NCST Technical Investigation of Hurricane Maria (Puerto Rico)

Characterization of Morbidity and Mortality

Project Leader: Judith Mitrani-Reiser, PhD, NIST
Project Team: Thomas D. Kirsch, MD, MPH
Director and Professor, National Center for Disaster Medicine and Public Health, Uniformed Services University

Objective: To complete a quantitative morbidity and mortality assessment of Puerto Rico, to better understand how damaged buildings and supporting infrastructure played a role in the injuries and deaths associated with Hurricane Maria. The study results will provide guidance to improve codes, standards and inform future approaches to accurately attribute and predict life loss due to building failure(s) caused by windstorms.

Updates on Mortality Contract

- **Contract Award:** Contract awarded to the George Washington University Milken Institute School of Public Health on **July 27, 2020**; subawards to University of Puerto Rico-Graduate School of Public Health and independent external consultants.

George Washington University:

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Valerie Donohue
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Lead Verbal Autopsy, IHME, University of Washington

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SmartVA, IHME, University of Washington

Aurelio Castro, MS
Geographic Mapping Technologies, Corp., San Juan, PR:

GIS and Remote Sensing

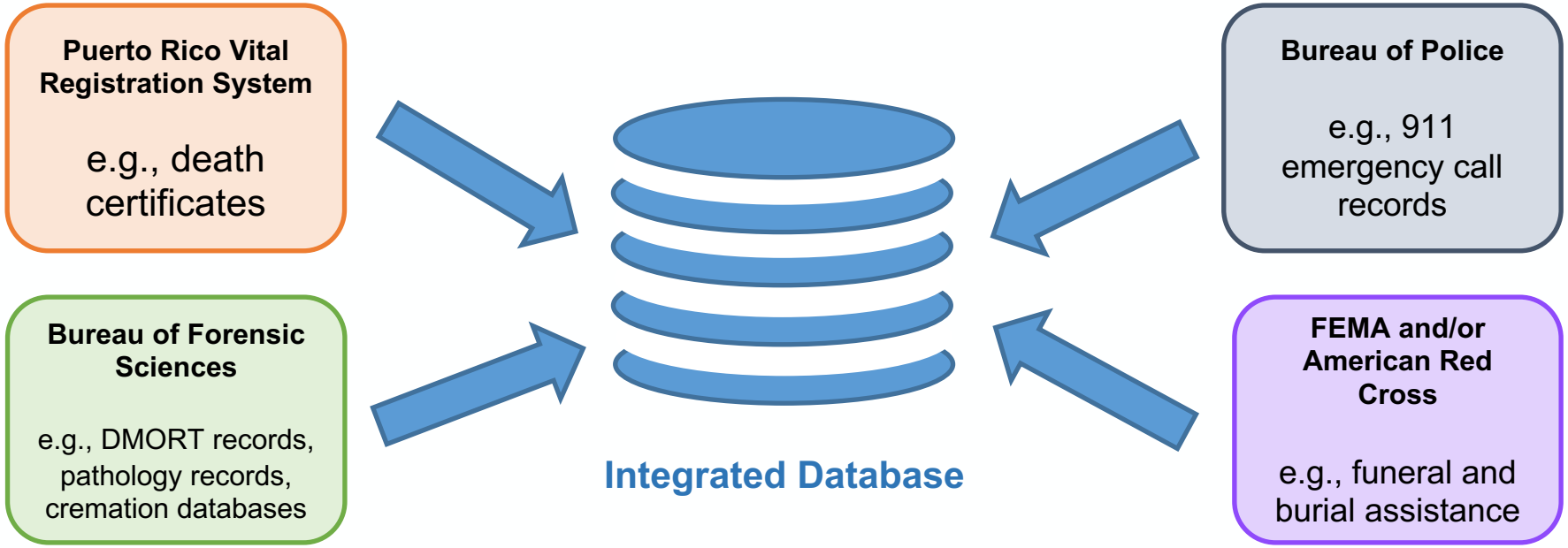
Updates on Mortality Contract

- **Contract Award:** Contract awarded to the George Washington University on **July 27, 2020**; subawards to University of Puerto Rico-Graduate School of Public Health and the Institute for Health Metrics and Evaluation at the University of Washington.
- **Kick-Off Meeting:** Held on **Aug 6-7**; thank you to NIST colleagues for attending, presenting, and contributing so thoughtfully throughout!
- **Work Plan:** Draft plan submitted to NIST on **Aug 27**; some updates since kick-off meeting include plans to address COVID-19; expansion of database to cover entire island; clear descriptions of what part of the data will and will not be delivered in Spanish and English; strategy for including next-of-kin and key informants outside the island as well; training and emotional support for interviewers; and secondary data requests to NIST.
- **Input on Work Plan:** NIST provided feedback on **Sept 11**; plan finalized on **Sept 23**.
- **Monthly Meetings:** Project meetings will be held **4th Wed of each month**.

