A survey on the factors affecting horizontal assisted evacuation in hospitals

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ABSTRACT

This paper presents the results of a survey on assisted evacuation conducted with 120 hospital staff members in Sweden. Staff members included people with different roles in the hospital (e.g. doctors, nurses, department heads, etc.). The survey consisted of a questionnaire aiming at investigating the factors which affect assisted evacuation in hospitals and the current status of assisted evacuation training in Sweden. The survey included a list of questions concerning factors which were previously identified through a literature review and that they may affect the effectiveness of horizontal assisted evacuation in hospitals. Hospital staff had to evaluate the importance of these factors through a Likert-scale questionnaire. Three factors were identified in the survey by hospital staff as the most important in horizontal assisted evacuation, namely 1) coordination/collaboration between staff, 2) the patient need for assistance and 3) Training on evacuation routines. According to the questionnaire results, occupants who are in need for life-sustaining equipment can be the most difficult to evacuate. Results also show that only 52% of respondents had ever taken part into an evacuation drill and 50% had practiced how to handle evacuation aid tools needed for assisted evacuation, with rescue mattresses being the most used evacuation aid. 78% of respondents were aware of the person responsible for arranging tasks in case of an emergency situation.

KEYWORDS:

Assisted evacuation, hospital, human behaviour, training, fire safety, survey.
INTRODUCTION

Evacuation plans and procedures in hospitals can be particularly critical given the need for assistance that some occupants may require. Occupants may in fact not be able to evacuate independently (i.e. perform self-rescue activities), thus needing assistance. Patients may vary in their self-rescue abilities, ranging from ambulant patients with reduced mobility to non-ambulant patients who need assistance with a wheelchair or other carrying device (e.g. stretcher, blankets, mattresses, etc.) [1], [2]. The rescuing abilities of hospital personnel can play a key role in the effectiveness of a hospital evacuation procedure. These individuals are generally responsible for assisting patients in their relocation to a safe place. In particular, hospital personnel may be responsible for the relocation of a number of people with a repeated procedure, which may generate physical fatigue [3]. This is also linked to the number of staff available for these tasks. This number may depend on several factors, such as the type of care provided by the hospital, time of the day in which an emergency take place, etc.

The investigation of the factors affecting the effectiveness of assisted evacuation procedures can be performed in several ways. One methodology would be to perform evacuation experiments and full scale drills. Nevertheless, experiments in hospitals may be difficult to arrange given the need to not interrupt the regular hospital operations as well as logistic and financial issues. Therefore, a limited number of experimental studies are available in the literature [3], [4] and they mostly focus on vertical evacuation, i.e., the usage of evacuation aid tools for assisted egress in multi-storey buildings.

Total evacuation strategies may not be practical in hospitals. For this reason, it is often recommended to relocate people horizontally to the nearest safe fire compartment [5]. The present paper focusses then on the issues associated with horizontal assisted evacuation, i.e. patient relocation procedures that take place within one floor [6]. Horizontal evacuation procedures in hospitals are generally an established process, and they include information concerning the prioritization of the patients [1], [7]. Staff must ensure that all patients needing assistance are relocated to a safe place and that this process does not hinder other staff intervention [7]. In this context, national [8] and International regulations and guidelines [9] give provisions and recommendations to account for the issues associated with evacuation planning, in some instances including information on the personnel actions that are expected in case of a fire emergency. Nevertheless, an evaluation of the evacuation procedures in case of the presence of people in need for assistance need to be done in light of the actual status of current knowledge and training of fire evacuation issues of the hospital personnel.

To address this issue, a questionnaire study has been arranged to investigate the status of current staff training experience in Sweden as well as to assess which factors are considered by hospital personnel as the most important ones during horizontal assisted evacuation procedures. It should be noted that the focus of the questionnaire is on the staff rather than on the patients as their role has been considered of primary importance in assisted evacuation scenarios. The scope of the work was to provide a context to current provisions and fire safety evacuation requirements concerning hospitals and understand the hospital personnel’s perspective on the factors which may (either positively or negatively) affect assisted evacuation.

