



ELECTIVE THEATRES SHUTDOWN CHECK, ANAESTHETICS TEAM

TEAM MEMBERS:

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Background:

Hospital operating theatres are highly specialised areas. They utilise powerful, high turnover ventilation systems, high level lighting and many electrical devices, which include anaesthetic machines with gas scavenging pumps and personal computers (PCs). Typically, an operating theatre consists of the theatre itself as well as an adjacent anaesthetic room used for the induction of anaesthesia (and smaller utility rooms beside). As a result, equipment such as PCs and anaesthetic machines are duplicated.

Planned (elective) operating usually takes place during daytime hours and during the working week only, while emergency operating occurs around the clock. Therefore, in our hospital with 20 operating theatres, the majority of these will not be used for most of the time (night and weekends).

Theatre ventilation systems involve powerful fans, achieving up to 500 air changes per hour in an operating theatre and thereby contributing to infection prevention. While we have not been able to find out energy consumption data of this equipment in our hospital, we know that it is significant, and furthermore they produce significant levels of noise (about 53dB at full power), which may be partially transmitted to adjacent hospital areas through walls and ceilings. This can represent a hidden source of patient and staff discomfort

Anaesthetic gas scavenging pumps and overhead radiators use large amounts of energy in anaesthetic practice¹. Per theatre (with adjoining anaesthetic room) the anaesthetic gas scavenging pumps consumed 18.03 kWh per 24-hour day. We do not use overhead radiators in our hospital, but anaesthetic gas scavenging is an important part of workplace safety in that it minimises staff exposure to inhalational anaesthetics.

According to the Carbon Trust switching off a computer and monitor out of office hours could reduce its energy cost by over 75%². In our setting the operating hours are longer, offering potential savings closer to 67%. Bearing in mind that there are approximately 100 computers in the operating theatres department, despite relatively low individual energy consumption the energy saving could be significant.





Our standard operating procedures did not include routine switching off of equipment at the end of the day. There have been energy saving initiatives in other hospitals, such as Operation TLC at Barts and the Royal London Hospitals resulting in significant financial savings and improved patient care³. We wanted to replicate this in similar fashion in our operating theatres department. By switching off electrical equipment and ventilation systems as well as lights in operating theatres outside of standard operating hours could result in significant energy savings.

Specific Aims:

To effect a behaviour change among staff, making the switching off of equipment at the end of the day second nature, increasing staff morale and resulting in carbon and financial savings.

Methods:

We compiled a list of electric devices that could be shut down routinely in elective operating theatres at the end of a working day. A member of our group took a snapshot audit of this equipment in all operating theatres during a night shift to give a baseline overview. We developed a theatres 'shutdown' list and poster (Appendix 1) with an eye-catching design, stating the Health Board's aim of carbon-neutrality and suggesting an easy "shutdown" list for elective operating theatres.

As we are members of the anaesthetics team it was important to get engagement from the surgical scrub staff who are responsible for roughly half of the devices on our "shutdown" list. Conversations were held with the senior management in theatres who have a surgical scrub background, and they expressed their support. When speaking to staff, it became apparent that to activate the routine self-check of the more sophisticated machines in the morning, the machine has to be switched off and back on again. So in this case our protocol of switching off the machine at the end of the day would not increase the overall workload for staff, but rather change the timing of a particular task.

Our posters were displayed within the operating theatres near the control panels for room ventilation and lights as well as in the anaesthetic rooms on the exit door. A clinical governance day was used to engage with staff and discuss with them about beneficial effects of following the new shutdown procedure.

When checking the anaesthetic gas scavenging we discovered a fault with the control panels, making it impossible to switch off scavenging pumps. The repairs were not completed by the time of writing of this report, so we are not able to measure this item on our shutdown list for the time being.

At time of writing, we are planning a repeat audit following a clinical governance day to review equipment use after our staff engagement. We also plan to integrate this review into our monthly audit cycle.





Measurement:

Patient outcomes:

We don't expect any direct benefits for patients. Potential harm could occur if staff forget to switch on equipment in the mornings, but checklists are already in place to help minimise this risk.

Population outcomes:

The reduction in energy use and energy expenditure for the health board will potentially benefit the wider population even though this may not be directly measurable.

Environmental sustainability:

Potential carbon savings were estimated by energy consumption of equipment, obtained from various Trust departments, namely medical electronics, IT and estates. We were successful in finding information on the energy consumption of the anaesthetic machines in standby modus. For the energy consumption of computer equipment, we have relied on information from the Carbon Trust. A group from Southampton has measured their energy consumption for anaesthetic gas scavenging and calculated the amount per theatre. We have not been able to find out the energy consumption of the theatre ventilation fan units nor the electric lights and have therefore excluded them from our calculations at this time.

Economic sustainability:

Our trust pays 28p per kWh of electricity, quoted by our Electrical and Biomedical Engineering Department.

Social sustainability:

We plan to assess staff satisfaction in unstructured conversation some time following the launch of the initiative.

Results:

Patient outcomes:

Checklists are already in place to help minimise risk to patients which will continue to be monitored and measured.

