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The Fidelity of Public Safety Protocol at Bureau of Fire Protection Districts: Strategic Community-Driven Operation Recalibration Framework

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Abstract

This study examined public safety protocol fidelity in relation to normalization of deviance, latent equipment deficits, and near-miss concealment among frontline Bureau of Fire Protection (BFP) personnel in Cebu City, Philippines. A quantitative, non-experimental descriptive-correlational design was employed involving 75 frontline firefighters purposively selected from the Cebu City Central Fire Station, Parian Fire Substation, and Mabolo Fire Substation. Data were collected using the validated Frontline Urban Firefighting Operations and Safety Dynamics Questionnaire and analyzed through descriptive and correlational statistical procedures. Findings revealed very high levels of latent equipment deficits (M = 3.47), near-miss concealment (M = 3.44), and normalization of deviance (M = 3.36). Personal protective equipment and breathing apparatus shortages (M = 3.56), procedural silence and reporting barriers (M = 3.55), and tactical shortcuts (M = 3.41) emerged as major operational concerns. These findings indicate that resource limitations, unsafe procedural adaptations, and restrictive reporting conditions collectively undermine operational safety and institutional accountability. The study recommends improved equipment allocation, strengthened safety monitoring, and confidential, non-punitive near-miss reporting mechanisms. Its purposive sample, limited geographical coverage, and reliance on self-reported data constrain generalizability. The proposed Strategic Risk Recalibration and Operational Reporting Framework provides an evidence-based foundation for strengthening firefighter protection, institutional governance, and urban emergency preparedness, supporting Sustainable Development Goals 3, 8, 9, 11, and 16 through safer working conditions, resilient infrastructure, sustainable communities, and accountable public institutions.

Keywords: Bureau of Fire Protection; Equipment Deficits; Firefighter Safety; Near-Miss Concealment; Normalization of Deviance; Operational Reporting; Protocol Fidelity

1. Introduction

Public safety protocol fidelity is essential for effective emergency response, firefighter protection, and institutional accountability. However, the Bureau of Fire Protection (BFP) faces operational challenges arising from urban congestion, equipment shortages, and administrative limitations. In Cebu City, restricted access routes and inadequate resources often compel firefighters to adopt tactical shortcuts that gradually become accepted practices. Such deviations may increase operational risks and encourage the concealment of near-miss incidents. Research indicates that organizational failures frequently result from accumulated institutional weaknesses rather than isolated human errors (Bjorge, 2023; National Institute for Occupational Safety and Health [NIOSH], 2022). The NFPA 1550 emergency responder health and safety standard underscores the need for systematic safety

management, while NFPA 1700 provides science-based guidance on structural firefighting tactics (National Fire Protection Association [NFPA], 2024a, 2026b). Safety governance in Philippine fire services also operates within the BFP modernization framework (Republic of the Philippines, 2021), while station-level operational guidance is documented by the Bureau of Fire Protection (2021).

Related literature identifies latent equipment deficits, normalization of deviance, and organizational silence as interconnected threats to operational safety. Resource limitations and repeated successful improvisations may reinforce unsafe practices (Graham, 2023; Barton & Sutcliffe, 2021). The normalization of deviance occurs when repeated departures from established procedures become organizationally acceptable (Vaughan, 1996; Price & Williams, 2021). Furthermore, punitive administrative environments discourage personnel from reporting operational errors and near-misses, limiting organizational learning and corrective action (International Association of Fire Chiefs [IAFC], 2022; Edmondson, 1999; Kahn, 2021). Current equipment standards address protective ensembles and self-contained breathing apparatus, including performance and maintenance requirements (NFPA, 2025b, 2026a). NFPA 1500 established an earlier framework for occupational safety and wellness programs (NFPA, 2021). Discussions of operational drift and safety culture are reflected in Barton and Sutcliffe (2021), Bjorge (2023), Graham (2023), and Price and Williams (2021).

