Forensic Science International: Synergy 8 (2024) 100462

Contents lists available at ScienceDirect

Forensic Science International: Synergy

journal homepage: www.sciencedirect.com/journal/forensic-science-international-synergy

Mass fatality and disaster response preparedness across medical examiner and coroner offices in the United States

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1. Introduction

In mass fatality and disaster response, medical examiners and coroners' (MECs') primary role includes identifying decedents, determining cause and manner of death, and certifying death certificates [1]. Recent research has focused on MEC access to mass fatality and disaster planning trainings/resources by examining factors such as MEC office/jurisdictional demographics (e.g., type of office, rural vs. urban), but the true level and scope of MEC access to these resources on a national scale is unknown [2–4]. One cross-sectional study found that emergency preparedness levels did not differ based on the type of office (medical examiner vs. coroner), jurisdictional characteristics (size of population and rural vs. urban), or the number of staff [4]. Other literature shows differences in access to resources between medical examiner versus coroner systems depending on the qualifications and training of those leading each system, with rural and smaller MEC jurisdictions, many of which are coroner systems, having less access to operational resources and training compared with those serving larger, urban jurisdictions [5–7]. Gershon et al. notably found that 42% of MEC offices reported they would not be able to respond adequately if there were more than 25 fatalities in 48 h [4]. Common lessons learned emerging from research and after action reports following actual mass casualty events—including shootings (e.g., the 2007 shooting at Virginia Polytechnic Institute and State University [33 fatalities]; the 2015 Inland Regional Center event in San Bernardino, California [14 fatalities]; Las Vegas's October 2017 event [68 fatalities]; the 2022 Uvalde Robb Elementary School event [19 fatalities]); natural disasters (e.g., Butte County, California, Camp Fire wildfire in November 2018 [84 fatalities]; Hurricanes Irma [>129 fatalities], Harvey [103 fatalities], and Maria [2975 fatalities]); and the COVID-19 pandemic, which caused 7 million deaths worldwide as of January 21, 2024 [8]—underscore the critical importance of pre-incident planning, preparation, and training exercises that lay out clear roles, communication plans, and cross-agency protocols among all first responders, including the MEC community [9–16]. Thus, there has been a push for increased preparedness capacity across all systems [7, 17].

Levels of access to mass fatality and disaster planning trainings/resources could be attributed, at least in part, to the lack of standardization of those resources. Table 1 summarizes selected standards, best practice and guidance documents, and other resources for mass fatality incidents (MFIs) that are published or currently in development. Gershon et al. noted that although some MECs have an MFI plan in place, it may lack completeness [4]. A 2013 national review of states' established MFI plans revealed many were inadequate or not actionable [18]. This points to the importance of training: MECs that provide staff training on mass fatality plans have higher levels of emergency preparedness than those reporting no staff training [4]. Merrill et al., 's 2016 study showed MECs had the greatest proportion of participation in jurisdiction-wide drills compared with other response sectors (e.g., death care industry, health departments, faith-based organizations, offices of emergency management) [19].

CDC: Centers for Disease Control and Prevention; **DHS:** Department of Homeland Security; **FEMA:** Federal Emergency Management Agency; **IACME:** International Association of Coroners and Medical Examiners; **INTERPOL**: The International Criminal Police Organization; **OSAC:** Organization of Scientific Area Committees for Forensic Science; **NAME:** National Association of Medical Examiners; **NIJ:** National Institute of Justice.

Even with more standardization and resources, MECs' access level to mass fatality and disaster planning training/resources could reflect their lack of knowledge about these resources or overall willingness to use them. It is also important to note that with more than 2200 MEC offices nationally, less than one in five MEC offices are accredited and 3 MEC offices have self-declared their use of standards on the OSAC Registry [5, 37,38]. With the vast majority of MEC offices serving rural areas with limited staffing and resources [7], accreditation and standards

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https://doi.org/10.1016/j.fsisyn.2024.100462
Received 19 December 2023; Received in revised form 6 February 2024; Accepted 13 February 2024
Available online 14 February 2024

Table 1
Selected mass fatality and disaster planning training resources.

