

## **Appendix A**

Appendix A includes the results from the quantitative analysis, organized as follows:

- Descriptive statistics of all variables considered in the analysis (Table A1)
- Heat map of the 24 principal components detected in the PCA analysis (Figure A1)
- Summary results of the top three linear regression models (Table A2)
- Scatterplots of statistically significant variables for model 1 (Figure A2), model 2 (Figure A3), and model 3 (Figure A4).

Table A1. Descriptive Statistics

<b>Variable</b>	<b>Variable Description</b>	<b>mean</b>	<b>std. dev.</b>	<b>min</b>	<b>max</b>
<i>SVI</i>	SVI using all themes	0.4995	0.2945	0	1
<i>close_hos</i>	Distance to closest hospital (km)	12.54	10.1908	0.3	52.8
<i>cen_tra</i>	Distance of center of municipality to trauma center (km)	77.32	47.1053	3.1	182
<i>school</i>	Distance to closest school (km)	3.51	5.56	0.2	39
<i>park</i>	Distance to closest park (km)	16.82	9.21	0.3	34.7
<i>religious</i>	Distance to closest religious site (km)	9.32	10.49	1.3	63.4
<i>beach</i>	Distance to closest beach (km)	18.68	10.28	0.4	45.6
<i>airport</i>	Distance to closest airport (km)	18.26	13.91	0.4	60.3
<i>port</i>	Distance to closest port (km)	16.38	8.42	0.9	35.2
<i>num_hos</i>	Number of hospitals	1.333	2.0744	0	12
<i>pct_pov</i>	% poverty for all families	45.85	8.5826	23.2	62.1
<i>inc_capita</i>	Per capita income	8938	2537.193	5755	20809
<i>income</i>	Mean family income	28108	7628.54	18499	64334
<i>pct_nohc</i>	% population without healthcare	5.55	1.8096	2.53	10.67
<i>num_prof</i>	# of medical professionals	231.1	78.9206	180.7	412.9
<i>clinics</i>	# of free walk-in medical clinics	0.9359	0.9165	0	5
<i>automobile</i>	Ownership of private automobile	29637	32402.55	1159	224147
<i>tran_imp</i>	Transportation improvement budget	1340172	2835150	0	17979220
<i>avg_veh</i>	Average number of vehicles owned by households	2.036	0.2532	1.25	2.94
<i>clos_pol</i>	Closest Police Station	1.372	1.9649	0.1	12.5
<i>clos_fs</i>	Closest fire Station	1.453	1.3044	0.2	6.2
<i>clos_pharm</i>	Closest pharmacy	1.472	6.9644	0.001	60.8
<i>pol_area</i>	Number of police stations per capita	0.03	0.03	0	0.16
<i>fs_area</i>	Number of fire stations per capita	0.01	0.01	0	0.08
<i>num_pharm_area</i>	Number of pharmacies per capita	0.12	0.15	0	1.03
<i>hos_area</i>	Number of hospitals per capita	0.01	0.02	0	0.1
<i>age65_pop</i>	=sixty_five/population	0.14	0.02	0.09	0.2
<i>no_tele_pop</i>	=no_tele/population	0.03	0.01	0.01	0.07
<i>workers_pop</i>	=workers/population	0.27	0.05	0.19	0.4
<i>num_prof_pop</i>	Number of professionals per capita	0.01	0.03	0	0.23
<i>clinics_cap</i>	Number of clinics per capita	0.01	0.01	0	0.05
<i>num_med_pop</i>	Number of people with medicaid per capita	0.81	0.42	0.02	2.16
<i>len_high</i>	Length of highways within county	79.52	267.6895	0	2066.39
<i>len_streets</i>	Length of streets within county	571.22	304.27	87.58	1699.92
<i>len_streams</i>	Length of streams within county	118.73	74.05	0	373.64
<i>hfacilities</i>	Number of hospitals and clinics	2.269	2.63	0	17
<i>f_pdam_capita_17</i>	Property damage per capita in 2017 due to flooding	8072.07	16450.63	0	84201.34
<i>avail_pubtran</i>	Availability of public transportation(Binary)	0.78	0.42	0	1
<i>pct_vac</i>	Percentage of vaccination	45.85	0.09	23.2	62.1
<i>num_med</i>	Number with medicaid	33431	28829.08	262	170119
<i>num_est</i>	Number with Estatal	425.2	344.98	1	2168
<i>num_chip</i>	Number with CHIP	2199	1770.18	25	9964



