



**US Environmental Protection Agency  
Office of Pesticide Programs**

**Final Summary of the Disinfection Hierarchy Workshop**

**February 23, 2016**

# Exploration of the Disinfection Hierarchy Stakeholder Workshop

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*U.S. Environmental Protection Agency – Office of Pesticide Programs*

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## *WORKSHOP SUMMARY*

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Note: The views expressed during the workshop are those of the individual panel member or participant and do not necessarily represent those of the U.S. EPA.

## Welcome, Introductions and Agenda

Jack Housenger, Director of the EPA Office of Pesticide Programs (OPP), welcomed meeting participants and thanked them for their involvement. Mr. Housenger noted that proposals to expand the disinfection hierarchy have existed for quite some time. Part of EPA's rationale for considering opportunities to expand the hierarchy is that it could help target resources associated with reviewing efficacy studies of disinfectant products. Mr. Housenger noted that there seem to be a range of opinions regarding the hierarchy and asked participants to keep an open-mind during the workshop and to make science the focus of the day's discussion.

Gail Bingham, the workshop facilitator, reiterated that the purpose of the workshop was to discuss the scientific questions associated with expansion of the disinfection hierarchy. Ms. Bingham added that the panelists seated at the table would be the primary source of input for the day's discussion, but that participants in the room and on the webinar would also have the opportunity to make comments and ask clarifying questions. Ms. Bingham pointed out the great opportunity that the workshop represented for shedding light on an important subject. She then welcomed those participating on the webinar and asked each of the panelists seated at the table to introduce themselves. Following introductions, Ms. Bingham gave an overview of the day's discussions:

- Session 1: Establishing a common foundation of disinfection hierarchy concepts through presentations and discussion.
- Session 2: Discussion of the variables that affect the applicability of hierarchy concepts.
- Session 3: Discussion of possible representative microorganisms.
- Session 4: Discussion on how the disinfection hierarchy might be further expanded, given current scientific understanding.
- Session 5: Discussion about additional information needs and considerations participants suggest EPA take into account when considering whether and how to further expand the hierarchy

Copies of the agenda and the list of panelists are attached.

## Session 1 – Overview

**Goal:** Review key disinfection hierarchy concepts and models and their current use in registering antimicrobial pesticide products.

### Presentations

#### Overview of Current Disinfection Hierarchy Models – J. Hudson Garrett Jr.

Dr. Hudson Garrett, PDI and a member of the board of the Association for the Healthcare Environment (AHE), provided meeting participants with background on the Spaulding disinfection hierarchy model. The hierarchy ranks different classifications of microbes from most resistant to disinfection to most susceptible to disinfection. Spores are considered the most resistant to disinfection, followed by mycobacteria, non-enveloped viruses, fungi, bacteria and enveloped viruses. In disinfection hierarchy theory, vertical application of the hierarchy postulates that a disinfectant that is effective against spores should also disinfect lower classes of microbe. Horizontal application of the hierarchy would suggest that a product that disinfects a particular microbe within a given class could also be able to disinfect some or all others within that class. Effective use of the hierarchy could expedite the process of testing new antimicrobial products and could increase the clarity of product labelling.

Aspects of the hierarchy are still not well-understood, however, and some question whether the assumptions are true in all cases. Factors that may impact the application of the hierarchy include: contact time, surface type, relative humidity, and temperature. Generally speaking, vertical applications of the hierarchy are better understood and more soundly established than horizontal applications.

Dr. Garrett noted that the hierarchy may pose difficulties for clinical end-users of antimicrobial products. Therefore, it is important to understand the context for and impacts of expanded usage of the hierarchy. Also, if end-users are not properly trained or experienced in using particular antimicrobial products, they may inadvertently use them off-label in an unintended manner. In some cases, this confusion stems from a lack of end-user comprehension about what level of disinfection is appropriate for a particular application.

Most healthcare facilities require the minimum of a Low Level Disinfectant (LLD) for usage in their facilities. An EPA certified LLD has been tested to disinfect *staphylococcus aureus* and *pseudomonas aeruginosa*. However, many hospital end-users do not feel comfortable using a product that has only been tested to kill those two microbes, due to uncertainty about which microbes are on a particular surface. It is important, however, that end-users don't use the most powerful disinfectants on a first-case basis, in part to avoid contributing to antimicrobial resistance.