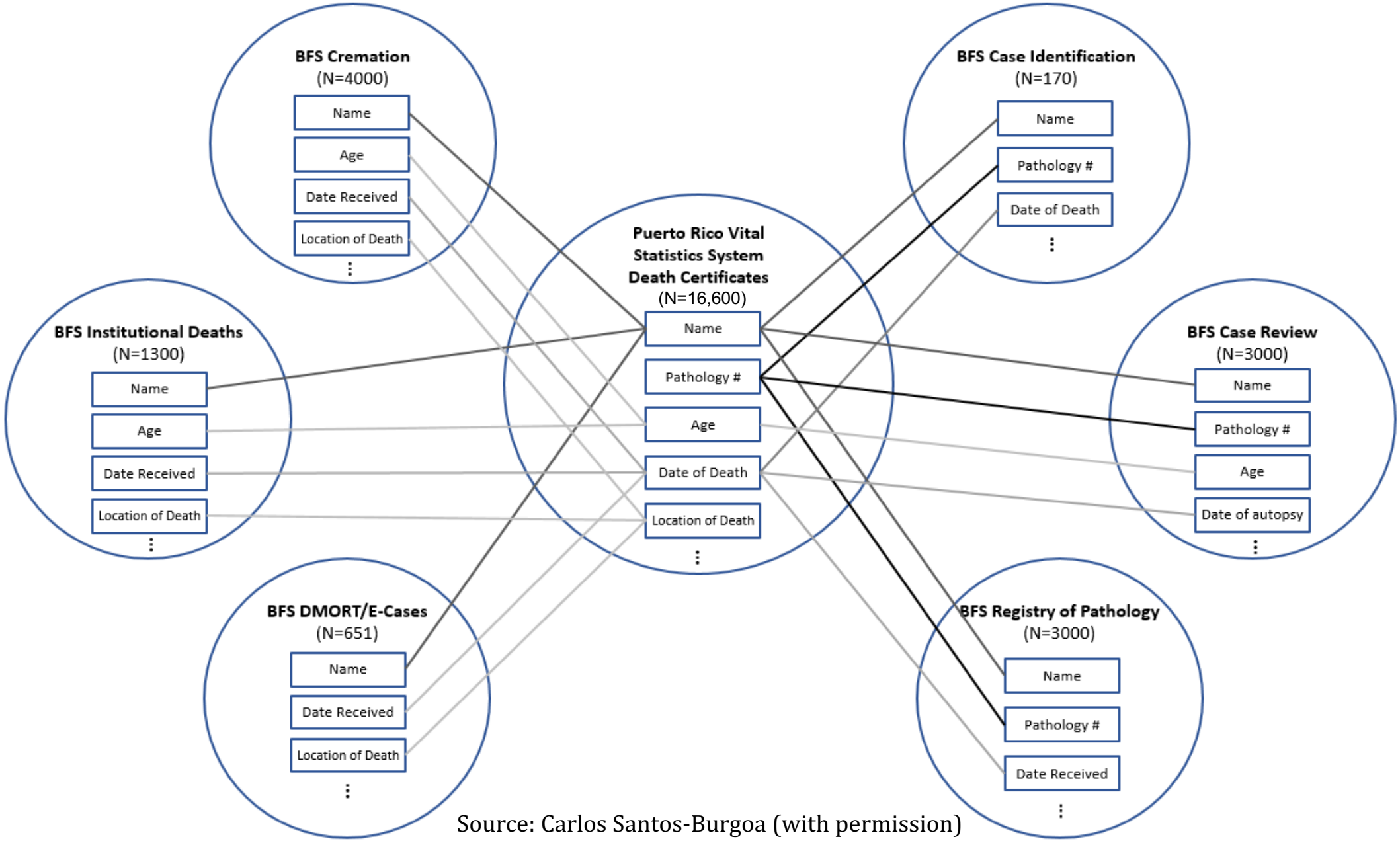
Project Plans: Integrated Database

Develop Integrated Database of Deaths in Puerto Rico

- Collect and merge geocoded data on the deaths occurring up to six months after Hurricane Maria made landfall in Puerto Rico.
- Data sources include the Puerto Rico Vital Registration System with available datasets from the Bureau of Forensic Sciences, including DMORT E-Cases records, pathology registry records, case identification, case review, and cremation and institutional death databases.
- Additional data to consider are 911 emergency calls obtained from the Bureau of Police, and funeral and burial assistance data from FEMA and the American Red Cross.



Project Plans: Integrated Database



Source: Carlos Santos-Burgoa (with permission)

Project Plans: Spatial & Temporal Analysis

Spatial and Temporal Clustering of Deaths

- Analyze the integrated database to calculate cause-specific mortality rates adjusted for age and gender and compare these to the prior years.
- Examine each broad cause of death (i.e. ICD-10 codes) and specific causes of death typically attributed to hurricanes (e.g., drowning, death from a fallen object, etc.) and compare them to previous years. Identify significant increases in death rates from particular causes between the period after the storm and years prior; flag all deaths from those causes in the first two weeks after the storm.
- Identify spatial and temporal clusters of deaths occurring up to six months after the storm (entire island), ***with a separate analysis for the first 14 days after the event (4 study regions).***