Table A2. Summary Results of the Linear Regression Models, Independent Variable: SVI

<b>Dependent var: SVI</b>	<b>Model 1</b>		<b>Model 2</b>		<b>Model 3</b>	
<b>Independent vars:</b>	<b>Coef</b>	<b>t-stat</b>	<b>Coef</b>	<b>t-stat</b>	<b>Coef</b>	<b>t-stat</b>
<i>school</i>	-0.025	-3.271	-0.027	-3.285	-0.01308	-2.089
<i>female_pop</i>					-0.737	-2.181
<i>emply_pop</i>			-1.49	-3.512		
<i>age65_pop</i>			-4.96	-3.958		
<i>cen_tra</i>	0.0018	2.869	0.002	3.617		
<i>religious</i>			0.007	1.734		
<i>inc_capita</i>					-6.4E-05	-5.681
<i>close_hos</i>	0.0123	3.039				
<i>len_stream</i>	0.00078	1.846				
<i>hfacilities</i>					0.03366	2.2758
<i>num_chip</i>					3E-05	-1.725
<i>college</i>					-0.00336	-1.725
<i>veh0</i>					2.79	3.991
<i>veh2</i>			-3.77	-5.971		
<i>len_streets</i>					-0.00044	-3.022
<i>_cons</i>	0.2008	2.27	2.54	9.991	1.033	3.831
<b>Indicators</b>						
Observations	36		36		36	
Rsquare	0.2219		0.5644		0.558	
F-statistic	6.49		15.25		11.82	
RSE	0.2598		0.1944		0.1957	

Figure A2. Scatterplot of Significant Variables in Model 1.

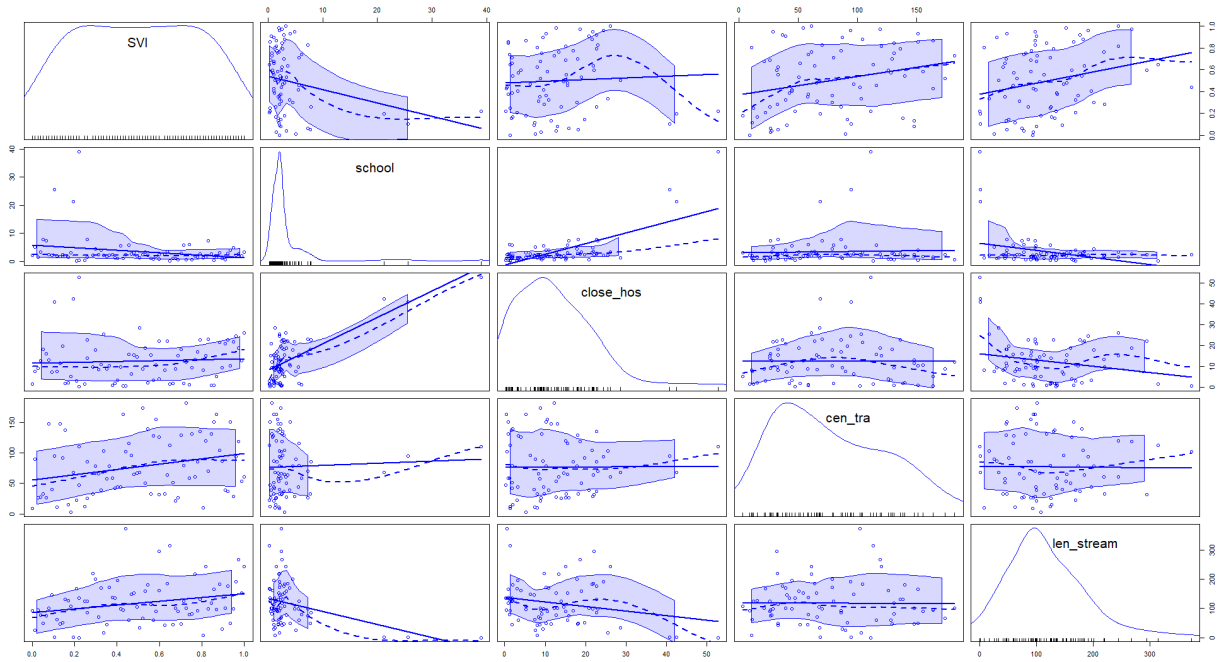


Figure A3. Scatterplot of Significant Variables in Model 2.

