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# Laundry Sanitation

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## INTRODUCTION

A critical part of the health care, hospitality and food service industries are the control of microorganisms, especially those that cause disease. In the sanitation industry, cleaning and germ control are important in kitchens, the patient or resident rooms, operating rooms, hallways, bathrooms, on floors, on walls and in the laundry. Cleaning and sanitation products are made to aid in this battle. The use of chemicals, heat and water in sanitation date back to the first concerns with the spread of disease. Today, every hotel, hospital or restaurant has programs to protect the customer, patient or resident from disease. One of the least understood, and the topic of this booklet, is the modern laundry. To understand why sanitation is important, consider the size of some of the industries involved.

In the United States, there are 787,000 restaurants, 17,000 nursing homes caring for 1,400,000 residents, 180,000 private physicians offices, 100,000 dentists offices, 13,200 laboratories and 7,000 hospitals with room for 1,267,000 patients. The average patient in a hospital uses between 8 and 20 pounds of linen a day. These numbers begin to demonstrate the size of the industry. Not all restaurants use linen, but between those restaurants that do use linen, and hotels, hospitals and nursing homes that all do from several hundred to tens of thousands of pounds of laundry each day, it's easy to see how vast the laundry industry is. Improper laundering can result in cross-contamination from one piece of linen to hundreds of others which can and has resulted in large outbreaks of disease. How big of a concern is it? Let's look at a few recent disease outbreaks that were spread by improperly cleaned laundry or poor linen handling procedures.

## RECENT DISEASE OUTBREAKS DUE TO IMPROPER LAUNDERING

As reported in "Infection Control and Epidemiology", a nursing home in southern Alabama had an outbreak of gastroenteritis that made 77 of 120 (64%) residents sick. The residents developed severe nonbacterial (probably viral) gastroenteritis which is a disease characterized by vomiting and severe diarrhea. Two residents died and nine required hospitalization. All three laundry workers became ill as well as 3 of 5 ancillary patient-care and administrative employees and 24% (8 of 33) of the nursing staff. None of the kitchen workers became sick. 50% of the infected employees (7 of 14) reported that one or more family members became ill as well. In this case improper laundering caused a virus to spread from one resident to about 100 additional people, killing two residents.

Outbreaks can occur in hospitals and nursing homes more easily than in the general public because patients in a hospital or nursing home residents are more prone to infections as their immune systems are already weakened. These people can be infected by less virulent organisms or by lower infective doses than healthy people.

"Infection Control and Epidemiology" published a report of a Tennessee nursing home that had an outbreak of salmonella involving 32 residents and 8 employees. The outbreak was food related, but the employees all became infected 7 - 10 days after the residents. Three of the eight employees infected were laundry personnel. The rest handled room linens. In this case, the laundry staff regularly ate their home prepared meals in the laundry room. Protective clothing (gloves, aprons, etc.) were never used by the laundry staff, except for the infrequent use of gloves. Transmission of infectious agents from soiled linen to laundry workers has been suggested numerous other times including two instances at separate hospitals where laundry workers were infected in outbreaks that involved handling infants laundry. The infants had become sick and transferred their disease to the adults washing the soiled linen.

"Epidemiology and Infection" reported an English hospital that had an outbreak of meningitis which was caused by a spore forming bacteria, bacillis cereus. The linen was stored damp in plastic bags while it waited for laundering. In addition, the hospital used a large continuous batch processing machine (also known as a tunnel washer) and had the habit of leaving linen in the tunnel overnight. B. cereus spores, like other spores, are difficult to kill. Tunnel washers use less water than washer/ extractors. Because of this, they have less dilution which means more of the spores were staying in the linen and contaminating all of the linen that was laundered. Sterile linen was sent through the tunnel to confirm this and it came out contaminated. This problem was detected when the B. cereus started showing up on operating room linens like doctor gowns. We next define some common terms.

## GLOSSARY OF TERMS

**Bacteria** - Microorganisms, often composed of one cell, sometimes containing chlorophyll, in the form of straight or curved rods (bacilli), spheres (cocci) or spiral structures.

**Bactericide** - Capable of killing bacteria, but not necessarily bacterial spores.

**Bacteriophage or phage** - A special type of virus that kills bacteria by surrounding them and absorbing the bacteria.

**Bacteriostat** - An agent, usually chemical, that prevents the growth of bacteria, but does not necessarily kill them or their spores.

**Biocide** - An agent that kills all living organisms. Because a biocide is assumed to kill spores, it would be a sterilant.

**Disinfectant** - An agent that frees an inanimate body from infection by destroying microorganisms but doesn't necessarily kill bacterial spores. Disinfectants kill 100.00% of certain microorganisms, but they are not used on people, only inanimate surfaces.

