

## Introduction

Since the development of the hydroxyl radical based Air Disinfection (AD) technology, Inov8 has conducted exhaustive laboratory tests on several types of bacteria, fungi as well as safe virus surrogates. These results, shown in figures 1 and 2, indicated that this technology can be very effective against many known pathogenic microorganisms including most superbugs.

In addition, early installations in some hospitals pointed to a reduction in the number of reported infections in patients and staff, as well as a noticeable reduction in the resulting number of ward closures. Figures 3 and 4 show the case of Hereford Hospital, where the AD technology was installed in July 2008 in the Hutted wards, and in January 2009 in other wards in the main hospital. It can be seen that the infections stopped in the Hutted wards immediately after installation. However these continued in the main hospital until January 2009 when the AD was installed there. Since then, there were no further outbreaks for the rest of 2009.

The aim of this paper is to study the correlation between the introduction of the AD in the Royal Worcester Hospital and the Redditch Alexandra Hospital, the reduction of environmental bio-burden and the subsequent reduction in the rates of infections.

Figure 1

Reduction of E-coli in air chamber

Detection limit of the E. coli studies is <0.02 cfu/l

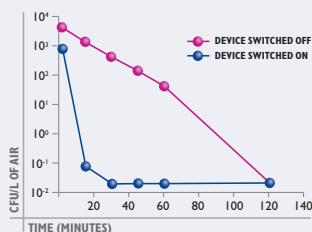


Figure 2

Reduction of MS2 phage in air chamber

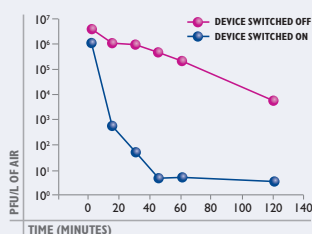


Figure 3

Hereford County: Hutted Wards

Number of reported infections "Staff", "Patients" and ward closures by date

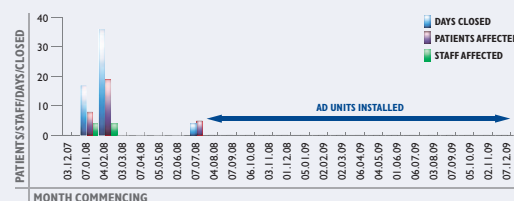
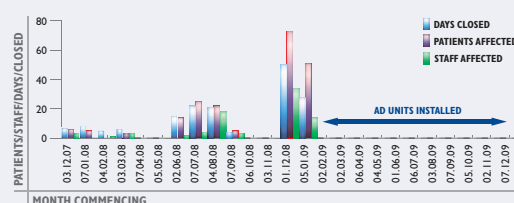


Figure 4

Hereford County: Main Hospital

Number of reported infections "Staff", "Patients" and ward closures by date



## Methodology

The objective of the study is to answer the question "Does the AD installation lead to a significant reduction in bio-burden in a hospital setting and does this correlate with a reduction in the rate of infections between patients?" Patient infection rates data and bio-burden data shall be collected for three periods; before installation, during installation and after installation. A means comparison test shall be performed on both sets of data to assess the significance. A significant reduction shall be measured with a p value < 0.05. In addition, correlation between bio-burden data and infection rates data for each period shall be performed.

## Results

Infection rate data and bio-burden data were obtained from two wards in each hospital for a 28 month period, which included the three months when the AD was installed. The 28 month period was divided into three parts; before AD installation, during installation and after installation. For each hospital, the variation in infection rates data was analysed and correlated with the corresponding variations in sampled bio-burden data for that period.

**Infection Rates Analysis** Table 1 shows the analysis results for Ward 5 of Redditch Alexander Hospital. It can be seen that the two tailed p-value is 0.048 which confirms that there is a very significant reduction in infection rates among patients following the introduction of the AD.

In the other wards, p-values recorded ranged between 0.1 and 0.4, confirming a reduction although not significant in all cases.

**Bio-burden Analysis** Table 2 shows the analysis results for Ward 5 of Redditch Alexander Hospital. It can be seen that the two tailed p-value is 0.01 which confirms that there is a very significant reduction in environmental bio-burden following the introduction of the AD.

In the other wards, p-values recorded ranged between 0.002 and 0.4, confirming a significant reduction although not in all cases.

**Correlation Analysis** Figures 5 and 6 show the graphical correlation of bio-burden data with the weekly average number of patients infected in the four wards at Redditch Alexandra Hospital and Royal Worcester Hospital.

Table 1 Infection Rate Data Analysis table

	REDD 5 BEFORE	REDD 5 DURING
Mean	4.15	0
Variance	77.81842105	0
Observations	20	4
Hypothesized Mean Difference	0	
df	19	
t Stat	2.103884467	
P(T<=t) one-tail	0.024468166	
t Critical one-tail	1.729132792	
P(T<=t) two-tail	0.048936331	
t Critical two-tail	2.09302405	

Table 2 Bio-burden Data Analysis table

	REDD 5 BEFORE	REDD 5 DURING
Mean	216	115.3571
Variance	6363.1429	5551.17
Observations	8	14
Hypothesized Mean Difference	0	
df	14	
t Stat	2.9151582	
P(T<=t) one-tail	0.0056492	
t Critical one-tail	1.7613101	
P(T<=t) two-tail	0.0112984	
t Critical two-tail	2.1447867	

Figure 5 Correlation between average weekly infection rate and mean cfu/m<sup>3</sup> at the Redditch Alexandra Hospital

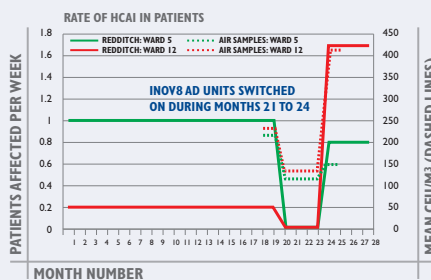
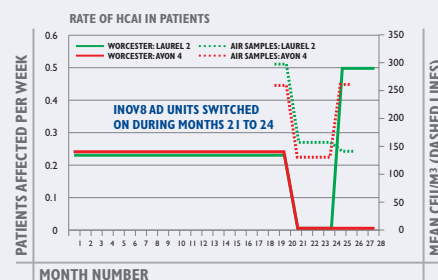


Figure 6 Correlation between average weekly infection rate and mean cfu/m<sup>3</sup> at the Royal Worcester Hospital



## Conclusions and Discussion

**Trials were conducted in several UK hospitals. In this paper, the results of trials at four wards from the Redditch Alexandra Hospital and the Royal Worcester Hospital are presented. It is shown that in seven out of eight means comparisons, there was a significant reduction of environmental bio-burden. It is also shown that in seven out of eight means comparisons, there was a significant reduction in the number of patients infected during the periods when the AD was installed and operational. Furthermore, it is shown that there is a strong correlation between bio-burden reduction and reduction in patient infection rates. Based on these positive findings, Inov8 Science Ltd continues to gather data from several other sites.**