OMB Control #0693-0078
Expiration Date: 07/31/2022
NIST Generic Clearance for Community Resilience Data Collections

HURRICANE MARIA NATIONAL CONSTRUCTION SAFETY TEAM
INVESTIGATION: VERBAL AUTOPSY AND SOCIO-ENVIRONMENTAL SURVEY
FULL IMPLEMENTATION

FOUR STANDARD SURVEY QUESTIONS

1. Explain who will be surveyed and why the group is appropriate to survey.

The National Institute of Standards and Technology (NIST) has the responsibility to investigate cases of serious failures of the built environment (buildings and infrastructure) under the National Construction Safety Team Act, signed into law in 2002[1]. Members of the National Construction Safety Team (NCST) based at NIST were tasked on February 15, 2018 to conduct a technical investigation of the effects of Hurricane Maria on the U.S. territory of Puerto Rico. NCST duties include:

1. *"...establish the likely technical cause or causes of the building failure and their associated impacts (e.g. severe injuries and fatalities);*
2. *evaluate the technical aspects of evacuation and emergency response procedures;*
3. *recommend, as necessary, improvements to building standards, codes, and practices based on the findings;*
4. *recommend any research and other appropriate actions needed to improve the structural safety of buildings, and improve evacuation and emergency response procedures, based on the findings of the investigation."*

NIST is conducting multiple projects that represent all of these areas for investigation. The survey for which this application is written is a pilot of a larger future survey that pertains to all four duties of the NCST listed above. All previous NCST investigations (WTC[2], The Station Nightclub Fire[3], and Joplin Tornado[4]) have focused on understanding how building and building

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[1] NCST (National Construction Safety Team) Act, Public Law No. 107-231 116 Stat. 1471 (2002). https://www.congress.gov/107/plaws/publ231/PLAW-107publ231.pdf

[2] Sunder, S.S., Gann, R.G., Grosshandler, W.L., Lew, H.S., Bukowski, R.W., Sadek, F., Gayle, F.W., Gross, J.L., McAllister, T.P., Averill, J.D., Lawson, J.R., Nelson, H.E., and S.A. Cauffman, 2005. Final report on the collapse of the World Trade Center Towers : federal building and fire safety investigation of the World Trade Center disaster, *NIST NCSTAR 1*. (September 2005)

[3] Grosshandler, W.L., Bryner, N., Madrzykowski, D., and K. Kuntz, 2005. Final Report of the Technical Investigation of The Station Nightclub Fire, *NIST NCSTAR 2*. (June 2005)

[4] Kuligowski, E.D., Lombardo, F.T., Phan, L.T., and M.L. Levitan, 2014. Final Report of the Technical Investigation of the May 22, 0211 Tornado in Joplin, Missouri, *NIST NCSTAR 3*. (March 2014)

system(s) failures resulted in substantial loss of life or that posed significant potential for substantial loss of life. However, the methods used in these previous investigations cannot be applied to the current investigation due to the large geographic area impacted by Hurricane Maria, the massive extent of building and building system(s) failures in Puerto Rico, and the lack of relevant details (e.g., directly or indirectly attributable to the storm) regularly included in death certificates. Therefore, a survey approach (verbal autopsy) that is often used by the public health sector to determine individuals' causes of death when incomplete vital statistics exist, will be employed in this project to identify deaths that may have been caused by Hurricane María. It seeks to identify the factors and conditions during and after the storm that may have contributed to these deaths (in the two weeks immediately following the storm) directly and indirectly, including building and building-system failures. This investigation is not considered research and is instead a fact-finding mission to establish the role that building failure and their associated impact had on hurricane-attributed fatalities. The purpose of NCST investigative activities is to make recommendations, based directly on findings, that can help prevent future deaths and injuries across the United States.

This survey will be administered to 1,800, next of kin and/or key informants[5] identified using death records and death certificates from the Puerto Rico Demographic Registry. To complete this data collection, NIST has partnered with contractors who can utilize trained personnel local to Puerto Rico for data collection activities. The contractors, in consultation with NIST scientists and engineers, have used death records and death certificates from the Puerto Rico Demographic Registry to develop a sampling strategy whereby data collection will occur in four specific regions of Puerto Rico that facilitate representation of key hurricane-impacted areas. The survey instrument will elicit data on circumstances and location of the deceased at the time of the storm's landfall, socio-environmental factors and stressors, emergency preparedness activities, response of relevant health care systems, and verbal autopsy of injuries, symptoms of those that perished on the island of Puerto Rico for Hurricane Maria.

