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Arias, Silvia

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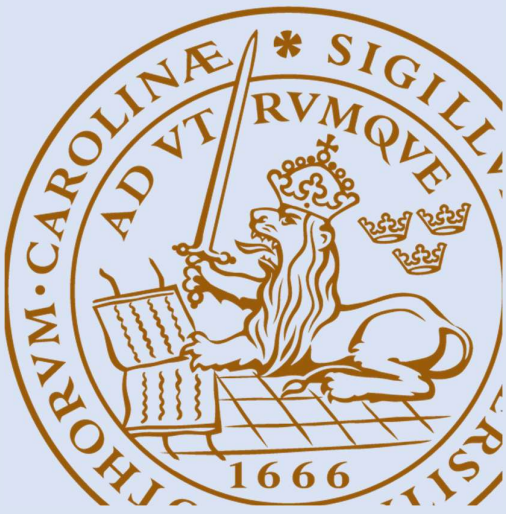
Silvia Arias
BRANDTEKNIK | LTH | LUNDS UNIVERSITET



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Silvia Arias

Lund 2026

Optimering av sjukhusutrymning och utrymningsövningar
Optimization of hospital evacuation and training

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Abstract
Hospitals are some of the most vital buildings in society, and yet their evacuation in the event of fires or similar emergencies is understudied. The delicate state of the patients means that the evacuation is mostly conducted by the staff, which means that training is crucial for their success. The present report presents the results of a 2-year study focused on collecting data about the different ways in which hospitals train their staff on fire evacuation safety in Sweden and other countries. The data was collected through interviews, observations and a survey. The results show common challenges and alternative approaches to fire evacuation safety, from the perspective of the hospital's emergency management and the healthcare staff. Recommendations about different training methods, their content, and scenarios are presented for decision-makers at hospitals to enrich their approach and assess alternatives to make a more effective use of the training events.

Brandteknik
Lunds tekniska högskola
Lunds universitet
Box 118
221 00 Lund

www.brand.lth.se
Telefon: 046 - 222 73 60

Division of Fire Safety Engineering
Faculty of Engineering
Lund University
P.O. Box 118
SE-221 00 Lund
Sweden

www.brand.lth.se
Telephone: +46 46 222 73 60

Foreword

This project was funded by the Swedish Civil Contingencies Agency (MSB) now known as Swedish Civil Defense and Resilience Agency (Myndigheten för civilt försvar) as post-doctoral support, with reference number MSB 2023-13942.

I would like to extend my sincere appreciation to the many people who were involved in this project: hospital staff members both in healthcare and emergency management, fire safety engineers, fire and rescue services, and researchers. They joined the project in different ways, from many countries in Europe and abroad. To preserve their integrity, anonymity was granted. Nonetheless, their contributions were invaluable and will meaningfully inform readers of the present report.

Summary

The evacuation of hospitals in the event of fires and similar emergencies can be a difficult endeavor. Patients usually require assistance, with a considerable number of them being unable to evacuate by themselves due to medical conditions or due to the treatment they are receiving. Assistance is to be provided by the healthcare staff in the affected ward, which means that their level of preparedness is crucial for a successful evacuation and the continuous provision of healthcare for the patients in need. However, there is limited literature on how to conduct evacuation of hospital wards, and even less on how to effectively train the staff on the matter. This project presents a detailed study about fire evacuation training in hospitals in Sweden and abroad. The purpose of the study is to map the common approaches, challenges and solutions they have, in order to find ways to optimize the time dedicated to training and make the evacuations more efficient.

The study consists of several data collection methods. First, over 60 interviews were conducted including key actors from different areas of expertise who are directly or indirectly linked to the fire evacuation strategy applied in hospitals (e.g., hospital emergency managers, fire engineers, fire and rescue services, healthcare staff, trainers, researchers). Then, several training events were included in an observational study, in which the purpose was to simply observe the way the instruction is given and how the drills are conducted. In a third step, a survey was conducted, aimed specifically at the healthcare staff who are the ones both receiving the training and conducting the evacuation. Through the survey, over 300 staff members contributed their perspectives, assessed their own preparedness, and identified aspects they view as important or in need of enhancement.

The results of this study provide insight into the difficulties of training hospital staff on fire and evacuation safety, as well as common issues and relevant approaches in practice by hospitals in several countries. Moreover, recommendations are made for the decision-makers to take into consideration when choosing a training method and/or a training scheme for the hospital staff.

Sammanfattning

Utrymning av sjukhus vid bränder och liknande nödsituationer är en komplicerad process. Patienter är ofta i behov av assistans, och många saknar helt förmåga att själva ta sig ut på grund av sina medicinska tillstånd eller den behandling de genomgår. Ansvaret för utrymningen ligger i många fall främst på vårdpersonalen på den berörda avdelningen, vilket innebär att deras förberedelser är avgörande för en lyckad utrymning och för den fortsatta vården. Trots detta finns det en begränsad kunskap om hur utrymning av sjukhusavdelningar bör genomföras, och ännu mindre om hur personalen effektivt bör utbildas i detta. Projektet redovisar en detaljerad studie av brand- och utrymningsutbildningar i vårdmiljöer i Sverige och internationellt. Syftet är att kartlägga vanliga arbetssätt, utmaningar och lösningar för att identifiera möjligheter att optimera utbildningstiden och göra utrymningar mer effektiva.

Studien bygger på flera metoder för datainsamling. Först genomfördes över 60 intervjuer med nyckelaktörer från olika expertområden som direkt eller indirekt är kopplade till sjukhusens brand- och utrymningsstrategier (t.ex. sjukhusens beredskapssamordnare, brandingenjörer, räddningstjänst, vårdpersonal, instruktörer och forskare). Därefter genomfördes en observationsstudie av ett antal utbildningstillfällen, med fokus på hur instruktioner ges och hur övningar genomförs. I ett tredje steg genomfördes en enkät riktad till vårdpersonal, som både är mottagare av utbildningen och ansvariga för att genomföra evakueringar. Genom enkäten bidrog över 300 medarbetare med sina perspektiv, bedömning av sin egen beredskap samt aspekter som de anser vara viktiga eller i behov av förbättring.

Resultaten ger insikt i de utmaningar som finns vid utbildning av sjukhuspersonal i brand- och utrymningssäkerhet, liksom vanligt förekommande problem och relevanta arbetssätt i praktiken vid sjukhus i flera länder. Vidare presenteras rekommendationer för beslutsfattare att beakta vid val av utbildningsmetod och/eller utbildningsupplägg för sjukhuspersonal.

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1 Introduction

Hospitals are key to the resilience of society. They provide care for some of the most vulnerable members of it, who in many cases are in high need of care for their health and well-being. In the event of a fire, the hospital staff has the duty to help patients to evacuate. However, there is limited guidance for how the evacuation should be conducted or how the staff needs to be trained in it. This lack of guidance is usually due to the complexity of the building and the variety of patients in them. Patients can have very different conditions that may vary between ambulatory and unconscious, making them a highly diverse group of building occupants in terms of mobility and alertness. Moreover, even during an emergency, some patients may still need medical care. Therefore, the training the staff needs is also highly dependent on the nature of the patients in their own ward.

The complexity of hospitals is also noticeable in the design of the building itself. Long corridors, low ceilings, doors that are inconvenient for the staff when closed, a variety of systems (ventilation, water, heating, oxygen supply, electrical installation, communication, security, etc.) that are constantly maintained or even upgraded, changes in the medical equipment and even in the use of different wards. Moreover, while hospitals are built to last for many decades, their original design may quickly fall out of date with the ever-changing standards for fire and evacuation safety. At the same time, hospitals usually consist of more than one building, with different features based on the requirements at the time of construction.

In addition to the building, the task of providing healthcare for patients is extremely demanding. Patients have all sorts of needs or conditions that require care on a regular basis, with the likelihood of sudden complications or other healthcare emergencies. This means that the staff is constantly busy and dealing with (sometimes life-threatening) emergencies on a regular basis. The job presents many challenges that can lead to understaffing: highly demanding work conditions, working in shifts including at night, perceived low pay, can lead staff members to search for different lines of work in less stressful conditions. Therefore, hospitals can have high levels of staff turnover, and the staff that stays still changes on each shift, they switch wards, and type of care they provide.

It is clear that in such a complex building in terms of occupancy, layout, and even staff, fire and evacuation training is an equally complex issue. Not only is difficult to determine the “right” way of training the staff, but it is also difficult to find the time for the staff to be trained. With so many demands in their work hours, it can be a challenge to remove them from active work to participate in fire and evacuation training. Fires do not occur nearly as often as needed to be considered top priority for the healthcare staff, when the high stakes of their job take place in every shift.

The challenges of conducting evacuation drills or field experiments reduce the availability of data to evaluate the evacuation procedures. Moreover, it can be difficult to train the staff often enough to ensure the correct application of the procedure in an emergency.

This project aims at surveying the state of the art of hospital evacuation design and training in Sweden and abroad, and learn about hospitals’ past experiences with evacuation. With the sum of experiences, a set of recommendations can be offered to learn from the past, train in the present, and build in the future.

1.1 Background

In an evening in December of 2020, a fire was detected by the automatic detection system at the maternity ward of the University Hospital in the city of Lund, Sweden (Viktorsson & Ling, 2020). The ward is part of the large complex of the hospital, but it is an individual building, only connected to the adjacent ones by a system of tunnels underground. Soon after, alarms started to go off on each floor of the several floors of the facility, raising the suspicion among the staff that an arson attack was taking place, igniting fires in different spots. Fire alarms going off on every floor was not an expected scenario, and the staff decided to conduct a total evacuation, finding no alternative as the smoke was

spreading in most wards. They could not use the underground tunnels as the basement level was where the fire was detected first. The elevators stopped operating the moment the fire was detected, so the only option was to evacuate outdoors. It was a difficult decision for the staff, especially those in the neonatal intensive care unit, as the incubators are extremely heavy to carry up or down even a few centimeters, and they need constant power supply. Women in labor were put in ambulances, and the incubators were moved to the reception area of the building. The automatic doors kept being opened and shut due to the large number of people at the reception, which mean the cold air from the outside came in. There were not enough outlets around for all the incubators, and remained disconnected during the ordeal. The alarms were blasting without a pause, and the newborns in the incubators were exposed to them.

Once the fire and rescue services arrived, they struggled to localize the fire (Röman et al., 2022). They tried to focus on the fire, but they had to assist the staff and bring women needing an emergency C-section to the surgery rooms on the first floor. The staff was unaware that they could stop the alarms, and they tried to get the firefighters to tell them how to reactivate the elevators or to operate technical systems in the building, which are not under the fire and rescue services' duty. They managed to control the fire, which turned out to be originated by an electrical fault in a lamp in a storage room in the basement. The smoke managed to spread throughout most of the building due to many penetrations that were not properly closed in the smoke barriers and fire walls.

There are several remarkable aspects of this fire:

a. The compartmentation of the building exhibited extreme deficiencies: the condition of the building was not according to the expectations of its fire safety concept.
b. The degree of the smoke spread was beyond any foreseeable scenario: the training they received relied on progressive, horizontal evacuation. It could not have prepared them for a total evacuation scenario.
c. The staff was not able to recall important parts of the training they had received: they were supposed to turn off the alarms if needed, they were not supposed to evacuate areas that were not directly affected.

It is clear that this event was due to an unlikely combination of undesirable conditions that managed to remain unnoticed until the fire started. There is no doubt the staff did everything possible to help their patients, and their courage and selflessness are, for all practical purposes, unquestionable. Moreover, the compartmentation was functionally nonexistent, which is effectively undermines any strategy that could have been in place. However, in the aftermath, it is clear that the training they had received was insufficient or ineffective. If the training was sufficient, at very least the alarms would have been disconnected. If the fire evacuation strategy was complete, a total evacuation scenario would have been included.

It is unlikely that the fire and its outcome could not happen in any other hospital in Sweden. It is more likely that other hospitals in Sweden may be equally unaware of shortcomings in the preparedness of the staff. A project was then conceived with the objective of studying the fire evacuation training offered to hospital staff in Sweden, in content and implementation. The purpose of the project was to survey how hospitals prepare their staff for the event of an evacuation due to a fire, and to provide alternatives in their approach to fire evacuation safety. Since conducting experiments in hospital contexts can be very difficult, an observational approach was chosen, in order to learn from experience instead. To expand the pool of experiences, the project also includes other countries in Europe and abroad, to broaden the spectrum of approaches.

a. What constitutes an adequate fire evacuation strategy for a hospital setting?
b. How should the staff be trained to effectively implement this strategy?

1.2 Purpose

The purpose of this study is to provide guidance to hospitals on how to improve the training of healthcare staff on fire evacuation safety to ensure patient and staff safety during a fire.

1.3 Objectives

The objectives of this study are as follows:

a. To study current hospital evacuation practices in Sweden and abroad, to identify different approaches to fire evacuation safety.
b. To collect data on how fire evacuation training is provided to the hospital staff in terms of training methods and their frequency.
c. To propose recommendations for improvements to the training approach, based on the pooled knowledge.

1.4 Disposition

The present report is divided in 10 chapters, describing the methodology used (chapter 2), and the five studies included in this project (chapters 3 to 7). Chapter 8 presents the description of a drill that was observed in the context of this project, that was designed as a test of the feasibility of a safe evacuation in a ward. Chapter 9 discusses the project on itself, with a brief discussion on its methodology and the results. Lastly, chapter 10 offers recommendations based on the insights gained in the project on important aspects to consider for the training of the staff. In addition, two appendices present the questions from the two surveys included in this project.

1.5 Scope and limitations

The present project focuses on the improvement of training methods for the staff in Swedish hospitals. Insights from other countries were included as additional sources of very valuable information, but the focus remains in the Swedish context.

An observational research method was deemed the most adequate for the project, given the difficulties of running a series of controlled training experiments including hospital staff.

The different groups of people providing their experiences and opinions in the context of this project agreed to participate, fully aware of the purpose of the project. This self-selected sample of willing participants means that the sample is biased towards those who thought the project was relevant and had time to participate. Many people were approached and declined the invitation to participate due to several stated reasons.

Given the voluntary participation in the project, some studies included are inconclusive due to the very low number of participants.

2 Methodology

This project included different methods in order to collect data from the key actors involved in the definition of a hospital evacuation strategy and its implementation through the training of the staff. Both key actors and the methods are presented in the following subsections.

2.1 Key actors and their roles

The key actors are the people that are involved in the design of the fire evacuation strategy, like the hospital emergency management and the staff. The key actors also include those affecting the fire safety concept of the building. Factors affecting this design are the kind of patients, the staff involved, the building features (e.g., automatic detection and suppression, compartmentation measures, etc.), and the firefighters' operations. The building features are defined in the design phase of the building, or later added due to refurbishments or due to the outcomes of inspections by the fire and rescue services. The building features involves fire safety engineers and the relevant codes and guidelines issued by the competent authority. Trainers were also included, as certain professional trainers (individuals or large companies) be hired by a hospital to provide the training the staff needs. These trainers are external to the hospital, usually hired on a basis of procurement. Lastly, researchers were included as key actors, since their work can show strengths and weaknesses found in their own study of hospital evacuation.

The following subsections will give a more detailed description of the roles these actors have, and how their input is relevant to the present study.

2.1.1 Healthcare staff

The healthcare staff is at the core of the fire and evacuation training design, as they are the ones conducting the evacuation and therefore the receivers of the training. Their background, their skills and their line of work need to be thoroughly considered in the design of their training. The healthcare staff is here defined as the medical doctors and all levels of nurses, who are the ones providing medical care to the patients, and in the event of a fire are expected to apply the fire safety procedures in place. The healthcare staff receives mandatory training from their employer, the hospital, in different forms. These different forms, here referred to as training methods, are meant to train the staff on the fire and evacuation procedures. In the context of this report, the ones deciding on the fire evacuation strategy and the training given to the staff are the emergency managers.

2.1.2 Emergency managers

The emergency managers may take different names in different countries or contexts. In this report, the term emergency manager is used as an umbrella term that refers to non-healthcare staff at the hospital that has the duty to oversee the preparedness and response to fire and other types of emergencies at the hospital. The emergency managers oversee the training strategy, and facilitate the training providing means and eventually different training methods. It is possible that not all interviewees classified here as emergency managers would describe their role as such, given the many backgrounds, responsibilities and reach each person has in their hospital context. However, it was considered that breaking down the role in more detailed description would add complexity at the expense of clarity. Emergency managers may have different backgrounds, being anything from medical doctors to fire safety engineers, with many alternatives in between. Even if their background may be in fire safety engineering or healthcare, they are included as emergency managers as that is their role. Other backgrounds are health and safety, security, management, among many other. They are deemed relevant in the context of the fire and evacuation strategy as they are the ones with the task of guiding the healthcare staff's approach to it and ensuring compliance. They have many more tasks that are not covered here as they are not relevant to the topic of staff training.

The emergency managers contacted in Sweden had different titles. Some of them were in charge of the building's technical installations for fire safety, while others were in charge of the organizational side of the response to a fire. Other countries have both functions under the same person.

2.1.3 Fire safety engineers

Fire safety engineers are indirectly connected to the fire and evacuation safety training at the hospital, as the fire safety concept developed by fire safety engineers for the approval of the building permit (either as a new building or a renovation) has a direct impact on the evacuation strategies in place. The configuration of the building in terms of compartmentation, the active and passive fire safety systems in place, the location of the evacuation routes and the emergency exits, have an implication on the evacuation as it provides the basic building features the evacuation strategy needs to be built upon.

Fire safety engineers may not have a saying on the organizational aspects of the use of the building in some countries, like in the case of Sweden. Therefore, they are restricted to the design of the building features, even if they could give advice on evacuation. This circumscription of their tasks may be detrimental to the organizational aspects of fire safety in the building, as the emergency managers could also benefit from listening to the advice of the fire safety engineers, who had to make considerations about evacuation in their design.

2.1.4 Fire and rescue services

The fire and rescue services (i.e., firefighters) have an active role in the event of a fire emergency. They are first-responders when a fire is detected, and also it is their duty to conduct inspections. Fire and rescue services are usually assigned to a given area, and therefore are well-aware of the hospitals in their jurisdiction. Their operations can range from a relatively simple inspection in the case of a small fire that was quickly extinguished by the staff, to active firefighting, rescue of patients trapped in their rooms, and eventual ventilation of the smoke after the fire was extinguished.

When it comes to inspections, they cover the building features, compartmentation aspects, active and passive fire safety systems, as well as organizational aspects like the fire safety strategy, the training provided to the staff and other internal fire prevention measures.

2.1.5 Trainers

Trainers are specialized people who deliver training services to hospitals. They usually work in private companies that cater, among other things, fire and evacuation safety training to the hospitals. Trainers can have different backgrounds, being active or former firefighters usually among them.

2.1.6 Authorities

Authorities are also indirectly involved in fire and evacuation safety for hospitals, as hospitals under their jurisdiction need to comply with the applicable codes. The authorities having jurisdiction vary immensely between countries, as well as their recommendations or requirements. This is because the applicable regulations are not always issued by the same level of authority in every country. In Sweden, hospitals are under the jurisdiction of each of the 21 Swedish regions. The building regulations in Sweden are issued by Boverket, the ministry in charge of buildings (or housing),which are mandatory in the entire country. Once the building is built, it requires continuous maintenance, which is covered by the Swedish Act on Protection Against Accidents (*Lagen om skydd mot olyckor in Swedish*). This law regulates the protection of people against accidents, and regulates how to protect building occupants from accidents like fires and other hazards. However, the training of the hospital staff is under the jurisdiction of the Swedish Ministry of Civil Defense (previously Swedish Civil Contingencies Agency). This means that a hospital needs to follow at least three independent directives (although some are at higher level than others) when it comes to fire safety in general: the Act on Protection Against Accidents, region, Boverket, and the Ministry of Civil Defense. The distribution of these tasks is likely different in other countries.