Environmental sustainability:

Our audit revealed that nearly 50% of equipment switched on in operating theatres that were not going to be used during the night. We have not been able to assess the effect of our theatre shutdown initiative yet following the clinical governance day and have therefore estimated the potential savings.





Equipment	Quantity of machines/equipment	Additional time switched off per day	Power consumption per item	Potential saving per year	KG CO2e/year
computers	70	13 hours	200 Wh ⁵	66,430 kWh	17,375
Anaesthetic machine	20	13 hours	210 Wh	19,929 kWh	5,212
Anaesthetic machine	16	13 hours	570 Wh	43,274 kWh	11,318
anaesthetic gas scavenging	17	13 hours	751 Wh ⁶	60,579 kWh	15,844

We also anticipate that a 90% reduction in additional hours use would be realistic, which is a potential saving **44,774 kg CO2e per year**, equivalent to driving 128,957.6 miles in an average car.

Unfortunately, due to faulty control panels which require maintenance work it is not possible to turn off anaesthetic gas scavenging machines at present. Excluding this from our calculations, with 90% applicability, savings of up to 30,514 kg CO2e per year can be achieved.

Economic sustainability:

By switching off all the eligible anaesthetic machines and anaesthetic gas scavenging pumps rather than 0-50% as per baseline practice, the health board could save well over £26,000 per year.

This does not consider the potential savings from switching off computers, lights and theatre ventilation fans, because we lack the information needed to calculate.

Social sustainability:

We plan to assess staff satisfaction in unstructured conversation some time following the launch of the initiative. There may be an improvement to the immediate ward environments in the vicinity of the operating theatres through the noise reduction when the ventilation systems are shut down, although this is unlikely to be measurable.

Discussion:

Switching off equipment at the end of a working day is a natural thing to do. In a hospital environment however, there is always the possibility of unplanned requirements, such as having to set up a theatre not currently in use for emergency cases. In these time-critical events every minute counts, and the more elements there are to “setting up” the theatre, the longer it takes and the higher the risk of unintended omission. For that reason, there can be reluctance towards shutting down in the prescribed way. On the other hand, with 20 theatres available, the majority will never





be used out of hours, and good planning can enable staff to fully shut down most elective theatres at the end of a working day, while two or three theatres remain on standby.

There could also be concerns about patient and staff safety if important equipment was not switched on at the beginning of the working day. Computers and lighting do not carry such risk. A widely used routine checklist by the Association of Anaesthetists in Great Britain and Northern Ireland is carried out by every anaesthetist at the start of the day, in addition to the checks performed by the anaesthetic assistant before the first patient enters theatre. If any essential equipment has remained switched off, this will be noticed and rectified.

If the theatre ventilation system was not switched on, it would be unlikely to go unnoticed as the room temperature would increase due to the strong lighting and other electrical equipment running, causing staff discomfort. The absence of the usual background noise would probably be noted before any rise in temperature. Patient harm due to the absence of appropriate theatre ventilation would be impossible to detect as the main beneficial effect for patients relating to this is a reduction in wound infections, the causes of which are usually multi-factorial, and tracing things back to the theatres environment whether or not there was adequate ventilation would be impossible.

Computers in the operating theatres and anaesthetic rooms are shared equipment and normally automatically login on booting. There are occasions when the automatic login does not happen and staff have difficulty remembering login details, in particular the generic ID. This potential obstacle to switching off computers was eliminated by GH by attaching labels to each computer in the theatres department stating their individual login IDs. The passwords required for login are generally known and should not be displayed for obvious reasons.

The timescale of ten weeks for this project was not sufficient to gather all the relevant information from the various departments about the respective energy consumption of the different parts of equipment used in the operating theatres. As a consequence we had to use data from the internet in the interim period to be able to estimate the savings made through this project.

Conclusions:

Switching off electrical equipment at the end of a working day has a positive psychological effect for staff in that it signals the conclusion of a day's task. It gives a good feeling through the knowledge of doing something right. This in itself can raise the morale, which is highly relevant in clinical workplaces.

Saving energy is part of an attempt to live and work in a sustainable fashion with future generations in mind. Although our hospital owns a solar farm it cannot cover all its electricity needs all the time, particularly not at night since it has no energy storage facilities.

The financial aspect of energy saving has become particularly relevant in recent months with the increases in the cost of electricity.

This initiative has beneficial effects in all of these aspects, and we hope that with time the actions prompted by our posters will be second nature to all staff in the operating theatres so much that they will be applied in other areas.





References:

1. Pierce et al. (Health Estate 2014 Mar;68(3):58-62)
 2. [CTV007_OfficeBasedCompanies-2021-update.pdf \(windows.net\)](#) accessed 6/12/22
 3. [Barts links energy saving to patient care and saves £105,000 in first year | Guardian sustainable business | The Guardian](#) accessed 6/12/22
 4. <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022>
 5. Source for energy consumption of a computer: [How much power does a computer use? And how much CO2 does that represent? – Energuide](#) (accessed 17/1/23)
 6. Source for energy consumption of anaesthetic gas scavenging machine: Pierce et al. Reducing theatre energy consumption. (Health Estate 2014 Mar;68(3):58-62)
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Appendix 1: Poster used for publicity of the Elective Theatre Shutdown Check:

