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Energy efficiency in the radiography department: An Irish perspective

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ABSTRACT

Background: Previous research has demonstrated that individual radiology departments do not use energy efficiently. Such studies have commented that radiologists hold a 'unique role' in the promotion of 'eco-friendly' radiology departments. Improving energy efficiency can save both energy and money and can therefore be viewed as a means of tackling – albeit on a minor scale – both global economic and environmental issues. The current research aimed to present an Irish perspective of radiology energy efficiency and more specifically the radiography department – a department primarily staffed by radiographers.

Method: Out-of-hours end-use energy surveys were undertaken in four Irish departments. Ancillary electrical equipment and lighting, if any, not powered off were recorded and the energy such equipment consumes in the out-of-hours setting annually was quantified. Additionally, all desktop and workstation displays – regardless of their power-state – were recorded for comparison both between studied departments and to previous research.

Results: A range of equipment including desktop and workstation displays, computers and CR plate readers are left on in closed departments. Lighting is not powered off in radiography departments, notably within X-ray suites and changing rooms. Estimated annual savings in individual radiography departments ranges from 6656 kWh to 27,542 kWh and €1095.58 – €4533.41 (£865.50 – £3581.39).

Conclusion: Irish radiography departments are energy inefficient and radiographers, as the primary staff in this area, have a role in the promotion of improved radiology energy efficiency. This study focused on radiography departments, but improvements are also likely to be achievable in the wider hospital.

Introduction

The implications of our over-reliance on fossil fuels as a source of energy have been heavily publicised in recent times. While the threats associated with environmental pollution have been widely perceived as scaremongering, the realities of climate and change and global warming are becoming ever more apparent. The United Nations has highlighted climate change as the '*defining human development issue of our generation*'.[1]

A global, united effort is required if the burden of climate change on the environment is to be lessened. Healthcare is just one sector where energy savings are achievable yet it consumes a notable fraction of energy within the tertiary or services sector. In the UK 7% of energy in the services sector is consumed by healthcare,[2] furthermore in the USA 9% of the commercial energy consumption is attributed to healthcare facilities.[3] The health and wellbeing of patients is considered paramount in healthcare, Deputie and Farrington[4] comment however that environmental pollution associated with energy wastage in hospitals seems to contradict this message. Rises in vector-borne diseases such as malaria as well as diarrhoeal diseases such as cholera after flooding and droughts have both been predicted. Additionally as climate change leads to the alteration of ecosystems, along with their associated allergens, there is expected to be an increase in asthma and other respiratory tract allergies.[5]

Energy efficiency refers to the reduction of energy input for a given output; it has been viewed as an effective means of tackling current global environmental and economic problems.[6] Quite recently both Prasanna et al.[7] and McCarthy et al.[8] have focused on energy efficiency specific to the radiology department and have demonstrated clear inefficiencies with respect to energy consumption. In one case 67.4% of desktop computers and 92.6% of PACS reporting stations were left switched on after the radiology department had closed.[8]

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The 24 h operating nature of the hospital environment must be acknowledged when approaching an issue such as healthcare energy efficiency, and despite radiology services often operating around the clock, the main department will generally close each evening and at weekends. While saving energy and money will never be the priority in healthcare, radiology departments have, according to Reiner et al.,[9] a '*dual mission*' and must also run departments which are as efficient, productive and profitable as possible. Prasanna et al.[7] have commented on the unique role of the radiologist in the promotion of energy efficiency, but, simply due to the nature of their profession, radiographers are responsible for the acquisition of the vast majority of images in radiology departments and similarly interact with electrical equipment daily.

Research conducted external to healthcare has shown that the way in which staff interact and behave with electrical equipment in their workplace can have a major impact on energy consumption[10,11]; it is likely that this stands true for hospitals and, more specifically, radiology departments. With this in mind the current research project aimed to gain an Irish perspective of energy efficiency in radiography departments, a subsection of the radiology department primarily staffed by radiographers.

