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Occupational Safety in Homecare Organizations: Design and Implementation of a Train-the-Trainer Program

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Occupational Safety in Homecare Organizations: The Design and Implementation of a Train-the-Trainer Program

Abstract

Homecare workers face significant occupational risks, necessitating effective safety training programs. This paper presents a comprehensive Train-the-Trainer (TTT) program developed to enhance occupational safety in homecare organisations. Through an analysis of 229 reported safety events, the frequency and type of incidents, such as injuries during handling, road crashes, slips, trips, and falls, were identified and primarily attributed to human errors and violations. Based on the results, a TTT program was designed and implemented. The TTT successfully engaged Health, Safety, and Environment managers, fostering collaborative activities, knowledge sharing, and resource discussions. The program modules address critical areas, including distractions and inattentions, fatigue, time pressure, frustration and aggressiveness, and safety behaviours. This innovative approach provides valuable insights for organisations seeking to improve homecare workers' safety. The findings add to the broader comprehension of occupational safety in the homecare sector, proposing a pragmatic framework for future interventions.

Keywords: Workplace Safety; Homecare; Communities of Practice; Training

1. Introduction

The International Labour Organization reported that work-related injuries and occupational diseases lead to a worker's death every 15 seconds, with 153 workers injured in the same time frame globally [1]. Every year, approximately 317 million workplace accidents occur, with many resulting in extended absences due to illness. Such accidents have significant human and economic repercussions, costing roughly 4% of the world's gross domestic product annually [2].

In light of these concerns, our study underscores the pressing issue of occupational injuries in the homecare sector and emphasises the need for tailored safety interventions. Specifically, this study describes the deployment of a Train-the-Trainer (TTT) program, highlighting the psychosocial factors

contributing to human errors and unsafe behaviours. Building on the Community of Practice (CoP) framework, the study aims to foster a safety-conscious work culture, involving in-house experts to avoid work-related accidents and injuries within the homecare domain.

Within occupational safety, the homecare sector emerges as an area of interest. Among various public health and social services sectors, the homecare industry is notably affected by occupational accidents and injuries [3], leaving homecare workers vulnerable to many safety issues related to patient care, for instance, the risk of injuries when moving heavy devices and handling a patient with limited mobility. Also, musculoskeletal disorders caused by strain on the back, neck, and other body parts and Slips, Trips, and Falls (STFs) are common risks for homecare workers. The professional duties of workers in homecare organisations mainly include transporting therapeutic materials (e.g., oxygen cylinders) and devices to patients' homes and providing homecare services. Both operations involve several situations where workers must observe safety-related behaviours and rules to minimise potentially hazardous conditions for patients and themselves.

Homecare organisations have instituted policies and procedures addressing these challenges, including employee training initiatives. A prominent strategy in this context is the TTT approach, where select individuals are trained to train others subsequently. This method has proven effective in enhancing safety, especially in sectors with distinct safety requirements and within expansive organisations [4,5]. Our research scrutinises the safety protocols of European branches of a multinational company offering various services. Services range from producing medical oxygen to the distribution to hospitals and patients' homes to direct homecare services. The homecare services include regular nursing visits and technical support for oxygen cylinder maintenance. This study does not concern the safety events occurring in the company's industrial sites of oxygen production and focuses on events occurring during the driving and transportation of medical equipment to homecare patients and in the homecare environment.

1.2. Challenges to homecare workers

1.2.1. safety during the transportation of medical equipment

Transporting medical equipment by homecare companies to patients' homes presents a significant safety issue [6], especially when respiratory therapy patients require liquid gases. Highly flammable

gases, such as oxygen, can pose a significant fire hazard when exposed to sparks, cigarettes, or other ignition sources [7]. An oxygen leak that meets a spark or other ignition source can lead to significant fire with severe consequences for anyone in the vicinity [8]. The impact can be even more severe in the unfortunate event of a road accident related to, for instance, driver distraction, failure to comply with traffic rules or environmental factors.

Homecare operators typically serve multiple patients throughout the day, meaning they drive for many kilometres daily, increasing the risk of road accidents [9]. Several risk factors are associated with traffic accidents at work, such as work schedules or individual factors. Fixed schedules and lack of flexibility in work execution [10], as well as individual factors such as driver tiredness [11,12] and cognitive fatigue [13,14], have been shown to contribute to the risk of car accidents. Therefore, homecare drivers and workers must follow strict safety protocols and guidelines to minimise this risk. These may include proper storage and transportation of oxygen cylinders in vehicles, regular maintenance of service vehicles, and employee training programs on vehicle operation.

The transportation of liquid oxygen and devices for respiratory therapy to patients' homes also requires handling, loading, and unloading heavy and bulky storage cylinders and devices onto delivery vehicles. Existing literature highlights the increased risk of accidents, incidents, and injuries during these processes. For instance, Chowdhury and colleagues [15] conducted an ergonomic assessment of gas production workers, revealing that workers often adopted awkward postures characterised by rapid and repetitive movements when loading and unloading gas cylinders. These postures increase the number of compressive forces applied to the spine, thus increasing the risk of injury. Chen et al. [16] reported a high incidence of wrist injuries in workers due to the repetitive activity of radial deviation in both wrists and dorsiflexion of the right wrist. In a recent study, Chen [17] observed that lifting gas cylinders from a lower level, carrying them on the shoulder, and unloading them were the actions and postures adopted during handling and delivering gas cylinders more related to Taiwanese workers' injuries and accidents. Carrying a gas cylinder on the shoulder on rainy days also increases the likelihood of STFs and, thus, the risk of accidents and injuries.