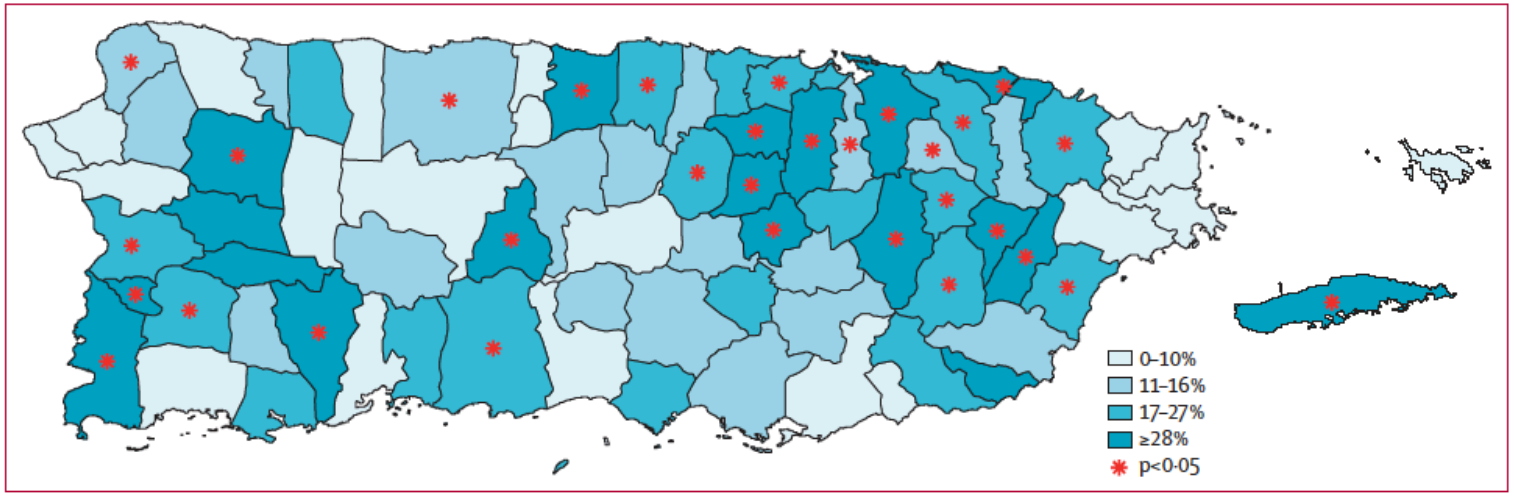


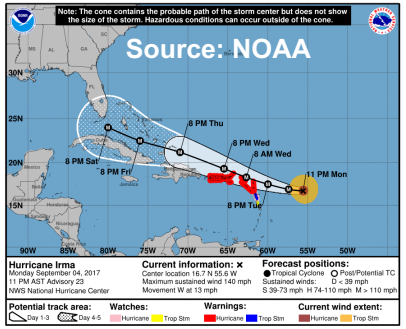
Figure 3: **Percentage increase in crude mortality by municipality in Puerto Rico**
Estimated increase in crude mortality from September, 2017, to February, 2018, relative to mean mortality in the same period in 2015–16 and 2016–17 under the displacement scenario.

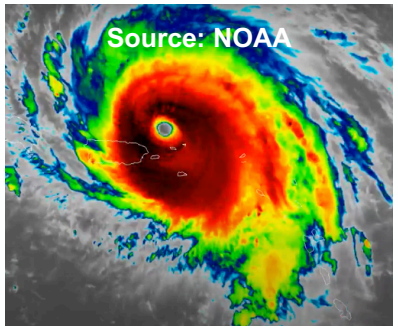
Source: Santos-Burgoa et al., 2018 (with permission)

Project Plans: Spatial & Temporal Analysis

Sept 4, 2017