**Fomites** - Inanimate objects such as hair and dust particles that are capable of carrying microorganisms and establishing human infections.

**Fungi/Fungus** - Sporebearing microorganisms that have a nucleus but don't have chlorophyll living as parasites on plants, animals or other fungi. Fungi reproduce sexually and asexually. Yeasts, mildew and mushrooms are all fungi.

**Fungicide** - Capable of killing fungi. This term generally means that fungal spores will be killed as well.

**Germ** - This is a generic term for microorganisms, usually for pathenogenic organisms.

**Germicide** - An agent that destroys microorganisms, especially pathogenic microorganisms. Generally germicides kill some microorganisms but not spores.

**Lyse/Lysis** - A technical term that refers to a substance that causes a cell to leak some of its constituents. Unless the damage is minor, cell death results. Lysing a cell is usually equivalent to killing a cell.

**Nosocomial Infections** - Infections that develop in the hospital that were not incubating at the time of admission or are caused by microorganisms that were acquired during a hospitalization. The baseline for bacterial nosocomial infection is 3 to 16%, typically 5%.

**Pathogenic** - Capable of causing disease. Generally any microorganism capable of entering another body and causing disease.

**Sanitizer** - An agent that reduces the number of bacteria on an inanimate surface to safe levels as judged by public health requirements. A sanitizer generally is a chemical that kills 99.999% of specific test bacteria in 1 minute.

**Spore** - A body, usually one cell (unicellular) found in plants and protozoa. Certain bacteria form thick walled spores that are difficult to kill. They are not reproductive. Some spores can withstand boiling in water for hours.

**Sporicide** - An agent capable of killing spores. Since spores are much harder to kill than other microorganisms like bacteria, fungi and viruses, sporicides are generally sterilants as well.

**Sterilization** - The act or process, physical or chemical, that destroys or eliminates all forms of life, especially microorganisms. Being sterile is an absolute expression. An object or body cannot be partially sterile.

**Virucide** - An agent that destroys or inactivates viruses, especially a chemical substance. Viruses are not living entities like bacteria or fungi, so technically, we don't kill viruses. Viruses are always found in a host cell or in a body fluid.

**Virus** - An infectious agent composed entirely of protein and nucleic acids. Viruses can reproduce only in living cells and are so small that electron microscopes are needed to see them. They are parasites relying on living cells.

## TYPES OF MICROORGANISMS

We now move to the topic of what, specifically, we are trying to kill. In the introduction we mentioned bacteria and viruses. This section explains what they are. Small organisms such as bacteria, fungi and viruses can only be seen under a microscope and are called microorganisms. Microorganisms become imbedded in linen and can cause infections and disease. Killing or removing these organisms through laundering is one of the two purposes of washing laundry. The other purpose is to remove gross soils like food, grass, blood, fecal material, etc. that can help microorganisms survive. Disease causing microorganisms can be found in many common soils in laundry.

## BACTERIA

Bacteria are the first type of microorganism we will consider. They usually have a single cell structure which may contain chlorophyll. Bacteria are so small that 50 billion would fit inside 1 cubic inch. They are a mix of 70-90% water, 1-10% mineral, proteins and carbohydrates. Bacteria are self-sustaining as long as they have food and water. They live in body fluids but don't actually enter a body cell like viruses. Bacteria move molecules of food and water through their outer membrane (called a cytoplasmic membrane) by a process called osmosis. This keeps the bacteria alive. While water and food are necessary for growth, oxygen may not be required. Bacteria that require oxygen are called aerobic bacteria, while bacteria not requiring oxygen are called anaerobic.

Every cell in a uniform population of bacterial cells retains the potential for duplication. The growth of bacteria can occur at an exponential rate. This means that two bacteria become four, four become eight, eight become sixteen and so forth. This is known as a logarithmic series. The rate of growth is measured by the generation or doubling time. The generation time is the time needed for the population to double. If reproduction occurs every 30 minutes, the generation time is 30 minutes. Under favorable conditions, bacteria can double as fast as every 15 minutes. In only 20 population doublings there would be over 1 million bacteria. In 30 doublings there would be over 1 billion. This means each bacteria could generate billions of others in 8 hours. Fortunately growth quickly slows as ideal conditions are difficult to maintain. Bacteria too far from food and water stop reproducing but can still cause disease.

Bacteria can also generate spores. A spore is a special, much more complex, dormant form of a bacterial cell. When a bacterial cell forms a spore, it grows a hard outer shell that makes it

impervious to most chemical attack. Penetration of the outer spore layers is necessary for an antibacterial agent to achieve a sporicidal action. Otherwise the spore can stay dormant indefinitely. As discussed by A Sussman and H.O. Halvorson in their book "Spores: Their Dormancy and Germination", spores stored for 50 years have been easily activated. When spores in laundry are not removed, they can easily spread disease, as was reported in "Epidemiology and Infection Control" (1994). When a tunnel washer used in a hospital laundry failed to remove spores of bacillis cereus, subsequently washed fabrics became contaminated with spores.