Previous research has encouraged efforts to prevent STFs in hospital and care facility workers by examining their frequency and causes. For example, investigating the types of accidents in homecare

services highlighted that STFs accounted for 36% of all accidents in a sample of Swiss caregivers [18]. Additionally, a mixed-methods study conducted by Muramatsu et al. [19] showed that STFs are widespread among homecare assistants, with over 12 per cent of respondents experiencing STFs in the past year. The leading causes of STFs in the analysed sample were icy ground, clutter in the work environment, worker fatigue, and rushing to complete work tasks. Slippery surfaces are a common cause of STFs, as Courtney and colleagues [20] found that they contribute to 40-50% of fall-related injuries. Previous literature further highlights that incidents, accidents, and injuries are often related to STFs resulting from human and organisational factors [21]. Attention lapses, distraction, fatigue, and poor time management can increase the risk of STFs [22]. Workers' misuse of personal protective equipment (particularly footwear) can also increase injury risk. Poor lighting, inadequate cleaning, and lack of maintenance can contribute to hazardous conditions that increase the risk of STFs [23]. Poor communication and ineffective training programs can lead to a lack of understanding of safe work practices, leading to increased employee incidents, accidents, and injuries [23].

1.2.2. safety in homecare environments

Homecare workers face several safety risks while caring for patients in their homes. The primary situations where safety-threatening events can occur are the relationship between the workers, the patients, and their relatives or caregivers and the handling of patients with mobility issues [24, 28].

The relationship between patients and homecare operators can also result in episodes of aggression on the part of the patient toward the operators. Research has shown that the threat of workplace violence is a significant concern for homecare nurses, more important than environmental hazards and transportation issues [29]. Several studies have shown that the percentage of homecare workers who experience some form of workplace violence ranges from 5% to 61% [30,31]. Verbal aggression is the most common, reported by 18-59% of homecare workers [32]. Physical assaults were reported by 2% to 11% of homecare workers [33], with the largest percentage observed in a study that used a broad definition of workplace violence, including the threat of a knife [32]. The smaller percentages were observed in a study including only generic questions about physical assault [29]. Aggressive and violent patient behaviours can pose a significant risk to the safety of home care workers, leading to

physical and psychological harm. Homecare organisations must take proactive measures to keep patients and workers safe, including implementing policies and procedures to deal with aggressive behaviour, training staff to recognise and respond to signs of aggression, and using de-escalation techniques to defuse potentially violent situations [31].

Handling patients represents another situation where workers' safety can be at stake. Assisting patients with mobility issues can put undue tension on the back and neck muscles and other body parts, leading to injury. Workers' STFs are common hazards during patient handling, mainly when patients rely on assistive devices such as wheelchairs or walkers [24]. During patient handling, wet or slippery floors, uneven surfaces, and cluttered environments can further increase the risk of STFs. Additionally, some patients may need to be moved through narrow spaces such as elevators, which can pose a further safety hazard in an emergency.

1.2.3. Interplay between workers duty and occupational health outcomes

As highlighted in the previous sections, different factors affect homecare workers' occupational health and safety outcomes, stemming from the multifaceted nature of their duties. While specific tasks like handling oxygen containers and spending much time travelling have received attention in the literature, the complex interplay between workers' duties may also be a factor in the development of musculoskeletal disorders (MSDs). In particular, the physical strain of handling oxygen containers, providing direct patient care, and extended periods of sitting during transportation may increase the risk of MSDs among these workers [25].

Beyond physical stressors, emotional and psychological stress also plays a significant role in the well-being of home care workers. Negative interactions with patients and caregivers could be potent triggers. Interestingly, a study by Karakaya et al. [26] observed that home care workers experienced high stress, social isolation, and negative thoughts about society. However, the timing of the study during the COVID-19 pandemic might skew such comparisons, suggesting external factors can also influence stress levels.

Job dissatisfaction further compounds these challenges. Denton et al. [27] highlighted the detrimental consequences of healthcare restructuring for home care workers, such as increased workloads,

heightened job insecurity, and diminished organisational and peer support. Such findings underscore the need to address not only the tangible physical demands of the role but also the emotional and organisational challenges these professionals face. In light of this, it is crucial to evaluate and address the numerous factors affecting the health and safety of home care workers holistically.

1.3. Training and development

Homecare organisations need training to prevent workplace accidents and injuries [34,35]. Homecare professionals are educated on proper techniques, procedures, and equipment to avoid potential hazards and perform their tasks safely [36]. This involves hands-on training and demonstrations of the use of medical equipment, as well as the management of hazardous items and emergency response procedures [37]. Regular training and drills are necessary to ensure healthcare professionals remain current on new safety rules and procedures and maintain proficiency.

In addition to preventing accidents and injuries, training in homecare organisations can also promote a workplace safety culture. Training may foster awareness and shared understanding of the significance of safety and everyone's obligation to contribute to it, thus promoting proactive behaviours that, in the end, result in a safer and healthier work environment [38,39]. This result can be accomplished by holding frequent safety meetings, encouraging staff to report potential risks or accidents, and fostering an environment where employees feel comfortable discussing safety issues. Creating a clear line of command for reporting problems, conducting investigations, and taking corrective steps can also be advantageous for ensuring a safe and healthy workplace [37].

Furthermore, homecare organisations must provide ongoing training to ensure professionals have the latest knowledge and skills to provide safe and effective care [37]. With the rapid pace of technological advancement and changes in healthcare policies, healthcare professionals should remain updated on new developments and practices. In addition to providing training on specific skills, it is also essential to provide education on the latest healthcare trends and encourage continuous learning and professional development.