Education of end users, considering clinically relevant factors in testing requirements and by testing clinically-significant microbes, is significant to the discussion of expanded applications of the hierarchy.

## Overview of Current Use of Hierarchies for Regulatory Purposes – *Mark Perry*

Mark Perry, from the EPA Office of Pesticide Programs, presented background information on how disinfection hierarchy concepts are currently used by EPA and others and why EPA is considering further expansion. EPA currently uses hierarchies for general disinfection product claims, guidance to users for addressing emerging pathogens, and approving product claims for towelettes. Others, including the EU and FDA also use hierarchies for similar purposes.

EPA has established three general claim categories for antimicrobial products: sterilants, disinfectants, and sanitizers. Disinfectants and sterilizers are further subdivided into hospital/healthcare disinfectants, broad-spectrum disinfectants, limited-spectrum disinfectants, food contact sanitizers, and non-food contact sanitizers. For each claim category, EPA requires products to be tested against specific representative organisms. This represents a horizontal application of the disinfection hierarchy. Product manufacturers may also choose to add claims for additional specific pathogens to their labels, beyond the general claim category, but only if they have submitted test data to support those claims.

EPA makes further use of the disinfection hierarchy through its guidance to users on how to address emerging pathogens. With EPA guidance, producers can make off-label claims about their product's efficacy against an emerging pathogen. As part of this process, EPA uses a vertical application of the disinfection hierarchy and generally supports the claims of products that are effective against microbes several classes higher than the particular emerging pathogen.

Towelette producers also are able to use the disinfection hierarchy in bridging efficacy data performed with a bulk liquid to support a towelette product that uses the same liquid.

EPA is considering further applications for the disinfection hierarchy to focus resources associated with the testing process where there is the most public health benefit, increase efficiency and improve safety. Further development of the hierarchy could also help refine its use as a tool for emerging pathogen issues.

### Panel Discussion<sup>1</sup>

During the panel discussion that followed the presentation, panelists were invited to add other concepts or considerations to keep in mind when discussing the topic.

Several panelists noted that the data and methodologies originally used to establish the hierarchy are now rather old and that it may be necessary to review and improve the hierarchy itself to bring it up to date with current scientific thinking. Some thought that information exists now to do this and might come from lab data or literature reviews. This could include blinded failure data from testing labs. Non-enveloped viruses are a particularly complex class of microbes, both in terms of how the class relates to other classes within the hierarchy, and the variability of susceptibility to disinfection within the class. Some panelists noted that the hierarchical relationship between mycobacteria and non-enveloped

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<sup>1</sup> Note: This report is a summary of points raised during the discussion by one or more participants, but no attempt was made during the workshop to ask for general group conclusions, recommendations or advice.

viruses can sometimes vary. For example, *M. tuberculosis*, a mycobacterium, is less resistant than certain types of non-enveloped viruses. Products that work with lipid layers may not affect certain viruses, and some viruses can repair themselves within a lab setting. A participant noted that, in some cases, non-enveloped viruses may not be susceptible to a sporicidal disinfectant, although another cautioned against a general conclusion that non-enveloped viruses are more resistant than bacterial spores. Rather, the virus may be smaller than a spore and, thus, is not accessed by the disinfectant.

Testing methods and conditions of use also affect results. A panelist noted that most testing is conducted on non-porous surfaces and that for these products it is not clear whether the product will be effective on a porous surface. EPA has made efforts to standardize testing methods. However, more consideration may be needed about consistency of test methods and their relationship to conditions of use when determining relative resistance or susceptibility of pathogens. Some panelists suggested that simulated use testing should be considered. EPA has made progress on standardizing methods and invited additional suggestions.

Additional variability in effectiveness can be caused by differences in product formulation. The disinfection hierarchy may be more reliable for active ingredients than for formulations, where the relative susceptibility to disinfection may not be as consistent for some pathogens.

Panelists suggested possible steps that could be taken to improve the hierarchy and improve end-user understanding of its applications. One panelist suggested the need to examine the variability between a surrogate and other microbes within the same class. Some of this is already known: gram-positive bacteria are more resistant than gram-negative bacteria. Others suggested considering separate hierarchies for those products designed for medical applications versus those designed for consumers. Requirements for consumer products could be different than those for medical products, reflecting differences in how they are used. The hierarchy could also potentially be broken into more groups, or sectors within larger groups to account for variability within particular classes. Some panelists suggested exploring the possibility of end-user testing for products to ensure that they are being used properly.