2.1.7 Researchers

Researchers were also included as key actors in hospital design because of their work on researching the topic of fire evacuation. Researchers may have different fields of expertise, and therefore different focus when it comes to fire evacuation safety. Some researchers may have a focus on healthcare, while others on evacuation simulation. Therefore, the approach to the problem also varies, attributing relevance to the aspects closer to their expertise.

2.2 Methods

These methods were selected based on the kind of data that was deemed relevant for the project. Figure 1 presents an overview of the data collection methods used and the target samples for each. The data collection methods are discussed in detail in the following sections, but a brief description of them and their interactions is presented here.

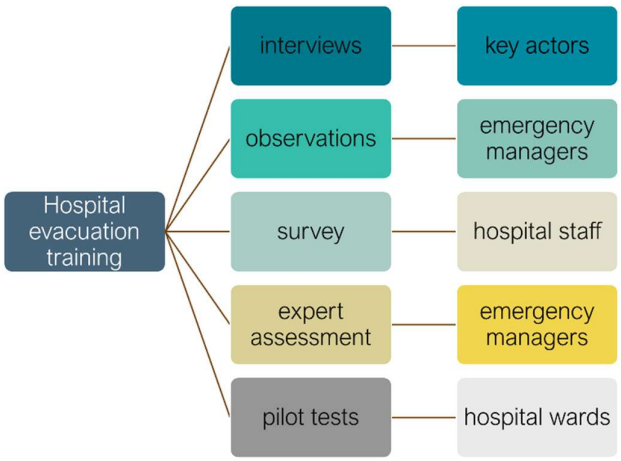

Figure 1 - Data collection methods implemented in this project and the target samples for each of them

The project started with interviews, aimed at people who are involved with the design of the fire safety concept of the hospital, from the healthcare staff (who are the ones performing the evacuation), to the local or national authorities who decide on the requirements in the building codes. The purpose of the interviews was to gather data from all key actors involved, to understand their stand point, their motivations, and their reasoning for their choices.

Then, observations were conducted at a handful of training events that hospitals provided to their staff. The purpose of these observations was to complement the picture presented by the interviews with a real-world training event.

As a third step, a survey was launched, aimed exclusively at hospital staff members who work with bedridden patients. The purpose of the survey was to hear from as many staff members as possible, since they may show a different perspective than that of the emergency managers who decide on the training the staff receives. Moreover, being the hospital staff members the ones to effectively conduct the evacuation during a fire, their perception about their preparedness is crucial to this project.

Then an expert assessment was conducted, in which emergency managers were asked to rate the different training methods commonly used by hospitals to train their staff. The purpose of the expert assessment was to contrast different training methods based on relevant aspects like the time they take, their costs, and how comparable they are to a real emergency.

Lastly, a set of pilot tests was conceived as a limited test of different approaches to fire evacuation training of the hospital staff. These were meant as simple tests, as no proper set of experiments could realistically be conducted given the limited opportunities that could be found to run the tests.

The project was intended to include a broad spectrum of people involved in the design and implementation of a fire evacuation strategy in a hospital setting (here referred to as key actors). The key actors are defined on section 2.1.

Moreover, the project was also intended to pool knowledge from different countries. The idea was to expand the horizon beyond Sweden, in order to include alternative solutions that are not commonly used in the Swedish hospitals. However, it quickly became clear that the focus should be on countries with economic conditions comparable to Sweden.

3 Interviews

In the first stage, a series of interviews was conducted, targeting key actors relevant to the design and implementation of a hospital evacuation strategy. The purpose of the interviews was to document the current practices, the problems hospitals face in fire and evacuation safety, and the reasons for them, from the perspectives of the different groups involved directly or indirectly in the fire safety strategy of a hospital.

3.1 Method

The recruitment of interviewees started by the network of the researcher. The interviewees were approached via email or on social media. In some cases, a cold approach was taken, due to the lack of any contact: searching on the internet for emergency managers in a hospital, and sending them an email or a contact request. In addition, a snowball sampling approach was implemented, with the intention to connect with more key actors through the network of each interviewee. The snowball approach led to many additional interviewees. In total, 62 interviews were conducted, working in 18 countries (see Figure 2). Most interviews took place in 2024, with only a handful taking place in 2025.

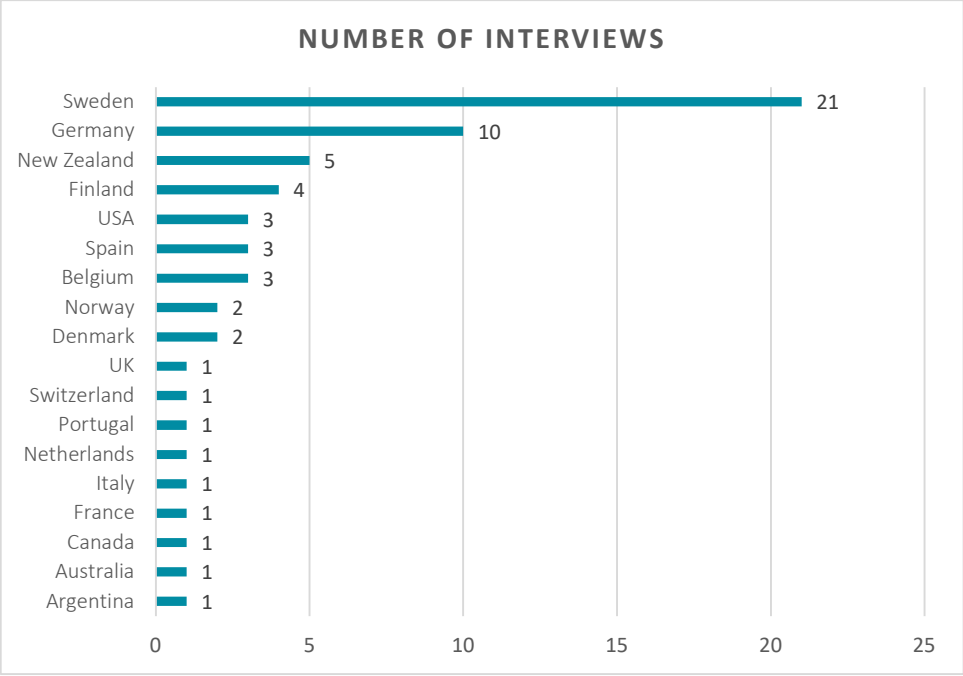

Figure 2 - Number of interviews per country

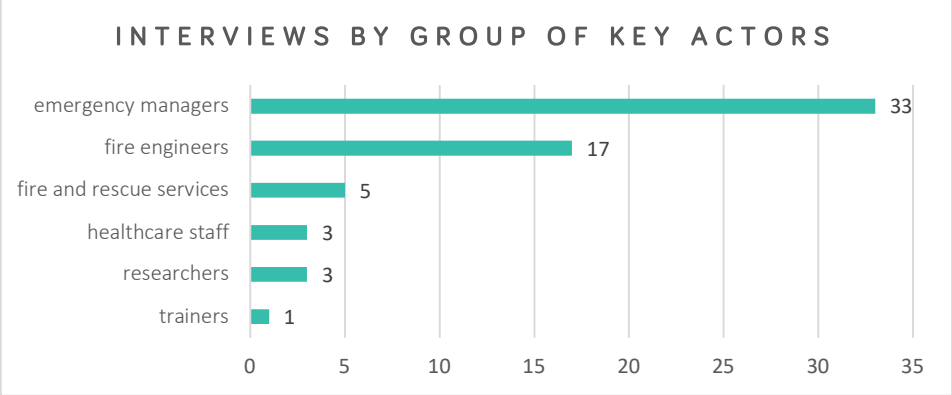

Figure 3 - Number of interviews per role (job description) of the interviewee

Anonymity was granted to the interviewees to encourage them to express their opinions and to avoid being identified by readers of this report. For the sake of maintaining their anonymity, their opinions are not presented verbatim in this report, even if quoted (quotation marks added when needed to make a clear differentiation between the interviewee's input and the writing of the author of this report), and they will be referred to in the context of either the country the interviewee works in, or their role (e.g., fire safety engineer, emergency manager, etc.), but not both. Figure 3 shows the number of interviewees in each of the key roles.

A semi-structured approach was selected for the interviews, to ensure that the most relevant aspects to the project were covered, and to allow the interviewees to guide the conversation to their own areas of concern. This approach has the advantage of allowing for more nuanced information to be collected, in aspects that each key actor may have extensive knowledge. However, a disadvantage is that some topics did not emerge as relevant until several interviews were already conducted. That is, some interviewees were not asked about certain topics because they did not bring them up and they were interviewed before the topic was identified as relevant.

The interviews were conducted usually between the researcher and one interviewee, but in some cases there were up to three other interviewees from the same organization at the same time. The interviews were conducted via an online meeting platform or on the phone, in English, Swedish, German or Spanish. One interview was conducted in French with an interpreter. Written notes were taken during the interviews. Recordings were not made for the sake of the interviewee, to safeguard their anonymity. Only a handful of interviews were recorded for clarity, due to language issues, and exclusively with the full consent of the interviewee. After a recorded interview concluded, the notes were improved with information collected while listening to the recording, and then the recording was destroyed. The interviews lasted usually one hour, in a handful of cases being extended to a second interview.

3.1.1 Analysis

The information provided by the interviewees was then pooled together in two ways: first, an overview of the approaches the key actors have to fulfil their roles. Then, some relevant themes were identified, which were often brought up by the key actors, but they show differences in the perspectives among them. These relevant themes group the perspectives from them on each of the identified themes.

3.1.2 Quantitative assessment

In most sections of this report, there will be no exact number of responses given to a specific topic. This is especially relevant to the Interviews section. This is due to two reasons:

First, the samples of interviewees for each key actor group are small and they are not representative of any given country or any given role. They are exclusively representative of the people who heard about this research project and found the time to answer questions, which is not a very useful descriptor to draw generalizations.

Second, because of the semi-structured nature of the interview, and the various backgrounds the people performing the same role had, not every person in the same key actor group answered to all the questions. Therefore, stating a proportion of key actors in the same group giving an answer to a question, will not mean that the rest of them disagree, they may not have been asked.

Therefore, the information presented here is qualitative instead of quantitative. In order to give the reader an impression of the frequency of an answer given, some terms are used in this report to convey a larger or smaller number of answers. In ascending order: one, a couple, a few, a handful, several, many, the majority, the vast majority. This is still a subjective and not rigorous approach, but it can help the reader.

Many times, in this report, the opinion of a single individual or an anecdote is presented for illustrative purposes. While it may not be representative of frequency of a problem, they are included in this report because they present a unique yet interesting perspective, approach or learned experience that can help readers of this report to expand their understanding of the reality of hospital evacuation and staff training. Anecdotes are not the most reliable source of information, but they can also be useful data in certain contexts (Birdi et al., 2026; Masvawure, 2025), and the author of this report considers it a valid context.

Lasty, in some cases the scenario is presented to the reader without identifying the key actor group the interviewee belonged to (neither their nationality), also in an effort to safeguard their anonymity. As an example, a phrase like "a hospital in Sweden" does not imply that the information was provided by its emergency manager or even an interviewee working in Sweden. It is simply a statement that the scenario that follows takes place in a hospital in Sweden.

3.2 Results

3.2.1 Emergency managers

Emergency managers were usually very engaged in their role. While it is also likely that only those very engaged signed up for the interview, their level of commitment to their job was remarkable.

Their background varied widely. Many of them ended up in the position because of internal changes at the hospital they worked in which led to the position needing to be filled by someone and they got to learn on the job. Others had specific backgrounds aligned with management or safety. In many cases the emergency manager was a medical doctor. Fire safety engineering was a common background in Sweden. While those people may likely not call themselves emergency managers, they were the only contact in the hospital and did not suggest an alternative person for the interview, even afterwards.

One emergency manager said that they used to do classroom/lecture-based training, but because of the sanitary measures during the Covid pandemic in 2020 they moved the training online. Since the end of the pandemic, the management refused to reinstate the lecture-based training, according to the emergency manager to save costs. In their appreciation, after reading the staff answers in a fire investigation report, the level of preparedness of the staff has shown a clear decline since. The interviewee believes that online training leads to low levels of engagement with the content, little reading and focusing on passing the test. There is no room for questions and interactions, which is not optimal from their point of view.

The kind of training offered to the employees at a hospital also shows different approaches. In some cases, "the training package is the same for all staff, from the cleaning staff to the executives", although it is unlikely these groups of workers would be involved in an evacuation. In other hospitals, they provide special training for the healthcare staff, and among them even more specialized training for certain units like surgery wards, intensive care units, dialysis units, and magnetic resonance imaging (MRI) rooms.

Several emergency managers, from a variety of countries and unprompted, brought up the case of vertical evacuation of bariatric patients. They expressed concern about the ability of the staff to move them vertically if needed. One interviewee mentioned they have addressed the issue by assigning rooms on the ground floor for bariatric patients. While this may be a very pragmatic approach, it is unlikely that any hospital would be able to provide all available medical procedures in those rooms. Nevertheless, even if imperfect as a solution, it may reduce the risk of having to move bariatric patients vertically, which can be rendered unfeasible for the staff in an emergency.

One emergency manager reflected on the feasibility of the successful evacuation of a ward due to a fire. They said that they use a reversed-triage system to identify the patients that are in best condition and prioritize their evacuation. The emergency manager recognized that this may mean that some of

the most vulnerable patients may not be evacuated on time, but considers that the right approach is to save the largest possible number of patients.

When asked if they have influence on the design of a new wing or its refurbishment, most emergency managers said they had *some* to *much* involvement. This points out a positive relationship between them and the building designers, who try to adapt their design to the needs of the wards.

3.2.1.1 Selecting training methods

The interviews helped to identify six training methods most commonly used in fire evacuation in hospitals. They are depicted on Figure 4.

Online training is the most common one. It is usually done in a computer, through a learning platform that allows the management to monitor the compliance of the staff with the mandatory training. This platform is used for many other kinds of training or courses the staff follows (e.g., healthcare training, procedures, security, etc.), being fire evacuation training a small part of it. It usually presents the information in a sort of slides and videos, and it can include at the end a series of questions as a quiz for the staff to show they have understood the content. The advantage of online training is that the staff can do it at any time, even from their own phones, without the need of scheduling a special time or coordinate with others. One disadvantage mentioned by a staff member is that they do not get the opportunity to ask questions in case of something being unclear or questions about specific cases not mentioned in the training material.

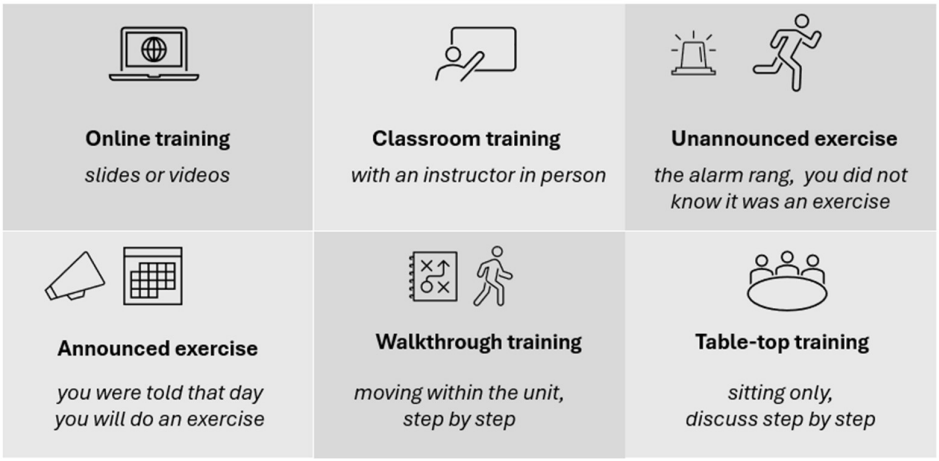

Figure 4 – The six training methods identified in the interviews with explanations prepared for the healthcare staff to clarify the meaning of the name of each method

Classroom training is used here to refer to a training method in which the information is presented in person by an instructor. It can still be based on a set of slides, but they are delivered by the instructor. This type of training has the advantage of allowing for questions not strictly included in the content of the slides, and an exchange of ideas with the instructor. It has the disadvantage of needing to be scheduled, and have several people attending at the same time. This means that the staff may have to be removed from duty during the lecture.

An unannounced exercise or evacuation in this context is an unannounced drill. The staff is not aware that a drill will take place at the moment it starts. This training method is very seldom used in hospitals and other healthcare facilities, given the significant difficulties of evacuating patients for no real reason like a threat to their lives. An unannounced evacuation has the advantage of being able to better capture the preparedness of the staff to tackle a fire emergency. The main disadvantage is the impact on the patients, which is commonly deemed unnecessarily large.

An announced exercise or evacuation is similar to the unannounced one, with the crucial difference of the staff knowing ahead of time that the evacuation will take place. This has the disadvantage of having the staff reasonably prepared for it, which makes the assessment of preparedness less truly representative of the reality of it. However, it can still give an assessment of preparedness without a detriment to the well-being of the patients, which is a sizeable advantage that makes this method much more common than the unannounced version.

Walkthrough training refers to a guided tour, during which the emergency manager or head of the ward shows the expected sequence of steps to be taken in the event of a fire, walking to each relevant point and giving the relevant instructions. It has the advantage of being relatively quick to perform, and it is based in the ward. It can include pointing at the equipment or the technical systems in place, to show the staff what to look for or how to operate them. The main disadvantage is that the staff is only passively receiving information.

Lastly, table-top training is a training method that is based on a group discussion about the procedure. It can be similar to the walkthrough, but instead of moving around the unit, the whole group sits together in a group, with a layout of the ward at sight, and they use figures to represent people and actions performed. The advantage of table-top training is that the staff gets an overview of the all the actions taking place at the same time, and it allows for different groups performing different tasks which completion would have an effect on the outcome of the entire procedure. The main disadvantage is that it removes the staff from duty and it does not makes use of the real ward but a representation of it on a board.

These six training methods are the ones considered here as theoretical training, as they are meant for the staff to learn about the right procedures. Arguably an unannounced evacuation is not so much a learning opportunity as it happens, but only in retrospect. However, it was mentioned by the emergency managers as a training method so it was included here.

The emergency managers get to select the training methods to be used. They claim that is always preferable to do those that do not take much time and do not take the staff away from the ward. There was no further detail on the selection process, but there were implications of them being the ones they are used to.

One emergency manager mentioned that they try to develop a point system to make the wards alternate between different training methods. The suggested point system would have a target score (e.g. 12 points) to be reached by each staff member within a given number of years (e.g. 5 years). Each training method available will provide a given number of points (e.g., 1 for online training and walkthrough training, 2 for table-top training, 4 for announced evacuation). The point system would make online training insufficient to accumulate enough points, and more complex training methods will need to be implemented within the specified timeframe. This point system is interesting, as it offers some flexibility to the ward to adapt it to their schedule, and it encourages the use of more complex training methods. However, it has the issue that it is hard to justify the number of points a given training method has without careful study.

In addition, the requirements that can be made can leave too much room for interpretations. Interviewees from certain countries mentioned that hospitals there are mandated by law to do an evacuation exercise every year. The interpretation of what an evacuation exercise varies, and it can be adjusted to the hospital's convenience. According to an emergency manager familiar with this kind of requirement, in some places they do the evacuation of a single ward and the law is followed.

3.2.1.2 Practical skills

Three practical skills were identified in the interviews, namely: horizontal evacuation, vertical evacuation, and the use of extinguishers. Figure 5 depicts the three of them with a brief description prepared for the healthcare staff.

Figure 5 - Practical skills mentioned by interviewees. The practical skills can be trained on, independently of the theoretical training method used.

These practical skills differ from the training methods as they can be given to the staff independently of the training method applied.

Horizontal evacuation can include the movement of patients using the hospital bed or other means, like evacuation mattresses, evacuation sheets, and wheelchairs. Any form of assisted evacuation is included here, which can simply be helping the patient to walk down the corridor.