Hurricane Watch + Warning Issued (NOAA-NHC)

Sept 5- Sept 7, 2017
Incident Period for Hurricane Irma (FEMA)





HURRICANE IRMA

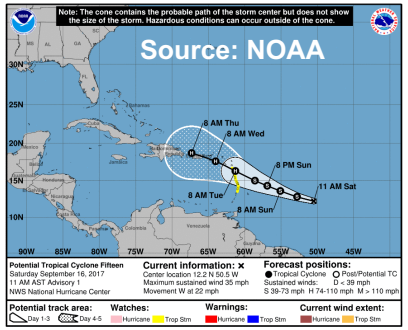
HURRICANE MARIA

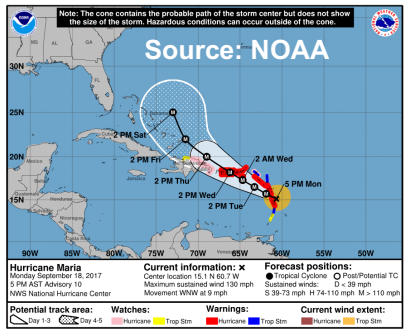
Sept 16, 2017
Potential Tropical Cyclone 15 (NOAA-NHC)

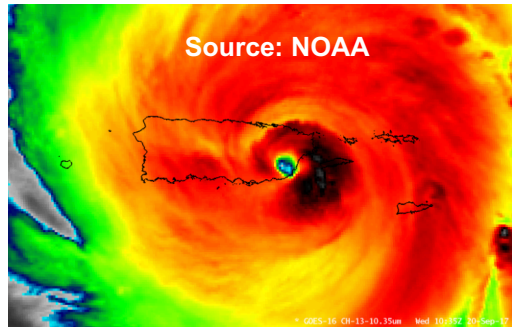
Sept 18, 2017
Hurricane Watch + Warning Issued (NOAA-NHC)

Sept 20, 2017
Hurricane Maria Landfall in PR + Disaster Declaration (NOAA-NHC FEMA)

Sept 17- Nov 15, 2017
Incident Period for Hurricane Maria (FEMA)