1.3.1. Train-the-trainers program and Community of Practice framework

A TTT program involves a small group of employees who receive training and are responsible for training the rest of the workforce [40]. By utilising the knowledge and abilities of a core group of employees, this strategy can effectively propagate safety information and best practices throughout the organisation. The program fosters a strong safety culture by encouraging a sense of responsibility and accountability among all employees by having employees train their peers. TTT programs can be tailored to the organisation's needs and cover various topics, such as hazardous materials handling, emergency response procedures, equipment usage, and ergonomics [4]. The TTT can also provide trainers with continuous support and resources, such as access to expert advice and updates on new safety standards. Additionally, regular program reviews can help identify areas for improvement [37].

Previous research reinforces the effectiveness of TTT programs. For instance, Yarber et al. [40] found that this method is cost-effective for broadly disseminating evidence-based public health principles and can be tailored to address local issues. This makes TTT a viable approach for scaling up new public health practices. In another study, Nakamura et al. [41] demonstrated the value of TTT in promoting the development of both skills and work practices by providing tailor-made training to the target audience's specific needs. Finally, a recent study by Summerside et al. [42] found that TTT effectively promotes and develops technical and non-technical skills in interprofessional teams.

To increase the effectiveness of the program, the Community of Practice (CoP) framework was also adopted. This concept was developed by Jean Lave and Etienne Wenger to describe the social structure and shared learning practices of groups of people who come together around a common interest or goal [43,44]. A Community of Practice is a group of people who share a passion for something they do and who regularly interact to learn from one another and improve their knowledge and skills in a specific area. Considering the social learning and the knowledge-sharing processes underlined by the CoP framework, those processes were incorporated in the TTT program. The program included actions and activities that promote knowledge sharing and learning from the other participants, and we expected that those actions would, in the end, reinforce the CoP of the organisation. Training to support the CoP of teams and organisations has been used in various settings,

including education, business, and social activism. It has been used to guide the design of online learning communities, collaborative networks, and other social learning environments [45].

Considering the distinctive characteristics of the homecare sector and the absence of literature on TTT aimed to improve safety in this area, the present paper describes the design and implementation of a TTT program tailored to the organisation's needs and composed of five training modules. Utilising a team of HSE managers to disseminate safety information and best practices throughout the company, the program covers various safety topics, namely reducing distraction and inattention, coping with fatigue, managing time pressure, managing frustration and aggressiveness, reducing human errors and fostering safety behaviours.

2. Materials and methods

2.1. Case description: the target organisations

The target organisations to which the TTT program was directed are subsidiaries of a larger company renowned as a global leader in gases, technologies, and health services. This parent organisation has an extensive international footprint with 350 subsidiaries spanning over 50 countries. It employs a robust workforce of over 60,000 and serves a client base of almost 4 million, with a significant majority suffering from respiratory ailments. The organisation's primary activities include producing therapeutic gas, transportation, and providing home care services specifically tailored to address respiratory challenges.

With the company, a specific process to develop the TTT program, depicted in Figure 1, was agreed. The process included analysing the safety events of the previous four years, recorded in the data management system; analysis of safety events and researchers' visits to company sites helped clarify the training needs. After this, the TTT program was designed and later implemented with the organisation's HSE managers. A total of 15 HSE managers, representing various European branches including, among others, Belgium, France, Germany, Italy, and Spain, participated in the first training conducted by the researchers. Managers will then implement the program with the employees they supervise.

In this and the coming sections, we describe the methods used to analyse the safety events and the results of this analysis. Then, we describe the design and the contents of the five modules of the TTT program. The next step is to evaluate the program's effectiveness when it will be directly delivered to the workers, the effective beneficiaries of the program.

[INSERT HERE FIGURE 1]

2.2. *Safety event analysis process*

The present work involved a series of steps aimed at identifying and addressing the specific safety needs of the organisations. The first step was an exploratory analysis of safety events that occurred in the organisation between 2018 and 2021. Data were collected on-site by the national HSE managers, who recorded the safety events in the company's reporting system.

In this phase, two researchers examined the organisation's safety event dataset and assigned a label to each event. After the first phase of analysis, the two researchers compared their labels, and in cases where uncertainties arose, a third researcher was consulted to clear any doubt. After completing the analysis, the researchers identified five categories of events, each with a unique label. Using the same approach, safety events were categorised based on the contributing factors identified when they occurred. Six categories of contributing factors, each with a unique label, were identified. This approach ensured the accuracy and consistency of the data analysis, and the resulting categories provided essential insights into the nature and prevalence of events in the organisation.

Following identifying categories when analysing critical safety events in the organisation, an analysis of narrative descriptions of the events was conducted. The researchers selected parts of the text that described the event, emphasising the setting and the contributing factors. This approach facilitated a more in-depth study of each event's contextual factors, thereby providing valuable insights into the underlying contributing factors of safety events.

2.3. Ethical and data security measures

The main ethical issues have been addressed in this study. Among the ethical issues, we identified the potential for unintentional disclosure of personal information. We recognised that even anonymised data if mishandled, could pose risks of re-identification of accident cases. Therefore, stringent data

handling and storage measures, such as using secure servers, were prioritised. The company did not provide personal data or identifiable information, thus not used in the analysis. We anonymised data about accidents and injuries by removing personal identifiers, using codes or aggregate data, redacting sensitive information, and aggregated disclosure techniques. These steps were taken to protect the privacy and confidentiality of individuals while still providing valuable insights into the nature and prevalence of safety events in the organisation. An independent reviewer was involved to validate the findings to reduce bias and conflict of interest. Additionally, the researchers ensured that the data were stored on secure servers with restricted access and that appropriate encryption and access controls were implemented.

