

Environmental science and its
importance in achieving Net Zero
Improvements



Quick Overview



Environmental/IPC research and development in collaboration with Cambridge University

Hospitals and East London Foundation Trust

Funded Through:



To understand building environments and their potential impact on staff and patient health delivering a number of novel technologies

- Enabling hospital trusts to reduce costs while improving patient care, patient satisfaction and safety.
- Significantly improve Net Zero goals

1. Clinical Outcomes

AAirDS-C (clinical)

a) Primary

- i) Incidence of SARS-COV2, adenovirus, HMPNV, Flu A|B, parainfluenza, RSV, picornavirus, norovirus, s.aureus, c.diff, and any Abx Rx \bar{c} CAP or HAP as indication.
- ii) Incidence of SARS-COV2 alone

b) Secondary

- i) Respiratory viruses excluding SAR-COV2
- ii) C.diff
- iii) S.aureus
- iv) norovirus
- v) HAP - by Abx indication
- vi) All other HAs
- vii) Severity of C.diff, SARS-COV2 and S.aureus
- viii) Length of stay
- ix) Bed days lost
- x) Abx usage
- xi) Abx cost
- xii) 30 day mortality

2. Feasibility

AAirDS-E (environment)

a) Air sampling weekly

- i) Fluidigm

b) Air sensors

- i) PM counts
 - 1
 - 2.5
 - 4
 - 10
- ii) CO2 levels
- iii) RH
- iv) Temperature

c) Cleaning

- i) Soap usage
- ii) PPE usage
- iii) Alcohol hand sanitisers usage

d) Validation

- i) Standard AGAR/MALDI

3. Acceptability

AAirDS-Q (quantative)

a) Patients survey

b) Staff

- i) Survey
- ii) Flu/Covid vaccine rates
- iii) Sickness

A pragmatic controlled
before-and-after study.

AAirDS

Implimentation of air disinfection to
prevent hospital-acquired infections in
medicine for older people wards.

Embedded CO2 segmented into two areas



Buildings



- Air Quality
- Energy Consumption
- Heating, Ventilation, Cooling
- Building materials and engineering
- Labs
- Medical equipment

Patients



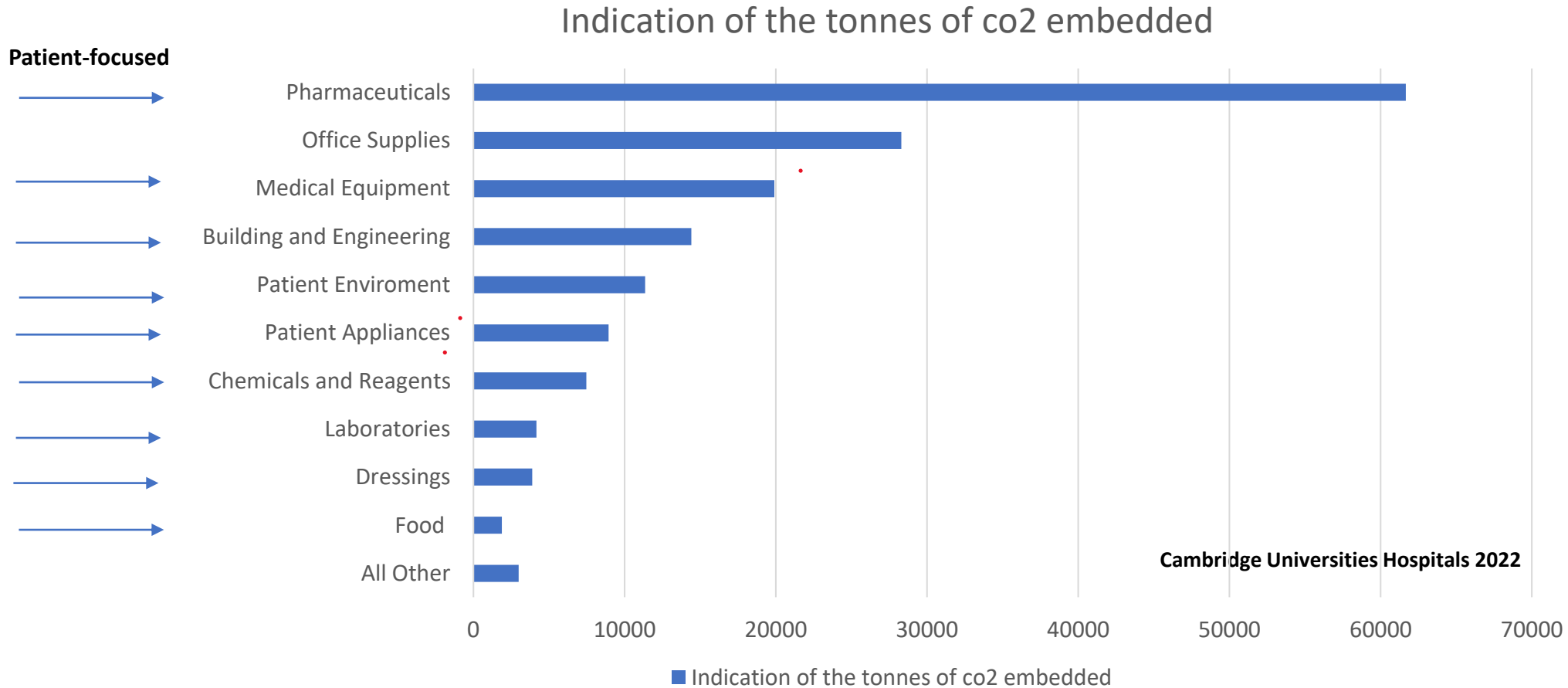
Patients consume more resources if becoming sick in a hospital environment