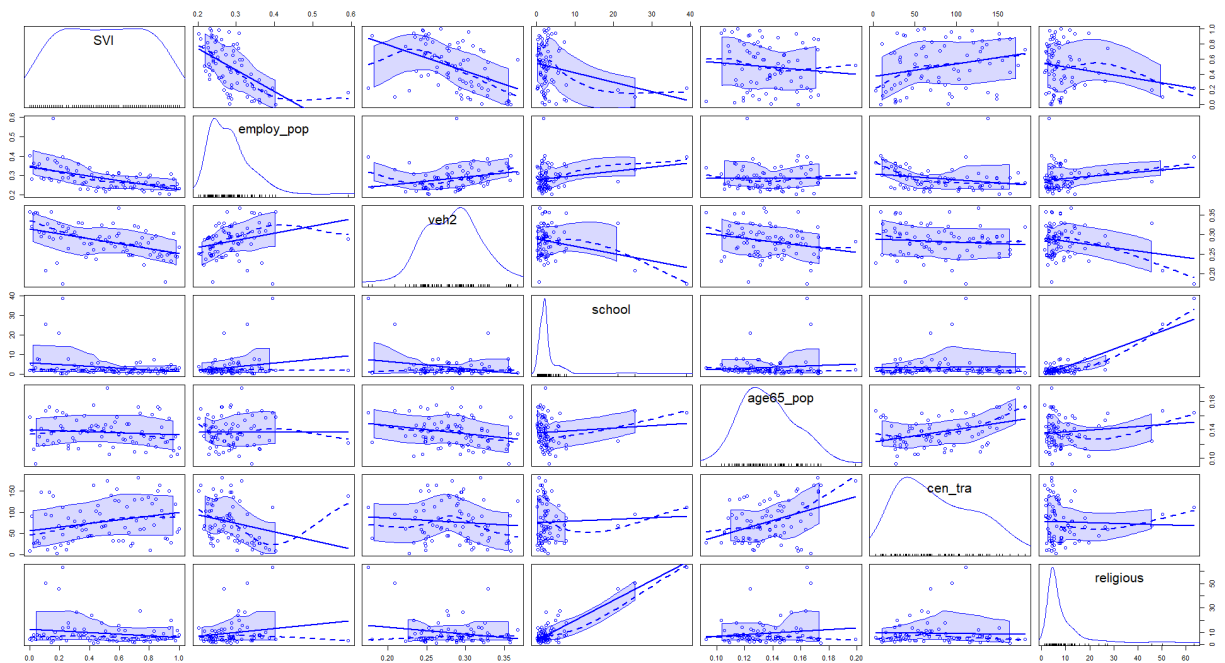
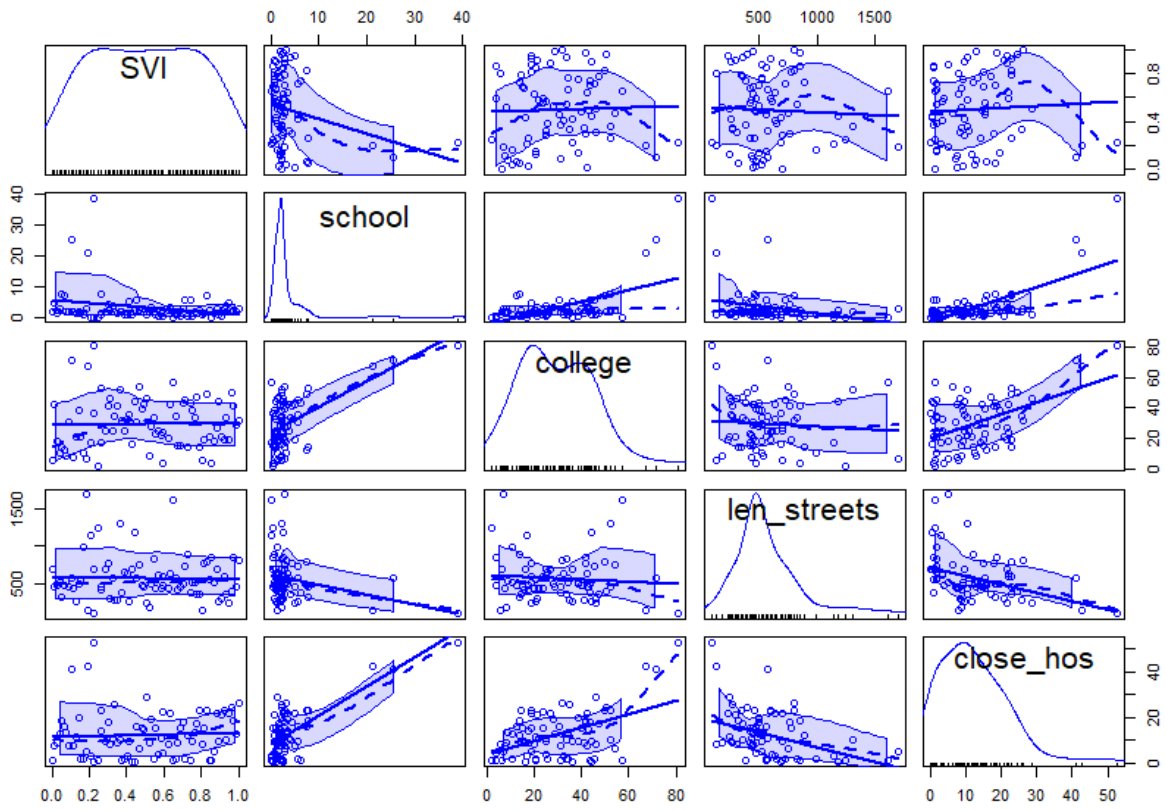


