JOURNAL OF MODERN SOCIAL SCIENCES
Vol. 1, No. 2, Dec. 2024, 353-367
https://doi.org/10.5281/zenodo.14553192

Enhance fire safety and emergency evacuation protocols:Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities

Zixuan Zhao[1]*, Tianyu Tang[1]

[1]*University of Shanghai for Science and Technology, Business School, Shanghai*
*Corresponding author:Zixuan Zhao

Abstract

This study investigates issues such as the modernization of fire equipment, evacuation difficulties in large public venues, and the inadequacies of current evacuation systems for people with disabilities. The subjects include newly built and aging communities, large public venues, and individuals with disabilities. Research methods include literature review, surveys, field observations, and expert interviews. The study covers fire equipment updates, evacuation drills in special venues, and the mobility and needs of disabled individuals in emergencies. Findings show that fire equipment updates in new communities are progressing smoothly, while renovations in older neighborhoods face challenges. Evacuation drills in large venues encounter multiple obstacles, and current evacuation systems fail to meet the needs of disabled individuals. Recommendations include improving fire equipment in older communities, implementing practical evacuation drills in special venues, and collecting data on disabled individuals to create personalized evacuation plans, thereby enhancing overall emergency management.

This study provides valuable guidance for the industry, advocating for optimized management practices, effective fire equipment, and enhanced public awareness of fire safety and self-rescue. It aims to prevent and reduce fire accidents, contribute to the theoretical and practical development of emergency management, and support the standardization and regulation of public safety, ultimately fostering a safer, more stable, and sustainable social environment.

Keywords: emergencies; urban management; emergency response; social security

OPEN ACCESS

Full Text Article

Introduction

1.1Background of the study

In recent years, rapid urbanization and increasing population density have led to frequent fire incidents, presenting significant challenges to urban public safety and emergency management. In China, the aging population and expansion of large public venues have made effective fire emergency response crucial. According to statistics, the number of fire alarms surged in the first half of 2023, particularly from electrical faults in self-built residential fires, resulting in significant casualties and property damage[1]. These incidents highlight deficiencies in the current fire equipment and evacuation systems, especially for vulnerable groups such as individuals with disabilities and the elderly.

In this context, optimizing fire emergency management is key to improving public safety. Properly functioning fire equipment not only enables timely rescue and reduces casualties, but also enhances public confidence in safety, fostering a more secure environment[2]. By improving management practices, equipment efficiency, and training, public awareness of fire safety and self-rescue can be strengthened, ultimately minimizing fire-related risks.

This study addresses three critical issues: 1) the modernization of fire equipment, 2) challenges in evacuation drills for large public venues, and 3) the failure of current evacuation systems to meet the needs of vulnerable groups. Through surveys of new communities, aging neighborhoods, large venues, and individuals with disabilities, this research identifies the gaps in China's fire emergency system and offers recommendations for improving evacuation drills, upgrading equipment, and creating specialized evacuation plans. It also fills a research gap by collecting extensive data through field observations and expert interviews on evacuation needs for disabled individuals.

The findings provide data to support improvements in China's fire emergency management, offering insights for more effective evacuation planning. This research also contributes to the theoretical development and practical application of emergency management, promoting the standardization of public safety and helping to build a safer, more stable, and sustainable society.

1.2Literature Research

1.2.1Fire protection retrofit

Fire protection retrofitting of old buildings faces many challenges and problems. The current fire code mainly applies to new buildings[3] , there is no customized fire guidelines for old buildings[4], resulting in the original design does not comply with the current code requirements, there are insufficient fire separation, fire facilities and equipment aging serious, low fire resistance rating of the building structure, and the existing evacuation system does not comply with the standards and other issues. Most of the structures and facilities of old buildings have aged, making fire safety hazards increasingly prominent, and once a fire occurs, it is difficult to quickly extinguish the initial fire, resulting in serious losses. For example, the renovation of the fire water system is one of the typical fire protection renovation, engineer Zheng Xiang[5] in the renovation of the Fuzhou People's Hall, the old water system to make a more complete exposition. It is urgent to solve the fire safety problems of old buildings, and it is necessary to formulate stricter fire codes, strengthen the upgrading of fire protection facilities and equipment, improve the fire resistance of building

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

structures, and improve the evacuation system, so as to ensure the safety of residents' lives and properties.

