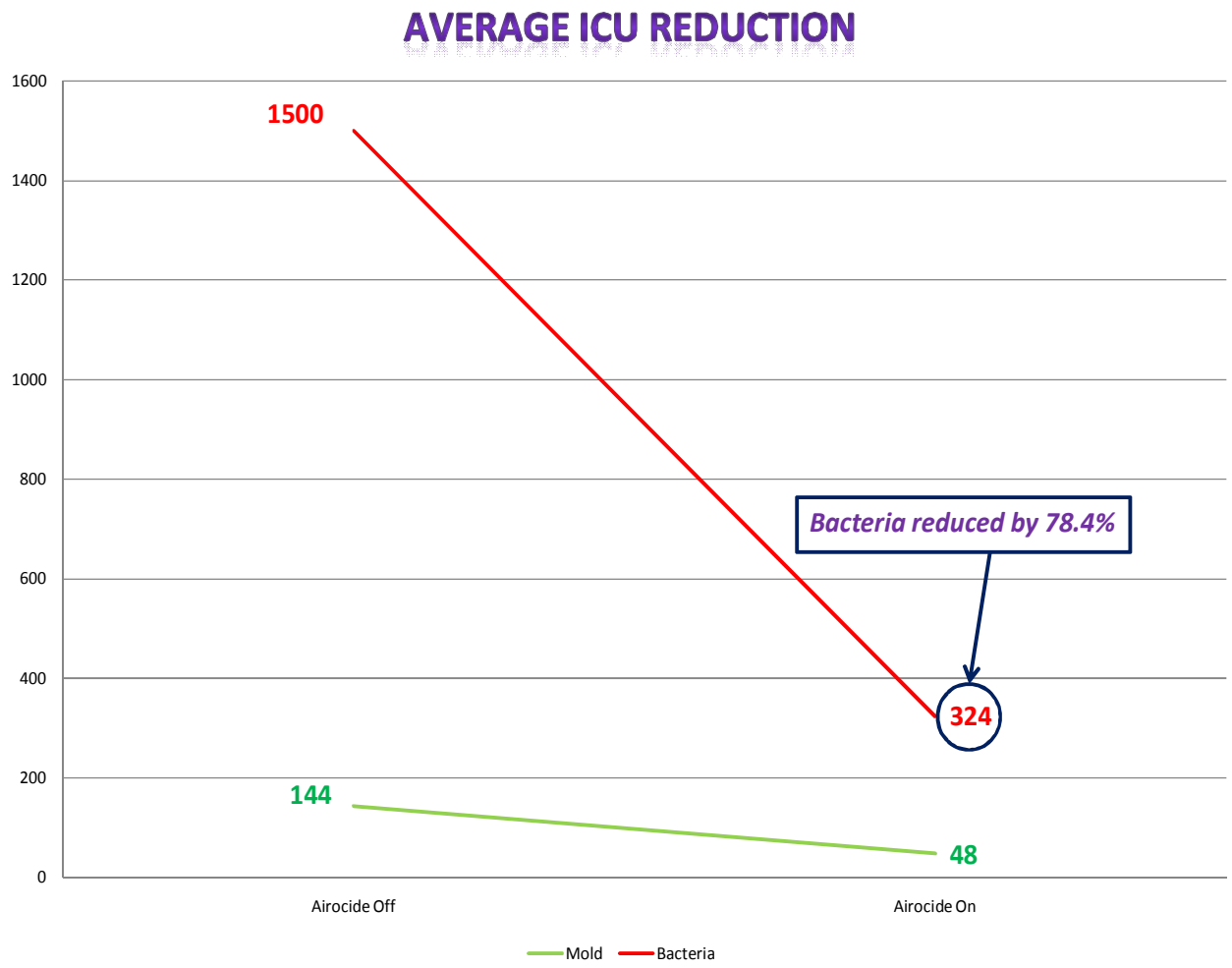


Red Dots indicate test locations and white blocks indicate AiroCide installation(s)

In the ICU the attending medical staff was typically comprised of 1 MD and 3 nurses. Day shift changes took place in the afternoons where three (3) to four (4) nurses replaced colleagues (minor overlap) and transferred patient status to the income nursing staff. Each morning at about 8-10am the MDs did rounds discussing each case and reviewing charts.
Cleaning practices for floor and equipment surfaces included disinfectants, like Surfanios and Anios respectively.

The entire ICU area had a dedicated air handling system which did not share common HVAC with outer areas or other units. Isolation room which was not occupied at the time of study and hence was excluded.

Two GCS 100 were installed in each patient room other rooms were excluded as they were unoccupied. In the nurseôs Station 3 GCS 100ôs were installed at equidistant.



In the study conducted in the ICU an average reduction of 78.4% was achieved in 72 hour period.