## FUNGI

Fungi make up a diverse group of microorganisms occupying a position between bacteria and protozoa. Fungi either grow as discrete cells (yeasts) or as multicell filaments (molds). Unlike bacteria, which are somewhat self-sustaining, fungi live as parasites on or in people, animals, plants or other fungi. Fungi are rarely encountered or cause trouble in laundry because they are easily killed. Rapid pH shifts kills fungi because they are very pH sensitive.

## VIRUSES

The last group of microorganisms are viruses. Viruses are acellular, that is they lack a cell structure. Viruses have a core surrounded by a protein coat and in some cases an additional envelope, composed of chemicals called lipids. Viruses have 3 common characteristics: they have a core surrounded by a protective protein shell, they multiply only inside living cells and are completely dependent on the host for energy, and in the initial step of multiplication, the virus sheds its protective shell. Viruses are small organisms that enter cells, reproduce in the cell and grow a protective shell. Viruses destroy or modify the cells in which they multiply; thus they are potential pathogens (disease causing).

The virus growth cycle is 6 to 36 hours. Up to 1,000,000 viral particles are produced by small viruses per cell. There is little that can be done to interfere with the growth of viruses since they multiply within the host cell, unlike bacteria and fungi. Viruses that have a low level of viral reproduction can establish an equilibrium in the host. This tends to develop a degenerative disease, especially if the virus attacks the central nervous system. AIDS is such a disease.

Viruses do not produce mildew or odors like bacteria. Fabrics have long been known to harbor viruses. In England there have been secondary cases of smallpox infection among laundry sorters due to contaminated textiles. Viruses are especially dangerous because they are highly infectious by the respiratory route and because they are especially resistant to drug therapy. Viruses cause the following diseases: AIDS, polio, rabies, canine distemper, feline leukemia, herpes and hepatitis.

In addition to these microorganisms, small bugs, called mites or dust mites can be found in clothing and bedding. While we will not deal specifically with these bugs, in general, dust mites are killed in laundering at temperatures of 130°F. A cold water wash with detergent, such as often is used in blankets or bedspreads, does not remove the mites although the allergen (fine dust) concentrations are reduced by more than 90%. This means that the dust is removed but not the bugs themselves. Water temperatures below 120°F do not kill significant numbers of mites. This is also important in household laundry because lower water temperatures are used. The wash time to hold this temperature is 10 minutes, which is typical of a short industrial formula or a standard household formula.

## THE SPREAD OF DISEASE

For a given bacteria, fungus or virus, it is generally accepted that one organism swallowed or breathed in will not cause a person to develop a disease. Beyond that however, the exact number necessary has never been determined for a microorganism. There are indications that less than 1,000 bacteria are necessary for infection. In addition, it has been shown that inhalation of airborne bacteria can cause infection at even smaller numbers than are required for oral ingestion. If a person shakes out contaminated linen, the airborne bacteria or viruses can be inhaled through normal breathing and cause disease much easier than through skin contact or other routes of entry.

In washing laundry, 100% microorganism kill rates are rarely achieved. This isn't critical except for linen used in surgery where small numbers of microorganisms can cause serious diseases. For operating room linens, an autoclave is used to sterilize the linen assuring that no microorganisms could be transferred to the patient. The average laundry worker doesn't often fully understand how the washing machine will remove soils and remove or kill microorganisms. One of the most common misconceptions is that laundering removes all microorganisms. This would give a level of germ control equivalent to sterilization. Unfortunately, that is not the case. The most appropriate term for germ control in laundry is sanitizing. Laundering reduces the number of microorganisms to safe levels. However, a kitchen sanitizer does not kill fungi or viruses, laundering typically kills both along with bacteria, reducing the numbers of microorganisms to safe levels.

When laundry workers are infected, the most common microorganisms are viral, like smallpox, hepatitis or a Norwalk type virus. These organisms produce high attack rates with relatively small infectious doses, such as might be expected from soiled linen. In addition, bacteria cause numerous outbreaks of disease as well.

## MICROORGANISM RESISTANCE

Based on the organisms discussed and on general microbiological studies, a list of relative susceptibility to inactivation can be constructed as follows. (A = Easiest to kill, F = Hardest to kill).

A - Retroviruses (AIDS), herpes, vaccinia, influenza, mumps, measles, conjunctivitis, many enveloped viruses, most bacteria and fungi.
B - Staphylococcus aureus (bacteria), some fungi, yeasts, algae
C - Adenoviruses
D - Tuberculosis, rotaviruses, reoviruses, and some molds
E - Polio, rhinoviruses, parvoviruses, hepatitis
F - Bacterial spores, including Clostridium botulism

The organisms that should be the hardest to kill are bacterial spores, then hepatitis A and polio viruses, then tuberculosis and so forth. Often in government regulations, such as the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogen Standard, the law is written to address killing the toughest organisms. Logically, if you can kill hepatitis or tuberculosis, you are killing anything higher up on the list.

