Real-time Epidemiological (COVID-19) Risk Assessment

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The present study derives and maps epidemiological risk consisting of three major components, namely, Hazard (H), Vulnerability (V), Exposure (E). Marginal contributions of all three factors are quantified. Hazard gives the "probability of occurrence of the disastrous event," vulnerability describes the "lack of resistance to damaging forces," and exposure refers to the "values/humans that are likely to be affected", respectively. In general, a risk map shows the magnitude and nature of the risk, which depicts the levels of expected losses at some spatial scale during a particular time period for a particular disastrous event. The risk map thus delivers the risk information to different end-users in an easy and understandable way. Here, we define hazard as the probability of randomly selected infected person in the country belong to the district of interest. Hence, it is computed as the ratio of infected persons in a district to the total number of infected persons in the country. If a district does not have any infected person, we assign a very low hazard value, by considering the number of patients very low (less than 1, say 0.5). In light of these needs and goals risk, a social vulnerability (SoV) map for India at district-scale has been developed that considers the SoV indicators derived from latest record (i.e., 2011) of Census of India (CoI). Indicator selection in vulnerability analysis by representing the characteristics of a vulnerable system or community, though just an initial step, is very crucial to avoid misunderstanding around the terms and concepts of vulnerability. Indicators are defined as variables which are operational representations of an attribute, such as quality and characteristics of a system regarding the susceptibility, coping capacity, and resilience of a system to an impact of a disaster. It describes a system's properties in a quantitative and transparent way and plays an important role in determining social vulnerabilities. Based on the availability of demographic data from the Census of India (CoI) and relevance to epidemiological disaster, a set of social indicators (for example - population density, child population, elderly population, number of households, % of household in bad condition, disabled population, non-working population, illiterate population etc.) have been considered in the present analysis. A widely used standard deviation or variance-based approach is applied to derive social vulnerability of each district at a quantitative scale within the closed interval [0.01, 1], where the values 0.01 and 1 imply least and most vulnerable districts, respectively. For defining exposure, we assign a value of 1 to the districts, which have minimum 1 infected person; 0.5, if the district does not have infected person, but the neighbouring districts have; 0.1, a very low value, otherwise. We compute risk as the product of hazard, vulnerability and exposure. The risks are further scaled in between 0 to 1, to develop a spatially relative real-time risk map.