Additional comments from panelists included:

- Australia and Canada also use representative organisms in their hierarchies.
- FDA requires end-user testing and testing on different types of surfaces.
- The EU has attempted to establish end-user testing, but there are many difficult factors to consider, including establishing proper protocols and ensuring that pathogens are isolated and effectively controlled.
- Just because other countries are using hierarchies it does not mean that the approach is correct. For example, some countries only test one virus when establishing a general virucidal claim.
- *M. tuberculosis* has traditionally been used as a surrogate microbe for testing the tuberculocidal product claim, but that claim itself does not necessarily have clinical relevance, as tuberculosis

does not spread through surfaces. However, there are non-tuberculous bacteria that can spread through surfaces. “Mycobactericidal” would be a more accurate product claim to use.

- The hierarchy should include consideration of which pathogens can spread through environmental surfaces and which do not. For example, although HIV has very serious consequences, there is no credible information to suggest it can spread through contaminated surfaces.

## Audience Questions and Comments

Members of the audience and webinar participants were given the opportunity to ask clarifying questions of the panelists and add points based upon the previous discussion.

One audience member asked whether the current hierarchy covers vegetative micro-organisms, or whether that is outside of the scope. A panelist responded by saying that vegetative micro-organisms are covered by the hierarchy, but that the current surrogates used for the category may not be the most appropriate, given that they do not survive in dry conditions. Another surrogate could potentially be chosen. Surrogates should be relevant to a clinical environment.

An audience member noted that different types of test surfaces will impact the efficacy of disinfectants. Wood and concrete, for example, can be difficult to disinfect. A panelist responded, noting that this certainly needs to be a consideration, and that porous surfaces introduce variability to the testing process. Another panelist pointed out that those surface types would not be found in a healthcare setting.

The panel received an additional question from the audience regarding appropriate surrogate organisms, but the discussion was deferred to Session 3, when the topic was to be discussed in detail.

Another member asked whether testing could continue but efficiencies could be achieved by only reviewing the data for surrogate pathogens. This question is relevant to Session 5.

## Session 2 – Variables Affecting the Reliability of Utilizing Hierarchy Concepts

**Goal:** Identify potential variables that might affect the hierarchical order and, thus, the stability of the hierarchy and reliability of representative organisms under different conditions.

*Charge Questions:*

- Which variables have the greatest impact on the stability of the hierarchy? To what degree does this vary between classes of microorganisms?
  - Physical parameters (pH, temperature, soil load, surface type, etc.)
  - Chemical parameters (active ingredient(s), formulation, surfactants, etc.)

- Method variability
- What options might be considered for addressing variables that have an impact on the stability of the hierarchy?

## Panel Discussion<sup>2</sup>

The panelists discussed variables that impact the relationship between classes and within classes of microbes. Survivability (and transmissibility), pH, mechanism of action and variations in formulation were among the variables panelists suggested should be considered when examining the hierarchy.

As a variable, pH has a differential impact on viruses, some of which are highly resistant to low-pH formulations, while others are susceptible to low-pH. For example, norovirus has adapted to low pH whereas ... is more sensitive in low pH conditions. Thus, caution about the differential effects of pH should be taken in using surrogate data.

Other panelists identified mechanism of action as an additional consideration. Lipophilic viruses, for example, are deactivated by lipophilic disinfectant formulations. If a product targets lipids, then it will not impact those organisms that lack the lipid mechanism of action, regardless of the organisms' relative position on the hierarchy. The panelists also identified other variables that would impact the performance of disinfecting products in lab testing versus clinical or ambient settings but that might not affect the stability of the hierarchy. These factors included differences in how products were applied and used, including product concentration and the hardness of the water with which a product is diluted, contact time, relative humidity, temperature, surface type, method of application, and soil load.