Figure A4. Scatterplot of Significant Transportation Variables in Model 3.



## **Appendix B**

Appendix B includes all supplemental material used for the qualitative study, organized as:

- B1. Script 1: In-depth interviews with key stakeholders
- B2. Script 2: Focus group study with communities in Puerto Rico
- B3. IRB Consent Form for In-Depth Interviews
- B4. IRB Consent Form for Focus Groups

### **B1. Script 1: In-Depth Interviews** **Exploratory Interview with Key Stakeholders**

#### **Information about the Interviewee**

Organization you work with.

What is your job about?

Experience in the job (years, functions, etc):

Contact information for follow-up:

#### **Role of your organization**

These first questions are related to your role in the organization (under normal and disaster conditions) and the main activities that your organization is involved regarding the access to healthcare in Puerto Rico.

1. What is the organization's role in normal conditions regarding the access to healthcare?
2. Does your organization perform any additional activity or activities in a post-disaster situation?

In the affirmative case, what motivates your organization to participate in these humanitarian efforts?

3. After Hurricane María, what was the role that your organization made during its immediate response to the disaster?
4. What was the role of the organization soon after the disaster occurred and during the initial stages of recovery?
5. We are interested in knowing the process from the moment a person requests a medical service (either because of a medical emergency or medical urgency) until the time they take to receive the service. From your organization's perspective, could you explain the details of this process and how it is implemented?
6. In the period immediately following the disaster, was it possible for your organization to respond to medical emergencies?
  - a. Did the organization have information about the emergencies in their community? When did the organization have this information and how were they able to access it?
  - b. How frequently did the information get updated?
  - c. How precise was the information provided?
  - d. Where there any needs in terms of ambulance services and other type of transportation in responding to the medical emergency?
7. After Hurricane María, did your organization partner with other organizations in response to the health situation after the emergency?

8. Do you know of any organization that played a critical role in terms of medical response after Hurricane María? What captured your attention about the response of this organization or organizations?

### **Your experience after Hurricane María**

Now I would like to ask about your experience as a medical responder after Hurricane María.

9. Where were you when the disaster occurred?

10. What medical emergencies did you evidence?

a. How were the people transported to receive immediate medical attention?

b. How were the people needing transportation located?

c. Where there any difficulties in providing transportation for these individuals?

d. Was there any medical infrastructure damage that impeded the provision of immediate medical attention?

e. What medical supplies or resources were missing in attending to the medical emergency?