Vertical evacuation training refers to the movement of patients downstairs. It can also be done using different kinds of equipment designed for this purpose. Vertical evacuation is seldom trained on due to the alleged unlikelihood of the need for vertical evacuation. Despite the purported unlikely need for vertical movement, most hospitals have some form of equipment to move patients downstairs, like evacuation chairs or evacuation mattresses. Some equipment like the evacuation mattresses could also be used for horizontal evacuation.

Extinguisher training is meant here with the use of real flames to practice. Extinguisher training cannot be done within the ward, and it can be done at the nearest fire station or a specific location in the hospital area meant for this kind of training. It has the downside of removing staff from duty, but it is generally easy to do and it does not require much time.

3.2.1.3 Main concerns

Emergency managers are mainly concerned with the difficulties of the implementation of the training. They are uncomfortably aware of the limitations imposed by the reality of a hospital ward.

Lack of time

The staff lacks time for any more extensive training; even the emergency managers themselves do not have much time to rethink the training strategy or even implement a different one. They referred to online training as a useful tool to educate the staff quickly and with minor disruptions to their daily tasks, especially considering staff rotation. However, some recognized that it is probably not the most effective training method in terms of engagement. Some want to implement more practical training, but then schedule conflicts play a role. To that end, they seem to prefer training exercises that do not remove the staff from the ward, so that they can dedicate time to training while still being able to immediately provide support to the staff taking care of the patients if needed.

Lack of opportunities for further education

They expressed their willingness to learn more, and some of them said they had taken additional fire safety courses, but that they are relatively general and not adapted to their needs as emergency managers at hospitals. When asked about what kind of courses would be useful to them, they indicated standalone courses that do not take much time (e.g., half a day), and/or that are based on modular sessions they can take every few weeks.

Some of them expressed their intention to rethink the strategies in place, but recognized they may not have the tools to come up with something better, let alone ascertain that their new approach is objectively better than the current one.

3.2.1.4 Silence

While the vast majority of the interviewees were open to all questions during the interview, in several cases a level of fear or distrust was present. In one case, the interviewee requested the list of questions first, in order to get clearance from their managers to partake in the interview. A few potential interviewees declined to participate due to fear of flagging issues they saw but may not be convenient for their place of employment to admit to. Few interviewees expressed some fear of retaliation for giving dissenting opinions about the common practices in their field of work. Only a couple of emergency managers mentioned having lost or resigned from their previous job for being highly critical of the hospital's approach. It is outside the scope of this project to ask the hospital their version of the events.

On the other side of the spectrum, several interviewees expressed their will to be quoted by name in this report, stating this would vindicate them in the eyes to those who refuse to listen to them. They claimed that they stand by what they say, that they are constantly repeating the same thing, and that their inclusion in the report would help them make their point.

3.2.1.5 Other issues

One emergency manager mentioned that even if they think that more can be done in the context of training of the hospital staff, there are limitations imposed by the reality of the daily operations of a hospital. For example, it can be difficult to find enough staff members to cover for those receiving training in a different location than their place of work. This is relevant in the case of training in the use of extinguishers, which cannot be conducted in the ward, and the staff needs to be taken to another location. Not being able to find enough replacements for those away can mean that the training needs to be postponed. Therefore, this emergency manager claims, the ideal training method can be conducted while on duty, at their place of work. This allows the trainees to quickly return to their duty if there is some urgent need for extra hands.

Another emergency manager mentioned that they wanted to implement a different kind of online training to the one that they already had in place at their hospital. The issue was not the cost of the new online training package, but rather that it was incompatible with the existing education platform the hospital uses for the rest of the other courses and education programs they offer to the staff. Acquiring this new training package would mean that the staff will have to create a new account, get used to the new platform, and not lose it from their sight, as it would become something fully separated from the rest of their education platform. Due to these relatively mundane difficulties, the emergency manager realized that it may not be a good idea to replace the existing online training package.

An emergency manager commented on the difficult decisions they need to make in the design of an evacuation strategy, as well as the decisions that the staff needs to make when they need to choose the patients to be evacuated first. They reflected on the reverse triages, which mean that the patients in better shape (those in the least delicate state) are given priority during the evacuation. Those who are in an already poor health status, almost independently of their risk due to the fire and the smoke, may be left for last. "It is a tough decision to make, and we may be criticized because one or two may die, but we save 20, and that should not be overlooked", they said.

One emergency manager who had an important fire in their previous place of work reflected on the reaction to the staff before and after the event. They said that before the fire they were not very conscious of how difficult an evacuation scenario could be, but that they observed a stark difference afterwards. The staff took the training extremely seriously, and they learned their lessons from the past fire, with a strong determination to not repeat mistakes. The emergency manager observed that with the time a difference emerged between those who were there at the time of the fire and the new employees who came with the years. Those who were not employed at the time of the fire were less concerned with the fire safety training.

Another emergency manager mentioned they had a case of a fire in the adjacent compartment. Their compartment was not affected by the fire or the smoke, but the alarms could be heard so loud, the patients became nervous. The staff did not know what to do, as they are trained on what to do when the fire is in their ward, not what if it is in the adjacent one.

Misconceptions about fire safety

Two main misconceptions were typically brought up: the fire resistance of the building elements and panic. It is a known problem in fire safety engineering that the material classification system leads to misunderstanding (Turkowski, 2022). A fire wall may be referred to as having one-hour fire resistance, but that does not mean that it can literally contain a fire for an hour. It means instead that it has passed a highly specific testing procedure that exposed it to a highly specific heat release rate curve for 60 minutes. This is because the effect of the exposure of a building element to a fire during testing is likely very different than the effect of the exposure to a real fire. While an element that resisted the fire test for 60 min is likely to resist the fire longer than the time needed for the firefighters to start suppressing the fire, it should not be considered a one-to-one duration of the resistance in a real fire, as the fire load also needs to be considered (Ministry of Works, 1946). Moreover, despite the given resistance, building surveys indicated that fire walls often have issues with penetrations and installations (Järvinen, 2014), which compromises the ability to mitigate smoke and fire spread and can lead to expensive repairs (los, 2024). An example of the misunderstanding was the case of an emergency manager with a background in medicine, who expressed the following idea: “I tell the staff that this wall has a fire resistance of one hour, so they do not need to worry about a fire on the other side at all”.

Panic has been a controversial topic in fire evacuation. A pervasive myth of panic taking over the rationality of people during a fire is deeply engrained in lay people. In the field of Human Behavior in Fire, panic is considered a myth and many publications have tried to address the misconception (Fahy et al., 2012; Proulx & Sime, 1991; J. Sime, 1980; J. D. Sime, 1984). In this field, panic is considered to rarely occur (if at all), and to be a short-lived, extreme sense of fear, that does not spread among other building occupants (Quarantelli, 1954). In that context, panic is usually assessed by observers, not the individual, and those observers tend to associate certain behaviors with panic, even though from the perspective of the individual (the information they had at hand, the reduced time they had to make decisions, their own lack of knowledge about fires or experience with them) those actions are reasonable. However, in the interviews, panic was brought up several times as a fact, in the context of people experiencing some level of irrationality that needs to be avoided. The myth of panic may lead to strategies that intend to restrict the information given to the people in the fire compartment, therefore delaying the decision-making process and reducing the remaining time for safe evacuation (Canter et al., 1980).

These two misconceptions are not unique to hospital emergency managers, and is therefore not surprising that they emerged in the interviews. They are highlighted here as they are a recurrent theme, and emergency managers can benefit from a better understanding of them and adapt their strategies accordingly.

3.2.2 Fire safety engineers

A number of fire safety engineers who had experience in the design of hospitals participated in the interviews. Their responses varied widely, given the different national or regional regulations they needed to follow. For example, the Swedish fire safety regulations apply at a national level. At the time of writing this report, both the old regulations (BBR 2011:6, in effect until June 30th, 2026) and the new regulations (BFS 2024:14, in effect from July 1st, 2026) can be used for the design of buildings (The Swedish National Board of Housing, Building and Planning, 2025). While the nomenclature under which hospitals fall in each is different (i.e., Br0, Vk5C in the old regulations and Verskamhetsklass 0 in the new ones), both present the same requirements for hospitals: they are

subjected to performance-based design, and they need to have an automatic sprinkler system. While performance-based design is required, this does not imply the application of computational fluid dynamics methods to simulate fire and smoke spread and estimate the available safe egress time, nor the use of evacuation simulations tool to assess the required safe egress time. From the point of view of a fire safety engineer in Sweden, the configuration of a regular hospital inpatient ward (i.e., a long corridor with relatively low ceilings) means that the smoke will spread rapidly, and no computational method is needed to assess that. At the same time, the additional safety features (automatic detection, automatic suppression, compartmentation, trained staff, etc.) help to account for the reduced time for safe evacuation.

In Germany, the fire safety regulations apply at a federal state level, so different codes with different requirements can be valid in different parts of the country. In the past, a hospital building code (Muster-Krankenhausbauverordnung, *MKHBauVO*) issued in 1976 was used when no federal state alternative existed. That code has been retracted, which led to fire safety engineers in most federal states having little guidance on the design of hospitals. Since then, a common approach has been to still apply the recommendations of the retracted code, even if not required. There are several documents that provide guidance about hospital design that apply in different federal states (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe, 2020), even if their application is not mandatory in other federal states. This shows that there is an active effort from fire safety engineers to get regulations at least as a starting point for their design. However, the recommendations included are usually related to the building features, and evacuation is not regulated.

The lack of a specific code addressing the design of hospitals does not mean that there is no legislation overseeing it. There are different laws in place, and even different recommendations. Both in Sweden and in Germany there are guidelines issued by other authorities about hospitals. They may not be legally binding, but they are a *de facto* code. In Sweden *The robust hospital building* (Myndigheten för samhällsskydd och beredskap, 2021) and in Germany the *Handbook for hospital alarm and emergency response planning* (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe, 2020) offer guidelines or recommendations for the design of hospitals with a high level of detail, much more than what their building regulations offer. Both agencies issuing these documents are national authorities for civil protection.

Fire safety engineers were the first to point out the problem with the integrity of the fire and smoke partitions. A fire safety engineer mentioned that this is an issue that needs to be taken into account in any fire safety concept for a hospital. As they said, while fire walls are considered smoke tight in principle, the reality may be very different in a hospital. More detail about the fire walls is provided in section 3.2.5.1

A fire safety engineer presented an interesting analysis of the situation for modern hospitals. According to this fire safety engineer, in the past hospitals used to in-hospital care to a much higher degree than today. Patients used to be hospitalized for longer periods until they were discharged. Nowadays, given different measures aiming at efficient use of resources and advantages in medical treatments, many patients come to the hospital to receive treatment, but do not stay overnight. In Sweden, relatively healthy patients are expected to do their recovery at home. There are also several “patient hotels”, which are hotel-like accommodations for patients who may be receiving treatment for a few days or weeks, but are generally able to walk. These patient hotels are part of the hospital’s premises, and only take in patients based on their doctor’s recommendations. These patient hotels also help patients from more remote locations that need to come to the hospital often for longer periods (e.g., undergoing chemotherapy, or recovering from giving birth) but are not in need of round-the-clock medical care. In Norway they have “ambulance busses”, which are mostly used to drive patients from remote locations to the nearest hospital for scheduled, relatively short procedures, providing care if needed during transport. Once at the hospital, the patient receives the treatment and is transported back in the ambulance bus to their hometown. These approaches mean that in general, modern

hospitals tend to only keep inpatients overnight if they are in a very delicate condition. Hospitals can be several decades old, which means that they were likely designed based on the older approach of taking in patients in better conditions and for longer periods. This means that in a modern hospital, more staff may be needed to evacuate a ward, as more patients in it may not be able to do so on their own.

Another aspect of modern hospitals, brought up by a fire safety engineer, is that there are also larger treatment areas (e.g., dialysis), in which many patients can receive treatment at the same time, and are supposed to be in for a few hours. These areas are usually large and do not have much compartmentation within them. This means that in the event of a fire in those areas, more patients need to be evacuated immediately.

None of these two issues (the overall health condition of the average inpatient, and the large areas to treat many patients at the same time) is a problem on itself, but they highlight the need for staff to be not only enough but also appropriately trained to manage an evacuation successfully.

3.2.3 Fire and rescue services

While only a handful of members of the fire and rescue services were interviewed in this study, their insight was able to show different ways of interacting with the hospital, depending on their duty in the given legislative context in the country or region they were in. The members of the fire and rescue services had different roles within their organization (e.g., incident commander), but will be referred to as "firefighters" here for simplicity.

One firefighter told the anecdote that upon arrival at the hospital, the hospital staff seem to relegate their duties to the firefighters. This is further explained in section 3.2.5.4. As they recollected, when there is a fire, there is chaos. The staff asks whether they should evacuate the patients and how (e.g., patients unable to walk), what to do with the women in labor, where they can plug the medical equipment once they have evacuated the patients. The firefighter was categorical on that they do not have any saying on most of the questions the staff ask. They claimed that their duty is to either fight the fire or rescue people trapped in the fire compartment, but that helping the staff with the already evacuated patients, and the technical installations in the buildings is incompatible with their task. They emphasized that their role is to control the fire and to safely extract trapped people, and they should not be tasked with anything else until that is done. They mentioned they are unfamiliar with the building and the technical installations in place, and that the staff does not understand that.

Automatic smoke detectors at hospitals trigger the alarm at the nearest fire station immediately. In the case of Sweden, there are different procedures from the side of the firefighters depending on whether it was the automatic smoke alarm or it was a phone call they receive from the hospital (as the call means there is a real fire, and it is not a false alarm). The firefighters have the duty to go to the hospital, even if told that it is a false alarm, and find the detector that went off to check it. The firefighter intervention has no cost for the hospital if the fire was real (even if contained before their arrival), but a false alarm can cost a fee during the day and a higher one during the night and the weekends. The number of false alarms vary, but if there are construction works they can get more than one a week.

From the perspective of an incident commander, the training provided to the staff in the hospital under their jurisdiction is unlikely to be enough. From their experience, the training is not based on drills but rather theoretical, and if drills are done, they take place in another unit or building or even a training facility, not in the staff's place of work. They also considered that the staff needs to train on vertical evacuation, moving patients down the stairs, but it is unlikely that this would be done regularly. This was highlighted as especially important for units that have a staircase as second means of egress. More focus should be placed on practical training, actual drills, because the performance of the staff can only be evaluated there and signal whether the strategy in place works or not, not through questions after a theoretical training session.

According to a firefighter, some hospital managers may have the expectation that installing a sprinkler system will allow them to reduce the number of staff members needed in the event of a fire (reduction of costs). However, the firefighter explained, the sprinklers system will be able to contain the fire, but they do not prevent the smoke from spreading. Therefore, there is still a need to have enough staff members around to perform an evacuation quickly, even if there are sprinklers.

3.2.3.1 Inspections

The fire and rescue services are tasked with conducting inspections at all sorts of buildings, including hospitals. In Sweden, there is a directive concerning the mandated inspections (Myndigheten för samhällsskydd och beredskap, 2025). It says that the municipalities need to plan for inspections of buildings with high risks in the event of a fire. The directive is not explicitly stating how often the inspections should take place, but it says on 5 § that if the municipalities assess that inspections should be conducted less often than every six years (or not at all) in a given building, they need to document their reasoning. This leads some firefighters interpreting the text as "inspections need to take place at least once every six years". Other may consider that an inspection is needed far more often than once every six years, some do it every year.

When it comes to the extent of the inspection, the interviewees at the fire and rescue services have said that they check compliance with the applicable codes or legislation, and more specifically the operation, control and maintenance of fire safety systems in the buildings. They have guidance from the authorities on what they need to inspect every time, like evacuation routes, staircases, fire load, passive fire protection, and the training the staff receives. The inspectors of the fire and rescue services ask the staff about training, if all of them have received training (especially new employees), and whether they repeat the training every year. They ask if they know how to use the fire suppression equipment (i.e., fire hose and fire extinguisher).

It is obvious that the inspection must cover the aspects of fire evacuation training. However, checking compliance with the training requirements does not ensure the training is adequate. It cannot be expected from the inspector to be well versed in what suitable training is (which is the objective of the present project), so it is understandable that they ask about compliance, expecting the hospital to ensure quality. Compliance should not be taken as evidence that the staff is effectively well trained, but it can be difficult for the inspectors to make that assessment. What is the right strategy and what is the right way to present it to the staff to ensure they can apply it in an emergency are difficult questions to answer, let alone to assess in an inspection.

When it comes to the inspections, firefighters may struggle with the extent of the inspection on itself. Large hospitals can be difficult to inspect thoroughly. The time allocated to the inspection and the extent of it are left to the discretion of the inspector. The inspectors from the fire and rescue services interviewed in this study reported common issues flagged in the inspections are penetrations in the fire walls, and fire doors that either are deliberately held open using physical objects to prevent their self-closing mechanism from acting, or that no longer close properly due to wear, loose hinges or other maintenance issues. These are not exclusive for hospitals, but they were also brought up by the emergency managers as typical issues identified during the inspections, meaning that this is also a common problem in hospitals. Hospitals are also required to do their own internal inspections, and not solely rely on the firefighters to ensure compliance with the fire safety concept of the building.

3.2.4 Trainers, Researchers and Authorities

Three people or less were included in each of these three actors, therefore limiting the number of perspectives included in this report.

Only one trainer was interviewed. They did not give any specifications of what makes the training "good". They referred to their own experience and successful evacuations of the staff they trained.

They said that “common sense” lead their approach, which can sometimes be difficult to define rigorously. The trainer was very familiar with hospital and elderly care homes.

Researchers consulted in this project about their experience working on projects about hospital evacuation mentioned that much of the training that is provided in hospitals is not related to evacuation, but rather to suppression.

The only authority approached in the context of this study was Boverket, which is the Swedish National Board of Housing, Building and Planning, which is highly relevant to the purpose of this project. As mentioned in section 2.1.3, the only recommendations about fire safety in hospitals made by Boverket are: hospitals are special buildings and need to be designed using a performance-based approach; and they need to be sprinklered. When asked why the recommendations are so succinct, their response was nuanced. They acknowledged receiving requests for more prescriptive recommendations for hospitals, to ensure a consistent baseline design across facilities. However, Boverket claims that their approach is based on a good reason. They say that the hospital’s building administration would know better than Boverket what works best for them, and therefore Boverket takes a step back and provide a more general approach in their requirements. They want to give them freedom to adapt the fire safety concepts to the very complex reality of hospitals, giving them the opportunity to find the optimal solution for each type of care they offer. With the requirement of performance-based design, additional thought is put in the design of the building, and each area can get the design it needs. Moreover, they are aware of a network of experts specialized in hospital fire safety in Sweden, known as Program för Teknisk Standard (PTS) Brukarråd Brand. PTS Brukarråd Brand represents 19 out of the 21 Swedish regions, and therefore is a forum for sharing knowledge and experience in fire safety for hospitals. Boverket considers that PTS Brukarråd Brand is a reliable group of experts specialized in the field of fire safety in hospitals, and that it provides guidance to the engineering design needed to meet Boverket’s requirements.

3.2.5 Relevant themes

In this section, the perspective is changed from the interviewee to the theme they talked about. This approach was chosen here as there were different groups of key actors expressing relevant points about the same theme. Therefore, it was chosen to present the theme as the main point and the different perspectives about it.

3.2.5.1 Fire walls

As mentioned in section 3.2.1.3, there is a misunderstanding about the fire resistance classification of building elements among the emergency managers. This misunderstanding is not unique to them, but it is highly relevant in the context of the strategy for fire evacuation in their hospitals.

Not only is the alleged duration of the resistance incorrect, but also they may not be fully aware of the issues related to penetrations in the fire walls and their effect on the integrity of the compartmentation. Fire walls are also rated for integrity, which refers to the ability the element has to prevent flames and combustion products from passing through it. A fire wall needs to be built in such way that it will keep its integrity for the duration of the corresponding fire test (usually 60 minutes, but it can also be longer). This means that penetrations through the fire partitions need to be dutifully closed afterwards with firestops. A firestop needs to be chosen according to the size of the hole, and the size and composition of the element passing through it. However, they are not always implemented correctly (Pasto, 2016). In addition to the adequate selection and construction of the fire stop, ensuring each single penetration is sealed can be a difficult task in large and complex buildings like hospitals. As one interviewee said, “a hospital is a construction site”, alleging that there are always works being conducted: new cables, pipes, ducts, etc. being added, fixed or removed constantly. The case of the Regional Hospital Gødstrup is an example of a relatively newly built hospital that had to make a large investment in fixing penetrations in the walls (los, 2024).

