

Milken Institute School of Public Health

THE GEORGE WASHINGTON UNIVERSITY

Preliminary Report

Ascertainment of the Estimated Excess Mortality from Hurricane María in Puerto Rico

Advances on Phase 1

May 21, 2018

Table of Contents

Executive Summary	1
Introduction.....	3
Establishment of the Project.....	5
Developing the Mortality Dataset and Analyses	9
Initiating the Assessment of the Communication Process	13
Perspectives and Next Steps	18
References	20
Annex 1.....	22

Executive Summary

This preliminary report provides an update on the activities for the Ascertainment of the Estimated Excess Mortality from Hurricane María in Puerto Rico project. The study includes two major components. The first is an assessment of excess mortality as a result of the hurricane through analysis of mortality data, the evaluation of the quality of death certificates, the process of death registration, design of a future in-depth analysis of mortality ascertainment related to hurricanes Irma and Maria. The second entails a review of the communication process before and after the hurricane to examine the preparation and dissemination of hurricane-related public health and mortality information, as well as an assessment of public perceptions about the communications received in light of their own experience during the hurricane.

The report describes how the project was planned and the team assembled as a rapid response to a public health and social crisis. In this process the research team at the George Washington University (GW), Milken Institute School of Public Health (Milken Institute SPH) established close collaborations with government institutions, academia and other organizations. This included a series of intense exchanges during the planning phases and once the study began; to understand the work of key government agencies, such as the Demographic Registry, the Forensic Sciences Bureau, and the Puerto Rico Planning Board, as well as how the hurricane affected their operations. Inter-institutional arrangements ranged from the contractual process, to the establishment of Memorandum of Understanding (MOU) and the development of Data Use Agreements; the implementation of the latter necessary to fulfill data protection commitments. During contract development, the Milken Institute SPH and GW provided administrative and financial support to enable the study team to begin work.

The Milken Institute SPH team actively sought the collaboration of faculty members from the University of Puerto Rico Graduate School of Public Health (GSPH UPR) and together they launched the project with a workshop to integrate the research team with the concerns of stakeholders who have faced the problem of mortality in Puerto Rico. The Milken Institute SPH and GSPH UPR signed an MOU to foster both academic and research collaboration between the two institutions. In addition, both universities signed an Institutional Review Board (IRB) Authorization Agreement, thus ensuring both institutions are compliant with the human subject protection requirements of both institutions, with the oversight of the IRB of the George Washington University.

Significant efforts were made to link with local and external institutions that could collaborate, that had professionals who could offer technical advice and orientation on the project.

One of the first research team activities was to establish a data warehouse that would include a secure platform wherein study team members could access, store, process and analyze data. For each one of the project components, methods and instruments had to be developed. These included statistical mod-

eling, demographic and migration projections, structured interview guides, transcription and qualitative analysis methods. The methods and instruments have advanced, and most of the data gathering is completed. The death certificates include the electronic files from September 1, 2017 – February 28, 2018, and scanned documents from September 1 – December 31, 2017. Access to them required agreement on data use, confidentiality, and transfer. Protocols and surveys were developed for the assessments of the death registration and communications studies. Once IRB approval was obtained for the death certification as well as the perceptions of mortality and communication studies, two teams conducted field research in Puerto Rico and are in the process of data transposition, review and analysis. Work has begun on designing the analysis of the mortality data to ensure the analyses will take into account demographic changes in Puerto Rico over the last decade.

Currently an expert review panel is being assembled that mirrors the different project components, including methods on verbal autopsies, crisis risk communication, mortality modeling, death attribution to natural disasters, and demographics to review our research activities and provide feedback on methodology. The project component reports will be integrated into a draft report to be reviewed by the expert review panel.

A proposal is being developed for a next project, an in-depth analysis of the excess deaths that should address the cause specific mortality attributable to the hurricanes. This responds both, to societal demands and technical requirements.

Introduction

The two-phase project for the Ascertainment of the Estimated Excess Mortality from Hurricane María in Puerto Rico has two components: to estimate excess mortality and to assess communication of mortality. Each of these components comes with a set of objectives. The following list describes the activities and objectives that will be carried out during this Phase 1 of the project.

Estimated Excess Mortality Objectives

- To conduct a rapid, accurate assessment of estimated excess mortality associated with Hurricanes Irma and María; study timeframe September 1, 2017 – February, 28, 2018.
- To evaluate the mortality registration processes followed to record and document mortality during this period.
- To design methods for a future in-depth analysis of mortality ascertainment (Phase 2)
- To establish a data warehouse to store relevant data for public and scientific use.
- To establish a collaborative framework for the implementation of the project.

Public Health and Mortality Communication Objectives

- To assess Puerto Rico stakeholder perceptions and attitudes of hurricane-related public health communications and mortality reports.
- To assess public health communications during and after the hurricane and make recommendations.
- To develop a public information report of the estimated excess mortality assessment findings.

These objectives will be accomplished through a combination of quantitative and qualitative methods to assess hurricane related mortality. Based on the results of the current study, a subsequent phase will be proposed consisting of an in-depth evaluation of the mortality data to estimate direct and indirect mortality attributable to the hurricanes from September 20, 2017 – February 28, 2018.

