Writing guidelines to require disinfection

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Summary: Disinfection, when performed correctly, is an important step in the control and elimination of specific disease agents. Typical disinfection instructions merely state that 'the premises or materials contaminated by or exposed to disease shall be disinfected'. Directions are rarely given on how to perform the job.

The first stage in a complete and proper disinfection operation for materials and property involves a thorough assessment of the problem and the development of a step-by-step action plan. Detailed guidelines should address the relevant questions – who should do what? where, when and how? – in relation to each step of the job. It should be ensured that all work is correctly executed and reported, and a follow-up evaluation of the premises should be made to verify that the disease agent(s) have been destroyed. Persons using disinfectants should always follow safety precautions to avoid the risk of occupational injuries.


INTRODUCTION

The following anecdote illustrates the potential dangers of imprecise or incomplete instructions for disinfection. A severe animal disease outbreak was in progress in a rural area. One farmer, whose herd had been destroyed by the disease, was told by the local animal health authority that he must disinfect the premises before re-stocking with new animals. The farmer proceeded to purchase a bottle of common household disinfectant from the local grocery store. The directions on the bottle said to mix the contents with a large amount of water. Following these directions, the farmer emptied the bottle into the farm pond, and merrily declared that his premises were completely disinfected. Well, perhaps this was true of the fish!

Typically, disinfection regulations are limited to statements of the following kind: 'to prevent the spread of disease, all premises, materials, and other items contaminated by or exposed to disease shall be disinfected'; or 'premises, materials and other items shall be cleaned and disinfected whenever necessary for the control and eradication of disease' (4). Generally, legislative guidelines do not give detailed instructions about specific procedures for cleaning and disinfection: what is to be accomplished, the order in which certain tasks should be performed, or the products and equipment which should be used.

If disinfection is really necessary, how should this be performed? All too often, in the past, disinfection has been considered far from essential, but regarded as harmless and

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possibly of some small value. However, for the farmer, disinfection can be of considerable importance. In some situations, thorough cleaning with a sanitizing detergent may suffice to eliminate most of the microbial organisms present. However, to kill specific disease-causing agents which may be present at an animal production facility, all structures, materials and associated items, both free-standing and attached, must be disinfected.

When the disinfection of premises is mandated, the goal should be to destroy the targeted disease-causing pathogen(s). Application of a disinfectant is usually necessary to accomplish this, but only as one part of a multiple-step action plan which must be developed, implemented, and then tested for efficacy (1).

To ensure compliance with any directive to disinfect a structure, action plan guidelines should be written to explain precisely what should be done, and how to verify whether the operation has been successful. Guidelines must deal with specific requirements for the facility and all related items.

**PREPARATION FOR WRITING GUIDELINES**

Guidelines should be written in the form of a multiple-step action plan. Each set of instructions should detail exactly what needs to be done, the order in which individual jobs must be carried out, the method to be employed, and what is expected to have been accomplished when each assignment is finished. There must be no uncertainty or ambiguity about what is supposed to happen. False assumption is at the core of almost all foul-ups, so nothing should be assumed.

The same basic approach should be adopted for most general disinfection guidelines; these should be simple and easy to understand. The first step in formulating and outlining the disinfection plan is to assess the situation as a whole, namely by defining the problem and examining the overall picture. Unique situations which may warrant special attention must be studied and analyzed.

The following factors must all be considered:
- environmental conditions
- microbial agent susceptibility
- type of facility and construction
- types of surface areas to be cleaned
- equipment required to perform special tasks
- cleaning and disinfection supply needs
- biosecurity on and off the premises
- resources
- personnel
- operating costs.

Before developing the final guidelines, each of these areas must be described in detail, common elements must be ascertained and priorities established (3).

In preparing to write guidelines, basic questions should be asked and answered: who should do what? where, when, how and why?
Specific questions to ask include the following:
- What should be cleaned and disinfected?
- Where is this located?
- What special considerations or precautions are needed for each item and surface area?
- What needs to be done first, second, third, etc., and why?
- How should each task be performed?
- When should it be done?
- What is the order of procedures?
- Who should perform each task?
- How long should it take to accomplish the job?

Each step of the action plan for the premises should be considered: assessment, cleaning, sanitization, disinfection and, finally, evaluation (6).

WRITING BASIC GUIDELINES

The writing of general guidelines for cleaning and disinfection of premises begins with establishing a goal for each task. A standard protocol should be developed and maintained throughout the guidelines. The duties and responsibilities of personnel assigned to specific tasks should be described in detail. Team personnel should be identified, and a hierarchy of accountability should be established for the supervisor of the cleaning and disinfection unit and the team members (3). The duties and responsibilities of each cleaning and disinfection unit should be briefly described. An itemized inventory of the equipment needed by the cleaning and disinfection teams should be presented, together with an outlined 'check-off' sheet.