When asked about the integrity of fire walls in hospitals ("*are the fire walls tight?*"), the vast majority of the interviewees asserted that they are not tight, and some said it is a constant problem they need to stay on top of, but it is not easy. Two replies from interviewees in Sweden offer a troubling scenario. One responded "*[they are] like Swiss cheese*". Another one, in a different role, said "*I can guarantee you will not find a single fire wall that is tight in a hospital. That is a fact*".

The problem with the improperly closed penetrations on the fire walls is that smoke can leak into an adjacent compartment, which may also need to be evacuated. This is what triggered a total evacuation of the maternity ward at Lund University Hospital in 2020, in which the fire was in the basement but the smoke spread throughout the building (Viktorsson & Ling, 2020). Another case of improperly closed penetrations in a hospital was the fire in a hospital in Turku, Finland, in 2011, in which the penetrations in the walls allowed for the smoke to spread rapidly, forcing the evacuation of 176 patients and 56 members of staff (Järvinen, 2014). Therefore, a more realistic assessment of the compartmentation in place at any hospital needs to be made and incorporated to the evacuation strategy.

3.2.5.2 Vertical evacuation

Vertical evacuation is rarely included in the training provided, as progressive horizontal evacuation is the preferred approach. Elevators are generally not allowed to be used in the event of a fire (and more often than not they descend to the ground floor and remain there with their doors open once the alarm is triggered), and staircases represent a major challenge when it comes to the movement of bedridden patients. Most wards have two independent, horizontal means of egress, but in older buildings, a ward may be a long corridor with a staircase at one end. Even then the staff is rarely trained in moving patients downstairs.

The difficulties of transporting bedridden patients or even patients on wheelchairs downstairs are many (limited training, extremely rare occurrence, tight spaces, various available types of equipment, etc.), and the risks are high. It is therefore reasonable to rely on a progressive horizontal evacuation. However, the use of elevators eliminates these difficulties, although the use of them is not allowed in most of the cases included in this study. It is not surprising that elevators are off the table when it comes to the fire evacuation strategy, due to decades of constant messaging about the danger of using elevators during fires. However, being hospitals such complex buildings with many patients that cannot evacuate on their own and need to be moved in wheelchairs or beds, the correct adaptation of the existing elevator system to facilitate vertical evacuation could be highly beneficial. Within the field of fire safety engineering, studies have been conducted about the advantages of rethinking the use of elevators for evacuation but this is not valid for any existing elevator (Mossberg, 2022). In this regard, hospitals need to be in the forefront of this kind of research, as the benefits of easily moving patients vertically are many. In an ideal future, different protective solutions could be tested and applied to existing elevators to ensure their safety during the early stages of an evacuation in a hospital.

A hospital in Belgium conducted an internal inspection of the evacuation sheets they have in each patient bed. These evacuation sheets are meant to be used to transport bedridden patients during an evacuation. The results of the inspection showed that only 50% of the beds had the sheets correctly installed. This highlights the need for quality assurance. Since then, the hospital changed their approached, and provided specialized training to ensure the staff making the beds are fully aware of the right installation of the sheets.

An emergency manager mentioned that they have evacuation chairs to be used in the event of a fire. However, they recognized that the odds of them being used are very low, as only some staff members are trained to use them. They conduct an exercise on the use of the evacuation chair every year, but they do not think they will ever be used. It is unclear if this is because the staff would not know how to use them, or because of the horizontal evacuation being the preferred approach.

3.2.5.3 Total evacuation

As mentioned in section 3.2.5.2, the hospitals rely on progressive, horizontal evacuation and avoid vertical evacuation as much as possible. When asked about a plan for total evacuation, few said they had one. While some of them also stated that a plan for total evacuation would not be under the responsibilities of the emergency manager but rather then disaster management, it is not unreasonable to include a consideration for total evacuation within each ward, as relatively recent events as the fire in the maternity ward in Lund, the one in the hospital in Turku with 176 evacuated patients (Järvinen, 2014), one in Frankenberg, Germany with 60 evacuated patients (hessenschau, 2024), among others, show a need for evacuation of more than a single ward, despite the initial strategy.

3.2.5.4 Relationship with firefighters

Only a few interviewees said there is a working relationship between the hospital and the local firefighters. The most prominent example came from interviewees in Denmark, on both sides of the relationship. Once an automatic fire alarm is triggered at a hospital, it alerts the local firefighters. It is possible that while they are on their way to the hospital, the staff at the hospital lets them know that it was a false alarm and there is no fire. Nevertheless, the firefighters have a duty to attest that there is in fact no risk. In these events, which are not unusual, the approach from the Danish firefighters is to conduct an exercise for themselves, and have the staff play their role as well. They may reduce their urgency on their way to the hospital, but once there, they follow their protocol as if the fire was real. They are received by members of staff, which lead them into the building. The firefighters check fire detector central, and the building plans, doing a whole walkthrough. Every three years they try to have a large exercise, to bring the roleplay a step further, including also the role of the ambulances and the police. According to the firefighters, this allows them to get acquainted with the building and the staff, and have a clear expectation of the sequence of events that would take place in the event of a real, uncontrolled fire. At the same time, the staff get acquainted with the firefighters' procedure, allowing them to be more aware of what is on the firefighters and what is on themselves. Therefore, a constructive relationship with the firefighters, beyond the mandated building inspection, can benefit both sides. Some other interviewees mentioned that they have a friendly relationship with the local fire brigade. One of the emergency managers said this is crucial for them, that they have a rapport strong enough to call the chief firefighter on their phone to discuss ideas or issues that may emerge.

Other interviewees mentioned that they seek the input from the local firefighters about different issues, even receiving some training on fire safety and extinguishing methods from them. Given the reduced number of opportunities for both sides to get acquainted with each other, finding a way to maintain a relationship can improve the performance of both sides during an emergency.

In Finland, they established "wellbeing services counties" since 2023. These wellbeing services counties are responsible for health, social services and rescue services, and are self-governing (Ministry of Social Affairs and Health, 2026). This means that hospitals and fire and rescue services are under the same organization, which may help to develop a strong and continuous relationship between them. The firefighters do inspections, to get familiar with the building (checking fire detection, ventilation, and sprinkler systems, evacuation routes, etc.), in a specific visit around once a year depending on the hospital (larger hospitals have more visits). The firefighters also run drills at the hospitals, and participate in disaster drills.

3.2.6 Differences in the expectations

It is clear that the key actors included in this study have different backgrounds, responsibilities, roles, and approaches to the shared problem of fire evacuation safety. These differences are not evident to all of them in their interactions, which leads to misunderstandings and even frustrations when interacting with each other. Some examples of misaligned expectations are presented here.

The first example refers to the role of the healthcare staff and that of the firefighters during a real fire event. According to multiple interviewees, the staff seems to perceive the role of the firefighters as a

leadership one, which means that they hand over the leadership on their own course of actions to the firefighters once they arrive. As one interviewee put it, the staff seems to act like they are not in charge of the situation upon arrival of the firefighters, and start expecting orders from them and asking them questions. Examples of those questions are about the use of alternative means of egress, activation/deactivation of the ventilation systems, ability to use the elevators, instructions on where to place the evacuated patients, among others. The firefighters, on the other hand, claim that they are not there to do anything but extinguish the fire. They see their primary role as containing/suppressing the fire, not helping out to move patients that are already out of the fire compartment. They claim they do not know the building, how its technical installations work, if the staff can use the connecting tunnels between buildings to evacuate patients, etc. A firefighter chief explained that they could help the staff if there is an excess of firefighters at the site, or if the fire is already contained, but until then, they cannot give an extra hand. That does not mean they will not evacuate patients that are still in the affected compartment, but rather that they do not expect to take over command of the activities of the staff. This example of misaligned expectations shows that the development of a relationship between the two parties, staff and firefighters, can lead to a better response in the event of a fire.

Another example of misaligned expectations was observed in the case of fire safety engineers and surgeons. Fire safety engineers design the fire safety concept for hospitals in such way that the fire safety systems in place will allow for a safe evacuation of all building occupants in the affected area. Loss of life is rarely contemplated in fire safety concepts for regular buildings. Either through prescriptive design or through performance-based design, the inclusion of some loss of life is an indefensible design solution. On the other hand, surgeons are very much aware that not all patients can be moved in the event of a fire. Surgeries can be extremely complex and delicate, depending on their target organ or tissue, the procedure on itself, the stage of it when the alarm is triggered, etc. These aspects play a role in the possibility of moving a patient who is undergoing an operation. In the case of serious surgeries (e.g., open thorax), an evacuation of the operation ward may mean that the medical staff needs to walk away and leave the patient behind. This is nothing but the reality of the medical procedure. They can try to stabilize the patient and move them, or they may even be in a convenient stage of it in which they can stop the procedure, but this is not always the case. As described in one of the training exercises observed in section 4.2.1, in an announced evacuation exercise in an operation ward, one of the surgeons in an operation room shrugged and said something to the effect of “we cannot move the patient, so we walk away”. While it is very likely that the insensitive gesture and phrasing were because they were in an announced exercise and no patient was around (in addition to the nature of thoracic surgeries that may be too invasive to be interrupted swiftly), it is clear that they are aware of this reality. It is obvious that hospital staff faces death on a regular basis, which may make them less deferential to it, but the refusal to acknowledge this fact from the side of the fire safety concept is unrealistic.

A third example is the case of firefighters and medical doctors disagreeing on whether an evacuation is needed or even possible. Firefighters may arrive to the site of the fire and determine that evacuating patients is a must. Medical doctors in charge of those patients may refuse, as they think the condition of some patients is too frail for them to be moved. The different perspectives lead to a disagreement, in which both sides see the other as unreasonable. It needs to be highlighted that these decisions are made from different perspectives, under much stress and time pressure, but both have the ultimate objective of life safety. Which one of the two is right, if any, is besides the point. Firefighters may be well aware that hospitals are special buildings, but still be adamant that every occupant in the affected area needs to be removed, as is the case in other types of buildings. Medical doctors may be strongly opposed to remove patients that are in a delicate state, and may have think that the risks associated with the evacuation are higher for the patient than those of the fire and smoke. This case shows how even having a shared objective may render opposite assessment of what is the best course of action.

3.2.7 Remarkable approaches

3.2.7.1 Marking cleared rooms

When an evacuation is deemed necessary, it is convenient for the staff to mark or indicate in some way that a given room has been already evacuated and is vacant. This avoids uncertainty whether all rooms were checked for patients. Several solutions to this problem were brought up in the interviews.

Tags. A hospital in Canada mentioned they use these special tags that go on the door, that have the sole function of identifying whether the room has been cleared. These tags are installed on each door and remain there, unused, until needed. According to the interviewee, they can cost around CAD 10 each. Considering the many rooms in a hospital, this can be a non-negligible cost. In addition, the fact that the tag is constantly visible but not supposed to be used, can lead to learned irrelevance (Bonardi & Ong, 2003), which has been investigated in the context of the usage of emergency exits (McClintock et al., 2001).This not to say that those tags will not be used, but they may as well be unused.

Paper hangers. In Germany, some interviewees said they use cardboard or paper signs, that are hung on the inside face of the door, similar to the ones used in hotels to request not to be disturbed. In the event of an evacuation, the staff is supposed to take the piece of paper and hang it on the outside face of the door. This is a cheaper solution than the one presented in that one case in Canada, as the paper sign can cheaply be printed if needed to be replaced. These may still be subject to learned irrelevance.

Common objects. One interviewee in Spain brought up a different solution. The principle is to use an everyday object already existing in the evacuated room (a pillow, a paper basket, etc.) to mark the room as clear. By placing an everyday object that would not normally be by the closed door in the hallway, it will signal to the staff that the room has been evacuated. They also brought up that the extinguisher used to attempt to extinguish the fire is used to mark the room of the fire origin. This approach is completely free of additional costs, and given that any object would do for a cleared room, there is no need for further interpretation.

When asked about the Spanish solution, several interviewees gave different points of view. Some claimed that the objects would become a tripping hazard. Some argued that they would add fuel load to the hallway. A firefighter asked about it said it is good to mark the rooms as cleared and even the fire origin, as they need to be as fast as possible, and being able to quickly identify the cleared rooms and the fire origin saves time. In Finland, they seem to have a similar approach in schools, in which case they use books to mark the evacuated rooms. However, questions remain about the robustness of the method, as an accidental kick could displace the object and a room could remain unchecked.

3.2.7.2 Risks for the staff

Interviewees from Spain mentioned that in their hospitals they have one staff member (usually a technician) is in charge of leading the firefighters to the origin of the fire. This means that this particular staff member receives also training on using a breathing apparatus to move with the firefighters through smoke. This does not apply in Finland, where the member of the staff tasked with guiding the firefighters to the origin of the fire would not go any further once they encounter smoke. This is due to considerations on the risk the staff is exposed to.

In an analogous way, in Sweden the staff is tasked with attempting extinguishment of the fire using extinguishers, and only after failing to contain the fire to consider an evacuation. The staff is usually well-trained in the use of extinguishers. However, according to some interviewees, maybe the staff is too confident in their extinguishing training. Based on their recollection of different events, the staff in some hospitals in Sweden do not make considerations about their own well-being before attempting to extinguish the fire. They could even enter the fire room, even if filled with smoke, in an attempt to follow the procedure. Therefore, there are some emergency managers doubting the extinguish-first approach, and are looking for ways to convey the importance of the staff's safety.

3.2.7.3 Training whenever possible

In the case of a hospital in the United States, they do not provide mandatory training on the use of extinguishers because of their considerations for the safety of the staff member. In their case, they suggest the staff consider extinguishing the fire but it is not required from them to even attempt (much consideration for their own risk). However, when they do social events for the staff, as for example a barbecue during the summer, they bring the local firefighters for them to do demonstrations on the use of extinguishers. They also have a couple of attendees volunteering to try and use one, with the rest of the staff observes, if they are interested.

3.2.7.4 Extinguish first vs. RACE

In Sweden, the training the staff receives almost invariably starts by locating the fire and attempting to extinguish it. Some hospitals in Sweden instruct the staff to first locate and do an attempt to extinguish the fire (considering their own safety). An interviewee mentioned the case of a hospital in the United States, in which they claim they cannot demand their staff to put themselves in any risk, so extinguishing it is not the first approach. The American staff is trained in the RACE acronym (generally phrased to the effect of Rescue people in immediate danger, Alert activating the alarm, Contain the fire, and Extinguish it or Evacuate if the fire is too large).

It is not clear which approach is more adequate, and each has their own advantages. The Swedish approach is more utilitarian, as a fire is more likely to be extinguished in its early stages, reducing the risks for everyone in the fire compartment. However, it is not likely that the Swedish approach implies that anybody in immediate danger should be neglected until the suppression effort is deemed unsuccessful. The RACE approach may imply more time until extinguishing is attempted, which would likely lead to a larger fire by the time the staff gets to it compared to that in Sweden. It is also unclear if the RACE acronym is consistently applied in the right order by the staff, individually or as a group, or if it is merely a distribution of the tasks for different staff members to do.

3.2.7.5 Leadership during the emergency

In the interviews, several ways to assign a leadership role during a fire emergency emerged. In some cases, the procedure was relatively strict, so that a specific individual had to be involved. That individual, some form of emergency manager, was supposed to make decisions. Also, some places have only specific employees (technicians, or security personnel) trained to extinguish fires. In those places, they had to wait until these designated people arrived on site. These approaches seem to be restrictive, and can lead to unnecessary delays, so they will not be further discussed in this report. Two approaches were remarkable, and are presented here in detail.

The yellow vest

In Sweden, each ward has a designated fire emergency panel, which is conceived as a meeting point for the staff to initiate the fire and evacuation safety procedures. The fire emergency panel usually consists of the fire alarm control panel (the central unit that monitors the detectors in the ward), drawings of the ward with the location of each detector, a yellow vest, and a set of action cards that, in the event of a fire, need to be distributed among the staff for

The yellow vest is a high-visibility vest, typically yellow but it could be other colors too, which is used to identify the evacuation leader. This evacuation leadership role is emergent, as it is supposed to be taken by the first person to arrive at the fire emergency panel. The evacuation leader is supposed to wear the vest, and distribute the action cards to their colleagues as they arrive at the fire emergency panel. The evacuation leader is tasked with ensuring that each action card is assigned and executed by someone, and to be the primary contact for the firefighters arriving to the site. Their role is not to decide on actions, but rather to ensure that the actions are taken care of and centralize the information to be communicated to the firefighters. In addition, they need to keep track of all evacuated patients, and be able to communicate with the paramedics from the ambulances, for them to prepare for possible relocation of patients to nearby hospitals.

In Sweden, the yellow vest approach is ubiquitous. It fits the Swedish culture from the standpoint that it considers that all coworkers are equally well-equipped to become the evacuation leader. Rank does not give priority in this context. Additionally, since anybody could be the evacuation leader, it is thought of as a way of providing the quickest response to the event.

However, this may be an idealistic approach. Some interviewees mentioned that the staff may avoid taking the yellow vest. Some staff members do not feel prepared to be the leader, and either drag their feet or try to handle the vest to somebody else. Why the staff feels this way is not clear.

As explained before, the evacuation leader needs to distribute the action cards. These action cards are very succinct and direct instructions for the staff members who receive them. These specific actions can vary, giving flexibility to adapt to the needs of the ward. Some examples of the actions indicated on those cards are:

1. Start extinguishing efforts (1 or 2 people): take the extinguishing equipment, localize the fire and start the extinguishment. When you are done, turn back to the coordinator
2. Rescue those in immediate danger (as many staff as needed): the evacuation should be horizontal within the building or out of the building. Do not use elevators! When you are done, turn back to the coordinator.
3. Move dangerous objects: remove gas bottles and other dangerous objects from the vicinity of the fire. When you are done, turn back to the coordinator.
4. Alert (1 person): alert the rescue services using the manual call point and call 112. Our address is on the back of this card. […] Meet the rescue services upon arrival and tell them where the fire is. When you are done, return to the coordinator.
5. Evacuate (1-3 people): search through the unit and ensure everyone is removed. Do not forget to check toilets and storage rooms. Close the door behind you. Do not use the elevators! Go the evacuation meeting point. Ensure nobody comes back into the ward. When you are done, turn back to the coordinator.

As seen, the yellow vest approach is simple and easy to follow. It assumes any staff member can take this role (although allegedly not all of them seem willing to), and it helps to organize the staff in a straightforward manner in an emergency.

The German model

The German model is known as the Krefeld model in Germany (Gretenkort et al., 2002; Leledakis, 2017). They developed an approach to the leadership role during an evacuation, which has several leaders: a medical doctor, a nurse, and a technician. The medical doctor is the head doctor during the shift when the fire takes place. They have also received education on "Incident Tactics in Mass Casualties" events (Gretenkort et al., 2002). Their role is to make medical decisions during a fire evacuation. The nurse is the charge nurse at the ward during the shift when the fire occurs, normally a registered nurse. Their main role is to evacuate the patients, following the medical advice of the head doctor. The technician is the one in charge of the building systems (e.g., ventilation, power, security, logistics, etc.) when the fire is detected. Each of them takes the leadership role in their own domain. This multi-leader approach delegates the specific knowledge needed to the specialist, but more importantly, it means that the three figures are preassigned per shift. The staff in hospitals works in shift, so the person knowing they will be charge nurse in the coming shift, also knows they would have the corresponding leadership role if a fire takes place. This scheduled rotation of leadership has the advantage of allowing the person to prepare ahead. The leadership role is attached to the shift, so it is part of their job description. This needs to also be complemented with either extra training or additional information, so that the person can revisit the information and stay prepared. Also, in the event of the charge nurse or head doctor being busy with other activities or away from the ward at the exact time the fire is detected, the leadership role can fall on any of the staff members present at the ward. It is likely that there will be among the staff members present another nurse who had the role of

charge nurse in a previous shift and is therefore also well-prepared for taking up the role. In the case of no staff members present who had taken a leadership role in their previous shifts, the leadership situation reverts to emergent, and one will take the lead.