This preliminary report provides an update on the activities for the project, from its launching to date. It is a narrative of performance more than products. Most of the sections describe processes that have been implemented. These processes will lead towards results that are yet to be obtained. The report is divided into four sections. The first is a narrative of the development of the Project. The second and third sections describe the progress on the two components of the project, the estimation of excess mortality and public health and mortality communication assessment. The fourth section of the report describes perspectives and next steps leading to the completion of the project.

Unlike more conventional research projects, this one was undertaken as a rapid response to a public health and social crisis. Therefore, the institutional, methodological and organizational activities were proposed, and the researchers were assembled immediately, without previous arrangements. The project start-up has required intense contact with diverse actors.

Establishment of the Project

In order to make progress on the project, the research team at Milken Institute SPH has developed collaborations with governmental institutions, the University of Puerto Rico (UPR), and other public and private institutions and individual experts within and outside Puerto Rico.

Within GW, a multi-disciplinary team was quickly assembled, consisting of a biostatistician, epidemiologists, a demographer, a policy analyst, an anthropologist, behavioral scientists and health promotion and communication experts. Humanitarian and medical emergency experts provided technical advice. Due to the level of data confidentiality agreed upon for the project, as a first step, a secure environment was established for storage and analysis of the data. Institutional review board (IRB) approval was obtained for the activities of the project requiring such oversight. An expert review panel is currently being established. While the contractual and data use agreements between GW and the Government of Puerto Rico were still in process, the Milken Institute SPH supported the project administratively and financially.

Collaborations and Inter-Institutional Agreements with the Government of Puerto Rico

The research team has had the full technical and administrative support of several governmental institutions in Puerto Rico. A series of intense exchanges took place during the planning period, as the study team sought to fully understand the work of these agencies as well as how the hurricane affected their operations. Such institutions include: The Department of Health (particularly the Demographic Registry and the Office of Public Health Preparedness & Response) the Forensic Sciences Bureau (FSB), the Puerto Rico Planning Board, the Puerto Rico Police, the Puerto Rico Department of Public Safety, and the Governor's Office of Communications.

Several meetings took place prior to the beginning of the study with the Demographic Registry to discuss the study protocol, data formats and the time period for the data requested. Technical personnel provided background on the changes in the death certificate data collected over the years and have made themselves available for technical meetings about the structure and limitations of the data.

Discussions with the Forensic Sciences Bureau personnel detailed their role in the crisis, the kinds of data they receive and the structure of the data.

The Puerto Rico Planning Board provided information and methodological suggestions regarding population changes and migration in our analysis.

Both a Data Use Agreement and a Data Management Plan were developed for the Demographic Registry at the Puerto Rico Department of Health to enable the project team to obtain the scanned death certificates from September 1 through December 31, 2017 and gain access to the electronic mortality database for September 1, 2017 – February 28, 2018. In addition, past Puerto Rico Vital Statistics System

mortality data were provided for the period of September 1, 1997 – August 31, 2017. The Data Management Plan describes how the data will be stored, managed and accessed to ensure the safe use of these data. A second data use agreement has been put in place with the Forensic Sciences Bureau to facilitate our access to their case data from September 1, 2017 – February 28, 2018 and past data from 2008 through 2017 for the sake of comparison.

In addition to the agreements on confidentiality and data use with the Department of Health and with the Forensic Sciences Bureau finalized in May, the contract between Milken Institute SPH and the Government of Puerto Rico has been signed by GW and has been executed by Puerto Rico

Collaboration with Academia

The Project research team is complemented by three faculty members from the University of Puerto Rico Graduate School of Public Health (GSPH UPR) who bring needed expertise in statistical analysis, epidemiological design, data processing, and community research methods in Puerto Rico. The project was officially launched with a workshop at GSPH UPR for the GSPH UPR and Milken Institute SPH teams and representatives from the Demographic Registry, the BFS, and the Puerto Rico Planning Board. The purpose of the workshop was to integrate the research team through discussions of the concerns of stakeholders who have faced the problem of mortality in Puerto Rico, and who will support the development of the project. Prior to the workshop, several GSPH UPR students presented their work from a seminar course to the Milken Institute SPH team members, detailing their review of newspaper reports about the burden of the emergency and estimated mortality.

Workshop discussions focused on the perspectives of key actors in the area of mortality registration in terms of experience gained, perceived needs, and concerns and methodological details that needed to be considered. Prior statistical assessments excess mortality after Hurricane María were presented and discussed. Attendees engaged in a methodological review of the mortality, mortality registration and communications components of the project. The workshop also covered organizational aspects of the project including the development of a Memorandum of Understanding (MOU) between the GSPH UPR and Milken Institute SPH. This MOU, which has been signed, serves as an agreement on both academic and research collaboration between the two institutions.

As research collaborators, the GSPH UPR requested an IRB Authorization Agreement between their school and Milken Institute SPH. This agreement ensures that both institutions are compliant with the human subject protection requirements of both institutions, with the oversight of the IRB of Milken Institute SPH at GW.