While it might not have a differential effect on organisms, soil load is particularly important to account for, as it hinders the ability of a disinfectant to reach and kill a micro-organism. Soil also can act on products being tested. EPA asked whether the question of the complexity or make up of the soil load is an issue and, if the hierarchy is to be brought up to date, how EPA should go about assessing the impact of soil load, e.g. should there be a consistent soil load matrix or is one default soil type enough, e.g. given that some pathogens are blood borne and some are found in food. One panelist suggested that soil load needs to be compatible with the organism being tested as a surrogate. It is important then to make sure this is used consistently for the other organisms in the tier. Another panelist observed that the issue of soil load is less important for relative susceptibility in terms of the hierarchy than for efficacy testing generally. Soil load issues work universally for all organisms. Another added that the impact of soil load may be more on the product than on the organisms, commenting that it does not seem to differentially impact organisms. Controlled studies would help determine if there are outliers to this conclusion. In that case, mechanisms of action might need to be considered.

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<sup>2</sup> Mid-way through the discussion the panelists clarified that in some cases the points made were about the significance of a variable on disinfection efficacy generally and in some cases the comment was intended to point out a variable that selectively impacts some organisms more than others (e.g. pH).

Some panelists reiterated that best practices encourage users to clean a surface before disinfecting, while others added that this cleaning does not always occur.

A panelist pointed out that temperature differences can be significant. Canada has been using a vaccine strain of polio for general virucidal claims. However, the weakness with that is that the polio virus does not survive well on dry surfaces. One needs to look at a better substitute for polio viruses. Some panelists noted that microbe survivability is a key consideration in selecting surrogates. A microbe with a short lifespan is not a good candidate for being a surrogate because it is difficult to verify whether the microbe was killed due to the natural lifespan, or due to the disinfecting product. The ability of a pathogen to survive in an environment is an indication of the risk of infection and therefore is an important consideration in selecting a surrogate organism. EPA could potentially look at clinical/epidemiological data (ex: from the CDC) to learn more about how microbes survive in the natural environment.

One may see more variation in the relative susceptibility of organisms for low-level disinfection products, particularly within a class, for example for non-enveloped viruses. For other organisms, the relative susceptibility is more intrinsic.<sup>3</sup>

To account for this and other differences between microbes, there could be additional sub-groups created within the hierarchy. Non-enveloped viruses could be broken down further into sub-categories, such as for lipid and non-lipid viruses. Certain small, non-enveloped viruses are very difficult to disinfect, and may be more difficult than some mycobacteria. Spores have a similar variability within classes, though due to different characteristics. One panelist proposed revising the hierarchy to make it more chemistry-dependent, drawing an analogy to the periodic table. There is little variability, based on chemistry, between classes, but there may be some variability within classes, particularly within non-enveloped viruses. This variability is particularly pronounced when milder anti-microbials are used.

Other considerations from panelists included:

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<sup>3</sup> The facilitator asked the panelist for a few examples, which were provided later as follows:

- **Poliovirus and Rhinovirus** – They belong to the same family of viruses and per the hierarchy they should have very similar susceptibility. However, Poliovirus seems always be more resistant than Rhinovirus.
- **Parvovirus/Circovirus and Picornavirus/Calicivirus** – All of them are small, non-enveloped viruses. Per the hierarchy they should, presumably, have similar susceptibility. However, Parvovirus/Circovirus are almost always more resistant than Picornavirus/Calicivirus.
- **Bovine Viral Diarrhea Virus (BVDV) and HIV-1** – Both of them are enveloped viruses and per the hierarchy they should have similar susceptibility. However, BVDV seems always be more resistant than HIV-1.
- **Murine norovirus (MNV) and Feline calicivirus (FCV)** – They belong to the same family of viruses. However, their resistance varies greatly, and sometimes entirely flips, depending on the active ingredients.

- Every decision made by FDA, EPA and CDC has an impact on the clinical end user .The clinical context needs to be considered in all decisions.
- In a clinical environment there is not a lot of variability in terms of surfaces. This should be taken into account when decided whether to revise testing procedures.
- The level of removal desired is an important point to consider. EPA should set product performance criteria high to give built-in confidence. Thinking in terms of log reduction could be a good way to set this threshold. There currently is not a set standard for log removal.
- Some question the correctness of the Spaulding hierarchy in its placement of mycobacteria and non-enveloped viruses.
- The hierarchy may never be perfectly able to cover all microbes. Instead, EPA should work to develop something that works with the majority of cases and could assign a confidence score for each class.
- Some microbes, such polio, do not survive well on dry surfaces. Canada is currently using polio as a surrogate for general virucidal claims, though it may not be the best choice for this reason.
- Infectious dose data is lacking for many diseases, though this does not impact confidence in the hierarchy. Another panelist added that it is difficult to generate data on minimum infective dose due to ethical considerations. Much of the original minimum infective dose data was originally generated using animal test subjects.