Globally, emergency response organizations encounter increasing safety challenges associated with urban complexity and resource constraints (Bjorge, 2023; Graham, 2023). In the Philippines, Republic Act No. 11589 mandates BFP modernization, while Republic Act No. 9514 strengthens fire safety enforcement. Nevertheless, logistical limitations continue to affect operational readiness. In Cebu City, the Central Fire Station, Parian Fire Substation, and Mabolo Fire Substation operate within congested residential and commercial environments where restricted apparatus access and equipment deficiencies complicate fire suppression operations. Emergency preparedness and response planning also require coordinated risk assessment and continuity arrangements (NFPA, 2024b).

The study is anchored in Vaughan's (1996) Normalization of Deviance Theory, Reason's (1990) Swiss Cheese Model, Edmondson's (1999) Psychological Safety Framework, and Weick and Sutcliffe's (2001) High-Reliability Organization Theory. These perspectives explain how organizational deficiencies contribute to procedural deviations, how punitive reporting environments discourage incident disclosure, and how institutional learning can strengthen operational reliability (Reason, 1990; Edmondson, 1999; Barton & Sutcliffe, 2021; Weick & Sutcliffe, 2022). Firefighter fatality investigations offer a complementary approach to organizational learning from critical incidents (National Institute for Occupational Safety and Health [NIOSH], 2026). The foundations of the framework remain the works of Vaughan (1996), Reason (1990), Edmondson (1999), and Weick and Sutcliffe (2001); later high-reliability scholarship provides a complementary perspective (Weick & Sutcliffe, 2022).

Despite existing research on firefighting safety and organizational reliability, limited empirical attention has been given to the relationships among equipment deficiencies, normalized tactical deviations, and near-miss concealment within densely populated Philippine urban fire districts. Addressing this gap, the study examines these variables among 75 frontline BFP personnel from three selected Cebu City fire stations using a quantitative descriptive-correlational design. The findings provide a basis for developing a Strategic Risk Recalibration and Operational Reporting Framework to strengthen operational safety, resource management, and institutional accountability.

The study supports SDG 3 (Good Health and Well-Being), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice, and Strong Institutions) by promoting firefighter safety, improved working conditions, equipment modernization, community resilience, and accountable public administration. Its sustainability contribution focuses on strengthening institutional governance, improving emergency response reliability, protecting frontline personnel, and supporting long-term community safety through evidence-based operational reforms.

2. Material and methods

2.1 Research Design

The study utilized a quantitative, non-experimental descriptive-correlational research design to assess operational safety conditions and examine relationships among the primary variables (Creswell & Creswell, 2023; Rea & Parker, 2021). The descriptive component evaluated respondents' operational profiles, perceived equipment deficiencies, tactical deviations, and near-miss concealment. The correlational component examined the associations between latent equipment deficits and normalization of deviance, as well as between normalization of deviance and near-miss concealment. The research followed an Input-Process-Output framework. Inputs included respondents' operational characteristics, equipment conditions, procedural deviations, and reporting practices. The process involved questionnaire validation, institutional authorization, data collection, and statistical

analysis. These procedures provided the empirical basis for developing the Strategic Risk Recalibration and Operational Reporting Framework. Survey design and interpretation were informed by methodological guidance (Creswell & Creswell, 2023; Rea & Parker, 2021).

2.2 Locale of the Study

The study was conducted in three BFP stations in Cebu City, Central Visayas, Philippines: Cebu City Central Fire Station, Parian Fire Substation, and Mabolo Fire Substation. These locations were selected because their jurisdictions represent distinct urban operational challenges, including congested residential settlements, narrow heritage corridors, and commercial-industrial environments. The Cebu City Central Fire Station serves densely populated communities where narrow interior pathways restrict fire apparatus access. Parian Fire Substation operates within historic commercial districts characterized by limited road accessibility, heritage structures, and heavy pedestrian and vehicular congestion. Mabolo Fire Substation covers mixed residential, commercial, and industrial areas requiring varied firefighting strategies. These environments provide relevant settings for examining how physical constraints and equipment limitations influence operational safety practices (Creswell & Creswell, 2023; Reason, 1990). The selection of these stations reflects the relationship between environmental barriers, organizational resource limitations, and frontline tactical adaptations (Barton & Sutcliffe, 2021; Edmondson, 1999; Underwood & Waterson, 2022).