Source	Document Number	Type	ANSI Approval/ ASB Published[a]	OSAC Registry[a]	Title	Reference Citation(s)
ANSI/ASB,	008	Best Practice Document	Y	Y	Mass Fatality Scene Processing: Best Practice Recommendations for the Medicolegal Authority	[20]
ANSI/ASB	009	Best Practice Document	Y	Y	Best Practice Recommendations for the Examination of Human Remains by Forensic Pathologists in the Disaster Victim Identification Context	[21]
ANSI/ASB	010	Best Practice Document	Y	Y	Forensic Anthropology in Disaster Victim Identification: Best Practice Recommendations for the Medicolegal Authority	[22]
ANSI/ASB	007	Best Practice Document	Y	Y	Postmortem Impression submission strategy for comprehensive searches of essential automated fingerprint identification system databases	[23]
ANSI/ASB	108	Best Practice Document	Y	Y	Forensic Odontology in Disaster Victim Identification: Best Practice Recommendations for the Medicolegal Authority	[24]
OSAC	2021-N-0007	Best Practice Document	N	Y[b]	Media Communications Following a Mass Fatality Incident: Best Practice Recommendations for the Medicolegal Authority	[25]
OSAC	2021-N-0008	Best Practice Document	N	Y[b]	Victim Accounting: Best Practice Recommendations for Medicolegal Authorities in Mass Fatality Management	[26]
OSAC	2022-N-0020	Standard	N	Y[b]	Standard for Mass Fatality Incident Management	[27]
DHS/ FEMA	–	Guideline/Guide	N	N	National Incident Management System	[28]
CDC	–	Toolkit	N	N	Death Scene Investigation After Natural Disaster or Other Weather-Related Events Toolkit	[29]
NIJ	NCJ 199758	Guideline/Guide	N	N	Mass Fatality Incidents: A Guide for Human Forensic Identification	[30]
INTERPOL	–	Guideline/Guide	N	N	Disaster Victim Identification Guide	[31]
NAME	–	Guideline/Guide	N	N	NAME Inspection and Accreditation Checklist. Section A7. Mass Disaster Plan	[32]
NAME	–	Standard Operating Procedure	N	N	Standard Operating Procedures for Mass Fatality Management 2010	[1]
IACME	–	Guideline/Guide	N	N	Accreditation Checklist for Medicolegal Office Practices. Section 11. Mass Fatality Planning	[33]

DEFINITIONS: Best Practice Document: A document that identifies and sets forth the optimal way to carry out an action or actions and can provide recommendations on preferred practices, procedures, and training. Unlike a standard, it does not set new requirements in the field [34]. **Guideline/Guide:** Written information and advice on processes that may include recommendations but does not establish best practices [34]. **Standard:** Established by consensus and approved by a recognized body, a standard is written to set objectively measurable requirements for a given topic or set of actions [34]. **Standard Operating Procedure:** A written procedure that serves to instruct how, when, and why techniques are implemented and facilitates uniformity of protocol among staff members [35]. **Toolkit:** A compilation of tools developed by subject matter experts for use in the field. Can consist of policy guidelines, training and educational resources, success strategies, forms, and checklists [36].

ACRONYMS: ANSI/ASB: American National Standards Institute/Academy Standards Board (for the American Academy of Forensic Sciences).

[a] ANSI Approval and OSAC Registry status as of February 2024.

[b] OSAC Proposed Standard sent to ASB for further development and publication.

implementation are difficult goals to achieve. Although standards exist and are being developed, MECs may lack awareness, infrastructure, capacity, ability, or willingness to adopt resources, which prevents them from seeking training opportunities (e.g., conferences, regional workshops) or implementing MFI/disaster victim identification (DVI) standards or best practices.

With a wide variety of incidents to respond to—natural disasters, mass shootings, transportation accidents, infectious disease pandemics, drug overdose crises, incidents with chemical, biological, radiological, nuclear, or explosive (CBRNE) agents—it is crucial to determine MECs' access to resources in preparation and response to such incidents. The extent of MEC access to mass fatality and disaster planning trainings/ resources in the United States is not well-known. Gershon et al.'s and Merrill et al.'s studies are just two examples using national survey data to evaluate preparedness levels among MECs in the United States [4,19]. However, regional variation in preparedness levels for some types of mass casualty events that are more common in certain areas of the country (e.g., hurricanes in southern and Gulf Coast states; wildfires in western states) is not fully delineated. The Bureau of Justice Statistics' (BJS') 2018 Census of Medical Examiner and Coroner Offices (CMEC) was the first national census collection to include questions about agency access to mass fatality and disaster planning trainings and resources and agency participation in emergency response drills [5]. Although the 2021 BJS CMEC report summarized some of the mass fatality data collected in the 2018 CMEC, it did not include an-depth analysis of results, which this paper provides [5]. In addition, we examine the relationship between different access levels and contributing factors to access levels, such as jurisdiction region, population, budget, and staffing. Although the literature uses many terms (e.g., critical incident, MFI), this paper will use the terminology, "mass fatality and disaster planning trainings and resources" and "emergency response drills" to be consistent with 2018 CMEC language. Table 2 summarizes selected terms from the literature.