Patient acquiring infection in Hospital



- Pharmaceuticals
- Avg bed days
- Medical equipment
- Labs
- Dressings/consumables
- Decontamination/Chemicals and Reagents
- Frequent visitations

Environmental improvement a strategic focus



- **Health care-acquired infection (HCAI) reductions will reduce co2 consumption per patient.**



NHS Energy Consumption

2019 2021 2023
£500m → **£630m** → **£1b+**

[Energy crisis will send NHS bill soaring past £1 billion - Energy Management \(energymanagementltd.com\)](https://www.energymanagementltd.com/news/energy-crisis-will-send-nhs-bill-soaring-past-1-billion)



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Hospital Acquired Infection Costs



A reckoning: the continuing cost of COVID-19 - NHS Confederation

Common NHS challenges



Healthcare associated infections (HCAI): statistics and performance

Effective infection prevention and control needs to be everybody's business and must be part of everyday healthcare practice and based on the best available evidence so that people are protected from preventable healthcare associated infections.

Welsh Government (WG) reduction expectations for April 2020 – March 2021.

Due to the COVID pandemic, the reduction expectation set for 2019/20 were extended for 2021/21.

Number and rate of *C. difficile*, *S.aureus* bacteraemia, *E. coli* bacteraemia, Klebsiella sp. bacteraemia and Pseudomonas aeruginosa bacteraemia per 100,000 population, April 2020 – March 2021.

	Rate of <i>C. difficile</i> / 100,000 population		Rate of MRSA bacteraemia/ 100,000 population		Rate of MSSA bacteraemia/ 100,000 population		Rate of <i>E. coli</i> bacteraemia/ 100,000 population		Rate of Klebsiella sp. bacteraemia/ 100,000 population		Rate of Pseudo aer bacteraemia/ 100,000 population	
	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate
Cwm Taf Morgannwg	112	25.16	6	1.35	110	24.71	316	70.98	96	21.56	20	4.49
All Wales	880	28.04	47	1.50	733	23.35	1882	59.96	620	19.75	148	4.72

Gram-negative bacteraemia

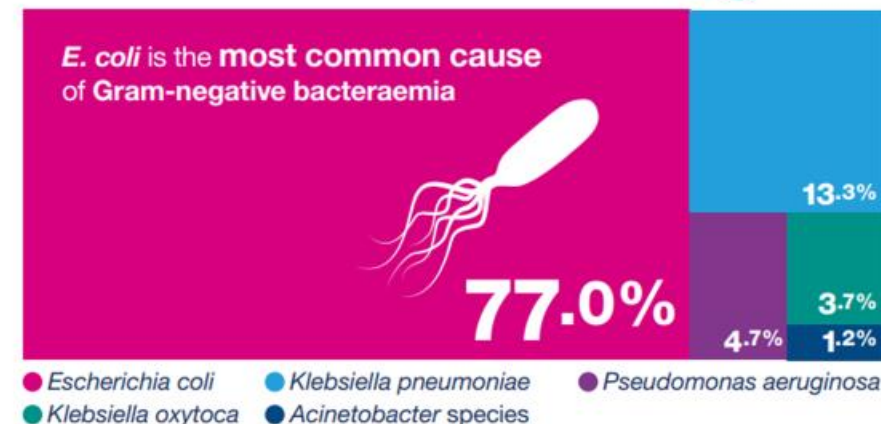
Gram-negative bacteria are an important cause of serious infections in healthcare and community settings.

