Review:
Efficacy of three surface disinfectants against spores of Clostridium difficile ribotype 027

* Original study: Douglas Horejsh¹, Günter Kampf²,³,⁴
Efficacy of three surface disinfectants against spores of Clostridium difficile ribotype 027.
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**Efficacy of three surface disinfectants against spores of Clostridium difficile ribotype 027**

*Clostridium difficile* is the most common cause of antibiotic-associated diarrhoea in hospitals. A recent study investigated whether sporicidal surface disinfectants are also effective against spores of *Clostridium difficile* ribotype 027.

The last few years have witnessed a rise in nosocomial infections caused by the spore-forming bacterium *Clostridium (C.) difficile* – particularly since the emergence of ribotype 027. Spores of *C. difficile* can survive on inanimate surfaces for months and are primarily found in the environment of infected patients, namely on toilet seats (33%), bed pans (26%) and the floor (15%) (1). The frequency of environmental contamination with *C. difficile* increases when the patient suffers from diarrhoea. The targeted decontamination of surfaces by using a sporicidal surface disinfectant (for instance with the active substance hypochlorite) has been shown to reduce the incidence of *C. difficile* infections (2). It is also known that hydrogen peroxide which is an oxygen-releasing agent is suitable for disinfecting surfaces contaminated with *C. difficile*. However, the efficacy of most active ingredients against spores of ribotype 027 is still unknown.

**Materials and methods**

In this study, scientists led by Douglas Horejsh (Richmond, USA) and Günter Kampf (Hamburg, Germany) investigated three surface disinfectants based on magnesium monoperoxyphthalate or aldehydes for their activity against spores of *C. difficile* strains including ribotype 027. The scientists examined the following surface disinfectants which are available as concentrates: Dismozon® pur (active ingredient: magnesium monoperoxyphthalate hexahydrate), Kohrsolin® extra (active ingredients: (ethylenedioxy)dimethanol, glutaral and didecyl-dimethylammonium chloride), and Kohrsolin® FF (active ingredients: glutaral, benzyl-C12-18-alkyldimethylammonium chloride and didecyl-dimethylammonium chloride). All three surface disinfectants are manufactured by Bode Chemie GmbH in Hamburg, Germany.

*C. difficile* NCTC 13366 served as representative strain for ribotype 027. The spore count preparations were generated using standard methods, yielding a spore share greater than 90 %. The efficacy was tested in suspension tests. The neutralisation was validated to exclude residual microbicidal activity of the surface disinfectants after the exposure time.

**Results**

All three surface disinfectants reduced the number of spores by ≥ 4 log₁₀ steps, e.g. Dismozon® pur at 1.5 % and within 2 hours of exposure, Kohrsolin® extra at 2 % and within 4 hours of exposure, and Kohrsolin® FF at 2 % and within an exposure time of 6 hours. Compared to the other two *C. difficile* strains, the spores of ribotype 027 did not demonstrate a lower susceptibility to Dismozon® pur (see table on the right).

**Conclusion**

Previous studies have already indicated that sporicidal surface disinfection (primarily with hypochlorite) can contribute to limiting the distribution of *C. difficile*-associated diarrhoea. Therefore, with the global emergence of *C. difficile* ribotype 027, it appeared necessary to investigate whether commonly used surface disinfectants with sporicidal activity are also suitable to kill spores of ribotype 027. This study shows that all three tested surface disinfectants – in specific concentrations and exposure times – yield sufficient efficacy levels. The authors came to the conclusion that the surface disinfectants Dismozon® pur, Kohrsolin® extra and Kohrsolin® FF are effective for sporicidal surface disinfection in outbreaks caused by *Clostridium difficile* ribotype 027.
**Glossar**

**Clostridium difficile**
Spore-forming, anaerobic Gram-positive, rod-shaped bacterium belonging to the Clostridia. It can be found in soil, water and the intestines of humans and animals. *Clostridium difficile* is extremely environmentally resistant, triggers diarrhoea and colitis and—due to its ability to form spores—is considered the most important nosocomial germ (pathogen acquired in hospitals).

**Clostridium difficile Ribotyp 027**
In recent years, there has been an increase in particularly severe infections caused by a new and aggressive *C. difficile* strain: *Clostridium difficile* ribotype 027. This strain produces levels of toxins A and B that are 16 and 23 times, respectively, higher than other strains and was responsible for outbreaks of *Clostridium difficile*-associated diarrhoea (CDAD) in North America and Europe.

**Clostridium difficile-associated diarrhoea (CDAD)**
This kind of diarrhoea is caused by a *Clostridium difficile* infection, often occurs in the course of an antibiotic therapy, and is associated with an increased fatality rate. The toxins of the bacterium *Clostridium difficile* attack the cells of the mucous membrane of the small intestine, thus increasing its permeability. Typical CDAD symptoms include watery diarrhoea, lower abdominal pain, fever (rare), and sickness. In severe cases, pseudomembranous colitis may occur.

**Reduction of Clostridium difficile spores by three surface disinfectants (log10-steps)**

<table>
<thead>
<tr>
<th>Surface disinfectant</th>
<th>Concentration</th>
<th>C. difficile strain</th>
<th>30 min</th>
<th>60 min</th>
<th>120 min</th>
<th>180 min</th>
<th>240 min</th>
<th>360 min</th>
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<tbody>
<tr>
<td>Dismozon® pur</td>
<td>1 %</td>
<td>Ribotyp 027</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td></td>
<td>1.5 %</td>
<td>ATCC 700057</td>
<td>2.89</td>
<td>4.20</td>
<td>&gt;4.98</td>
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<tr>
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<td>1.5 %</td>
<td>ATCC 9689</td>
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<td>3.35</td>
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<tr>
<td></td>
<td>1.5 %</td>
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<td>3.36</td>
<td>&gt;5.53</td>
<td>&gt;5.53</td>
<td>—</td>
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<tr>
<td></td>
<td>2 %</td>
<td>Ribotyp 027</td>
<td>—</td>
<td>4.53</td>
<td>&gt;5.53</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Kohrsolin® extra</td>
<td>2 %</td>
<td>Ribotyp 027</td>
<td>—</td>
<td>—</td>
<td>3.53</td>
<td>—</td>
<td>4.53</td>
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</tr>
<tr>
<td></td>
<td>3 %</td>
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<td>—</td>
<td>—</td>
<td>3.84</td>
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<tr>
<td></td>
<td>6 %</td>
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<td>—</td>
<td>3.35</td>
<td>—</td>
<td>&gt;5.42</td>
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<tr>
<td>Kohrsolin® FF</td>
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<tr>
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<td>3.17</td>
<td>5.00</td>
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<td>—</td>
<td>2.19</td>
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<td>3.31</td>
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**Sources:**
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