Step-by-step instructions for cleaning and disinfection should be developed for all tasks to be performed on the contaminated premises, including biosecurity, and cleaning and disinfection activities required at the entrance to the premises for persons and vehicles permitted to enter or leave. To facilitate follow-up activities, the guidelines should require a report to be compiled of all cleaning and disinfection activities accomplished, indicating the date, time, and who completed each task. This record should include the names of persons entering or leaving the premises, and vehicle identification tag numbers (1). Written instructions and precautions against the disease should also be prepared in the guidelines, so that copies may be given to all persons leaving the contaminated premises.

PROCEDURAL ASSESSMENT FOR WRITING CLEANING AND DISINFECTION GUIDELINES

Selection of disinfectants

The guidelines must document the infectious agents which are likely to be present or are actually present at a facility, and should either indicate an appropriate disinfectant or describe how the disinfectant should be selected.

Certain chemicals are particularly effective against specific microorganisms (Table I). The efficacy of disinfectants also varies due to environmental conditions (e.g. extreme cold, moisture, pH) and the ability to remove organic matter prior to disinfection (types of flooring) (5).
<table>
<thead>
<tr>
<th>Target organism</th>
<th>Disinfectant</th>
<th>Factors affecting activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gram-positive</td>
<td>Quaternary ammonium compounds</td>
<td>Activity reduced by soaps and organic matter; non-toxic</td>
</tr>
<tr>
<td>Gram-negative</td>
<td>Calcium hydroxide</td>
<td></td>
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<tr>
<td>Acid-fast</td>
<td>α-phenylphenol</td>
<td></td>
</tr>
<tr>
<td>Spore-forming</td>
<td>Hydrochloric acid, formaldehyde,</td>
<td>Elevated temperatures increase sporicidal activity</td>
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<tr>
<td></td>
<td>sodium hydroxide</td>
<td></td>
</tr>
<tr>
<td><strong>Rickettsiae</strong></td>
<td>Formaldehyde, iodine compounds</td>
<td>Mutagenic and carcinogenic; iodophors are non-toxic</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td>Chlorhexidine, formaldehyde,</td>
<td>Efficacy reduced in acid pH</td>
</tr>
<tr>
<td></td>
<td>iodine compounds</td>
<td></td>
</tr>
<tr>
<td><strong>Enveloped viruses</strong></td>
<td></td>
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<tr>
<td>Herpes, rabies</td>
<td>Quaternary ammonium compounds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phenolics</td>
<td>Phenolics retain activity in the presence of organic matter, pH affects activity</td>
</tr>
<tr>
<td>Influenza, equine</td>
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<td>infectious arteritis</td>
<td></td>
<td></td>
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<tr>
<td>Hog cholera, velogenic</td>
<td></td>
<td>Chlorine compounds are neutralized by organic matter</td>
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<tr>
<td>viscerotropic</td>
<td>Phenolics, sodium hypochlorite</td>
<td></td>
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<tr>
<td>Newcastle disease,</td>
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<tr>
<td>African swine fever</td>
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<tr>
<td>Aujeszky's disease</td>
<td>Sodium hydroxide</td>
<td>Caustic/corrosive</td>
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<tr>
<td><strong>Non-enveloped viruses</strong></td>
<td></td>
<td></td>
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<tr>
<td>Foot and mouth disease,</td>
<td>Sodium hypochlorite, sodium</td>
<td>Increased pH decreases activity of chlorine</td>
</tr>
<tr>
<td>vesicular exanthema of swine</td>
<td>hydroxide, sodium carbonate</td>
<td></td>
</tr>
<tr>
<td>African horse sickness</td>
<td>Acetic acid</td>
<td>Acids should not be added to hypochlorites, as chlorine gas is liberated</td>
</tr>
<tr>
<td>Swine vesicular disease</td>
<td>Sodium hypochlorite</td>
<td></td>
</tr>
</tbody>
</table>

**Safety in the use of disinfectants**

The instructions of the disinfectant manufacturer should be followed to minimize damage to the environment and prevent the transmission of disease-causing agents between premises.

All persons responsible for applying disinfectants must be aware of the characteristics of the disinfectants being used, and must follow the instructions of the manufacturer and other recommended safety precautions to prevent possible injury. Chemical disinfectants are often corrosive and poisonous, and must be handled with care. Guidelines should
include a list of any protective equipment needed. Information should be given on the correct use of protective clothing, boots, gloves and goggles, to prevent exposure of the eyes and skin. Other protective equipment (e.g. respirators) should be described, together with instructions for use and details of circumstances under which they are needed. The location and telephone numbers of the nearest hospital and poison control centre should also be listed in the guidelines, for use in emergencies (2).