Please refer to the **COVID-19 chapter** as changes in the hospital population and activity during 2020 may have affected the epidemiology of Gram-negative bacteraemia and comparison of results should be interpreted with caution.

In 2020, there were **5,462** Gram-negative bacteraemia in Scotland caused by **5** key Gram-negative pathogens

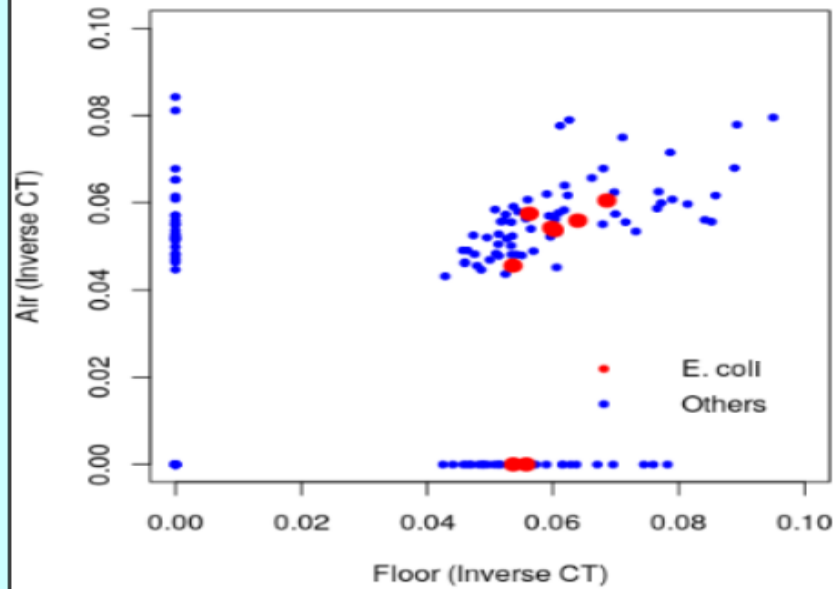


E. coli is the **most common cause** of Gram-negative bacteraemia

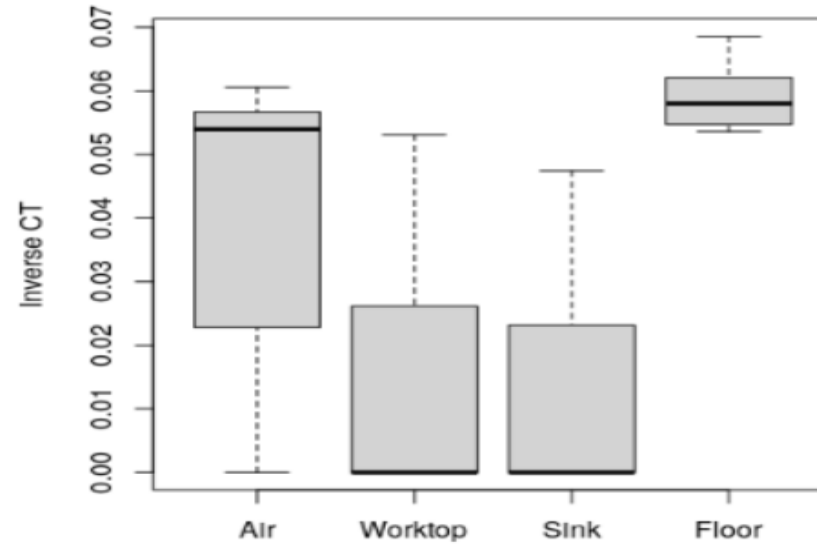


● *Escherichia coli* ● *Klebsiella pneumoniae* ● *Pseudomonas aeruginosa*
 ● *Klebsiella oxytoca* ● *Acinetobacter* species