2.4. Training development process

The subsequent step of the project involved designing a comprehensive TTT program encompassing all the issues identified in the events analysis phase. The expert researchers developed five modules specifically targeted at HSE country managers. The program focused on addressing human factors issues in workplace safety in the homecare sector, based on the quantitative and qualitative analysis of the events and including info from the literature. The TTT program aimed to promote a culture of safety and responsibility among all staff by equipping HSE managers with the necessary knowledge and skills.

3. Results

3*.1. Quantitative analysis of safety events*

Safety events in a healthcare organisation were analysed to identify the most frequent types and locations of incidents and the underlying causes. The safety events data set in the organisation between 2018 and 2021 included 229 events. All the events were assigned to a specific typology of event; the analysis showed four more frequent categories, one in which less frequent types of events were collapsed and named "Others" (see Table 1). The four main categories, in decreasing order of frequency, are: injuries during materials handling, loading, and unloading; road crashes; fire-related events; slips, trips and falls (STFs) not associated with handling, loading, or unloading; and the "Others" one.

Furthermore, these events were classified based on their contributing factors, revealing five predominant categories: Worker Errors and Violations (WEV), Physical Exertion (PE), Damaged Equipment (DE), Environmental Factors (EF), and Unsafe Patient Behaviours (PB), notably aggression.

[INSERT TABLE 1 HERE]

Table 1 shows the 2018-2021 safety events, detailing the type of events and respective contributing factors. Injuries during handling, loading, and unloading, especially of oxygen cylinders, the most frequent and dangerous material transported by those workers, were the most common event (n=68, 29.7%), with half of these incidents occurring when workers were under physical exertion. Road crashes and fire-related events were the second most frequent occurrences (n=48, 21%). Among these, 26 crashes were attributed to workers' errors and violations, while non-compliant patient behaviours (e.g., smoking near open oxygen cylinders) were the primary contributing factors associated with fire-related events. STFs (n=38, 16.5%) ranked as the fourth most common event type, with 19 incidents resulting from workers' errors and 15 due to environmental factors (e.g., wet floors, scattered materials). A minority of safety events (n=27, 11.8%) occurred under other contributing factors, such as patients' aggressiveness or patients' pets causing worker injuries.

The location of the events was analysed, with almost half of the events (n=126, 55%) occurring in homecare environments. One-third of the events (n=56, 24.5%) were reported when employees were transporting materials or driving, and 40 events (17.5%) occurred in the office or warehouse. The location of the remaining 7 events (3.1%) was categorised as "Others," which includes events that occurred during activities such as commuting to and from work on foot or in areas adjacent to the homecare environment.

3.2. Qualitative analysis of safety events

This section presents the results of the qualitative analysis of safety event descriptions, which was integrated into the quantitative analysis of safety events. While the quantitative analysis provided

valuable data, the qualitative analysis of narrative reports gave us a deeper understanding of the contributing factors to these events. This approach allowed us to identify common themes and patterns not specified in the quantitative data alone. Combining quantitative and qualitative analysis of the safety events, we developed a more comprehensive approach to safety that addresses the trends and underlying factors.

3.2.1. Worker unsafe actions in handling, loading and unloading tasks

Based on the analysis of the narrative descriptions of safety events, many injuries occurred during handling, loading, and unloading tasks, with workers' behaviour as the main contributing factor. In some cases, the narrative description of the event highlighted that workers failed to use appropriate tools for unloading goods or misused the tools.

The worker manually unloaded an oxygen cylinder from the vehicle at the site without using the vehicle's lifting platform. When he unloaded the cylinder from the cargo area to the ground, it dropped, hitting the worker in the foot.

Muscular strain experienced by workers was also common during handling, loading, and unloading. The posture and movement could cause strain on the lower back muscles, leading to muscular pain. Contributing factors to these events are also related to workers' behaviours, including lack of proper lifting techniques and inadequate use of equipment.

When the worker was raising the cartwheel with the oxygen cylinder, with his back to it and forcing his feet on the ground to climb the slope, he lost his balance and, to prevent the cartwheel with the cylinder from falling down the slope, he held it tightly, feeling a muscular pain in the lower back area. The worker could hold the cylinder even though he fell, not suffering injuries on impact with the ground.

The worker would remove an oxygen concentrator from the cardboard box in which the manufacturer packed it. The cardboard box was placed on a pallet. The worker bent his back to grab the concentrator with his left hand and lift it out of the box. Next, while holding the concentrator with his left hand in flight, he removed the plastic packaging with his right hand, and his back bent before

placing the equipment on the ground. At that moment, the worker felt a muscle pull in the left part of the lower back.

3.2.1. Safety implications of distractions, fatigue, and environmental factors

Several safety events related to the traffic environment were found to occur due to reduced attention and distractions. These events were caused by a lack of concentration, distraction, poor situational awareness, and violation of traffic rules, which can increase the risk of collisions. For instance, using a mobile phone can distract a worker's attention from the road, thereby increasing the likelihood of an accident.

The worker parked the vehicle two wheels up on the sidewalk because he had to call a patient who had received a warning. When the telephone call ended, the worker started the march with the vehicle, not noticing that in front, there was a wooden bench colliding with it.