Operating Room

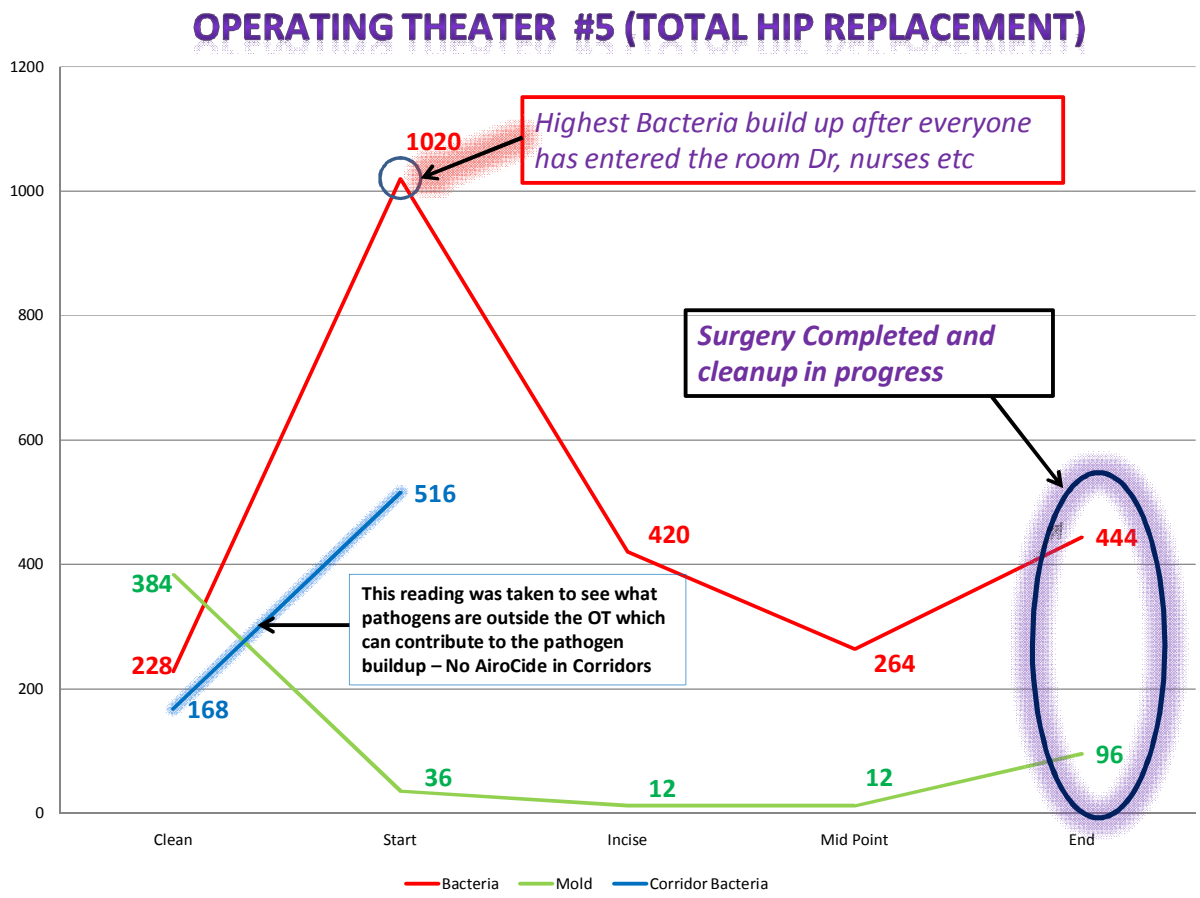
As shown in the figure above 4 GCS 100ŝ were installed on slanted ceiling panels above the operating table.

The HVAC system is shared between the 4 OTŝ with a dedicated HEPA filter (.03 Micron Filter) installed in each theater. Laminar flow was also present and operational during the procedures.

Notes: *Air samples were collected during ACL (Knee Reconstruction) and THR Surgeries, which lasted for 3 and 4 Hrs respectively. Air samples were collected from a single location inside the OT so as not to create any disturbance for the operating staff during the surgical procedure. During the surgery there were 10 people inside the OT (including 2 people from Airocide team), and the air samples were collected 10feet away from the OT table. The door of the OT was opened 3-4 times during the surgery to receive disposable items, instruments etc.*

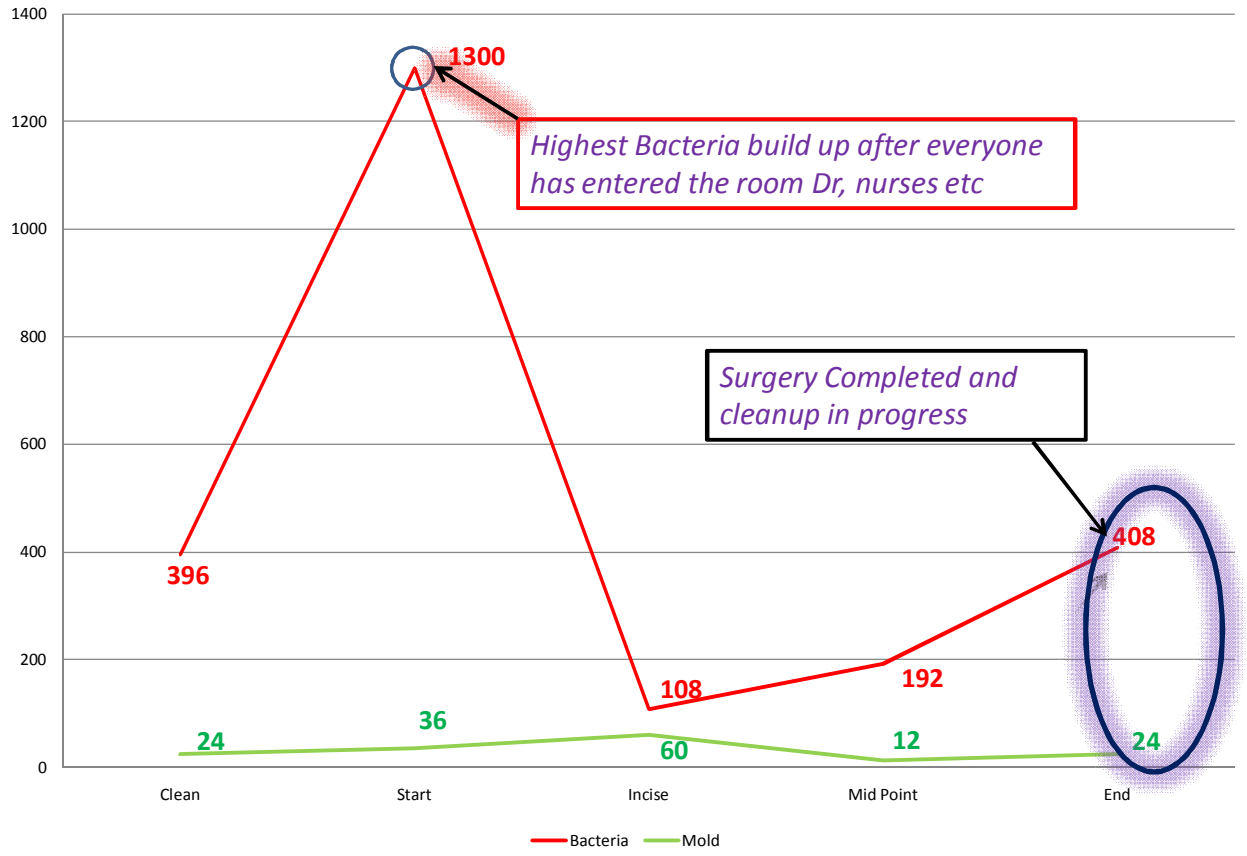
Prior to surgery Airocide Units were powered on and air samples were collected from just outside the entrance into the Operating theatre to enable a better understanding of the pathogen flow into the OT as the surgery gets underway. Air samples were collected in an empty theater prior to the arrival of the surgical team and the patient. Another reading was taken once the team and the patient we in the OT

(prior to incision) .Three more reading were taken ï one at incision, one at Midpoint of the surgery and another after surgery, during clean up. Total surgery time for hip replacement was 4 hours and ACL reconstruction was 3 hours.



Patient Detail: *Female patient, 72 Years old and cemented stem (Austin Moore Prosthesis) was implanted; it was hemi-arthoroplasty surgery.*

OPERATING THEATER (KNEE RECONSTRUCTION)



Patient Detail: *Male Patient, 28 yrs old, ACL was re-constructed.*

The results as expected were lowest when the theater was empty but there was a quick pathogen buildup once the medical staff arrived. As shown in the Graph above the pathogen ñspike ñconsisted of the following species as identified in both the cases:

- Acinetobacter Genospecies 3
- Brevundimonas Vesicularis
- Flavoacterium Mizutani
- Gram Positive Rod
- Kocuria Rosea
- Micrococcus Luteus
- Staphylococcus Hominis
- Acinetobacter Genospecies 13TU

Ancinetobacter Genospecies 13 TU had the highest count with over 1030 cfu/m^3
Micrococcus Luteus had the second highest count with over 900 cfu/m^3

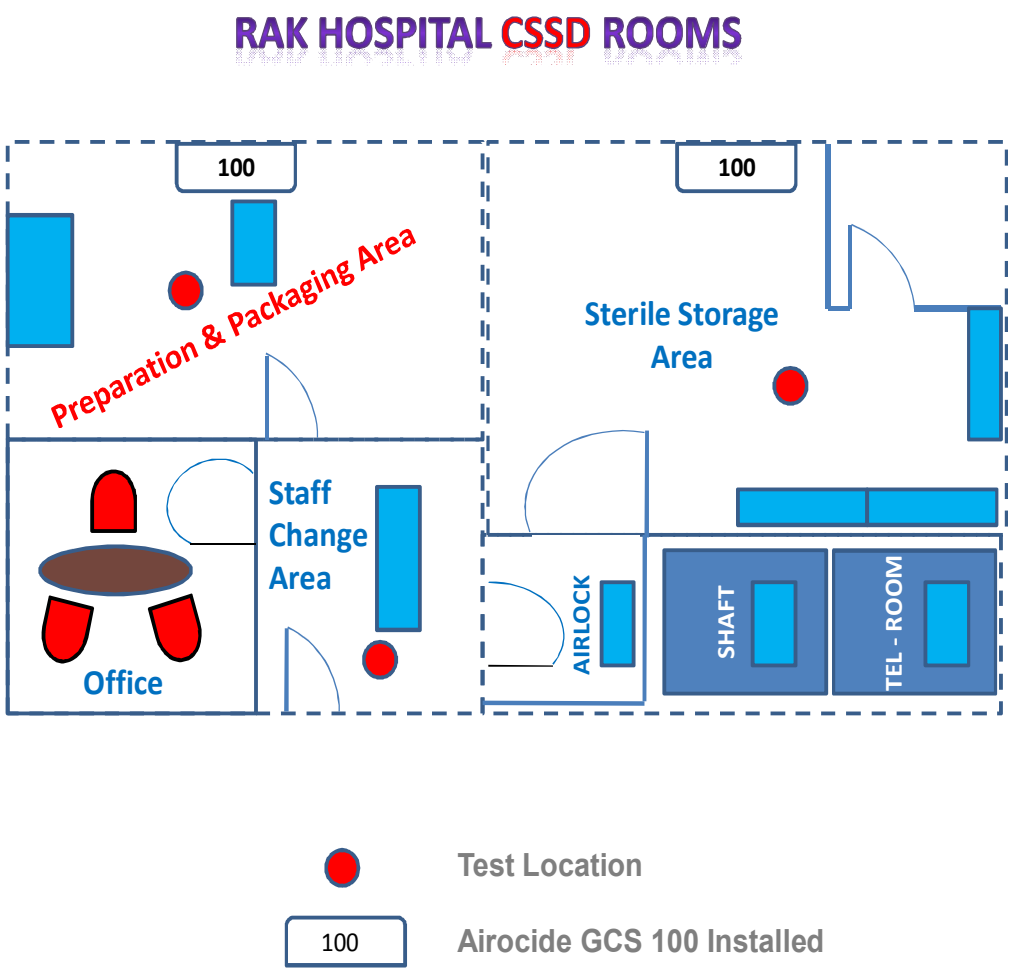
Ancinetobacter Genospecies 13TU – Ancinetobacter species are non-fermentative Gram-negative coccobacilli and they have emerged as important Nosocomial pathogens which are associated with the significant multidrug resistance in recent years.

Micrococcus Luteus is a Gram positive spherical, saprotrophic bacterium that belongs to the family Micrococcaceae.An obligate aerobe, M. Luteus is found in soil dust, water and air, and as part of the normal flora of the mammalian skin. The bacterium also colonizes the human mouth, mucosae, oropharynx and upper respiratory tract. Although M.luteus is non-pathogenic and usually regarded as a contaminant, it should be considered as an emerging Nosocomial pathogen inimmunocompromised patients. M.luteus is resistant to reduced water potential and can tolerate drying and high salt concentrations. M.luteus is coagulase negative,bacitracin susceptible, and forms bright yellow colonies on nutrient agar.To confirm it is not staphylococcus aureus, a bacitracin susceptibility test can be performed. M.luteus has been shown to survive in oligotrophic environments for extended period of time.