Preliminary cleaning

Many infectious agents can survive for long periods in soil, faeces, water, animal products, bedding, feed and fomites. Therefore, guidelines should include the procedure for thorough cleaning to precede disinfection. Specific instructions may be written for the cleaning of various materials and surface types, e.g. wood, metal, brick, stone and dirt floors. This may include instructions for preliminary cleaning of areas while they are dry. If dust is a problem in a facility, guidelines should be developed on how to deal with this. In this case, it may be necessary to wet the area with disinfectant solution before commencing general cleaning. All dogs, cats, poultry and other animals on contaminated premises should be confined until cleaning and disinfection have been completed.

General guidelines must include provisions for a system for hauling manure, debris and feed to a disposal site for burning, burial or composting. In the case of manure and bedding which cannot be burned or buried, recommendations should be made for these to be composted, sprayed with appropriate disinfectant, and overlaid with 6 mm thick black plastic (2). This will exclude birds, rodents and insects, and will promote the production of heat by fermentation, and thus the destruction of infectious agents. Directions should be provided for thorough composting of manure, which may subsequently be spread on fields after an appropriate period of time.

Guidelines for disinfection of contaminated holding lots and areas of livestock concentration should note that the top 5-8 cm of soil can be removed and buried or composted.

All contaminated surfaces must be thoroughly cleaned and gross debris particles removed, to ensure direct contact between the pathogen and the disinfectant. Guidelines should begin with instructions for large debris to be removed by shovel, then for all loose debris to be scraped off, and finally for surfaces to be wiped clean and small particles swept up. Disinfectants are only effective when they come into direct contact with the pathogen: they are ineffective when the disease-causing microorganisms are covered and protected by organic matter, debris or other pollutants. It should be noted that halogen-based disinfectants (sodium hypochlorite) are inactivated by organic matter, and that the cleaning phase is therefore critical when such products are to be used (5).

Although thorough cleaning with a solvent and cleanser can remove most pathogens from smooth surfaces, this does not always kill the pathogens.

Use of detergents

Guidelines for general cleaning should include instructions for washing and scrubbing surface areas with detergents, and then diluting and rinsing with clean water. It should be noted that electrical supplies must be turned off in any building before it is washed down.

Cleaning dislodges and removes the surface contamination, while sanitizing reduces the large numbers of microorganisms to a low level. If conditions warrant that certain areas and items be ‘steam cleaned’, special instructions must be written, together with
the necessary safety precautions (6). Inspection and reporting after cleaning also form part of the task, and appropriate instructions must be included in the guidelines.

Drainage and ventilation systems at the facility must be inspected before final decisions are made on the method of disinfection. When writing disinfection guidelines, care should be taken to address special problems which may arise, together with possible solutions.

After the cleaning is complete, all surfaces should be rinsed and inspected. Residues of soaps and detergents used on surfaces following cleaning can interfere with some disinfectants (especially quaternary ammonium compounds).

Disinfection

A disinfectant should be used to inactivate or kill the specific pathogen(s) against which it is directed. It is imperative to write clear and concise guidelines for proper use and application of an appropriate disinfectant. (If a particular product is to be used, this should be named in the guidelines.) Chemical disinfectants should be mixed in the recommended concentrations at the correct temperature, applied properly using suitable equipment, and always handled with care. The guidelines should describe how to calculate these concentrations, measure temperature, and safely operate the required equipment. Care should always be taken to read and follow the directions of the manufacturer. The following brief is a generic example of how to write this type of directions. It involves mixing a liquid disinfectant concentrate in water:

- Dilute one part (10 ml) base into ten parts (100 ml) cold (< 30°C) tap water, then add one part (10 ml) activator, to make a total of twelve parts (120 ml). Do not mix the base and the activator parts directly together; each should be mixed separately into the water solution. The resulting mixture should appear as a clear, greenish liquid.

- The disinfectant may be safely used on stainless steel, glass, plastic, ceramic and rubber. Prolonged exposure will corrode aluminium. Do not use on copper or zinc.

- The solution may be sprayed (hand pump or power sprayer) or wiped on by any convenient means (mop, sponge, cloth rag, etc.). The surface to be disinfected should be thoroughly wet with the solution. Apply for one minute to inactivate bacteria, viruses and fungi.

- The product has an effective shelf life of seven days after it is mixed into a suspension. Mix well each time before each use. Discard any remaining solution after each day’s use.

Initial spraying with the disinfectant may be required to reduce dust and particles which might otherwise become aerosols (6).

Disinfection personnel should be provided with waterproof protective clothing, rubber boots and face masks (especially if a zoonotic disease potential exists). If machinery is used (e.g. mechanical sprayers), specific instructions should be provided detailing safe and correct operating procedures. It should be noted that electrical supplies must be turned off in any building before it is washed down.