Methodology

A critical aspect of radiology energy wastage which can be meaningfully tackled, and with little or no cost, is that consumed after the department closes. Out-of-hours end-use energy surveys were undertaken in four radiography departments in Irish public hospitals. The method employed in this project aimed to determine if a role for the radiographer exists in the promotion of energy efficiency in radiology, to estimate the potential energy and cost savings available and produce the first multi-centre study of energy efficiency in radiology.

Sample population

It was determined, after consulting the Health Services Executive (HSE) website[12] and contacting individual centres, that there are 50 hospitals operated by the Health Services Executive (HSE), all of which have radiology departments. Irish public radiography departments were grouped depending on whether they were located in hospitals with (i) <200 beds or (ii) 200 beds or greater and stratified random sampling (SRS) was undertaken to ensure equal inclusion of both groups.[13]

Out-of-hours end-use energy surveys

Surveying energy consumption in the out-of-hours setting, as has been demonstrated in previous studies focussing on the hospital in general[6] and those specific to the radiology department,[7,8] is a successful means of data collection. To improve research standardisation all energy surveys undertaken as part of this research took place on Friday evenings after individual departments had closed; the duration of these surveys varied depending on the amount of equipment and lighting to be recorded. Ancillary electrical equipment and lighting seen in modern radiology departments were the focus of this study. Heating, ventilation and air-conditioning (HVAC) and medical imaging equipment (generators, control panels and X-ray tubes) were excluded from the current study due to difficulties in quantifying the associated energy consumed.

For the purposes of this study three power states (On, Standby and Off) were recorded and are subsequently referred to. Initially equipment which was not powered 'Off' during the surveys was focused on; the type of device, model specifications, its location in the department and power state (On/Standby) were recorded. A data collection sheet was then also used to specifically record all desktop and workstation displays (including those in the 'Off' power state) in studied departments along with their associated power state (On/Standby/Off). Furthermore, during both data collection and data analysis, the recognition of potential roles for the radiographer in the promotion of energy efficiency was given attention by the researcher.

Quantifying energy consumption

It was assumed that equipment which was left on at the time of the out-of-hours end-use energy surveys was never turned off in the out-of-hours setting (defined for the purposes of this study as 5pm–9am on weekdays Monday to Thursday and from 5pm on Friday to 9am on Monday morning – 128 h weekly). Potential energy and monetary savings were then quantified on an annual scale.

For the vast majority of equipment, energy was quantified by directly attaining energy consumption information (in kWh) from equipment manuals available in the radiography departments studied or online at vendor websites. In some cases this was not possible and three alternative methods to quantify energy consumption were used:

1. Use of EU EnergyStar online resources to find energy consumption information (kWh) for desktop and workstation computers.[14]
2. Returning to departments with a plug energy meter to measure energy consumption (kWh) of equipment at the power state recorded in out-of-hours end-use energy surveys.
3. Voltage and current values from information plates on equipment were multiplied to give a value for power in watts. Values in watts were divided by 1000 to give kilo-watt (kW) and multiplied by specific number of hours to give kilo-watt hours (kWh).

Results

There were some interesting findings in the four departments studied which the researcher found difficult to directly extrapolate, such findings may however be present in other radiography departments. In the two large departments (H1 and H2) while the majority of out-of-hours work was undertaken remote to the main radiography department, there were instances when equipment in the main department was required. It was also noted in H1 and H2 that the main department served as a route for patient transfer and staff movement to other imaging modalities (notably CT) in the out-of-hours setting and lighting was therefore required. The equipment and lighting mentioned above were excluded from the current study to ensure that a truly representative perspective of energy efficiency in radiography departments was presented.

Out-of-hours energy consumption

Estimated annual cost savings are presented in both Euro and GBP (exchange rate correct as of 6th September 2014), with the cost per unit energy calculated based on the average price offered across four Irish electricity suppliers in 2014.[15]

Electrical equipment

A range of electrical equipment was found to be powered on during out-of-hours end-use energy surveys including: workstation and desktop displays, computers, printers and CR plate

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