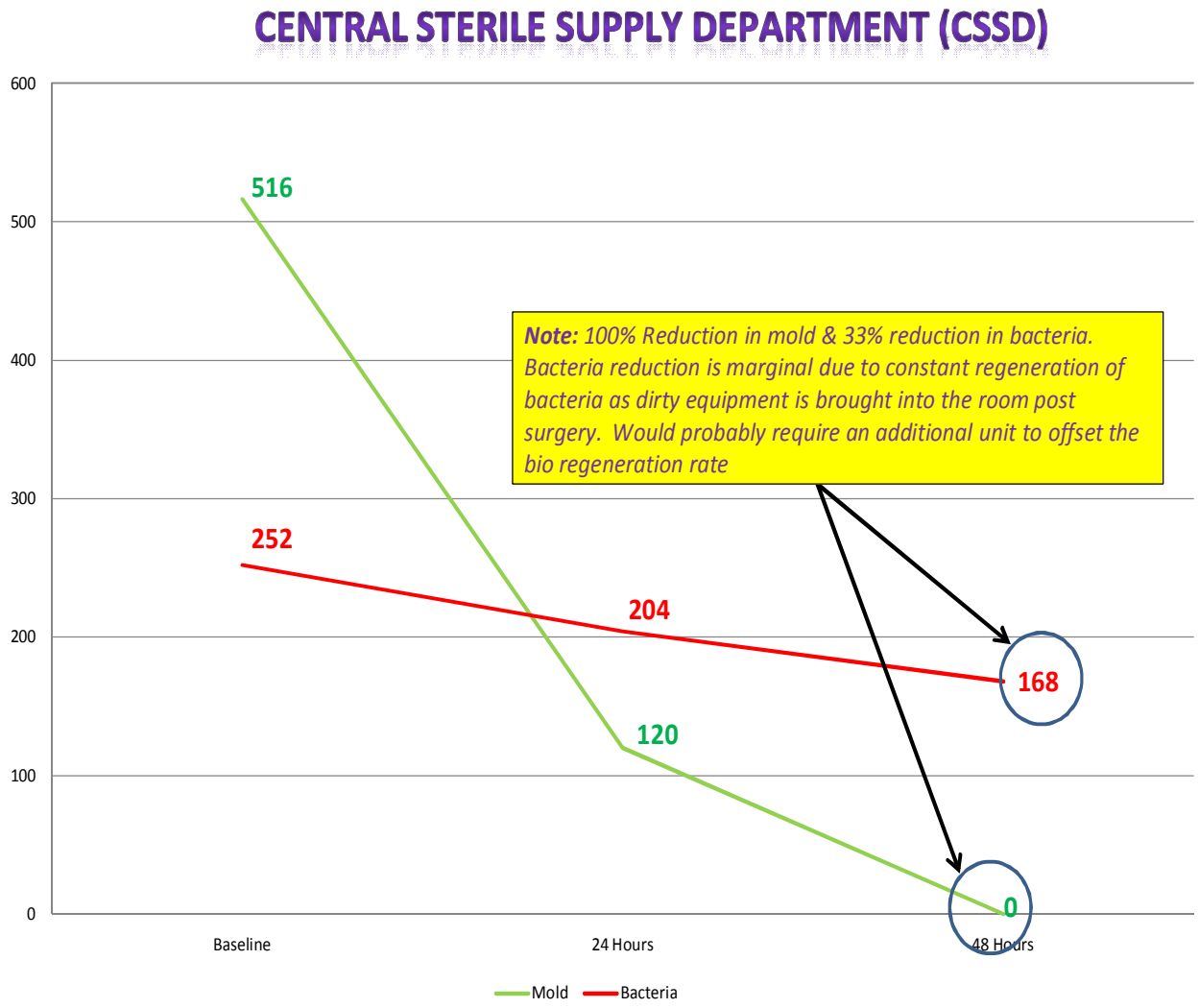
Once surgery was in progress AiroCide units working continuously bought the pathogen build up down by over 77% in a matter of 20minutes while maintaining acontinued reduction of well over 80% during the rest of the surgery; whereby reducing the risk of Nosocomial infection by 80% not to mention the safety factor being elevated for the care givers as well.

Once the surgery was completed and as the cleanup was in progress another reading was taken and as expected it showed an increasing pathogen count. This increase was a direct result of surface bound pathogens being pushed into the environment as the cleaning process was underway with moping, dusting, scrubbing of the floor, tables, equipments etc. As seen in both the resultant graph the spike patterns were extremely similar in each surgical case.

