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An FMEA on the training of staff to evacuate patients from a hospital ward

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Peter Wilkinson and Charles Hancock explain how potential problems with training staff to evacuate patients in an emergency were identified, leading to action to remedy them.

A failure mode and effects analysis (FMEA), conducted on the training of staff to evacuate patients from a hospital ward, has identified 12 potential failure modes and their effects. For most of these failure modes, an action has been recommended to reduce their likelihood, reduce their consequences or eliminate them completely. One identified failure mode, however – the potential for trainees to suffer fatigue – does not have a corresponding action. The effects of fatigue are unavoidable and reflect the realities of patient evacuation. Successful staff training requires effective and timely pre-planning, and good communication and collaboration with managers at all levels, ward staff and other professionals such as back care and infection control specialists.

Healthcare fire safety

In hospital buildings, particularly in patient-access areas, the immediate and total evacuation of the building in the event of a fire may not be possible or desirable. Patients with restricted mobility, those who use wheelchairs and those confined to bed cannot negotiate escape routes, particularly stairs, unaided. Patients under medication may require staff assistance, and patients who are dependent on electrical or mechanical equipment for their survival cannot always be disconnected and moved rapidly without serious consequences.

The two main fire strategies used in healthcare premises are "progressive horizontal evacuation" and "defend in place". The principle of progressive horizontal evacuation is that of moving occupants from an area affected by fire through a fire resisting barrier to an adjoining area on the same level, designed to protect the occupants from the immediate dangers of fire and smoke (a refuge). The occupants may remain there until the fire is dealt with or await further evacuation to another similar adjoining area or down the nearest stairway. This procedure should give sufficient time for non-ambulant and partially ambulant patients to be evacuated down stairways to a place of safety, should it become necessary to evacuate an entire storey.

The principle of defend in place is to isolate patients and staff from fire and smoke while emergency personnel respond to the situation. It is not of primary relevance to this study.

Disaster planning is essential to develop a range of procedures to cover potential events that could require the evacuation of patients. Manion and Golden describe the importance of pre-planning and the multiple challenges presented to those undertaking the plan; the reliability of vertical evacuation equipment (including elevators), the manpower needed to transport patients, and the time needed for stabilisation before patient transfer.

Training

Pre-planning for a fire is key to the success of safeguarding the occupants of a hospital. As mandated in the Department of Health’s fire safety policy framework, the overall aim in the event of a fire is to ensure that all occupants can escape unharmed to a place of safety either inside or outside the building. There must be a prompt response to the alarm and an effective strategy for evacuation. Therefore, a sufficient number of adequately trained staff will need to be available to assist occupants who may be unfamiliar with the building layout, or require assistance due to their medical condition.

Fire safety training is essential for all hospital staff and is a legal requirement under the Health and Safety at Work Act 1974, the Management of Health and Safety at Work Regulations 1999 and the Fire Safety Order 2006. Staff need to know what to do in the event of fire so that fire safety procedures can be applied effectively. It is therefore imperative that healthcare organisations provide appropriate levels of fire safety training. The DH stipulates that this applies to all members of staff without exception.

There are a number of organisational competence and ethical issues that need to be considered in the training of students. Wilkinson describes the guidance available to fire safety practitioners in the health sector, and advocates a flexible approach to fire safety training programmes. Induction training must be given before the commencement of work, and must include fire safety material. Training for staff on night duty is particularly important in the view of the reduced levels of staffing which apply at that time. It is the responsibility of the healthcare organisation’s fire safety manager to develop a modular training programme which reflects staff responsibilities for fire safety and sets in place appropriate means for recording and monitoring staff training.

It is expected that staff who are involved in the direct care of patients, who are likely to need to help evacuate them, should receive training more frequently than others. The type of training should be based on the particular features of the premises and should:

- take account of the findings of the fire risk assessment;
- explain the emergency procedures; and
- take account of the work activity and explain the duties and responsibilities of staff.