2.3 Respondents of the Study

The respondents consisted of 75 active frontline BFP personnel assigned to the three selected fire stations. They held ranks ranging from Fire Officer I (FO1) to Senior Fire Officer IV (SFO4) and performed operational duties involving fire suppression, apparatus operation, search and rescue, ventilation, and safety monitoring. Only personnel directly involved in emergency response operations were included to ensure that the data reflected firsthand experiences with equipment deficiencies, tactical improvisations, operational hazards, and incident-reporting practices. Administrative and non-operational personnel were excluded.

2.4 Sample and Sampling Procedure

The study employed purposive sampling to select frontline personnel with direct experience in urban firefighting operations. A total of 75 respondents were distributed equally among the three stations, with 25 participants (33.33%) from each location. This allocation ensured balanced representation of operational experiences across different urban environments. Respondents from the Central Fire Station represented high-density residential fire suppression, those from Parian reflected heritage-district operational challenges, and those from Mabolo represented mixed commercial-industrial and residential firefighting conditions. Selection was based on active operational assignment and direct involvement in emergency response activities.

2.5 Research Instrument

Data were collected using the Frontline Urban Firefighting Operations and Safety Dynamics Questionnaire (FUFOSDQ), a structured, self-administered instrument developed to assess operational safety conditions and organizational reporting practices. Its development incorporated established principles of quantitative measurement and organizational safety assessment (Creswell & Creswell, 2023; Rea & Parker, 2021). The questionnaire consisted of four parts. The first gathered respondents' rank, station assignment, years of frontline service, and operational role. The second assessed latent equipment deficits involving protective equipment, firefighting hoses, water delivery systems, portable pumps, and communication hardware. The third examined normalization of deviance through tactical shortcuts and the use of makeshift or degraded equipment. The fourth evaluated near-miss concealment involving operational close calls, equipment failures, and incident-reporting practices. A four-point Likert scale was used to measure responses and eliminate neutral midpoint selections (Creswell & Creswell, 2023). The instrument underwent expert validation and reliability testing using Cronbach's alpha, with reported internal consistency coefficients exceeding 0.80 across all scales (Creswell & Creswell, 2023).

2.6 Data Gathering Procedure

Data collection began with formal requests for authorization from the respective BFP station commanders. Survey administration was coordinated with station personnel to avoid disrupting emergency response operations and regular duties. The procedures emphasized institutional compliance, voluntary participation, and a non-threatening research environment (Barton & Sutcliffe, 2021; Edmondson, 1999). The questionnaires were administered anonymously to qualified frontline personnel. No personal identifiers were collected, and confidentiality was maintained in accordance with Republic Act No. 10173, or the Data Privacy Act of 2012. Completed questionnaires were retrieved, checked for completeness, and prepared for statistical processing.

2.7 Data Analysis Techniques

The collected data were encoded, screened, and analyzed using descriptive and inferential statistical techniques appropriate to the research objectives (Creswell & Creswell, 2023; Rea & Parker, 2021). Frequency counts and percentages were used to describe respondents' rank, station assignment, years of frontline service, and operational

roles. Weighted means and standard deviations were employed to determine the perceived extent of latent equipment deficits, normalization of deviance, and near-miss concealment. Responses were interpreted using the established four-point rating scale (Creswell & Creswell, 2023). For inferential analysis, normality testing, including the Shapiro-Wilk test, was identified to assess distributional assumptions. Pearson's product-moment correlation coefficient was designated for parametric data, while Spearman's rank-order correlation coefficient was identified for non-parametric or ordinal distributions. These procedures were intended to examine relationships between equipment deficits and normalization of deviance and between normalization of deviance and near-miss concealment. Correlation coefficients were interpreted according to their direction and strength to determine the statistical associations among the study variables.