CSSD ROOM

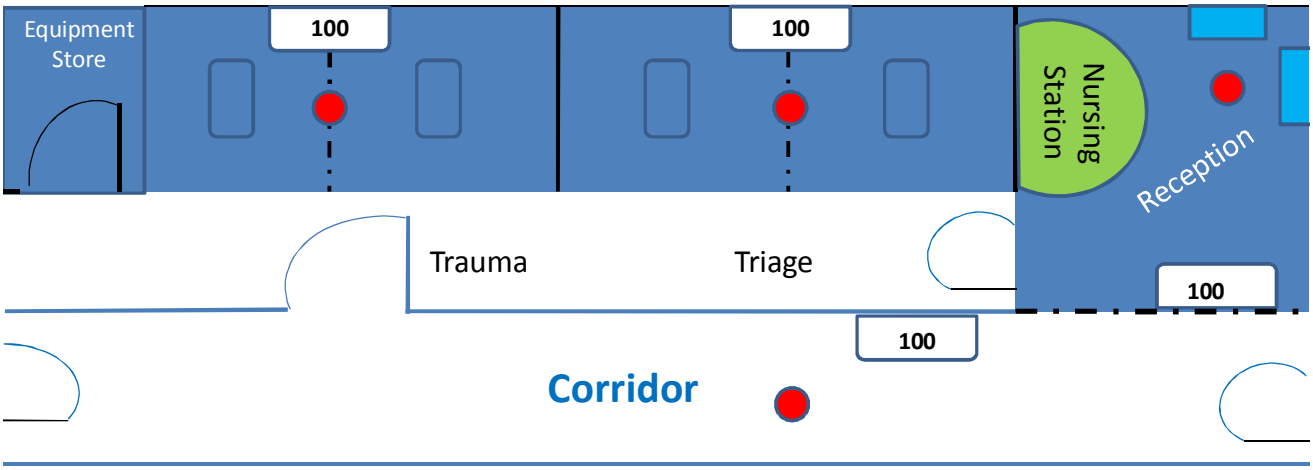


Notes: *2 people were present at the time of sample collection from the hospital, excluding the team from Airocide (3 people); CSSD was busy because of few Gynecology and Ortho cases posted for surgery the following day and sterilization of the instruments returned from the day's surgery, GCS100-2Nos were installed, one in the packing area and the other in the sterile area, they were installed on the side walls, air samples were collected from single location in each area. Sample collectors were asked to take all precautions to ensure that they do not increase the bio-burden in CSSD; strict sterile conditions were maintained throughout the testing procedures.*



Baselines were established in an empty CSSD room (no instrument disinfection was scheduled). However at the 24 hour reading, instrument cleaning was in progress contributing to a lesser reduction in the pathogen buildup. Although the mold/fungi reduction was almost at 100% the bacterial microbial load was not reduced as dramatically as expected. This was primarily caused by a faster build up of the bacterial bio burden than the AiroCide units were able to process. Adding an additional unit near the cleaning area would help significantly in minimizing bio burden reduction times.

EMERGENCY ROOM



RAK HOSPITAL EMERGENCY AREA

Test Location

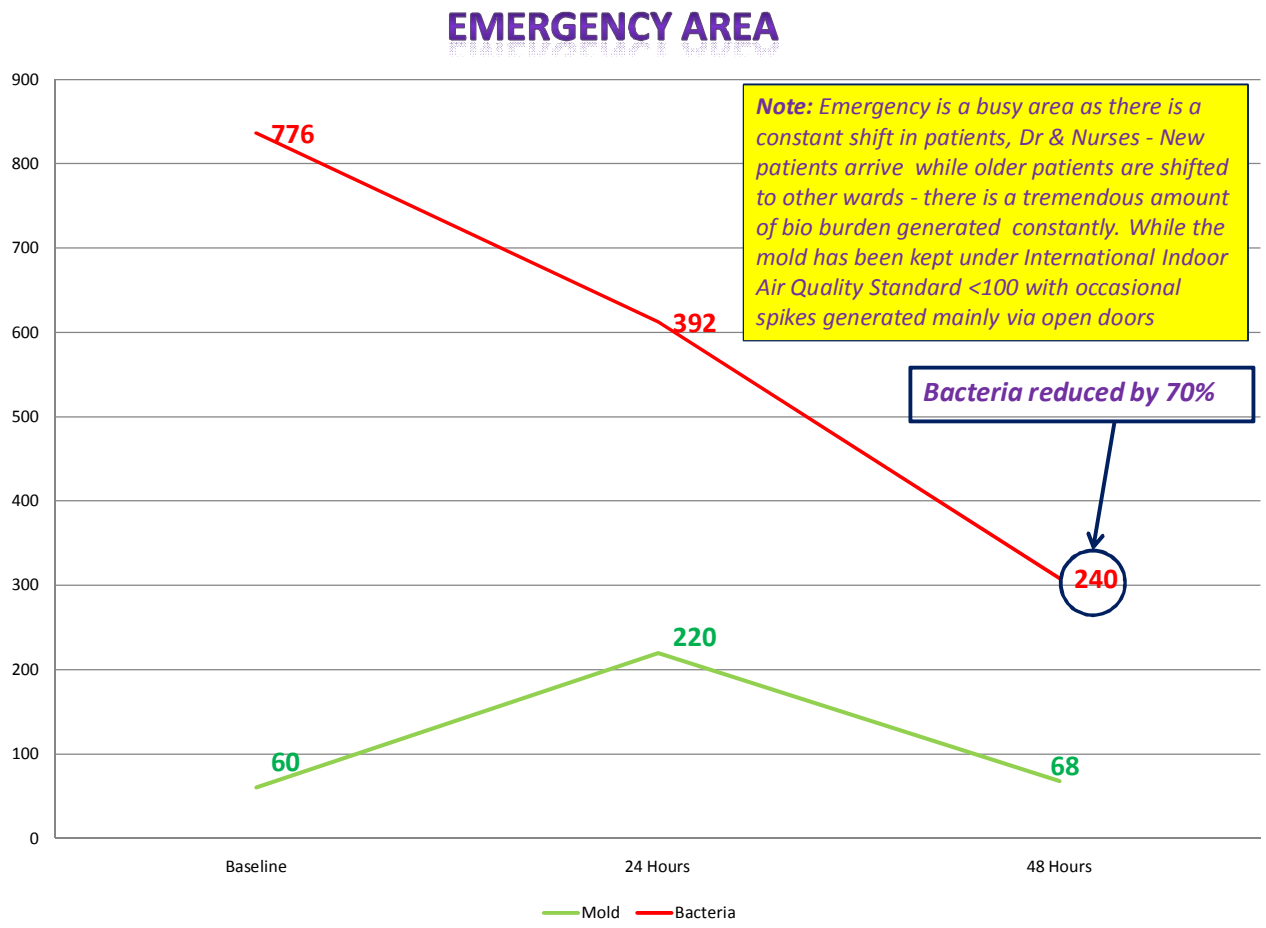
100 Airocide GCS 100 Installed

The **Emergency Department** (**ED**) at RAK Hospital is a medical treatment facility specializing in acute care of patients who present without prior appointment, either by their own means or by ambulance. Due to the unplanned nature of patient attendance, the department must provide initial treatment for a broad spectrum of illnesses and injuries, some of which may be life-threatening and require immediate attention. Emergency department is an important entry point for those without other means of access to medical care. The emergency department operates around the clock, although staffing levels varies in an attempt to mirror patient volume.

