

Use of virulence traits to characterize waterborne pathogens: Introduction

A workshop was convened by the US Environmental Protection Agency (USEPA) in October, 2004 to evaluate a new concept, "virulence factor activity relationships" (VFARs). The VFAR approach was proposed by the National Research Council (NRC) of the National Academy of Sciences (NAS) for evaluating waterborne microorganisms as candidates for future regulation and for discovering currently unrecognized pathogens. The VFAR concept was inspired by the quantitative structural activity relationships (QSARs) used by toxicologists to evaluate the toxicity of structurally related chemicals. The VFAR concept predicts that virulence factors of various microbes should be structurally related, that their genes should exhibit significant homology and that these relationships can be used in evaluating their pathogenic potential. Thus, VFARs are hypothesized to be the microbiological equivalents to the QSARs used to evaluate the toxicity of chemicals. The long-term goal envisioned by the NRC was to eliminate the culturing of microorganisms by developing a database of virulence factor DNA sequences and analyze DNA for virulence genes directly from water samples using microarrays.

There has been a broad difference of opinion among public health microbiologists with regard to whether the VFAR approach will be useful in the immediate future, the long-term future or even whether it will be useful at all. The purpose of the EPA workshop was to bring experts in the field of microbial pathogenesis together to answer questions about the possibilities and also the limitations of the VFAR concept and to assist EPA in developing near-term and long-term research programs to address the ways in which the concept could be utilized to characterize known pathogens and discover newly emerging waterborne pathogens. The workshop presentations were developed in response to specific questions conceived by the EPA Steering Committee to address issues that would lead to a better understanding of this concept and how it might be utilized by the Agency.

The questions developed by the steering committee and the speakers who addressed them are: (1) What are the

U.S. EPA's interests in virulence factor activity relationships? (Dr Jeffery K. Griffiths of Tufts University, Boston MA); (2) What are virulence factors and what are their mechanisms of action? (Dr Arturo Casadevall of Albert Einstein School of medicine, New York, NY); (3) Is the detection and identification of virulence factors sufficient to imply pathogenesis? If not, what more is needed? (Dr Stephen Edberg of Yale University, New Haven, CT); (4) Is the diversity of microbial virulence factors overlapping to the point that unknown pathogens can be detected with available probes using non-cultural methods? (Dr Ashok Chopra of the University of Texas Medical Branch, Galveston, TX); (5) Most of the recent emerging waterborne pathogens are not bacteria. Will the VFAR approach work with viruses and protozoa (e.g. Hepatitis E, *Cryptosporidium*)? (Dr Ronald Fayer of the USDA, Beltsville, MD); (6) There are a number of pathogens that have emerged in the last 30 years. Given current technology, could we have detected/identified these pathogens with the VFAR approach? (e.g., Hepatitis E virus, *Mycobacterium avium* complex, *Legionella* spp.) (Dr Gerard Cangelosi of the Seattle Biomedical Institute, Seattle, WA); (7) Where will future emerging pathogens come from? What approaches can we use to find them, in addition to VFARs? (Dr Mark Sobsey of the University of North Carolina, Chapel Hill, NC); and (8) What technology is available for examining virulence factors, now and in the future? (Dr Timothy Straub of the Pacific Northwest National Laboratory, Richland, WA). A summary and several conclusions were presented by Dr Ricardo DeLeon of the Metropolitan Water District of Southern California, Los Angeles, CA. All of the presentations except those by Dr Griffiths and Dr Straub were expanded into articles suitable for publication in a scientific journal and are presented in this special issue of the *Journal of Water and Health*.

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