THE SURVEY

As a first step of the work, a literature review has been conducted in order to identify a list of factors which may impact horizontal assisted evacuation in hospitals. The scope was to identify a set of commonly identified assisted evacuation issues which will subsequently be ranked by the survey respondents with a Likert-Scale questionnaire. Different sources were used to collect information on those factors, such as guidelines focusing on general evacuation strategies in Sweden and internationally [8]–[10], evacuation plans adopted for Swedish hospitals [11]–[13] and research studies investigating human behaviour during hospital evacuation [2], [3], [6], [7], [14],[16]. This analysis also included the review of different routines adopted in relation to the type of patients and the department in the hospital that are involved in an evacuation. In addition, a set of most commonly used evacuation aid devices for assisted evacuation have been identified and their features have been reviewed (e.g. carry chairs, wheelchairs, evacuation chairs, rescue sheets and mattresses, stretchers, etc.)

Based on the literature review, the following 10 factors have been identified and included in the survey questions:

1. The patients need for assistance (e.g., depending on whether the patient is older / pregnant / has a disability / in need of life-support equipment)
2. The distance to which the patient has to be moved
3. The number of staff per patient (ratio between staff/patients) available in evacuation scenarios
4. The physical abilities of the staff
5. Coordination/collaboration between staff members
6. The consistency between written instructions on evacuation procedure and the actual implementation (e.g. who does what, prioritization of patients, etc.)
7. Training on evacuation routines (e.g. rescue, alert, alarm, extinguishment, assembly)
8. The amount of rescue equipment available
9. Training in the usage of evacuation aid devices
10. Movable and fixed physical objects that are present on the evacuation route depending on the type of room (e.g. beds, equipment attached to the patient, furniture, locked doors)

The survey respondents were asked to grade the importance of each factor with a 5-point Likert scale ranging from (1= not important at all to 5=very important). Additionally respondents were asked to list what they thought they are the most important factors affecting assisted evacuation (giving them the possibility to explain their answer). Participants were also given the possibility to mention additional factors which may affect assisted evacuation procedures as well as reviewing 1) experience of hospital evacuation drills, 2) experience of actual fire evacuations, 3) knowledge of people responsible for the evacuation procedure in the hospital, and 4) experience with training with individual evacuation aid devices. Background questions to the survey participants included information on their role in the hospital (e.g. nurses, doctors, department heads, secretaries, etc.), time spent working in the current hospital, age and gender.

Survey dissemination

The survey was prepared in a spreadsheet form and distributed both through online mailing (approximately 300 emails were sent with a Google form link) as well as distributing the questionnaires in person in hospitals (approximately 100 paper copies were distributed). The target distribution list included a variety of roles within hospitals and a variety of hospitals all over Sweden (varying in size and location, i.e. from smaller to larger Swedish cities/towns).

Participants

As the refusal rate increases, the potential volunteer bias increase [17]. For this reason, the questionnaire was made as short and simple as possible to decrease rejection rate and to avoid volunteer bias. A total of 120 filled questionnaire forms were collected (30% response rate). This included 76% of women and 24% of men. This gender ratio is in line with current hospital staff gender ratio in Sweden, where the total number of female staff in the three largest categories of personnel (nurses, doctors and physiotherapists) are 77% of the total [18]. Approximately 50% of the respondents were aged between 40-60 years old, 30% of the respondents were aged between 20-40 years old and 20% over 60 years old. The majority of the respondents had worked in the hospitals for more than 5 years. The geographical distribution of the respondents is presented in Table 1.