To date, GSPH UPR faculty members have been in close collaboration with investigators of Milken Institute SPH. They have made and continue to provide important key methodological contributions to

guide study activities. They will continue working with Milken Institute SPH investigators to accomplish study objectives.

Establishment of a Data Warehouse

The Milken Institute SPH agreed to establish a data warehouse that would include a secure platform wherein study team members could access, store, process and analyze data. Upon project completion, Milken Institute SPH also agreed to make available through a secure platform data and analytic coding programs used in the proposed mortality analysis for interested members of the public and scientific community. All collaborators will have different levels of access to this platform, in keeping with their roles in the project. The levels of access are determined by the Data Warehouse Manager in coordination with the Project Coordinator and the principal investigator (PI).

Collaboration with Other Institutions and Experts Within and Outside of Puerto Rico

The team at Milken Institute SPH has worked with six technical advisors in the areas of mortality modeling, qualitative data collection and analysis, risk communication, media and public affairs, and graphic design.

The research team has also reached out for other technical expertise and met with the Puerto Rico Institute of Statistics, statistical experts with knowledge and experience related to a wide range of statistical data about Puerto Rico. A few meetings were held with them to discuss methodology for the estimation of excess all-cause mortality. They have provided advice and data on air passenger mobility, migration, and particularly, with respect to the demographic changes Puerto Rico has been experiencing. At the University of Puerto Rico, the team will be building interactions with different units for technical advice from the School of Communications, the School of Medicine — Pathology, and the GSPH Biostatistics and Epidemiology Department. Although the team received multiple inquiries about collaboration with the project, it was not possible to accommodate all requests. The research team has met with personnel from CDC's National Center for Environmental Health (NCEH), in particularly their Emergency Response division and the Mortality Branch of the CDC National Center for Health Statistics to discuss death certification in disasters and related issues.

The team at Milken Institute SPH is currently working on putting together a small panel of expert reviewers in different areas, including methods on verbal autopsies, crisis risk communication, mortality modeling, death attribution to natural disasters (medical disaster), and demographics to review our research activities and provide feedback. This expert panel will also inform activities for Phase 2 of the project.

Collaboration with Communities and Community-Based Agencies in Puerto Rico

As part of the communication assessment process, research team members have begun to establish relationships with community leaders and community-based agencies. These relationships will be leveraged to gain stakeholder feedback on communication materials and methods, as well as for the dissemination of study results. Specifically, relations have been established with community-based organizations and civic groups such as Enlace in San Juan; Casa Pueblo in Adjuntas; and Comité Pro-Desarrollo Villa Canona and Taller Salud in Loiza. Also, relationships have been made with local community leaders in the municipalities of Loiza, Humacao, Coamo, Adjuntas, Camuy, Morovis, and San Juan.

(A complete list of all institutions that have collaborated with our research team thus far can be found in Annex 1.)

Developing the Mortality Dataset and Analyses

This effort has several components, described below. Additionally an expert panel will be assembled to review and provide feedback about each of these components.

Estimated Excess All-Cause Mortality Assessment

The main source of data for this assessment is the Puerto Rico Vital Statistics System (PRVSS) registration data from January 1, 2010 – February 28, 2018 and the population census estimates at mid-year. The “expected” (as if the hurricanes had not occurred) monthly mortality from September 1, 2017 – February 28, 2018 (study timeframe) will be estimated, taking into account historical heterogeneity of monthly mortality by age, sex, and region. These estimates will be evaluated relative to actual mortality in this period, allowing for estimation of excess mortality due to the hurricanes with 95% confidence intervals.

Methods

Several potential sources of mortality data have been explored, including the Forensic Sciences Bureau, the Police, hospitals, and funeral homes for adjustments in the mortality estimation. All of them end up concentrated at the PRVSS. The Forensic Sciences Bureau is in the process of completing their investigation of deaths within our study timeframe. These will be included in the final data set. In addition, air passenger information from the Bureau of Transportation Statistics and from the *Instituto de Estadísticas de Puerto Rico* (Puerto Rico Institute of Statistics) and travel survey data from the *Junta de Planificación de Puerto Rico* (Puerto Rico Planning Board) will be considered for the population-at-risk adjustment.

In May the team obtained access to the PRVSS electronic file on death certificates from September 1, 2017 – February 28, 2018. They are currently beginning the harmonization and preparing these data for statistical assessment of the excess mortality. The team received the scanned death certificates from September 1 – December 31, 2017, and are expecting the last two months of scans. Further information from the FSB will be obtained now that the agreement is signed. Publicly available census estimates of population size by health region, sex, age and year/month from 2010 to 2017; these will serve as the baseline populations at risk for estimation of rates. The research team is preparing code in Stata and R software to estimate the overall mortality using Poisson regression models with generalized additive modeling (GAM) approach using these data. This type of approach provides a general framework for extending linear models by allowing a non-linear function for each predictor to be included (James et al. 2013). In

addition, general additive models with an auto-regressive (GAMAR) component will be explored, an approach similar to that used previously to estimate excess mortality (Yang *et al.* 2012).