2. Methods

The CMEC is part of BJS' portfolio of forensic and law enforcement data collections, which all focus on staffing, budget, caseload, capacity, and access to resources. Two data collections have been administered, including the 2005 collection that referenced 2004 information and the 2019 collection that referenced 2018 information (hereafter called "2018 CMEC"). Both CMEC collections were designed to focus on the U. S. MDI system, providing a national picture of MEC offices, including personnel, expenditures, workloads, capabilities and procedures, and access to resources and technology. The present analysis uses the 2018 CMEC public dataset [49] to provide a national picture of MEC disaster planning and emergency response resources, including access to such trainings or resources and participation in emergency response drills based on agency characteristics, such as agency size and geographic location. The present analysis draws from the 2018 CMEC data collection RTI International performed for BJS (contract number 2017-MU-CX-K052). Approvals from the Office of Management and

Table 2
Incident, planning, response, and training types.

Term	Description	Reference
Critical Incident	An event outside the normal experience that poses actual or perceived threats of injury or exposure to death that can overwhelm both an individual's and organization's coping resources (e.g., natural disasters, mass casualty accidents, acts of violence [with and without fatalities]).	Navy Medicine Leaders Guide, 2012 [39]
Disaster	A serious disruption of the functioning of society, causing widespread human, material, or environmental losses, that exceeds the local capacity to respond and calls for external assistance. The response requires rapid, efficient triaging to optimize outcomes [40].	Centers for Disease Control and Prevention (CDC), 2022 [41]
Disaster Victim Identification	The process and procedure for identifying and re-associating human remains via the application of scientific methods, as a component of mass fatality management.	Organization of Scientific Area Committees (OSAC) for Forensic Science, 2022 [42]
Emergency Preparedness	Planning and response to a disaster, which is an event of a sudden phenomenon of sufficient magnitude to overwhelm the resources of a hospital, region, or location requiring external support.	Gebbie & Qureshi, 2002 [43] Puryear & Gnugnoli, 2022 [44] Metzler et al., 2015 [45]
Emergency Response	A reaction to a catastrophic disaster or emergency consisting of the coordination and management of resources (including personnel, equipment, and supplies).	Bexar County Office of Emergency Management, n. d [46].
Emergency Response Drill	A practice method to prepare individuals for a potential emergency. It is a procedure that involves simulating emergency circumstances (e.g., fire, earthquake, lockdowns, active shooter incidents) to train individuals to respond in a real-life scenario.	Javed, 2023 [47]
Mass Causality Incident	An event that overwhelms the local healthcare system, where the number of casualties vastly exceeds the local resources and capabilities in a short period of time. This event may require a response to injured survivors and fatalities, requiring rapid, efficient triaging to optimize outcomes [40].	DeNolf & Kahwaji, 2022 [48]
Mass Fatality Incident	Any incident that results in, or has the potential to result in, the death of a certain number of individuals, which can overwhelm the MEC system. The number of fatalities that a jurisdiction can manage should be predetermined and documented in a preparedness plan.	National Association of Medical Examiners (NAME), 2010 [1]
Mass Fatality Management	The overarching operation involving processing a disaster incident, including communicating with victims' families, conducting search and recovery; processing and identifying the dead, and returning them to their families. Fatality management operations are split into distinct roles, including scene operations, morgue operations, and family assistance (i.e., victim information). The protocols for each are held within the individual medicolegal authority's mass fatality plans.	OSAC, 2022 [27]

Budget and RTI's Institutional Review Board were obtained before any data collection activities began.

2.1. 2018 CMEC

In 2019 and 2020, RTI administered the CMEC referencing 2018 MEC information for BJS. BJS and RTI coordinated with a forensic expert panel review to design the census questionnaire and tested the draft survey across a selected pool of MECs before finalizing the instrument. RTI utilized a mixed-mode data collection approach that included email, mail, web, and computer-assisted telephone interviewing response options to bolster response, ultimately achieving an 81.4% response rate [5]. More information regarding the data collection methodology can be found in the 2021 BJS report [5]. For the present analysis, the 2018 CMEC public dataset was acquired through the National Archive of Criminal Justice Data at the University of Michigan (NACJD) [49].

As the 2018 CMEC BJS report describes, both a long and shortened version of the 2018 were fielded [5]. The shortened version was fielded in the last few months of the survey and was designed to bolster response by only including critical item capture. Within the current analysis, only data from the long version of the 2018 CMEC [50] are included, because only the long version of the survey included the mass fatality and disaster planning resources questions. The long version respondent pool was comprised of 1340 responding offices out of the enumerated 2112 offices [5]. Item response across the long and short surveys ranged from 0 to 18% overall. For the present analysis, item nonresponse percentages—that is, the percentage of missing data by survey item—across the measures defined below ranged from 1.4% (disaster planning resources) to 2.4% (mass fatality investigations) [5].

