Pathogen Solutions

Confidential

Air Sampling Report

Queen Elizabeth Hospital Kota Kinabalu

CCU Wards 1 and 3

Air Quality - An Introduction

"Fresh – outdoor - air can be full of transient populations of microorganisms, but none actually live for very long. Most microbes die off in fresh air - as a result of sunlight, temperature extremes, dehydration, oxygen and pollution. Certain spores and some environmental bacteria are however naturally more resistant and do occur outdoors in high concentrations.

Indoors artificially controlled climates favour the survival and transmission of pathogens capable of infecting human beings. These include bacteria, viruses and certain of the outdoor fungi.

We spend 93%* of our time indoors and thus we require engineered control of the environments within which we live, work and sleep to provide protection against microbial aerobiological contamination."

Penn State University: Department Of Aerobiology

Medixair - Air Sterilisation Unit

The Need For Air Sterilisation.

The dangers from microbial pathogens, which thrive in artificially-lit, heated environments, are well known and are growing daily. As a nation many of us spend 93% of our time amongst these microscopic germs - in open-plan offices, leisure spaces, homes and multiple forms of transport.

Unfortunately, strains of microorganisms resistant to antibiotics have compounded the problem.

Air filters which simply create breeding sites are not the answer. What the world required was something powerful enough to actually target and kill all the microorganisms that cause both simple and complex ailments – ranging from the common cold and influenza to the myriad of more serious illnesses such as TB, Measles, Mumps and Chickenpox.

There is however now an even greater concern.

Hitherto, much of the spread of infection was considered to be linked to droplet nuclei, spread by sufferers of respiratory diseases such as colds and 'flu.

We now know that many of the burgeoning and more stubborn hospital infections - such as Staphylococcus spp. and other Gram positive microbes may be attributable to dust and skin particles which are actually carrying bacteria and viruses around hospital wards and treatment areas.

As long ago as 1991 *Schaal* writing in the Journal of Hospital Infection described this scenario stating that organisms become additionally threatening as a result of *remaining viable and infective whilst settled on dry dust - thereby infecting patients through inhalation and precipitation as the dust is subsequently disturbed into the hospital air.*

The history of public health has witnessed a massive amount of growth in the understanding and development of protective services; beginning at the start of the twentieth century when we began to come to terms with high mortality rates from poor diets, risks from child birth and poor sanitation. In the latter half of the century, antibiotics and advancements in clean air further brought about even more dramatic improvements to health. More recently, as the new century begins we are dealing robustly with airborne contamination - from smoking and hospital acquired infections. We continue however to suffer from the spread of germs in the workplace and the annual death toll of influenza.

Today influenza and hospital acquired infections continue to result annually in thousands of deaths, and many more suffer each year from poor health and illness contracted in the workplace.

An engineered solution is however now at hand. Pathogen Solutions has created a device that actually kills microorganisms - by applying a technology, known about for over a 100 years, in a totally new way.

The product called Medixair uses ultraviolet irradiation which breaks up the DNA within bacteria and virus cell nuclei – even when attached to dust and skin particles - thus preventing any reproduction. Crucially, the device addresses the fact that ultraviolet light does not propagate very far through the air and revolutionary technology has been incorporated to ensure that all bacteria and viruses entering the Medixair machine will be exposed to a sufficient level of radiation to render them totally harmless – in a single pass.

Queen Elizabeth Hospital Kota Kinabalu

CCU Wards 1 and 3

This report describes the air sampling programme carried out during February 2006 at the above hospital.

Air Sampling

The pre Medixair installation air samples were taken on 6th - 8th February 2005 and the post Medixair installation air samples were taken on 9th – 11th February 2006.

The major activities within the air sampling programme were:

1. Air samples from CCU 1 area 1- Near the head of the patient
2. Air samples from CCU 1 area 2- Near the feet of the patient
3. Air samples from CCU 3 area 1- Near the head of the patient
4. Air samples from CCU 3 area 2- Near the feet of the patient
5. One air sample from Outdoors

Note:
In the context of all data presented within this report, outside "fresh" air will typically produce a TVC (Total Viable Count) figure of circa 150 – 200 colony forming units per metre cubed (cfu/m^3)

Method

Two rooms each occupied by a single patient were used for testing; CCU-1 and CCU-2 were chosen as the sampling site. Two TVC samples were taken from each room on each day of testing - from Area 1 (Near patient's head, 100L of air) and Area 2 (Near patient's feet, 200L of air)

1. Air samples were taken with Medixair units switched off on the first 3 days of sampling (6th to 8th Feb 06).
2. Further air samples were then taken with Medixair unit switched on for the following 3 days of sampling (9th to 11th Feb 06).
3. One TVC sample (200L of air) was taken from outdoors to provide a comparative datum point..
4. The TVC agar strips were incubated at 30±1°C for 72 hours.