Discussion on leadership

It is understandable that some personalities are less willing to take the leadership role, in the case of the yellow vest approach. It can be a new employee, or a young nurse with limited experience with patients and even the hospital work. A Swedish interviewee claimed that nurses are good at taking leadership roles, since they are used to work in a fast pace, high stress environment.

It is hard to argue against the benefits of the German model. While it may require additional training or material for the staff to read up if unsure, ideally ahead of their shift, it combines the duty with their job description. This does not mean that the leaders have to have an authoritarian approach, in which no other staff member can propose alternative actions, and the responsibility falls exclusively on their shoulders. The staff in a hospital ward is already hierarchical to some extent, so retaining that hierarchy for the benefit of the group does not seem to be out of place. Moreover, in the absence of the preassigned leader, someone else would take the role, just as they would if no leadership role was preassigned in the first place.

3.2.7.6 Training for medical doctors

An analysis of the hierarchies in hospitals is not within the scope of this study. Nevertheless, several interviewees mentioned that medical doctors tend to disregard fire evacuation training, which means that nurses are the ones taking the leadership in such events. Some emergency managers expressed a range of emotions when describing their attempts to get medical doctors to take the training seriously or at all: frustration, resignation, and indifference. One emergency manager mentioned that instead of expecting the medical doctors to do the online training, they bring the online training to the medical doctors. They managed to wedge a fire evacuation safety seminar on a yearly competency day (or similar), in which the medical doctors attend courses, workshops or seminars within their field of expertise.

Another emergency manager mentioned that in their hospital, surgeons were very reluctant to do any fire evacuation exercises, but once they finally got to do one, they were very positive about it. The emergency manager claimed that they received very positive feedback from the surgeons, mentioning that the exercise helped them to understand the difficulties involved in the evacuation during a fire.

3.3 Conclusions on the interviews

The interviews rendered very valuable insights on the perspectives of the different key actors. By pooling together the information they provided in two ways, the results of the interviews offer a multifaceted perspective of the challenges of training in the context of a hospital and how they concur.

4 Observational studies

A set of observations were conducted with the purpose of having a complete depiction of the process of the training provided to the staff. Only a reduced number of hospitals agreed to coordinate a training exercise in which an observational study could be conducted. Due to the sensitive nature of the observational study conducted, the hospitals were also granted anonymity. In total, three hospitals agreed to have the observational study conducted during a single evacuation training event each.

4.1 Method

Visits were scheduled based on the willingness and availability of the hospitals. The visits consisted of a simple observational study, in which the researcher followed the entire training event, without interfering. Notes were taken and after the training was done, clarifications were gotten from the host emergency manager and/or the training instructor.

4.2 Results

Three training events took place in the fall of 2024. In the fall of 2025, two additional hospitals agreed to have their training exercise observed in the context of this project. Five of the hospitals included in this observational study are located in Sweden, and one in another Scandinavian country. The training methods observed are listed as follows:

- Three announced evacuations: one in an outpatient ward, two in inpatient wards
- One unannounced evacuation: in an outpatient ward
- One practical training event: in an inpatient ward

4.2.1 Announced evacuations

Announced evacuations are a common type of practical training in Sweden: "*scenarioträning*" or scenario-training. In its most typical case, a scenario-training session is done at the ward (the staff's place of work) and lead by a specialized instructor from a private company, subcontracted by the Swedish region (as a reminder, a Swedish region is each of the 21 administrative subdivisions in the country, and are responsible for all public healthcare services). The instructor is usually a former firefighter, but that is not a necessary background. The session starts by gathering all the staff members receiving the training in a single room, like a meeting room or the staff's kitchen area. The instructor goes through some slides starting by fundamentals of fire safety, like the fire triangle, and advances step-by-step until the entire fire evacuation procedure is covered. Then, the staff is usually separated into two groups, for the practical part of the training. One of the groups is supposed to scatter around the ward, and they are supposed to play the role of patients ("patients" group). The other half of the staff remains in the staff role (the "staff" group), and are the ones expected to conduct the attempt at fire suppression and eventual evacuation of the premises. The "staff" group waits in the meeting room while the "patients" group is scattered, and the instructor prepares the scenario. The instructor places a sort of artificial fire in a room of their choice (usually a digital screen that shows flames that can be extinguished using its corresponding artificial fire extinguisher, which emits a signal to the screen to extinguish the flames). They write the number of the detector in that room on a piece of paper, and place that paper in the fire detection control panel for the "staff" to read when the alarm goes off, simulating the real case of reading the number from the panel itself. Then the instructor returns to the meeting room and starts playing an alarm sound on a cellphone or a hand-held speaker. This is the alarm that the "staff" needs to react to. Then the staff gets up from their seats and start the procedure.

4.2.1.1 The expected procedure

Usually, what the staff is supposed to do is as follows:

1. Rush to the fire detection control panel: the first person there wears the yellow vest and takes the leadership role, as described under section 3.2.7.5. The leader starts distributing the action cards. These tasks are conducted often simultaneously.
2. Read the number on the piece of paper: which corresponds to the detector that got activated and find the corresponding room number in a set of layout plans available by the panel. It is important to mention here that the detector number and the room number do not match. Being able to read the detector map and identify the real room is an important part of the task.
3. Take a real fire extinguisher, and carry it to the room of the fire. Once there, exchange the real extinguisher by the artificial one, and extinguish the digital flames. At this point, the time it took for extinguishment is usually recorded. The instructor then instructs the staff to pretend the extinguishment attempt has failed, and they are supposed now to conduct an evacuation.
4. Start the evacuation: the "staff" starts searching for the "patients" and evacuating them to the adjacent fire cell. Depending on the type of ward the training takes place in, this can include the movement of beds or just helping patients to walk out. In the meantime, someone has closed the valve to the oxygen supply in the ward (and any other dangerous gases), and alerted the management
5. Once the evacuation is over, the instructor plays the role of the arriving firefighters and requests information from the evacuation leader.

The procedure can be slightly different, as the action cards are meant to be tailored to the requirements of each ward. With the entire exercise completed, the instructor gives feedback on their performance to the whole staff (including the "patients"). Then the two groups swap roles, the instructor places the digital fire in a different room, and the exercise is repeated. After this second go, the staff heads back to the meeting room and the instructor (and possibly the emergency manager) give additional feedback to the staff, to put the experience in perspective and address possible issues. With that, the training event is concluded.

4.2.1.2 The observed procedures

Three announced evacuations (scenario training) were observed, as described before. The three events took place in different kinds of wards: a gynecological ward (outpatients only), a dialysis ward, and a thoracic surgery ward.

Rushing to the fire detection control panel

The first step includes the assignment of the leadership role by wearing the yellow vest. Certain hesitation was observed among the staff arriving first, but it did not imply a major delay in the actions. It is also possible that the hesitation was due to the group moving together, since the alarm started when all of them were in the meeting room. Therefore, the first may be two people walking together in the front of the group, they are aware that the rest are just one or two steps behind, and may not want to come up as too eager to be the leader. The real reasoning is unknown.

On one occasion, some "staff" made fun of the leader wearing the yellow vest, making derisive comments about how fashionable the vest is, or encouraging the leader to call to order a pizza instead of alerting the emergency management system. It is clear that the staff in that event found the training tedious and possibly not very meaningful. While this was a juvenile attitude, it raises the question on whether the time being spent in this training was worth it.

Reading the detector map

A recurrent issue is that the staff struggles to read the detector map. This can be due to several reasons. As mentioned before, the detector number and the room number are independent. Usually, the detector numbers have more than four digits (connected by a hyphen), adding difficulty to its interpretation. In at least one case the orientation of the detector map was wrong, and did not match the standpoint of the reader. It had to be turned upside down to match the layout of the ward.

It is unclear why the staff seems to struggle so much with it. An emergency manager downplayed the need for an alternative to the common detector map, claiming that it is not difficult to train the staff on reading the map. While it is true that the staff can be trained in that, it seems a rather optimistic take, since at most of the observed training events the staff was not good at it. As mentioned before, in one of the cases, it took them several minutes of effective inaction, which would later translate into a larger fire to try to extinguish, and marked reduction in the available safe egress time. It is not hard to train the staff on reading the map, but if it was that simple, they would have already been trained and they would not have struggled reading the map. To be clear: in most of the observed training events the staff struggled to identify the detector. It was not a single event.

Starting the evacuation

In the observed cases, there was no problem with the attempt at extinguishing the fire. The instructor gave them some feedback if minor issues were observed, and then instructed them to pretend the extinguishing failed, and start the evacuation. The "staff" then started to search for the "patients" in the ward, and helped them out to the adjacent fire compartment. In most cases, the "patients" mimicked the reactions from real patients (many times making both the "staff" and other "patients" laugh). While hilarity ensued, it was a more positive way to deal with the awkwardness of the roleplay than the derisive comments mentioned before.

Guidance and performance

The performance of the staff at these observed trained events showed substantial variability. Some groups performed remarkably well (especially in the second round, when the "patients" swapped roles with the "staff" and repeated the scenario with the fire placed in a new room), but in one case the instructor mentioned (after the staff were gone) that it was the worst performance they had witnessed in over a decade of doing the job. That was the case in which the staff took several minutes trying to read the detector map, and acted as a unit throughout the evacuation, not distributing tasks among themselves. The staff looked very uncomfortable during that session, like they did not know what to do at all, and realized they were underperforming. It is unclear why they were in such an awkward disposition.

The involvement of the instructor also varied. One instructor was guiding the "staff" one step at a time. As an example, the instructor started the alarm on a speaker, and told the staff to try and find the location of the fire, emphasizing that they were not supposed to distribute the action cards yet, and they were not supposed to do anything but identify the fire room. Once they did that, the instructor repeated that they were only supposed to try to extinguish the fire, and not attempt to move patients just yet. After the extinction attempt, the instructor cleared them to start the evacuation procedure. This guided approach is not necessarily inadequate, but under this guided course of action, an assessment of the performance of the staff should not be done. In one of the observations, that assessment was done, deeming that the staff performed adequately. A theoretical session, immediately followed by a guided, step-by-step exercise, should not be used as an evaluation of the performance or preparedness of the staff.

Scenarios to be trained in

The wards that received this training were very different in the kind of patients they had. One had mostly ambulatory, outpatients. One was a dialysis unit, with patients that may be conscious and may not be able to walk by themselves. One was a thoracic surgery ward, with unconscious patients that cannot move by themselves, and in some cases cannot be moved by anyone, including the surgeons. However, the scenarios were mostly the same: a fire in a room, the detection, the suppression, the evacuation. The conditions of the patients were hardly included, the staff was always ready to take action, and all exits were available. There was no difference in the approach, even though the wards had patients with very different needs.

Not all patients can be evacuated safely

As mentioned in section 3.2.6, the surgeons in the scenario-training observed had no qualms about walking away from a pretended patient that was in the middle of thoracic surgery. When asked why, the emergency manager explained that the ability to move the patient depends on the stage of the surgery, in some cases it being possible to stabilize the patient and move them, but in other cases it cannot be wrapped up quickly in any way. Doctors face the choice of remaining with the patient or protecting their own lives, a choice that cannot be easy to make.

It is hard to argue that patients should not be left behind, at the expense of the doctors. Doctors should not be expected to sacrifice their own lives to increase the chances of survival of the patient. However, as mentioned on section 3.2.6, fire safety engineers and the authorities should pretend that their design allows everyone to safely leave the affected ward. Not everyone will be evacuated safely in every fire, and that is a reality that should be faced and not glossed over. There are fire safety engineering solutions that can help improve the chances of a delicate patient, but the cost-benefit relationship may not be deemed reasonable.

It is unlikely that there is no possible engineering solution to make the operation room smoke and fireproof to allow the surgeons to stabilize any patient and allow them to evacuate safely. There could be many solutions, but there are also economic and practical constraints. Economic from the costs of increasing the fire protection systems in place, and practical from the usability of the room for the daily activities of the staff (e.g., operation rooms are designed for daily activities, not for the improbable fire, and therefore they serve the needs of walking in and out easily rather than a good smoke compartmentation). The questions then can easily go to the philosophical realm, pondering if it is worth increasing fire safety measures to the expense of other ways of spending the same resources, like hiring more doctors and nurses, providing better treatments to more patients, etc. These are questions outside of the scope of this project. Nevertheless, some solutions could be considered.

In New Zealand, operation rooms have at least two exits: one to the corridor, and one to at least one adjacent operation room. This allows the staff to move the patient from one operation room to the next, if needed, avoiding the hallway if it is filled with smoke, and allowing relocation to a smoke-free operation room. This does not mean that doctors have the duty to remain with the patient, but it gives them more options to either delay the decision to evacuate until the patient is ready to be moved (if at all), or if the fire is contained, continue the operation in an adjacent room.

4.2.1.3 Recommendations on announced evacuations

The detector map

It is clear that reading the map takes longer than it should. It is outside the scope of the present project to offer a solution that works for these maps, but one approach could be to relate the maps to something that is already familiar to the staff. An example could be a system of coordinates (like the algebraic notation used in chess, with letters on one axis and numbers on the other to indicate a precise square on the board). The fire detection central panel will still output the same several-digits-long number (assuming that it is unlikely that it can be tweaked much), which the staff tries to find in a list, with an adjacent column showing the algebraic notation (e.g., E5). Then the staff checks the detection maps, and can read the same coordinates system on the edges of it. This solution has not been tested in any way, but it is suggested here as a possible, more user-friendly alternative to the current plans. Most people are familiar with this kind of coordinate system, and it may make it easier for the right detector to be found on the map.

Coming up with a similar idea or an alternative one is possible, but bringing it to reality can be a challenge. When an example of this idea for a detector map was presented to an emergency manager, they appreciated the concept, but explained that it can be hard to implement in reality. There are several hundreds of plans like that in a large hospital, and with the constant refurbishment works or construction works in the hospital complex, it is already a strenuous task to keep them as they are, let

alone add more work to them. While it is important to keep the reality of the implementation on sight, the sunken cost fallacy may truncate opportunities for effective change.

Starting point and division of tasks

It is unclear why the staff is told to head to the panel from the meeting room the training is given at, but every time the starting point was not a realistic representation of where the staff would be in the event of a fire. While any kind of training, in general, does not need to be a 1-to-1 representation of reality, starting as a unified group in the same room seemed to lead to the group operating together, as a unit, in some cases. In one of the observed events, the whole group gathered together to try identify the detector that went off in the detector map. This means that about 8 people were standing together, taking no action for several minutes other than trying to decipher the map. Instead, the staff could leave two people behind, trying to figure out the detector map, and start checking the rooms in the meantime. Not only would this help to find the fire quicker (if the map still proves a challenge), but it could also help to map the patients in the rooms and possibly prepare them for a possible evacuation.

Testing and training

The training session should be separated from the testing session. One approach could be to alter the order of the different stages of this kind of announced evacuation (scenario training). For example, they could start with a performance test. Upon arrival of the instructor, the alarm is triggered and the staff needs to respond to it as instructed in their previous training (i.e., rush to the detector panel, identify the detector, try to extinguish, fail and evacuate the patients), under the supervision of the instructor. Then, once over, the instructor gathers everyone in the meeting room, and goes through the theory, highlighting the rights and the wrongs observed during the testing session. Lastly, the training is completed by repeating the scenario-training, in order to allow the staff to apply the corrections needed, if any. This approach has the same steps, including the theory session and two scenarios being trained on, but one serves as a test of the actual preparedness of the staff, and the second serves as a grounding method for the improvements needed. The proposed test and training sessions have not been tested, but they would not take more time or resources than those the hospital and the staff are already dedicating to these scenario-training sessions. It has the advantage that it is a test of their current preparedness, and therefore is a way to probe the status of the different wards.

4.2.2 Unannounced evacuation

The unannounced evacuation was done in an outpatient ward. The ward is on an upper floor, accessible through stairs and elevators. The patients showed different degrees of mobility constraints. The staff did not know about the event, which was led by the emergency managers and the local fire and rescue services. Upon the alarm being triggered, the staff realized there was (theatrical) smoke on the staircase leading to the entrance of the ward, so they directed the patients towards the emergency stairs.

The performance of the staff was generally spotless, checking every room and helping the patients to evacuate, providing support to patients that were uneasy because of the alarm. One issue that emerged was that the staff tried to evacuate vertically a patient who could not walk by themselves, using an evacuation chair. It took five members of staff around ten minutes to bring the patient one floor down. As an outcome of the exercise, the ward decided to look further into means of vertical evacuation and training their staff on how to use them safely. While the outcome was not underwhelming, it is not possible to tell how it would have turned out if there were more patients needing to be moved vertically.

4.2.3 Practical training event

The practical training event receives this name because of a lack of a better descriptor. The event was planned by the head nurse. Different training stations were placed in various areas of the ward. The training stations were under the supervision of a few staff members. In one station they trained on

using an artificial fire extinguisher on digital flames, in another station they trained on moving a patient horizontally, and in a third station they trained on moving a patient vertically downstairs. The staff were distributed in groups, so that one group is at each station, and then moves on to the next one.

The training event had mixed results. The staff was active and engaged. The training was focused on performing the right actions, not necessarily making the right decisions, but equally useful training. However, about half of the staff received the wrong training on how to bring a patient downstairs using the available evacuation mattress. The technique they used was incorrect (dragging the patient by the head side of the mattress, instead of the feet). Moreover, they were not told how to strap the patient correctly to the mattress (the patient being one of the staff members), which reduces the bouncing of the head when dragged down each step. Lastly, they did not provide the patient with a helmet, to protect them in the case of an accident on the stairs.

Also remarkably, the head nurse who planned and designed the training event, was on duty during the entirety of it. This is an unfortunate outcome, as it would have been beneficial for them to also oversee the execution.

When asked how much time they had to plan and prepare, the nurse said they may have used in total about eight hours, in chunks spread between other duties: half an hour here, one hour there. They said it was not particularly hard, but that they did not have much time to solely focus on it.

4.3 Conclusions about the observations

The handful of training sessions observed within this observational study is likely not a statistically relevant representation of the status of training sessions in all hospitals in Scandinavia. While not all of them ran according to the expectations of the emergency managers in charge, they show the importance of practical training sessions, as they are a much better indicator of the problems the staff may have in an evacuation event than any quiz performed in the typical online training sessions. The mishaps in the practical trainings observed here give a very clear signal of aspects to be worked on, how prepared the staff is, and how effective the previous training events they have had are.

One important issue went unnoticed until many months after the observations were made. There was no reference to when the training would be repeated for the shifts that were not on duty at that time. Even in the few cases in which the visit had to be rescheduled, the alternatives were usually in a different ward. It is unclear how the wards provide these training events to their whole staff.

4.3.1 Training in vertical evacuation

It is natural that hospitals rely on progressive, horizontal evacuation, but vertical evacuation should not be neglected. The long time and the many staff members needed to bring a single patient one floor down needs to be underscored. Considering the number of staff members expected to be in any ward at nighttime, which is generally considered the worst-case scenario for a fire, a similar situation may have serious implications for the safety of all patients in the ward. Hospitals should not only provide means of egress for vertical evacuation, but also ensure that the staff can operate them correctly. There are many devices available on the market, but the staff need to be very well trained in how to use them. In the case of the practical training event, the staff were trained on the wrong technique to use the evacuation mattress. Lack of training or inadequate training leads to a false sense of preparedness, and the consequences of the inadequate use of the equipment are major as they can lead to an unfortunate chain of events: the patient who may suffer a fall with the risk of serious injury, the staff who may be injured because of the accident, and the rest of the patients in the ward, with less staff members available to assist them.