Recent events, such as the fire at London’s Royal Marsden Hospital on 2 January 2008, demonstrate how crucial the actions of well trained staff are when an emergency evacuation is necessary.
FMEA and healthcare FMEA

Since the 1960s, FMEA has been widely used as a tool for safety and reliability analysis of products and processes in a range of industries. It is a technique to define, identify and eliminate known and/or potential failures, problems, errors and so on from the system, design, process, and/or service before they reach the customer.

The National Center for Patient Safety of the US Department of Veterans Affairs adjusted FMEA to the healthcare setting, resulting in the Healthcare Failure Mode and Effect Analysis (HFMEA). HFMEA is a five-step process which uses a multidisciplinary team to proactively evaluate the healthcare process.

It is suggested that the team use process flow diagramming, a hazard scoring matrix and a decision tree to identify and assess potential vulnerabilities. In this way, vulnerabilities are judged by their likelihood of occurrence, their potential severity and the ease at which they might be detected and intercepted before causing harm.

The FMEA on staff training

This FMEA focused on the training of staff to evacuate patients from a hospital ward both horizontally and vertically. It also concentrated on the role played by the hospital’s fire safety manager when planning, delivering and evaluating evacuation training.

Although in this case it was conducted by one person (the report’s author) a multidisciplinary team would be preferable. For this topic, it would be prudent to include nursing staff and ward managers, estates and facilities professionals, portering staff, the health and safety advisor and back care advisor, the human resources department, senior management (to get their support and buy-in to the exercise), and the evacuation equipment supplier (for advice regarding correct use of horizontal and vertical evacuation aids). A patient may also be a useful team member to give their perspective.

For this FMEA, there were a number of processes to describe, and then break down into sub-processes. A high level description of the main stages of hospital evacuation could be:

- Horizontal evacuation from the sub-compartment where the fire originates to an adjoining sub-compartment or compartment.
- Horizontal evacuation from the entire compartment where the fire originates to an adjoining compartment on the same floor.
- Vertical evacuation to a lower floor substantially remote from the floor of origin of the fire (at least two floors below), or to the outside.

As defined by Gwynne et al., the main activities (here numbered 1–5) involved in moving patients with their beds from one fire zone, horizontally, to a neighbouring fire zone are:

1. prepare the patient;
2. move the patient out of a room;
3. move a patient to a place of relative safety;
4. place the patient in a safe location; and
5. return to pick up the next patient.

Similarly, the main activities (activities 6–10) in moving patients vertically from the fire floor to a lower floor are:

6. prepare the patient to be lifted from the bed;
7. lower the patient from the bed;
8. move a patient to a place of relative safety on the lower floor;
9. place the patient in a safe location; and
10. return to pick up the next patient.

When conducting training for evacuation, further activities are required (activities 11–16). Before training, one needs to:

11. plan the scenario, ward type and patient type to be practised;
12. consult with management regarding time, resources, and objectives;
13. identify the individuals to receive the training;
14. identify the venue and equipment for training;
15. invite trainees; and
16. give a pre-training briefing and safety briefing.

Post-training, one must:

17. monitor and record effectiveness of the training;
18. provide feedback to trainees;
19. provide feedback to management; and
20. review policies and procedures to reflect any issues encountered (updating them if necessary).

The fourth stage involves conducting a hazard analysis. For the sub-processes identified under activities 1–20, all possible potential failure modes were listed. Next, the severity and probability of each was determined so as to understand which, if any, failure modes were so serious as to warrant process redesign.

To this end, a risk priority number (RPN) for each potential failure mode was established. The RPN is an index that expresses the risk level priority associated with each failure mode. It is determined by calculating the product of three indexes – severity, frequency and detection.

Table 1 lists four sub-processes, their activity number, identified failure modes associated with them and their RPN scores (highest first). For each of the failure mode causes identified, it was necessary to determine whether to eliminate, control or to accept the failure.