| Geographical area of respondents | Respondents [n] | Respondents [%] |
|---------------------------------|-----------------|-----------------|
| Norrland (Northern part of Sweden) | 7               | 6               |
| Svealand (Central part of Sweden) | 31              | 26              |
| Götaland (Southern part of Sweden) | 78              | 65              |
| Unknown                         | 4               | 3               |

The roles of the hospital staff who responded to the survey is presented in Figure 1. This included nurses, heads of hospital departments (intended as the chiefs of different hospital units), assistant nurses, doctors and other (this can include administrative staff, or other personnel working at the hospital).
RESULTS

Results are here presented both in terms of the factors affecting assisted evacuation as well as the four questions concerning the previous experience/knowledge of hospital staff concerning evacuation procedures. Results show that 52% of the respondents had performed an evacuation drill in a hospital. Among the respondents, 16% had experienced an actual evacuation in a hospital. 22% of the respondents were not aware of the person responsible to hand out information in case of an emergency evacuation. A 50/50 split was obtained concerning the number of respondents who had practiced the use of an evacuation aid device. Among the respondents who have practiced the use of an evacuation aid device, the majority of them had experience with rescue sheets/mattresses, followed by stretchers (see Figure 2).

The descriptive statistics of the Likert-scale responses to the questions concerning the most important factors in case of assisted evacuation in hospitals are presented in Table 2 (presented as percentages). Results show that most of the factors received quite high scores. This is not surprising as the factors have been defined through a literature review aiming at identifying the most important factors affecting assisted evacuation.

In order to investigate which differences between the different factors were significant, a Wilcoxon-Signed Rank Test was used (corrected critical value applying the Bonferroni correction was 0.0025). This non-parametric test was used comparing all factors against each other, with the aim to provide a ranking of factors. The resulting ranking of factors has permitted the identification of the three most important factors, namely coordination/collaboration between staff, the patient need for assistance and Training on evacuation routines.

It should be noted that the responses are here presented in an aggregated form (i.e. responses from all survey respondents are presented together). This is mostly due to the limited sample size of the survey. Nevertheless, a qualitative analysis of the responses given by people belonging to different groups has also been performed. Some of the key findings of this analysis show that while 100% of the head of departments are aware of who is responsible for the evacuation procedures, this percentage is reduced to 71% for the nurses, 33% for doctors and 78% for the category “other”. In contrast, the number of experienced emergencies is overall consistent among different groups while the number of people that have practiced the use of evacuation aid devices corresponds to approximately 60% for both the head of departments and the category “other”, 33% for doctors and 42% for nurses.
Table 2. Responses (expressed in percentages) to Likert-scale questions on the factors affecting assisted evacuation in hospitals.

| Factor number | Factor                                                                 | Likert-scale response |
|---------------|-----------------------------------------------------------------------|-----------------------|
|               |                                                                       | 5 (very important)    |
|               |                                                                       | 4                     |
|               |                                                                       | 3                     |
|               |                                                                       | 2                     |
|               |                                                                       | 1 (not important at all)|
| 1             | The patients need for assistance                                      | 85                    |
|               |                                                                       | 8                     |
|               |                                                                       | 6                     |
|               |                                                                       | 0                     |
|               |                                                                       | 0                     |
| 2             | The distance to which the patient has to be moved                      | 53                    |
|               |                                                                       | 28                    |
|               |                                                                       | 18                    |
|               |                                                                       | 0                     |
|               |                                                                       | 0                     |
| 3             | The number of staff per patient                                        | 63                    |
|               |                                                                       | 28                    |
|               |                                                                       | 7                     |
|               |                                                                       | 2                     |
|               |                                                                       | 0                     |
| 4             | The physical abilities of the staff                                    | 40                    |
|               |                                                                       | 27                    |
|               |                                                                       | 28                    |
|               |                                                                       | 6                     |
|               |                                                                       | 0                     |
| 5             | Coordination/ collaboration between staff members                       | 81                    |
|               |                                                                       | 18                    |
|               |                                                                       | 1                     |
|               |                                                                       | 0                     |
|               |                                                                       | 0                     |
| 6             | The consistency between written instructions on evacuation procedure and the actual implementation | 68                    |
|               |                                                                       | 24                    |
|               |                                                                       | 8                     |
|               |                                                                       | 0                     |
|               |                                                                       | 0                     |
| 7             | Training on evacuation routines                                        | 69                    |
|               |                                                                       | 23                    |
|               |                                                                       | 8                     |
|               |                                                                       | 0                     |
|               |                                                                       | 0                     |
| 8             | The amount of rescue equipment available                                | 48                    |
|               |                                                                       | 29                    |
|               |                                                                       | 13                    |
|               |                                                                       | 8                     |
|               |                                                                       | 2                     |
| 9             | Training in the usage of evacuation aid devices                        | 49                    |
|               |                                                                       | 29                    |
|               |                                                                       | 14                    |
|               |                                                                       | 6                     |
|               |                                                                       | 2                     |
| 10            | Movable and fixed physical objects that are present on the evacuation route | 66                    |
|               |                                                                       | 24                    |
|               |                                                                       | 8                     |
|               |                                                                       | 2                     |
|               |                                                                       | 0                     |