Expected Outputs

In addition to the model-based estimates of excess all-cause mortality after the hurricanes described above, the team will also replicate prior published estimates in order to provide a way for the public to assess relative differences between them and those produced by the current project (Sosa Pascual 2017, Robles *et al.* 2017, Santos-Lozada 2017, Sutter 2017, Rivera & Rolke 2018). Results from this assessment will be compiled into a report summarizing excess all-cause mortality following Hurricanes Irma and María using different estimation techniques and adjustments for the population at risk during the period.

Assessment of the Implementation of the Procedures for Mortality Registration in the Aftermath of a Hurricane

The project seeks to assess the performance of the death certification process. This evaluation includes a review of the implementation of the CDC's process and procedures for determining hurricane-related deaths in Puerto Rico (CDC 2017; CDC 2018). The study involves a thorough review of the death certification process, using as a basis the CDC evaluation protocol: *Updated Guidelines for Evaluating Public Health Surveillance Systems* (CDC 2001). The guidelines call for identifying and interviewing stakeholders who participate in the certification and registration of deaths in Puerto Rico. Additional stakeholders include key technical and administrative personnel associated with the process and procedures carried out by these sources. Still, this section has required the development of additional steps.

Methods

In compliance with the CDC evaluation guidelines (CDC 2001), a list of potential stakeholders and individuals involved with death recording and registration was developed. Stakeholders were added as they emerged during our review process. Interviews were carried out in San Juan and in several municipalities around the island. The municipalities were selected to cover, as best possible, potential variability in terms of the impact of the hurricane. An interview guide was developed by the research team, tested for feasibility, and corrected before going into the field. Interview guides were developed and tailored to each stakeholder group. All research protocols were reviewed and approved by the appropriate IRBs to ensure that they were in compliance with human subjects research regulations.

Although interview guides were tailored to different stakeholder groups, all included questions on the following:

The death certification and registration process and their role in it on a regular basis;

-
- How changes in the death certification process are communicated and implemented under normal conditions;
 - How mortality registration procedures changed after Hurricane María; and
 - Whether the stakeholders received any guidance on filling out or handling death certificates after the hurricane.

Interviews were carried out within a two-week period in April 2018, in Puerto Rico. In total, 26 stakeholders from the following categories were interviewed: funeral home directors, demographic registry staff members, pathologists, and physicians working at different levels of the medical system (i.e. hospital directors, doctors). After obtaining informed consent, all interviews were audio recorded and are currently being transcribed. Transcriptions from these interviews will be analyzed and key findings will be summarized. The findings from this study will also inform data analysis in the second part of this assessment.

In addition to the stakeholder interviews, literature reviews are being performed of the literature on death certification procedures, mortality and morbidity from disasters, identification of direct and indirect deaths from hurricanes and other disasters.

Expected Outputs

Results from this assessment are being compiled into a report summarizing the death certification and registration process and how its implementation was affected by Hurricane María. In addition, a set of preliminary recommendations will be developed based on findings from a review of the literature and stakeholder interviews.

Assessment of the Quality of the Death Certificates

The end-product of the death certification process will be assessed for quality (Hernandez 2011), as this might have been affected by the aftermath of the hurricane. The direct assessment will be done by a set of independent expert coders and recommendations will be produced. There will be two processes: the analysis of the frequency of ill-defined causes of death and the so called garbage codes; the second process will be the generation of an index of information quality for the death certificates.

Methods

After obtaining the death certificates in a database, they will be assessed in three domains:

- The definition of basic cause of death;
- The frequency of ill-defined causes; and

-
- The global index of quality including coverage, timeliness, integrity, validity, accuracy and internal consistency.

Expected Outputs

A tabulated report on the quality of the death certificates will be produced and recommendations will be provided for the further assessment of coding quality, based on the actual death certificate.

Design Methods for a Future In-Depth Analysis of Cause-Specific Mortality Attributable to the Hurricane

This initial stage will provide access to and organization of the data, understanding of the internal processes, as well as a first estimation of the excess mortality and of the quality of certification. Still, there is the need to further explain the deaths that might be attributable to the hurricane. We therefore propose the development of a second phase of this project that will (a) expand the statistical modeling, (b) complete the analysis of quality of death coding and certification, (c) develop an algorithm for attribution of mortality to the disaster, and (d) conduct an in-depth exploration of the mechanisms of mortality. This part of the project would also seek to strengthen public health communication capacity on the Island. Without this component, the study will not provide enough input for adequate public health action.

Methods

The research team has started to adapt an algorithm that will take into account the context and circumstances of all deaths during the study period. A systematic literature review is under way in order to build the foundation for the algorithm. Based on the interviews that were conducted, the literature review (Malilay 2014), and the technical advice that would have been received, the team will establish and conduct a preliminary test of a first algorithm for death attribution that will assign the excess deaths to one of three categories: directly related to the hurricane, indirectly related injuries, and indirectly related diseases. A literature review is also being conducted on verbal autopsies (Serina 2015) and their implementation for conditions similar to the crisis that happened in Puerto Rico. With this review and with the support of the technical reviewers, an approach for verbal autopsies will be devised, and tested for possible implementation.

Expected Output

This component will generate a Phase 2 proposal, related to the cause specific mortality attributable to Hurricanes Irma and María, which will serve to justify the support for an in-depth study.