## PHYSICAL FACTORS AFFECTING MICROORGANISMS

There is general agreement that viral and bacterial survival increase with reduced wash temperatures. The higher the temperature of the water in the washer, the more microorganisms killed. Soil removal and bacterial reduction are closely linked. As visible soils are removed, the bacteria and viruses, which often live in these soils, are removed as well.

Within the laundry machine, we rely on the physical actions of dilution, the mechanical action of the water and machine and the temperature of the water. Bacterial spores will survive wash temperatures higher than 160°F, so none of the discussion in laundering hopes to kill spores, rather remove them through the mechanical action and dilution of the laundry cycle.

Both drying and ironing use high temperatures, so the bacterial counts drop by as much as 95% after drying or finishing, compared to the bacteria counts from the washer. However, bacteria survival depends on the attraction of the bacteria to the type of linen involved. “The Journal of Infectious Diseases” reported that after drying, terrycloth towels had bacterial counts about ten times the respective counts from polyester cotton blend sheets washed at the same time, regardless of the water temperature. indicating that thicker linens will retain more bacteria.

## CHEMICAL INACTIVATION OF MICROORGANISMS

In addition to using hot water for germ kill, sodium hypochlorite (chlorine) bleach is often added. Hypochlorite bleaching has been used for more than 100 years. Sodium hypochlorite serves two purposes in industrial laundering. It bleaches and sanitizes the linen. Much misinformation exists about the effects of bleach on cellulose (cotton) fibers. Extensive testing shows that regular use of chlorine bleach does not appreciably affect the life of the linen, if chlorine bleach is properly used. Unremoved soil and the mechanical action of the drum cause more fiber damage than the bleach. Cloth diaper studies show that chlorine bleach removes yeasts and bacteria that contribute to diaper rash. The Centers for Disease Control (CDC) recommends using 500 to 5,000 ppm of bleach (depending on the organic soil load) as a general disinfectant where bloodborne pathogens like AIDS, tuberculosis or hepatitis may be found on hard nonporous surfaces. These concentrations of chlorine are not appropriate for laundry applications as it would severely damage the fabric. The levels U S Chemical recommends in laundry are much lower (50 - 200 ppm), but laundry also takes advantage of water temperature to kill germs. Recommended operating parameters for the use of chlorine bleach as well as all other laundry chemicals can be found in the U S Chemical Training Department publication “Laundry Cycle Functionality”.

Washing in an “Applied and Environmental Microbiology” study demonstrated that water temperatures of 120°F to 140°F were as effective as temperatures of 167°F in the presence of 50 - 250 ppm chlorine. Bleaching time was 8 - 11 minutes. Even at the top temperature, 167°F, there was still some bacterial growth when no bleach was used. The “Journal of Hospital Infection” reported that when exposed to 150 ppm chlorine for 5 minutes at room temperature on a hard surface, almost all of a test bacteria were killed. At an exposure of 500 ppm, all of this bacteria were killed in 5 minutes at room temperature. However, a concentration of 500 ppm is impractical in laundry because it would lead to excessive fabric damage. When blood was added to the bacteria, much higher levels of bacteria remained. Obviously, soil removal is critical for bacteria kill. The “Journal of Infectious Diseases” reported a study that showed bacteria levels at various points in the wash cycle, especially after bleach addition. Within 3 minutes of bleach being added at 125 ppm, bacteria levels fell dramatically. There was little change after this time. This shows that the bacteria kill due to the chlorine bleach is fast. By the end of a 6 or 8 minute bleach bath, the bleach has completed its job. Longer cycle times do not help. Also, the major bacteria killing in laundering due to chemicals occurs after the bleach addition, so the use of detergents has little effect on killing bacteria, although the detergents aid in the physical removal of bacteria from the linen.

Some laundries use hydrogen peroxide, also called oxygen bleach or all-fabric bleach, for bleaching. Peroxides are safe for use on colors, so in some areas they can be used where chlorine bleach cannot. However, peroxides used at the levels they are in laundries offer no antimicrobial benefits. Although peroxide is used as a skin disinfectant, the concentration is 100 times that found in the laundry.

