



## KEY POINT SUMMARY

### OBJECTIVES

The objective of this study was to evaluate negative pressure isolation rooms using the balanced scorecard framework.

## Post-occupancy evaluation of negative-pressure isolation rooms: Using the balanced scorecard framework

Wang, C. H., & Kuo, N. W. 2009 | *Journal of Architectural and Planning Research*. Volume 26, Issue 1, Pages 1-13

### Key Concepts/Context

To combat the spread of severe acute respiratory syndrome (SARS) following an epidemic outbreak in Taiwan in early 2003, all hospitals were mandated by health authorities to convert their patient rooms into negative pressure isolation rooms. The authors believe that it is necessary to evaluate these rooms to ensure that they are functioning effectively. They use the concept of post-occupancy evaluation (POE) with a balanced scorecard approach to conduct such an evaluation. The evaluation resulted in some interesting findings in terms of the necessity of an anteroom, ideal air change rates, the single patient room, and the use of HEPA filters in the context of isolation rooms.

### Methods

This study uses a balanced scorecard (BSC) approach for the POE. This approach aims to achieve a balance in assessing the finance, business process, learning and growth, and customer perspectives to avoid an overemphasis on the financial aspects. For this POE, the four aspects of the BSC were determined on the basis of the hospital's mission as to the perspectives of economics, internal processes, learning and innovation, and customers. The hospital where the POE was conducted was one of the major hospitals in Taipei, Taiwan treating SARS patients in 2003. A walk-through field survey and two focus group discussions were conducted in late 2005. Each focus group consisted of six participants; they included physicians, nurses, and other staff who had worked in the negative pressure isolation rooms. The field survey was conducted by the researchers.



### DESIGN IMPLICATIONS:

- The use of anterooms may not be necessary if there is a negative-pressure room with a suitable ventilation system and good pressure differential.
  - Multi-occupancy rooms might be used to cohort patients infected by the same microorganism in overflow conditions.
  - HEPA filtration should be considered.
- There may be a benefit for visual cues and warnings to alert staff to high-risk areas (e.g., color, signage, pressure monitors, alarms), for the use of elbow- or sensor-controlled doors, and conveniently located hand hygiene stations within the room.
- Dedicated elevators should be assigned for the transport of infectious patients during an outbreak.
  - It may be noted that for the design of isolation rooms/quarantine units, it is necessary to refer to the guidelines of the health authorities of the country.

## Findings

### Economic perspective:

**Anteroom:** An enclosed space where healthcare workers can put on or remove their personal protective gear after exiting the isolation room. From an economic perspective, an anteroom may not be added to the design if space was limited, but on the condition that the negative pressure isolation room is of high quality and has a robust ventilation system and a good pressure differential.

**Air change rates per hour:** This should ideally be between 8-12 times per hour.

**Pressure differentials:** Based on their experience of 2003, the focus group suggested that a pressure differential of 8 pascals should be sufficient.

**Single-bed room design:** Single-bed rooms are more effective in limiting the spread of airborne pathogens, and evidence indicates that they lower nosocomial infection rates.

**HEPA filters:** The focus groups highly recommended this, especially in places which have a high population density, like Taiwan.

### Internal process perspective:

**Need for surgical suite:** A quarantine unit should be equipped with a surgical unit to cater to emergency surgical needs of isolated patients. Alternately, at least one hospital in every region should be equipped with a negative pressure surgical suite.

**Patient and staff flow:** The transport of infected patients and materials should be via an elevator/ route separate from that of the staff.

**Air discharge:** Air from negative pressure isolation rooms should be directly discharged outside the facility at least 3 meters above the building height.

**Transporting patients:** Specially-designed equipment like negative pressure chambers may be used to transport infected patients.

**Doors:** Foot-stepping mechanisms for opening doors at the entrance to quarantine units had a drawback – over time there may be a shift in the wall that may upset the pressure differential. The focus group suggested the use of elbow-controlled mechanisms or sensor-controls for opening doors.

**Handwashing:** Conveniently located sinks and alcohol gels should be present in each room.

### Learning and innovation perspective:

**SOP compliance:** All SOPs must be posted at every entrance and other important areas to remind the staff.



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**High-risk areas delineation:** The focus groups suggested that different colors may be used for the walls and furniture to alert staff that they had entered a high-risk area.

**Airflow monitoring:** Monitoring of opened doors is crucial to maintaining the negative pressure in the isolation rooms. The focus groups suggested two mechanisms should simultaneously monitor airflow and pressure at each door and that pressure-sensing devices should have audible alarms.

#### Customer perspective:

**Outcomes:** Negative pressure isolation rooms had been very effective in controlling the 2003 SARS outbreak by preventing its spread; 90-95% of the isolated patients had recovered. No group nosocomial infection had occurred after these isolation rooms were built.

**Satisfaction of internal customers:** Over 83% of the focus group participants were satisfied or very satisfied with the negative pressure isolation rooms.

#### Limitations

The authors indicate that the single hospital site in Taiwan was a limitation of their study. They also note that while there are benefits of the balanced scorecard approach, subjective feedback may be less effective to determine performance than objective measures of room pressure (or even scored questions). Even though the authors feel the findings are generalizable in Taiwan based upon the standards for occupational health and safety, they do not cite that there may be specific requirements or cultural considerations that limit generalizability to other countries.

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