E. coli



E. coli

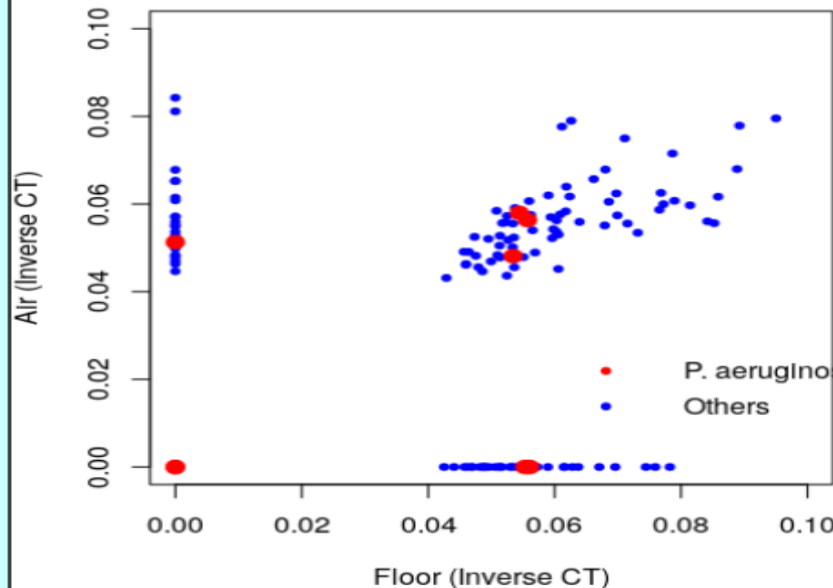


E. coli

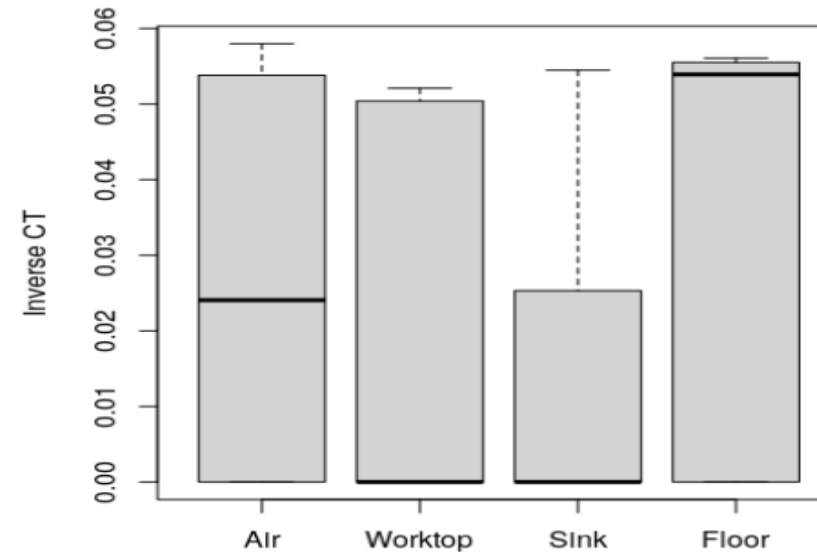
- Gram negative
- Colonises the gut
- Not thought to survive for long in air or on dry surfaces.



