

*Case Study: Are Microfiber Mops Beneficial for Hospitals?  
This is a reprint of a 2004 study*

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### **Summary**

This work focuses on the environmental and health and safety aspects of microfiber mops, in order to help hospitals fully evaluate microfiber mops as an alternative to conventional loop mops.

Microfiber mopping systems are now being aggressively marketed as an alternative to traditional wet loop mops for cleaning hospital floors. Microfiber is an ultrafine synthetic fiber that is very strong and lint free. Each fiber is split during manufacturing, and this split structure contributes to two characteristics that makes microfiber effective for mopping:

- ♦ The density of the tiny fibers makes the material very absorbent, holding ~six times its weight in water. This means that a microfiber cloth head is lightweight and compact, yet holds sufficient water for cleaning and at the same time it does not drip. Instead of repeatedly rinsing and wringing as with a loop mop, soiled microfiber mop pads are replaced frequently with clean pads, then the soiled pads are washed in the laundry and reused. Much less water and cleaner are required with microfiber mops, and the floor is merely damp and quickly dries after cleaning rather than being visibly wet.
- ♦ The microfibers have a positive charge that attracts dust, which has a negative charge. Therefore, dust and dirt particles are not only attracted to the microfiber, but are held tightly and are not redistributed around the room during cleaning.

In addition to reduced water and cleaner use, the microfiber mops prove to be favorable from the worker's perspective. Ergonomic analyses of both microfiber mopping and wet loop mopping concluded that the microfiber mop system significantly reduces heavy lifting and awkward postures that could contribute to back or other musculoskeletal injuries. This is mainly because microfiber mops avoid the need for a large bucket of water, eliminating repeated filling, lifting, moving, and dumping a heavy bucket of water. Workers also find microfiber mopping less tiring because it eliminates rinsing and wringing out a heavy loop mop and eliminates the need to repeatedly change the bucket of dirty cleaning solution.

Although our analysis did not directly estimate operational cost implications, we observed reduced use of water and cleaners. This and other favorable attributes would result in microfiber mopping having lower overall costs. The EPA publication "Using Microfiber Mops in Hospitals"<sup>1</sup> provides an excellent overview comparing operational costs with microfiber versus conventional loop mops. Our observations are consistent with and reinforce the EPA findings.

Overall, microfiber mops appear to be a very favorable alternative to conventional loop mops. The benefits observed include reduced water and cleaner usage, less time preparing or replenishing the cleaning solution, more favorable worker postures, less lifting and awkward postures, drier floors (hence less risk of slips and falls), reduced potential for cross contamination of rooms, and reduced load on the hospital laundry.

### **Purpose and Scope**

A microfiber floor mopping system was piloted in a Boston area hospital and was compared to the conventional wet loop mop and bucket cleaning system. The new cleaning system, called Microscrub Mops, is manufactured by White Mop Wringer Company. This system was first developed in Scandinavia and has been widely tested and used in Europe.

The objective of the project was to evaluate the impact of the microfiber mopping on health and the environment, compared with the loop mop system. Ergonomic analysis was the major focus of investigation, and we also observed chemical, biological, physical, and safety aspects of each system.

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<sup>1</sup>Found at: <http://www.epa.gov/region9/waste/p2/projects/hospital/mops.pdf> (Accessed 5/22/15)

## Methods

A combination of the following methods were used to analyze microfiber and loop mopping for cleaning floors in patient room and common areas:

- ◆ Observational surveys conducted before and after introduction of the alternative system
- ◆ Interviews with managers and staff responsible for floor cleaning
- ◆ Review of Material Safety Data Sheets (MSDSs) for cleaning agents. Review of chemicals toxicity information for ingredients in the cleaners

A detailed ergonomic analysis was performed using the following methods:

- ◆ Ergonomic job analysis
- ◆ Ovako Working Posture Analyzing System (OWAS)
- ◆ NIOSH lifting equation
- ◆ Interview with managers and staff. Permission was granted by the hospital staff person being videotaped and by the manager of housekeeping

## Findings

### Materials and tools

Floor cleaning is the responsibility of the Environmental Services Department. Each patient room is cleaned at least once every day and common areas are cleaned more often. Selection of the cleaning agents is determined by the Infection Control Department. Their guidelines require that the cleaning agent must be able to destroy blood borne pathogens (Hepatitis B and C, HIV) and the disinfectant must have fungicidal, sporicidal and virucidal properties. The disinfectant of choice at the hospital is GD-80, which is a liquid containing the chemical n-alkyl dimethyl benzyl ammonium chloride. It is being used with the traditional mop and bucket cleaning system.