Due to the nature of care expected ***in case of an emergency*** ***the care givers are exposed to the highest risk of acquiring an infection*** from an unknown case.

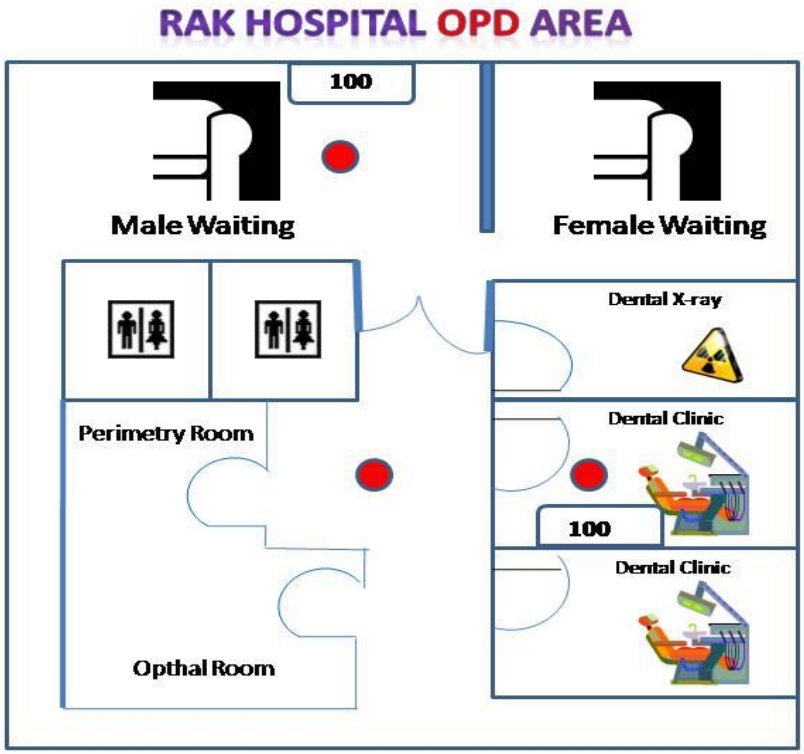
Notes: *Samples were collected from 4 locations. At the time of sample collection there were 2 Doctors, 4 Nurses and 1 receptionist, with few patient's and attendants. Air Samples were collected by 2 people from Airocide team. Emergency area is busy area as there is a constant shift in patients, new patients arrive and the old patients are shifted to their respective wards and the patient's relatives are waiting in the waiting area, which increases the bio-burden. GCS100 - 4 Nos were installed in Emergency Department, 2 units were installed between the beds, 1 was installed in the reception area and 1 was in the corridor.*

Air samples were collected from 4 locations in emergency department, 2 samples were collected from the treatment area, 1 was from the reception area and 1 from the corridor. Emergency area is constantly exposed to high level of bio-burden due to inflow of patients and their attendants.



As noted in the graph the bacterial load was reduced by 70%. Although there is a continual spike in the bio burden there were enough AiroCide installed to handle the frequent pathogen spikes.

