USING NHTS TO ESTIMATE TRANSPORTATION NEEDS OF PEOPLE WITH MEDICAL CONDITIONS DURING DISASTER IN HAWAII

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INTRODUCTION

NHTS contains rich socio-demographic information and detailed inventories of travel behavior. NHTS data was used to assess medical conditions of travelers and travel needs for evacuation planning. The study:

(1) Provides a framework to estimate travel and evacuation needs of those with medical conditions using the NHTS dataset.
(2) Demonstrates the applicability of the framework for a volcano lava hazard in Hawaii County, Hawaii

- imputing travel characteristics from the 2009 NHTS dataset;
- quantifying travel and evacuation needs in the affected area.

DATA AND METHODS OF ANALYSIS

Figure 1: Analysis Framework

Figure 2: Study Area, Lava Flow Hazard and Alternate Roads

Table 1: NHTS Data File Record Selection for Imputation

SN	Description	Unit	Study Area	NHTS Variable	Frequency
1	Total NHTS Household File Records	Number			150147
2	MSA heavy rail status for HH	-	No	RAIL	124196
3	Home address in urbanized area	-	No	URBAN	43583
4	Population Density	per sq mile	41.14	HTPPOPDN	23248
5	Housing units Density	per sq mile	19.21	HTRESDN	38580
6	NHTS Household data fulfilling SN 2-5 characteristics				20402
7	Total NHTS Person File Records				308901
8	*NHTS Selected Person data based on SN 6*				*42142*

Table 2: Medical Condition and Travel Impact of selected NHTS 2009 data

SN	Description	NHTS Variables	Yes	No	Total	% of Total
1	Have medical condition making it hard to travel	MEDCOND	4793	32490	37283	12.9%
	Impact of medical condition on auto travel					
2	Medical condition results in reduced day-to-day travel	CONDTRAV	4012	760	4772	84.1%
3	Medical condition results in giving up driving	CONDRIVE	1270	3468	4738	26.8%
4	Medical condition results in asking others for rides	CONDRIDE	2561	2220	4781	53.6%
5	Medical condition results in limiting driving to daytime	CONDNIGH	2317	2286	4603	50.3%
	Impact of medical condition on Transit/Bus Travel					
6	Medical condition results in using bus/subway less frequently	CONDPUB	337	3918	4255	7.9%
7	Medical condition results in using special transit services	CONDSPEC	218	4530	4748	4.6%
8	Medical condition results in using a reduced fare taxi	CONDTAX	76	4668	4744	1.6%

Table 3: Medical Condition and Yearly Mile of Travel in NHTS 2009 selected data

SN	Description	N	Mean
1	Mean VMT for person without medical condition	24598	15548
2	Mean VMT for person with medical condition	2742	8135
3	VMT All Cases	27340	14804
4	% reduction in travel due to medical condition		52%

FINDINGS AND RESULTS

Table 4: Imputed Travel for Study Area

SN	Description	Unit	Total
1	Study Area Population	Number	11060
2	Traveler without Medical Condition	Number	9638
3	Traveler with Medical Condition	Number	1422
4	Annual Travel by person with Medical Condition	Million VMT	11.6
5	Annual Travel by person without Medical Condition	Million VMT	149.9
6	Total Travel in the Study Region	Million VMT	161.4
	Evacuation/Assisted Travel Demand during Hazard Event		
7	Medical condition results in others providing rides	Number	1469
8	Medical condition results in using special transit services	Number	170

Figure 3: Lava Flow Hazard and Distribution of People with Medical Condition

Table 5: Impacted Population in the Study Area

SN	Area	Total	TWOMC	TWMC	ASSIST	PARA
1	Pahoa	1075	927	148	148	29
2	Hawaiian Beaches	3628	3191	437	486	63
3	Nanawale Estates	1565	1373	193	235	18
4	Kapoho	1191	1035	157	181	13
5	Leilani Estates	3007	2607	401	336	45
6	Kalapana	593	506	87	83	2
	Total	**11060**	**9638**	**1422**	**1469**	**170**

TWOC: Traveler without Medical Condition
TWMC: Traveler with Medical Condition
ASSIST: Medical condition results in others providing rides
PARA: Medical condition results in using special transit services

FINDINGS AND RESULTS

Table 6: Additional Travel due to Lava Flow Hazard

		TWOMC		TWMC	
SN	Area	Railroad Avenue	Chain of Craters Road	Railroad Avenue	Chain of Craters Road
1	Pahoa	3313308	37210478	276368	3103787
2	Hawaiian Beaches	-4225756	94284768	-302557	6750630
3	Nanawale Estates	6010576	35395983	441202	2598214
4	Kapoho	-65816	20526015	-5218	1627210
5	Leilani Estates	5686427	43738234	457533	3519203
6	Kalapana	2545557	5890248	229838	531830
7	**Total**	**13,264,296**	**237,045,725**	**1,097,167**	**18,130,874**
8	***Additional VMT for Railroad Avenue***				**14,361,462**
9	***Additional VMT for Chain of Craters Road***				**255,176,600**
	% VMT increase from base case	**8.9%**	**158%**	**9.5%**	**157%**

Table 7: Evacuation Travel Need for Lava Flow Hazard (Miles)

		ASSIST		PARA	
SN	Area	Railroad Avenue	Chain of Craters Road	Railroad Avenue	Chain of Craters Road
1	Pahoa	723	8124	142	1600
2	Hawaiian Beaches	-1200	26780	-155	3455
3	Nanawale Estates	2119	12478	161	951
4	Kapoho	-27	8485	-2	629
5	Leilani Estates	1854	14257	247	1901
6	Kalapana	1171	2710	32	73
7	**Total**	**4640**	**72834**	**426**	**8609**

DISCUSSION

- Using socio-demographic variables for the study area with the NHTS 2009 public dataset yielded 20,402 household and 41,142 person data;
- Approximately 12.9% of travelers reported medical conditions;
- Among those with medical conditions, 53.6% depend on drivers; and 6.2% depend on paratransit;
- Lava hazard increases 9% or 158% of annual VMT in the study area depending on the alternate road available for travel;
- A random distribution of the imputed cases on 6 Transportation Analysis Zones (TAZs) provided estimates of assisted travel or paratransit useful for evacuation planning.

CONCLUSIONS

- Proof concept for estimating transport needs for those with medical conditions using NHTS and local data;
- Those with mobility limiting medical conditions are most vulnerable during disasters;
- They may require assistance to evacuate to a shelter;
- Health workers may need to provide home-based visits to residents unable to leave homes;
- Evacuation strategies are needed;
- Routing for health service providers during emergencies is also needed.