1.2.2Review of relevant domestic and international studies

With the acceleration of urbanization and the frequent occurrence of natural disasters, emergency management, evacuation, and escape have become key areas of societal focus[6]. Emergency management aims to reduce losses and protect life and property through effective organization, command, and coordination. However, with the increasing frequency of natural disasters and rising social security risks, emergency management faces more complex challenges. To address these challenges, researchers have proposed various strategies, such as developing contingency plans, conducting drills, and building infrastructure.

In international research, evacuation and escape behavior[7][8] have become important topics in the field of emergency management. Many factors influence evacuation behavior, including demographic characteristics and risk perception. However, existing studies have limitations, such as a lack of forward-looking design and insufficient exploration of psychological factors. Future research should enhance forward-looking design, delve deeper into the impact of psychological factors on evacuation behavior, and strengthen international comparative studies.

In summary, emergency management, evacuation, and escape are crucial fields related to societal stability and development. Ongoing research and practice will provide more scientific and effective strategies for responding to emergencies and ensuring the safety of life and property.

1.3Innovative points of this study

1.3.1Research innovations in program design

Traditional fire research focuses on unidimensional analysis. This study adopts a multidimensional evaluation approach, combining the experience of professionals and general staff to customize evaluation metrics for different industries and venues. It introduces big data and artificial intelligence technologies to enhance the accuracy and efficiency of assessments and optimizes the plan by incorporating the latest fire safety standards. The design emphasizes operability and long-term benefits, ensuring implementation and promotion. These innovations enhance the scientific rigor and practicality of the study.

1.3.2Research Innovations in Data Acquisition

Traditional methods such as surveys and in-depth interviews are combined with modern technologies like text mining and social media analysis to collect more accurate fire-related data. Advanced statistical methods and big data analytics are used to ensure the authenticity and validity of the data, providing strong support for the development of fire safety systems.

1.3.3Innovations in analytical methods

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

This study integrates both qualitative and quantitative analysis to explore fire safety awareness. Qualitative analysis is based on field research and interviews, while quantitative analysis uses various statistical techniques to identify the influencing factors of fire safety awareness, providing a scientific basis for improving fire education and training. These methods enhance the accuracy and reliability of the research.

Data sources and sample situation

2.1Survey units and targets

2.1.1Investigation unit

The survey focuses on emergency evacuation management for fire safety and is conducted in a variety of locations such as nursing homes, hospitals, factories, office buildings, stadiums, and convention centers. These diverse venues were chosen because they involve many people in their daily operations and have certain safety hazards and special evacuation difficulties. By investigating these diverse locations, we can gain a comprehensive understanding of the current status of fire safety and emergency evacuation management in each area, and identify problems and improvements.

2.1.2Target audience

The survey respondents were subdivided for different venue types:

(1) Nursing homes and hospitals: Focus on the head of the security department, permanent residents, staff, inpatients and transients. These groups require special attention and protection during emergency evacuations.

(2) Factories and office buildings: the main investigation is of the head of DSS, workers and employees. These places are densely populated and evacuation in case of emergency is crucial.

(3) Stadiums and convention centers: Focus on the head of the Department of Safety and Security, randomly moving personnel and exhibition staff. These venues often host large-scale events, with frequent movements of people, making emergency evacuation management more challenging.

2.2Designing the questionnaire

This project is divided into two parts: a pre-survey and a formal survey.

2.2.1Pre-survey

The preliminary investigation for this project consisted of two main parts:

First, a preliminary questionnaire was designed with 20 questions. The team reviewed relevant literature to understand the theoretical background and developed the initial questionnaire. During the distribution and collection, the team evaluated the logical consistency of the questions, addressing issues like unclear wording and insufficient options. These revisions improved the reliability and accuracy of the final survey.

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

Second, field visits were conducted to better understand real-world challenges. The team visited several large public venues, where they discussed issues encountered in the formal survey with experts, ensuring the study's conclusions were more representative.

Key aspects of the investigation:

Survey Design: A 20-question preliminary survey was developed and refined based on feedback to enhance its clarity and reliability.

Field Investigation: The team conducted site visits to key locations, gathering insights on emergency management practices and challenges for further survey design.