3. Results and Discussion

3.1 Demographic and Operational Profile of the Respondents

3.1.1 Rank Classification

The majority of respondents were Fire Officer I (37.33%), followed by Fire Officer II (25.33%) and Fire Officer III (18.67%). Senior Fire Officers accounted for the remaining 18.66%, indicating that most respondents were directly involved in frontline firefighting operations. This distribution reflects the experiences of personnel frequently exposed to operational hazards and equipment limitations. Junior firefighters are particularly vulnerable to resource constraints and may adopt informal operational practices learned from experienced personnel (NFPA, 2025b; Reason, 1990; Price & Williams, 2021).

3.1.2 Years in Frontline Service

Most respondents had three to five years of frontline service (34.67%), followed by those with less than three years (24.00%), six to ten years (22.67%), and eleven years or more (18.67%). These findings indicate varied operational experience among respondents. Graham (2023) emphasized that repeated exposure to emergency operations may contribute to behavioral adaptation, particularly as personnel transition from formal training procedures to experience-based tactical practices.

3.1.3 Primary Tactical and Operational Role

Nozzle Crew and Interior Attack personnel comprised the largest group (45.33%), followed by Apparatus Drivers and Pump Operators (22.67%), Search, Rescue, and Ventilation personnel (20.00%), and Station Safety/Logistics Focal Officers (12.00%). The predominance of frontline suppression personnel strengthens the operational relevance of the findings. Weick and Sutcliffe (2022) emphasized that personnel directly managing hazards provide essential insights into organizational safety, equipment reliability, and operational risks.

3.2 Level of Normalization of Deviance in Operations

3.2.1 Tactical Shortcuts Due to Access Constraints

Tactical shortcuts were practiced to a very high extent, with a composite mean of 3.41. Common deviations included advancing interior attack lines without established Rapid Intervention Teams and extending hose lines beyond recommended hydraulic limits without adequate relay pumping support. These practices indicate that restricted apparatus access and congested urban environments encourage deviations from established safety procedures. Vaughan’s (1996) Normalization of Deviance Theory explains how repeated operational shortcuts become accepted when they produce immediate tactical success without apparent adverse consequences.

3.2.2 Use of Makeshift or Degraded Gear

The use of makeshift or degraded firefighting equipment was reported at a very high extent, with a mean of 3.31. Respondents frequently utilized protective equipment beyond its recommended service life, including damaged turnout gear, worn gloves, boots, helmets, and compromised breathing apparatus. These findings suggest that prolonged equipment shortages contribute to the routine acceptance of unsafe operational conditions. Bjorge (2023) and Underwood and Waterson (2022) emphasized that persistent resource limitations may gradually redefine organizational perceptions of acceptable equipment performance and safety.

3.2.3 Overall Normalization of Deviance

The overall normalization of deviance obtained a composite mean of 3.36, interpreted as a very high extent. Tactical shortcuts (3.41) were more prevalent than the use of makeshift or degraded equipment (3.31). This pattern indicates that environmental access limitations are particularly influential in encouraging procedural deviations. Reason's (1990) Swiss Cheese Model explains how operational shortcuts may emerge when institutional safety requirements conflict with actual field conditions and available resources.

3.3 Extent of Latent Equipment Deficits

3.3.1 Water Supply Delivery Apparatus and Portable Transfer Pumps

Water supply and pumping equipment deficiencies registered a very high extent, with a mean of 3.41. Major concerns included insufficient lightweight portable pumps for narrow urban passages and delays in preventive

maintenance of firefighting apparatus. These limitations reduce the efficiency of water delivery during structural fire suppression, particularly in congested communities. NFPA (2026b) similarly identified inadequate specialized pumping equipment as a major operational constraint in densely populated urban environments.

