Warning! Fire in the ICU

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Abbreviations:
ICU: Intensive Care Unit
UPS: Uninterruptible Power Supply
CORE: Regional Emergency Operations Centre

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Abstract

At 5:30 PM on December 17, 2010, shortly after a power failure, smoke filled the Intensive Care Unit (ICU) of Federico II University Hospital in Naples, Italy, triggering the hospital emergency alarm system. Immediately, staff began emergency procedures and alerted rescue teams. All patients were transferred without harm. The smoke caused pharyngeal and conjunctival irritation in some staff members. After a brief investigation, firefighters discovered the cause of the fire was a failure of the Uninterruptible Power Supply (UPS).

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Introduction

Fires in public buildings are emergencies, especially in hospitals where a fire may pose great difficulties in moving patients with limited mobility or requiring intensive care.[1] The 1000-bed University Hospital "Federico II" of Naples (Italy) was constructed in the late 1960s and early 1970s, and has 440,000 m^2 of floor space spread out over 21 buildings. Patient transport is carried out by an internal ambulance service.[2] Completely renovated and reopened in 2008, the Intensive Care Unit (ICU) has 14 beds including four isolation rooms.

Report

At 5:30 PM on December 17, 2010, nine non-ambulatory patients were in the ICU with seven requiring mechanical ventilation, and two of those requiring chest drains. The staff consisted of two specialist physicians, three residents, five nurses and a technical auxiliary staff member. Suddenly, medical equipment alarms sounded, alerting staff to a lack of power supply. The lights remained on. A few minutes later, as personnel verified the operation of equipment, fire alarms were triggered as a thick blanket of smoke reached some quarters on the hospital first floor, which was separated from the ICU by a fire door.

Immediately, the following departments were alerted to the emergency, in this order: 1) Fire Department; 2) Hospital Technical Service; 3) Police; and 4) Health Emergency Operations Centre 118, which connected to the Regional Operations Centre (CORE). It was determined that there was an immediate need for transfer of hospital patients to ICU beds in the metropolitan area. Aware that the battery life of the ventilators would have an average duration of 30 minutes, nurses and resident physicians began monitoring ventilator patients and were ready to provide manual ventilation when batteries gave out. At the same time, with the help of the Medical Direction and the Internal Emergency Operations Centre, the ICU staff sought appropriate beds in other parts of the hospital. The hospital ambulance service was alerted to convene as many ambulances as possible outside the ICU for transport.

At 5:50 PM, two teams of firefighters and a police patrol arrived. The Fire Department secured a source of transportation to assist in the evacuation of patients. Inside the hospital, alternate beds for the smoke-damaged ICU were provided by opening a post-operative intensive care area. Four appropriate beds were located in another building of the hospital, while further bed availability was located in the Cardiac Surgery Intensive Care. The CORE, meanwhile, reported five open beds at the nearby Cardarelli Hospital, and the availability of ambulances to transport patients. Ultimately, nine patients were transferred: three to Cardarelli Hospital and six within the hospital. Power was restored forty minutes after the initial shutdown, but staff decided to continue the transfer of

patients, as the failure of the Uninterruptible Power Supply (UPS) did not guarantee supply of electricity in the case of a second power failure. No harm to patients was reported.

Discussion

A fire in an ICU is highly dangerous because of the very high density of canisters with oxygen and medical air at high pressure (4.0 bar-3.040 mmHg) and cables and electrical equipment. In addition, there can be loss of compressed and environmental oxygen which ICU patients generally breathe at high rates.

In this case, the intervention of the fire brigade, police and ambulances was slowed by heavy traffic in the city (it was the last weekend before Christmas, and cold weather and rain discouraged use of public transport). Also, the Fire Service discovered that the cause of the fire was the failure of a UPS (this equipment consisted of multiple storage batteries) located in the basement, near the central staircase of the building. Investigation revealed that the failure may have been caused by a lightning strike. The UPS unit was normally placed on the electrical circuits that supply essential and life-saving medical equipment (special outlets in the headboards of the beds). For this reason, the interruption of electricity affected only the equipment and not the overhead lighting, where electricity was provided by another line. The automatic electrical bypass, while functional, was not activated as it relied on the failed UPS. Technicians were able to restore power in 30 minutes with manual activation of a bypass, but were not able to guarantee that the electricity supply would be stable if power failed again. Of note, the hospital central generator starts approximately 30 seconds after power failure, which is too long for continued medical equipment support of most patients in an ICU.

During the emergency, it was discovered that nearly all department telephone lines were disabled; therefore it was necessary to use mobile phones. Mobile phones proved crucial in enabling direct communication between the CORE and the commanding doctor and allowed for continuously updated transfer-related needs. Phone ringtones were almost inaudible because of the noise of the fire alarms, which were silenced only after the intervention of the technical service.

The fire door between the stairs and the ward limited but did not halt the entry of smoke into the ICU. Staff members experienced pharyngeal and conjunctival irritation; all patients had respiratory filters and were not harmed.[3] The windows of the ICU department were usually blocked; in addition, the window handles were in places not readily accessible.

Among the interventions and improvements made after the fire, fire doors were doubled to create a "filter," and a new fire door was placed between the first level of the basement and the central stairs of the building. In addition, highly visible boxes made from safety glass and containing handles to open the windows were hung on the ICU walls.[4]

The reservation of one of the four elevators (the one furthest from the fire) for use by the Fire Brigade was essential for the rapid evacuation of patients, which took place horizontally (ward → lift), vertically (first floor → ground floor), and then horizontally (ground floor → ambulances → final destination). The evacuation of each patient from the bed in the ICU to the ambulance took an average of seven minutes.[5]

The event received major coverage in regional media. Press relations were managed as planned by Medical Direction. The department was re-opened after a week of work and testing.

Conclusion

To the authors' knowledge, this is the first report of simultaneous fire and blackout in an ICU. The event highlighted critical material and organizational issues specific to the ICU environment, along with the need to have an organized approach for evacuation of an ICU during critical emergencies.

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