Initiating the Assessment of the Communication Process

Assessment of Stakeholder Perceptions of Public Health Communication and Mortality Reports, and Development of a Project Results Communications Plan

One of the key aims for this component includes an assessment of stakeholder perceptions regarding public health communications and mortality reports received prior to and following the hurricane. These perspectives contribute to the assessment of the communication process, and also inform the research team's communication plan for disseminating study results. This component was developed in order to gain a deeper understanding of community experiences related to the hurricane, to ascertain perceptions of how mortality reporting was received by different stakeholders, and to identify factors that should be considered for future public health communications.

Methods

Identifying a stakeholder interview sample and developing interview protocols. In order to represent potential variability in responses, municipalities were identified for stakeholder interviews based on the following criteria: geographical distribution and regional representation, socioeconomic status, political affiliation, demographics, and proximity to hospitals/clinics. For recruitment of stakeholder interview participants, community leaders, local non-profit agencies, and service providers were contacted. Additional interview participants were identified using snowball sampling methods. Interviews were carried out at local municipalities throughout Puerto Rico within an 11-day period in April 2018. A total of 21 interviews were conducted by two bilingual researchers in the following stakeholder categories: municipal mayors, community leaders, emergency management staff, police, faith leaders, health care providers, non-profit organization staff, and funeral directors. A semi-structured interview protocol was developed, tested and translated to Spanish. The interview protocol guided data collection in the following domains: experiences related to Hurricane María; hurricane-related emigration; perceptions of mortality reporting and reassessment; information received related to public health and mortality; recommendations for future communications; and identification of target audiences, channels and community leaders for information dissemination (See Figure 1 below).

Development of a communications plan. Based on the results of stakeholder interviews, a communications plan will be developed for the dissemination of study findings. This will entail the development of key messages and materials to communicate those messages, as well as the identification of target audiences, channels, and outreach collaborators and strategies for information dissemination.

Infographic materials. Two sets of draft infographics have been conceptualized by the team and developed by a graphic designer to communicate study methods and results. These infographics were pilot tested with community stakeholder interview respondents, and are being revised accordingly. Further review by study collaborators and partners, as well as experts in the area of public health communication, will be sought prior to finalization. The methods infographic and the results infographic will be used to support the final report and related public dissemination and press activities. The infographics are designed to convey study-related information to a general public audience.

Figure 1. Overview of Stakeholder Perceptions and Communications Assessment

Data Source	Methods	Outputs
<p>Primary Data Collection Stakeholder Interviews</p>	<p>Stakeholder Interviews N=21: April 2018 Qualitative Coding and Analysis Thematic Summary</p>	<p>Summary Report of Stakeholder Perceptions of Mortality Reporting</p>
<p>Primary Data Collection Stakeholder Interviews</p>	<p>Communications Personnel Interviews N=10: April–May 2018 Qualitative Coding and Analysis Thematic Summary</p>	<p>Communications Plan for Mortality Assessment Report</p> <p>Infographics for Methods and Results</p>
<p>Primary Data Collection Communication Personnel Interviews</p> <p>Secondary Data Review</p> <ul style="list-style-type: none"> • Press Releases • Press Conferences and Facebook Live Events • Media Coverage 	<ul style="list-style-type: none"> • Press Release • Press Conference • Media Coverage Assessment <p>September 20, 2017–February 28, 2018</p> <p>Review with WHO and CDC CERC Criteria</p> <p>Media Content Analysis</p>	<p>Summary Report of Communication Process and Media Coverage</p> <p>Assessment with Recommendations</p>

Assessment of Public Health and Mortality Communications and Media Coverage

The communication component includes an assessment of the communication process from the perspective of individuals involved in the preparation and dissemination of public health and mortality information to the public, as well as from the perspective of institutional structure, processes and inter-agency collaboration. Examination of the communication process may identify barriers or issues that affected communications during Hurricane María, and will support the development of recommendations regarding communication processes and procedures for future disaster situations. Instruments and methods for this component were guided by established guidelines, including those detailed in the World Health Organization's (WHO) *Effective Media Communication During Public Health Emergencies* handbook (2005) and the CDC's *Crisis Emergency Risk Communication (CERC)* manual (2014).

Assessment of the communication process also includes a review of press releases, press conferences, and Facebook live activities, as well as media coverage surrounding those public information events and activities where hurricane-related mortality was discussed. This study component elucidates the sequence of events, content of those communications, and media and public reaction to those public events, with the intention of making recommendations for the communication process in the case of future disasters.

Methods

Identifying a communications personnel sample and developing interview protocols. Respondents for communication personnel interviews were identified based on their role in developing, approving, and/or disseminating public health or mortality information to the public. Interviews were carried out in San Juan, Puerto Rico within an 11-day period in April 2018, and additional interviews in Washington, DC are pending for May 2018. A total of 10 interviews were conducted by two bilingual researchers with personnel from the Government of Puerto Rico, and 4 interviews are planned, including with individuals from the Federal Emergency Management Agency (FEMA), the U.S. Department of Health and Human Services (HHS), and the Governor of Puerto Rico Office of Communications. A semi-structured interview protocol was developed, tested and translated to Spanish. The interview protocol guided data collection in the following domains: agency's role and functions in public health communication and/or mortality reporting, including under emergency circumstances; communication plans or other processes for the preparation, approval and dissemination of information to the public; target audiences for communication; inter-agency collaboration; experiences related to Hurricane María with regards to communication; and recommendations for future communications.

