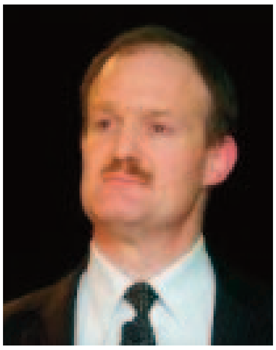
Can we protect staff, patients and visitors better whilst reducing waiting times, saving money and driving towards net zero in the nhs estate?



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Data and modelling for all NHS hospitals in England (by adding specialist hospitals), estimated 834 000 Health Care Acquired Infections (HCAIs) in 2016/2017 costing the NHS £2.7billion, and accounting for 28,500 patient deaths, 7.1million occupied hospital bed days (equivalent to 21% of the annual number of all bed days across all NHS hospitals in England) and 79,700 days of absenteeism among front-line Health Care Professionals (HCPs)(Modelling the annual NHS costs and outcomes attributable to healthcare-associated infections in England, 2020, J. Guest et al)

Later in the pandemic, between June 2020 - March 2021 circa 131,000 patients acquired Covid in hospitals, 1.5% of all admissions (Ben Cooper et al 2023) but also the table below confirms some sample hospital figures on staff sickness from the pandemic and the reduced level of PPE that this could entail.

Hygiene is crucial in all settings providing healthcare services. ill patients are the most vulnerable to disease or infection. Also, there is a large staff cohort and a significant number of visitors which combine to escalate the infection risk significantly and indeed, potentially, to be at risk from others too.

2500 years ago, the Father of Medicine, Hippocrates, developed the "Miasma Theory", stating that diseases were the product of environmental factors such as contaminated water, foul air, and poor hygienic conditions. We estimate that approximately 25% of HCAIs are from airborne infection of respiratory diseases, so the correct ventilation rates in healthcare buildings' is essential so that the air that people breathe within our NHS facilities is clean, wholesome and uncontaminated and that the air that occupants exhale, which could be a potential source of infection risk to others, is removed or inactivated quickly.

However, increasing these air change rates indoors can be costly and also, disruptive if one has to upgrade existing healthcare building mechanical ventilation systems. (We estimate that approximately 50% of NHS facilities are non-compliant with the requisite minimum ventilation standards). Such traditional methods of improving ventilation rates also impact the availability of clinical spaces whilst works are safely undertaken and so, have the potential to add to waiting times, one of the greatest challenges in the NHS.

We also need to bear in mind that Government policy dictates a decarbonisation agenda and therefore, providing higher ventilation rates to protect healthcare facilities better will require more energy than currently utilised even with enthalphy recovery systems, which is counter-policy. However, there are alternatives to satisfy the necessary Net Zero aspirations and comply with the various Guidelines, Standards and Regulations relating to Health Care Building Ventilation and Infection Control and Prevention.

Alternative solutions that have been used during the pandemic are portable air cleaning devices, which are helpful for short-term and temporary situations but the longer-term answer that should be considered for roll-out across the NHS Estate is to install, hard-wired high-level "Upper Room" GUV air cleaning that use a certain wavelength of light to disinfect the air closest to the source of airborne contamination risk (above the human exhaled air plume) Similar GUV technology could be applied to overall building

Table 1: Annual Sickness Absence Rates by NHS England region

		2019-20			2020-21			2021-22		
		Full Time Equivalent Days Lost to Sickness Absence (includes non-working days)	Full Time Equivalent Days Available (includes non-working days)	Sickness Absence Rate	Full Time Equivalent Days Lost to Sickness Absence (includes non-working days)	Full Time Equivalent Days Available (includes non-working days)	Sickness Absence Rate	Full Time Equivalent Days Lost to Sickness Absence (includes non-working days)	Full Time Equivalent Days Available (includes non-working days)	Sickness Absence Rate
	England	**19,568,889**	**436,884,468**	**4.48%**	**21,182,524**	**454,869,841**	**4.66%**	**25,570,899**	**474,999,954**	**5.38%**
Y56	London	2,812,414	72,753,780	3.87%	3,187,140	75,924,854	4.20%	3,710,128	78,532,290	4.72%
Y58	South West	1,858,512	42,159,972	4.41%	1,795,094	43,302,314	4.15%	2,353,899	45,864,901	5.13%
Y59	South East	2,379,085	57,127,680	4.16%	2,626,216	59,651,244	4.40%	3,048,654	62,489,831	4.88%
Y60	Midlands	3,656,790	76,262,071	4.80%	3,901,398	79,710,626	4.89%	4,732,562	83,799,687	5.65%
Y61	East of England	1,706,151	39,925,535	4.27%	1,908,684	41,733,136	4.57%	2,259,575	43,437,805	5.20%
Y62	North West	3,424,429	65,885,885	5.20%	3,807,522	68,906,318	5.53%	4,527,099	71,238,583	6.35%
Y63	North East and Yorkshire	3,393,176	71,298,031	4.76%	3,681,485	73,536,048	5.01%	4,533,539	75,639,823	5.99%
QZZ	Special Health Authorities and other statutory bodies	338,332	11,471,514	2.95%	274,986	12,105,300	2.27%	405,443	13,997,034	2.90%

Figure 1: NHS Sickness Absence Days from the Health and Social Care Information Centre. As you can see from the data an extra 4.4 million "sick days" were taken by NHS staff during 2022 – adding to costs and waiting list times.

ventilation improvement using chemical free photo-disinfection in the HVAC system. This is easily achieved by placing an engineered design array GUV lamps within the ventilation system's ductwork which means that air is decontaminated at source.