P. aeruginosa



P. aeruginosa



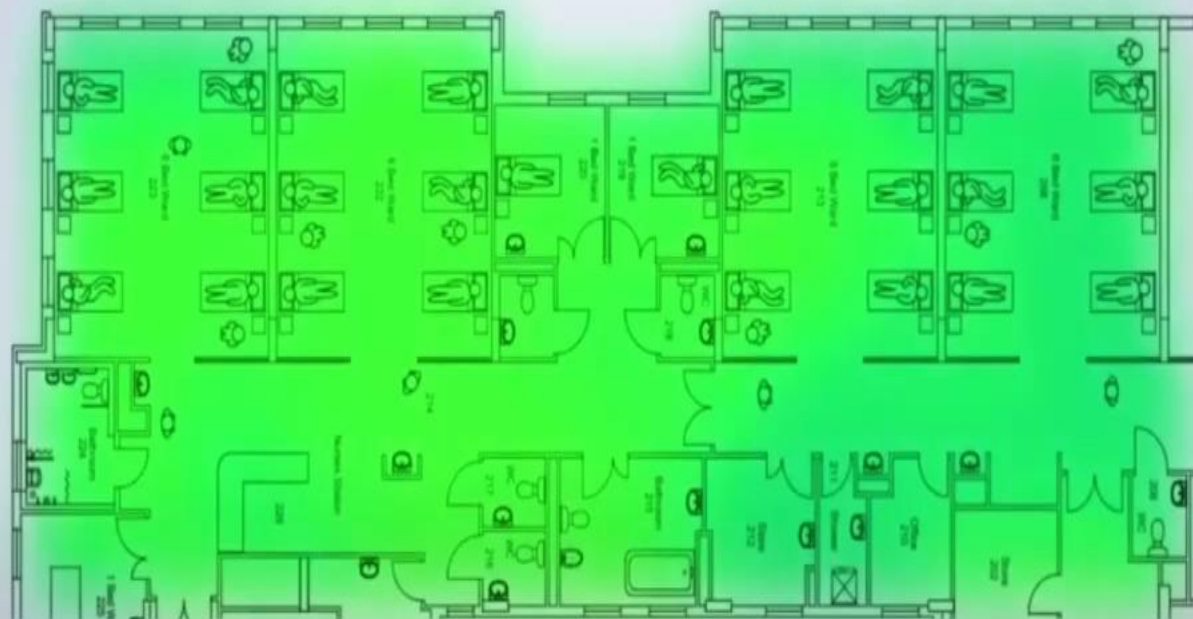
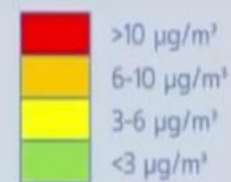
Pseudomonas aeruginosa

- Gram negative
- Lives in soil & water
- Not thought to survive for long in air or on dry surfaces.





PM $<1 \mu\text{m}$



3.29am

3.30am

3.50am

Health Economics



A nosocomial infection is an infection you get while you're in the hospital for another reason. It's also called a hospital-acquired infection or a health-care associated infection [\[1\]](#).

According to HES Inpatient data for FY2022, 109,565 admissions were registered in the UK with ICD-10 code Y95: Nosocomial infection as secondary diagnosis. An average of 5.81 excess bed days was also seen for this particular ICD-10 code in 2022. As per [\[2\]](#), the excess LOS attributable to HAI was 7.8 days (95% confidence interval (CI): 5.7-9.9).

Assuming 22.8% of all Healthcare associated infections (HAI) are respiratory [\[3\]](#), that results in about 24,4980 admissions with a respiratory healthcare associated infection.

Total annual cost in the UK due to bed days lost to HAI was estimated to be £774 million [\[4\]](#).

As per [\[5\]](#),

RESOURCE	COST
General ward cost per bed day	£586.59
General ward cost per excess bed day	£351.00
Isolation ward cost per day	£586.00
ICU cost per day	£1621.16



Part of
The **AHSN** Network



Office for Life Sciences



Air Purity Intervention cost per bed day

Between £.90 - £1.50 per bed day. This depends on the environment, ward layouts.

Health Economics



Combined HCAI Infections - Financial Impact to 18th November 2019

	Total Number of cases	Cost per case (approx.)	Total cost
<i>Clostridium difficile</i>	91	£10,000	£910,000
<i>Staph. aureus</i> bacteraemia	89	£7,000	£623,000
<i>E. coli</i> bacteraemia (antibiotic sensitive)	154	£1,100	£169,400
<i>E. coli</i> bacteraemia (multi-resistant)	38	£1,400	£53,200
Total impact HCAI			£1,755,600

- Pre covid average monthly cost due to infections £250k

*Swansea Bay University Health Board Monthly HCAI
Performance against IMTP 2019/20 to 18th November 2019*

Health Economics



- *Cambridge University Hospitals trust put the estimated cost of a single 8 patient outbreak at between **£32,000 and £82,000** due to increases in length of stay, staff costs. The wide range for the estimate accounts for the potential costs incurred due to litigation for 3 patient deaths that occurred as a result of the outbreak used to demonstrate the business case*
- A single resistant infection has been estimated to cost about **EUR 8 500 to 34 000 more** than a non-resistant infection, due to additional hospital days and additional treatment costs (OECD, 2017)
- Surgical Site Infections cost between **10k-100k** on average per case
- 25 bedded ward closure: average 7 days x £586 per bed day: **£102k**