2.2.2Formal survey

The formal survey was divided into two parts:

First, expert interviews were conducted. The team identified key emergency issues in public places and gathered relevant terms from online sources. In-depth interviews were held with the primary persons in charge to discuss the real problems.

(1) Shanghai Municipal Fire Bureau Chief: He acknowledged current fire safety measures but highlighted areas needing improvement, such as the introduction of new technologies to enhance efficiency. He stressed the need for individualized firefighting facilities and emphasized the future application of intelligent firefighting systems, as well as the importance of public education and prevention.

(2) Fire Commissioner of Shanghai Children's Medical Center: The commissioner detailed the center's high standards in fire safety, from architectural design to advanced facilities. Regular fire drills are conducted to improve emergency response. The center also focuses on pediatric-specific evacuation plans, ensuring a high level of preparedness for both staff and patients.

(3) Director of Red Sun Nursing Home: The director described the nursing home's fire safety initiatives, including militarized management, strict ignition source control, and specialized staff training. The home's infrastructure is optimized for elderly residents, with clear fire escapes and regular fire drills. Special measures are taken to adapt evacuation routes and facilities to the elderly's mobility and cognitive needs.

(4) Head of Security at Shanghai Mental Health Center: The head outlined the hospital's fire safety measures, including regular patrols and corrective actions to maintain clear fire escapes. The hospital has experienced only one small-scale fire, which was promptly extinguished. The security staff are well-trained, and regular fire drills are conducted to improve emergency response. Improvements have been made to the alarm system to reduce false alarms.

Second, a formal questionnaire was designed and distributed. Based on feedback from the pre-survey and expert interviews, the questionnaire was refined to address new issues. The final version, titled "Survey on Social Cognition and Opinions on Emergency Management," was released via Questionnaire Star, with widespread publicity to ensure comprehensive data collection.

2.3Quality control

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

In order to ensure that the research results are accurate and scientific, the survey team needs to strictly control the survey quality and evaluation. The survey will start from training, auditing, optimization and gap filling to ensure that the questionnaire is logical and coherent, the data is true and objective, and the analysis is accurate and effective.

2.3.1Interviewer training phase

After the establishment of the research team, the investigators received strict training, learned the theoretical knowledge and practical methods of market research, laying the foundation for the actual combat. Subsequently, the investigators brainstormed to determine the direction, purpose and ideas of the research, which provided a good concept and clear planning for the launch of the research.

2.3.2Research and implementation phase

When collecting literature data, members utilized websites and authorities such as Knowledge.com and Wanfang to screen out academic materials suitable for the research, which provided literature support for the survey. In the questionnaire design, the researchers discussed the details of the research in depth to determine the design direction, and the questions were designed by different members to ensure comprehensiveness and objectivity. Meanwhile, remarks were set to reduce ambiguity. For sensitive or private issues, hidden questions and indirect ways of obtaining information were used to improve the quality of recovery.

2.3.3Data collation phase

After recovering the questionnaires, the data analysis members are responsible for examining and screening the questionnaire data, using SPSS and other analytical tools and models to conduct more accurate and scientific screening, and to regard multiple questionnaires with too much similarity, questionnaires whose answers do not conform to the logic of the questions as invalid questionnaires, and to exclude them to ensure the authenticity and accuracy of the data results. The following quality control was realized in this research: (1) checking the data sources to ensure that they are reliable and meet the quality standards; (2) ensuring that the data are complete without omissions or errors; and (3) recording and verifying the details of the data.

Questionnaire data analysis

3.1Data cleansing

The main purpose of data cleaning is to address errors or unreasonable data and perform consistency checks to ensure that variable values fall within a reasonable range, and to identify any logical errors or outliers. Since the sample size is relatively large, if missing values are minimal and correlations between variables are low, we will retain the cases with missing values and only exclude them when necessary in the analysis. However, if a questionnaire has too many missing values, the case will be removed (for example, if there is only one healthcare or social security

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

worker in a particular group, and detailed analysis is not possible, it will be excluded in subsequent analysis such as one-way ANOVA).