*As part of the floor cleaning process, GD-80 disinfectant is added to water in specified proportions. Materials and tools are stored in a housekeeping storage closet that includes the cleaning cart, two bottles of GD-80 concentrate, loop mop, wringer and bucket (for conventional mopping), clean microfiber cloths, mop and basin (for microfiber mopping), liquid cleaners for other tasks, long handled dusting tool, dust pan and brush, toilet tissue, plastic liners, and protective gloves. The utility sink is located in the same closet.*

### Process description

Conventional Loop Mopping: The bucket is filled with 2 gallons of water (~16.7 pounds) at the utility sink. This requires the worker to reaching into the closet The bucket is held .The bucket is then lifted approximately 18 inches from the body and at waist height and placed on a cart (surface height 6 inches) located outside the closet. The concentrated germicidal cleaning solution is added, using a ratio 0.5 oz. solution to 1 gallon of water. A wringer (weighing 5 lbs.) is hooked on to the lip of the bucket. A wet mop is placed in the bucket. The water in the bucket must be changed every 2-3 rooms at which time the worker returns to the closet, dumps the dirty cleaning solution and prepares a new solution. Each room is mopped twice using the wet mop. During mopping the worker periodically rinses the mop in the bucket and wrings it out as necessary. At the end of the shift the loop mop head is sent to the laundry for washing and drying.

Microfiber Mopping: In a manner similar to that above, a plastic basin is held and filled with 1 gallon of water (~8.3 pounds) at the utility sink. The basin is placed on the cleaning cart and the cleaning solution is added to the water. Fifty Microscrub cleaning cloths (with Velcro strips for attachment to the mop) are placed to soak in this basin of cleaning solution. A mop, the head of which also has Velcro adhered to it, is placed on the cart. A clean cloth is taken from the basin, hand wrung out, dropped flat on the floor and the mop head is placed on it. The Velcro attaches the cloth to the mop, which is ready for use. Two cleaning cloths are used per room. To change the cloth, the mop is turned upside down, the cloth removed and placed in a bag on the cart and a fresh cloth is attached for use. There is no refilling or changing of cleaning solution and soiled microfiber cloths never go back into the solution. At the end of the shift the soiled microfiber cloths are sent to the laundry for washing and drying.

## ***Comparison of Methods***

### *Use of resources*

The use of microfiber mops can reduce significantly the amount of water & chemicals used. This reflects two factors:

- ♦ Conventional loop mopping requires changing the cleaning solutions after 2-3 rooms to prevent cross-contamination. This means that the cleaning solution (water and disinfectant) is being disposed and replenished repeatedly. The amount of water used for loop mopping is 24 gallons per day for a 25-bed hospital. With the Microscrub system, only clean clothes are soaked in the 1 gallon of the disinfectant solution. Hence, there is no need to replace or replenish the cleaning solution. This will considerably reduce the amount of water and disinfectant used.
- ♦ Water usage is reduced also in the laundry because micromops take considerably less space in washers and dryers than conventional mops, reducing the number of laundry loads and therefore water, detergent, and energy usage.

### *General workplace hazards*

The major chemicals listed in the MSDS were identified as n-alkyl dimethyl benzyl ammonium chlorides and n-alkyl dimethyl ethylbenzyl ammonium chlorides. They are part of the group of disinfectants called quaternary ammonium compounds. These compounds are used because of their anti-microbial properties, but they are very harsh chemicals. Exposure to vapors can cause respiratory irritation and skin contact could cause burns. Gloves and other PPE are required and were properly used when we observed the process.

No biological hazards were observed but there is a potential for exposure to body fluids. The use of the microfiber mopping system eliminates cross contamination of the rooms because fresh product is used in every room.

The physical layout of the cleaning closet is poor. The utility sink contained in the closet consists of a water spigot at waist height with a dike on the floor. The dike and size of the closet limits access to the inside of the cleaning closet, requiring workers to stand back from the sink and stretch into the closet, assuming awkward postures. This is of particular concern because of lifting and maneuvering heavy buckets of water at arm's length (a significant risk for back injury and spills) and reaching beyond the full base of support, i.e. one's toes, (a risk for losing balance and falling).

