

PRA Application Supporting Statement

OMB Control #0693-0078

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**HURRICANE MARIA NATIONAL CONSTRUCTION SAFETY TEAM INVESTIGATION: CHARACTERIZATION OF DEATHS AND INJURIES (DI)
IN PUERTO RICO AFTER HURRICANE MARIA**

HOSPITAL INTERVIEWS

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 2002¹. 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:

- *“...establish the likely technical cause or causes of the building failure and their associated impacts (e.g. severe injuries and fatalities);*
- *evaluate the technical aspects of evacuation and emergency response procedures;*
- *recommend, as necessary, improvements to building standards, codes, and practices based on the findings;*
- *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 interview for which this application is written pertains to all four duties of the NCST listed above. All previous NCST investigations (WTC², The Station Nightclub Fire³, and Joplin Tornado⁴) have focused on understanding how building and building 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, an in-depth interview approach with hospital personnel is critical to developing understanding into emergency management and accounting for deaths.

Specifically, the “Hurricane Maria Mortality Investigation: Option 1” aims to identify the deaths associated, directly and indirectly, with this hurricane, and the factors associated with attribution, taking into account the conditions during the two weeks immediately following landfall. It is necessary to identify all the factors related to these deaths to distinguish those that have to do with critical infrastructure and failures of the hospital system. One of the key components of the Option 1 project is extracting data from the medical records of people who died in a sample of six to eight hospitals. This will make it possible to validate the causes of death and inform about the contextual variables to be considered in the attribution to the storm and the construction failures under consideration, specifically in the health system. The “Medical Records Extraction Form” is an instrument developed for this research to facilitate the process of extracting data from medical records. There are also interviews that will be conducted with key hospital personnel, such as administrative and clinical staff, to better understand system, organizational, individual, and environmental conditions/failure related to the patient care.

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)

This research proposes to study the excess mortality in Puerto Rico from Hurricane Maria. The implementation of the project is being carried out by a multidisciplinary and inter-university contracted team led by NIST, including the Milken School of Public Health of George Washington University, the Graduate School of Public Health of the Medical Sciences Campus of the University of Puerto Rico and the Institute of Health Metrics of the University of Washington. The purpose of this research is to identify the contextual conditions in Puerto Rico two weeks after the storm in order to understand the link between the conditions the population—including hospital personnel—was forced to live under, their own health constraints, and their deaths. This will shed light on how mortality was affected in the short and medium term in the aftermath of Maria and establish specific protective and preventive strategies for future emergencies. Option 1 consists of evaluating the potential impact of the conditions created by Hurricane Maria on the care of patients in hospitals. The aim is to identify and describe factors that could have contributed to hospitalization and mortality. Data will be collected by abstracting medical records and conducting interviews with administrative personnel and clinicians in 6 selected hospitals.

The 6 hospitals selected for study include:

- Hospital Auxilio Mutuo
- Doctors' Center Hospital
- Ryder Hospital
- HIMA San Pablo Bayamon
- Hospital General Menonita de Caguas
- University Hospital at Carolina

The participants' knowledge and experiences will prove to be essential to our research's purpose. While the risks of participation are minimal, the participants' insights will contribute to a better understanding of the shortcomings of the emergency response within hospitals. Moreover, the results that the study will gather will be extremely valuable for the strengthening of Puerto Rico's hospital system infrastructure. Given the nature of Puerto Rico's economic and climate crisis, it is of utmost importance to improve our emergency response and preparedness. The expected yield for the project is:

1. Provide insights into the specific organizational, environmental, and social conditions the population experienced two weeks after the landfall of Hurricane Maria.
2. Supply information on how critical buildings (hospitals) and emergency communications systems performed during the storm.
3. Facilitate an analysis as to what were the health care conditions in the selected hospitals and the obstacles the administrative and clinical personnel faced before, during, and after the storm.
4. Evaluate and validate the association of death in hospital settings and structural failure and organizational dysfunction of the hospitals during the two weeks after the devastation of Hurricane María
5. Provide insights that can be used to improve construction and building safety codes and standards, and to inform future approaches for the accurate attribution of death after disasters, such as hurricanes.