## Audience Questions and Comments

A webinar participant noted that biofilms are not well studied and may play a clinical role, while artificial soils are often used in testing environments. A panelist added that this is an issue that affects the food industry as well. Another panelist noted that this relates to product application and might not impact the hierarchy.

A webinar participant asked whether the hierarchy might be different for different active chemistries. In response, a panelist stated that formulations might make a difference and could completely change how a product with a certain active ingredient behaves.

An audience member observed that the hierarchy and the efficacy are not mutually exclusive and that it would be problematic to only address the hierarchy. An audience member asked for additional clarity on why EPA convened the workshop, i.e. why EPA is considering expanding the use of the hierarchy. An EPA participant responded that there were two initial goals for convening the workshop: determining how to improve emerging pathogens response, and examining the efficiency of the regulatory process and whether resources are being used for the greatest benefit.

A webinar participant asked whether any discussion have occurred in addressing disinfectants that claim residual activity against non-enveloped viruses and spores. A panelist responded that a test method exists for sanitizers to verify effectiveness against residual effect, but that other products are not generally tested for residual effects.

### ***Session 3 – Selection of Representative Microorganisms***

**Goal:** Discuss the selection of representative microorganisms within a class of microorganisms.

Charge Questions:

- What are the relevant characteristics of the microorganisms to consider in determining the most appropriate test organisms to represent all pathogenic organisms within a class?
- In what classes does the science suggest that more than one representative organism may be needed? For which other class(es) of microorganisms is there sufficient information to identify a representative microorganism that reliably meets all the relevant characteristics?

#### **Panel Discussion**

Panelists discussed characteristics of microbes that would help establish an appropriate surrogate for other microbes within the same class.

One commented that it isn't practical to use a single organism for each class or subclass.

Some panelists noted that an effective surrogate should be representative in worst case but real life situations (i.e. this should not be taken to extremes). It also should be robust enough to survive well under both testing conditions (e.g. carriers used) and under dry conditions. Others agreed and added that data such as that from the CDC's National Healthcare Safety Network (NHSN) could be used as the basis for selecting relevant organisms. Other panelists offered a different view that the surrogates should be clinically relevant, rather than relevant to the general population. Influenza, for example, is a pathogen that affects large portions of the general population but has limited relevance as a clinical pathogen as its means of transmission is not primarily through contaminated surfaces. Another panelist pointed out, however, that in an agricultural setting surfaces are important for avian influenza. Panelists added that the surrogates should be lab safe, widely available and well-characterized.

Panelists discussed the extent to which a surrogate organism should be the most difficult within its class to disinfect. Some panelists felt that this was a complicated threshold to establish, as the testing conditions can affect resistance. Different influenza viruses can produce different efficacy results. This does not depend on the active ingredient. The most resistant influenza virus also can change as new strains emerge. Others noted that the selection of the most difficult microbe to kill could give greater confidence in vertical applications of the hierarchy. Difficulty of disinfecting could potentially be measured by log kill, rather than a pass-fail test.

Based on these characteristics, panelists provided recommendations about potential surrogate organisms that could represent others within their classes. *Staphylococcus aureus*, already used as a surrogate by EPA, was identified by some panelists as a strong candidate for a gram-positive vegetative bacteria surrogate due to its high resistance to disinfection and its clinical relevance. A panelist suggested that Enterococci, such as Vancomycin-resistant enterococci (VRE) might be a good gram-positive surrogate (spreads through surfaces, persists for long periods of time, and is easy to grow). *Pseudomonas aeruginosa*, currently used as a surrogate by EPA for gram-negative vegetative bacteria, was viewed unfavorably by some panelists due to its inability to survive in dry environments and its difficulty growing in a lab setting. Some panelists suggested that other gram-negative bacteria might be more suitable, such as *Acinetobacter baumannii* (more survivable, more clinically relevant, inherently more resistant to disinfectants, not affected by dry environments) and *Serratia marcescens*. For the mycobacteria class, some panelists also suggested *Mycobacterium terrae* (fast growing, safe, well characterized, standardized strains are available) and a rapid grower such as *M. smegmatis* (more resistant than *M. terrae*) as potential surrogates.