In the analysis, the rate of question nonresponse was determined to be less than 25% for the 2018 CMEC data, including across variables listed in Table 3. Out-of-range or missing data were reviewed and recoded as well. The data collection team performed data quality follow-

Table 3
2018 CMEC questionnaire, mass fatality and disaster preparedness or response.

Section	Question	Response Type
Administrative	A5: What jurisdictions does your office serve?	Open Response, with instructions of example answers such as Illinois State, Los Angeles County, New York City, and First Judicial District. Multiple jurisdictions could be reported.
Administrative	A8: Enter the number of employees during the pay period including December 31, 2018.	Open numerical response, with instructions to report each employee in only one category. If an employee fills more than one role, they should be put in their primary role. If none, enter 0. Full-time employees are those who work on average 35 or more hours per week. Part-time employees are those who work on average 34 or fewer hours per week.
Budget & Capital Resources	B1: For the most recently completed fiscal year, what was your total budget?	Open numerical response, with instructions to report if an estimated amount.
Resources & Operations	F3: Does your office currently have access to the following trainings or resources, either directly or through a partner agency?	a. Mass fatality investigation • Yes, directly • Yes, through a partner agency • No access b. Disaster planning (e.g., NIMS) • Yes, directly • Yes, through a partner agency • No access
Resources & Operations	F4: Does your office participate in county/statewide emergency response drills?	a. Yes b. No

Source: BJS, 2018 CMEC [51].

up with the survey respondents to rectify question nonresponse during the active data collection period. If the data were still outstanding, the team used a hot deck imputation technique. This analysis technique is where individual values are secondary to inferences of a larger population's parameters; a missing value of one respondent is replaced with the value from a similar respondent within the same dataset. The 2021 BJS report contains further information regarding the imputation procedures used for the 2018 CMEC administrations [2,5,51].

2.2. Measures

To determine access to mass fatality and disaster planning training and resources available to and used by MECs, the present analysis chiefly drew from Section A (Administrative) and Section F (Resources and Operations) of the 2018 CMEC survey, which are summarized in Table 3. This analysis focused primarily on mass fatality and disaster preparedness and response questions. Data on access to drills were drawn from Question F4, which included a yes/no response to the question, "Does your office participate in county/statewide emergency response drills?"

To provide a nuanced and meaningful view of these variables of interest, we examined the variables of interest by jurisdiction size, census region, agency budget, and agency staffing size. Jurisdiction size was drawn from Question A5, which asked, "What jurisdictions does your office serve?" The data from this question were subsequently matched to 2018 Census population data. Using the same methodology as BJS' 2021 report, jurisdiction size was classified across three categories, including large jurisdictions serving 250,000 populations or more, medium jurisdictions with populations between 25,000 and 249,999, and small jurisdictions with populations of less than 25,000. Census regions were derived using the state associated with the MEC address listed (See Table 4).

Agency budget data were derived from question B1, which asked "For the most recently completed fiscal year, what was your total budget?" Respondents entered their response into a numeric field. The budget data ranged from $0 to greater than $20,000,000; offices reporting budgets greater than $20,000,000 were excluded as outliers in the present analysis. Offices that reported a $0 budget operated on a fee-for-service basis or did not have a dedicated budget.

The measure of staff size was drawn from Question A8 of the 2018 CMEC instrument, which asked respondents to enumerate the number of full-time, part-time, consultants/contractors, and on-call employees across eight different types of staffing roles (e.g., autopsy pathologists, coroners/non-physicians, death investigators, etc.). The staff size measure is a composite measure of full-time employees (i.e., 1.0 equivalent) and part-time employees who are valued at 0.5 of a full-time equivalent, such that an office with four part-time employees would have an employee count of two.

2.3. Data analysis

These analyses rely primarily on descriptions of frequency distributions, measures of central tendency (e.g., mean, median), and cross-tabulations to explore the bivariate relationships. The data were analyzed using IBM SPSS version 28.0.1.1 (Armonk, NY) to group results by general MEC characteristics, emergency preparedness characteristics (e.g., direct training vs. training through a partner), and policies/procedures around evidence retention and recordkeeping. For the 2018 analysis period, chi-square tests were used to determine significant differences in whether an agency reported on a specific emergency preparedness-related question. For continuous variables, Mann-Whitney U tests were conducted to determine whether there were any statistically significant differences for emergency preparedness in 2018 because of the zero-inflated non-normal distribution of emergency preparedness use and the potential influence of extreme outliers. For these inferential tests, the alpha level was set to 0.05, and any cases with missing values for that bivariate pair were omitted.