3.3.2 Attack Hose Lines and Nozzle Hardware

Deficiencies in attack hose lines and nozzle hardware were assessed at a very high extent, with a mean of 3.39. Respondents reported using aging hoses beyond their recommended service lives and experiencing shortages of certified lightweight attack hoses. These findings indicate increased vulnerability to equipment failure during fire suppression operations. NFPA (2026a) emphasized that prolonged equipment use and repeated physical abrasion can compromise hose reliability and firefighter safety.

3.3.3 Tactical and Safety Hardware

Tactical and safety hardware deficiencies obtained a mean of 3.50, indicating a very high extent. The most prominent limitations involved thermal imaging cameras, structural monitoring equipment, and reliable tactical communication devices. The absence of essential monitoring and communication equipment reduces situational awareness during hazardous operations. NFPA (2024a) and Barton and Sutcliffe (2021) emphasized that dependable safety equipment and communication systems are necessary for effective risk assessment and coordinated emergency response. Systems-oriented approaches to safety assessment offer additional context for these operational vulnerabilities (Underwood & Waterson, 2022).

3.3.4 Personal Protective Equipment and Breathing Apparatus

Personal protective equipment and breathing apparatus recorded the highest deficiency rating, with a mean of 3.56, interpreted as a very high extent. Major concerns included insufficient functional self-contained breathing apparatus, shared breathing equipment, and inadequate protective gear allocation. These deficiencies directly compromise firefighter protection and operational readiness. Republic of the Philippines (2021) and NFPA (2025b) identified inadequate protective equipment allocation as a continuing challenge despite modernization initiatives under Republic Act No. 11589.

3.3.5 Overall Latent Equipment Deficits

The overall extent of latent equipment deficits registered a composite mean of 3.47, indicating a very high extent. Personal protective equipment and breathing apparatus deficiencies ranked highest (3.56), followed by tactical and safety hardware (3.50), water supply equipment (3.41), and attack hose lines and nozzle hardware (3.39). These findings demonstrate widespread resource limitations affecting operational safety. Reason's (1990) latent failure paradigm explains that persistent logistical deficiencies create organizational vulnerabilities that may encourage unsafe tactical adaptations and increase exposure to operational hazards.

3.4 Level of Near-Miss Concealment

3.4.1 Operational Close Calls and Fireground Hazards

Concealment of operational close calls and fireground hazards obtained a mean of 3.39, indicating a very high extent. Commonly concealed incidents included near-miss structural collapses, sudden flashovers, backdrafts, and other potentially dangerous situations that did not result in immediate injuries. These findings suggest that operational hazards are frequently managed informally rather than documented through official reporting procedures. The International Association of Fire Chiefs (IAFC, 2022) emphasized that failure to report near-misses prevents organizations from identifying emerging hazards and implementing preventive safety measures.

3.4.2 Mechanical and Equipment Failures During Active Operations

Concealment of mechanical and equipment failures registered a mean of 3.37, interpreted as a very high extent. Frequently unreported incidents included communication failures during interior operations and breathing apparatus malfunctions. These findings indicate that equipment failures are often resolved internally without formal documentation, limiting administrative awareness of recurring maintenance concerns. NFPA (2026b) and Underwood and Waterson (2022) emphasized that informal management of mechanical deficiencies can conceal organizational weaknesses and delay corrective interventions.

3.4.3 Procedural Silence and Reporting Climate

These reporting concerns are also relevant to firefighter safety guidance from the International Association of Fire Chiefs (2022) and organizational silence research (Kahn, 2021). Procedural silence and reporting climate recorded the highest near-miss concealment mean of 3.55, indicating a very high extent. Respondents identified fear of administrative sanctions, potential legal liability, and the absence of confidential, non-punitive reporting mechanisms as major barriers to incident disclosure. These findings reflect the importance of psychological safety in organizational reporting practices. Edmondson's (1999) Psychological Safety Framework explains that employees are less likely to disclose operational concerns when reporting may result in punishment. Similarly, Kahn (2021) and Edmondson (1999) emphasized that punitive administrative environments encourage organizational silence and restrict institutional learning.