During the discussion several panelists noted concerns that a decision to expand the hierarchy might cause end-user confusion, as users are traditionally eager to see each verified organism on a label and want the ability to view the test data for those organisms if needed. Other panelists added that product producers also want to have test data for specific microbes to back up their claims. EPA participants noted that no decisions had yet been made about whether the use of the hierarchy would be further expanded, or what that expansion would entail. The surrogates for a product claim would not necessarily be the only things listed on a label; producers might also be able to list additional claims. Some panelists expressed concern about limiting labels claims to surrogates and others expressed concerns about allowing producers to list additional claims beyond those established by the surrogates.

Other points made by panelists included:

- It may be more logical to discuss the stability and applicability of the hierarchy before discussing surrogate organisms. This will affect what claims one can make for surrogates.
- The hierarchy is already in use. The question is what a reasonable approach for expanding it is.
- Should there be a separate set of surrogates for drug-resistant bacteria? Some panelists felt that a separate test for drug-resistant bacteria would not equate with disinfection resistance, while others noted that it might pose lab safety concerns.
- There should be considerations given to how accurate the hierarchy must be, given that it may not always be 100% accurate. It may be necessary to establish confidence levels.

## Audience Questions and Comments

Members of the audience and webinar participants were given the opportunity to ask clarifying questions of the panelists based upon the previous discussion.

An audience member noted that many of the exceptions to the hierarchy that currently exist could be resolved through improved methodologies for testing.

Another audience member asked how EPA would plan to establish confidence in the ability of a surrogate to represent others within its class and within lower classes and whether all clinically relevant microbes would still be listed on the label of a disinfecting product. An EPA representative noted that this had yet to be determined. The facilitator added that this was an area that could potentially be covered during the Session 4 discussion.

An audience member asked whether porous surfaces impacted the hierarchy and whether the hierarchy needed to be different for different settings. Panelists noted that there is not currently a reproducible method for testing on porous surfaces, though one is in development. In all cases, however, disinfectants will be less effective on porous surfaces than in hard surfaces. Agricultural settings, in particular, face a separate set of disinfecting challenges than a clinical environment.

The panelists spent additional time discussing the use of surrogates for viruses. Some panelists noted that viruses might be more difficult to classify using just one surrogate, and that three or four separate surrogates might be needed to cover the different characteristics. Size of the virus (large vs. small), rate of growth and ease of growth might be potential considerations for selecting a surrogate. Panelists suggested the following viruses as potential surrogates:

- Bacteriophage MS2: well-studied, grows rapidly, and can grow to high levels allowing easier determination of amount of kill.
- Rotavirus: an example of a large, non-enveloped virus that would be easy to work with in a lab and would have clinical relevance. The rotavirus also has an internal lipid, making it an effective surrogate for lipid viruses.
  - Adenovirus could be another suitable large, non-enveloped virus.
- Feline calicivirus: a small, non-enveloped virus that rapidly grows to a large quantity, is resistant to drying, resistant to disinfection, and is less resistant to low pH.
- Hepatitis C: one of the smallest enveloped viruses and is highly resistant to disinfection.
- Additional potential surrogate for enveloped viruses might include Influenza, due to high relevance.
- Small, non-enveloped viruses could potentially be divided into two or three sub-categories, with a surrogate for each, potentially including:

- Tier 1 (smallest): Parvovirus, Circovirus, and Astrovirus
- Tier 2: Polio, Hepatitis A and Calicivirus
- Tier 3: Rhinovirus

Some panelists noted that surrogates would need to be vetted more thoroughly, possibly using a literature review, before EPA reached any decisions, as there is likely not to be clear consensus around surrogates otherwise. Others warned that any literature review would need to take differences in methodology into account.

## ***Session 4 - Application of the Disinfection Hierarchy***

**Goal:** Discuss ways in which uses of disinfection hierarchy concepts are supported by current science.

Charge Questions:

- Given current science, in what ways and/or for what classes of microorganisms can disinfection hierarchy concepts be applied sooner rather than later?
- What are important limitations based on current science?