While performing mopping tasks, one could spill the heavy bucket of water, slip and fall on a newly washed floor or drop the loop mop wringer on one's feet. With microfiber mopping, the weight of the bucket is reduced by about 50% making it easier to handle. Because the microfiber holds the cleaning liquid without dripping, it leaves behind only a light film of water on the floor which dries quickly, resulting in less opportunity for slips and falls on a slippery floor.

### *Ergonomic analysis*

One worker was videotaped while performing both conventional loop mopping and microfiber mopping. One cycle of the job was analyzed, focusing on forceful exertions, awkward postures, localized contact stresses, vibration, working ambient temperatures, , repetition or prolonged activities. These components are all risk factors for musculoskeletal injuries. The cycle analyzed included setting up the cleaning cart and room cleaning. (Laundering was not assessed in this evaluation). Tasks and subtasks performed during the cycle were identified for both systems. The results of the biomechanical analysis are shown in Table 1.

Although the analysis revealed similar unfavorable postures in both mopping methods, the microfiber mopping system significantly reduced the frequency and severity of the risk factors. The postures of concern included: trunk in forward flexion, rotation, flexion at knees, hips and trunk, upper extremity flexion, supination, pronation and neck flexion and extension. Based on these limited observations, the microfiber mopping system is expected to be more comfortable and result in fewer musculoskeletal injuries.

Wet loop and microfiber mopping require similar gross motor skills but the microfiber system is more favorable from an ergonomic perspective for several reasons:

- ♦ Microfiber mopping uses a smaller volume of water and disinfectant, resulting in less weight to lift and less potential for fatigue, back pain, neck strain, and other upper body injuries. There is also less worker exposure to the concentrated disinfectant due to reduction of both volume of cleaning solution & frequency of preparation.
- ♦ The microfiber mopping system completely avoids the wringing of the heavy wet loop mop. This is expected to reduce potential for back pain, shoulder, elbow, and wrist tendonitis and hand injury from stress on the small joints of the fingers.
- ♦ Overall, the worker is lifting less and maneuvering lighter loads with microfiber mopping. There is a smaller volume of cleaning solution, the water-soaked microfiber mop head is considerably lighter than a water-soaked loop mop, the wheeled cart is correspondingly lighter and the worker does not need to repeatedly return to the cleaning closet to dispose of and replenish buckets of cleaning solution. All of these benefits are beneficial to the worker's health and well-being.
- ♦ Although this analysis did not consider the laundering of used mop heads, it is likely that laundry workers would experience ergonomic benefits from the reduced size and weight of microfiber mop heads. Microfiber cloths might also use less energy for drying, compared with loop mops.

In our opinion, the most significant ergonomic hazard with either system reflects filling the bucket or basin of water at the utility sink. Because of the closet layout and the floor mounted sink dike, the worker cannot get right up to the water spigot in cleaning closet. Supporting and carrying a load at a distance from the body is a significant risk factor for back injury. Regardless of mopping technique, this is one shortcoming that warrants prompt resolution.

There was only one new drawback observed with the microfiber mopping system. The wringing and squeezing of microfiber cloths before use introduces a new ergonomic hazard that bears watching. Other than this, the microfiber mopping system appears to be favorable to wet loop mopping in reducing ergonomic risk factors and in making the worker's job less physically taxing.

#### *Cost analysis*

Initial purchase costs for the microfiber system are approximately twice that of the conventional loop mopping system. However, lifecycle costs are lower for microfiber mopping because the useful life of a microfiber mop is about 10 times that of a conventional loop mop. Reduction in chemicals and water usage with microfiber mopping is a further cost saving. Although one cannot easily quantify it, another likely benefit is reduced lost work time and compensation claims due to musculoskeletal injuries. The microfiber mopping system appears to be very cost effective on many fronts.

#### **What are the benefits of the microfiber system?**

- ♦ It is an effective mopping technique
- ♦ Microfiber mops appear to be easier and more comfortable tools for the workers
- ♦ Single use mop heads prevent cross contamination between rooms
- ♦ There is a reduction in water usage and use and exposure to disinfectant chemicals
- ♦ Major ergonomic hazards of conventional loop mops are reduced or eliminated
- ♦ It is anticipated that use of microfiber mops could reduce worker injuries, lost work time and compensation claims