### **Lessons Learned**

My last questions are related to the lessons learned in responding to the healthcare situation during Hurricane María.

11. What were the main challenges in accessing healthcare after Hurricane María?

12. What were the positive aspects about the medical response after the disaster?

13. What were the lessons learned that you would like to share regarding a medical emergency after a disaster like Hurricane María?

14. Is there any additional information that you would like to share that would benefit our study?

15. If you were to do the entire operation all over again, what would you do differently?

**Thank you very much for your time and your participation.**



## **B2. Script 2: Focus Groups**

### **Focus Group Study with Communities in Puerto Rico**

*Note: Instructions are written in italics.*

#### **Welcome**

*Introduction to the organizer, two moderators and the assistant(s) (who will take notes)*

My name is \_\_\_\_\_, I am the facilitator of this focus group (*Do introductory round*)

#### *Introduce Discussion Topic*

The study is designed to understand the access to healthcare after a natural disaster strikes, the challenges faced by the affected population, and the critical transportation infrastructure needs in these disaster areas. Your participation is vital in identifying needs at the public health and disaster response level. We will use the experience after Hurricane Maria as an example.

The findings of this focus group will be used for the purposes of our research, including anonymous citations, which may be presented at professional or scientific meetings and conferences, published in scientific journals, or otherwise shared with the general public. Your responses will remain anonymous, and no statement will be attributed to the names of the participants.

#### **General Instructions**

- This focus group discussion will last between 2 to 2.5 hours, we will have two 15-minute breaks in between.
- There is no good or bad answer, just different points of view.
- We will be recording/taking notes during the session. We appreciate if you would take turns to speak.
- This is just a conversation, and I am part of this group. We will refer to us by our first name.
- You do not need to agree with the rest of the group. You are entitled to your own opinion and judgement. Please also respect the opinions of others in the group.
- This is also an open conversation. Please feel free to speak to others and make questions.
- Please keep the opinions and comments mentioned throughout the group confidential.
- Also please turn off your cellphones or keep them in silent mode. If you need to attend a call, please let us know beforehand and take the call outside of the focus group.
- My role as the facilitator or moderator is to guide the conversation. To maintain the order, please raise your hand and wait until you are given the chance to speak.

## **Part A: Remembering the experience of a natural disaster**

We will do a short memory exercise. Our community is constantly affected by natural disasters, particularly tropical storms, and hurricanes. One of the most shocking in recent years was Hurricane Maria in the fall of 2017. We would like to know what you remember about this event. Where were you when it happened? How did the event unfold? What impacted you the most and how did you get ahead?

## **Part B: Access to Healthcare after Hurricane María**

Continuing with the anecdotes of Hurricane María, we would like you to comment on your experience about the access to hospitals or medical centers after an emergency. Do you remember a situation when you or a family member had a medical emergency after the hurricane? If you do:

1. Did you encounter any challenges in seeking immediate medical attention?
2. What conditions made it difficult to access the medical service?
3. What aspects of the transportation were particularly challenging?
4. Do you feel that place you live in makes it extremely difficult to access healthcare after a disaster?
5. What aspects of your location make it challenging to seek immediate medical attention?
6. If you were able to Access a hospital or medical facility, did you have any problems to seek a prompt medical service? What challenges did you oversee in that situation?
7. Were you able to observe any infrastructure damage in the medical facility or lack of resources that impeded you to receive immediate medical attention?
8. Was there any presence of the official response soon after the hurricane to help the impacted receive medical attention? Were there any other organizations involved?
9. As a community, do you think that you were able to support others in same or worse conditions?
10. What were the positive aspects of the response with regards to improving access to healthcare during the emergency and what aspects could be improved?

## **Part C: Strategies to Improve Access to Healthcare**

After knowing the experiences of Hurricane Maria, I will like us to think as a community and come up with strategies that can better improve the access to healthcare, especially after a natural disaster occurs. In this analysis, put yourself for a moment in the role of public health responders and emergency responders. Suppose that you have the opportunity and funds to invest in a project to improve access to healthcare after a disaster strikes. I would like to know your opinions. Remember, there is no right or wrong answer. Any idea is valid, there are no limits to what can be done.