### **Panel Discussion**

A panelist underscored the importance how to make any expanded use of the disinfection hierarchy understandable to end users and the general public. Another added educating front line workers and their managers, using a recent OSHA experience with MSDS and SDS as an example.

Panelists noted that use of surrogates for classes of bacteria, possibly including some of the surrogate organisms identified by some panelists in Session 3, could potentially serve as a starting point for further expansion of the disinfection hierarchy. Bacterial surrogates are already used for the general hospital disinfectant claim, so this change could be implemented sooner rather than later, if desired. Hierarchy concepts could also be applied to fungicidal claims, similar to the current system being used by Canada, to include pathogenic and non-pathogenic fungi might be an easy expansion. Vegetative bacteria might also be an area for expansion. Viruses would be far more challenging and as there are a number of open questions regarding the surrogates used for both classes of viruses.

A key point of discussion between panelists was how labelling would be treated if EPA were to expand its usage of disinfection hierarchy concepts to additional general label claims. Simplifying the process to only include general labelling claims, with no additional product claims listed, might reduce redundancy in lab testing and in regulatory review, but would also have implications for product producers and end users. A panelist noted that many producers use additional listed claims as a selling point to differentiate their product from their competitors' and that some end-users prefer to see all organisms listed on a label. EPA could potentially approach the labelling/testing issue in several different ways:

1. Allowing producers to make additional claims if the producers tested the organisms separately, but not requiring producers to submit the data for EPA review. Panelists noted that it may be risky to allow producers to make claims without EPA verification. EPA could potentially conduct spot-checking to verify these claims or could receive summary reports from producers listing the key factors for the additional claims.
2. Allowing producers to make additional claims without a test, due to confidence in the surrogate. Some panelists noted that producers might be uncomfortable making product claims without having testing data to support the claim.
3. Requiring that all labels only list the general disinfection category claim. The EU currently uses a similar system, with labels that include standard language about particular grades of disinfectants, without listing additional organisms. The EU only tests four organisms for their general label claims. While some panelists noted that the rates of infection do not appear to be higher in Europe and other countries that have adopted such a model, others countered that these countries may not have close tracking of hospital-caused infection rights, or might be supplementing their product reviews with added confidence from EPA-approved products.

EPA noted that any changes to the current testing model would be conducted in a way that does not compromise the quality of the final antimicrobial product.

An expanded hierarchy would need to be clear enough to be well-understood by the general public. An educational campaign may be needed for the end-users of disinfecting products to ensure that the products are properly applied in a clinical setting. Clarity around terms and labelling would also help facilitate understanding: clinical users do not understand terms such as “intermediate” and “low-level” disinfectants. It is important to understand the end users’ needs and thought process. One panelist pointed out that in a hospital setting, users want to have confidence that the products they use are effective against gram negative bacteria, gram positive bacteria and some viruses. In hospital settings, variation in kill time is a problem; it is sometimes confusing to know how long to allow a product to remain on a surface. If a hospital is seeing a particular pathogen in their units, they want to make sure the disinfectant is effective against that pathogen. Hospital users would be uncomfortable if claims were made for specific pathogens not actually tested. Considerations also need to be given to how this guidance might differ for users in food service settings.

Additional comments from panelists included:

- How might any changes to the application of disinfection hierarchy concepts affect FIFRA and the proposed global pathogen standard?
- The current EPA review process is held in high esteem both by end users and by the international community and is seen as the ultimate guarantor of product quality. It is important to test the products to protect the public health.

- The use of the hierarchy in Canada and Australia is not leading to public health crises there. A panelist noted that noroviruses have been causing infections in some countries and might be an example of a microbe that has not been properly accounted for in the usage of hierarchies for product testing. Another panelist noted that this could potentially be due to improper use of the product or through non-surficial spread.
- Education can help with the concerns associated with changes to the regulatory process.
- There are other ways to improve efficiency: reduce redundancy in lab testing and reduce redundancy in regulatory review, taking into consideration the amount of confidence lost.
- Another option is to require the testing and require that companies maintain the data. This can get reviewed during GOP reviews. EPA also could require a summary report, listing what was tested, the contact time, etc.
- Multiple surrogates in a class or subclass might increase confidence.
- Label simplification is a topic that is worth considering in the future.