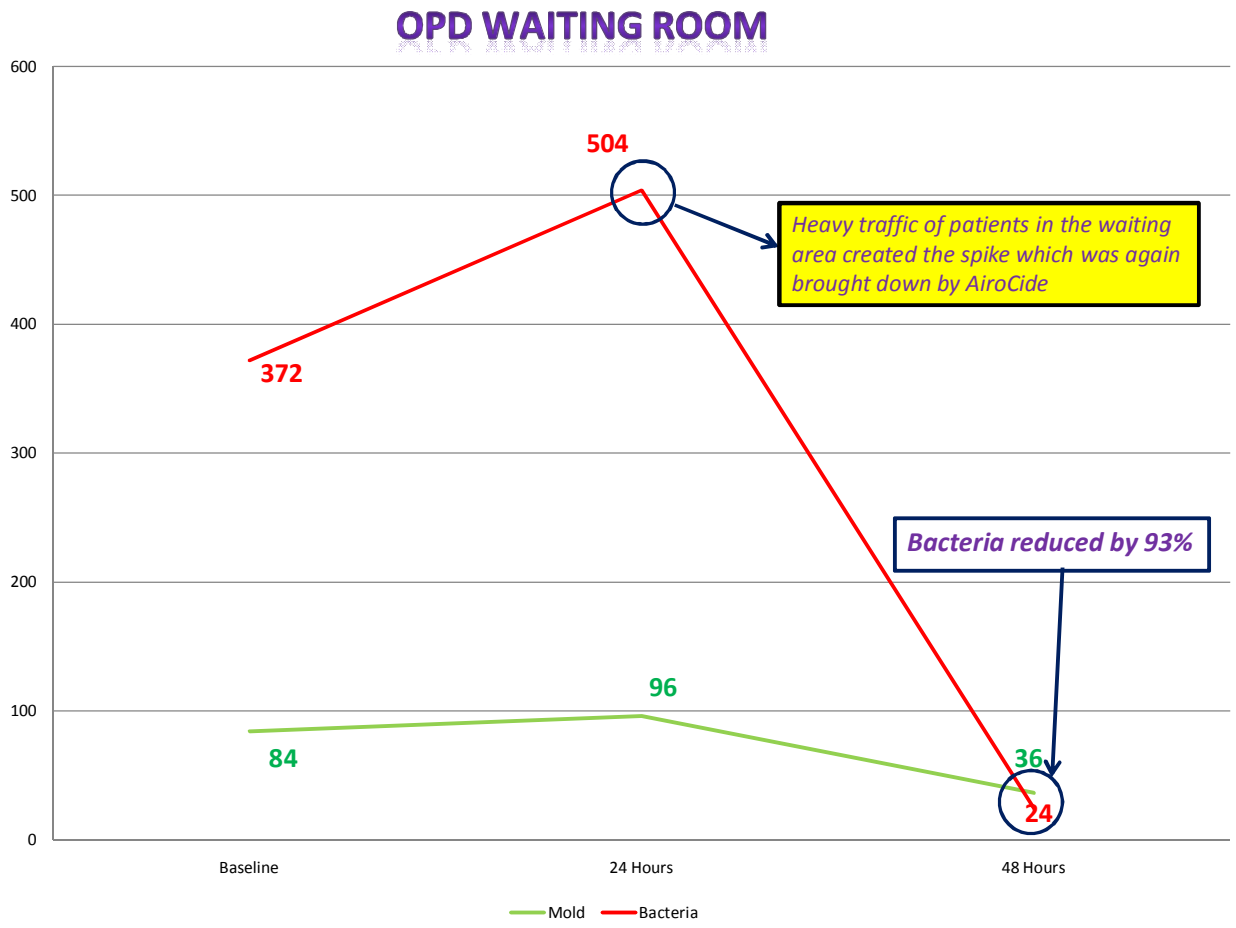
OPD AREA



Air samples were collected during the evening, since the inflow of out ï patients is high very high during the day. One Airocide unit was deployed in the Dental Clinic, as the bio-burden is high in dental clinics. Air samples were collected by 2 personal from Airocide team.

Note: *Hospital staff assisted in explaining the technology to the curious out-patients, in order to put them at ease so they felt relaxed and comfortable. Normal conditions are extremely important to maintain while the air quality tests is in progress; absence of which could lead to erroneous readings.*

As shown in the graph bio-burden created by the inflow of new patients was successfully controlled by Airocide



Micrococcus. Luteus had the highest count with over 372cfu/m^3
Staphylococcus haemolyticus had the second highest count with over 35cfu/m^3

.

Staphylococcus haemolyticus is a species of bacterium belonging to the genus Staphylococcus. It is a Gram positive coccus, coagulase negative, and catalase positive. Frequently found as a commensal organism on humans and animals, S. haemolyticus occurs infrequently as a cause of soft-tissue infections, usually in immunocompromised patients. S. haemolyticus is resistant to multiple antimicrobial agents. Resistance to vancomycin has been recorded, and this is a cause for concern because such resistance could be acquired by other, more pathogenic staphylococci

As shown in the graph bio-burden created by the inflow of new patients was successfully controlled by Airocide with the bacterial load being reduced by 93% in 48 hours.

Test Results

As anticipated AiroCide technology had a significant impact on the environment:

- **Airborne bacteria were reduced by 93%-33% over a 48 hour period of AiroCide purifying the air as compared to a baseline prior to AiroCide being activated.**

- **Fungi/mold level was reduced 99.99%-57% over a 60 hour period of AiroCide purifying the air as compared to the highest spikes occurring during the test period.**

Note: As the air samples were being drawn a thorough cleaning process was occurring in some areas with bed sheet changes, dusting sweeping, Clorox/Lysol decontamination was used to wash the floors resulting in a pathogen spike as contaminants on floors, beds, furniture got airborne as noted in the graphs aboves. However these spike were not significant enough to affect the final result. However such spikes are common and decreasing trends continue beyond the 48 hour period as AiroCide works 24/7 in controlling and managing pathogen build up continuously.

As is typical, the largest percentage reduction occurred during the initial 24 hour period as baselines samples showed the highest levels of contamination. As time passed various spikes were encountered as new contamination threats entered the area, but AiroCide repeatedly brought those back down to lower safer levels. Results demonstrated one of the key operating advantages of the AiroCide technology, namely ongoing 24/7 steady microorganism protection.

Results show a significant impact on the environment during the 48 hour period. Continued AiroCide use is expected to result in a long term trend to lower bacteria and mold/fungi levels. Be aware that microorganism reductions of this magnitude are not linear. As the result of this reduction, coupled with diffusion and dispersion, the statistical probability of contracting an airborne pathogen has been geometrically lowered.

Conclusions

- Airborne bacteria were reduced by an average of 79% throughout the test area over a 48 hour period of AiroCide purifying the air as compared to a baseline prior to AiroCide being activated.

- Fungi/mold level was reduced by 88% over a 48 hour period of AiroCide purifying the air as compared to a baseline prior to AiroCide being activated.

  Note: in the two surgical procedures readings taken at the time of the entrance of the surgical team was used as a basis for a baseline

- Informal interviews were conducted with patients nurses and doctors on their experience post installation. Patients felt they coughed less, nurses and doctors felt the area smelt much better (reduction in VOCôs) especially in the cases of highly infected surgical procedures where prior to AiroCide installation odor was a major concern.

  Note: Both surgical cases in operating theater #5 have fully recovered and did not suffer any post operative infection.

- One of the reasons for better smelling hospital was as direct effect of the reductions in the Volatile Organic Compounds (VOCôs) by AiroCide which were being generated by using hand sanitizers located across the test areas and floor cleaners. As hands are scrubbed with the alcohol and floors are washed, VOCôs are generated in the form of phenol which is known to cause fatigue and red eyes in individuals who come in constant contact with this carbolic acid. Phenol and its vapor are corrosive to the eyes, the skin and the respiratory tract. AiroCide is proven to eliminate all types of VOCôs from the indoor environment including phenol.

- The results prove that the AiroCide system provides a high level of effectiveness, reducing cross-contamination between health staff and patients and also improving the working conditions of the caregivers within RAK hospital.