## PUBLISHED STANDARDS FOR RESIDUAL MICROORGANISMS

At one time, hospitals would routinely send out samples of linen for testing to determine the level of microbial contamination after washing. What was discovered is that routinely linen still has some microorganisms but won’t necessarily cause disease. Certain linens, such as for operating rooms, will be sterilized in an autoclave after washing to kill all microorganisms. There are no

current standards for acceptable levels of bacteria or any other microorganism in laundered linen, mainly because infection is not solely determined by the number of organisms present. Even low numbers of microorganisms on laundered fabrics are an infection hazard; however, the risk is slight. In published tests, the range of microorganisms remaining on washed linen seems to be dependent on a number of factors, such as degree of contamination and the bacterial attraction for the fabric. This further complicates establishing standards for maximum safe levels of pathogens. Current guidelines for laundering do not require or even suggest it is necessary to do linen testing for microbial contamination.

In reaching this consensus, various tests have been done to determine what water temperatures would insure the highest rate of bacterial kill and virus inactivation. Most viruses are destroyed by moderate temperatures. Poliovirus is inactivated within 10 minutes at 122°F. Hepatitis B is more resistant to destruction by heat and is probably the toughest of the common microorganisms to inactivate. Some viruses at room temperatures can survive for months especially when dried into a soil. It has been established that certain viruses can persist for significant periods of time on fabrics typical of those used in clothing and household fabrics. Fortunately, most viruses pathogenic (disease causing) to humans survive for only brief periods in the open. Viruses adhere less effectively to linen than bacteria. Thus, viruses are removed more easily by the mechanical action of the washer. In fact, the mechanical action of the washer does as much to remove the viruses from the linen as the temperature and chemicals do to inactivate the viruses.

In establishing the minimum washing temperature to kill bacteria, a variety of tests have been done. Survival rates and effective temperatures show a wide range, indicating that the effective control of bacteria is not a settled debate. In water temperatures as low as 72°F, success against particular strains of bacteria has been demonstrated. However, with temperatures as high as 160°F, bacteria have survived. These conflicting results have made it impossible to set a universal standard for residual bacteria.

## LAUNDRY HANDLING GUIDELINES

In this section, U S Chemical has compiled guidelines for linen handling in health care. In the United States, there are a variety of organizations whose regulations may apply to a nursing home, hospital or other health care facility. These guidelines will help comply with those regulations. Any laundry that handles linen contaminated with blood or body fluids must comply with the Occupational Safety and Health Administration (OSHA) Bloodborne Pathogen Standard found in 29 Code of Federal Regulations (CFR) 1910.1030. OSHA is a federal agency with responsibility for writing regulations for the safety of the workplace. This standard requires precautions to prevent exposure to blood or body fluids, especially those that may contain a bloodborne pathogen. This standard became effective in 1992. It requires environmental controls and that personal protective equipment be provided free to employees to prevent exposure.

Specifically 29 CFR 1910.1030 (d)(4)(iv), LAUNDRY, of the Bloodborne Pathogen Standard states:

(A) Contaminated laundry shall be handled as little as possible with a minimum of agitation.
(1) Contaminated laundry shall be bagged or containerized at the location where it was used and shall not be sorted or rinsed in the location of use.
(2) Contaminated laundry shall be placed and transported in bags or containers labeled or color-coded in accordance with paragraph (g)(1)(i) of this standard. When a facility utilizes Universal Precautions in the handling of all soiled laundry, alternative labeling or color-coding is sufficient if it permits all employees to recognize the containers as requiring compliance with Universal Precautions.
(3) Whenever blood soaked laundry is wet and presents a reasonable likelihood of soak-through of or leakage from the bag or container, the laundry shall be placed and transported in bags or containers which prevent soak-through and/or leakage of fluids to the exterior.

(B) The employer shall ensure that employees who have contact with contaminated laundry wear protective gloves and other appropriate personal protective equipment.

(C) When a facility ships contaminated laundry off-site to a second facility which does not utilize Universal Precautions in the handling of all laundry, the facility generating the contaminated laundry must place such laundry in bags or containers which are labeled or color-coded in accordance with paragraph (g)(1)(i).

Contaminated Laundry means laundry which has been soiled with blood or other potentially infectious body fluids. This does not appear to include human wastes like fecal material or urine unless contaminated with blood.

## U S CHEMICAL LAUNDRY HANDLING RECOMMENDATIONS

**1. Responsibility and Quality Assurance**

Anyone who provides reusable washable healthcare textiles and apparel (referred to as linen) and/or laundering services is responsible to the healthcare facility (HCF) administrator or a designee and must comply with all appropriate federal, state and local laws as well as accreditation requirements. Such laws and requirements supersede these guidelines. The person(s) responsible for the operation of the laundry should be qualified for the position by education, training, and experience. If the healthcare facility uses an outside linen service or laundry service, both parties should agree on the specific methods to be used in achieving substantial compliance with these guidelines.