## Audience Questions and Comments

Members of the audience and webinar participants were given the opportunity to ask clarifying questions of the panelists based upon the previous discussion.

An audience member commented that this has been a good discussion and noted that end users of products will often want to have lab certifications on file for the products that they use. Limiting the number of organisms listed on a label would require a significant user education campaign.

Another audience member added that it is important for EPA to ensure that any regulatory changes are conducted in harmony with state regulatory bodies to ensure consistency, adding that data submitted to EPA and the states are also shared with Canada. Canada and the European Union regard EPA as being the platinum standard for testing, and are more comfortable when they receive these disclosures. A panelist added that Canada considers itself mostly in lockstep with EPA's approach, with the exception of virucidal testing.

An audience member suggested that it might be possible to reduce the batches necessary for testing non-surrogate organisms to reduce redundancy and burden.

## Session 5 – Next Steps/Path Forward

**Goal:** Identify information gaps and other stakeholder perspectives for EPA to consider.

What data and/or scientific studies could be completed relatively quickly, which could support additional application of the disinfection hierarchy – and in what ways?

- What other scientific or policy considerations should EPA take into account in considering expanded use of the disinfection hierarchy for regulatory purposes?

## Wrap Up Comments from the Panel

Panelists provided wrap-up comments regarding the path forward and areas for future exploration:

- Literature review could provide a good starting place for comparing how well certain disinfectants affect different organisms. These results will need to be analyzed in a way that takes methodological differences into account. It's not enough to consider pass/fail only; quantitative information on log reduction is needed. This information could be supplemented with expert consultations. Another panelists commented that relying on the literature might be risky because of differences among labs.
- We need to be open to change, but EPA should consider how expansion of the hierarchy might impact end users and industry. Future discussions should include medical staff.
- EPA could draw from existing models, such as the Centers for Medicare and Medicaid Services (CMS) "deemed status" program. The program certifies certain trusted labs for reduced testing requirements.
- EPA's efforts should be aligned with those of the CDC's on the clinical environment of care.
- EPA could develop a quantitative, microbial risk assessment approach, similar to that used by the EPA Office of Drinking Water.
- Future discussion and study should include consideration of how disinfectants are used in a farm setting and on non-porous surfaces.
- It is important to standardize test methodologies to increase confidence in the results. EPA has conducted some work on standardizing test methods, including taking a leadership role in OECD discussions, but additional standardization of testing methods is needed. An example of this might be how physical action such as wiping impacts disinfection.
- Additional discussion and research should be conducted to ensure that the hierarchy is scientifically sound. There is not a consensus on whether it is correct or not. Additional research is particularly needed to validate the stability of the hierarchy within classes of microbes. It is easier to answer the question of whether the hierarch is stable, say, within vegetative bacteria than it is to answer the question of whether the entire hierarchy is stable.
- Blinded failure data from labs is important information in understanding and improving the disinfection hierarchy.
- Disinfectants can sometimes be marketed in a way that increases the confusion of end users and causes them to inadvertently use it in a manner that does not disinfect the intended pathogens.

## Audience Comments

Members of the audience and webinar participants were given the opportunity to provide any final comments regarding the day's discussion.

An audience member noted that the day's discussion had assumed that all surfaces were horizontal, and asked whether there needed to be a consideration about vertical/3-D surfaces and contact time for those surfaces.

An audience member observed that the day's discussion reaffirmed that EPA's current regulatory approach is held in high regard, noted that many end users rely upon the information that EPA provides, and asked that EPA be sure to communicate regarding any follow-on activities.

As a parting thought, an EPA participant asked panelists to consider factorial designs that might be used to establish standardized approaches for testing different variables and products. The participant urged panelists and attendees to provide input and thoughts.

## Meeting Wrap-up

Dr. Jennifer McLain, Deputy Director of the Antimicrobials Division within OPP, thanked participants for their active engagement and expressed her appreciation for the deep and compelling discussion. Dr. McLain noted that the day's proceedings have given OPP a number of ideas to take into account in considering how to proceed, including policy impacts, potential research topics, and possible programs for working with the user community. OPP will be making the presentations and meeting summary available online for public viewing, and will consider conducting another workshop in the future.