## **Part D: Evaluate Potential Transportation Strategies**

In this next phase we will present some scenarios after the natural disaster. For this, we will use the HAZUS tool, which will indicate the magnitude of the disaster and the effects on

infrastructure and geographical conditions that will affect transportation and access to immediate health care.

Experience with similar research indicates that people generally respond in one way, but in reality they act quite differently. For this reason, as the scenarios are presented to you, imagine that you are in the situation described and that you WOULD ACT as indicated by the selected preference. Please help us to measure the preferences correctly by paying attention to the conditions presented before giving your answer.

**“Suppose a disaster has occurred and they are completely isolated. The conditions are not ideal to get to a hospital and they are waiting for the official emergency to arrive with a solution.”** Next, we will introduce you to the following scenarios. In each case, imagine that you are in this situation and indicate your preference. Think that the medical service or care is for you.

*The moderator will present the scenarios, where the program will indicate the level of damage on the ground (landslide, road blockade, flood), destruction of hospitals, housing and other critical infrastructure. FEMA’s HAZUS tool for Hurricanes is used to create some scenarios of potential damages to the transportation infrastructure and healthcare facilities, building, and economic losses. After participants are presented with these disaster outcomes, they will be able to mark their preference before starting the discussion. The moderator will explain the scenario and ask for possible strategies.*

***Strategies to evaluate:***

- Send emergency responders to clear off roads to allow for people to drive or walk to the nearest medical center
- Send ambulances to the affected area to pick up the people to receive immediate medical attention
- Evacuate people from their homes to a nearby shelter that offers medical attention
- Evacuate people out of the island
- Send emergency medical care directly to the communities, without evacuating them
- Send resources to build a medical shelter that has emergency medical care

**Conclusions**

*The moderator makes a summary of the study and asks participants if they have any further comments and questions about the study. The session is adjourned.*

**Attached please find two Consent Forms for subjects 18 and over:**

- 1. In-Depth Interviews**
- 2. Focus Groups**

### B3. IRB Consent Form for In-Depth Interviews

**Rensselaer Polytechnic Institute  
Institutional Review Board**

**Consent to Participate in Social/Behavioral Research  
*In-Depth Interviews***

You are invited to participate in a Research study that has been approved by the Rensselaer Institutional Review Board (IRB). The IRB reviews and approves all human subject research in accordance with applicable state law and federal law governing Human Subject Research.

**DESCRIPTION**

Diana Ramirez-Rios, faculty at Rensselaer Polytechnic Institute, is conducting a research study titled "Exploring How Transportation Access to Healthcare Impacts Social Vulnerability in Puerto Rico." This study is conducted in collaboration with local partners from the Manatí Medical Center Hospital and the Schools of Medicine from Universidad de Puerto Rico and San Juan Bautista School of Medicine. The study is designed to gather information and data about access to healthcare after a disaster strikes, the challenges incurred to the impacted populations, and the critical transportation infrastructure needs in these disaster areas.

**METHODS**

Your participation consists of phone or virtual interviews, during which you will be asked questions regarding your role of facilitating access to healthcare and/or involvement in medical emergencies after a disaster strikes. The interviews may be digitally audio-recorded and transcribed. The research team at Rensselaer Polytechnic Institute will share the data among themselves but will not share to anyone else. The recordings and transcripts from this interview will be archived at the institution and may be used for legitimate teaching or research purposes in the future with the approval of the Principal Investigators. Your participation will take approximately one hour.

**RISKS AND BENEFITS**

The risks associated with this study are minimal, as your answers are a matter of your own experience or opinion. There will be no physical effects and no attempts will be made to either change or influence respondents' behavior or environment. The benefits which may reasonably be expected to result from this study are: (1) Gain a better understanding about the access impacts on healthcare after a disaster; (2) Propose transportation-related strategies to get faster medical service after a disaster; and (3) Help the public health officials, private health organizations, and emergency response agencies to better meet the healthcare needs of communities in Puerto Rico and consequently improving their wellbeing. Payments or remuneration are not considered a benefit to subjects.

**PAYMENTS**

You will not receive any form of payment or remuneration for your participation in this research.