The provider of laundering service should have written policies and procedures covering all areas of responsibility relating to service provided to the health care facility (HCF). This can be accomplished as part of a contract in the case of an off-site linen

and/or laundering service. The provider should maintain records of the nature of problems and agreed-upon solutions. The provider and the HCF should annually review the linen and laundry service program.

**2. Recommended Practices**

A Universal Precautions program to prevent contact with blood or other potentially infectious materials as required by OSHA should be implemented. Initial and continuing training and educational programs on the following topics should be provided to all laundry workers and other employees handling linen:

- Bloodborne pathogens
- Personal hygiene and handwashing techniques
- The use of personal protective equipment such as, but not limited to, gloves, gowns, laboratory coats, safety glasses, masks, engineering controls and work practices to minimize the risk of exposure to blood or other potentially infectious materials
- The Exposure Control Plan
- Postexposure follow-up
- Treatment
- Record keeping

The HCF and the laundry provider should provide free hepatitis B vaccinations for employees with reasonably anticipated exposure to blood or other potentially infectious materials. An employee's participation in the program should be documented.

**3. Employee Practices**

Employee precautions not related to linen handling in the laundry should include:

- No eating
- No drinking
- No smoking
- Personal hygiene guidelines including handwashing
- Designated uniforms to be worn clean each day
- Protective garments to be worn over the uniform when sorting soiled linen and to be removed when leaving the soiled linen area
- Unauthorized persons should not be permitted in the laundry, especially in the soiled or contaminated linen processing areas

**4. Laundry Cleaning and Sanitation**

Proper laundry cleaning procedures should include:

- All residue shall be removed from laundry carts and baskets
- The carts and baskets should be cleaned each day with a disinfectant cleaner
- Trash containers should be emptied daily or more frequently according to facility policy
- Cleaning of trash containers after emptying
- Machines and work tables should be cleaned daily with a disinfectant cleaner
- Laundry floors should be damp mopped with a disinfectant cleaner daily
- Use, cleaning and care of equipment
- Cleaning and disinfection of work surfaces and stations
- The selection, measurement, and proper use of cleaning supplies
- The maintenance of cleaning schedules and the evaluation of cleaning effectiveness
- The proper handling and disposal of sharps (needles and syringes) collection containers
- Contaminated single-use collection bags and other medical waste
- Communication with the HCF's infection control committee

**5. Inventory of Linen**

The HCF and/or the provider of linen service should ensure that there is an adequate supply of clean linen to meet the needs of the HCF. Linen life is maximized with a par level of 3 or higher. One complete set of fabrics for all areas of a facility is a par. Facilities typically strive to have a par level of 3, which allows for one set of fabrics in use, one in the laundry being processed, and one resting in storage. Allowing fabric time to rest in storage greatly improves fabric life. Having a par level of 3 allows a facility the flexability to only run full loads in the laundry machines. Partial loads increases costs by wasting time, chemicals, water and energy.

**6. Facility Design and Construction**

A good laundry process for removing bacteria becomes of little importance if the environment in which it is carried out serves only to recontaminate the linen with the same organisms. The laundry facility should be designed, equipped and ventilated to minimize the spread of microbial contaminants. The ventilation system should include adequate intake, filtration, exchange rate and exhaust in accordance with applicable codes. The bacteria count in the average sorting room is usually high. The soiled linen area should be separated from the clean linen processing area. Separation of clean and soiled areas may be achieved by any one of the following methods: physical barriers such as doors, negative air pressure system in the soiled linen area with a minimum of 10 air exchanges per hour and positive air flow from the clean linen area through the soiled linen area.

When the laundry sorting area is in the healthcare facility, it should be separated from patient rooms, areas of food preparation and storage, and areas in which clean supplies and equipment are stored. Adequate hand washing facilities and personal protective equipment must be available to laundry personnel. Appropriate containers must be provided for collection and proper disposal of sharps (syringes and needles). Warning signs should be posted in work areas in which soiled laundry is accumulated, held or sorted prior to processing. Washer/extractors, especially those used for contaminated linen, should be vented to the outside and the drain should be sealed to keep bacteria from becoming airborne in the draining.

**7. Soiled Fabric**

Although soiled linen has been identified as a source of large numbers of disease causing microorganisms, the risk of disease transmission appears negligible as long as appropriate precautions are observed. Rather than rigid rules and regulations, hygienic and common-sense processing and storage of soiled and clean linen are recommended.