Case Studies Net Zero



East London Foundation Trust Head Quarters:

- Ventilation improvements required £2.8m
- 6 months work
- Limited capacity due to HTM03-01 ventilation compliance (100 people)

Air Purity Solution:

- Keep existing ventilation and add Air purity system £90k **saving more than £2.7m**
- 2 days work
- Larger capacity complying to HTM03-01 ventilation compliance (150 people)
- 40% energy saving on Heating/Cooling
- 4x Energy savings vs ventilation
- Annual energy saving approximately £38,000

Case Studies Net Zero



East London Foundation Trust Podiatry Clinic

Ventilation cost: £48k

Air Purity: £9.8k

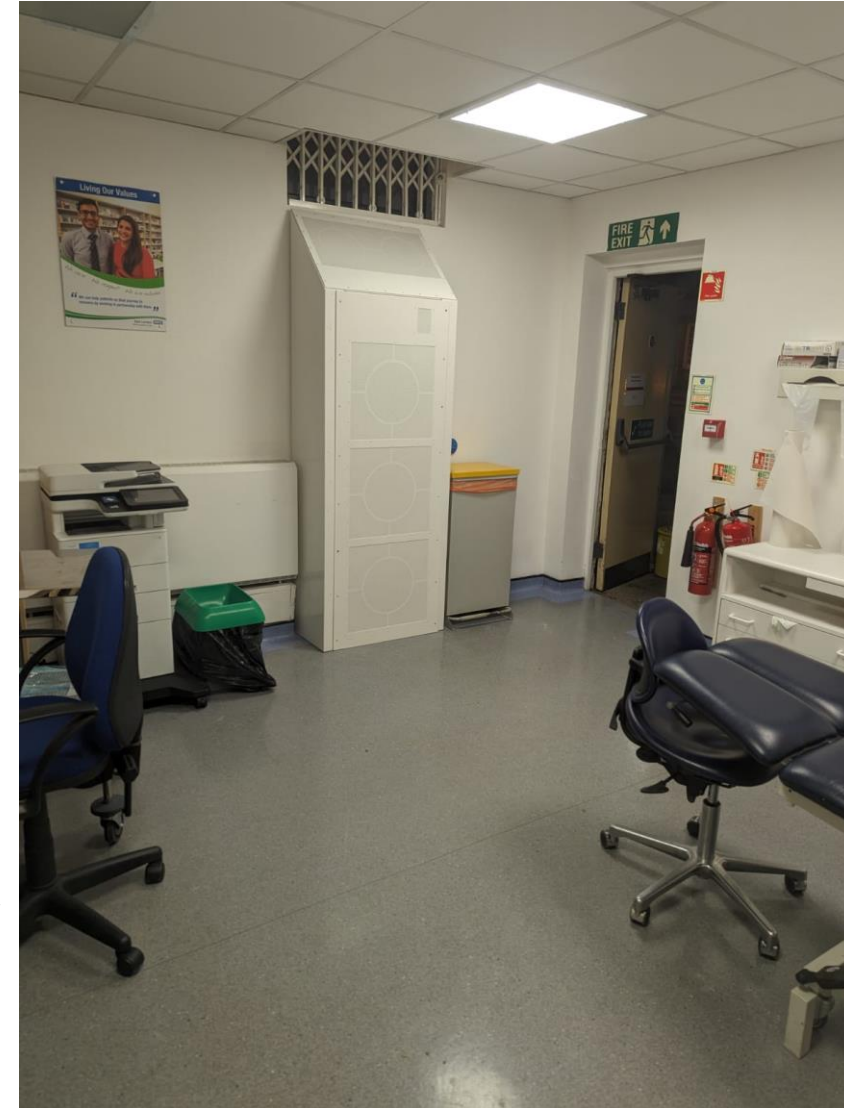
Ventilation works: 5 months

Air Purity: 3 hours

320% energy efficiency

Energy Saving: £2,100 per annum

Clinically all types of procedures can be undertaken, better heating and cooling, no odors and more clinical assurance that patients and staff are safe.



More Visuals



Please follow AAirDS

Any Questions Please contact Darren Sloof directly on

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AirPurity



AeroTitan™



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