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, public health preparedness and social psychology. The survey instrument was reviewed in depth by employees at NIST (Drs. Judith Mitrani-Reiser, Joe Main, Maria Dillard, and Emina Herovic), 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, psychology, communication, wind engineering, and structural engineering.

A semi-structured questionnaire guide was developed, using and expanding on the Comprehensive Disaster Assessment and Readiness Tools (CDART) that was generated by CDC after Hurricane Maria (2019) in Puerto Rico. The guide considers sections for the general management of the hospital, addressing the infrastructure, supplies and personnel conditions for the operation of the hospital before, during and immediately after the hurricanes landfall. It also includes a section for the staff providing or supporting the direct care to patients in the areas where deaths occurred, to consider the point of care context during the care of patients including the sufficiency of staff, electricity, electronics, medical supplies, gases, equipment, and physical infrastructure. It will be pilot tested in two hospitals, before being used for the key informant interviews. Given the current Covid-19 situation in Puerto Rico, most of the interviews will be performed virtually by the project investigators.

This pilot survey was performed to test the instrument and to enable interviewers to gather feedback from respondents on the survey questions. 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 expertise and will help to evaluate clarity of language and terminology, and ensured that questions are appropriate, relevant, and effective in meeting their objective.

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.**

Initial contact will be made by the Study PI in UPR, Ralph Rivera-Gutierrez. This communication will be via email. In this message, there will be several documents attached: (1) letter from NIST; (2) letter from the Department of Health of PR; (3) Informed Consent Form; (4) Data Use Agreement. These documents are attached to this PRA package.

Each participant will receive an informed consent sheet before their participation. The participant shall read the document and verbally agree to participate in the study. If the participant has any questions regarding their participation, the senior members of the research team will answer as needed. The participant will be notified through the informed consent sheet that they can deny your answer to any question, as well as stop the interview if deemed necessary and/or leave the study in at any time without any penalty. The investigator will also be aware that the participant is in a safe and private place without the interference of third parties. In addition, the interview will stop if the participant is at risk. If any discomfort or problem arises related to participation in the study, the interviewer will advise the participant to contact the PAS psychosocial helpline at the number 1-800-981-0023.

The expected total number of subjects that will be interviewed in the study is 30-48 subjects. The total number of hospitals in the sample will be from 6-8, and we seek to interview 5-6 members from each hospital's clinical and administrative staff. The duration of the interview process which will be conducted virtually is from 45-60 minutes.

48 subjects x 60 minutes = 48 burden hours expected

The selection criteria for this study consist solely of hospital personnel, specifically administrative staff and clinical personnel who worked at any of the sampled hospitals during two weeks after the landfall of Hurricane Maria. To select the participants, we will solicit the hospitals' directors to suggest key personnel to interview that fit our inclusion criteria, i.e., a convenient sample. No exclusion or inclusion of participants will be made regarding sex, race, or ethnicity. Additional exclusion criteria: to not have worked as an administrative or clinical staff in the hospitals of the sample during the period of interest (September 20, 2017 to October 4, 2017). The research will be conducted in Puerto Rico. Hence, we are expecting a high number of Hispanic US Citizens to participate in the study. Hispanic US Citizens, such as "Puerto Ricans", are considered an ethnic minority.

For the interview process, we seek 1-3 members from the administrative personnel. These may include: Executive Directors, Medical Directors, and other high-level administrative staff that worked during the 14-day period after Hurricane Maria made landfall. In regards to the clinical staff, we seek to interview 1-3 clinicians who worked in the clinical units where there were more defunctions during the 14-day period after Hurricane Maria made landfall. Physicians and staff will refer subjects but will NOT receive incentives to recommend subjects for study participation.

Participants will not receive inducements before or rewards after the study. Given that it is a convenience sample the subjects' names will be known to the research team. However, the interview responses will be deidentified to assure confidentiality. Moreover, to ensure confidentiality and privacy, and to avoid public disclosure of personal and sensitive information, written consents and interview responses will be independently stored in a separately closed area located at the University of Puerto Rico, Medical Sciences Campus, Graduate School of Public Health-Department of Health Services Administration (in an office separate from the data management and

analysis sections of the main project site) and at George Washington University. Regarding privacy and confidentiality, informants will be given an ID which is linked to the answers. NONE OF the responses will be linked to the personal identity. This entire process is strictly confidential. We are governed by HIPPA law to protect participants' identities. In the same way, we are under the ethics committee of the Institutional Review Board (IRB) of the University of Puerto Rico-Medical Sciences Campus. To ensure confidentiality of subjects data, all informants will be linked to an ID code. Their names or personal information will not be revealed.

