



## WIPING AWAY UNCERTAINTY: WHEN TO USE DISPOSABLE MICROFIBER



## EXECUTIVE SUMMARY

Microfiber is well known both as a powerful cleaning textile *and* as an “essential tool in an infection control program,”<sup>1</sup> owing to its highly efficient and effective ability to remove organic matter and microbes from surfaces.<sup>2-3</sup> What may be less well known is that microfiber actually comes in two forms: launderable (also called durable or reusable) and disposable microfiber. While launderable microfiber has played a major role in cleaning and disinfection for decades, disposable microfiber (DMF) is a relatively newer development—one that offers the evidence-based value of microfiber but in a single-use, disposable form.

DMF has been high in demand in recent years, in large part because, by virtue of its single-use nature, DMF offers a reduced risk for cross-contamination through encouraging the use of a new cloth for each surface and task. This is a fundamental principle in surface cleaning, often called the “1 wipe, 1 application” or “1 wipe, 1 site” policy,<sup>4-6</sup> based on a robust body of evidence showing that cleaning cloths can become contaminated during cleaning and subsequently spread pathogens from one surface to another.

While disinfectant-impregnated disposable wipes are designed to encourage the same principle, research has shown their efficacy can be limited by the range of materials from which they’re made as well as the moisture content/wetness of the wipe,<sup>7-10</sup> wipe product storage time,<sup>11</sup> wipe packaging,<sup>9</sup> application time,<sup>5,8,10</sup> and presence of soiling.<sup>12</sup>

DMF also possesses a number of unique features that collectively set it apart from other disposable cleaning textiles. Quality DMF is distinguished by its high absorbency, powerful cleaning performance, chemical compatibility, enhanced microbe removal, and durability all of which are, to a certain degree, a product of its small fiber size, large surface area, and durable polymer construction.

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Importantly, there are no “right” or “wrong” times to use either disposable or launderable microfiber when proper cleaning technique and laundering processes are followed. Yet, there are some scenarios for which disposable microfiber is uniquely suited, largely based on clinical risk—be it risk of improper handling, risk posed to people (e.g. patients), or risk posed by the environment.

HYGEN™ disposable microfiber is purposefully engineered to serve as the optimal product choice for these scenarios, providing the innovative, evidence-based technology of HYGEN™ microfiber in a single-use form. HYGEN™ disposable microfiber is constructed from premium polymers for optimal cleaning performance and chemical compatibility, proven to remove 99.7% or more of tested, clinically relevant microorganisms, and created with a low-linting, single-use design to reduce risk of cross-contamination.

As the scope of cleaning and disinfection in healthcare and beyond has broadened, so has the need for a wider range of cleaning products. Careful consideration of all factors, ranging from laundry to staffing to infection risk, can help a facility choose the optimal microfiber product, or combination of products, to meet their needs and achieve the desired outcome—stopping infection in its tracks.

## INTRODUCTION

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Microfiber has been described as an “essential tool in an infection control program”<sup>1</sup> and for good reason. Its small fiber size, large surface area, and electrostatic charge translate into a product that is both highly efficient—helping to reduce water/chemical consumption and cleaning times, and effective—providing powerful cleaning performance and microbe removal.<sup>2-3</sup>

Although we often refer to microfiber as a single category of textiles, it is important to note that it actually comes in two forms: disposable and launderable (also called durable or reusable) microfiber. Launderable microfiber long predates disposable microfiber (DMF), having first appeared on the scene in the 1970s, ultimately causing a paradigm shift in cleaning practices as facilities increasingly transitioned away from cotton and other textiles to microfiber.<sup>2-3</sup> But over the past decade DMF has become a ‘hot commodity’, begging the questions of what exactly disposable microfiber is, how it differs from other disposable options, and, finally, when to use it?

## MICROFIBER BASICS

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In order to best understand the “what,” “how,” and “why” behind disposable microfiber, it is helpful to understand what defines *all* microfiber. At its most basic, the term “microfiber” refers to a synthetic fiber measuring less than one denier, a unit of measurement for the linear weight or mass density of fibers, or more simply, a measurement of the fiber thickness.<sup>13-14</sup> To put this in relative terms, a human hair measures in at roughly 20 denier, so a microfiber is exactly what the name implies: a “micro” or very small fiber.