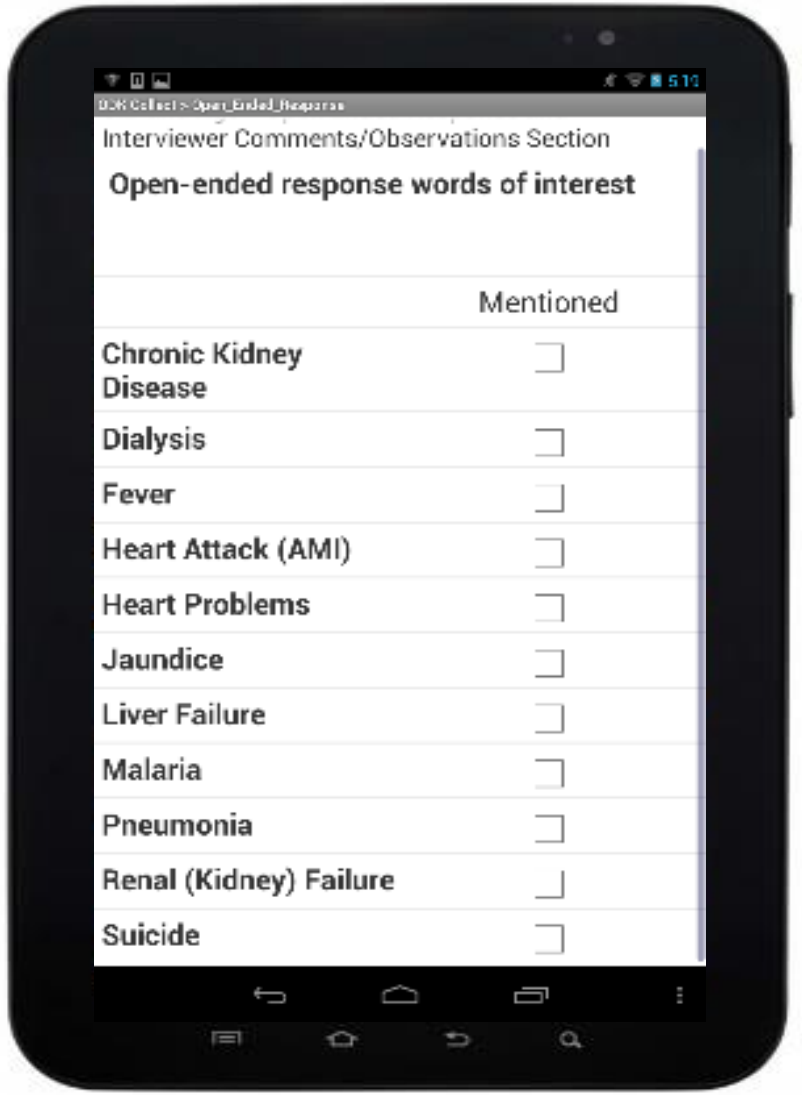
Source: Pablo A. Méndez Lázaro (with permission)

Sept 4, 2017 (16 days time period) Sept 20, 2017

Project Plans: Verbal Autopsy (VA) + Social Environmental (S'E)