Common themes emerging from review

Analysis of the failure modes and causal factors in the FMEA has led to the identification of common themes. Correct planning and execution of manual handling good practice was the first theme identified, which is common to a few of the issues raised. Therefore, it is crucial to take correct advice from back care specialists whilst planning and conducting evacuation training, especially where the training involves vertical escape.

This leads on to the second common theme identified from analysis of causal factors, namely, problems that may come to light if effective communication and collaboration with all levels of management, ward staff and specialist colleagues is missing. It reinforces the need for a collaborative approach to evacuation training.

The third common theme involves the availability and reliability of equipment and beds. In order to minimise the consequences of disruption to training it is important that effective planning allows for alternative arrangements such as the use of alternative equipment, alternative venues such as in-ward training, or even different types of training such as desk-top exercises.

In effect, the underlying causal factors can be reduced or removed by ensuring effective planning, and effective communication and collaboration.

It should be noted that the processes and sub-processes identified through this FMEA are not exhaustive. It may be necessary for the fire safety manager to analyse further scenarios – including evacuation of the whole hospital – in order to complete the range of possible events requiring evacuation of patients.
**TABLE 1: FOUR KEY FAILURE MODES**

<table>
<thead>
<tr>
<th>Sub-process (activity number)</th>
<th>Potential failure mode</th>
<th>Potential effect of failure</th>
<th>Risk priority number (RPN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do decide which patients to move in priority order; assist first patient to move (activity 7)</td>
<td>Volunteer patient suffers injury from incorrect handling</td>
<td>Training terminates early and potential longer-term issues for individual volunteer</td>
<td>84</td>
</tr>
<tr>
<td>Give background, describe objectives of training, describe scenarios, conduct safety talk, gain consent (activity 16)</td>
<td>Foreign language speaking trainees do not fully comprehend theory being discussed</td>
<td>Trainees make mistakes during training putting themselves and others at risk</td>
<td>50</td>
</tr>
<tr>
<td>Conduct vertical evacuation (activity 8)</td>
<td>Trainee's undisclosed back problem aggravated by lifting operation</td>
<td>Training terminates early and potential longer-term issues for individual trainee</td>
<td>42</td>
</tr>
<tr>
<td>Repeat process until all patients evacuated to lower level (activity 10)</td>
<td>Trainees suffer fatigue</td>
<td>Training terminates early</td>
<td>36</td>
</tr>
</tbody>
</table>

**Results and conclusions**

This FMEA resulted in 12 potential failure modes of which four are shown in table 1. For each of the failure modes, the potential effect has been identified and an action recommended. Most of these recommended actions result in a change to the failure mode, whether by reducing the likelihood, reducing the consequences or by eliminating the failure mode completely.

One identified failure mode, however, does not have a corresponding action or beneficial result. The potential for trainees to suffer fatigue when repeating vertical evacuation of patients has an impact on the whether the training exercise has to be terminated early, but the effects of fatigue are unavoidable, and reflect the realities of effecting patient evacuation.

The underlying causal factors identified in this FMEA study can be reduced or removed by ensuring effective and timely pre-planning, and effective communication and collaboration with all levels of management, ward staff and other professionals, such as back care and infection control specialists.

The study identified the following specific actions:

- Use fully articulated training manikins in place of human volunteers to retain realism, but ensure training does not introduce unnecessary risks.
- Ensure understanding of theory training via the assessment of each trainee prior to practical training.
- Ensure that all manual handling risks are fully discussed with the trainee and that written consent is gained.
- Ensure that adequate numbers of observing staff are available to assist the fire safety manager.
- Check all equipment and beds prior to training exercise, and ensure that spares are available if required.
- Ensure that desk-top exercises and ward training can be undertaken as a reserve measure.
- Plan training events well in advance, and send reminders to trainees.

Although essentially a theoretical discourse, this FMEA points towards the failure modes that would be picked up by a more rigorous process involving a full multidisciplinary team.

**References**