3. Results

Over nine in 10 agencies reported access to mass fatality trainings/resources (90.5%) and disaster planning trainings/resources (91.0%), with a higher percentage of respondents reporting access through a partner (Fig. 1). Over three-quarters (78.7%) of MECs participated in county/statewide emergency response drills (Fig. 2).

With respect to geographic location, the Midwest and South had lower percentages of access to mass fatality and disaster planning trainings/resources and lower participation in emergency drills than the Northeast and West (see Fig. 3). For access to mass fatality trainings/resources, the Midwest had the lowest proportion at 87.9%, while the South had the lowest percentages for access to disaster planning trainings/resources (89.3%) and participation in emergency response drills (75.7%). Chi-squared tests for the relationship between region and resource access is significant for both mass fatality and disaster planning trainings ($\chi = 17.90$; $p < .001$; $\chi = 13.53$; $p = .004$, respectively) at the 0.05 level. Although variability is observed across region, the difference in participation in emergency drills is not statistically significant ($\chi = 6.63$; $p = .085$). Note, the District of Columbia (DC) and Puerto Rico (PR) are included in the CMEC dataset with PR and Massachusetts (MA) being the only state and territory that did not respond to the three outcome measure questions analyzed.

3.1. Population

Respondent agencies were categorized by the jurisdictional population size they serve to determine the relationship between population size and access to trainings/resources and participation in emergency response drills (Table 3). Overall, the MECs serving the smallest jurisdictions reported the least amount of access and participation levels, ranging from 78.7% for participation in emergency drills to 87.1% for disaster planning resources. The MEC offices serving the larger jurisdictions ranged from 88.1% emergency drills to 99.5% for access to mass fatality trainings/resources. The chi-squared test for each resource: mass fatality ($\chi = 38.59$; $p < .001$), disaster planning ($\chi = 22.24$; $p < .001$), and emergency drills ($\chi = 20.14$; $p < .001$) is statistically significant at the 0.05 level.

3.2. Budget and employment

This analysis examined the relationship between budget and staffing and mass fatality and disaster planning levels. The median budget among reporting offices was $68,000. A binomial logistic regression was

Table 4
Agency responses to access to mass fatality and disaster planning trainings or resources, and participation in emergency response drills by population size, CMEC 2018.

	Mass Fatality (n = 1184)	Disaster Planning (n = 1192)	Emergency Drills (n = 1039)
Large (>250,000)	99.5% (191)	97.4% (186)	88.1% (171)
Medium (25,000–250,000)	92.6% (525)	92.8% (528)	80.4% (463)
Small (<25,000)	85.2% (468)	87.1% (478)	78.7% (405)

Source: BJS, 2018 CMEC

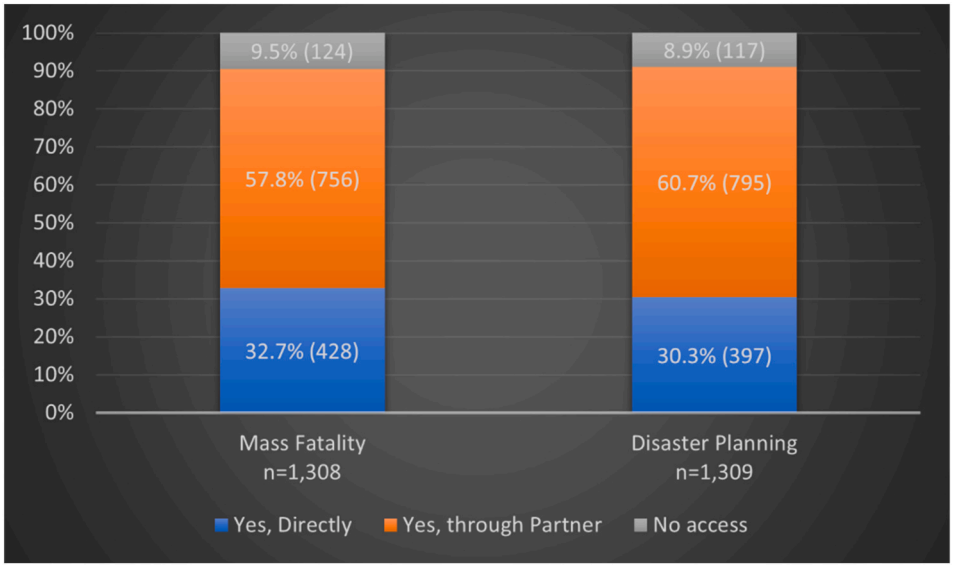

Fig. 1. Agency Responses to Access to Mass Fatality and Disaster Planning Trainings or Resources Directly or through a Partner, CMEC 2018. Source: BJS, 2018 CMEC. *Note:* The percentages do not total to 100% because of rounding.