5 Survey

As a third step, a survey was prepared and launched, to get the perspectives of a large number of healthcare staff themselves. The objective of the survey was to listen to those who receive the training in a context separated from that from their employers. Anonymity was granted to them as well, only asking limited background questions.

5.1 Survey design

The full set of questions can be found in Appendix A. The questions aimed at collecting data on the kind of training they have received (in their present place of work and any previous ones), their perception of the quality of the training, their perception of preparedness, and their personal opinions on what would make their preparedness better.

The background questions asked were their profession (medical doctor, nurse, registered nurse, other), their years of experience, and the country they work in. While the survey was explicitly targeted to healthcare staff members who work in wards with patients that need assistance to evacuate, they were asked if there are patients in their unit who cannot evacuate by themselves, and if they are tasked with taking care of those patients on a regular workday. Respondents who answered no to either of those two questions were removed from the analysis of the responses.

The survey was prepared in four languages: Swedish, German, English and Spanish. The languages were those in which the vast majority of the interviews were held in.

5.1.1 Training methods

The questions about the different training methods were based on those mentioned by the interviewees. The training methods the respondents were asked about were:

Theoretical training

- *Online training: slides or videos*
- *Classroom training: with an instructor in person*
- *Unannounced evacuation: organized by the management, but you were not informed ahead of time*
- *Announced evacuation: you were told about it ahead of time*
- *Walk-through training: an instructor walked you through your unit, showing you the procedure*
- *Table-top training: in groups, sitting only, you discussed the procedure step by step*

Practical skills

- *Practical training: moving a bedridden person horizontally to a safe location*
- *Practical training: moving a bedridden person down the stairs*
- *Practical training: using an extinguisher on real flames*

The brief descriptions were added to make it easier for the respondents to classify the training methods they were familiar with in the categories used in this study. The subcategory of practical training with its three variations was included since the interviews indicated that in many cases, staff members receive one form of theoretical training (most typically online training) and also a form of practical training (most typically the use of extinguishers). Therefore, subcategory of practical training does not replace the main training methods, but complements them.

5.1.2 Distribution

It was distributed initially through the network of emergency managers created during the interview phase, for them to distribute it in the hospitals they were affiliated with. A link to the survey was also

circulated on social media, including by some emergency managers, for further outreach to healthcare staff in other hospitals and possibly also other countries.

5.2 Results

A total of 749 responses were submitted. However, more than half of them were from people who do not work in wards with patients that cannot evacuate on their own. After removing these answers, 328 remained as valid ones. Figure 6 presents the number of responses received by country the participant works in. The vast majority of the answers came from Sweden (140 responses) and Germany (129 responses), with Spain in a distant third place (23 responses). The rest of the countries had between 1 and 3 respondents, and there were 15 respondents who did not answer this question.

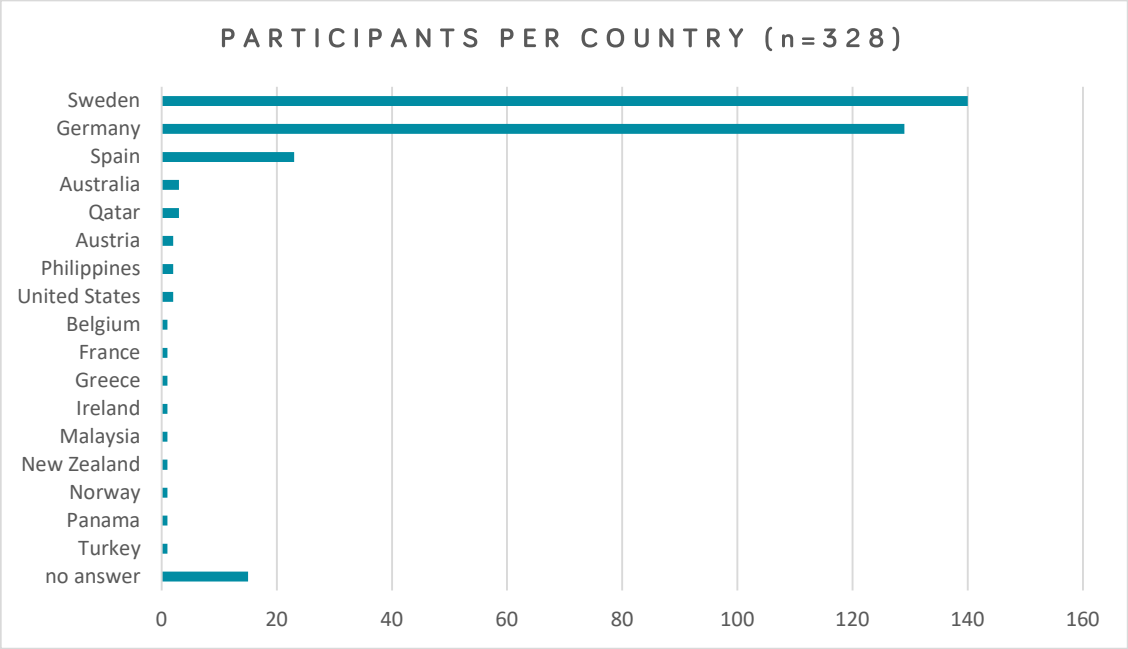

Figure 6 – Number of participants per country they work in.

Figure 7 shows the proportion of participants claiming they have received a given training method. Most participants reported more than one training method received. It is not surprising that unannounced evacuation is the least common training method used, but it is remarkable that the evacuation through stairs was reported by less than 15% of the respondents. Most of the "other" training methods received refer to "scenario-training" (which is a type of announced evacuation), or were described as "none", meaning that they have not received any form of training.

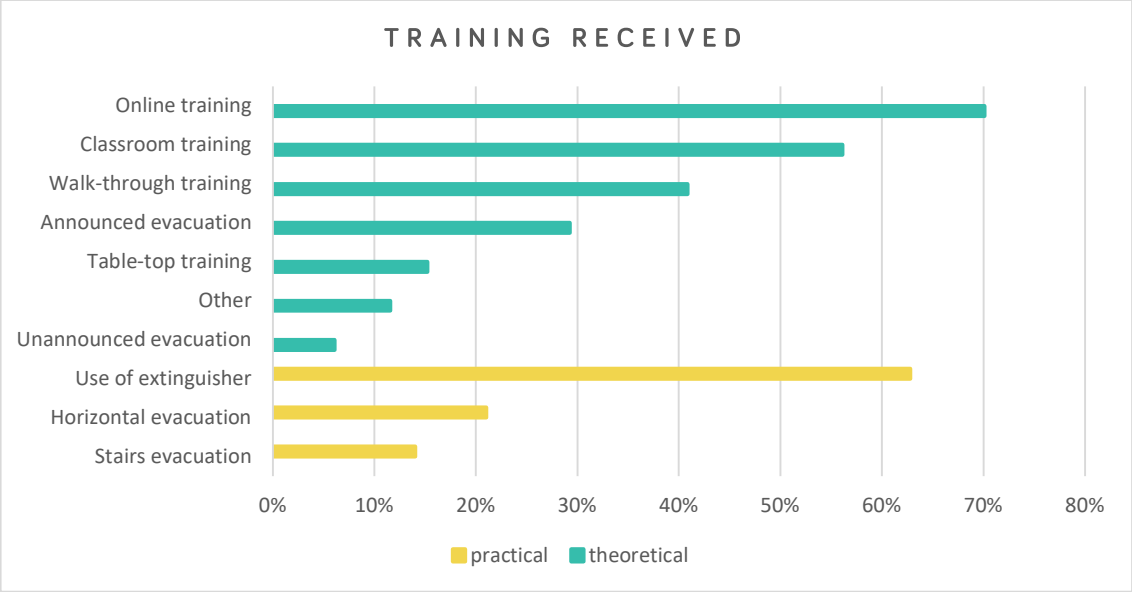

Figure 7 - Proportion of respondents who received each kind of training included in the survey. Most respondents reported more than one training method.

Respondents also rated the quality of the training received. Figure 8 presents the results regarding this perceived quality of training received. The vast majority of the training methods they were asked about received generally positive qualifications. Notably, online training received generally "good" rating (47%), but only 17% considered it "very good", when around 70% of the respondents claimed to have received it. Walk-through training was considered as "good" or "really good" by around 80% of the respondents who claimed have received it, which were only 15%. Similarly, evacuation through stairs was considered "good" or "very good" by around 80% of respondents, but as mentioned before, only 17% of the respondents have received it.

Most of the "other" training methods that received "very poor" rating were those who claimed they had received no training whatsoever. The "other" that received "very good" training were those who received "scenario training", and were generally pleased with it.

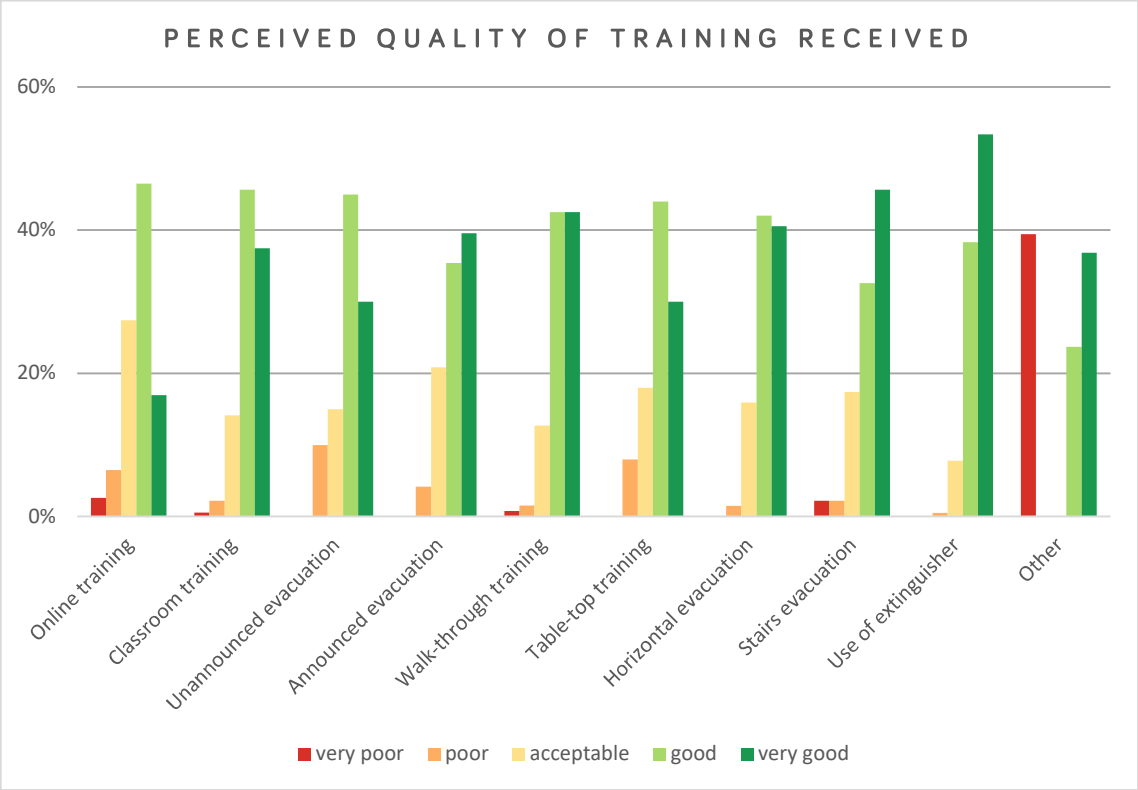

Figure 8 – Participants' perception of the quality of the training received. Percentages are based on the total number assessments made by all participants. Each participant made as many assessments as training methods they indicated they received in the past, which is presented on see Figure 7)

Respondents were asked to rate their perceived preparedness from 0 (not prepared at all) to 10 (fully prepared). Figure 9 presents the scores for 285 out of 328 valid respondents, because 43 respondents did not provide a score. The average score for these 285 respondents was 6.0.

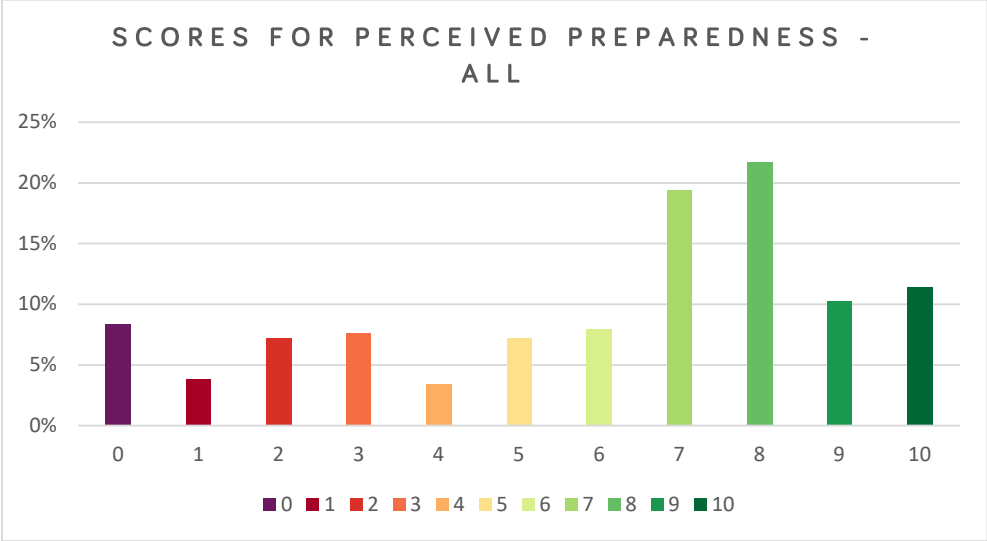

Figure 9 – Scores participants gave when asked how prepared they think they are to tackle a fire evacuation, from 0 (not at all) to 10 (fully).

When reading the responses on the open-ended question "*Is there something you wish to change to make the fire and evacuation training you receive better for you and your colleagues?*", it became

clear that answers were biased based on the language in which the survey was answered. Figure 10 presents the same scores from Figure 9, but they are classified by language used to fill out the survey. The data not shown as percentages here but as frequency of a given score, because the large differences in the number of respondents per language (111 in Swedish, 97 in German, 55 in English, and 22 in Spanish) making it harder to appreciate the magnitude do each score per language.

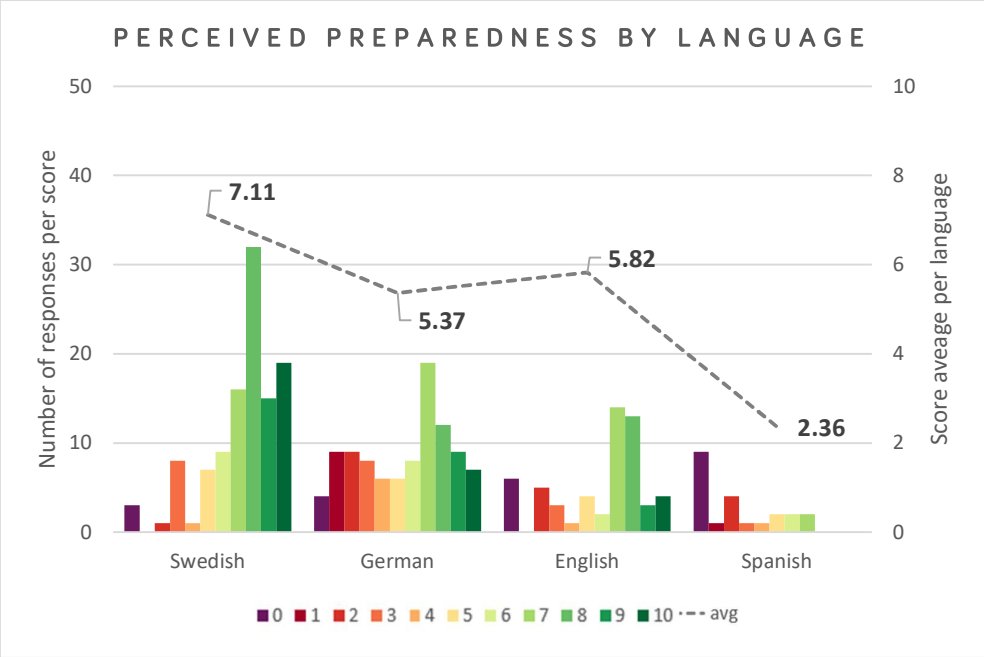

Figure 10 – Rearrangement of the scores presented on Figure 9 based on the language the survey as answered in. The average score is also indicated per language.

5.3 Comments provided

This section presents some remarkable comments provided in the survey. The comments are presented in English, with an indication of the original language it was written in and the score the respondent gave to their own preparedness.

Table 1 – Sample of comments written by respondents and the score they gave to their own preparedness

Comment	Original language	Preparedness score
We have good education and knowledge about fires	Swedish	10
More exercises to search and rescue patients	German	10
We should have exercises every year	Swedish	8
It would have been good to train on the evacuation of patients	German	8
We have provided feedback with tips for this year's training and it was carried out better than the previous one.	Swedish	8
Exercises more frequent and better instructors	Spanish	7
I think the training in my job is good	English	5
Play the entire scenario	German	5
Maybe need to have them more often	Swedish	3
I work in neonatal care. In the event of a fire, all patients need to be evacuated. During the night there would not be enough staff	German	2
Needs to be face-to-face	English	2
There is too much to do!	German	1
Receive any training	Spanish	0
Adapt the theory to the place of work	German	0

5.4 Discussion

5.4.1 Number of respondents

The total number of valid responses is 328, but not all respondents gave an answer to all questions. While 328 is not a low number for respondents, it is still a relatively small sample of hospital staff, given that large hospitals can easily have more beds than the total number of respondents. As a reference, Eurostat reported 19,747 hospital beds in Sweden in 2023 (Eurostat, 2024), and it is very likely that Swedish hospitals have many more staff members than beds. Therefore, 140 respondents is a very small sample of respondents in Sweden. Germany was the second largest group of respondents in this survey (129 people), which is even a smaller representation of hospital staff members, given the Germany has easily around 8 times the population of Sweden.

5.4.2 Quality of the training received

Most assessments of the quality of the training received were either "good" or "very good". Online training was the least and the practical training on using the extinguisher was the most "very good" with 17% and 53% of respondents assessing it so, correspondingly.

It is important to consider when reading this data that their assessment is based on the quality of the specific training they received, which may or may not be a fair representation of the training method itself. As an example, a given classroom training occasion may be rated as "good" or as "poor" depending on the instructor and/or the content being so, and not the nature of classroom training as a medium for imparting training. Therefore, this data should be considered more a descriptor of the respondents' satisfaction with the training received than an evaluation of the medium (the training method) itself.

5.4.3 Perceived preparedness

The assessment of their preparedness was very different in the four languages the survey was filled out in. Most responses in Swedish were overall positive (average score of 7.11 out of 10). The responses in German were less optimistic, with an average of 5.37 out of 10. The responses in English are based on many different countries, and give an average of 5.82. Lastly, the responses in Spanish were pronouncedly negative (average of 2.36 out of 10).

5.4.3.1 Perceived preparedness in Swedish

There was a markedly more positive assessment from respondents answering in Swedish. This can be due to the staff simply feeling prepared. They receive the training, they have no reason to believe the training is not enough for them to tackle an emergency, and they feel confident they can do so. Swedes tend to have higher levels of trust in authorities than people from other Western countries like France and the United Kingdom (Viklund, 2003). However, this relatively high level of perceived preparedness contradicts much of what was described in the interviews, and what was observed in the training events.

5.4.3.2 Perceived preparedness in Spanish

The respondents filling out the survey in Spanish gave the lowest scores to their perceived preparedness by a large margin. When reading their written answers about what could help them to improve their response to an emergency requiring an evacuation (as a reminder, 22 respondents filling out the survey in Spanish answered this question), many expressed a complete lack of training or having received extremely poor training. It is unclear why the answers are so negative, but given the small sample and the lack of additional context, no conclusions can be drawn from it.