Worker oversights and lapses in attention were identified as contributing factors in some events. Failure to adhere to established protocols and procedures for equipment handling and storage can also contribute to the incident.

After loading the vehicle at the dock, the worker forgot to pick up the side metal platform that was installed to facilitate the loading of oxygen cylinders. When the worker moved the vehicle, he moved the platform laterally and broke the platform.

In STFs, contributing factors involved pavement conditions, although worker distraction or inattentiveness to their surroundings also played a role in these incidents. Poor visibility or insufficient markings on walkways may be considered contributing factors, but it is equally possible that the worker was not closely observing their surroundings or moving excessively. Here are two examples.

A worker reported that when he left the cabin of his vehicle, he felt pain in his right ankle. Without noticing, he put his right foot in a hole in the pavement, causing a light twist of his right ankle.

A worker was going to a patient's house, and she did not realise there was a stone between the road and the sidewalk. She then tripped and fell. She immediately suffered severe pain and was accompanied to the hospital for a medical check. She reported a fracture of the lateral malleolus of the left fibula.

Fatigue and overwork also contributed to errors and injuries. In addition, the lack of appropriate equipment to assist with patient handling resulted in the operator using incorrect techniques.

A nurse was moving a patient from the bed to a wheelchair together with another colleague. When the patient was rotated from the bed to the wheelchair, the nurse twisted her right knee. Subsequently, severe pain emerged. The nurse was taken to the hospital, where the meniscus torn from her right knee was diagnosed.

3.2.3. Patients' behavior influencing safety

The workers may also ignore warnings from other personnel and decide not to follow safety protocols.

The worker went to load the vehicle on the dock. The filling personnel informed him that the loading platform was broken. The worker ignored his partner's warning and asked another partner to help him place the platform. After placing the platform between the dock and the loading area of the vehicle, the worker went to load an oxygen cylinder. When the worker put one foot on the platform, it slipped away, dropping the cylinder to the ground. The worker's leg got caught between the platform and the dock.

Patient agitation episodes were also identified as a contributing factor. The patient's medical condition may also result in stress or discomfort, leading to heightened emotions and aggression toward the healthcare worker. In some cases, the patients' aggressive behaviours escalated into verbal abuse or physical aggression of the homecare worker, creating potential safety-related events. Also, a lack of effective communication with the patient-healthcare worker led to the patient's frustration anger, and safety-related issues for the workers.

A worker visited a patient's home to address an issue with a portable concentrator. However, the patient reacted by cursing and yelling at the worker while aggressively hitting a table. The patient demanded a new equipment that no one else had used before. The worker was unable to fulfil the patient's request and had to leave home without being able to substitute the equipment.

The patient expressed a desire to discontinue the Continuous Positive Airway Pressure (CPAP) treatment and requested to be contacted to have it removed. When the nurse phoned back the patient, he answered rudely. It was later discovered that the patient was angry because he had been awoken from a nap. The patient abruptly ended the call and did not respond to any further attempts at contact.

Lastly, patient behaviours and related violations of safety protocols may also result in safety issues. Workers may fail to adequately communicate the dangers (e.g., do not smoke during oxygen therapy) to the patient or may be unable to supervise the patient during the procedure.

When one of our workers was resupplying a patient with oxygen, he noticed she had some minor burns on her face. When he inquired further about the causes, the patient eventually admitted that she had smoked during the oxygen therapy.

3.3. Design of the Train-The-Trainer program

The quantitative and qualitative analyses of safety events were used to develop a customised TTT program addressing the specific safety needs of the organisation. Additionally, the qualitative analysis of safety event descriptions informed the development of the TTT program by providing real-world examples to illustrate key concepts and facilitate discussion among participants. Considering the theoretical framework of CoPs, the program aimed to support the development of safe work culture and practices among employees [43,46,47]. The participatory approach of the program was aimed at creating a CoP centred on the common interest of promoting safety. The intensive TTT program was then developed and delivered to a group of HSE managers of the homecare organisation, who engaged in joint activities, shared knowledge and information, and developed a repository of resources and practices that may be adapted and modified to respond to the changing circumstances in the workplace.

The program comprises five modules, each addressing a different facet of workplace safety behaviours: 1) reducing distraction and inattention; 2) coping with fatigue; 3) managing time pressure; 4) managing frustration and aggressiveness; 5) reducing human errors and fostering safety behaviours. The modules and their contents were developed by integrating the results of the analysis of the safety events collected by the company together with the evidence from previous research findings [48-51], highlighting these factors' importance for workplace safety.

3.3.1. structure of the training program

The first module of the training program delves into the challenges of distractions and inattention, with a spotlight on the risks associated with distracted driving among homecare workers. Existing research underscores the significant distractions caused by phone calls, notifications, and drowsiness, which can divert workers from safety-critical tasks [51-53]. This module is designed with a dual purpose: firstly, to fortify workers' ability to maintain focus amidst potential distractions, and secondly, to arm them with tools for promptly returning to tasks after distractions. Within the module, the pitfalls of multitasking are explored, and participants are acquainted with various distractions they might face during their work. Emphasis is placed on tangible strategies such as designating specific phone "quiet times", harnessing focus-enhancing techniques, and taking periodic short breaks to mitigate and manage these distractions. The module is enriched with real-world examples and interactive scenarios to enhance retention and application. This design encourages participants to introspect on their behaviours and put the strategies into practice in simulated environments, fostering theoretical understanding and practical application.

