

DESIGN FOR ELDERLY EGRESS IN FIRE SITUATIONS

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ABSTRACT

In response to an aging population and an increasing number of fires in homes designed for the care of the elderly, this research project looks at the role that human behaviour plays in the fire safety of long term care (LTC) and retirement homes. Through reaching out to care homes in Ottawa, Canada, interviewing senior staff members, and observing fire drills at three LTC homes, a baseline was developed for the current fire safety practices and procedures used by these facilities. Information gained and observations made during the research process are discussed along with the conflicting expectations and realities of fire drills and evacuations in LTC and retirement homes.

INTRODUCTION

The global population is aging and the design of the built environment must adapt to reflect this in order to meet the needs of such a population through ensuring comfort and safety levels¹. This is particularly true in the case of LTC and retirement homes as they specifically cater to the needs and care of the elderly. As people age, they are more likely to have some form of disability and require more time to evacuate due to added physical, mental and mobility barriers². In many cases, evacuation is impossible without assistance. This results in a greater reliance on the ability of staff members within LTC and retirement homes to evacuate the residents in the case of a fire emergency. The limited number of staff, combined with the added challenge of assisting those in vulnerable physical and mental states, means that the required safe evacuation time is much greater than in other evacuation scenarios.

BACKGROUND AND MOTIVATION

Within the last three years, there have been five fires in Canadian LTC and retirement homes. Three of these fires resulted in fatalities. The issue of fire safety in such homes is a pressing one, even more so as the population ages. As such, research into how fire safety can be improved in LTC and retirement homes needs to be conducted. In 2015, Pichler et al. conducted research into the architectural considerations of Canadian LTC homes with respect to fire safety and egress³. That research concluded that in addition to architecture and design, the human behaviour element was also critical in the outcome of fire safety in LTC homes. In that study, two LTC homes were interviewed and a drill was observed at one home. As human behaviour was not the focus of the interviews or of the drill observation, the information collected on human behaviour was preliminary.

Building on previous work, the research presented in this paper focuses on broadening the scope and understanding of the human behaviour aspect of fire safety and egress in LTC and retirement homes. Comprehensive data has been collected on the fire safety procedures and training in these homes, as well as on the major challenges faced by staff members and residents. The goal of this research is to develop a baseline for the current practices, procedures and challenges in order to determine the areas most in need of further study. The research described in this paper will bring into question whether fire drills in LTC and retirement homes are accomplishing what they set out to achieve, and it will direct the focus of the authors' future research towards defining the stages of the evacuation process and the time required by each stage.

METHODOLOGY

Initial Contact

The initial phase of the research involved reaching out to LTC and retirement homes in Ottawa, Canada. Electronic communication in the form of emails were sent to seven LTC homes and seven retirement homes. The emails briefly explained the focus of the research project, fire evacuations in LTC and retirement homes, and asked if a senior staff member would be willing to have an in-person interview to answer questions about the home's evacuation procedures and fire safety practices. Four LTC homes responded positively, while no response was received from the other three. Of note, one of the positive responses received came from the LTC home visited by Pichler et al. the previous year³. Responses were received from two of the seven retirement homes contacted. Of these, one was able to participate in the research project.

Interviews

During late 2015 and early 2016, interviews were conducted at the participating LTC and retirement homes. Each interview lasted between one to two hours, and during this time, the facility contact responded to over 50 questions divided into the follow categories: *General Information and Facility Design, Resident State and Demographics, Fire Evacuation Procedure, Fire Drills and Training, Smoke Detectors and Sprinklers, and Personal Experience*. The facility contact at each home was either a senior administrator or the person in charge of organizing the fire drills and staff training.

Fire Drill Observations

As a follow-up to the interviews, each participating LTC and retirement home was asked if one of the facility's mandated fire drills could be observed. All four participating LTC homes initially agreed, however, one home could not be reached to set up a drill observation. The participating retirement home agreed to the observed drill, however, conflicting schedules resulted in delays and, at the time of this writing, a drill has yet to be observed. Therefore, the findings discussed in this paper refer solely to the three LTC home fire drills observed thus far. The drill conducted by Pichler is discussed elsewhere¹.