Disinfection is accomplished by thoroughly soaking the surface areas with the disinfectant solution. Guidelines should stress that a disinfectant must be applied on all surfaces in the correct concentration. The recommended time frames for surface contact with the disinfectant (usually 1-5 min) should be observed. This time is needed for the disinfectant to act on bacteria, viruses and pathogenic fungi prior to rinsing with a neutralizing or diluting solution.
Disinfectant should be sprayed on hard graded surface areas, such as concrete 'holding lots' used for livestock concentration. The pH value of liquid manure lagoons or holding tanks may be raised or lowered using appropriate chemicals to destroy certain pathogens. Sewers and drains should be flooded with concentrated disinfectant (6).

Instructions should be included on the disinfection of a water supply (e.g. by flushing sodium hypochlorite through the water system).

Some equipment, such as electric motors, electronic sensors and sensitive mechanical devices, cannot be disinfected using chemicals which may be corrosive. In this case, fumigation may be the only way to decontaminate these items. If fumigation is to be used for disinfection, special guidelines and personnel safety precautions are required. Fumigation can be performed only in buildings which can be thoroughly sealed. Appropriate warning signs must be posted at all entrances. Special note should be taken of the need to open or remove permanent protective covers from the equipment or machinery, so that the fumigant can act on all surface areas, both inside and out.

**Evaluation and inspection**

A specific 'down time' must be determined, which must elapse before inspecting and re-stocking the facility following complete cleaning and disinfection. Before the introduction of sentinel animals, if this is required, a designated official inspector should perform a final examination of the entire premises to ensure the integrity of the operations performed. The final evaluation includes inspection, swabbing with culturing, testing the environment to ensure that all the disease-causing agents have been destroyed, and writing a final report (2). The inspector will be responsible for issuing the final report approving the site.

**CONCLUSION**

In conclusion, use of disinfectants is a very important step in the control of infectious diseases. However, a successful disinfection plan requires initial consideration of microbial susceptibility and environmental conditions. Guidelines should be written to ensure complete disinfection of materials and premises. The guidelines should present an assessment of the problem, formulate an action plan, provide details on how to accomplish each task and how to ensure work is executed correctly, and provide a method for follow-up evaluation of the premises to ensure that the disease agents were destroyed. When an appropriate disinfectant has been selected, step-by-step instructions for proper application of disinfectants (including concentration and method of application) are imperative. Use instructions must also specify all safety precautions to prevent occupational injuries. Guidelines should be specific and concise for each step of the plan, and should never assume anything.

Résumé : La désinfection, lorsqu’elle est correctement réalisée, constitue un important moyen de prévention et d’élimination d’agents pathogènes spécifiques. La plupart du temps, les instructions en la matière se limitent à cette simple mention : « les locaux et matériaux contaminés ou ayant été en contact avec des malades doivent être désinfectés », sans jamais, ou presque, indiquer comment s’y prendre.

Une désinfection complète et correcte du matériel et des locaux implique, au préalable, une évaluation minutieuse du problème et la mise au point d’un plan d’action en plusieurs étapes. Les consignes doivent apporter une réponse précise aux questions suivantes : qui, quoi, où, quand et comment, pour chacune de ces étapes. Il convient, en outre, de s’assurer que l’opération dans son ensemble a été correctement effectuée et consignée dans un rapport. Enfin, il faut procéder à une évaluation des résultats de la désinfection dans les locaux, afin de s’assurer que les agents pathogènes ont bien été détruits. Quant aux personnes utilisant les désinfectants, elles doivent suivre scrupuleusement les consignes de sécurité pour éviter tout risque d’accident du travail.


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Resumen: La desinfección, si se lleva a cabo correctamente, es un importante medio de prevención y de eliminación de agentes patógenos específicos. En general, las instrucciones al respecto se limitan a mencionar que «deben desinfectarse los locales y los materiales contaminados o que han estado en contacto con animales enfermos», sin indicar cómo hacerlo.

Para llevar a cabo una desinfección completa y correcta de los locales y los materiales del caso es necesario efectuar previamente una evaluación minuciosa del problema y elaborar un plan de acción en varias etapas. Las directivas deben aportar una respuesta precisa a las preguntas acerca de qué, cuándo, dónde, por quién y cómo desinfectar, en cada una de esas etapas. Es conveniente, por otra parte, poder garantizar que la operación en su conjunto se ha efectuado correctamente y consignado en un informe. Es necesario evaluar los resultados de la desinfección en los locales, de modo de poder verificar que los agentes patógenos han sido destruidos. Las personas que utilizan los desinfectantes deben seguir cuidadosamente las consignas de seguridad, para evitar los riesgos de accidentes de trabajo.


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REFERENCES