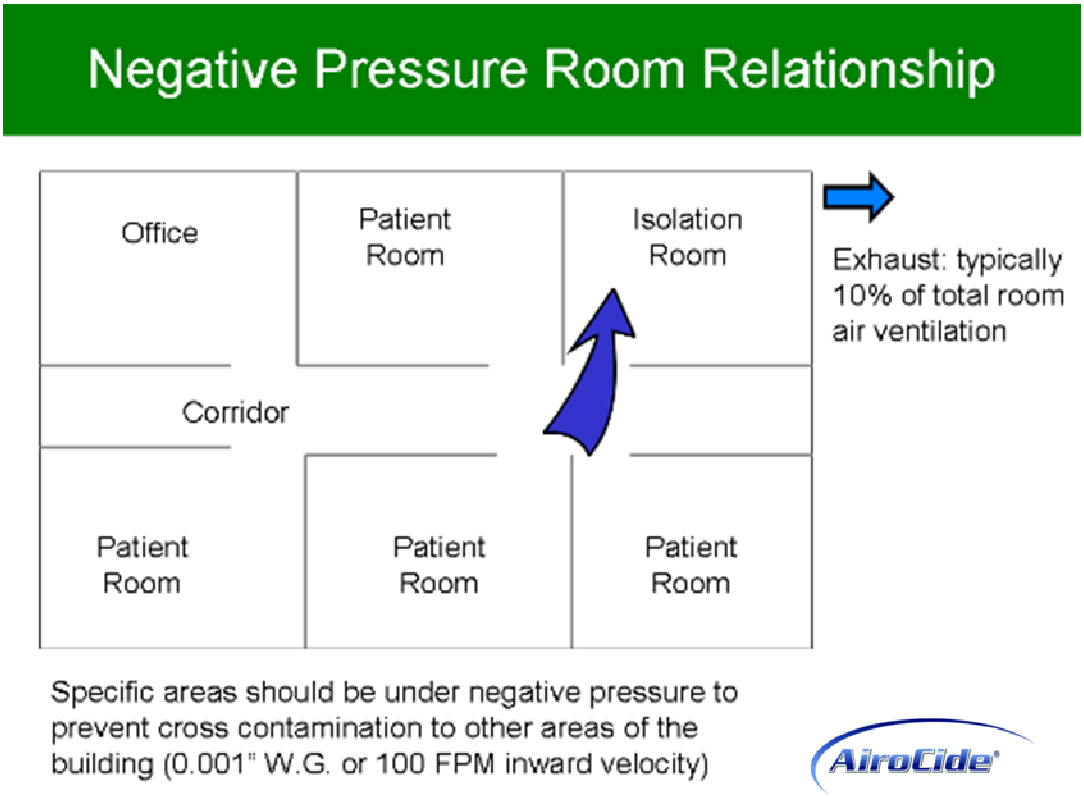
- Hospital acquired infections are a threat to patient safety and require improvement in clinical practice. We believe that AiroCide implementation will help the hospital reduce these known risks.

- AiroCideôs low cost implementation and maintenance should be considered when weighing the cost/benefit analysis of reduced nosocomial infections. It is our belief that the reduction and prevention of such infections, as a result, will translate into significant savings for the hospital, patient and/or public health system.

- An opportunity for a unique public awareness position is supported by AiroCide installation. Specifically, its ability to deliver unequalled air purification could be effectively marketed to the affluent local Saudi population, as well the foreign medical tourism consumer.

AiroCide In Negative Pressure Rooms

Negative Room Pressure to Prevent Cross-Contamination A negative pressure room includes a ventilation system designed so that air flows from the corridors, or any adjacent area, into the negative pressure room, ensuring that contaminated air cannot escape from the negative pressure room to other parts of the facility.



Air naturally moves from areas of higher pressure to areas of lower pressure. When negative pressure exists, a continuous air current enters the room under the door, which prevents airborne particles generated in the room from escaping into the corridor. A common example of negative pressure is a bathroom with an exhaust fan. When operating correctly, and with the door closed, the fan prevents unwanted odors and moisture from escaping.

Negative pressure is created by balancing the roomôs ventilation system so that more air is mechanically exhausted from a room than is mechanically supplied. This creates a ventilation imbalance, which the room ventilation compensates by continually drawing in air from outside the room. In a well-designed negative pressure room, this air is pulled in under the door through a gap (typically about half an inch high) for that purpose. Other than this gap, the room should be as airtight as possible to prevent air from being pulled in through cracks and gaps, for instance those around windows, light fixtures and electrical outlets. Leakage from these sources can compromise or eliminate room negative pressure, even if the system is balanced to achieve it.

Negative pressure in a room can be altered by changing the ventilation system operation or by the opening and closing of the room's doors, corridor doors or windows. When an operating configuration has been established, it is essential that all doors and windows remain properly closed in the negative pressure room and other areas (e.g., doors in corridors that affect air pressure) except when people need to enter or leave the room or area.

Although negative pressure rooms are widely used to control the spread of infections, but as described above they can be compromised if the pressure is lost. AiroCide with its proven ability to remove airborne infections can greatly assist in functioning/controlling the spread of infections in negative pressure rooms, to be clear, it is not recommended replacing negative pressure rooms with AiroCide technology, however *Airocide can greatly help boost and derive optimum performance in negative pressure rooms*.

AiroCide Technology can be further deployed in the following areas in healthcare applications:

- ✓ **Operation Theatres**
- ✓ **Intensive Care Units (ICU's)**
- ✓ **Organ Transplant Rooms**
- ✓ **Neonatal**
- ✓ **Patient Waiting Areas**
- ✓ **Pathology Labs**
- ✓ **Blood Banks**
- ✓ **Patient Rooms**
- ✓ **Negative pressure rooms**
- ✓ **Any area where Indoor Air Quality is of concern**

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APPENDIX

LABORATORY REPORTS

Airocide Test Protocols

- Indoor & outdoor air sampling
- Baseline, 24-hour, extended periods of time
- Known & unknown variables
- CFU/m^3 (colony forming units)

Anderson/Aerotech 6 Air Sampler