3.4.4 Overall Near-Miss Concealment

The overall level of near-miss concealment obtained a composite mean of 3.44, interpreted as a very high extent. Procedural silence and reporting climate ranked highest (3.55), followed by operational close calls and fireground hazards (3.39) and mechanical and equipment failures (3.37). These findings indicate that administrative reporting conditions represent a major obstacle to transparent incident documentation. Weick and Sutcliffe (2022) emphasized that high-reliability organizations depend on open communication and systematic learning from near-misses to prevent recurring operational failures and strengthen institutional safety.

4. Conclusion & Recommendations

The study concluded that public safety protocol fidelity among 75 frontline Bureau of Fire Protection (BFP) personnel from three selected Cebu City fire stations was challenged by persistent equipment deficiencies, normalized tactical deviations, and near-miss concealment. Findings revealed a very high extent of normalization of deviance, particularly tactical shortcuts adopted in response to restricted apparatus access and challenging urban environments. Latent equipment deficits were also highly evident, especially shortages of personal protective equipment, breathing apparatus, and essential firefighting hardware. Furthermore, near-miss concealment was prevalent, with procedural silence and fear of administrative sanctions emerging as major reporting barriers. Collectively, these findings suggest that operational safety challenges extend beyond individual compliance and reflect broader organizational, logistical, and administrative weaknesses. The study highlights the importance of aligning safety protocols with actual operational conditions, strengthening equipment readiness, and promoting transparent reporting to improve institutional accountability and frontline firefighter protection.

The Department of the Interior and Local Government and BFP leadership should prioritize operational safety reforms through improved equipment procurement, maintenance, and resource allocation based on the specific requirements of urban fire districts. Particular attention should be given to providing adequate protective equipment, functional breathing apparatus, reliable communication devices, and portable firefighting equipment suitable for narrow access routes. Regional and station commanders should strengthen compliance monitoring, equipment inspections, and practical training on safe tactical adaptations. A confidential, non-punitive near-miss reporting system should also be established to encourage personnel to disclose operational hazards, equipment failures, and procedural concerns without fear of unnecessary administrative sanctions. Regular after-action reviews should emphasize organizational learning and corrective action rather than individual blame. The proposed Strategic Risk Recalibration and Operational Reporting Framework should be considered for implementation and evaluation to strengthen operational reliability, institutional accountability, and firefighter safety. Future research may assess its effectiveness across additional fire districts.

The study was limited to 75 frontline BFP personnel from the Cebu City Central Fire Station, Parian Fire Substation, and Mabolo Fire Substation during 2026. Its purposive sampling approach and restricted geographical coverage limit the generalizability of findings to other fire districts with different operational conditions. Furthermore, the quantitative descriptive-correlational design and self-reported questionnaire measured respondents' perceptions rather than directly observed operational practices. The cross-sectional approach also limited the assessment of changes in safety behaviors over time. Future studies may include larger samples, additional fire stations, direct operational assessments, and longitudinal or mixed-method approaches to strengthen the evidence supporting institutional safety reforms.

5. Compliance with ethical standards

The author declares no conflict of interest in relation to this study. The research involved 75 frontline Bureau of Fire Protection (BFP) personnel from the Cebu City Central Fire Station, Parian Fire Substation, and Mabolo Fire Substation, with institutional coordination documented in the manuscript. Participation was voluntary, and informed consent was obtained through the survey questionnaire, which required respondents to acknowledge their understanding and agreement before participation. In accordance with Republic Act No. 10173 (Data Privacy Act of 2012), anonymity and confidentiality were maintained by excluding personally identifiable information and processing responses in aggregate statistical form. The 2025 NFPA exposure-control standard provides additional context for protective-equipment and contamination-risk management (NFPA, 2025a). Data privacy obligations were considered under the Data Privacy Act of 2012 (Republic of the Philippines, 2012).

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