The second module explores the issue of fatigue and its impact on the safety of home care workers. Drawing from our results and existing research, the module highlights the challenges posed by long work hours, insufficient sleep, and irregular schedules, all of which contribute to fatigue. This state can compromise safety, increasing the risk of accidents and injuries [54,50,55]. This module deepens workers' understanding of how fatigue manifests and affects their work and provides them with practical strategies to manage and mitigate fatigue. The connection between fatigue and reduced cognitive abilities is emphasised, particularly its role in incidents like STFs [56]. Practical advice is shared, from understanding one's sleep patterns and maintaining proper sleep hygiene to being cautious about extending work hours. To ensure the training resonates, the module incorporates relevant examples, such as the effects of chronic fatigue on daily routines, and hands-on exercises, like self-assessment quizzes on sleep habits and interactive discussions on personal experiences with fatigue. These elements help participants internalise the content, encouraging them to apply what they've learned daily, leading to safer work practices.

The third module delves into time management, emphasising the challenges homecare workers face operating under time constraints. Existing literature elucidates that inadequate time management and decision-making skills contribute to workplace injuries, incidents, and accidents [57]. For example, hurried task completion, especially when handling equipment, can magnify accident risks [51]. Additionally, many STFs are directly attributed to haste [23]. The module aims to bolster participants' skills in efficient time management and informed decision-making, especially when under pressure. It underscores the importance of task prioritisation and introduces participants to effective time management techniques, such as leveraging schedules or to-do lists, to provide a structured approach to daily routines.

Furthermore, the module delves into cognitive biases that can skew rational decision-making under time constraints, including overconfidence, confirmation bias, and present bias. Participants are equipped with practical strategies to counteract these biases, fostering informed decision-making. To ensure comprehensive understanding and real-world application, the module incorporates interactive activities. For instance, participants engage in exercises that simulate real-life scenarios, requiring them to allocate time judiciously to tasks and make decisions amidst competing priorities.

The fourth module delves into the critical areas of recognising and effectively managing aggression and frustration encountered by homecare workers. Grounded in prior research, there is a recognised prevalence of aggressive behaviours directed towards homecare professionals from various sources, such as patients, their families, and caregivers [30,58,31]. Our findings further underscore a concerning incidence rate within the target organisations. This module empowers home care workers with the skills and strategies required to navigate such challenging situations. The primary focus is ensuring workers can maintain a safe environment for themselves and the patients they care for. Participants are introduced to the diverse manifestations of aggression, ranging from verbal altercations to more overt physical confrontations. A significant portion of the module is dedicated to imparting de-escalation techniques. These strategies provide workers with the tools to defuse potentially dangerous situations, ensuring their safety and that of their patients. Alongside this, the module addresses the nuanced issue of frustration. If unchecked, such feelings can lead to negative emotional responses, disorganised behaviour, and even accidents. Through the module, participants

are equipped to identify potential frustration triggers and are guided on methods to manage their expectations to deal with frustrations. In this regard, mindfulness is introduced as a valuable technique for regulating negative emotions [49].

The fifth module addresses human errors and their implications on safety behaviours. Our safety event analysis identified workers' errors as a triggering factor for several accidents, injuries, and other safety-related incidents. This observation aligns with existing research, suggesting that persistent errors by workers are potent predictors of injuries and workplace incidents [48,59]. Moreover, a recent study emphasises the significant influence of human errors on preventable incidents within the healthcare sector [60]. In response to these findings, this module is structured to give participants an in-depth understanding of human failures. It categorises these failures into "errors, " unintended actions or decisions, and "violations, " deliberate deviations from recommended practices. Such distinctions are pivotal in comprehending the nuances of why mistakes occur and how they can jeopardise safety. Beyond mere recognition, the module delves into these behaviours' underlying causes (antecedents) and their subsequent outcomes (consequences). A central theme explored is the role of reinforcement in shaping behaviour. Participants can better navigate their work environments and foster safer behaviours by understanding how positive and negative reinforcements influence actions. A crucial aspect of this module is its focus on proactive strategies. Participants are introduced to techniques like constructive feedback, which serves as a tool to rectify errors and violations, fostering an environment of continuous improvement.

Moreover, with respect to training methods, the design of the modules considers the results of the meta-analytic study by Burke and colleagues [61] that shows that methods become more engaging based on learners' participation in the training process; so active learning methods were adopted as behavioural simulations or different methods where interactions between trainees and trainers are frequent and based on reciprocal feedback. Finally, following the results of Burke and Hutchins's study [62] in the analysis of needs, design of training content, and methodologies, special attention is given to training transfer, which has been defined as the extent to which learning is transferred into changes in behaviours in the workplace and behaviours are maintained over time [63].

4. Discussion

The present paper aims to provide an approach that can promote occupational safety in the homecare sector and possibly reduce the incidence of unsafe behaviours leading to work-related accidents and injuries. To this aim, a TTT program based on safety-related event data and built on the theoretical framework of CoPs has been described here. As part of the preliminary analysis, this paper assessed safety events reported by a multinational homecare company between 2018 and 2021 and used the results to inform the design of the TTT intervention, addressing the most frequent safety-critical situations.

Most safety events occurred while driving to or from patients' homes and during equipment handling, with traffic accidents and musculoskeletal injuries being the most common consequences. The analysis showed that many safety events were due to workers' errors and violations, physical strain, and inappropriate behaviour of the patients. Proper use of personal protective devices, as well as proper equipment and patient handling, were identified as critical factors in preventing safety incidents in-home care. Besides helping to identify the most frequent type of safety event, the findings highlight the need for continued efforts to improve safety awareness, training, and practices among the company's employees [66]. Moreover, providing continuous training through the TTT concept led and conducted by HSE experts in someone's own company is an added value as it creates a greater sense of involvement on the part of the company, ownership for those who benefit from the training, commitment, and participation [69]. To this aim, a five-module TTT program has been designed and tailored to the company's needs based on recent literature. The TTT program also involves simulations and hands-on instruction to guarantee healthcare professionals have hands-on experience dealing with real-life circumstances. This allows trainees and trainers to get feedback on their work and pinpoint their areas for improvement.

