Evaluating ‘Acquired Immunity’ May Improve Estimates of Infectious Disease Risk

Washington, D.C. – A new health study that accounts for “acquired immunity” when evaluating the risk of microbial illness from food or environmental exposures suggests that some current approaches may significantly overestimate their role in causing such illnesses. Immune status is a major factor in susceptibility to foodborne and environmental infectious diseases. By considering both the impact of acquired immunity to a pathogen and the amount of a pathogen to which people are exposed, researchers have developed a novel approach for more accurately assessing the potential health risks of infectious diseases.

A.H. Havelaar and A.N. Swart, from the National Institute for Public Health and the Environment (RIVM) and Utrecht University in the Netherlands evaluated the impacts of various dose-response models on the Dutch population’s exposure to C. jejuni, a species of bacteria commonly found in animal feces, food and the environment. Dose-response models help to estimate the risk of human illness caused by differing levels of exposure within a certain timeframe—in this case exposure to the common pathogen C. jejuni.

In their article—“Impact of Acquired Immunity and Dose-Dependent Probability of Illness on Quantitative Microbial Risk Assessment,” published in Risk Analysis, the journal of the Society for Risk Analysis—Havelaar and Swart looked at four illustrative scenarios of exposure: (1) low frequency, low dose exposure (recreational water); (2) low frequency, high dose exposure (consumption of raw chicken liver); (3) high frequency, low dose exposure (direct contact with sheep and goats, i.e. farmers); and (4) high frequency, high dose exposure (visits to petting zoos).

Results of their research provided strong evidence that using dose-response models with an acquired immunity component can significantly affect the estimated disease risk of individuals and populations. According to Havelaar and Swart, “The risk [estimated] in immunity models is approximately ten times lower than [in risk estimate] models that do not take immunity into account” for certain scenarios. In most dose-response models, direct animal contact, such as in petting zoos, is the main risk factor for illness caused by C. jejuni, with 64 to 74 percent of the risk attributable to direct contact. However, with dose-response models incorporating acquired immunity, only 26 percent of the risk was attributed to exposure through petting zoo activities—a much lower probability of disease from exposure to a given source. Differences in the results of the models examined were also dependent on the exposure scenario and exposure frequency. There seems to be improved correspondence with epidemiological estimates of disease.
incidence. Accounting for immunity could lead to more effectively identifying and managing public health risks from microbes.

This research demonstrates that the model used has an impact on both risk estimations and the attribution of illness to different sources of exposure, which is key to preventing infection and managing disease. By combining acquired immunity and dose-dependence into incidence estimates, the results differ drastically. Since the models were developed in the face of scarcity of data on immune parameters and exposure doses, exact impact on human disease is hard to quantify. Nonetheless, the results are robust and consistent.

Based on this research, the authors urge the public health community to more carefully take acquired immunity into account to improve estimates of the potential impacts of infectious diseases and to assist in preventing and managing them. They also discuss the need for further studies to better characterize and quantify the effects of acquired immunity on intestinal infections.

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