Air sampling was carried out using a BIO-TEST RCS Hi Flow Air Sampler.

In each location 100/200 litres of air were taken, the micro-organisms from the samples being deposited on TVC agar strips integrated within the BIO-TEST equipment.

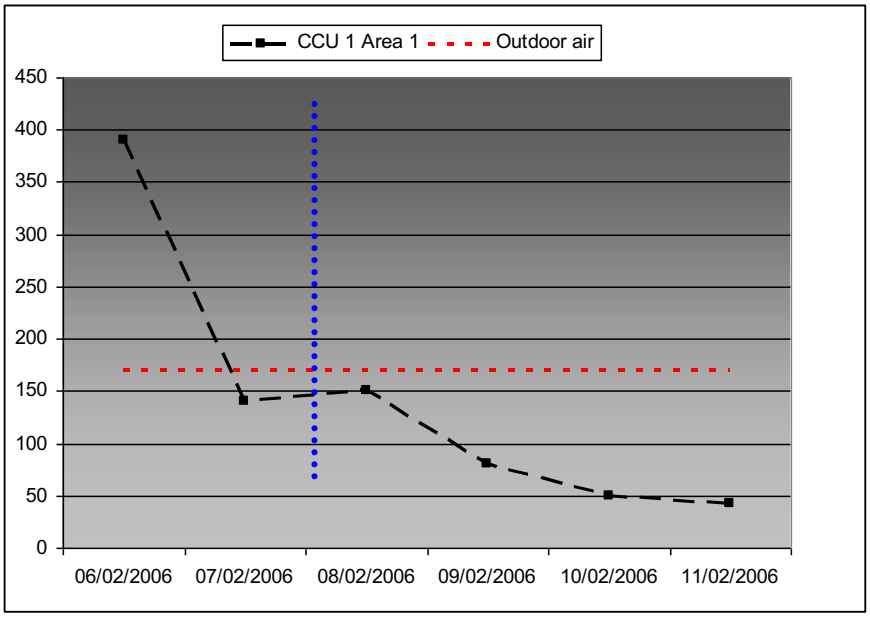
The agar samples were submitted for testing to Chemsain Environmental Consultants, Kota Kinabalu.

The figures included in this documentation are contained in written reports from Chemsain

Results

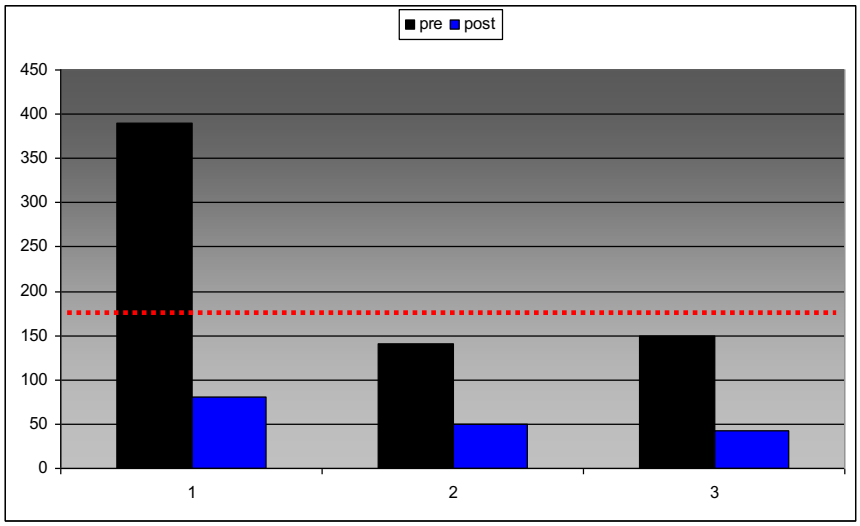
Pre and Post results from CCU 1 Area 1

Progressive Daily Test Results



The blue line shows installation point of a single Medixair unit.