Each microfiber is made from synthetic polymers, which provide it with some of its defining features, including tensile strength, durability, and cleaning power.<sup>15</sup> The polymer is forced through a mold to form one continuous fiber, or monofilament, of a very small cross-sectional diameter. This part of the manufacturing process is key, because microfiber’s size is fundamental to how it works. A single microfiber cleaning product contains thousands of tiny microfibers which are able to trap microscopic particles, microbes and liquids within the intricate network of small fibers far more effectively than products comprised of larger fibers which tend to just push particles around a surface.<sup>2-3</sup>

While all DMF is traditionally monofilament and comprised of a single polymer (i.e. polyester), most launderable microfiber is often what is termed “split-blended.” Split-blended refers to the fact that the microfiber is manufactured from a combination of polymers (e.g. polyester and polyamide) which undergo a “splitting” process that separates the polymers at their interface, further reducing the size of each fiber.

## DISSECTING DISPOSABLE MICROFIBER

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So, why is disposable microfiber in such high demand? The answer begins with its unique features that, collectively, account for its efficacy and efficiency and distinguish it from other disposable textiles.

**Absorbency:** Each disposable microfiber cleaning tool is comprised of thousands of incredibly small individual monofilament microfibers. Together, they endow the cleaning tool with a tremendous surface area—roughly 40 times that of cotton, allowing the microfiber to absorb up to 6-7 times its weight in fluid.<sup>2-3</sup> Importantly, the microfiber’s design also allows for uniform fluid release so that the cleaning fluid with which they are used—be it water, detergent, or disinfectant—can be evenly applied to a surface.

**Cleaning Performance:** DMF constructed from quality polyester polymers provides powerful surface cleaning<sup>16</sup> which the Centers for Disease Control and Prevention (CDC) call the “necessary first step in any sterilization or disinfection process.”<sup>17</sup> In fact, the CDC further states that the “actual physical removal of microorganisms and soil by wiping or scrubbing is probably as important, if not more so, than any antimicrobial effect of the cleaning agent used.”<sup>17</sup> DMF’s fine fibers effectively pick up dirt and debris, trapping and removing them from a surface.

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**Chemical Compatibility:** DMF is made exclusively from polyester fibers which means it has minimal quaternary ammonium binding (quat binding)—a phenomenon in which other textiles, including cotton or some nylon-containing microfibers, attract and bind the disinfectant in the fibers, reducing the quantity of chemical available for surface disinfection.<sup>18</sup>

**Enhanced Microbe Removal:** Between the miniscule size of each microfiber and the large, collective surface area created by thousands of these fibers combined in one cleaning tool, it's little wonder that DMF is highly effective in removing microbes from a surface.<sup>16</sup>

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**Strength/Durability:** Polyester is a highly durable material. When polyester polymers are melded together to form a single monofilament, the result is a fiber with significant tensile strength. This is fundamental to a cleaning product's efficacy, so that the pressure applied and the chemical used don't break down the cloth during the wiping process.<sup>19</sup>

**Reduced Risk for Cross-Contamination:** DMF's very name, *disposable* microfiber, highlights its most obvious but also most unique attribute: its single-use nature encourages use of a new cloth for each surface and task. This is a fundamental principle in surface cleaning, often called the "1 wipe, 1 application" or "1 wipe, 1 site" policy,<sup>4-6</sup> based on a robust body of evidence showing that cleaning cloths can become contaminated during cleaning and subsequently spread pathogens from one surface to another.<sup>6,20-22</sup> The 8-fold method (folding a cloth to create 8 fresh surfaces from one cloth)<sup>23</sup> and color coding are often used with launderable microfiber to facilitate the same practice. DMF are additionally low-linting, meaning they won't leave significant fiber residues behind that can generate cross-contamination.

## DIFFERENTIATING DISPOSABLE MICROFIBER FROM OTHER DISPOSABLE WIPES

Within the disposable wipe category there are a variety of options and some facilities might be tempted to use disposable non-woven disinfectant-impregnated wipes for the convenience of having the disinfectant already "in" the cleaning tool; however, just as one microfiber cloth doesn't necessarily measure up to another microfiber cloth in performance,<sup>13,24</sup> one disposable wipe doesn't necessarily measure up to another disposable wipe.<sup>16</sup>

Disposable disinfectant-impregnated wipes (also called germicidal wipes, disinfectant wipes, or ready-to-use wipes) are very different from disposable microfiber, beginning with the composition and structure of the materials from which they're made. Unlike microfiber, nonwoven disinfectant wipes can be manufactured from any of a number of materials including polypropylene, polyester, viscose, tencel, wood pulp, or cotton.<sup>11,19</sup> Many commercially available products include a combination of these materials that have been spun-bonded or melt-blown together and lack the high tensile strength and durability inherent in monofilament microfiber.<sup>11,19</sup> Disposable wipes made from cellulosic fibers like wood pulp or cotton are often held together by glues or binders which can amount to as much as 30% of the wipe's weight and which can render the wipe vulnerable to degradation with certain chemicals.<sup>19</sup>