**PARTICIPANT'S RIGHTS**

Your participation is voluntary and you have the right to terminate your participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You may refuse to answer any question. You may ask the researcher to pause or stop

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**Note: Do not sign this consent form  
if it does not have the IRB approval  
stamp, or if the date has lapsed.**



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recording at any point to ask a question, clarify a response, or to indicate that a response should be deleted from the interview record.

**DATA COLLECTION AND USE**

Interview data will be collected by the methods described in the Methods section. The results of this research, including anonymous quotes, may be presented at scientific or professional meetings, published in scientific journals, or otherwise shared with the general public. **However, no statements will be directly attributed to you, and your name or other identifying information will not be publicly shared or included in published materials, unless you sign Statement 2 at the bottom of this form.**

**DATA PRIVACY AND SECURITY**

All recordings of your interview will be made using the digital voice recorders or phones. The research team will produce written transcripts of the interviews. All materials (recordings and transcripts) will be stored in a manner consistent with the participants' decisions regarding their confidentiality. All personal information and records will be kept in a locked file cabinet in the Principal Investigators' locked office, and digital documents and recordings will be entered into password-protected databases when applicable. The information provided will not be released in any way or form that permits identification of specific subjects. The recordings and transcripts from the interviews, as well as any other information collected or generated during this study, may be used for legitimate research purposes in the future with the approval of the Principal Investigators. The data will be archived at Rensselaer Polytechnic Institute and may be used in future research. There will be no time limit for archiving the data collected through this research. Disasters are rare events by definition and occur quite infrequently. As a result, the process of accumulation of knowledge is slow and the amount of data collected is very small. It is of primary importance to archive the data in raw form to keep unaltered for future research and analyses. To ensure confidentiality the data, the information will be electronically encrypted and only the Principal Investigator will have access to the encryption key, that will be stored in a password protected computer.

**CONTACT INFORMATION**

**For further information about this research, please contact:**

Dr. Diana Ramirez-Rios, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY 12180,  
Email: ramird3@rpi.edu

Chair, Institutional Review Board, Rensselaer Polytechnic Institute, CII 9015, 110 8th Street,  
Troy, NY 12180 Phone: 518- 276-4873. irb@rpi.edu.

**SIGNATURE 1: CONSENT TO PARTICIPATE IN RESEARCH**

By signing below, I confirm that I am at least 18 years of age and that I consent to participation in the research study described above.

**Signed** \_\_\_\_\_ **Date** \_\_\_\_\_

**Printed Name** \_\_\_\_\_

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**Note: Do not sign this consent form if it does not have the IRB approval stamp, or if the date has lapsed.**



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Institutional Review Board**

**SIGNATURE 2: OPTIONAL DISCLOSURE OF IDENTIFYING INFORMATION**

By signing below, I consent to public disclosure of my participation in this study, including direct attribution of quotes to me, through the use of my name and other personal identifiers relevant to the study. I understand that my consent to public disclosure is optional and may be withdrawn at any time by contacting the Researcher and/or the IRB Chair.

**Signed** \_\_\_\_\_ **Date** \_\_\_\_\_

**Printed Name** \_\_\_\_\_

**Please keep the extra copy of this Consent Form for your records.**

(rev. 12/09/16)

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stamp, or if the date has lapsed.**





## B4. IRB Consent Form for Focus Groups

### Rensselaer Polytechnic Institute Institutional Review Board

### Consent to Participate in Social/Behavioral Research *Focus Groups*

You are invited to participate in a Research study that has been approved by the Rensselaer Institutional Review Board (IRB). The IRB reviews and approves all human subject research in accordance with applicable state law and federal law governing Human Subject Research.

#### **DESCRIPTION**

Diana Ramirez-Rios, faculty at Rensselaer Polytechnic Institute, is conducting a research study titled "Exploring How Transportation Access to Healthcare Impacts Social Vulnerability in Puerto Rico." This study is conducted in collaboration with local partners from the Manati Medical Center Hospital and the Schools of Medicine from Universidad de Puerto Rico and San Juan Bautista School of Medicine. The study is designed to gather information and data about access to healthcare after a disaster strikes, the challenges incurred to the impacted populations, and the critical transportation infrastructure needs in these disaster areas.

