

## ***Unknown or Hidden Reservoirs of Infection and Prevention Strategies: Where to look and what to look for***

In recent years, reports of severe outbreaks with pathogens from previously unrecognized or underestimated reservoirs have been a major concern for the general public as well as the scientific community. For the 2013 Symposium of the Rudolf Schülke Foundation, which took place in Hamburg in November, a panel of internationally renowned experts was invited, who tackled the difficult task of exploring various infection reservoirs and essential elements for the design of suitable infection control and hygiene protocols. A multidisciplinary approach was taken including scientific views from chemistry, microbiology, pharmacy as well as hospital hygiene. The following three main topics evolved from the discussion: methods of pathogen detection, lessons learned from outbreaks, outbreak prevention and management.

Currently, routine test systems for detecting microorganisms are culture media-based. These bacteriological tests, however, will fail to detect bacteria which are in the viable but nonculturable (VBNC) state. VBNC bacteria are alive because they are capable of metabolic activity. On the other hand, they appear dead, because they cannot grow and multiply on conventional nutrients. Bacteria such as *P. aeruginosa* or legionellae may enter the VBNC state as a response to stress such as extreme temperatures, presence of heavy metals, or changes in pH. As a consequence, the number of bacteria may be greatly underestimated when establishing the bioburden using traditional test culture media. Prof. Flemming, Biofilm Centre Duisburg-Essen, Germany, pointed out the fact that the seemingly dead bacteria are simply dormant and may be resuscitated when exposed to favorable conditions. Most importantly, they can resume growth and regain their infectivity. This may at least partly explain why sometimes outbreaks recur or persist despite implementation of comprehensive infection control measures. While the symposium participants agreed that it is important to be aware of these “hidden reservoirs” of infection and that basic and applied research must be intensified in this area, also with regard to efficacy testing for disinfectants, they also consented that the present routine test methods do offer useful information about identification of the bioburden and about reducing microorganisms below their infectious dose.

Detailed investigations of numerous large-scale outbreaks in medical and community settings have revealed further insights in previously unrecognized pathogen reservoirs as well as outbreak management schemes. For example, in the hospital setting, privacy curtains, water walls, electronic faucets, ultrasound transducers, wipe dispensers as well as intravenously administered drugs and nutrients are amongst the lesser known sources of infection. In medical institutions, nursing homes as well as in private households, contaminated laundry can present a hygiene risk, especially when taking care of elderly patients at home. Another previously unreported infection reservoir is a waste water treatment plant which was found to be associated with the contamination of cooling towers resulting in a community-wide outbreak of legionellosis in Germany in 2013.

As far as the microbial spectrum is concerned, gram-negative bacteria are increasingly being identified as causative organisms, often representing multiple-resistant strains.

Taking into account outbreak report statistics and current practices in infection control, the symposium participants pinpointed aminoacid admixtures for intravenous application, siphons and wash-basin design,

certain endoscopic and surgical equipment and improper surface disinfection as particularly important examples for underestimated or overlooked infection reservoirs.

Although it does not appear feasible to prevent all outbreaks of infection, the goal is to reduce the number of outbreaks to a minimum and to control existing outbreaks as rapidly as possible. In the discussion among the symposium participants, considerable differences in the organization of hospital infection control between the countries became apparent. In the United States, every hospital has an infectious disease physician who has undergone a 3-year fellowship training program and on-site training. His duties include hygiene precautions, infection control and hospital epidemiology. France has a national list of 500 approved “clinical hygienists” who can be recruited by hospitals. Crisis management training and media training is mandatory for all hygienists on a regular basis. Germany has a quota for infection control staff depending on the number of beds and on the type of hospital. Two different educational backgrounds for infection control physicians coexist, one being a medical specialist following the “classical” 5-year specialist training, and one being a medical specialist with an additional training of 200 hours in infection control. This second possibility has been created as a compromise to make up for the severe shortage in infection control specialists which currently exists in Germany. The German Commission for Hospital Hygiene and Infectious Disease Prevention (KRINKO) has issued several guidelines, including a guideline on outbreak management, which offers assistance to those in charge. However, in order to be able to implement the suggested measures, independent state institutions responsible for the training of infection control personnel as “preventionists” and consultants and coordinators for outbreak management should be established. Furthermore, a task force for outbreak management should be available at every hospital. Although training and education as well as motivation of healthcare personnel are vital for the success of any infection control measures, empowerment of the patients or patient involvement programs to help comply with hygiene precautions should also be promoted. This especially applies to home care settings. Apart from formal training and “extrinsic” teaching, “intrinsic” teaching methods are considered important. These have been proven particularly successful with children. Once hygiene behavior such as hand-washing and appropriate coughing techniques has become a routine, it will be kept for a lifetime. Therefore, proper hygiene education during childhood is a mainstay in infection prevention and hygiene programs for children and families should be strengthened.

A more detailed report on the conference proceedings and the results of the discussion among the participants of the Rudolf Schülke Symposium will be published in the near future.

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