

## Infrastructure Needs of Vulnerable Populations in Catastrophes

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**Project Scope.** Anecdotal evidence about natural hazards suggests that certain vulnerable sectors of the population, such as the elderly, are both direct victims of natural hazards and victims of insufficient infrastructure services necessary for survival, since infrastructures are often destroyed or inaccessible to them. For example, they lack transportation for evacuation, electric power to provide heating, cooling, lighting, and life support systems, water, sanitation, and communication. This research evaluates co-location at a broad geographic scale of natural hazards, the elderly, and transportation infrastructure necessary for elderly to respond to emergencies. These problems are not only applicable to the elderly but also to many vulnerable populations, e.g., disabled, infirm, and children and to different hazards, e.g., terrorism. Analytical techniques are broadly applicable to many kinds of infrastructure.

**Recent Progress.** Qualitative material, literature reviews on transportation and the elderly, and preliminary data were presented at last year's first DHS Summit and other conferences. Subsequently, for this research, data on natural hazards and census data at the county level were obtained and statistically analyzed, verifying that counties with higher proportions of elderly in their resident populations generally had a higher proportion of natural hazards. The co-location of transportation availability and condition, hazards, and vulnerable populations is evaluated for broad geographic areas to determine infrastructure vulnerability and risk reduction opportunities for the elderly. This pilot guides future research (below).

**Future Plans.** The analysis will be expanded to (1) incorporate transportation information more comprehensively to support statistical analysis of transportation, hazards, and elderly co-location, building on earlier work; (2) cover electric power where data exist; and (3) combine elderly, transportation, and risk allocation data, building on Culpen's paper (2006).

**Relevance to listed research areas.** This is relevant to infrastructure protection (analyses for consequence estimates for elderly); transportation security (how to improve transportation security by analyzing vulnerable population needs in emergencies); social, behavioral and economic sciences (how communities can improve response to catastrophic events).

**Publications.** (1) B. Nagorsky, A. Culpen, "Special Vulnerabilities of Elderly in Disasters from Infrastructure Failures," Poster, U.S. DHS 2007 HS S&T Stakeholders Conference, DC, May 23, 2007: background for current research (2) R. Zimmerman, C.E. Restrepo, B. Nagorsky, A.M. Culpen "Vulnerability of the Elderly During Natural Hazard Events," U. of Colorado (Boulder), Hazards & Disasters Researchers Mtg., Boulder, CO. 7/12/07: statistical analyses (3) A. Culpen, "Disasters and DHS Funding Allocations by State," December 2006.