While it might be tempting to "measure" a disinfectant-impregnated wipe by its chemical disinfectant ingredient alone, there is evidence to suggest its material make-up might be every bit as important. Studies have shown that different disinfectant-impregnated wipe materials may be better at removing certain microorganisms than others<sup>5,11</sup> and many can lead to the spread of microorganisms from one surface to another.<sup>4-5</sup> Sinai et al found wide variability amongst nine different commercial disinfectant-impregnated wipes when assessing for *Clostridioides difficile* spore removal, spore-wipe binding, and spore transfer with subsequent wiping, concluding that at least some of the differences were likely owing to "the very different construction" of the wipes tested.<sup>5</sup>



Other research has similarly pointed to a direct link between a wipe’s material and its ability to remove microbes. Gonzalez et al found that not only did two commercially available disinfectant-impregnated wipes remove less bioburden from the surface of an anesthesia machine than gauze wetted with water alone, but when the disinfectant in each wipe was subsequently applied on gauze, the microbial removal was equal to that of gauze with water, leading the study authors to conclude that the “texture and composition” of the wipe materials was likely a contributor to the difference in efficacy.<sup>7</sup> In another microbial removal study, Sattar et al found performance differences not only between different brands of disinfectant wipes (which they attributed to the difference in wipe materials and formulations), but also among the same brand of wipe when repeating experiments with all other variables remaining constant.<sup>25</sup> The researchers speculated that there was variability in materials used to make the very same wipe product, stating “such data may suggest some variability in the material tested despite the same batches being tested in all three laboratories.”<sup>25</sup> They went on to reiterate their findings from previous research suggesting that a wipe’s construction, including its material and the interaction between that material and the impregnated chemical, plays a critical role in its ability to “remove and/or kill bacteria on surfaces.”<sup>28</sup>

A disinfectant wipe’s material is not the only factor that influences its efficacy. Research has also shown that the efficacy can be limited by the moisture content/wetness of the wipe—both too much and too little,<sup>7-10</sup> the wipe product storage time,<sup>19</sup> the wipe packaging,<sup>9</sup> the application time,<sup>5,8,10</sup> and the presence of “soiling” on a surface such as sebum transferred by human touch.<sup>12</sup> For example, in a study assessing the cleaning efficacy of 6 different disinfectant-impregnated wipes, Gold et al found that the best and worst-performing wipes had the same active ingredient, attributing the performance difference to both the excessive moisture content and individual packaging of the worst-performing wipe.<sup>9</sup> Nandy et al found that the presence of sebum, an oil-based skin secretion commonly transferred by human touch, reduced the cleaning performance of a number of disinfectant-impregnated wipes.<sup>12</sup>

These potential limitations have led to words of caution from some scientists and organizations regarding the importance of recognizing both the advantages and disadvantages of these wipes.<sup>11,26-27</sup> In their “Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Healthcare Settings,” Canada’s Provincial Infectious Diseases Advisory Committee cautions, “Concerns with ready-to-use wipes include a lack of data on efficacy, the limited contact times, and the potential for wipes to dry out prior to use (if incorrectly stored) or rapidly during use.”<sup>26</sup>

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## WIPING AWAY UNCERTAINTY: WHEN TO USE DISPOSABLE MICROFIBER

Some sources claim that, when it comes to disposable and launderable microfiber, there are “right” and “wrong” times to use them. In reality, there is no right or wrong for either type of microfiber when proper cleaning techniques and laundering processes are followed. Yet, there are some scenarios for which disposable microfiber is uniquely suited, largely based on clinical risk—be it risk of improper handling, risk posed to people (e.g. patients), or risk posed by the environment. The decision should ideally include consideration of laundering capacity, staff training constraints, frequency of cleaning, and infection risk.

**Laundry:** Launderable microfiber can be safely cleaned and rid of microbial contamination between uses when it is laundered according to CDC parameters.<sup>28-29</sup> These include the use of water of at least 160° Fahrenheit for a minimum of 25 minutes and chlorine bleach at a concentration of 50-150 parts per million.<sup>28</sup> However, DMF is an excellent option for facilities with limited/no laundry capacity or who lack confidence in their available laundry facility’s ability to comply with CDC specifications.