After preliminary screening, we used Excel for data cleaning. For example, we assigned the value of 1 to male and 2 to female for gender, and grouped age and education levels into scalar data (e.g., 1/2/3/4, etc.). After completing data cleaning and entry, the cleaned data was imported into SPSS for further analysis.

3.2Frequency analysis of demographic variables

In questionnaires, demographic variables (e.g., age, gender, education, occupation, etc.) are used to describe the basic characteristics of respondents and are essential for data analysis and interpretation of results. As part of the questionnaire, these variables help in further analysis, group comparisons, controlling for confounding factors, and ensuring that the findings are more comprehensive and accurate.

TABLE 1 Numerical characteristics of demographic variables

Frequency analysis of demographic variables					
variant	options	frequency	percentage	Means	standard deviation
distinguishig between the sexes	male	357	62.3%	1.38	0.49
	women	216	37.7%		
age	18-25 years	4	2.1%	3.03	0.8
	26-35 years	46	24.1%		
	36-50 years	82	42.9%		
	51 years and over	59	30.9%		
educational level	Junior high school and below	47	24.6%	2.83	1.48
	High school/secondary school	21	11%		
	university college	32	16.8%		
	university undergraduate course	67	35.1%		
	Graduate students and above	24	12.60%		
Type of work	ward care	30	15.7%	4.43	2.39
	Outpatient and emergency medical care	13	6.8%		
	medical post	8	4.2%		
	administration	26	13.6%		
	Property Services	61	31.9%		
	security post	2	1%		
	unit of construction contracted out	22	11.5%		
	building industry	19	9.9%		

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

	service industry	9	4.7%		
	Health care/social security	1	0.5%		

Table 1 reveals the numerical characteristics of the demographic variables, demonstrating the distribution of respondents. The mean and standard deviation indicate concentration trends and fluctuations, respectively. The results of the frequency analysis show that the distribution of the variables basically meets the requirements of the sample survey. For example, in the gender distribution, male students accounted for 62.3% and female students accounted for 37.7%; in the age distribution, 18-25 years old accounted for 2.1%, 26-35 years old accounted for 24.1%, 36-50 years old accounted for 42.9%, and 51 years old and above accounted for 30.9%. This shows that the survey results mainly reflect the wishes of the middle-aged male group.

3.3Questionnaire Reliability and Validity Tests

Reliability refers to the consistency or stability of measurement results. It primarily examines whether the questions in a test measure the same content or traits. Reliability does not assess the correctness of the results but tests the stability of the questionnaire itself. Cronbach's alpha coefficient is commonly used to measure reliability.

3.3.1Credibility survey for non-quantitative data

We first verified the IP addresses and time taken to complete the questionnaire. Random phone calls were made to respondents to confirm data accuracy, and a few representative samples were selected for in-depth interviews. All respondents indicated they answered the questionnaire subjectively, with only a few showing misunderstandings. These deviation samples were corrected or deleted to ensure the data closely reflected the true values.

3.3.2Confidence analysis of quantitative data

In quantitative research, reliability analysis is essential, particularly for attitude scale questions. We used Cronbach's alpha for survey data that can be quantified. An alpha coefficient above 0.8 indicates high reliability, between 0.7 and 0.8 indicates good reliability, between 0.6 and 0.7 indicates acceptable reliability, and below 0.6 indicates poor reliability. Items with a CITC value below 0.3 were deleted. If deleting an item significantly improved the alpha coefficient, it was removed, and the analysis was re-run. The results of this analysis are as follows:

TABLE 2 Reliability Analysis of Fire Apparatus Understanding

concern	Mean	Scaled variance	Correlation	square multiple correlation	Clone Bach Alpha
1、Do you know how to use a fire extinguisher?	4.6	0.704	0.426	0.269	0.492

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

2、Have you ever used a fire extinguisher in real life?	4.28	0.446	0.308	0.097	0.588
3、Do you recognize the following fire fighting facilities	4.47	0.493	0.459	0.248	0.414
4、Do you recognize the following fire fighting facilities	4.57	0.626	0.435	0.246	0.457
5、Do you recognize the following fire fighting facilities	4.63	0.833	0.268	0.155	0.574

According to Table 2, it can be seen that the overall standardized reliability coefficient on fire apparatus understanding is 0.652, and based on the reliability coefficients after item deletion, it can be seen that they are all less than the overall 0. 652.Therefore, the questions on the dimension of fire apparatus understanding do not need to be adjusted.