2. **Explain how the survey was developed including consultation with interested parties, pre-testing, and responses to suggestions for improvement.**

The survey instrument was developed by NIST contractors, who are scientists with backgrounds in epidemiology, global health, environmental health, and social psychology. The survey instrument was reviewed in depth by employees at NIST (Drs. Judith Mitrani-Reiser, Luis Aponte-Bermúdez, Maria Dillard, Kenneth Harrison, Jennifer Helgeson, Katherine Johnson,

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[5] In survey and interview research, *key informant* refers to the person with whom an interview about a particular issue, organization, or problem is conducted. The key informant is a proxy for the individual or group with the desired information.

Marc Levitan, Joseph Main), the Centers for Disease Control and Prevention or CDC (Captain Rebecca Noe), and at the National Center for Disaster Medicine and Public Health or NCDMPH (Dr. Thomas Kirsch), who are scientists and engineers with backgrounds in emergency medicine, epidemiology, global health, disaster science, sociology, anthropology, communications, psychology, wind engineering, and structural engineering. The survey instrument encompasses aspects of the social, environmental, health, and health care system effects that surround human loss in the context of hydro-meteorological disasters.

The first phase of the development of this survey instrument focused on a literature review on the state-of-the-art of the research and study of hydro-meteorological natural disasters and human deaths, as well as health system response and barriers to care. A scoping review explored the literature with respect to the hazards, determinants, conditions, factors, and mechanisms, through which an individual can die, sustain an injury or suffer illness, or disability, in relation to a hydrological disaster e.g., hurricanes, cyclones, tropical storms, floods, landslides. The literature review also focused on identifying, obtaining, and reviewing existing data collection instruments related to disasters such as death scene investigation manuals, verbal autopsies (VA), and social autopsies (SA), and environmental surveys. The instruments, collected in this literature review phase, were developed for US government entities (e.g., CDC: NHAMC, NHDS, NVSS, NCEH, DER, DEHHE; EPA: NMMAPS; NOAA; USGS; FEMA; NIH: NIEHS, NASE, NWS, NIOSH, OTPER; state and local health departments, etc.); global multilateral organizations (e.g., UNGA-UNDDRR; WHO); international centers and governmental institutions (e.g., CRED (Belgium), India); universities (e.g., UCSF, UCLA, USC, etc.); previous hurricane experiences (Hurricanes Katrina, Ike, Sandy, etc.). Both phases of the literature review employed PubMed, Google Scholar, Google to identify papers, reports, and survey instruments in peer-review journals and the grey literature.

A conceptual framework was then developed as the foundation for designing the verbal autopsy and socio-environmental (VA+S'E) instrument. This conceptual framework informed the definition of domains to be included in the instrument. A total of 234 potential questions were extracted from more than 20 existing instruments to assemble an inventory of questions that includes broadly two components: (1) a verbal autopsy, aimed to ascertain the cause of death, and (2) a socio-environmental section, aimed to understand the conditions in which the death occurred, exposure to stressors, response and problems faced in the response to the disaster.

The first version of the survey received written and verbal feedback by employees at NIST, the Centers for Disease Control and Prevention (CDC), and the National Center for Disaster Medicine and Public Health (NCDMPH), who are scientists and engineers with backgrounds in emergency medicine, epidemiology, global health, disaster science, and structural engineering. This version was also pre-tested with Puerto Rican residents (family members of the contractors)

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to assess general understanding and length of the interview. The feedback reduced the original questionnaire from a 2-hour survey to complete, to an updated version, which averages 45 minutes to complete. The revised questions were disseminated to Hurricane Maria NCST project leaders at NIST. A final round of revisions was made focusing on details of the content, including issues with item clarity, consistency in wording across Hurricane Maria NCST projects, and question ordering.

This pilot survey was performed to test the instrument and to enable interviewers to gather feedback from respondents on the survey questions (Hurricane Maria National Construction Safety Team Investigation: Verbal Autopsy and Socio-Environmental Survey OMB Control #0693-0078, ICR Rreference #201906-0693-003). Responses were obtained from 50 next of kin and/or key informants. The pilot helped verify that the questions are clear, and that the participants correctly understood the terminology, concepts and potential ambiguous words (including colloquial meanings). The pilot survey provided invaluable local expertise and will help to evaluate clarity of language and terminology, and ensured that questions are appropriate, relevant, and effective in meeting their objective. The following minor edits were made to the survey instrument after the pilot test: 1) the addition of four questions that were accidently omitted in the conformation of the questionnaire, which are critical to capturing exposure of the residence to environmental stressors. (Q3.5, Q5.11-13) and 2) addition of a "closed" response option for questions about the health facilities and hospitals and access to care (Q9.2.16, Q9.3.13, Q9.3.18). With feedback from respondents and analysis of pilot data from the contractors, NIST is now well positioned to meet its NCST duties with an excellent final survey instrument.