When pathogens are exposed to GUV light of the correct intensity and for the correct exposure time their DNA/RNA is reconfigured and damaged such that mitosis cannot occur and inactivate the pathogen, rendering it harmless and unable to multiply. This will result in safer building environments for patients, staff, and visitors. Potentially allowing safely decontaminated air to be recirculated in more areas of the Estate which will help our ability to hit Net Zero and also allow greater utilisation of work space and theoretically reduce waiting times.

A Nobel Prize for Medicine was awarded to Niels Finsen in 1903 for "his contribution to the treatment of diseases, especially lupus vulgaris, with concentrated light radiation, " This light, GUV has been successfully applied against highly infectious airborne diseases

The inactivation solution depends on the medium (air, water, surface), environment, hazard source, presence of people or animals, temperature, humidity, bio-load, exposure time and the target microbe(s) that one seeks to eradicate. GUV lamps operate between 200 and 280nm wavelengths of the electromagnetic spectrum by passing an electrical discharge through a low-pressure gas (including mercury vapour) enclosed in a soft glass or quartz tube. Researchers over the past 80 years have found that the optimum wavelength for lamps to operate at is 254 nm, at which they are Germicidal, the most efficient to destroy microbiological matter. GUV emitters of 222nm, known as FAR UV, are currently being assessed for future potential by several UK and international universities and are less harmful to human skin and eyes.

HEPA filters are another alternative to GUV, they were created originally for the Manhattan Project to stop radioactive material escaping the labs. They are very effective at stopping microbes too, however, they are also very energy-intensive because the filter pores are so small to push air through, and the pressure drop reduces the airflow significantly unless more energy is applied to get the air flow rate to the requisite level for adequate ventilation.

OPTIONS

Portable Air Cleaning Units

Portable UVC or HEPA devices should only be considered as a temporary solution and where used, they must be positioned to avoid interference. They operate as a recirculating air system that passes air from the room space through the device decontamination chamber which has a GUV light which disinfects or a HEPA filter and then, discharges that cleaned air into the room, so they need clear space in front of their intake and their discharge grills to be effective. Unfortunately, most types exceed NHS standards on noise.

Infection Source Control – GUV Upper Room Devices

GUV Upper Room devices have been in use for several decades to combat respiratory diseases such as tuberculosis and importantly, they were deployed in the previous COVID pandemic (SARS in 2003) in Hong Kong Hospitals successfully. These devices were positioned between patient beds and about 2.7m off the floor to intercept/disinfect the exhaled air from the patients below.

Upper room devices are also, a low-cost and easy-install intervention for areas with inadequate ventilation (We estimate over 50 % of Health Care Spaces are insufficiently ventilated) because they provide an equivalent decontamination rate to make up for the shortfall that should exist to comply with conventional ventilation requirements, often exceeding 10 air changes per hour.

The Hong Kong hospitals were fully equipped with these GUV tools to deal with airborne pathogens, and they managed incredibly well under the COVID-19 (SARS-2) pandemic.

Primary Building Ventilation

Correctly engineering GUV lamps installed into HVAC ductwork, whether that be retrofit into existing or newly built hospitals' ventilation systems, would make sites safer from respiratory-driven nosocomial infection sources, would make the NHS Estate pandemic-resilient but also reduce the enormous burden that respiratory illnesses bring to hospitals, especially each winter. This safe intervention can only serve to free up beds and so also, to reduce waiting times.

Adding GUV light to building ventilation systems is a long-term investment with little maintenance and some of the products on the market can be linked to the building management system for optimising energy and ventilation rates. GUV is now specified in the latest version of The Building Regulations and so, the use of GUV should now be retrospectively applied to the NHS Estate to bring all healthcare facilities up to the correct compliance levels and standards of healthier building.

There have been very few studies undertaken on the impact of GUV and its positive impact on internal air quality. The next stage for the NHS Estate is to run some large trials to confirm the savings that they bring in both electrical costs, reduction in staff sickness absence, and the reduction in nosocomial infection leading to prolonged stays for patients and bed spaces freed. Some work undertaken on creating infection-resilient environments puts the potential savings at around £23 billion per year per the Royal Society of Engineering report on Infection Resilient Environments social cost benefit analysis. ■