**Staffing Concerns:** Effective cleaning requires proper staff training on various processes, including the use of new cloths per patient area, frequent changing of cleaning cloths within a patient area, and keeping soiled cloths separate from clean cloths. However, proper training, not to mention staff compliance with the protocols and procedures taught in that training, is often challenging.<sup>6,30</sup> Environmental services staff are increasingly being asked to do more in less time which puts the quality of cleaning and disinfection they perform in jeopardy.<sup>6,30</sup>

In one survey of cleaners working in industries ranging from healthcare to education to hospitality, 91% of cleaners reported having to rush because they don't have enough time to do their job.<sup>31</sup> Not surprisingly, there is high turnover in environmental services with one report citing a turnover rate as high as 256% among cleaners.<sup>32</sup> High turnover leads to a high demand for new staff training, but as one healthcare review article states, many hospitals don't have "sufficient systems in place to train and certify their cleaning staff" and what training they do have can, in many cases, be impacted by language barriers.<sup>30</sup> In the aforementioned cleaner survey, a staggering 70% of respondents said they never received face-to-face training.<sup>31</sup>

Despite the sometimes herculean tasks they're asked to perform, cleaners are indeed human and studies have reported that staff can have trouble remembering to change cleaning cloths between surfaces/rooms. In a 2018 study, Wong et al report, "The cleaning staff could not remember exactly which wipes had been used to perform terminal cleaning in empty rooms; the waste room; the isolation room, which contains multiple-drug-resistant organisms; or the nursing station."<sup>33</sup> This poses a significant infection risk given that studies have repeatedly demonstrated the ability of contaminated cleaning cloths, including disinfectant wipes, to spread pathogens from one surface to another if not frequently changed.<sup>4,20-22</sup>

By virtue of its single-use, "1 wipe, 1 surface" or "1 wipe, 1 site" intended application, DMF adds an added layer of safety/assurance against the risk of cross-contamination that can occur from rushed cleaning and disinfection or inadequate training on proper methods with launderable products. And research has shown that protocols that encourage the use of more cloths per area or the use of new cloths for each new surface—such as use of disposable products or color-coded cloths—achieve better cleaning outcomes.<sup>20,33</sup> The odds of inadvertently spreading contamination from one surface to another are just simply lower when the user regularly switches to a clean cloth. For example, Gan et al demonstrated that switching from use of one cleaning cloth to three per patient zone in an ICU significantly reduced the presence of multidrug-resistant organisms on environmental surfaces.<sup>20</sup> In another ICU study, Wong et al found that a shift to color-coded disposable cloths from single color launderable cloths helped EVS staff ensure use of new cloths not only per patient but per specific areas within a patient zone which led to improved cleaning outcomes as measured by ATP tests.<sup>33</sup>

**High Risk Scenarios:** It has been stated that "Cleaning practices should be tailored to clinical risk."<sup>34</sup> Similarly, microfiber product choice can be tailored to clinical, or infection, risk. When the stakes are higher, DMF's single-use is a perfect fit. These stakes can be thought of in terms of "people, places, and bugs." Who are the people that represent the greatest risk for infection—either of spreading it or acquiring it? In healthcare, for example, those at risk of acquiring it would include the most vulnerable patient populations—hematology-oncology patients with compromised immune systems, ICU patients with multiple in-dwelling medical devices that provide a direct conduit for environmental pathogens into the body, or surgical patients with open surgical wounds.<sup>35-36</sup>

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What are the places that represent the greatest contamination risk? Again, in healthcare, this could include cleanrooms (also known as compounding pharmacies), where medications intended for direct administration into the bloodstream or a body cavity are prepared. Similarly, in an office or school setting, DMF are suitable options for areas like restrooms or kitchens where contamination is likely to be higher and the associated infection risk greater.

And, finally, "bugs." Is there a "bug" or pathogen that represents a significant threat, because it is especially virulent or contagious or the cause of an outbreak? For example, methicillin-resistant *Staphylococcus aureus* (MRSA) causing a bloodstream infection in a patient in an isolation room or norovirus causing an outbreak of gastroenteritis on a cruise ship.

In all of these scenarios, the risks posed by someone inadvertently using a single cleaning cloth between patients or on multiple surfaces (think cleaning a toilet followed by the bathroom sink and faucet handles with the same cloth) and, in so doing—spreading pathogens—are high. This is particularly true when, in the words of medical microbiologist Dr. Stephanie Dancer, there's evidence to suggest "just a few colony-forming units of *Staphylococcus aureus* or less than 10 spores of *C. difficile* are sufficient to initiate infection."<sup>6</sup> While launderable microfiber cloths can be used in all of these instances if proper handling is ensured, DMF can help mitigate the risk of unintentional cross-contamination by inherently encouraging one wipe, one application per surface.