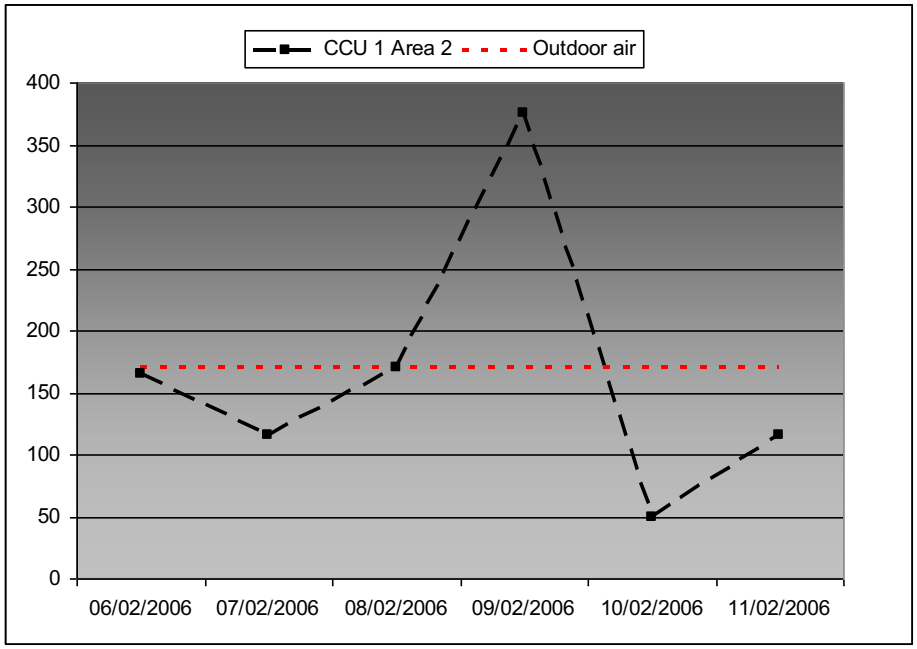
Comparative Test Results for Pre and Post Medixair Installation



The red line indicates the outside "fresh" air result 170 cfu/m^3

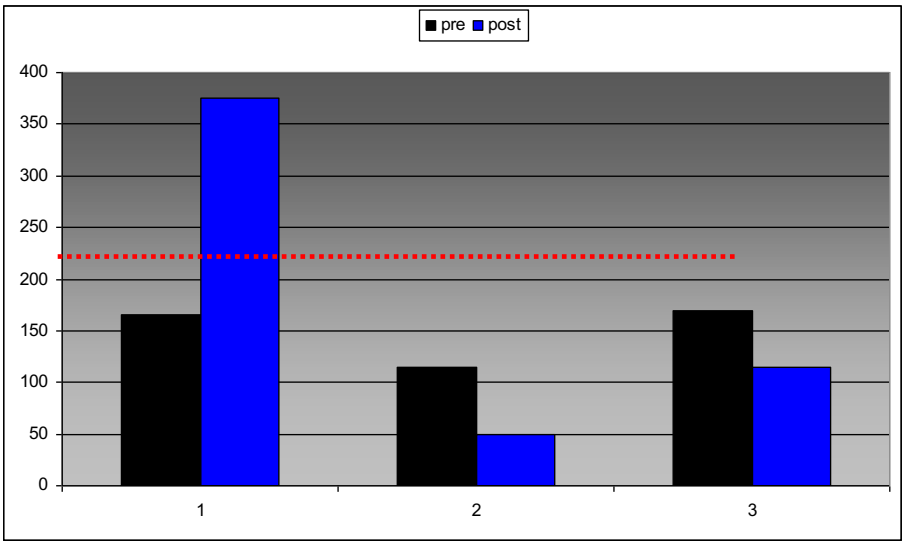
Pre and Post results from CCU 1 Area 2

Progressive Daily Test Results



The blue line shows installation point of Medixair unit.

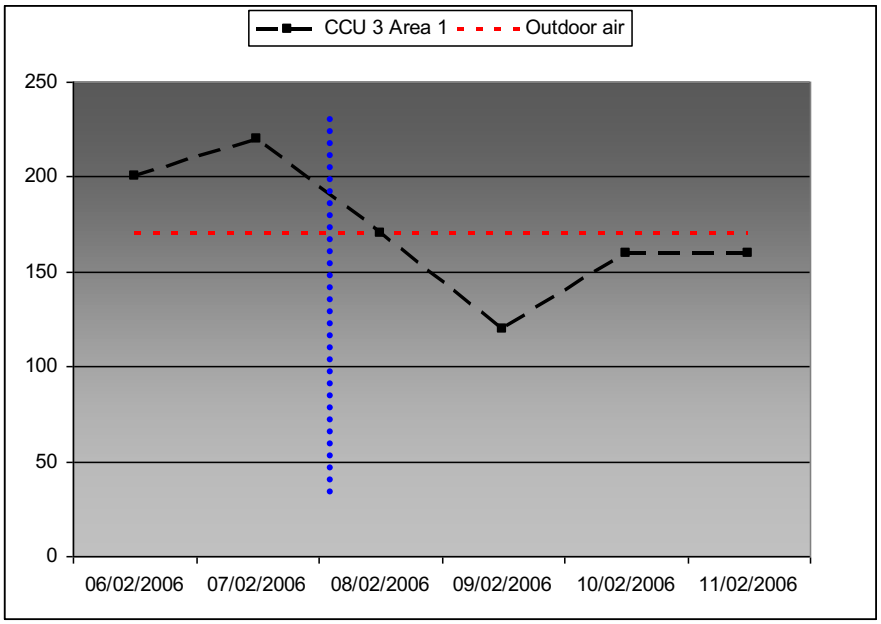
Comparative Test Results for Pre and Post Medixair Installation