Press conference and media content analysis. The official press releases disseminated by the Governor's office, press conferences, and Facebook live events were reviewed for the period of September 20,

2017 – February 28, 2018. Additionally, all relevant media coverage pertaining to the topic of mortality reporting from major online news outlets in English and Spanish were collected and reviewed for the same time period. Press releases, press conferences/Facebook live events, and media coverage are being evaluated using criteria from the WHO *Effective Media Communication During Public Health Emergencies* (2005) handbook and the CDC *CERC* manual (2014). Both the content and delivery of the press conferences and Facebook live events are being examined in the following domains: expression of empathy; clarifying facts/call for action; what is not known; process to obtain answers; statements of commitment; and referrals to more information/scheduled updates. Each domain has specific evaluation criteria which determine the extent to which trust, credibility, transparency, and accountability were established through the delivery of information to the press.

Furthermore, as part of a series of seminars, a group of six GSPH UPR students enrolled in the Master of Science Program in Epidemiology Program also collected and reviewed all online news articles published in Puerto Rico and abroad between September 20, 2017 and February 28, 2018. The news articles were classified into five time periods on the basis of changes in official statistics related to the number of hurricane-related deaths. These news articles were reviewed in order to identify common words, themes, and groups of themes. A preliminary codebook was designed and later used for analysis using ATLAS.ti, a software for qualitative data analysis. Pending work includes the content analysis that will be conducted with the experts from GW.

Conducting the interviews and data analysis. After obtaining informed consent, all stakeholder and communication personnel interviews were conducted in Spanish in a private setting, were approximately one hour in duration, and were audio recorded and transcribed. Codebooks for stakeholder and communication interviews have been developed, and transcriptions are complete. The transcripts are currently being coded and analyzed for key themes related to research questions, using NVivo Version 11 software (QSR International).

In a collaboration between the GSPH UPR students and faculty and GWU team, the findings from the communications assessment will be reviewed; content analysis will be guided by WHO and CDC guidelines as well as the content analysis guided by both the chronological and thematic analytical strategies. The findings from both strategies will be integrated for the creation of a summary report that will include recommendations for future disaster-related media activities.

Expected Outputs

After analysis of the data, this will be integrated and discussed for inference between the research team and technical advisors. Results related to stakeholder and communication personnel interviews, press activities and media content analysis will be summarized in a report, which will be reviewed by

an external expert review panel. Preliminary recommendations will be discussed and provided regarding future public health and mortality communications in disaster situations. Furthermore, findings will inform the next phase of the study.

Proposed Activities for the Communications Component of Phase 2

The Phase 2 proposal will recommend continuing collaborations with government agencies and community-based partners. Study findings and recommendations, will guide the implementation of selected recommendations and the revision of existing public health communications and media plans for emergencies. There will also be a proposal to support selected government agencies for the review of updated Emergency Plans (available starting May of 2018) and provide recommendations regarding public health and/or mortality communications for those plans.

The next proposal will also include a plan to collaborate on a publication of a collection of case studies of local communities in Puerto Rico that applied effective community-based emergency management, communications, and leadership approaches, which helped to minimize the devastation and potential loss of life in their local communities in the aftermath of Hurricanes María and Irma. Given the circumstances of the hurricane's aftermath, communities were faced with unprecedented challenges. As a result, new local leaders emerged and local solutions to challenges were implemented. This publication will serve to highlight the strength, resilience, and resourcefulness of local communities in Puerto Rico, as well as to identify promising community-based approaches that contribute to effective preparation and response in emergency situations. This publication would contribute to the science and practice of community-based disaster preparation and response, and will provide the Government of Puerto Rico with promising models for local community preparation and response.