The interviews will be taped for transcription purposes and this is specified in the consent form. Responses will not be anonymous because subjects' names will be known to the research team, given that it is a convenience sample. The interview responses will be de-identified and coded to assure confidentiality and anonymity. The audiotape recordings and transcriptions will be stored in a locked file cabinet in the UPR PI's office (B434). They will also be stored in an online drive with special security measures, such as a two-factor identification process. The transcriptions and audiotape recordings will be deleted six months after the report is sent to NIST.

The hospital interview component of the Hurricane Maria Mortality Investigation is expected to be completed by the end of June 2022.

4.

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

Analysis of the interview data will be consolidated by the contractor and delivered to NIST. The interviews will be transcribed and transcripts will be coded for key content areas. Then, the data can be queried for analysis to reveal key trends across the respondents, as well as to identify unique considerations that may be specific to one type of respondent.

The new information from hospital facilities and medical records will add to the individual information that we will have from the spatiotemporal analysis, the secondary data (death certificate, forensics and in the case possible, 911 police, and the information that we might obtain from FEMA and electricity and water supply), and the VA+S'E survey analysis. Multiple sources of information will be available for each decedent is going to be integrated to discern whether a death can be attributed directly, indirectly, or probably to the hurricane.

Attribution analysis will be conducted doing a decision based on sensitivity analysis in the continuous probability of attribution to ascertain the meaningful probability of death related to hurricane. We will establish two tiers: First, we will determine the probability that a death is related to the hurricane. In the second tier, we will refine the analysis to discern between hurricane related deaths that can be attributed to a building or systems failure, and those that were hurricane related but not attributable to a systems or building failure. In this algorithm, the probability of attribution to the storm, and to the specific factors that most explain the death will be estimated, differentiated by broad ICD codes, CDC keywords, and categorized by systems or building failure (present/absent).

While the lessons learned from each respondent will be unique, and richly qualitative, we are expecting through this work to be able to highlight those areas where professionals agree on needs for strengthening hospital emergency management. We are confident that although the 6 hospitals included in this sample will not provide statistically generalizable results, the common themes within and across the data will give us a representative picture of hospital emergency management related to Hurricane Maria.

Through this research, we hope to gain the following:

1. Provide insights into the specific organizational, environmental, and social conditions the population experienced two weeks after the landfall of Hurricane Maria.
2. Supply information on how critical buildings (hospitals) and emergency communications systems performed during the storm.
3. Facilitate an analysis as to what were the health care conditions in the selected hospitals and the obstacles the administrative and clinical personnel faced before, during, and after the storm.
4. Evaluate and validate the association of death in hospital settings and structural failure and organizational dysfunction of the hospitals during the two weeks after the devastation of Hurricane María
5. Provide insights that can be used to improve construction and building safety codes and standards, and to inform future approaches for the accurate attribution of death after disasters, such as hurricanes.

While there are no direct benefits to the participants of this study, the results will produce benefits to society. These will potentially lead to federal and local

recommendations on construction and building safety codes and standards, and regulations for critical buildings, such as hospitals. These recommendations will reinforce the hospital system infrastructure so it is more resistant and resilient to future natural disasters, like hurricanes and the effects of climate change.

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 use and effectiveness of emergency communications, and their influence on evacuation behaviors, 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. For example, lessons learned by NIST's NCST investigation of the Joplin, M.O. tornado in 2011 have been applied to develop the first-ever engineering-derived probabilistic tornado wind speed maps produced for the United States for use in tornado-resistant design of buildings. The entire NIST Hurricane Maria investigation team is hopeful that this kind of impact will also be possible based on the results of our hospital interview survey.

Associated Attachments: (1) letter from NIST; (2) letter from the Department of Health of PR; (3) Informed Consent Form; (4) Data Use Agreement (5) Instruments