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DNI/NIE/Passaport	33950763A
Nom i cognoms	Eduard Cubi Montanya
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(Mínim 1 i màxim 4, podeu veure els codis a http://doctorat.upc.edu/gestio-academica/impresos/tesi-matricula-i-diposit/codis-unesco)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

Surgery rooms are a space type with particularly stringent indoor environmental quality (IEQ) requirements, which translate into high energy use. Due to the unclear IEQ and infection control requirements for surgery rooms in Spain, these spaces are often designed and operated 24 hours per day and 7 days per week, to meet the most stringent recommendations (not only the requirements) in the available guidelines. While health and safety must remain top priority in hospitals, the high energy use of HVAC systems in surgery rooms makes these a clear energy efficiency target. The objective of this thesis is to identify and evaluate energy efficient ventilation strategies in surgery rooms that maintain acceptable indoor environmental quality and cleanliness while reducing the associated energy use.

A comprehensive and critical review of the indoor environmental quality and infection control requirements in surgery rooms identifies the key performance goals of the requirements in the available standards, and sets the boundaries for the definition of energy efficiency improvements in surgery room systems. The intrinsic performance motivations for the requirements for total supply airflow, outdoor airflow, temperature, and relative humidity are different, which brings the opportunity to improve energy performance by individually controlling the different setpoints. A general method to adjust system operation (outdoor airflow rate, total supply air, indoor air temperature, and indoor air relative humidity) to meet IEQ performance goals while reducing energy use is developed.

A calibrated computer-based energy model of a standard surgery room system is used to assess the potential benefits of control strategies. A careful control of a standard surgery room air handling unit can reduce primary energy use and associated CO2 emissions and energy costs by up to 83% while meeting all the indoor environmental quality and infection control requirements in the standards. In view of the magnitude of the potential energy savings, control measures for surgery rooms should be strongly encouraged for their wide application. Further savings are possible by controlling supply airflow based on real time measurement of particle concentration. However, the potential benefits of this strategy are constrained by the current unavailability of particle count targets during surgery room operation as a function of surgery type. Real performance-based infection control will not be possible until real-time sensors are capable of counting and identifying microorganisms.

A calibrated energy model is also used to assess the potential energy use and thermal comfort benefits of controls in old and non-standard systems. Results show that customized control strategies can also be successfully implemented as a retrofit solution.

The large volumes of outdoor air supply in surgery rooms make these particularly suitable for energy recovery systems. An evaluation of the thermal energy use required for ventilation air conditioning across Catalonia is provided. This is meant as a tool to assess the potential benefits of different types of heat recovery units. Ventilation air conditioning energy use is dominated by heating thermal energy over cooling thermal energy even in the warmest regions in Catalonia.

Energy efficiency in surgery rooms could be largely improved with control and heat recovery strategies that fall within the limits of the current indoor environmental quality standards. Future research should study appropriate technologies to monitor surgery room occupancy for air handling unit control purposes, and work towards defining infection control performance targets and monitoring tools.

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