The red line shows outside air result 170 cfu/m^3

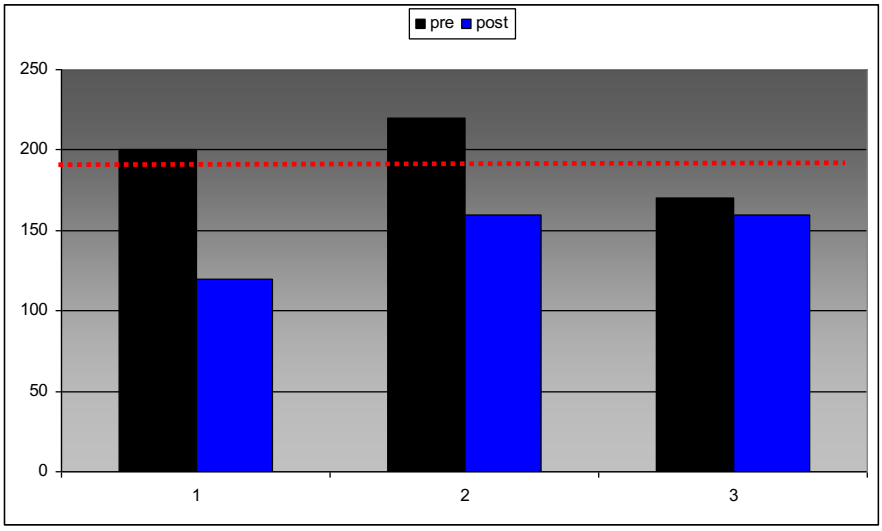
Pre and Post results from CCU 3 Area 1

Progressive Daily Test Results



The blue line shows installation point of Medixair unit.

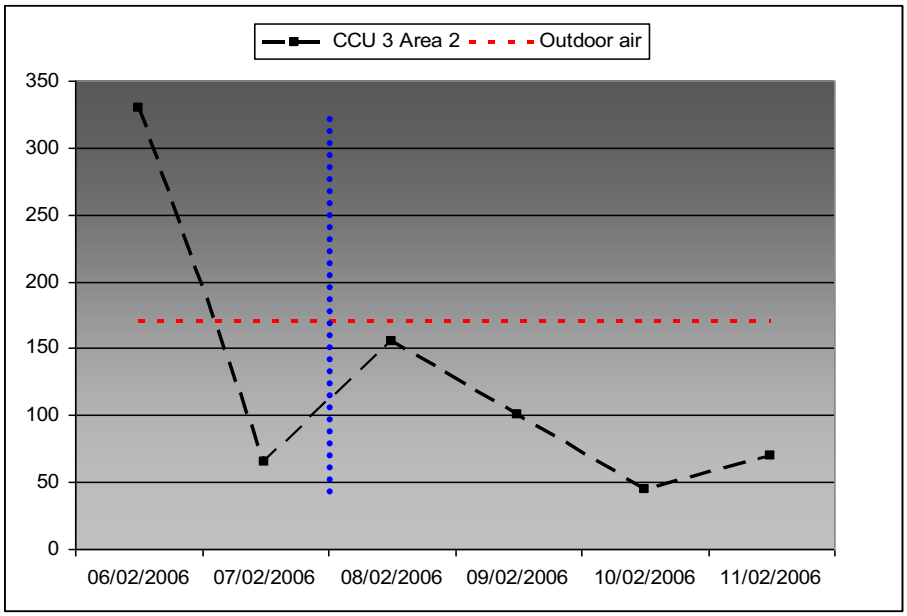
Comparative Test Results for Pre and Post Medixair Installation