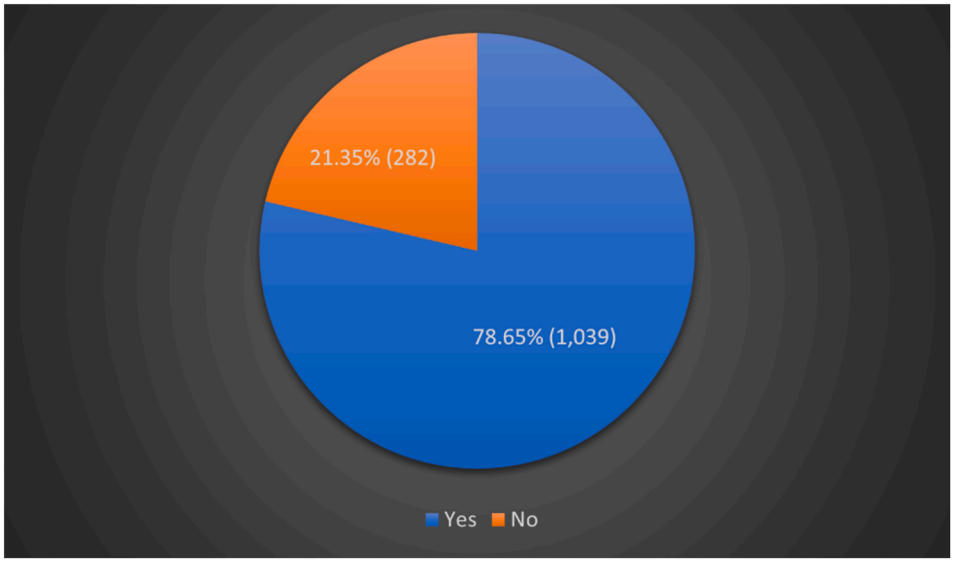

Fig. 2. Agency Responses to Participation in County/Statewide Emergency Response Drills, CMEC 2018. Source: BJS, 2018 CMEC. *Note*: The percentages do not total to 100% because of rounding.

used to assess the relationships between the resources/trainings and the agency budgets. For mass fatality training, larger budgets were significantly associated with an increased likelihood of access ($p < .001$). Each additional $10,000 increases the odds of having access to this resource (exp(B)[odds ratio] = 1.01). Similarly, the data show that larger budgets were associated with increased likelihood of access to disaster planning ($p < .005$; (exp(B) = 1.006)) and emergency drill participation ($p < .001$; (exp(B) = 1.003)).

The median number of full-time employees was 1, and the median number of part-time employees was 0. The measures of central tendency are low because of the zero-inflated distribution of employees, specifically part-time employees, meaning that the typical agency has none. However, a binomial logistic regression can still be useful for examining the effects of the number of employees to assess the relationships between variables. For access to mass fatality trainings/resources, additional employees were significantly associated with an increased likelihood of access ($p < .001$). Each additional employee increases the odds of access (exp(B) = 1.2). Similarly, we found that additional employees were associated with access to disaster planning trainings/resources ($p < .001$ each additional employee increases the odds of having access (exp(B) = 1.13) and emergency drill participation ($p < .001$; each additional employee increases the odds of participation (exp(B) = 1.06). The noted observations about population, budget, employment, and caseload are in the same direction, likely because of the correlation between these variables, which could all be attributed to larger, busier, and better-funded agencies having more resources. Budget and population were correlated at 0.646.

4. Discussion

To understand the extent of MEC agency access to mass fatality and disaster planning trainings/resources and participation in emergency response drills, data from the 2018 CMEC were analyzed. This analysis shows that the vast majority of MECs have access to mass fatality