- Soiled linen should be handled as little as possible and with minimum agitation to minimize microbial contamination of the air and of people handling the linen.
- Soiled linen must not be sorted at the location of use.
- When not contaminated with blood, rinsing of linen heavily soiled with fecal material is acceptable but sorting or rinsing linen contaminated with blood or other potentially infectious materials is never allowed.
- Contaminated laundry should not be presorted or rinsed, but should go directly into the washing machine (see below for additional handling procedures).
- The use of personal protective equipment such as gloves, gowns, laboratory coats and masks should be based on the likelihood of contact of exposed skin and clothing with soiled or contaminated linen and used where appropriate to prevent exposure.
- To reduce cross-infection potentials, remove linen from the bed with a minimum of shaking. Any movement of bed linen that is contaminated with microorganisms will put thousands of air borne bacteria in circulation. The person stripping beds should do this as cautiously as possible and place the linen immediately into a laundry bag.
- Minimize the distance loose linens must be carried to the hamper or the bag.
- Do not drop loose linens on the floor or down the laundry chute.
- If laundry chutes are used, the linen should be bagged and the chutes should be properly designed. Bagging is necessary if chutes are used, because chutes can be a source of disease. The air currents in the chute can carry bacteria and make them airborne.
- Linen should not be held against the uniform when carrying.

Clean and soiled linen containers shall be separated by at least one room width separation at all times (see below). Care shall be taken to avoid the possible spills of fecal material and/or urine during the removal of bed linen from the bed, flushing fecal material from the linen and transferring bed linen to the soiled linen containers. When not contaminated with blood, linen soiled with fecal material or urine should be flushed into a hopper/toilet prior to placing in soiled linen container. Containers should be kept tightly sealed and not filled beyond normal capacity. This will eliminate the possibility of spills or contamination during the transfer process to the laundry sorting area. Transport all soiled linen in well covered clearly identified carts used solely for that purpose. Separate containers should be used for transporting clean and soiled linens.

Laundering facilities should be separate from the clean linen processing area, from patients rooms, from areas of food preparation and storage and from areas where clean material and equipment is stored. The liners of the carts should be laundered frequently unless disposable. Used disposable plastic bags should be destroyed daily. Soiled or contaminated linen should be bagged and stored in a designated area. All doors leading from the soiled area must be kept closed. Soiled linen containers should be kept covered at all times and cleaned after each use. Soiled linen should not come into contact with the floor or furniture.

In the sorting area, soiled linen should be sorted into: diapers and pads, bed linens (sheets, pillowcases), bath linen (towels and wash cloths), personals and blankets or spreads. Sorting helps remove foreign objects and prevents recontamination of washed linen during sorting. Protective apparel and appropriate ventilation helps minimize exposure during sorting. Provide a clean area for sorting of linens. The sorting room should be scrubbed down and disinfected daily. The laundry employees should wear clean uniforms and report open sores or respiratory ailments. They should keep their hands away from their eyes and mouths and wash their hands with an antibacterial hand soap when they leave the sorting area.

The use of a commercial laundry service does not relieve the laundry supervisor of the responsibility for establishing adequate quality assurance procedures. When the user transports soiled linen (contaminated laundry) off-site to a provider that does not follow universal precautions, the user must place the contaminated laundry in bags or containers that are properly labeled or color coded.

**8. Contaminated Fabric**

The Occupational Safety and Health Administration (OSHA) has defined “contaminated laundry” to mean linen that has been soiled and may be contaminated with blood or other potentially infectious material or may contain sharps (needles or syringes). This includes most operating linen and linen from patients or residents on isolation precautions. Operating room linen should be handled separately from other hospital linen. The linen should be checked for foreign objects, especially surgical instruments. Contaminated linen should not be sorted at all. Water soluble bags eliminate the handling. The ties and the bag dissolve as the temperature reaches 140°F. Washing should start with a cold water flush less than 100°F to remove blood stains. This is because blood is a protein which coagulates or is set by heat. All water soluble bags with infectious linens must go directly into the washer. Spotting for stains on contaminated linen must not be done.

Special personal protective equipment is recommended, including mask, gloves and apron. When removing contaminated linen from a room, place contaminated linen in a water soluble bag. Tie bag shut with water soluble tie and carry to the door of the room. Have a second person holding a clean bag to be used as the

outer bag. These bags should be easily distinguishable (by color) from ordinary linen. Have the outside person cuff the outer bag about six inches and hold the bag with their hands under the cuff. Place contaminated bag in clean bag. The outside person should close the outer bag securely, tying if necessary and carry the bag to the laundry pickup area for contaminated linen. The bag must be clearly marked as having contaminated linen. Ideally, the outer bags are marked in a way that is consistent with Universal Precautions. The outside person then washes their hands with an antibacterial soap. The person in the room should remove their personal protective equipment, dispose of appropriately and wash their hands using an antibacterial soap.

When the contaminated linen reaches the laundry, the laundry personnel should put on the same protective equipment that the room worker used. Opening the outer bag, the inner bag should be pushed into the washer. If a water soluble bag is not used, both bags should be untied and the linen dumped into the washer. The outer bag(s) should be disposed of according to facility policy for hazardous waste or laundered if appropriate. Close the washer door immediately after adding linen. Remove protective clothing by the same procedure as above. Select proper formula and start washer. Disinfect the door handle while the load is running.