5.5 Conclusion from the survey study

The survey showed that there are marked differences between the languages the survey was filled out in. Respondents writing in Swedish were overall positive in their assessment of the trainings they have

received and their own level of preparedness. Those answering in Spanish were the opposite. In German and in English, the average was around the middle of the scale.

The staff mentioned that they would like to do more practical training. There were many opinions on which kind (announced evacuation, unannounced evacuation), with whom (with firefighters operations, with patients), where (in our place of work, moving patients outside our ward), and how often (every year, every two years). Some also brought up the need to do training with fire extinguishers, and some, but few, walkthroughs. Despite the differences in the precise nature of said practical training, their requests may come from their own insecurities about their preparedness, and given that they are the ones supposed to conduct the evacuation, their concerns should not be disregarded.

6 Expert assessment

After the interviews and the observations, it became clear that the wishes of the emergency managers in terms of training are often overruled by reality. They may want to do things differently, but constraints may stop them. Therefore, a Delphi study was designed to collect the experts' assessments on the six training methods covered in this study, namely online training, classroom training, unannounced exercise, announced exercise, walkthrough training, and table-top training. The purpose of this study is to analyze the benefits of a given method from their perspective.

A set of six factors were identified that cover the issues raised during the interviews. These factors are listed on Table 2, and refer to aspects of the reality of running a hospital that may make a training method more or less applicable in that context.

Table 2 – Factors to be used to compare two training methods to each other using a pairwise comparison. The meaning of the factor and the example were provided to the emergency managers to clarify the terms.

Factor	Meaning	Example
Time efficiency	It refers to how much time it takes to perform the training for the staff member, beginning to end	A training method is more time efficient if it takes less time to complete
Easy planning	It refers to how much time it takes to arrange this training session, for the training manager (not the staff member being trained). Think of how much of your time takes to conduct each training	A training method is easier to plan if it less time to plan and schedule
Cost-effectiveness	It refers to how much it costs for how good the quality of the training is	*A training method is more cost-effective if it does not cost much compared to how rich the training experience is*
Immersion	It refers to how realistic the training experience is, compared to being in a real emergency	*A training method is more immersive the more similar it is to experiencing a real fire emergency at the hospital*
Interaction with others	It refers to how much the actions of a trainee have an effect in the outcome of the evacuation. Think of the emergency response as a group effort, and interacting with other staff (e.g., distributing tasks, areas to check, etc.) is highly beneficial for a successful evacuation	*A training method allows for interactions with others when the training is done as a group with different tasks to complete*
Patient realism	It refers to how much the training method takes into account the medical condition of the patients	*A training method has higher patient realism when the condition of the patients has an effect in the content of the training (e.g., some patients need certain healthcare during the evacuation, does the training method contemplate that?)*

In addition, their perspectives about practical skill components (horizontal evacuation, vertical evacuation, and use of extinguishers) was requested in the form of a rating from 0 (poor) to 10 (excellent) foe arch of the factors (i.e., time efficiency, ease of planning, cost-effectiveness, immersion, interactions with others, and patient realism).

The Delphi study was designed to consist of only two rounds of assessments, to minimize the workload for the participants.

6.1 Participants

A total of 20 emergency managers were invited to participate in this study. They were selected based on their level of engagement with this project, based on the perception of the author. These emergency managers were located in 9 countries, and each received an email with the invitation to participate, a document with instructions, and a spreadsheet in which they were asked to perform the pairwise comparison. The invitation, the instructions and the spreadsheet were sent in Swedish, German, English or Spanish, depending on the language used during the interview. It was estimated that the

6.2 No results

Only one response was received after several weeks, when the study was closed. The extremely low level of participation rendered this study unviable. Two more invited participants mentioned months later that they could still do the study, but given the very reduced number of replies, their work would not lead to any meaningful results in the context of this study.

6.3 Issues with the expert assessment study proposed

The low level of participation is unfortunate but it shows a problem with the approach of this project. Similarly to the case of the interviewees in the initial stage of this project, their participation was not part of their jobs. They had to dedicate their own time to participate, and even if their participation would be included in their work hours, it is still an added burden to an already busy schedule. Moreover, the nature of this study is tedious, the rating is relative and therefore requires much thought, and spreadsheets are not the most user-friendly medium. Due to these reasons, the expert assessment was not performed.

7 Pilot tests

The last stage of this project was to perform pilot tests. The pilot tests were training scenarios designed to test a single solution identified in the different previous studies in this project, to eventually implement it if considered effective.

A few emergency managers were invited to join this part of the project, by selecting a number of possible training scenarios to be tested from a list of five training scenarios provided. They were also given the option to propose their own scenario.

It was expected that the pilot test would take place during a regular, scheduled training session at their hospital. The participants would be the staff members in the scheduled unit, and there would be a before and after questionnaire (which is presented in Appendix C in Swedish only, and consist of a very much reduced version of the survey described in Chapter 5) to collect data about the participants' profession and perceived preparedness before and after the training event.

Two hospitals signed up for a pilot test, but one ended up canceling it. A single pilot test was then conducted, but the implementation of the procedure was too laxed, it is difficult to assess it as a controlled trial. Therefore, the single pilot test event was included in section 4.2.1 as one of the observations.

7.1 Issues with the pilot tests proposed

There were two main issues. First, the relatively lack of time (or interest) from the hospitals invited to participate. It is unclear why time would be an issue since they did not need to book any additional training sessions. Similarly to the issue with the expert assessment, the present project is outside their own priorities and therefore it is likely that they did not have the need to make adjustments for it. Second, there was no way to ensure experimental control. The hospital operated on their own terms, but that went against the purpose of the pilot test, and no conclusions could be drawn. For such a study to be successful, more experimental control is needed, and to get it, the research team needs to work in seamless collaboration with the hospital.

8 Announced evacuation with firefighter operations

An additional announced evacuation exercise was observed in the fall of 2025. This was not included in Chapter 4 because it was very different from the rest. Rather than a training event, it was a test.

In 2017, an inspection conducted by the property management at the Swedish region where the hospital is, assessed that a given floor could not be used for patients because of insufficient means for safe evacuation, and the wards in that floor were closed. In 2024, the hospital decided to reconsider what is needed to reopen the area for regular use, and asked for an inspection from the local fire and rescue services. The inspection rendered the same outcome, but suggested performing a test. The hospital administration and the rescue services prepared together for almost a year to run this test, and this section of the report details the observations made about it.

The test was conceived as an announced evacuation. It was planned as a joint effort between the hospital emergency response and the local fire and rescue services, in order to assess the feasibility of the evacuation including the fire and rescue operations.

Volunteers from a local nursing high-school joined as patients, in order to include medical care in the tasks of the staff during the evacuation. Three teachers were present too, representing family members of some patients. One of the teachers also pretended to have a medical emergency during the evacuation.

As the ward under study was not currently used for inpatients, there was no staff allocated to it. The trainees were staff members from different wards. This means that they were not very familiar with the ward. Also, they were recruited on a voluntary basis, from different wards, to minimize the burden on any given ward, which means the staff was also not very familiar with each other.

8.1 People involved in the drill

Table 3 presents the roles of the main actors during the drill and their number.

Table 3 - Main actors in the drill - not including fire and rescue services

Role	Organization	Number
Patients	Nursing high-school	12
Relatives	Nursing high-school	3
Staff	Hospital	8
Security personnel	Hospital	2
Ambulance	Hospital	2

In addition to these actors, there were a number of observers: hospital management, technicians, a representative from the Region, the Region property manager, and a large set of observers, both from the hospital and from the fire and rescue services.

The day before the drill, all actors involved attended a meeting at the ward to be tested. Representatives from all groups were present, in order to agree on the technicalities: where to start, who is in charge of the smoke, when is the alarm triggered, what happens next. A high level of coordination and cooperation was observed among all groups.

8.2 Description of the drill

On the day of the drill, the patients and the parents arrived early to get into their hospital gowns and occupy their designated rooms before the alarm started. Each of the patients had a specific medical condition and a requirement for certain care (e.g., oxygen supply). Some were supposed to be bedridden, and one was in a wheelchair. At the time of the fire, the person in the wheelchair was supposed to be at the balcony with their parent, needed to eventually be rescued from there.

The staff was also in place, and was asked to fill out the before part of a before and after questionnaire, like the one designed for the pilot tests and presented in Appendix C.

A representative of the fire and rescue services used a smoke machine in the staff kitchen area, which was the room designated as the origin of the fire. Once the kitchen was filled with smoke, the smoke entered the hallway and reached a detector. Then the alarm went off.

The alarm went off exactly at 9.00 am. One staff member tried to use an extinguisher, but was discouraged by an observer (the emergency manager), because the room was filled with smoke and therefore too dangerous for the staff member. The staff member was insisting they should try, but was discouraged again. Around 9.03 the first patient was helped out of the ward. This patient could walk with assistance. The first bed was evacuated at 9.05. By then, the hospital security personnel arrived to the site and helped the healthcare staff to search for and move patients.

The staff moved patients to the adjacent compartment, leaving them in the vicinity of the door. One bed and around three mattresses were placed in that area. By 9.07 the staff looked confused. Some ambulatory patients were still being removed. The staff tried to provide care for the evacuated patients. By 9.10 little sense of urgency was observed, mostly confusion. The staff member wearing the yellow vest told them to wait for the fire brigade.

At 9.13 the fire brigade arrived at the adjacent fire compartment. They started to place their equipment, connect the hose, install the fan, and wear their breathing apparatus. At 9.15 more firefighters arrived. Their operations drew all the attention from the staff and observers, everyone turning into a passive observer and trying to stay out of the way. At 9.23 the firefighters started the fan and two minutes later they went into the fire compartment with the hose.

At 9.27 the staff tried to move the patients away from the door area, instructed by the firefighters. By then it was difficult, as the fire hose blocked most of the hallway and the beds could not be pushed. The patients had to be moved with their mattresses. The staff did not use the mattresses correctly every time.

The staff attempted a vertical evacuation using the mattress down the stairs. Three staff members collaborated. In the meantime, firefighters were rescuing some trapped patients. These patients claimed they were in their rooms and there was little to no smoke coming in from the hallway.

The firefighters extracted several patients, including one in a bed. By 9.44 the ambulance staff arrived at the scene. They asked the evacuation leader (the one with the yellow vest) about the number of patients that have been evacuated and where they were. The staff was unsure.

The firefighters continued their operations. All patients were rescued by the time the ambulance staff arrived. The drill ended 15 minutes later, when the firefighters were done.

8.3 Post-drill discussions

After the drill was concluded, there was a general discussion with all groups involved, as well as internal discussions for the fire and rescue services and for the hospital staff. The comments made are presented here by group.

8.3.1 The trainees

The trainees (the hospital staff members taking the role of staff at the ward during the evacuation) stated a general sense of confusion during the drill. They expressed feeling overwhelmed and unsure of what to do. They claimed it would have been good to have more information ahead of time, although they were not specific about what information exactly would have helped.

When asked if the yellow cards had helped them, most remained silent and some tried to recall. One trainee mentioned that they grabbed one, read it, and stuffed it in their pocket and forgot about it, signifying they did not use it at all.

They said they were confused about the yellow vest and its meaning or intended purpose. They did not know that the point of the vest is to make the evacuation leader easy to identify, as they are responsible for communication between the staff and with the fire and rescue services, as explained in section 3.2.7.5.

They maintained that there was almost no discussion about which patients to evacuate first, and that they defaulted to proximity and the need of medical oxygen supply for them.

They stated that they hoped the firefighters would tell them what to do once they arrived. This is attested by the observations made in the previous subsection, as the staff did stand by, watching the firefighter operations and not doing much more.

One trainee brought up the issue with the lack of roles. The medical doctor described the experience as confusing, as there was no clear leadership. This was not criticism of the staff member who wore the yellow vest, but rather they contrasted the response to the regular operations in a hospital: “when we do any kind of procedure involving several people, we have a very clear idea of who is there doing what, so it is strange not to have the same thing in an emergency”. They contrasted a surgery to the drill, how in one everything is coordinated, and in their experience during the drill, they did not know what their role was and had no clear instructions of what each should do. They attributed the general confusion during the drill to this lack of roles (It should be noted though that the yellow vest and the action cards are supposed to provide said leadership role and specific actions to each staff member).

Someone mentioned that it is clear to them that evacuating 18 bedridden patients with 4 staff members at nighttime is a nearly impossible task, if an evacuation would be needed in their ward.

They discussed the difficulties of finding the fire room in the detector plans. There was confusion between the number of the detector and the number of the room.

8.3.2 The fire and rescue services

The firefighters mentioned that they encountered an issue upon arrival, as they realized that they had lost their key (that would let them into the building), that is usually in the firetruck. They said they had to knock on a side door (the one nearest to the dry riser on the floor of the fire) until someone noticed them and let them in, losing several minutes in the ordeal. They mentioned they will change their procedures to always have a key in their jackets.

The firefighters claimed that they encountered “*full Armageddon*” upon arrival to the ward. They said there were far too many observers (wearing blue vests to distinguish between them and the trainees and the patients) and the place was too crowded, which was a fair assessment (there were at least 13 observers). They mentioned that the patients should have been moved further away from the fire compartment by the time they arrived, and not left by the door to it. They explained that when they open the door to enter the fire compartment, smoke may come out, compromising the adjacent compartment. Moreover, they explained that they need space for their equipment, and having the staff moving patients out of the way was needed in any case. Their recommendation is to have patients moved at least two compartments away from the fire.

In their own report, issued weeks later, they mentioned that they expect to develop a plan for their operations at the hospital.

8.3.3 The management

Prevention was highlighted by the management. According to them, given the complexity of a real fire and the difficulties of evacuating patients, the concept of avoiding ignition is the safest bet. They brought up the use of timers in the staff kitchen area, constant monitoring of the facilities in terms of inappropriate storage of flammable materials, and blockages of the means of egress.

8.3.4 The ambulance staff

Part of the response to such a fire in a hospital comes from external rescue services driving ambulances. Their role is to keep track of the patients that have been evacuated and coordinate, if needed, an eventual transfer to another hospital. The ambulance staff mentioned that when they arrived, nobody could give them full information on the number of patients evacuated or where to find them. They claimed they were told two were taken to the Internal Care Unit one floor below (not for medical care but as a safe location away from the fire), only for the ambulance staff to go there and no evacuated patients were to be found. The staff should keep track of the evacuated patients.

8.4 Conclusions

As mentioned before, this drill was a test rather than a training event. As such, it was able to flag problems or oversights in their expected course of action during an evacuation. It is besides the point of this project whether the performance of the staff was sufficient to pass the test. What is relevant is that testing is highly important. This was an announced evacuation event. While this was not their usual place of work, and they were not colleagues, the staff was fully aware of the event and knew exactly when it was going to start. Yet there was confusion and a lack of structure in their actions. The yellow vest approach did not work for them. If this was the case in an announced evacuation, it is unlikely that in a real emergency (an unannounced evacuation) their performance will be much better.

There is no doubt the staff was committed and took the drill seriously. Their confusion and stress were visible. Their comments in the aftermath are consistent with the insights given by interviewees and conclusions of the observational study in section 4.3. This outcome is another example of the training they have received in the past not being sufficient or adequate for the real task.

9 Project discussion

9.1 Methodology

This project on training of hospital staff on fire evacuation was intended to collect experiences from the hospitals themselves, as a way to identify common difficulties and approaches, as well as offering alternative solutions.

The methodology explained in chapter 2 covered several data collection methods, and included different groups of relevant actors. Not all studies expected to be conducted were successful. Some, like the interviews and the survey, were relatively extensive. Only a handful of observations were conducted in the observational study. The expert assessment and the pilot tests were unsuccessful.

The main issue with the methodology was the relatively low response from the key actors. It was difficult for them to find the time to commit to the different studies, and without them, there was little else that could be done. Some key actors remained fully engaged, and offered more information and time than expected. Those who could only commit little time still provided extensive insights. The names of all contributors to this project are not mentioned here for the sake of anonymity, but their contributions were extremely valuable.

9.1.1 Validity of the results

The present project was conceived as a qualitative study. It is difficult to assess the validity of the results. The samples used were biased towards those who had the time and the will to talk about the issue of hospital evacuation. It is possible that many who declined to participate do not see the training of the staff as a problem, and saw no point in discussing it. In addition, there were those who declined to participate because of having disagreements with the status quo. Therefore, the results present an incomplete picture of the issue. Nevertheless, the study does not point to a solution that can be applied uniformly across contexts. The results and recommendations are offered as options, but their suitability in the context of a given hospital is not guaranteed.

9.2 Results

9.2.1 Training should not imply staff reduction

It is likely that well-trained staff can perform an evacuation in a more efficient way (Strating, 2013). However, assessing “well-trained” can be a difficult task. Based on the insights gained during this project, staff preparedness is generally insufficient. Improving training most certainly will help to streamline the decision-making process and improve the evacuation, avoiding mistakes and reducing the risk for the staff and the patients. Nevertheless, less staff is hardly a desirable outcome. The staff already struggles with time, hospitals struggle with staffing. As mentioned by one person in the announced evacuation described in section 8.3.1, there may be too few staff members to move too many patients in need of assistance. At some point, training cannot replace hands moving the patients. This is also similar to the comment made by the fire and rescue services in section 3.2.3 about the sprinklers. The sprinklers do not stop the smoke, so installing a sprinkler system with the intention of reducing the number of staff members needed for an evacuation is misguided.

No amount of engineering can solve the problem of insufficient staff. Optimization is a worthwhile objective, but beyond a certain threshold it becomes counterproductive. At some point, it ceases to refine essential functions and instead it begins to erode them. Where that threshold may be remains unclear, and finding it is unlikely, even with controlled experiments. Hospital evacuation is exceptionally complex, compared to other buildings, because of the many factors at play: health status of the patients, their level of mobility, the available staff, their level of preparedness, the size and location of the fire, the fire safety systems in place. Moreover, hospitals are fundamental for a healthy

and resilient society. Reducing the staffing to the bare minimum in this context is not beneficial for the patients, nor for the staff at work on a regular day, and certainly not during a fire evacuation event.

9.2.2 Sufficient training

It is hard to estimate what sufficient training is without a systematic method for assessment. Emergency managers try their best with the limited resources they have. However, they cannot conduct systematic evaluations extended to all the wards, and taking into consideration their special characteristics in terms of kind of care provided and health status of their patients. While there is no doubt that they try their best, a single hospital may not be able to offer enough opportunities for testing and comparing outcomes.

9.2.3 Required Safe Evacuation Time

Much of the scientific publications about hospital evacuation focus on the time to disconnect patients, walking speeds, bed movement speeds, vertical evacuation speed (Geoerg et al., 2025; Hoondert, 2017; Hunt et al., 2020; Strating, 2013). The uncoupling or disconnection times for patients can be very difficult to know precisely, as it depends on the kind of treatment the patient is receiving, and their overall health status. The disconnection time is very much needed for evacuation simulations, as well as how fast a bed can be pushed or how fast a patient can be brought downstairs. These aspects are relatively easy to measure in a controlled environment, and collecting data more often than not useful. However, focusing on these aspects can give a false sense of security. The pre-movement time is not fully explained by these values, and there is much that remains unknown.

There are two problems with focusing on these times and speeds. First, is that the disconnection time varies wildly, depending on the equipment the patient needs, and the proximity to the fire. Even if the proper procedure may take several minutes, if the fire is in the same room, the staff will disconnect the patient immediately and push them out, hoping to be able to stabilize and further treat the patient again once away from the fire. “Seconds”, said a healthcare staff member as the shrugged, referring to that scenario. This is a reasonable approach, as they have to make a quick decision and the fire rapidly growing is more likely to lead to a certain death than an improper disconnection due to said fire. The second problem with fire safety engineers’ interest in disconnection times and movement speeds is that the real problem starts long before movement speeds come into place. That is important data to be collected, but the pre-evacuation time does not start to count when the staff starts moving towards the patient’s room, but rather from the moment the fire is detected. The pre-evacuation time that fire safety engineers are interested in for evacuation simulations is a small proportion of the complexity of the pre-evacuation process in a hospital. The main problem is not how fast a bed could be pushed, the problem is that the staff may not know what to do, and take too long to start evacuating patients. Understaffing, confusion, unclear role during an evacuation, misconceptions about their tasks during an emergency can delay the decision to evacuate to a point which is too dangerous for the staff and the patient. A delay assuming leadership, a delay reading the detector map, a delay fighting the fire or containing the smoke, a delay deciding the move the patients and where and how and with whom, all of those delays are based on the training the staff receives, the training that according to many people participating in this project is not sufficient. This takes an important proportion of the available time for safe evacuation. It cannot be separated from the pre-evacuation time, and it is the most difficult part to assess in the estimation of RSET in hospitals. The pre-evacuation time seems to be so difficult to estimate (given all the difficulties found in this study) that the contribution of a well-assessed disconnection time and movement speeds would be limited. More studies are needed about the training of the staff, which has a direct impact on a quicker resolution to evacuate.