Additional open questions conducted during the actual survey showed that the greatest proportion of respondents claimed that one key issue is the limited number of staff per patients in case of emergency. An additional factor that was mentioned by respondents included the fact that often it is unknown the number of relatives that are actually inside hospitals and this may have dual impact on the evacuation effectiveness (they might be of help during evacuation procedures or they may hinder the evacuation).

**DISCUSSION**

The findings of the survey give information concerning the experience and training that hospital personnel has on assisted evacuation and their responses might be useful to provide guidance both on future safety improvements for assisted evacuation scenarios in hospitals as well as future research studies.

The collaboration and coordination between hospital staff members has been identified as one of the most important factors in assisted evacuation procedures, especially given the fact that a procedure relies on the correct handling of the roles that each staff member has in case of emergency. Clearly communicated instructions on the roles of each staff member should be provided and they should improve coordination of rescuing activities. This is somehow in contrast with the fact that 22% of the survey respondents were not able to identify who is the person responsible for giving instructions in case of a fire evacuation scenario. Evacuation drills and training on the use of evacuation aid devices might be of help to increase the effectiveness of an assisted evacuation procedure. Nevertheless, the survey showed that only half of the personnel have taken part in evacuation drills and approximately half has ever practiced the use of an evacuation aid device. The survey shows that this seems to be associated also with the fact that not all staff is on site when such type of training is performed, thus part of the hospital personnel do not receive any evacuation training.

The assessment of the resources for patients needing assistance relies on a correct evaluation of patient’s health conditions and self-rescue ability (or inability). Future work should focus on increasing both patients and staff awareness of their emergency evacuation procedures in order to facilitate the staff performance of assisted evacuation.
The survey findings also indicate that the most common device in use for training in Swedish hospitals is rescue sheets/mattresses. It should be noted that an experiment conducted by Hunt et al [14] showed that rescue sheets resulted in the slowest average horizontal transportation speeds (0.9 m/s) if compared with stretchers, evacuation chairs and carry chairs. This finding though should also take into consideration the preparation time associated with each patient and device, i.e. how long it takes to place patients in an evacuation aid device in relation to the type of patient and the device itself.

Despite the present survey has as main limitation the limited sample size of the respondents (120 people), it allows to identify some potential key issues affecting the effectiveness of assisted evacuation in hospitals. In particular, some of the results demonstrated that a significant part of the hospital personnel (50%) had experienced neither an evacuation drill nor practiced the use of an evacuation aid device. This finding should lead to a larger discussion on the need to take actions to improve the awareness on the benefits that evacuation drills and training may have. On this matter, future studies should assess quantitatively the relationship between the hospital staff training and the time that could be gained in case of an emergency given a more trained personnel.

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