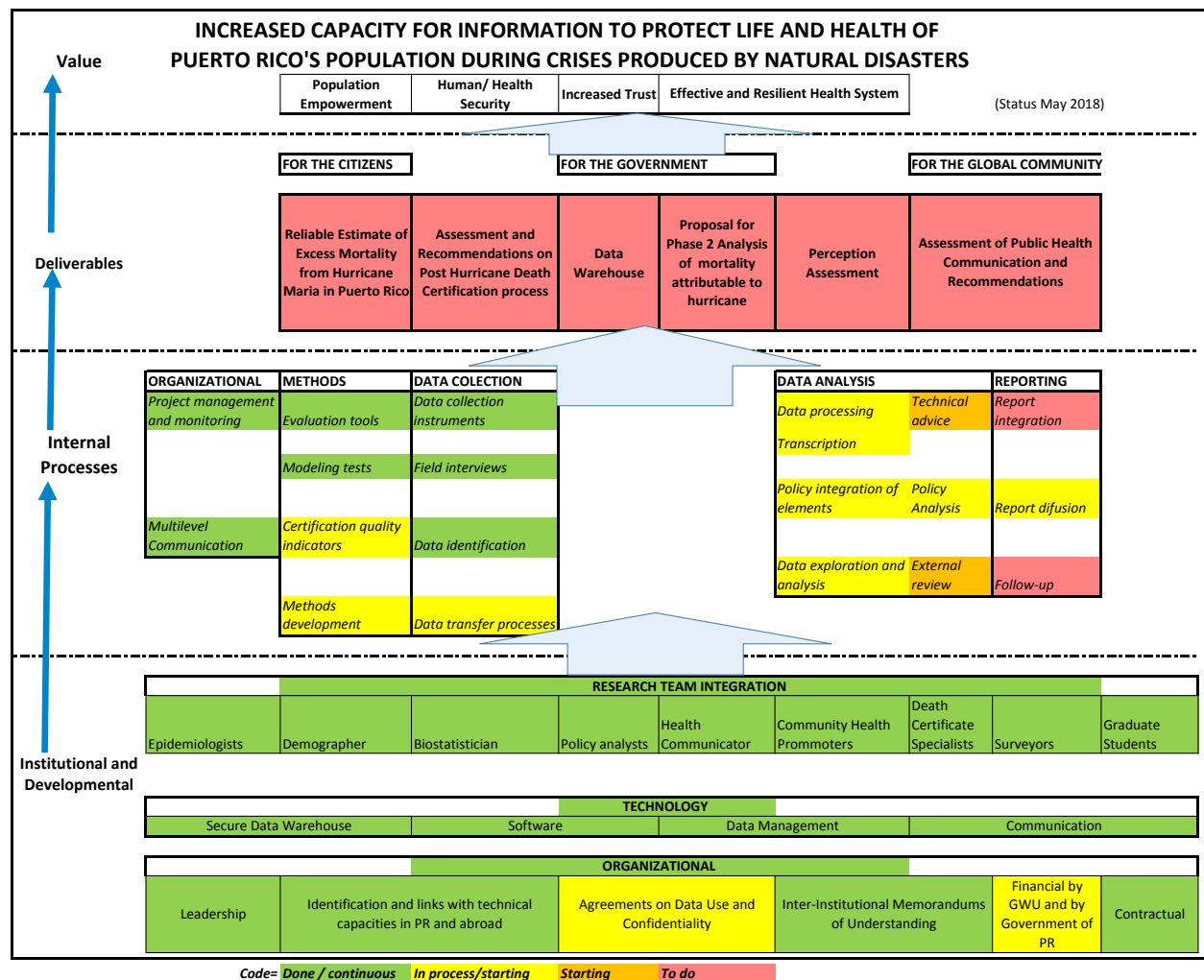
Perspectives and Next Steps

This project was established as an immediate response to a crisis confronted by Puerto Rico. After launching, it required a significant investment in organizational development, including starting up the team, providing a secure data environment, developing institutional agreements. Establishment of these agreements required a special effort by the agencies and institutions involved, considering the urgency to move forward on the project. Thus, the project required far more organizational development than originally anticipated but Milken Institute SPH did not hesitate to support the team to begin each component of the work as soon as relevant approvals were established. The GSPH UPR also helped to advance the collaborative effort. Team members prioritized this project despite their already busy academic agendas in their commitment to support this public health effort. Technical counterparts within governmental agencies went to great lengths in fostering the exchange and preparing the information needed.

The figure below details a project map with an overview of project milestones, as well as current activities. *The map is designed to be read from the bottom up — illustrating the institutional building blocks needed to support and facilitate the processes and operations of the project in order to produce the deliverables and generate the expected societal value from the project.* Achievements are highlighted in green, activities in process are yellow, while activities pending completion are in orange and pink. Some of the main research activities such as: project design; methods and instruments development; and data gathering including interviews and surveys have already been developed. Although it took some time to make the arrangements for accessing government data, agreements are now finalized and secure access to the complete information from death certificates obtained. Access to additional data and information from the Forensic Sciences Bureau is close to being obtained. Given the study timeframe and the fact that the study period includes data up to February 2018, the data processing and integration of the study period data set took longer than anticipated.

Perspectives on next steps relate mainly to processing the data from the death certificates, death certificate quality, as well as the assessments of death certification, and communications and perceptions of mortality. Data processing and documenting such processing is critical to overall project quality and reliability. Following that, the team will proceed to data exploration and analysis, building the statistical models for the mortality excess estimates, and generating the interpretation and inference from the transcribed and analyzed interviews.

Figure 2. Project Map—Ascertainment of the Estimated Excess Mortality from Hurricane María in Puerto Rico



The team will present the intermediate results to external reviewers for their orientation and improvement. As mentioned before the external experts are yet to be assembled.

In the meantime, the work continues on developing the proposal for the in-depth analysis of the cause-specific mortality attributable to the hurricane, including more complex statistical modeling as well as an in-depth survey on death circumstances. Funding to complete this part of the project is actively being sought from different sources and institutional synergies.

The researchers expect to finish this project within the timeframe of the contract. With a specific plan for dissemination, a report will be produced and provided openly to the public, as an independent assessment of the possible excess mortality from Hurricane María in Puerto Rico.