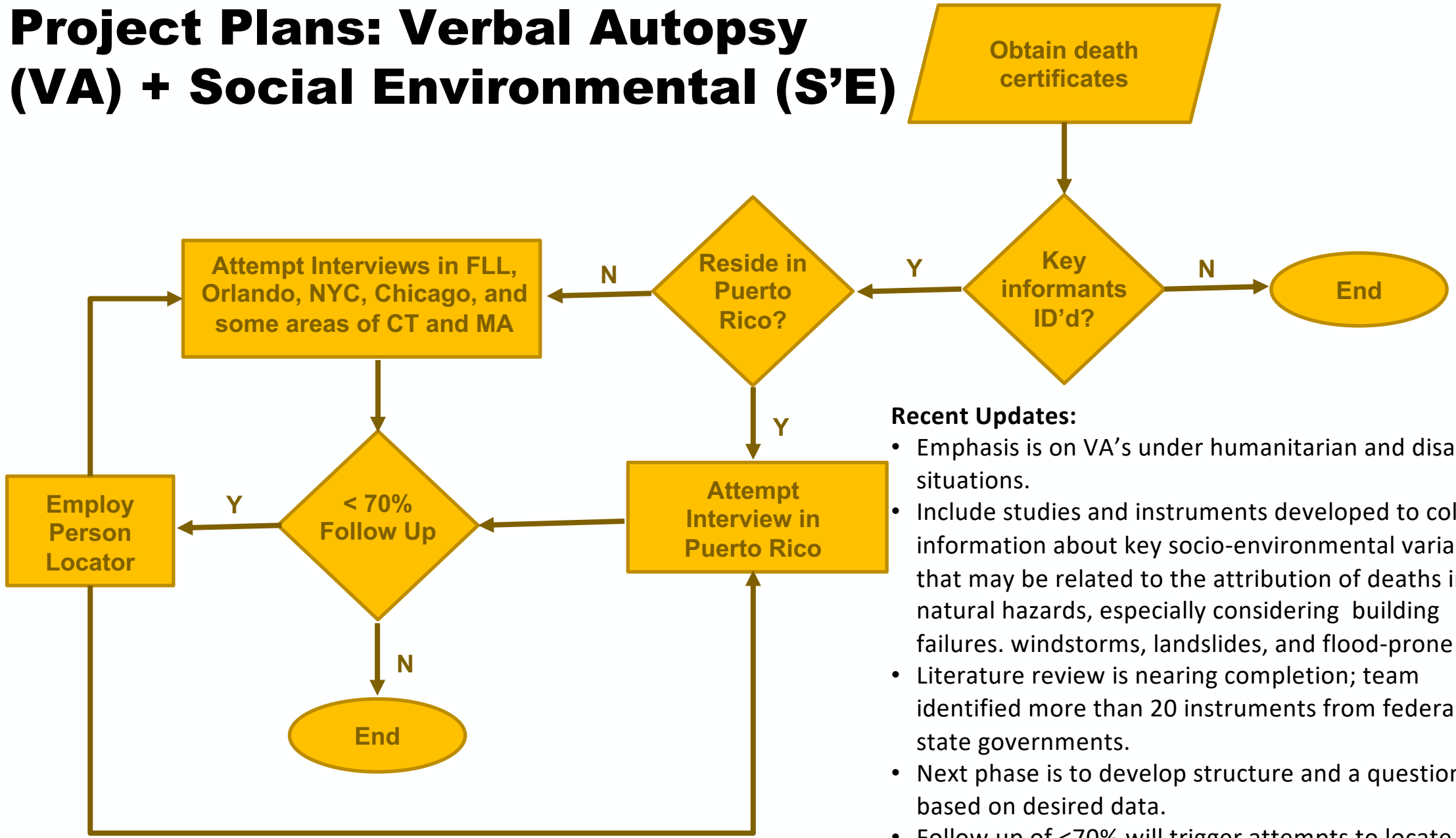
Foundation for survey with Next of Kin and Key Informants

- SmartVA is an application developed by Institute for Health Metrics and Evaluation (IHME), University of Washington).
- SmartVA includes a VA questionnaire, and a module of analysis to ascertain of cause of death.
- Spanish verbal autopsy instruments are also available.
- SmartVA-Analyze uses the Tariff method to ascertain cause of death from a list of 34 causes for adults, 21 for children and 6 for newborns, excluding stillbirths.
- SmartVA-Analyze uses the Tariff method to provide most likely underlying cause of death, and the next two or three most likely ones.
- Suggested mode is face-to-face but exploring other options due to COVID-19.
- This VA+ S'E will mark the beginning of the development of disaster centric verbal autopsy.