The format of the fire drill observation process was consistent across all LTC homes. To ensure the integrity of the information collected, the observations were made during the homes' scheduled drills. Upon arrival at each site, a brief, private meeting was held with the facility contact to discuss observation strategies and drill expectations. The research team entered the wing where the drill was to be conducted just prior to the commencement of the drill. This was done to minimize the chances of alerting the staff and residents of the forthcoming drill. Cameras could not be used to record the drill as most residents were unable to give informed consent due to their reduced mental capacity. As a result, all observations were made by the three or four members of the research team and were recorded by hand. The observations were compared and compiled to maximize the amount of information collected. However, it was acknowledged that some information would be missed due to the limitations posed by the allowable observation and recording methods, and that alternative techniques could be considered for future studies. The drill was followed by a staff debriefing where the facility contact discussed what occurred during the drill and answered any questions posed by staff members. After observing this debriefing, the research team was able to interview willing staff members about their interpretation of the drill's success. The visit concluded with a meeting between the facility contact and the research team to discuss the observations made and to address any questions or concerns regarding the fire drill.

DISCUSSION OF FINDINGS

Codes and Regulations

Seeking to improve the fire safety of LTC and retirement homes in Ontario, there have been a number of additions made to the Ontario Fire Code and the Ontario Building Code. As of January 1, 2014, the Ontario Fire Code requires that in addition to the mandated monthly drills held at LTC and retirement homes (care occupancies), an approved fire drill scenario with the lowest staffing level must

also be observed by the fire department once per year. During this drill, all residents in the fire zone wing must be evacuated, or staff members must stand in for the residents and be evacuated in their place. The Fire Code also mandates that in care occupancies, the training of staff carried out under the home's fire safety plan must be recorded. This was seen during the observed fire drills when all involved staff members signed a document verifying their participation in the drills.

Interviews

The purpose of the interviews was to learn how individual LTC and retirement homes approached their fire safety and to gain a better understanding of the care environment. General information about the homes can be seen below in Table 1.

Table 1: General Information

	Long Term Care Homes				Retirement Home
	Home 1	Home 2	Home 3	Home 4	Home 1
Number of Stories	3	3	7	2	5
Number of Residents	161	193	180	192	127
Fire Procedure Followed	REACT ^a	REACT ^a	RACE ^b	REACT ^a	REACT ^a

^a REACT - Remove those in danger, Ensure door is closed, Activate alarm, Try to extinguish the fire

^b RACE - Rescue, Alarm, Contain the fire, Extinguish

All of the participating LTC and retirement homes had similar staff distributions. The greatest number of staff worked on the day shift, followed by the evening shift. The least number of staff worked on the night shift. Their resident populations were also quite similar. The average age of the residents in the LTC homes ranged from 75 to 88 years of age, while the average age of the residents in the retirement home was 90 years of age. In the LTC homes, 88 to 100% of residents would require assistance during horizontal evacuation, with over 86% of residents having some form of dementia (a severe impairment in memory, language and thinking) and over 80% requiring some form of physical assistance. In the retirement home, 24% of residents would require physical assistance during horizontal evacuation and 90% would need assistance to descend the stairs. In addition, 26% of the retirement home residents had some form of dementia.

Upon hiring, staff members were given fire safety training as part of their orientation. In addition to the fire drills, staff were also required to partake in annual training. The extent of this training varied slightly from home to home. Four of the five homes visited used the REACT method (Remove those in danger, Ensure door is closed, Activate alarm, Try to extinguish the fire) and one home used the RACE method (Rescue, Alarm, Contain the fire, Extinguish). In accordance with the 2007 Ontario Long Term Care Act and the Ontario Fire Code, the fire plan of each home specified holding three fire drills per month, one on each working shift. So as to limit resident distress caused by the sound of the fire alarms, at least one of the three monthly drills was silent.

While all of the homes had different architectural designs and features, each plan was typically organized into wings or units. These units were straight hallways which branched off of a central core, with the fire stairs at the far end of each hallway. In the LTC homes, each unit was separated by a set of fire doors. As horizontal evacuation was the primary form of egress in the LTC homes visited, these doors created a barrier behind which the residents would be moved. In the retirement home visited, only the floor designated specifically for those with dementia was fitted with fire doors at the beginning of each hallway. Horizontal evacuation was also the primary egress strategy in the retirement home. On the memory care floor, the residents would be evacuated behind the fire doors, and on all other floors, the residents would be moved down the hallway and into the safety of another resident room.

Fire Drill Observations

The initial intent of the fire drill observations was to see how the residents moved and behaved during the drills. However, most of the information that was able to be collected pertained to the staff members who participated and to the overall challenges faced during the drills. This was largely due to the fact that so few residents took part in the drills. In the drills observed, no residents participated in the first drill, two participated in the second, and one participated in the third. It should be noted that only three residents were involved in Pichler et al.'s drill. The residents who participated during the

three drills observed by the research team were all in wheelchairs and were either moved down the hallway and out of the fire zone, or were moved back into their rooms. As most residents in the LTC homes had some form of dementia and required physical assistance to evacuate, the staff were only supposed to move those who were willing and able to participate in the fire drill. Residents who were in bed at the time of the drill were not evacuated. Overall, the staff appeared reluctant to move any residents as they did not wish to disturb or cause them further distress.