**High-Touch/Frequent Use Areas:** Our hands are a major culprit when it comes to transferring microorganisms to and from surfaces and other people.<sup>37</sup> Some surfaces pose a greater risk than others simply by how often or how likely they are to be touched.<sup>38-39</sup> These high-touch or high-use surfaces can range from the call button and bed rail in a hospital patient room, to an elevator button or computer key board in an office, to a TV remote in a hotel room. In order to reduce the risk of spreading infection, they must be frequently and thoroughly cleaned.<sup>38</sup> DMF is a convenient, easy to use solution for this high-demand, high-use need. DMF can effectively and efficiently clean each surface and the single-use application reduces the risk that a launderable cloth might be used repeatedly without proper laundering. Further, facilities with high volumes of patient/staff/customer traffic may not have the infrastructure or budget in place to handle the supply of launderable microfiber that must be properly stored, before and after use, and laundered according to CDC parameters; disposable microfiber might be an easier, more cost effective solution for quick, efficient cleaning.

**Examples of Microfiber Use Scenarios in Healthcare**

LAUNDERABLE MICROFIBER	DISPOSABLE MICROFIBER
Hospital Nursing Units Except ICU	Outpatient Operating Rooms
Outpatient Clinics	Hospital Operating Rooms
Public Spaces	Compounding Pharmacies
Waiting Rooms	Hospital Isolation Rooms
	Procedure Rooms
	Intensive Care Units
	Staff And Patient Kitchens

**THE HYGEN™ DIFFERENCE**

If disposable microfiber represents the solution to a cleaning and disinfection problem, then HYGEN™ disposable microfiber represents an excellent solution. Studies have demonstrated that when it comes to microfiber, not all products are created equal.<sup>13,24</sup> In fact, there is wide variability among different microfiber products in terms of both cleaning performance and microbial removal.<sup>13,24</sup> HYGEN™ launderable microfiber sets the bar high for cleaning textiles, but over the past decade Rubbermaid Commercial Products has worked hard to create a disposable microfiber product that achieves the same quality and excellent performance that is now synonymous with the HYGEN™ name. The result is a product that delivers the power of HYGEN™ microfiber technology in a disposable form. **HYGEN™ disposable microfiber is purposefully engineered to incorporate all of the evidence-based features that deliver cleaning efficacy and efficiency:**

- Manufactured from premium polymers for optimal cleaning, absorbency, and chemical compatibility
- Proven to remove 99.7% or more of tested microorganisms by third-party laboratories, including *Clostridioides difficile*, *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus aureus*, *Feline calicivirus* and human coronavirus OC43, a coronavirus belonging to the same genus as SARS-CoV-2, though it is important to note that HYGEN has not yet been tested against SARS-CoV-2 itself
- Created with a low-linting, single-use design to reduce risk of cross-contamination
- Developed to withstand the degradative effects of pressure and chemicals
- Comprised of 100% polyester monofilament microfiber, resulting in minimal (3-5%) quat binding
- Cloths possess industry-leading thickness with 70 grams per square meter (gsm) of material compared to an industry average of 52 gsm, translating into better absorption

HYGEN™ disposable microfiber products are designed to help facilities reduce the risk of infection in high-risk areas by maintaining cleaner and safer environments with products that have superior efficacy and improve worker productivity in a disposable format.

## CONCLUSION

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We now know that a cleaning cloth (or mop) is much more than just a piece of cloth. That 'piece of cloth' can have a myriad of different properties—from absorbency to microbe "grabbing" capacity—that ultimately translate into how clean it leaves a surface. Microfiber's superior performance as a cleaning tool is well-established.<sup>3</sup> It has repeatedly been shown to be a highly effective, highly efficient cleaning tool that supports a facility's efforts to reduce the spread of infection.<sup>1-3,15</sup> Its availability in both a disposable and launderable form is an added boon, for as the scope of cleaning and disinfection has broadened, so have the needs for products tailored to the unique risk posed by different people, places, and bugs.

HYGEN™ disposable microfiber is designed with these risks in mind. There are no "rights" and "wrongs" when it comes to choosing between disposable and launderable microfiber, but there are product choices that just make good sense for certain scenarios limited by laundry or staffing constraints or jeopardized by higher infection risk. HYGEN™ disposable microfiber is purposefully engineered to serve as the optimal product choice for these scenarios, providing the innovative, evidence-based technology of HYGEN™ microfiber in a single-use form. Careful consideration of all factors, ranging from laundry to staffing to infection risk, can help a facility choose the optimal microfiber product, or combination of products, to meet their needs and achieve the desired outcome—stopping infection in its tracks.



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