The overall standardized reliability coefficient was 0.652, which is between 0.6 and 0.7, indicating that the reliability of this analysis is acceptable.

3.4Questionnaire validity analysis

To ensure the rationality of the questionnaire design, we analyzed its validity, particularly for the attitude scale questions in the quantitative data. We began by assessing the KMO (Kaiser-Meyer-Olkin) value. A KMO value above 0.8 indicates excellent validity and suitability for data extraction. Values between 0.7 and 0.8 suggest good validity, while values between 0.6 and 0.7 indicate average validity. A value below 0.6 suggests poor suitability for data extraction. It is important to note that when only two question items are included in the analysis, the KMO value tends to be 0.5, which does not adequately reflect validity.

Next, we analyzed the correlation between question items and factors. If the communality value was below 0.4 (sometimes 0.5) or the correspondence was inconsistent with expectations, the item was removed. Items were deleted if they did not meet expectations, and this process was repeated until the KMO value met the required standard and the correspondence aligned with expectations. Finally, data with good validity were obtained for further analysis.

TABLE 3 Questionnaire validity analysis

KMO and Bartlett's test		
KMO Quantity of Sample Suitability		.856
Bartlett's test of sphericity	approximate chi-square	1469.561
	degrees of freedom	171
	significance	.000

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

Based on the results of Table 3, the coefficient result of KMO test is 0.856, which is higher than 0.8, indicating that the research data is very suitable for extracting information.

According to the Bartlett's test of sphericity it can also be seen that the significance of this test is infinitely close to 0 and the original hypothesis is rejected, so the questionnaire has good validity.

3.5Independent samples t-test

The independent samples t-test is used to compare the means of two independent groups and is suitable for samples that are independent and normally distributed. The process involves first performing descriptive statistics, followed by a chi-square test, then conducting the t-test, and finally interpreting the results. This test is commonly used in experimental and observational studies to assess differences between two groups on various variables. Since gender is categorized into two groups (male and female), we used the independent samples t-test to analyze gender differences across each dimension.

TABLE 4 Analysis of variance by gender

Analysis of differences in the dimensions by gender						
variant	gender	Number of cases	Means	standard deviation	t	Sig. (bobtail)
Degree of understanding of fire apparatus	male	119	5.38	0.781	-5.293	0
	women	72	6.07	1.012		
Degree of certainty of escape in emergency situations	male	119	45.71	5.245	1.624	0.106
	women	72	44.5	4.584		

The independent samples t-test results show gender differences in various dimensions. The test for knowledge of fire apparatus is close to 0, indicating a significant difference, with women having much higher knowledge than men. However, the test for certainty in emergency escape is 0.106, greater than 0.05, meaning there is no significant difference between genders, with men being more confident than women.

3.6One-way analysis of variance

One-way ANOVA is primarily designed to achieve a test of equality between three or more means, involves only one factor or independent variable, and needs to satisfy two principles of experimental design, namely repetition and randomization.

3.6.1Age

Univariate analysis shows a significant difference in fire apparatus knowledge by age ($p = 0.028$). Younger age groups (18-50) have higher knowledge than those aged 51 and above, likely due to greater exposure to firefighting education.

3.6.2Educational level

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

Univariate analysis revealed a significant difference in fire apparatus knowledge by education level (p = 0.012). Multiple comparisons showed that those with graduate and higher education had the most knowledge, followed by those with middle school or lower education, while those with high school, college, and undergraduate education had less knowledge. This suggests that while higher education may limit exposure to firefighting knowledge, those with lower education levels are more likely to be familiar with fire apparatus due to stronger firefighting education.

3.6.3Type of work

Univariate analysis showed a significant difference in fire apparatus knowledge by job type (p = 0.008). Multiple comparisons revealed that medical care roles had higher knowledge than property services, security, and outsourced construction workers. This suggests that medical-related jobs have more exposure to firefighting knowledge, while other sectors have less.