The red line shows outside air result 170 cfu/m^3

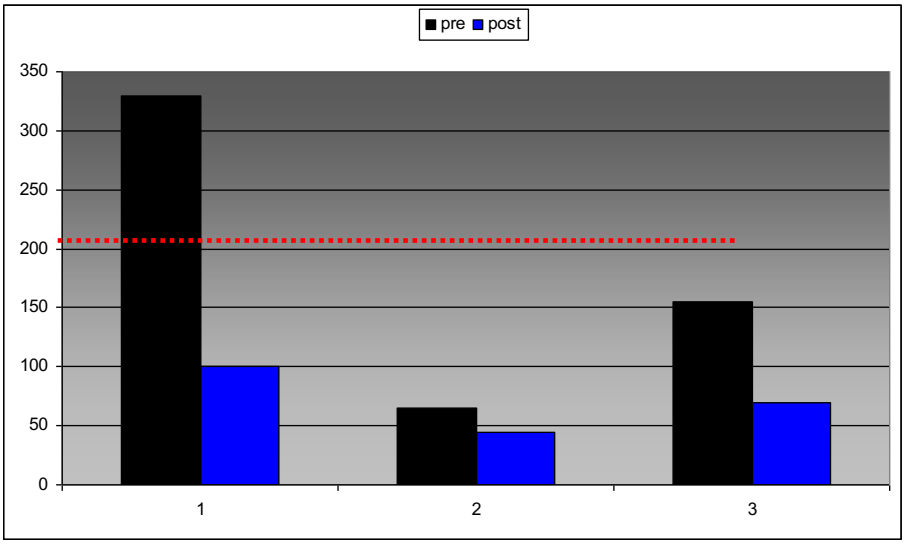
Pre and Post results from CCU 3 Area 2

Progressive Daily Test Results



The blue line shows installation point of Medixair unit.

Comparative Test Results for Pre and Post Medixair Installation



The red line shows outside air result 170 cfu/m^3

Discussion of pre and post Medixair Installation Results

CCU 1 area 1

The graphs indicate a reduction in bio-burden when the Medixair unit is switched on.

There is a peak of aerobiological contamination on the first day of testing which maybe postulated as being associated with a specific patient or surgical related activity within the CCU Ward immediately prior to the taking of the air sample e.g. coughing, a dressing change, a doctors visit etc.

However during the post testing phase Medixair is shown to have decreased the aerobiological burden by 79% on the first day, 64% on the second day and 71% on the third day.

Post Medixair the overall bio burden has been reduced by **71%**

CCU 1 area 2

There is a single high peak of aerobiological contamination at area 2 on 9th February when Medixair was installed in the ward. This will be related to a specific "challenge" to air quality related to activities or conditions around or involving the patient immediately prior to the air sample being taken.

The graphs indicate however that Medixair has then significantly reduced the level of bacterial contamination within the 24 hour period between air samples – in fact showing an 86% reduction in aerobiological bio-burden at the time of the next air sample on 10th February.

Apart from the one peak of aerobiological activity reported above Medixair has demonstrably reduced the contamination levels in CCU 1 – Area 2 and an overall reduction of **44%** was achieved.

In overall terms a 56% reduction in bio burden was achieved for CCU 1.

CCU 2 area 1

As in CCU 1, there is a clear indication of reduced aerobiological contamination following the installation of Medixair.

Further, in this ward and in this location the aerobiological contamination levels – post the installation of Medixair - are lower than those recorded from outdoor "fresh" air.

On day one of post Medixair testing the result was 40% lower then day one of the pre testing phase.

On day two of the post Medixair testing the result was 27% lower than day two of the pre testing phase

On day three of the post Medixair testing the result was 6% lower than day three of the pre testing phase

Post Medixair the overall bio burden has been reduced by **24%**

CCU 3 area 2

A similar pattern has emerged within CCU 3 area 2. There is a clear point within the graph indicating the installation of Medixair and post installation aerobiological contamination levels have been reduced to significantly below those of the outdoor "fresh" air.

During the post testing phase the bio burden was reduced against the pre- installation period by 69% on day one, 30% on day two and 54% on day three.

Post Medixair the overall the bio burden has been decreased by **51%**

In overall terms a 38% reduction in bio burden was achieved for CCU 2.

Conclusions

The data provides a clear indication of the levels of contamination that one would expect to encounter within the subject CCU Wards and the positive effect provided by Medixair in all locations tested.

Of particular note is the fact that the all post Medixair installation results – with the exception of just one sample – almost certainly relating to a single challenge event are below the contamination level for fresh outdoor air.

We wish to point out that this particular air sampling programme – comprising single air samples per location per day of testing will provide a good indication of the level of air quality within the subject environments.

To gain further knowledge of the specific impact of operational challenges being presented in the CCU a grater number of samples would be required, sampling on a continuous basis over a number of days.