#### **METHODS**

Your participation consists of virtual focus groups that consists of an open discussion with a group of 8 to 12 participants. During the study you will be asked to share your opinion regarding access to health facilities and services after a disaster occurs. The research team will use as an example your experience after Hurricane Maria. Your participation is vital in identifying needs at the public health and disaster response level. The study will be digitally audio-recorded and transcribed. The research team at Rensselaer Polytechnic Institute will share the data among themselves but will not share to anyone else. The recordings and transcripts from this interview will be archived at the institution and may be used for legitimate teaching or research purposes in the future with the approval of the Principal Investigators. Your participation will take approximately between 2 to 2.5 hours.

#### **RISKS AND BENEFITS**

The risks associated with this study are minimal, as your answers are a matter of your own experience or opinion. There will be no physical effects and no attempts will be made to either change or influence respondents' behavior or environment. The benefits which may reasonably be expected to result from this study are: (1) Gain a better understanding about the access impacts on healthcare after a disaster; (2) Propose transportation-related strategies to get faster medical service after a disaster; and (3) Help the public health officials, private health organizations, and emergency response agencies to better meet the healthcare needs of communities in Puerto Rico and consequently improving their wellbeing. Payments or remuneration are not considered a benefit to subjects.

#### **PAYMENTS**

You will not receive any form of payment or remuneration for your participation in this research.

#### **PARTICIPANT'S RIGHTS**

Your participation is voluntary and you have the right to terminate your participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to

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participate. You may refuse to answer any question. You may ask the researcher to pause or stop recording at any point to ask a question, clarify a response, or to indicate that a response should be deleted from the record.

**DATA COLLECTION AND USE**

Focus Group data will be collected by the methods described in the Methods section. The results of this research, including anonymous quotes, may be presented at scientific or professional meetings, published in scientific journals, or otherwise shared with the general public. **However, no statements will be directly attributed to you, and your name or other identifying information will not be publicly shared or included in published materials, unless you sign Statement 2 at the bottom of this form.**

**DATA PRIVACY AND SECURITY**

All recordings of the study will be made using the digital voice recorders or phones. The research team will produce written transcripts of the focus group discussions. All materials (recordings and transcripts) will be stored in a manner consistent with the participants' decisions regarding their confidentiality. **However, keep in mind that the information you share will be heard by other participants in the group. It is highly advised that you make the best effort to keep the conversation confidential and please do not repeat what was discussed to others outside the focus groups.** All personal information and records will be kept in a locked file cabinet in the Principal Investigators' locked office, and digital documents and recordings will be entered into password-protected databases when applicable. The information provided will not be released in any way or form that permits identification of specific subjects. The recordings and transcripts from the interviews, as well as any other information collected or generated during this study, may be used for legitimate research purposes in the future with the approval of the Principal Investigators. The data will be archived at Rensselaer Polytechnic Institute and may be used in future research. There will be no time limit for archiving the data collected through this research. Disasters are rare events by definition and occur quite infrequently. As a result, the process of accumulation of knowledge is slow and the amount of data collected is very small. It is of primary importance to archive the data in raw form to keep unaltered for future research and analyses. To ensure confidentiality the data, the information will be electronically encrypted and only the Principal Investigator will have access to the encryption key, that will be stored in a password protected computer.

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Institutional Review Board**

**SIGNATURE 1: CONSENT TO PARTICIPATE IN RESEARCH**

By signing below, I confirm that I am at least 18 years of age and that I consent to participation in the research study described above.

**Signed** \_\_\_\_\_ **Date** \_\_\_\_\_

**Printed Name** \_\_\_\_\_

**SIGNATURE 2: OPTIONAL DISCLOSURE OF IDENTIFYING INFORMATION**

By signing below, I consent to public disclosure of my participation in this study, including direct attribution of quotes to me, through the use of my name and other personal identifiers relevant to the study. I understand that my consent to public disclosure is optional and may be withdrawn at any time by contacting the Researcher and/or the IRB Chair.

**Signed** \_\_\_\_\_ **Date** \_\_\_\_\_

**Printed Name** \_\_\_\_\_

**Please keep the extra copy of this Consent Form for your records.**

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