References

1. Centers for Disease Control and Prevention (2001, July 27). Updated Guidelines for Evaluating Public Health Surveillance Systems. Atlanta, Georgia. <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm>
2. Centers for Disease Control and Prevention (2014). Crisis Emergency Risk Communication (CERC) manual. [https://emergency.cdc.gov/cerc/resources/pdf/cerc_2014 edition.pdf](https://emergency.cdc.gov/cerc/resources/pdf/cerc_2014%20edition.pdf)
3. Centers for Disease Control and Prevention, National Health Center for Health Statistics, National Vital Statistics System (2017, October). Vital Statistics Reporting Guidance: A Reference Guide for Certification of Deaths in the Event of a Natural, Human-induced, or Chemical/Radiological Disaster Report No.1., <https://www.cdc.gov/nchs/data/nvss/vsrg/vsrg01.pdf>
4. Centers for Disease Control and Prevention, National Center for Health Statistics (2018). Completion of Death Certificates in the Aftermath of a Hurricane. Downloaded January 2018. https://www.cdc.gov/nchs/data/dvs/hurricane_certification.pdf
5. Hernández B, Ramírez-Villalobos D, Romero M, Gómez S, Atkinson C, Lozano R (2011). Assessing quality of medical death certification: Concordance between gold standard diagnosis and underlying cause of death in selected Mexican hospitals. *Popul Health Metr.* 4;9:38. doi: 10.1186/1478-7954-9-38.
6. James, G, Witten, D, Hastie, T, Tibshirani, R. (2013) *An Introduction of Statistical Learning with Application with R.* Gareth James *et al.* Springer.
7. Malilay J, Heuman M, Perrotta D, Wolkin AF, Schmall AH, Podgornik MN (2014). The Role of Applied Epidemiology Methods in the Disaster Management Cycle *Am J Public Health* 104:2092–2102. doi:10.2105/AJPH.2014.302010
8. Rivera R, Rolke W (2018). Estimating the death toll of Hurricane Maria. *Significance* <https://doi.org/10.1111/j.1740-9713.2018.01102.x>
9. Robles F, Davis K, Fink S, Almkhatar S (2017, December 9). Official Toll in Puerto Rico: 64. Actual Deaths May Be 1,052. *The New York Times*
10. Rocha LA, Fromknecht CQ, Davis Redman S, Brady JE, Hodge SE, Noe RS (2017). Medicolegal death scene investigations after natural disaster- and weather-related events: A review of the literature. *Acad Forensic Pathol* 7(2): 221–239
11. Santos-Losada AR, Howard JT (2017, November). Estimates of excess deaths in Puerto Rico following Hurricane María. *SocArXiv*
12. Serina, P., I. Riley, A. Stewart, A. D. Flaxman, R. Lozano, M. D. Mooney, R. Luning, et al (2015). “A shortened verbal autopsy instrument for use in routine mortality surveillance systems.” *BMC Medicine* 13 (1): 302. doi:10.1186/s12916-015-0528-8.

-
13. Sosa Pascual, O. (2017, November 8). María dispara las muertes en Puerto Rico en un 43%. Centro de Periodismo Investigativo. Retrieved from <http://periodismoinvestigativo.com/2017/11/maria-dispara-las-muertes-en-puerto-rico-enun-43/>
 14. Sutter JD, Puerto Rico orders review of deaths after hurricane. CNN, Dec. 18, 2017
 15. World Health Organization (2005). Effective Media Communication During Public Health Emergencies Handbook. http://www.who.int/csr/resources/publications/WHO_CDS_2005_31/en/
 16. Yang L, Qin G, Zhao N, Wang C, Song G (2012). Using a generalized additive model with autoregressive terms to study the effects of daily temperature on mortality. BMC Medical Research Methodology 12:165

Annex 1

Institutions that have been contacted, and or have contributed with technical advice or support

- Asociación de Salud Primaria de Puerto Rico
- Centers for Disease Control and Prevention, National Center for Environmental Health
- Centers for Disease Control and Prevention, National Center for Health Statistics
- Centro Mexicano para la Clasificación de Enfermedades
- Communications, Department of Public Safety
- Cruz Roja de Puerto Rico, Capítulo de Puerto Rico
- Departamento de Salud, Bioseguridad
- Departamento de Salud, Secretario
- Director de Estadística, Policía, Departamento de Seguridad Pública
- Federal Emergency Management Agency (FEMA)
- Negociado de Ciencias Forenses, Departamento de Seguridad Pública
- Instituto de Estadística de Puerto Rico
- Junta de Planificación
- National Institute of Standards and Technology, Disaster and Failure Studies Program, Engineering Laboratory
- Office of the Press Secretary, Governor of Puerto Rico
- Pan American Health Organization / WHO (Headquarters and Office in PR)
- Puerto Rico Federal Affairs Administration
- RCHN Community Health Foundation
- Registro Demográfico, Departamento de Salud
- Resilient Puerto Rico Advisory Commission (Reimagina Puerto Rico)
- Sistema de Vigilancia de Muertes Violentas de Puerto Rico
- University of Puerto Rico, Graduate School of Public Health

Milken Institute School of Public Health

THE GEORGE WASHINGTON UNIVERSITY

950 New Hampshire Ave, N.W.
Washington, D.C. 20052
(202) 994