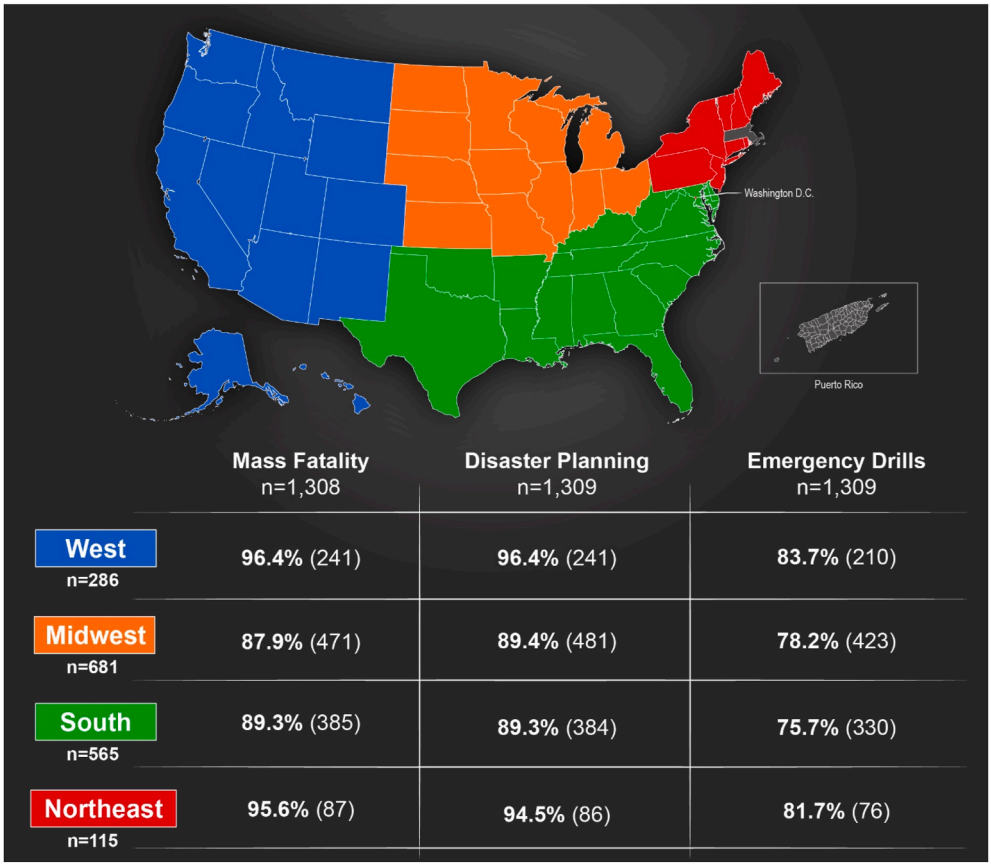

Fig. 3. Agency responses to access to mass fatality and disaster planning trainings or resources, and participation in emergency response drills by region, CMEC 2018. Source: BJS, 2018 CMEC

trainings or resources and disaster planning trainings or resources and participate in emergency response drills. These findings align with Gershon et al. who found that 95% of agencies had an MFI plan in place [4].

Although these data are encouraging, it should be noted that high access levels to resources may not necessarily indicate thorough preparedness levels or readiness. For example, MFI resources may not include policies and requirements for a multiagency communication plan indicating (1) which agency is the command/lead agency; (2) which agencies should be notified and when this should happen; (3) which agencies will be responsible for family notification and grief services; (4) which agencies will be responsible for media outreach; (5) what are options for immediate and increased staffing needs; (6) what services will be a part of the post-incident plan, including workforce wellness and resilience polices; and (7) other necessary planning needs and resources [52,53]. These are all issues that have been identified as crucial in after action reports following MFIs [9–11,15,16,54]. Even though the literature shows it is beneficial for MEC offices to use standard operating procedures and training, studies point out that existing plans may be incomplete, and it is important to prepare for the probability of an "all fatal" incident [4,55]. Additionally, although a majority of MEC offices reported access to mass fatality trainings or resources and participated in emergency response drills, the rate is not reflective of the frequency or quality of material review or participation levels.

It is also notable that MECs in the Midwest and South reported less access to emergency response resources than their counterparts in the Northeast and West. This is important because the Midwest and South tend to have more rural areas that depend on less-resourced coroner offices [7] and serve areas where natural disasters such as tornadoes (South and Midwest) and hurricanes and coastal storms (Southeast and Gulf Coast) occur most often [55]. In the absence of disaster planning and preparedness in part or in whole, and in light of known workforce shortages and training budgets among MECs [37], the federal government can dispatch Disaster Mortuary Operational Response Teams (DMORTs) to areas affected by an MFI and can also bring organizational structure through frameworks such as Emergency Support Functions via the Administration for Strategic Preparedness and Response [56]. Moreover, other federal participation may include the Federal Emergency Management Agency (FEMA), National Transportation Safety Board, and the Federal Bureau of Investigation when and where appropriate; these teams can bolster, and sometimes lead, less experienced local or regional efforts for disaster response. Finally, it is imperative that these organizational and communication frameworks are inclusive of MEC leadership and staff and involve them from the beginning with disaster planning and preparedness.

