Reducing Energy Consumption in UCSF ORs

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Introduction

The healthcare industry is one of the most energy intensive industries in the United States. It is estimated that upwards of 10% of all greenhouse gas emissions in the US are directly or indirectly related to the healthcare sector. While this problem is not unique to the United States, the country lags behind compared to other similarly developed nations. For example, Australian healthcare emissions are estimated to represent 7% of national greenhouse gas emissions and the United Kingdom's healthcare industry makes up only 3% of their emissions.

Hospitals remain one of the worst offenders for energy consumption. Nearly 40% of all healthcare-related emissions are hospital-related and over a third of that is for hospital power generation and supply. Furthermore, operating rooms are one of the most energy intensive spaces in hospitals. One study found that both peak and base operating room energy consumption per square meter was nearly triple that of inpatient wards.

Targeting heating, ventilation, and air conditioning (HVAC)—which can be up to 90% of daily OR energy utilization—represents a potential major source of energy reduction. Currently no system exists across the University of California San Francisco (UCSF) hospital system to turn down or off lighting, air conditioning or electrical appliances in unused operating rooms overnights or on weekends.

Between the three main UCSF hospitals (Moffitt-Long, Mission Bay, and Mount Zion), there exist 60 operating rooms, most of which are used between the hours of 7am and 7pm. No more than 10 operating rooms are used over weekends and even among those used they are not continuously running. Despite this, most of the rooms run with lights and air conditioning on regardless of OR occupancy. With over 70% of UCSF operating rooms not operating during these off hours, this represents a potentially large source of savings in both energy utilization and cost for the hospital.

Project Goals

The project is split up into multiple phases. The first part of the project seeks to more accurately assess energy consumption in operating rooms across the UCSF hospital system to establish a baseline. From there, the project hopes to identify areas of energy wastefulness and to create changes to hospital workflow that address the waste.

- **Collect Data:** Gather data from different operating rooms across multiple UCSF hospitals. This includes HVAC, lighting and plug load energy consumption.
- **Interpret Data:** Take data to analyze for potential energy and cost savings. Identify areas of energy excess or waste.
- **Enact Change:** Work with hospital clinical engineering, facilities and other perioperative staff to create changes in workflow to help reduce energy consumption.
- **Analyze Outcomes:** Collect and analyze post-intervention data to assess environmental and financial impact.

Materials and Methods

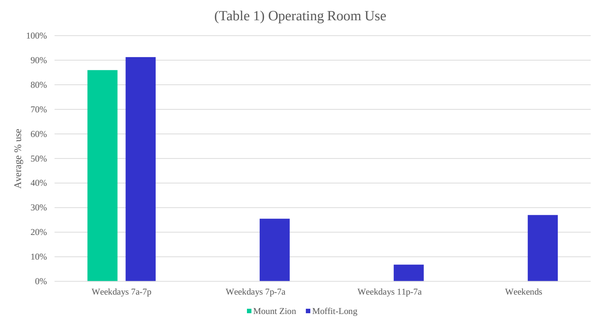
The project worked with facilities and engineering to identify representative operating rooms across two of the three UCSF hospitals. Five operating rooms from Moffitt-Long and five operating rooms from Mount Zion were identified and installed with temperature and humidity data loggers. Temperature data was recorded for one full month at each clinical site (March 2017 for Moffitt-Long and April 2018 for Mount Zion).

The UCSF "Caseview" system was also used to track operating room use across all ORs at Moffitt-Long and Mount Zion hospitals for one full month (April 2018). This data, along with the temperature data from the installed loggers, was then split into the following groups: weekday 7a-7p, weekday 7p-7a and weekends.

From the baseline data gathered above, energy use from air conditioning was correlated with OR use and cost savings projections were made based on similar "set back" pilot projects.

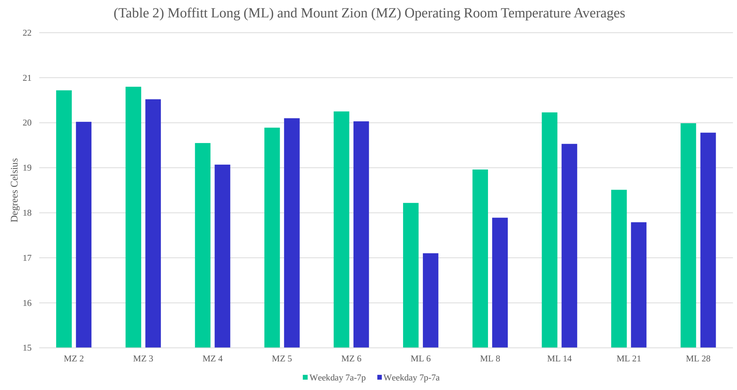
Results and Outcomes

(Table 1) Operating Room Use



Defining the problem: While nearly all ORs at both hospitals run at capacity during the day, the number of operating rooms in use overnight and weekend drop significantly—especially from the 11pm-7am range.

(Table 2) Moffitt Long (ML) and Mount Zion (MZ) Operating Room Temperature Averages



From the data above, there is little variation between OR temperatures during high occupancy and low occupancy. The temperature even begins to trend further downward during periods of low occupancy. Furthermore, if we assume an ambient room air temperature of 22C, the data suggest these rooms are being air-conditioned 24 hours per day.

Projections and Savings:
Using the logger data from above as well as reference data from similar case reports, we can calculate estimated savings from an HVAC setback program.

During setback hours, guidelines allow a decrease in air turnover from 20 air changes per hour to just enough to maintain a positive pressure gradient.

Based upon similar data in other case reports, this represents a reduction in air velocity from 11000 cubic feet per minute (CFM) to approximately 8000 CFM of conditioned air during off hours per Air Handling Unit (AHU).

Assuming a setback of eight hours at Moffitt-Long:

- → estimated reduction by 21,000 CFM (approximately 70 tons) per hour of conditioned air across 28 ORs
- → assuming one ton of conditioned air requires 3.52 kW of energy
- → at $0.11 per kWh, this represents $800 per week in savings
- → which translates to a potential $41,500 per year in savings

Assuming a setback of twelve hours at Mount Zion:

- → estimated reduction by 7,500 CFM (approximately 25 tons) per hour across 10 ORs
- → assuming the same conditions as above, this represents $430 per week in savings
- → which translates to a potential $22,250 per year in savings

Conclusion

Currently there exists no system in place to reduce air ventilation and energy consumption in unoccupied UCSF operating rooms.

75% of Moffitt-Long ORs and 100% of Mount Zion ORs are unused overnight and during the weekend. Logger data suggest that these rooms are being continually air conditioned despite being unoccupied. This represents a potential significant source of cost and energy savings for the UC hospital system.

Future Directions

- Collect CFM data from UCSF hospital AHUs to better quantify potential savings
- Work with facilities and engineering to establish HVAC setback workflow
- Collect data on other potential sources of wasteful OR energy consumption (e.g. plug loads)

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