Quantitative analysis of interview texts

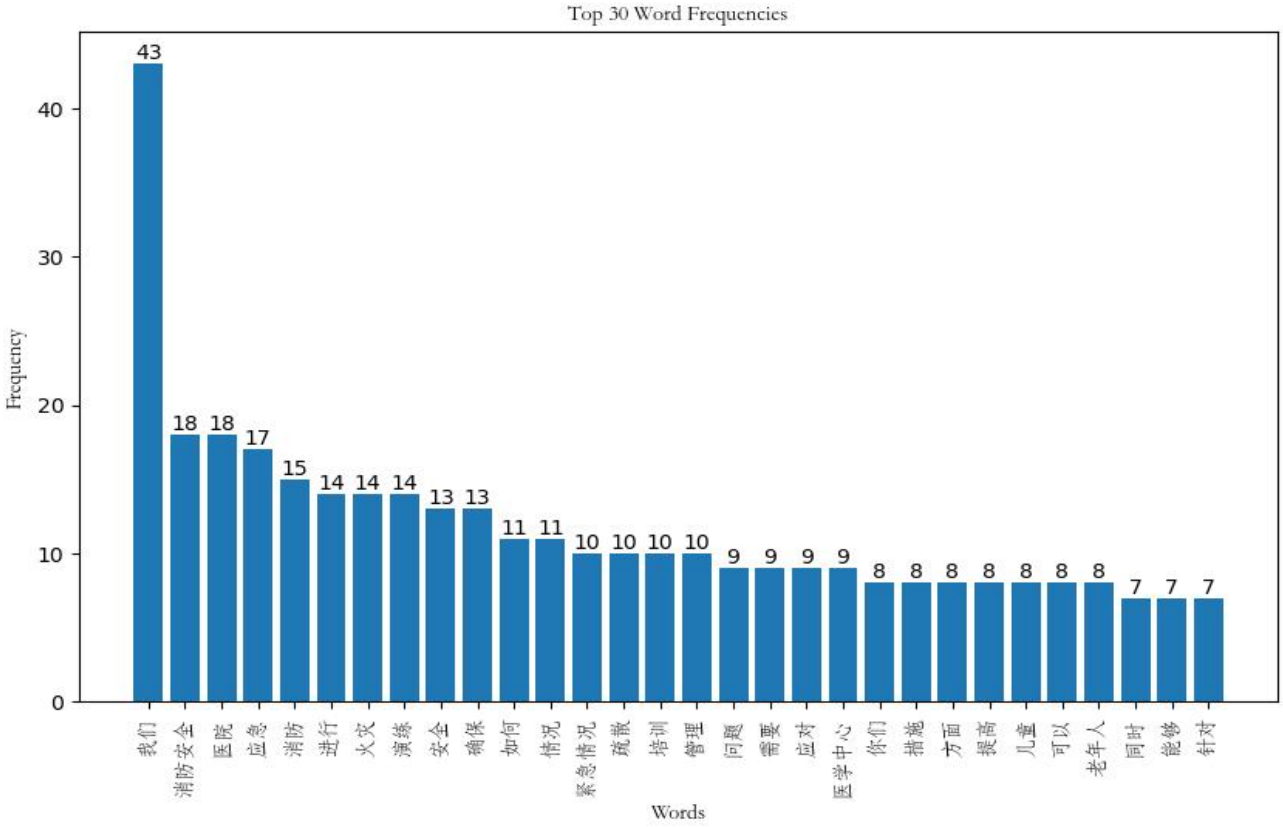

Chart 1 Word frequencies of quantified interview text

Public institutions in Shanghai cover a wide range of fields, and emergency management in large public places needs urgent attention. The research team visited the Shanghai Municipal Fire Bureau, the Mental Health Center, the Children's Medical Center and the Red Sun Nursing Home in Yangpu District, and found that these institutions need to pay attention to emergency management and fire safety to ensure the safety and stability of public places. The team deeply analyzed and discussed

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

the interview records of the experts, and quantified the text of the interview records to make the following analysis of word frequencies:

4.1Fire safety

Fire safety is an important task in the management of public organizations, and the recent frequent fire incidents have attracted wide public attention. Interview records show that the public is highly concerned about fire safety. To address this issue, several measures need to be taken, such as the maintenance and updating of facilities and equipment, staff fire training, regular fire drills and popularization of escape knowledge.