Table 2: Fire Drill Information

	Drill 1	Drill 2	Drill 3
Working Shift	Evening – 3:30pm	Evening – 3:00pm	Evening – 3:30pm
Number of Staff Who Participated in the Drill	7	9	7
Number of Residents Who Participated in the Drill	0	2	1

As seen in Table 2 above, all three of the observed drills took place on the evening shift. The first drill observed was a silent drill, meaning that the fire alarm was not sounded. Instead, a “Code Red” call was made over the intercom system indicating the location of the fire. In this case, as the location of the fire room was specified, the staff did not need to check all of the rooms to find the fire. The other two drills used the fire alarm. This meant that the initial responsibility of the staff was to locate the fire room. In the third drill, the call light above the fire room was ‘lit up’ so less time was spent locating the fire. There was no indication where the fire was located in the second drill, so additional time was needed to check all of the rooms. A timeline of the behaviour and actions observed in the first and second drills can be seen below in Figure 1. These drills lasted 3.20 minutes and 4.85 minutes respectively. The third drill lasted only 2.33 minutes, with the “All Clear” call made one minute later (given the speed of this drill, there are no added insights to be compared at this time and as such the data is not included in Figure 1).

During the drills, there were behaviours and actions common to all three LTC homes. These can be seen in Table 3 below. Each home used some form of notification tag, either Evacuechecks (a tab attached to the front face of the door the can be flipped) or a small sign hung on the door handle to indicate if a room had been checked for residents. Some confusion was observed during the drills as to the meaning of these tags, with some staff members unsure whether to use them as soon as the resident door had been closed, or only if the room had been searched and evacuated. Given the vulnerable state of the residents and their likely fearful reaction to the fire alarm, thoroughly checking resident rooms was a critical task as the residents may have been hiding. During the drills, however, it was observed that staff members spent only a short amount of time going into and searching the resident rooms and may not have thoroughly checked all possible hiding places. This, along with the lack of resident evacuations, meant that the drill time recorded was not an accurate representation of the time required to actually evacuate a wing in the case of a real fire. During the staff debriefing after the fire drill, each facilitator mentioned the amount of time that the staff had to evacuate the fire zone. In each case, the available safe evacuation time was said to be 75 minutes, based off of the rating of the fire doors and compartmentalization. No mention by drill participants was made of the tenability of the fire zone or the impact that smoke would have on the evacuation process.

When looking at the fire room specifically, it was observed that the room was checked at least twice by different staff members. This meant that the door to the fire room was opened multiple times thus creating the opportunity, via the introduction of air, to further fuel the fire, spread the fire, or allow smoke to move more easily into the hallway. Overall, there seemed to be a sense of uncertainty amongst the staff members. They often appeared to look to each other for guidance or for confirmation that what they were doing was indeed correct. The large number of staff who participated in each drill (at least seven staff members) could have been a contributing factor to this confusion. It was also observed that there seemed to be a lack of instruction given by the designated person in charge. This was, however, understandable as said staff member was responsible for a large number of tasks including: *the checking and entering of the fire room, extinguishing the fire and evacuating the resident in the fire room, delegating tasks, confirming that all rooms have been evacuated, and communicating with staff outside of the fire zone.*