Source: Bernardo Hernández Prado (with permission)

Project Plans: Verbal Autopsy (VA) + Social Environmental (S'E)

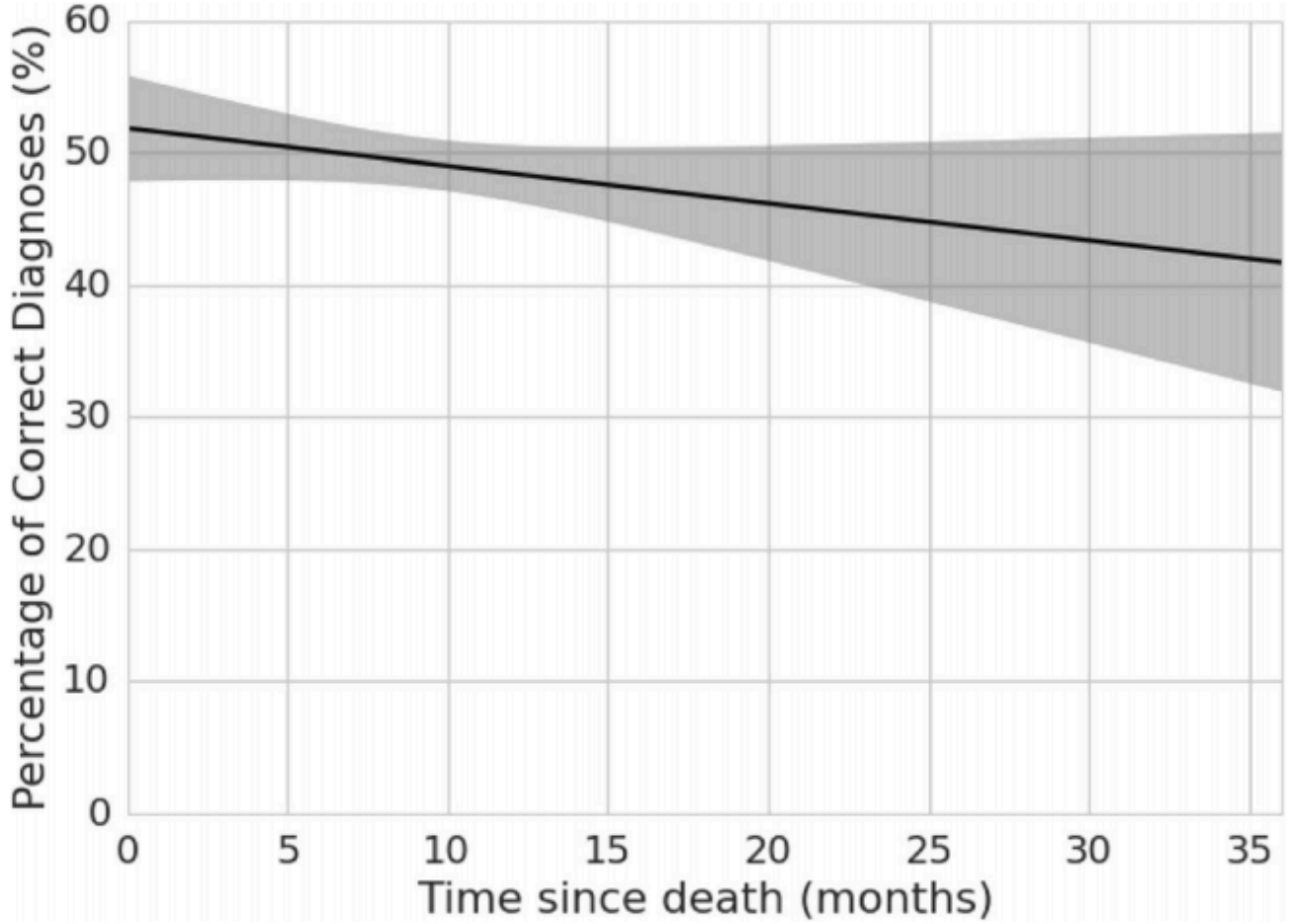


Recent Updates:

- Emphasis is on VA's under humanitarian and disaster situations.
- Include studies and instruments developed to collect information about key socio-environmental variables that may be related to the attribution of deaths in natural hazards, especially considering building failures. windstorms, landslides, and flood-prone areas.
- Literature review is nearing completion; team identified more than 20 instruments from federal and state governments.
- Next phase is to develop structure and a question bank based on desired data.
- Follow up of <70% will trigger attempts to locate informants off island.