The protection of fire safety requires the concerted efforts of the whole society. In addition to traditional measures, it is also necessary to continuously introduce new technologies and equipment to enhance the efficiency and accuracy of emergency escape. By investing in new technologies, such as intelligent sensing equipment and remote monitoring systems, real-time monitoring and early warning of fire risks can be realized, so that effective measures can be taken in a timely manner to reduce the likelihood of fire. At the same time, the input of new equipment can also enhance the effectiveness of emergency escape, making it possible to respond and act quickly in emergencies and effectively protect the lives of personnel.

4.2Hospitals and nursing homes

Hospitals and nursing homes, as an important part of the public sector, are critical to safety management. In the event of an emergency, these institutions must be able to respond quickly to ensure the lives of doctors, patients and the elderly. Interviews revealed a high level of social concern for these special groups, especially in children's medical centers, where special attention needs to be paid to the special needs of children, such as the ability to escape, safety and security, and the improvement of first aid facilities. Specialized response measures should be developed for children to ensure that they receive timely rescue and care in emergency situations.

Nursing homes, on the other hand, need to pay special attention to the health conditions and daily needs of the elderly, especially the evacuation of the disabled elderly. In emergencies, older persons may have limited mobility, so ensuring their safety is an issue that needs to be seriously considered by all sectors of society. Emergency plans should consider the special needs of the elderly, such as the provision of specialized rescue equipment, the training of caregivers in emergency rescue skills, and the establishment of safe evacuation routes for the elderly, in order to ensure that they are properly cared for and protected in emergencies.

4.3Emergency management

Emergency management is crucial for public organizations, especially as social and security challenges become more complex. Key terms like "emergency," "crisis," and "evacuation" frequently appeared in interviews, reflecting the importance placed on emergency management. It encompasses three phases: prevention, response, and recovery. Prevention focuses on reducing risks and hazards, response emphasizes quick and organized action to minimize casualties, and recovery

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

addresses post-disaster rebuilding. Recently, there has been a shift towards proactive prevention, highlighting the need for risk identification and early warning systems. Public institutions must recognize the urgency of emergency management and strengthen their systems to protect public safety and property.

4.4Management and enhancement

In the daily management of public organizations, in addition to focusing on safety issues, it is also necessary to pay continuous attention to the improvement of the management level. A good management level can improve the overall operational efficiency and effectively prevent evacuation difficulties during emergencies. The interviews revealed a high frequency of words such as "management", "measures" and "improve", indicating the importance people attach to the level of management. Units need to adopt a series of measures, including continuously improving management systems to adapt to challenges and changes, strengthening staff training to enhance their ability to cope with emergencies, and focusing on improving management efficiency by applying technological and management tools to enhance the efficiency and quality of management work.

Conclusions and recommendations

5.1Conclusions

5.1.1Difficulties with live training and evacuation drills for large special public places

In large special public places like hospitals, nursing homes, and psychiatric hospitals, practical training and evacuation drills face several challenges. Safety risks arise due to the nature of special populations, making it difficult to prevent harm during drills. The large number of elderly and physically diverse patients complicates simulating realistic evacuation scenarios.

Additionally, the structure and facilities of these places, such as restricted areas, limit disaster scenario simulations. Healthcare workers, lacking experience, struggle with evacuating special populations, affecting the effectiveness of drills. Lastly, patient privacy and mental health must be prioritized during training to avoid negative impacts. These issues require careful handling to ensure patient rights and safety.

5.1.2Existing emergency evacuation system does not consider the locomotor ability of disabled and handicapped persons

Existing studies show that while particle simulation methods are widely used for crowd evacuation, they have limitations in simulating the evacuation of people with disabilities. These methods fail to account for individual mobility differences, such as those of wheelchair users, visually and hearing-impaired individuals, who require special facilities.

Furthermore, these simulations neglect the psychological and behavioral factors that affect disabled people during emergencies, such as heightened stress and slower decision-making. To improve accuracy and reliability, these factors must be incorporated into evacuation simulations.

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

This research highlights the need for more inclusive and realistic simulation methods in urban safety and emergency management to better accommodate people with disabilities.