Figure 1: Fire Drill Timeline for Two LTC Homes

First Fire Drill	Time (minutes)	Second Fire Drill
Drill Starts - "Code Red" is announced over intercom	0:00	Drill Starts - Fire alarm goes off
Staff member A enters wing wearing safety vest and carrying the fire extinguisher and door tags		Staff member A (already in hallway) walks to end by fire doors
Staff member A enters designated fire room	0:30	"Code Red" call is made, hallway of fire is indicated
Staff member A simulates fire extinguisher (sound)		Staff member B enters from stairs at end of the hallway
Staff member B and C enter wing, one carrying a fire extinguisher		Staff member B puts on vest
Staff member A leaves fire room, does not close the door fully, and moves down hallway		Someone says "We have to check rooms"
Staff member B checks designated fire room	1:00	Staff members C and D enter, one with a fire extinguisher
Fire room door is closed by staff member B		Staff members E, F, G and H enter from stairs at end of hall
Discussion between staff member A and B to put towel down at base of fire room door		Staff member I enters
		Resident A is moved down hallway
		Resident B is moved back into resident room
		A resident (outside of the fire zone) tries to enter hallway, staff member stops the resident
		A staff member locates the fire room
Towel is placed along base of fire door	1:30	Resident A is evacuated from wing, staff member re-enters the fire zone
Green checkmark tag is placed on fire door handle Staff member D enters		Staff start clearing the hallway
	2:00	Door is closed to fire room
Room left of designated fire room is tagged with green checkmark		A resident (outside of the fire zone) tries to enter hallway, staff member stops the resident
Staff members E, F and G enter wing, one asks "Did you check the room?"		
A staff member says that all residents are in bed	2:30	Two staff members go back into fire room without checking if the door is hot
		Two staff members leave the fire room, closing the door behind them, another staff member asks "Did you check if anyone is in there?"
		A cleaning staff member moves cleaning trolley out of fire zone, leaves it just outside fire doors, partially blocking doors
A staff member finishes checking a resident room then stands outside the door as a resident is still in room, door is left open	3:00	Hallway is clear
Within the hall, all clear is declared	3:30	A staff member opens the fire room door again
All staff have left hallway		Evacucheck is flipped on fire room door
Post-drill staff debriefing begins	4:00	Staff are flipping Evacuchecks on other resident doors, not checking if residents are in rooms
	4:30	Drill facilitator says that the drill is over
"All Clear" is announced over intercom	5:00	"All Clear" is announced over intercom

Table 3: Fire Drill Observations

Commonalities Amongst All Fire Drills Observed	
<ul style="list-style-type: none"> Obstacles left in hallway were moved into resident rooms Limited communication between staff inside and outside of the fire zone Staff focused on "Critical Triangle" - the rooms beside and across from the fire room General uncertainty, limited direction given within fire zone Fire extinguisher was brought to fire room 	<ul style="list-style-type: none"> Less than five seconds spent checking resident rooms Staff told at de-brief that they would have 75 minutes to evacuate the fire zone in a real fire Method for showing that rooms had been evacuated - Evacucheck or card hung on door handle At least seven staff participated within the fire zone The fire room was checked at least twice

PRELIMINARY CONCLUSIONS AND FUTURE WORK

The emphasis placed on fire drills in relevant legislation showcases the extent to which they are seen as critical elements in improving safety in LTC and retirement homes. When put into practice, however, there seems to be a disconnection between what is expected and what is actually taking place, largely as a result of the challenges associated with caring for a vulnerable population. With three fire drills required per month, it is understandable that staff members do not wish to disturb the residents on such a regular basis by evacuating them for training purposes only. Evacuating residents this frequently could also increase the potential risk of injury to both residents and staff members. However, as it now stands, the effectiveness and realism of the observed style of fire drill is debatable. The main purpose of the mandated monthly fire drills is to train staff members to know how to act in the case of a real fire event. Each drill acts as a hands-on supplement to the mandated annual training. In the drills observed, the lack of resident participation meant that the staff members did not have the opportunity to experience how strenuous an actual evacuation would be, nor how long it would take to complete. In addition, given the amount of uncertainty observed among the staff, having the delegated leader focus solely on instructing and coaching the other staff members would possibly eliminate some of the confusion and increase the effectiveness of the evacuation. Ultimately, it can be argued that drills that do not reinforce the desired actions are only helping to perpetuate inaccuracies and potentially create a false sense of confidence regarding capability.

To further expand the understanding of fire safety and evacuation realities in LTC and retirement homes, it is clear that more information needs to be gathered from fire drill observations. The methodology used to observe these drills must be further developed to better reflect what is actually taking place during these drills. In order to have a comprehensive and realistic idea of how long a horizontal evacuation would take, the amount of time required by each individual stage of the evacuation process must be measured. This means looking at a combination of how long it takes to: find the fire room, evacuate the resident in the fire room and/or extinguish the fire, thoroughly check all resident rooms, and evacuate residents (removing them from their beds, and transferring them down the hallway and into a safe zone).

As shown in the fire drills observed by the authors thus far, both quantitative and qualitative data about the actions of residents and the time required for staff member to evacuate them is missing due to a lack of resident participation. The authors are currently focusing on annual drills observed by the fire department. In these drills, more information can be obtained as all residents, or staff “stand-ins”, are actually evacuated. The authors are also looking to collaborate directly with the participating homes to observe the individual stages of the evacuation process in a context separate from the fire drills. Once a better understanding of movement times in these homes is obtained, this information will be modelled using egress modelling software. It is the intent that the information acquired from the fire drill observations be used to improve the ability of software to model the movement of the elderly. The possibility of these models being used for training purposes in LTC and retirement homes is also being explored.

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