Project Plans: Verbal Autopsy (VA) + Social Environmental (S'E)

"What is the optimal recall period for verbal autopsies? Validation study based on repeat interviews in three populations"
(*Population Health Metrics* 14:40)



from Serina et al., 2016 (with permission)

Key Points from Recall Bias Study

- Study dataset included 2113 deaths interviewed twice and with recall periods ranging from 0 to 52 months.
- Probability of a correct diagnosis in VAs collected 3-11 months after death will, on average, be 95.9 % of that in VAs collected within 3 months of death.
- Probability of a correct diagnosis of cause of death decreased by 0.55 % per month in the period after death.

Key Next Steps: Contract Dashboard

NVST AC Meeting, October 23, 2020

Forms — Maria Tasks Sheet

RYG	Contract Date	Client Requested Date	Deliverable	Deliverable Format (if applicable)	Unanticipated Task	Flagged	Flagged Comments	Task	Status	Primary Responsible Org	Co-Responsible	Start Date	Due Date	Predecessors
								Hurricane Maria Analysis				07/27/20	01/09/22	
								Pre-Work				07/27/20	07/27/20	
							At-risk reason:	Kick-off Meeting: GW and NIST teams intro, discussion of procedures and plan	50% Complete	GW Team		07/27/20	07/27/20	
								Project Work Plan	Not Started	GW Team				
	11/04/20							**Integrated Secondary Database**				08/02/20	03/11/21	
								Datasets exploration and integration				08/02/20	08/27/20	
								Datasets extraction key variables	75% Complete	GH		08/02/20	08/23/20	
								Datasets transfer DB Manager	50% Complete	GH	BSC	08/16/20	08/27/20	
								Database Integration - PRVSS and BFS Datasets				08/23/20	09/23/20	
								Databases interfase / query	25% Complete	BSC		08/23/20	09/08/20	
								Databases cleaning and verification	25% Complete	BSC		09/06/20	09/22/20	
								Documentation of decisions						
								Database Integration - acquired datasets - ongoing until just prior to final analysis						
								Databases interfase / query						
								Databases cleaning and verification						
								Documentation of decisions						
								Data base analysis						
	11/04/20							**Reporting of DB structure and management**						
	12/14/20							**Spatial and Temporal Clustering of Deaths**						
	12/14/20							**Cause specific adjusted rates analysis (6 months)**						
	12/14/20							**Spatial and temporal analysis**						
	11/04/20							**VA Literature Review and Instrument Development**						
								Survey VA Next of Kin and key informants						
	10/11/21							**Process Reporting**						
								Optional medical records and expert panel						
								Project Progress						

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

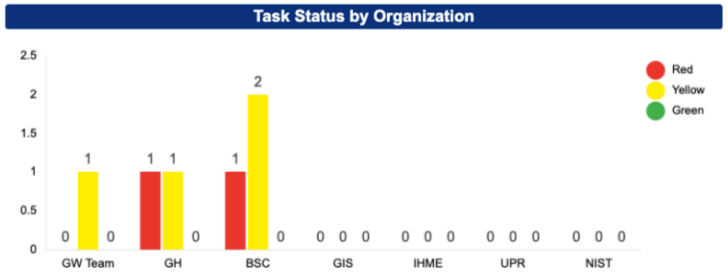
HURRICANE MARIA ANALYSIS

Key Data & My Open Tasks

07/27/20
Start Date

01/09/22
Projected End Date

14.87%
% Complete



2 Total Red
4 Total Yellow
0 Total Green

My Open Tasks

At Risk	Contract Date	Task	Primary Responsible Org	Co-Responsible	Status	Start Date	Due Date
		Datasets extraction key variables	GH		75% Comple	08/02/20	08/23/20
		Datasets transfer DB Manager	GH	BSC	50% Comple	08/16/20	08/27/20
		Classify cause of deaths by ICD 10 Chapters, underlying cause	BSC	GH	Not Started	09/23/20	10/04/20

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A special thanks to **Captain Rebecca Noe (CDC) for sharing her time and expertise so graciously with the Hurricane Maria NCST investigation, and specifically, with this project!!*

Questions?