5.1.3New neighborhoods on the adaptability of firefighting equipment, old neighborhoods face "difficult to transform" problem

New neighborhoods benefit from advanced fire protection technologies, such as intelligent fire alarms, automatic sprinklers, and smoke detection systems, which enhance system performance and responsiveness. However, old neighborhoods face significant challenges in upgrading fire facilities, including aging equipment, high costs, and complex building structures that hinder fire escape efficiency. Additionally, residents' lack of fire safety awareness and self-rescue skills further complicate retrofitting efforts. Factors such as budget constraints, construction timelines, and resident cooperation also impact progress. This research emphasizes the need for targeted solutions to improve fire safety in both new and old neighborhoods, highlighting the importance of technological innovation and community engagement in urban safety and emergency management.

5.2Suggestion

5.2.1Individualized evacuation plans through on-site observation to collect data on people with disabilities

To develop effective evacuation plans for people with disabilities, field observations should be conducted to collect data on their mobility, use of aids, and obstacles they face. This includes observing their movement patterns and conducting interviews or surveys with individuals and caregivers to understand their specific needs. The data collected will inform the creation of tailored evacuation plans that provide accessible routes, necessary assistive tools, and specialized evacuation guidelines. Psychological and emotional support must also be considered to ensure their safety and well-being during emergencies.

5.2.2Multi-party coordination promotes consensus improvements in older neighborhoods from infrastructure to safety

To improve fire safety in older neighborhoods, comprehensive inspections of fire facilities should be conducted to ensure effective fire escapes and adequate equipment. Modern fire protection technologies, such as smart fire alarms and automatic sprinklers, should be introduced based on the neighborhood's needs. Public awareness campaigns are essential, and collaboration between the government, community, and property management is key to successful renovations. Increased investment, policy support, and resident participation are critical to overcoming challenges and improving fire safety.

5.2.3Virtual simulation training using a combination of live modeling and virtual reality (VR) technology

To address challenges in live training for large public places, a combination of live modeling and virtual reality (VR) should be used to simulate complex emergency scenarios. This allows

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.

healthcare workers and security personnel to experience interactive, personalized training tailored to the evacuation needs of special populations. Effective training schedules should be implemented to ensure full participation and improve professionalism. This method also protects patient privacy and enhances training effectiveness, reducing risks during real emergencies.

References

[1] National Fire & Rescue Administration. (2023, July 17). Average daily number of fires nationwide exceeded 3,000 in the first half of 2023 [EB/OL]. Retrieved from https://www.119.gov.cn/qmxfqk/sjtj/2023/38420.shtml on December 11, 2024.

[2] Kodur, V., Kumar, P., & Rafi, M. M. (2020). Fire hazard in buildings: review, assessment and strategies for improving fire safety. *PSU research review*, *4*(1), 1-23.

[3] Yang, X. (2023). Discussion on fire safety of historical building renovation in old urban areas. *Engineering and Construction*, 37(01), 306-308.

[4] Ye, L., & Mei, C. (2024). Promoting synergy by cultivation: The logic of change of collaborative governance under the perspective of social production theory—A study based on the development of social emergency response forces in Guangzhou. *Theory Exploration*, (02), 63-69. https://doi.org/10.16354/j.cnki.23-1013/d.2024.02.006

[5] Zheng, X. (2021). Research on upgrading and remodeling of fire water system in old building renovation projects. *Fujian Architecture*, (8), 107-112.

[6] Wu, Q., Han, J., Lei, C., Ding, W., Li, B., & Zhang, L. (2021). The challenges and countermeasures in emergency management after the establishment of the ministry of emergency management of China: A case study. *International journal of disaster risk reduction*, *55*, 102075.

[7] Liu, J., Chen, Y., & Chen, Y. (2021). Emergency and disaster management-crowd evacuation research. *Journal of Industrial Information Integration*, *21*, 100191.

[8] Wu, W., Li, J., Yi, W., & Zheng, X. (2022). Modeling crowd evacuation via behavioral heterogeneity-based social force model. *IEEE Transactions on Intelligent Transportation Systems*, *23*(9), 15476-15486.

DOI: https://doi.org/10.5281/zenodo.14553192
Zhao, Z., & Tang, T. (2024). Enhance fire safety and emergency evacuation protocols Addressing equipment modernization, public space evacuation challenges and the needs of persons with disabilities. *Journal of Modern Social Sciences*, 1(2), 353 – 367.