In addition to jurisdictional, regional, and population demographics, resources were affected by agency budget and number of full-time staff. Unlike Gershon et al.'s study, which found that emergency preparedness levels did not differ based on population size and number of staff, the present analysis showed access to relevant trainings and resources differed by these measures [4]. However, it should be noted that Gershon et al.'s study relied on a convenience, cross-sectional study of 122 responding MEC offices; given the methods used to recruit MEC respondents (i.e., recruitment through newsletters, websites, and mass emails) and the short response period of 6 weeks, their findings may have skewed more toward agencies that were better resourced, better staffed, and more aware and supportive of research. By contrast, the 2018 CMEC was a census of all MECs and achieved a high response rate across all types of MECs, including small to large offices with varying types of agency resources, and was fielded over 41 weeks to achieve an 81.4% response across the long form of the survey. Population, budget, and employment are likely correlated with larger, busier, and better-funded agencies

having more resources. For this analysis, it is difficult to isolate one contributing variable for why some MECs possess more mass fatality and disaster planning trainings or resources than others, which is one limitation of the data that could be explored in future studies.

The 2018 CMEC survey had other limitations as well. First, an abbreviated CMEC survey was sent out after a full survey and did not include any emergency preparedness questions. Thus, this analysis did not include the 307 respondents who provided shortened survey responses, which may have introduced some bias. Second, the CMEC instrument was informed by an expert panel and vetted via cognitive interviews; however, given the large pool of respondents who range widely in nomenclature, educational attainment, and practices, the CMEC questions may not have captured all nuances involved. Third, the frequency of the main questions of interest regarding county/statewide emergency response drills and access to mass disaster fatality and disaster planning trainings or resources lacked any timeframe boundaries. It was not clear how often and how these resources were being used in the present analysis. More research is needed on what access to these resources really means to offices. Finally, it is important to note the measures of employment in this analysis may not be a true representation of time worked by MEC staff. For instance, part-time employees who were deemed half of a full-time employee may work significantly less hours in the MEC office.

Because the 2018 CMEC was the first census to cover questions specifically related to mass fatality and disaster planning resources, it will serve as a foundation for future comparison [5]. Notably, the 2018 survey data are gross national metrics for emergency preparedness; future studies should look at more detailed measures of emergency preparedness, which could include training timeframes, use of resources, implementation of standards, and participation in emergency response drills. The federal government may also consider adding questions about DVI software and recently released standards (Table 1) in future CMEC surveys—e.g., adopting best practices and standards for DVI and MFI management [26,27], communications following MFIs [25], and victim identification [42]—that would provide for greater insights into the adoption of these resources and practices moving forward. With the variety of natural disasters, mass shootings, and CBRNE agents at incidents, future studies could also investigate which agencies have implemented standards, best practices, tools, and policies and procedures and have access to resources specifically pertaining to those types of incidents. MECs continue to participate in the process to develop standards and best practices through ANSI/ASB and OSAC to help improve MFI response. More standard operating procedures, toolkits, and training should continue to be developed, and existing resources should be disseminated more broadly. MFI plans could address workforce resilience and follow-up to ensure post-traumatic stress disorder and other potential mental health issues are identified and treated. Similarly, MFI plans that put processes in place to avoid inequities could also improve these services.

MECs are faced with a wide variety of mass fatality and disaster incidents (e.g., natural disasters, mass shootings, infectious diseases). This analysis of 2018 CMEC data sought to review U.S. MECs' access to mass fatality and disaster response resources and participation in emergency response drills, identify potential contributing factors for gaps in this access, and offer recommendations for future surveys and possibly an independent FEMA census.

Funding

This work was supported, in part, by the Forensic Technology Center of Excellence (Award 15PNIJ-21-GK-02192-MUMU), awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. This work was also supported by the Centers for Disease Control and Prevention (Contract Number HHSM500201200008I, Task Order Number 200-2016-F-91567). Funding for this research was also provided, in part, by RTI International.

The original data collection effort, the 2018 Census for Medical Examiner and Coroner Offices, was performed under Cooperative Agreement 2017-MU-CX-K052 made to RTI International by the Bureau of Justice Statistics, Office of Justice Programs, U.S. Department of Justice.

CRediT authorship contribution statement

Micaela A. Ascolese: Writing – review & editing, Writing – original draft, Investigation, Formal analysis. **Kelly A. Keyes:** Writing – review & editing, Writing – original draft. **Jeri D. Ropero-Miller:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Sean E. Wire:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Hope M. Smiley-McDonald:** Writing – review & editing, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect those of the U.S. Department of Justice. We would like to acknowledge and thank all individuals who helped contribute data from participating medical examiner and coroner offices across the U.S. whose inputs where critical for ensuring that their offices were represented.

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