Capsule

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What’s new, what’s hot, what’s timely? If you don’t have time to search the Internet for the latest developments that might impact your work environment, you just might find some of this information in this “Capsule” column. Please e-mail any comments or suggestions to felix.gmuender@bh.com.sg or to Co-Editor Barbara Johnson at barbara_johnson@verizon.net or Co-Editor Karen B. Byers at karen_byers@dci.harvard.edu.

Aerosols Transmit Prions, Role of Particle Size in Aerosol Transmission, New Tuberculosis Vaccine, Urbanization of Infectious Diseases, and Behavioral Health Screening for BSL-4 Laboratorians

Aerosols Transmit Prions to Immunocompetent and Immunodeficient Mice

Prions are the causing agent of transmissible spongiform encephalopathies. Typically, they are taken up by oral, parenteral, and sometimes transdermal routes. It is thought that aerosols do not transmit prion diseases. Haybaeck et al. (2011) reported in a paper that caused some stir in the biosafety community that inbred, crossbred wild-type, and immunodeficient mice develop Scapie upon exposure to aerosolized prions. In addition, Haybaeck et al. (2011) presented data that aerogenic exposure to prions can lead to a direct invasion of brain cells without prior processing by the immune system. They concluded that aerosol transmission may need to be reconsidered in research and diagnostic laboratories. In an interview, the head of the research team (A. Aguzzi) cautioned that the results do not mean that animals or people with prion diseases could transmit the prions through the air (MacKenzie, 2011). No unexplained cases have suggested this route of transmission. However, workers in mills that process potentially infected carcasses may need better respiratory protection. The authors (Haybaeck et al., 2011) used a nebulizer to challenge mice for 10 minutes with brain homogenates of 0.1%, 2.5%, 5%, 10%, and 20% concentration from terminally Scapie-sick mice; a dose-response relationship was shown. Aerosol particles were smaller than 10 μm; with about 60% of the particles less than 2.5 μm in diameter. In laboratories that test for prions, a 10% concentration of brain tissue is typically prepared and handled (MacKenzie, 2011).

Editor’s Comment: For the biosafety practitioner these results do not change the way brain tissue for prion testing is manipulated and processed in a biosafety cabinet. The selection of additional safety measures depends on a risk assessment. Aerosols should be prevented, minimized, or contained (BSC), and respiratory protection is advised if direct exposure cannot be prevented. In relation to this, it is known that viruses that are not typically transmitted via aerosols, such as the dengue virus, can become airborne if the virus concentration is very high, for instance when centrifuge pellets are inappropriately resuspended (Kuno, 2005).


The Role of Particle Size in Aerosolised Pathogen Transmission: A Review

Gralton et al. (2010) have compiled data and information from 26 studies on the size of aerosol particles generated from breathing, coughing, sneezing, and talking for a review article. Healthy individuals generate aerosol particles and droplets between 0.01 μm and 500 μm. Individuals with respiratory tract infections produce aerosols and droplets that range from 0.05 μm to 500 μm. Particle size is an important parameter for the transmission of respiratory tract infectious diseases. Droplets larger than 100 μm settle quickly to the ground, usually within 1 meter from the source. Such droplets can contribute to fomite transmission. In contrast, aerosol particles remain suspended in the air for longer periods and can expose a greater number of individuals to possible infections. Particles smaller than 10 μm have more serious health implications because they can reach the lower respiratory tract. Gralton et al. (2010) present methods and technologies on how to measure particle numbers and size distribution, and discuss phenomena such as evaporation and aggregation. For a better understanding of respiratory infectious diseases, the authors have included in their review a very good introduction and overview on droplet and aerosol generation, disper-
tion, and role in the transmission of aerosolized pathogens. They present some interesting knowledge gaps; for instance, what makes some individuals become a super-spreaders, and why some expelled particles carry pathogens and others do not.


**A Multistage Tuberculosis Vaccine That Confers Efficient Protection Before and After Exposure**

Good vaccines are lacking for diseases characterized by chronic and intracellular infections where the protection depends mainly on the T-cell mediated immune response. Tuberculosis is the most prominent example of this category. The TB-bacterium can subvert the host’s immune defense and establish a latent infection. The BCG vaccine is currently the only one approved for human use. Aagaard et al. (2011) report that a row of new vaccines is currently in clinical trials because a lot of progress has been made in the research and development of new generation TB vaccines in the last 5 years. The new generation vaccines differ from the BCG vaccine in that they rely on early expressed antigens, which makes them suitable as a prophylactic vaccine. Aagaard et al. (2011) have developed a multistage vaccine that could be used both before and after an exposure. The H56 recombinant vaccine includes a combination of early antigens with early secretory antigens (prophylactic protection) and a latency-associated protein (post-exposure protection against latent infections). In mouse models the authors were able to show that this multistage vaccine promotes a T-cell response against all vaccine protein components. It is able to prevent new infections and significantly lower the bacterial load after exposure. The authors announce that the H56 vaccine will go into clinical trials shortly.


**Urbanisation and Infectious Diseases in a Globalised World**

Demography-wise, the world is becoming urban: More and more people are drawn to the cities. The United Nations predicts that between 2007 and 2050 the urban population will double to 6.3 billion, and the growth will happen predominantly in low-resource countries. Urban areas in low-resource countries can act as incubators where all conditions for an outbreak of infectious disease are met: low hygiene, low herd immunity, dense populations with increased rates of contact, mobility of people, and limited health surveillance and medical treatment. Therefore, the public health system in these countries is faced with remarkable challenges as discussed by Alirol et al. (2011). According to the authors, urbanization bears the potential for disease to rapidly propagate from incubator-areas into other parts of the cities, including tourist areas. Some diseases such as dengue and chikungunya may become permanently established in tropical cities; others such as Ebola or Marburg hemorrhagic fever may produce occasional and patchy outbreaks. The availability of preventive and curative measures, as well as diagnostic capacities and the competencies in the public health sector, shape the risk to a large extent. The authors mention that measures other than those from the public health sector can reduce the risks; these include urban planning and shaping of the environment and behavior. For instance, in Singapore, a first control measure to limit dengue and chikungunya transmission was eradicating breeding sites in and around residential areas (littered cans, buckets, flower pot plates, etc.). A second element is case detection and control (isolation and quarantine). The authors conclude that cities provide many opportunities for action and illustrate this with programs developed in the Philippines and South Africa.


**Developing a Behavioral Health Screening Program for BSL-4 Laboratory Workers at the National Institutes of Health**

Personnel working in biosafety high-containment facilities may pose a greater security threat than terrorists or potential intruders. However, it is generally agreed that it is extremely difficult to identify and select suitable personnel for these facilities, and to monitor their health, behavior, and attitude. Skvoc and Wilson (2011) report on the development and administration of a behavioral health screen for BSL-4 workers at the National Institutes of Health. The goal of this program was to proactively build a safety culture by promoting group cohesiveness, trust, respect, and reliability. The screening program includes four components: (i) verification of the individual’s background; (ii) BSL-4 training; (iii) assurance of physical fitness; and (iv) an annual behavioral health screening to assess the worker’s psychological resilience and attitudes toward safety practices and responsibilities. The lessons learned include the following suggestions for similar programs: transparency (with a good balance of privacy), group meetings, facilitating and encouraging questions and discussions, clear communication, consistent and stringent administration of procedures, and involvement of professionals for the interpretation of results.