3. **Explain how the survey will be conducted, how customers will be sampled if fewer than all customers will be surveyed, expected response rate, and actions your agency plans to take to improve the response rate.**

A team of 17 interviewers have been trained to work in coordination with the contractor leadership and the Field Coordinator to conduct the surveys. The interviewers are responsible for conducting the surveys and assisting in the data analysis. A sub-team will be responsible for locating and contacting relatives of the deceased persons.

The respondents (next of kin or key informants) will be contacted by telephone to verify contact information, explain the objective and methods of the study, ask participants if they are willing to participate, to explore availability for the interview and if possible, make an appointment for the interviewer to collect the survey. The interviews will be conducted via telephone and the response data will be recorded on tablets. The interview will be conducted using the Survey

CTO application installed on the tablets. This application supports secure data collection with end-to-end encryption thereby protecting the transfer of the data from the tablets to the secure servers. Efforts will be made to complete the survey in one call, although, if necessary, another call can be scheduled.

1800 Respondents / 60 minutes for response time = 1800 burden hours.

Response rates will be closely monitored to achieve the expected 80% survey completion rate. It is expected that the population may have some resistance to answer the survey, either for privacy and confidentiality issues, or to some extent because of survey fatigue as several segments of the population have been previously surveyed about Hurricane Maria. In order to increase our response rate, several outreach efforts will be undertaken to enhance the visibility and legitimacy of the project and to achieve expected response rates. First, the NIST Hurricane Maria webpage is used to generate awareness of the project, planned data collection, and to prepare respondents for study participation requests. Second, introductory letters describing the scope and objective of the Hurricane Maria investigation and consent letters for the survey will be sent to next of kin to provide preliminary information about the project before phone contact. We expect this preliminary information can increase the initial response to the first approach to participate in the survey. Third, a survey landing page will be used as an additional space to provide additional project background information, including an introductory letter from NIST, a recruitment letter from the data collection team, and contact information for NIST contractors assisting with data collection. This information can help as a resource for potential participants to learn more about the project and increase their confidence to participate in it.

The death certificate is the primary source of contact information for next of kin. The team will verify and/or update the initial contact information using other sources of information to reduce the proportion of persons who cannot be reached due to lack of location data.

This is not a Privacy Act System of Records, therefore SORN and Privacy Act Statement are not applicable.

4. Describe how the results of the survey will be analyzed and used to generalize the results to the entire customer population.

This survey will generate information about the characteristics of deceased persons in a period of 14 days from the landfall of Hurricane Maria in the study regions, including living characteristics that may affect their vulnerability to die, preparedness and resources to face the disaster, cause of death, process of search for medical care and disruptions to care when required. Besides characterizing these deaths, the information from this survey will contribute to the project in three ways:

1) It will serve as another source of information on the medical cause of death, which we can compare with the one existing in death certificates.
2) It will provide information for the attribution analysis, which will attempt to identify the likelihood of a death occurred in the study period to the disaster.
3) It will provide information on the extent to which some deaths can be attributed to physical infrastructure and service disruptions resulting from Hurricane Maria.

Results of the analysis will be generalizable to the regions included in the study, but can provide useful information for similar settings in disaster situations.

We will analyze the survey results to reconstruct the pathways that led to individual deaths. We will identify keywords contained in the open text and build on the CDC algorithm (Issa et al., 2017) and the gained knowledge from the secondary data to ascertain whether a death is directly, indirectly, or probably attributable to the hurricane. The keywords will also be analyzed to determine a potential cause of death, and any relation to infrastructure, environmental and socio-economic factors, as well as problems with operation in cases of death in a hospital environment. The verbal autopsy data including the keywords will be linked to external data, if provided, and cross-checked against police computer aided dispatch (CAD) information and 911 calls as well as information on electricity outages and hazards including, wind, floods and landslides.

We will most likely use a general linear model framework to assess the relative contribution of defined and coded sets of risk factors on the likelihood of direct and indirect death (by any cause and broad International Statistical Classification of Diseases and Related Health Problems (ICD) categories of cause of death), both independently and in interaction with others. We will assess age and sex as basic factors determining mortality. Categories of risk factors will include individual and household demographic characteristics, medical and physical characteristics including disability and prior or current disease or illness, socio-contextual and community factors, and factors associated with deprivations caused by the storm including those related to residential building failures (e.g., lack of water, electricity, housing, and transport) and specifically identified building failures in institutional structures, primarily hospitals. Interactions of other identified factors with residential and institutional building failures will be estimated to identify characteristics of individuals with higher risk of mortality when exposed.

The purpose of an NCST investigation is to help prevent future deaths and injuries across the U.S. by recommending actions that can influence codes, standards, and practices. Lessons learned from Puerto Rico regarding the role that building failures and their associated impact on hurricane-attributed fatalities can be useful not only to better understand the impacts from this particular storm, but also can also be relevant for other hurricane prone regions and in other hazard conditions.