The present study promotes the idea that the TTT approach, in general, is a valuable strategy for developing a strong safety culture and continual learning and improvement by equipping employees with the information and abilities to train their colleagues. Since the program is also tailored to address

the unique peculiarities of the organisation, it can be considered a flexible and cost-effective solution to enhance workplace safety.

The present study emphasises the intricate interplay of physical and emotional challenges for healthcare workers. The continuous handling of equipment like oxygen containers presents not just an immediate physical risk but, when combined with the frequent necessity for patient assistance, contributes to a heightened susceptibility to Musculoskeletal Disorders (MSDs). This risk is further magnified by the prolonged durations spent in transportation, often marked by extended periods of sitting, which can exacerbate musculoskeletal strain. Beyond the palpable physical demands, the psychological facet of their profession cannot be overlooked. Regular interactions with patients and caregivers, while fundamental to their role, can be a double-edged sword. While many interactions are positive and fulfilling, negative encounters can engender considerable stress, affecting the worker's overall mental well-being. This dynamic interplay of diverse factors underscores the need for a multifaceted approach to improving occupational health outcomes for home care workers. Acknowledging the interconnected nature of these challenges can pave the way for more comprehensive and effective interventions tailored to their unique professional landscape.

The present study can influence the safety event data analysis and the developed TTT program. First is the need to improve workers' training: several safety incidents in the study resulted from errors and violations. This result emphasises the need for enhanced education and training initiatives to guarantee that staff members know appropriate operating procedures and safety measures. Secondly, many safety events were related to employee violations: the study found multiple cases where accidents and injuries happened because established safety protocols were not followed. This stresses the importance of putting safety protocols into practice. It is, in fact, crucial to guarantee that all employees are aware of and adhere to established safety measures. For human errors and violations, as advocated by [64, 65, 66], it is, in fact crucial to underline that they should be the starting point of investigations rather than the result. This perspective recognises that humans are fallible beings and that errors are an inherent part of human nature. Instead of blaming individuals for their mistakes, it is more productive to examine the circumstances and factors that contribute to human error. Researchers highlight that there are various circumstances in the work situation that can facilitate human error. For example, time

shortage and fatigue are two common factors that can increase the likelihood of errors [64]. Individuals under time pressure may be more likely to take shortcuts or skip important tasks, increasing the risk of errors. However, it is important to note that individual factors do not solely cause human error.

The work environment and organisational factors also play a significant role. Poorly designed procedures, inadequate training, lack of resources, and ineffective communication are examples of organisational factors that can contribute to errors [67]. Organisations can implement interventions that address the root causes of human error and improve safety outcomes by focusing on these underlying factors. Adopting a human error-centric approach to investigations has several benefits. Firstly, it promotes a non-punitive culture where individuals feel comfortable reporting errors and near-misses, enabling organisations to gather valuable data for analysis. Secondly, it allows for a more comprehensive understanding of the complex interactions between humans, technology, and the work environment.

In the third stance, this work emphasises the importance of participatory safety strategies: the TTT program described here was designed to aid in the growth of safe work cultures and practices among employees, stressing the potential benefit of participatory safety techniques, in which staff members are motivated to exchange expertise and information and work together to establish safety procedures, as suggested by Burke and Hutchins [62]. Lastly, this study implies the need for ongoing monitoring and evaluation of workplace safety procedures and interventions: this allows companies to pinpoint areas that need improvement, ensure that safety procedures are being followed correctly, and demonstrate their effectiveness.

4.1. Limitations and strengths

The present work has limitations common to studies based on safety event data recorded using company reporting systems. There may be an underreporting of safety events since not all incidents are generally reported or documented. Some minor safety events might go under the radar due to reporting bias. Employees may be more likely to report events that are more serious or have more

visible consequences, leading to a skewed representation of the data [69]. Another limitation of the present work is data quality, which may be compromised by errors or omissions in the reporting process connected to factors such as recall bias [70]. Omissions may also lead to a lack of crucial detail in the description of the event. The data recorded in safety event reporting systems may not provide sufficient detail about the context or circumstances of the incident, making it difficult to draw meaningful conclusions and establish causality. It can thus be challenging to establish causality between the recorded event and the underlying factors that contributed to it. Lastly, the present work has limited generalizability as the data may not represent other companies or industries, particularly if safety culture and reporting practices vary significantly.

A strength of the present work was using safety event data to tailor the TTT program to the company's actual needs, focusing on its development and implementation phases. This approach allows for a sustainable and scalable way to promote occupational safety in homecare organisations by training key personnel to disseminate the information to other staff members. By training key actors, the study promoted a culture of safety within the company, possibly resulting in better compliance with safety practices and decreased work-related injuries. In addition, the study's focus on developing an interactive and participatory training program, rather than a lecture-based approach, likely helped to increase engagement and retention of the safety information by the trainers and their trainees.