9.3 Future studies

It is possible to provide more evidence-based guidance with a large-scale data collection study. This study should be conducted with full involvement of hospitals, allowing for the training offered to the staff on a regular basis to be administered and tested systematically. The large-scale aspect of it allows

for the inclusion of multiple similar wards, and the conduction of an overall large number of tests (hundreds) to collect data on the staff's perception of preparedness, retention of knowledge, and performance in a drill as a test.

In that study, it would also be possible to conduct the expert assessment as a first step, to focus on the most reasonably applicable training methods, instead of an idealistic selection of them.

10 Recommendations

This chapter focuses on the recommendations drawn by the author given the knowledge gained during the study, and general expertise in fire evacuation. These recommendations can be seen as an expert opinion.

10.1 The staff safety should come first

During one of the announced evacuation scenarios observed in the context of this project, one example emerged of an instructor presenting to the staff the whole procedure in the event of a fire, starting by the attempt to extinguish the fire first, with an emphasis on how important that is. It was only until the end of the theoretical training that the instructor mentioned that the staff's own safety comes first. While this is arguably true, it is a rather unfortunate order of aspects to consider. If their own safety comes first, it should be brought up first, and the assessment of the situation (i.e., the risks involved in the extinguishing) should be part of the procedure, not an afterthought before finishing the training session.

10.2 Practical training as often as possible

The results of the survey showed that the staff want to do practical evacuation training in their place of work more often. Not only is it reasonable to listen to the expressed needs of the group of people tasked with performing an evacuation in the event of the fire, but also it is a reasonable request for the sake of their own preparedness. The staff need to have the opportunity to apply the lessons learned in their training events to ensure that the information learned is translated to action in reality. In several sections in this report, expressions of the staff being confused or uncertain about what to do in an evacuation were brought up. Giving them the theory and allowing them to then bring it into action would improve their confidence in the event of a fire. Not only is important to practice a realistic evacuation scenario, but also include other elements like other staff members playing the role of the patients, and inconvenient conditions such as the alternative means of egress. If the ward is suited with equipment for vertical evacuation (such as evacuation chairs or evacuation mattresses or sheets), the staff needs to be trained in their use. Not training the staff on their use renders the equipment unusable.

10.3 Evacuation beyond the adjacent compartment

Invariably, interviewees and observations conducted rendered the same outcome: patients are moved to the next compartment. However, this relocation is rather unfortunate, as they may need to be further moved either due to the operations of the firefighters or due to improperly closed penetrations in the compartment walls, filtering smoke into the adjacent compartment. Based on the observations and even the advice of firefighters, the patients should be moved horizontally at least two compartments away from the fire.

10.4 A fire in the adjacent ward

Only a couple of interviewees mentioned that in the event of a fire in the adjacent ward they need to monitor the situation next door and prepare for an eventual evacuation of their own or to receive patients. Again, due to penetrations improperly closed on the compartment walls, smoke can come in, or the firefighters may need the space to conduct their own operations. The time can be used for surveying the medical needs of the patients, and making any pertinent preparations to move them (e.g., getting oxygen bottles, getting mobile equipment ready, etc.). Alternatively, they can prepare rooms to receive evacuated patients from another ward temporarily. Ignoring the alarm will mean a waste of time, turning the eventual evacuation more difficult.

10.5 Drills as a test, not education

The announced evacuation including the operations of the fire and rescue services observed was not meant to be a training event but a test. This is a very reasonable approach, as a drill is more useful as a tool to flag strengths and weaknesses than as a training occasion. In all cases a so-called "scenario

träning" was observed, the theoretical training was immediately followed by the announced drill. This usually leads to a very good performance from the staff, since they were just told what to do. While it is not necessarily wrong to offer theoretical background and then put it into action, this is a missed opportunity to properly assess how well the staff can handle an evacuation. It is therefore recommended, that a drill is conducted before the theoretical part takes place, so that the instructor can then address the shortcomings of the drill in the theoretical part. A second drill can be conducted right after the theoretical part, with the intention of allowing the staff to correct the mistakes highlighted during the initial (test) drill.

In addition, if the drill is meant to include the operations of the firefighters, it could be beneficial for the organization to conduct a table-top exercise with representatives of the different groups involved ahead of the drill. A table-top exercise allows all groups to see the development of the actions from each party in combination, not just their own role, unaffected by the rest. This kind of exercise can help to identify gaps in communication or planning, and trace all steps that are expected to be followed by each group before the event takes place.

10.6 A relationship between the hospital and the firefighters

The differences in the expectations of the staff and the firefighters can be removed with the development of a relationship between them. The way to establish said relationship will depend on the parties involved. However, working as allies can help to reduce the expected dependence from the staff on the firefighters, the location of the critical infrastructure in the hospital by the firefighters, and the efficient relocation of the evacuated patients out of the areas of action of the firefighters.

10.7 Close the knowledge gap

Emergency managers may be well informed in terms of fire and evacuation safety, but the design of a fire and evacuation strategy in a given ward falls on the healthcare staff in charge of the ward. This is because it can be difficult for the emergency management to understand the needs of the patients in the ward, so it makes sense to give the staff running the ward the flexibility they need to implement a strategy that meets their needs. However, the healthcare staff is usually less versed in fire evacuation safety, due to their focus being healthcare. There seems to be a missing link between the fire safety experts working at a hospital and the healthcare staff managing the wards. The emergency management provides guidance, but it does not seem to be a seamless transition of knowledge and understanding. It is possible that the work duties of the healthcare staff are already too many for them to think in depth about fire safety strategies (fires do not occur nearly as often as healthcare emergencies in their ward). It is important then to ensure that the staff has enough guidance given their own limitations in time and depth of knowledge.

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A. *Fire evacuation training for hospital staff – guideline for decision-makers*

This guideline is meant for decision-makers in the context of training for hospital staff in fire evacuation. It condenses the lessons learned in the project *Optimization of Hospital Evacuation and Training* funded by the Swedish Civil Defence and Resilience Agency.

1. The purpose of fire safety training

The main purpose of the training provided for the staff is to prepare them to act in a **safe** and **efficient** manner in the event of a fire or similar emergencies. Their safety needs to come first, as it cannot be expected that they put their lives at risk. Their safety is as important as the patients'.

Moreover, an injured or incapacitated member of staff also need care from their coworkers, which adds a level of difficulty to the evacuation effort, as the staff forces are reduced and the number of patients to evacuate increased. It is therefore relevant to ensure the staff can assess the risk and make informed decisions before taking an action. Since their own risk evaluation comes at play, it is important to start the training procedure with a fire safety risk assessment lesson, in which they are told about smoke toxicity, and fire growth and spread, from the perspective of the staff, not the building.

The staff's preparedness is therefore crucial to ensure the safety of patients in the affected wards, and their ability to

2. Choosing a training method

The training method should be chosen considering the perspective of the staff: what is the best way to prepare them to act? With this thought in mind, it can be argued that practical training (i.e., announced or unannounced drills) is a good approach as it is reasonably similar to the real emergency event, compared to other training methods. Unannounced drills can be more difficult to schedule without having a significant toll on the duties of the staff and the needs of the patients. Announced drills are a reasonable alternative. In addition, including part of the staff as patients to be evacuated can also include the provision of healthcare during the drill, based on typical patient conditions in the ward.

Since practical training can be difficult to organize given that it needs time from a large part of the available staff, it is important to optimize it. A theoretical approach (e.g., online training, or classroom training) could be used ahead of the practical training event, in order to provide the staff with enough information before they conduct the drill. The theoretical approach, ideally, should be easy to revisit, so that the staff can reinforce their knowledge at will, more often than what is mandated if they prefer it so.

When drills are not possible, alternatives such as walkthrough training (conducting the entire evacuation procedure while walking through the relevant areas, in order to show the different steps in situ). Table-top training is another alternative, which has the advantage of providing a birds-eye point of view to the staff about the different things happening at the same time in different parts of the affected wards, and the different groups involved and their tasks. Table-top training also requires many of the staff members to be available at the same time, which can make it more difficult to schedule than a walkthrough.

It is likely that a single training method is not enough, or it is not suitable for all staff members. Therefore, it can be useful to plan the training involving different training methods, to reinforce the information and allow staff with different skills to find better ways for them to learn. In addition, it is here suggested to avoid repeating the same training method and/or content. Repetition can be useful but it can quickly turn into tedium. Maintaining engagement from the staff is also needed for the training to be effective.

3. Training content

The content of the training should be tailored to the staff's needs. This can be difficult to achieve, given that the staff and the fire experts have different expertise and their understanding of one another's duties is very limited. Providing a general framework to the head of the ward and leaving the rest of the decisions for them to adapt the fire safety training to their needs is an ineffective approach. Usually, the head of the ward (or any other healthcare staff member) has limited understanding of fire growth and spread, human behavior in fire, and firefighter operations. On the other hand, the fire experts have limited understanding of the patients' needs and the staff's abilities. Given that each side has limited knowledge of the other, relegating the task to one or another leads to a biased perspective. Therefore, the content of the training should be designed by both of them on equal standing.

4. Assigning responsibility

Fire evacuation safety can come as an afterthought to most staff members. Fires are rare, and most of the time they are relatively small or quick to contain. It is understandable that the staff may prefer to prioritize other duties that are relevant on a day-to-day basis. Because of this, assigning responsibilities in terms of fire evacuation safety to their role or job description can help to emphasize its importance.

One way to assign this responsibility in practice is to attach the figure of an "evacuation leader" in a relatively senior position within each shift. For example, the head nurse on each shift could have the role of evacuation leader. This means that it is their responsibility to take the lead if and when a fire emergency occurs. Since head nurse is a role that is assigned to an individual in a given shift but it is not necessarily always the same individual, with time, there can be more people in the ward who have had this leadership role. This means that other people could take that role if the head nurse is for some reason unavailable or unreachable during the fire emergency.

Preassigning this role to their duties in a given shift has the implication that the assigned individual will potentially be in charge, and therefore feel encouraged to take the training more seriously, and/or develop their own questions about the strategy. It is very important to give them access to all the information they need, and the opportunity to refer to someone else if they have further questions or needs for information. While their preparedness for this role is on them, it is crucial that there is information or means for them at hand, at any time.

The staff should also be trained on how to keep a log of the patients even after they have been evacuated. They need to be trained in how to account for them (i.e., know their location and medical needs) during the entire event. This means that there must be a registry system at hand. This registry will allow the evacuation leader to have an overview of the status of the patients that have been evacuated, so that if needed, the patients can be sent to other wards and even other hospitals if needed for medical treatment.

5. The training scenario

A fire in the given ward is the basic training scenario, but there are others that need to be considered.

A fire in the adjacent ward

The staff needs to know what to do if a fire is detected in a nearby ward. In some hospitals there may be an expectation of assistance among wards. This is a useful approach, as there will hardly be too many hands to help during an evacuation. However, some hospitals have an approach in which each ward is on their own. In this approach, a given ward should be able to manage an emergency by themselves, and should not expect assistance from adjacent wards. This does not seem to be very helpful, and a collaborative approach will mean more resources. Even in this isolationist approach, it is important for a ward to know what to do when a fire is detected in an adjacent ward. It is always possible to have smoke spread into a ward due to a fire in an adjacent one. This can be due to

improperly sealed penetrations in the walls of each fire compartment, or due to the firefighter operations. Either way, smoke can enter a ward, even if the fire does not. This means that the ward needs to prepare for an eventual evacuation due to smoke. In addition, the firefighters usually require some available space for them to place their center of command. They can choose a ward that is unaffected by the smoke, meaning that patients may need to be moved.

Lastly, in the event of a fire in an adjacent ward, a given ward should prepare to receive evacuated patients. This may mean preparing rooms or beds, and even staff for possibly incoming patients.

Evacuation of multiple wards

In the case of smoke spread as mentioned before, it may be possible that more than one ward may need to be evacuated. Therefore, it can be important include some scenario for evacuation further away, and even a total evacuation. It is not needed to plan a drill with the entire building, but training the staff on scenarios in which the evacuation needs to be directed further away than the adjacent ward or elevator lobby is necessary to contemplate these possible scenarios. Fire evacuation is within the umbrella of disaster management, and therefore training should include larger scale than a single ward evacuating.

Vertical evacuation

Wards that have a secondary means of egress consisting of a staircase *must* train on vertical evacuation. This means that the staff needs to be able to efficiently transport patients down the stairs using the available evacuation devices (e.g., evacuation chairs, mattresses, sheets, among others). The training must include a person being transported with said device.

In the case of evacuation sheets, the staff needs to be trained on the correct application of the sheets on the mattresses. This also includes the non-healthcare staff such as cleaning staff who clean the rooms and change the bedding on a regular basis.

Fire safety systems

In some cases, such as intensive care units, neonatal intensive care units, and other sensitive wards, the staff needs to be trained in how to operate any special system they may have (e.g., silencing of the alarms), as well as which systems are interrupted automatically and who can reactivate them (e.g., ventilation systems, elevators), if they can be reactivated at all.

6. Evaluating knowledge

The staff need to apply the lessons learned in their training events to ensure that the information learned is translated to action in reality. Conducting drills not as training but also as tests can show the level of preparedness that the ward has. This means that the drill can be announced, but it cannot be done soon (let alone immediately) after any other training method, to avoid an overrepresentation of the knowledge level the staff members have.

If a drill is to be conducted once a year, it could be beneficial to conduct the drill as a test, in which an instructor oversees the staff's performance. After the drill is concluded, the instructor can provide theoretical training, and link it with the observations made during the observed drill. This reinforces the relevance of the information provided theoretically in the context of the drill.

7. Relationship with the local firefighters

If possible, although likely not every year, the drill could include the operations of the firefighters. Building and maintaining a relationship with the local firefighters is important, since sometimes there can be mismatched expectations from both sides. Hospital staff tend to see the arriving firefighters as a form of authority, and tend to delegate decisions on the evacuation of patients and the fire safety systems in the building to them. On the other hand, firefighters have limited knowledge of the building

layout, the needs of the patients, and the systems in place and how to operate them. Therefore, linking drills to their operations can help both sides to understand the role of the other better.

The role of the firefighters in a fire evacuation needs to be understood by the staff in order to have the expectations aligned, and improve the firefighters' operations. Their familiarity with the building and their acquaintance with the realities of evacuating patients will also improve their response.

B. Appendix B – Survey questions

What happens when there is a fire?

Imagine the following situation. The fire alarm starts ringing, and you do not know where the fire is located. What are the three most important things you need to do in that case?

First:/Second:/Third:

Patients in your unit

Are there patients in your unit who cannot evacuate by themselves? Yes/No

Do you take care of patients in a regular day of work? Yes/No

About you

What is your profession? Doctor/registered nurse/nurse/Other (please specify)

How many years of experience do you have in your profession?

For how many years have you worked in your current place of work?

In which country do you work?

The training you have received

What kind of training have you received in your job? (in your current place of work and any former)

- ☐ Online training: slides or videos
- ☐ Classroom training: with an instructor in person
- ☐ Unannounced evacuation: organized by the management, but you were not informed ahead of time
- ☐ Announced evacuation: you were told about it ahead of time
- ☐ Walk-through training: an instructor walked you through your unit, showing you the procedure
- ☐ Table-top training: in groups, sitting only, you discussed the procedure step by step
- ☐ Practical training: moving a bedridden person horizontally to a safe location
- ☐ Practical training: moving a bedridden person down the stairs
- ☐ Practical training: using an extinguisher on real flames
- ☐ Other (please specify)

Training

How good did you think each type of training you received was? Please rate

	Very poor	Poor	Acceptable	Good	Very good
Online training: slides or videos					
Classroom training: with an instructor in person					
Unannounced evacuation: organized by the management, but you were not informed ahead of time					
Announced evacuation: you were told about it ahead of time					
Walk-through training: an instructor walked you through your unit, showing you the procedure					
Table-top training: in groups, sitting only, you discussed the procedure step by step					
Practical training: moving a bedridden person horizontally to a safe location					
Practical training: moving a bedridden person down the stairs					
Practical training: using an extinguisher on real flames					
Other					

Poor training

Have you gotten poor or very poor training? Yes/No

What made that training poor or very poor?

Frequency

How often do you receive each type of training in your current place of work?

	never	every 5 years or even longer	every 4 years	every 3 years	every 2 years	Once a year	More than once a year
Online training: slides or videos							
Classroom training: with an instructor in person							
Unannounced evacuation: organized by the management, but you were not informed ahead of time							
Announced evacuation: you were told about it ahead of time							
Walk-through training: an instructor walked you through your unit, showing you the procedure							
Table-top training: in groups, sitting only, you discussed the procedure step by step							
Practical training: moving a bedridden person horizontally to a safe location							
Practical training: moving a bedridden person down the stairs							
Practical training: using an extinguisher on real flames							
Other							

Preparedness

How confident do you feel the training you received prepared you enough to handle an emergency? Rating from 0% (not confident at all) to 100% (fully confident)

Your opinion

Is there something you wish to change to make the fire and evacuation training you receive better for you and your colleagues?

Is there something you would like to add in general about the training you have received or about this survey?

Thank you for your replies.

C. Appendix C – Pilot test questions

Om dig

Vad är ditt yrke? Läkare/sjuksköterska/undersköterska/Annan (var god ange)

Hur många års erfarenhet har du i ditt yrke?

Hur många år har du arbetat på din nuvarande avdelning?

Utbildning/träning

Vilken typ av utbildning/träning har du haft I ditt jobb? (på din aktuella arbetsplats och tidigare)

- ☐ Onlineträning: med bilder eller video
- ☐ Föreläsning: med instruktör
- ☐ Oannonserad utrymningsövning: du visste INTE att det var en övning
- ☐ Annonserad utrymningsövning: du visste ATT det var en övning
- ☐ Guidad genomgång: du går igenom avdelningen med en instruktör som visar proceduren
- ☐ Table-top-träning: med gruppen runt bordet, man diskuterar proceduren
- ☐ Praktisk träning - horisontell utrymning: flytta en sängliggande person till angrensande brandcell
- ☐ Praktisk träning - vertikal utrymning: flytta en sängliggande person ner via trappa
- ☐ Praktisk träning - använda en brandsläckare: på en riktig eld med en instruktör
- ☐ Annan (var god ange)

Dålig utbildning

Har du fått någon dålig träning? Ja/Nej

Vad var det som gjorde träningen dålig?

Förberedelse

Just nu: är du tillräckligt förberedd för att hantera en nödsituation? 0% (inte alls), 100% (helt och hållet)

Utbildningen sker nu

Vänligen fortsätt enkäten när övningen är avslutad

Idags övning

Har den träning du fått, förberett dig tillräckligt för att hantera en nödsituation? 0% (inte alls), 100% (helt och hållet)

Vad var det viktigaste du lärde dig på utbildningen idag?

Hur ofta tycker du att en utbildning som dagens bör upprepas? Mer än en gång om året/Varje år/Varje andra år/Varje tredje år/Varje fjärde år/Varje femte år eller ännu längre/Annan (var god ange)

Din åsikt

Hur skulle du ändra den träning du fått om brand och utrymning så att den skulle passa dig och dina kollegor bättre?

Tack för dina svar