#### **Recommendations**

This analysis shows that the microfiber mopping system offers many health and safety benefits, reduces environmental impact, and has tangible cost benefits. It is anticipated that many tasks and activities associated with microfiber mopping could be further optimized for more efficient mopping, greater health and safety benefits, and additional cost savings. In addition to the analysis described in this summary, readers can consult the helpful EPA fact sheet on microfiber mopping ("Using Microfiber Mops in Hospitals") that is consistent with our findings and provides a more comprehensive cost analysis.<sup>21</sup>

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<sup>1</sup>Found at: <http://www.epa.gov/region9/waste/p2/projects/hospital/mops.pdf>

For the hospital in this study, the major improvement recommended for the current floor-mopping job is to eliminate the need to support and maneuver water buckets at arm's length (or at any distance away from the body). It is recommended that the hospital create easier and unobstructed access to the utility sink for filling and dumping. If the current configuration cannot be readily modified, an interim step might be to add a hose for filling the cleaning bucket on its cart outside the closet. If this interim step is used, care should be taken not to inadvertently add new hazards such as slips and falls from the hosing or water on the floor.

*Table 1. Ergonomic Analysis of Conventional Loop and Microfiber Mopping*

<b>Tasks</b>	<b>Conventional Loop Mopping Ergonomic Hazards</b>	<b>Microfiber Mopping Ergonomic Hazards</b>	<b>Comparison: Is microfiber mopping better, worse, or the same?</b>
Lift empty metal/plastic bucket from cart	Lift metal bucket (5 lbs.) Trunk flexion 60 <sup>0</sup>	Lift plastic basin (1 lb.) Trunk flexion: neutral	Better
Carry empty bucket/basin and walk 3 feet	Forces at trunk, shoulders, elbow, hands (carrying 5 lbs.)	Negligible forces (carrying 1 lb.)	Better
Fill and lift bucket /basin	Fill and lift metal bucket. Lifting with the distance from the body center. Forces acting on neck, back, hands, wrist, and shoulders (water ~16 lbs.)	Fill and lift the plastic basin. Less forces acting/ lower weight (1 gallon of water = 8.3 lbs.)	Better
Lift bucket from sink over hob / basin to the cart.	Flexion of trunk, hips, knees, shoulders. Forces at trunk shoulder, elbows, hands and lower body when lifting ~21 lbs. total weight.	Carry plastic basin filled with water to the cart. Total weight is ~9.3 lbs. Upper body posture is neutral. Less forces acting on hands, wrist, shoulder and lower body	Better
Carry bucket of water, walk to cart	Forces at trunk, wrist, shoulder, elbow.	No longer performed	Better
Lift bucket of water and place on the cart surface	Wrist and elbow flexion. Forces acting as previously	No longer performed	Better
Walk to closet for bottle of cleaning solution on shelf above faucet. Reach and grasp bottle.	Neck extension, hips flexion, shoulder flexion 120 <sup>0</sup> (Fig 6)	Neck extension, hips flexion, shoulder flexion 120 <sup>0</sup> (Fig 6)	Same
Add cleaning solution and replace the bottle of on shelf	Neck extension, hips flexion, shoulder flexion 120 <sup>0</sup>	Neck extension, hips flexion, shoulder flexion 120 <sup>0</sup>	Same
Pick up wringer and hook it on to lip of bucket	Trunk flexion 80 <sup>0</sup> , elbow flexion 60 <sup>0</sup> , shoulders flexion 80 <sup>0</sup> . Forces acting at trunk.	No longer performed	Better
Push cart to room, distance 25'	Waking with trunk flexion 30 <sup>0</sup> . Shoulder and elbow flexion. Forearms pronation.	Waking with trunk flexion neutral. Pushing cart with standard equipment.	Better (due to significantly lighter water weight)
<b>Cleaning routine begins</b>			
Depress wringer down to remove excess water.	Palmar grasp, shoulder elevation and flexion, elbow flexion	New task: wring the cloth to excess water: wrist /hand twisting (ulnar and radial deviation), wrist twisting motions with grip force	Risks are present in both systems
Mopping the floor (half room)	Trunk flexion (Fig. 7)	Trunk flexion (Fig.7)	Same
Return to cart. Place mop in bucket of water, use wringer, finish mopping room	Same as above	New task: Turn mops head downside up. Remove cloth from mop head.	Risks are present in both systems

*The Safe Home Care and Hospitals Program is a research group within the University of Massachusetts Lowell, Department of Work Environment. Please send comments and questions to: SafeHomeCare@uml.edu. For more information, visit our website: [www.uml.edu/SafeHC](http://www.uml.edu/SafeHC)*