4.2. Novelty and future work

To our knowledge, no prior studies have presented the development and implementation of a TTT program, based on the analysis of safety events data, to improve occupational safety specifically for homecare organisations. While similar programs have been developed for other contexts, such as medical emergency departments [71], firefighting [72], and construction [73], this study focuses specifically on the unique safety challenges faced by homecare workers, who often work alone in clients' homes without direct supervision. The program is designed to create a sustainable safety culture within the organisation. This approach addresses a gap in the literature and offers a practical solution to improve occupational safety in the homecare industry.

Future work to improve and enrich the present study is suggested. First, the TTT program should include a follow-up study to evaluate the program's effectiveness in reducing work-related injuries, improving safety outcomes in homecare organisations and reinforcing the sense that the organisation is a CoP. The decision not to conduct a follow-up study at this stage was influenced by the nature of the Train-the-Trainers (TTT) program. The program was presented and delivered to health and safety managers of the company and will now be progressively implemented with employees; to examine the program's effectiveness, it must be tested with employees. Having all employees, or at least employees in a branch or a country, complete the training before the evaluation would ensure uniform dissemination of the safety knowledge and competencies.

Training, at least a well-identified sub-sample of employees, is a good starting point to obtain a clearer and more accurate reflection on the program's effectiveness by comparing the program's effects within the trained sample and between trained and untrained workers. Secondly, the program could be replicated in other homecare organisations to improve its generalizability and adaptability across different contexts and populations. Replicating the program in diverse settings allows for a broader understanding of its applicability and effectiveness. Different homecare organisations might have unique challenges or organisational structures, and understanding how the TTT program performs in these varied contexts can provide insights into potential modifications or adaptations necessary for wider implementation. In third place, the effectiveness of the TTT program could be compared to other interventions, such as traditional safety training or technology-based interventions. This can be a promising approach to identify the most effective strategies for improving occupational safety in homecare organisations. Furthermore, a cost-effectiveness analysis could be conducted to assess the economic benefits of the TTT program, such as reduced healthcare costs, reduced worker compensation claims, and improved productivity. Lastly, future research could focus on strategies to increase workers' engagement and participation in the TTT program and identify barriers to worker participation in occupational safety initiatives.

5. Conclusions

The homecare sector is a growing industry that provides a range of needed services, but driving to

deliver a service at the patients' home increases the risks of road accidents, injuries during the transportation of medical equipment or aggressiveness of patients fostered by being in their premises. This study analyses the types of accidents in four years in a company that provides home care services tailored to address respiratory challenges. Based on this evidence, the study describes a train-the-trainer program developed and delivered to 15 HSE managers that, in turn, will provide the program to the employees they supervise. The program comprises five modules that address distraction and inattention, fatigue, time pressure, patients' frustration and aggressiveness, and suggest how to reduce human errors and foster safety behaviours.

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Table 1. Safety events (2018-2021): types and conditions

Type of events	WE/M	PE	DE	EF	PB	U	O	Total (%)
Injuries during handling, loading, and unloading	16	34	8	7	0	3	0	68 (29,7)
Road crashes	26	0	7	13	0	0	2	48 (21.0)
Fire-related events	15	0	6	0	26	0	1	48 (21.0)
STFs	19	2	15	15	0	1	0	38 (16,5)
Others	5	6	7	0	9	0	0	27 (11.8)
Total	81	42	29	35	35	4	3	229 (100)

Note. STFs = Slips, Trips, and Falls; WE/M = Workers' Errors or Mistakes; PE = Workers' Physical Exertion; DE = Damaged equipment; EF = Environmental Factors; PB = Unsafe Patient's Behaviours; U = Unidentified, O = Others

(%)
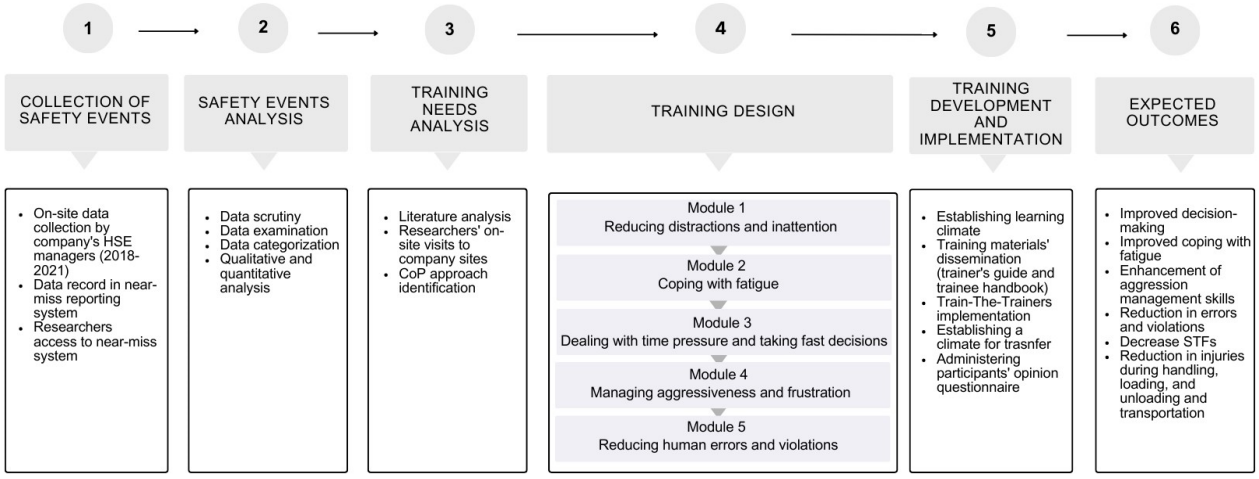
Figure 1. TTT program building process