**9. Washing Parameters**

The antimicrobial action of washing is controlled by: dilution (which washes away microorganisms), detergents which loosen soil, the heat of the water, chlorine bleach used between 50 - 200 ppm for an additional margin of safety, and souring rapidly to a pH of 5 to help kill germs. Some studies have shown that water temperatures of 120°F can give satisfactory results in reducing the microbial contamination. Lower temperature laundry cycles rely on the presence of bleach to reduce levels of microbial contamination. Regardless of the washing temperatures, the temperatures achieved during drying and ironing provide significant additional microbiocidal action. If hot water is used, but bleach is not, washing the linen with a suitable detergent in water of at least 160°F for 25 minutes gives the most assurance that the laundry will be sanitary. Since washing in a single bath is impractical and often not possible, to achieve 25 minutes of washing time, the 25 minutes should be split into 2 or 3 baths, each from 8 to 10 minutes thus the total washing time in hot water will exceed 25 minutes.

If lower temperature water is used, chemicals suitable for low temperature washing at proper use concentration should be used. Using a bacteriostat in the final rinse can be useful in controlling the growth of bacteria. When cotton breaks down to form small balls, this lint, called pilling, can be a carrier of infectious bacteria. Adding a fabric softener helps control pilling by relaxing and lubricating the fiber, which helps keep the fiber from breaking.

The following laundry formulas summarize U S Chemical recommendations:

| | Ideal Conditions (with Bleach) | Minimum Conditions (no Bleach) | Minimum Conditions (with Bleach) |
|---|---|---|---|
| Soiled Linen | 150ºF for 25 minutes | 130ºF for 25 minutes | 120ºF for 8-10 minutes |
| Contaminated Linen | 160ºF for 25 minutes | 140ºF for 25 minutes | 120ºF for 10-13 minutes |

When bleach is added, the concentration of bleach should be 50 - 150 ppm at the drain at the end of the bleach bath. As stated previously, since washing in a single bath is impractical and often not possible, to achieve 25 minutes of washing time, the 25 minutes should be split into 2 or 3 baths, each from 8 to 10 minutes. Thus the total washing time in hot water will exceed 25 minutes. The actual structure of the wash formula should follow standard U S Chemical formulas based on soil load. All washes of contaminated linen should include a cold water flush, followed by a warm water flush, followed by the hot water washes. All washes of soiled linen should include a warm water flush followed by the hot water washes.

Some laundries add a liquid quaternary disinfectant cleaner, especially when they don't use chlorine bleach, to control micro-organisms. U S Chemical does not recommend this practice for several reasons:

1. The quaternary disinfectants are only tested when mixed with water and a specific soil load. In the presence of the detergents and different soil loads, they can become inactive and not work.
2. Disinfectants are only tested on hard surfaces. There is only limited data to support their effectiveness in laundry.

**10. Clean Linen**

There should be an adequate supply of clean linen, handled and stored in such a way as to minimize contamination from surface contact or airborne deposition. Clean linen must not come in contact with soiled linen at any time. All clean linen transport carts should be cleaned and disinfected daily. Excess clean linen should be stored on clean shelves designated for this purpose and covered. Excess linen must be reprocessed if stored for more than 5 days. Linens that are repaired or altered must be rewashed. Carry only the amount of linen needed into the patient room. Patients in a hospital should be assigned a blanket and pillow that is laundered when they leave. Using a plastic cover for the pillow so that it can be disinfected is acceptable.

Clean linen may be transported in containers used exclusively for that purpose. Several methods that may be used include:

1. Placing clean linen in a hamper lined with an unused plastic liner or a clean reusable liner. The hamper should be covered with a disposable cover or a clean reusable cover or the liner closed to cover the linen.

2. Placing clean linen in a cart, covering it with disposable plastic or clean reusable material, and securing the cover.
3. Placing the clean linen on a linen rack and covering it with a suitable cover.
4. Clean linen can be wrapped with disposable plastic for delivery.

Separation of clean and soiled linen will be maintained if:
1. The container used to transport soiled linen is properly cleaned before it is used to transport clean linen.
2. Bundles of clean linen are wrapped in plastic or other suitable material and sealed or taped.
3. Transportation of clean and soiled linen is done in separate containers.

Linen containers and covers should be properly cleaned.
Proper cleaning procedures would involve one of the following:
1. Clean fabric containers and covers with an appropriate detergent disinfectant
2. The use of reusable textile covers, which can be removed and washed and dried.
3. Steam cleaning of the entire fabric container and cover.

Whatever method of delivery is used, development of and compliance with written policies and procedures for cleaning and maintenance of containers, liners and covers should be documented and approved by the provider and/or the healthcare facility's infection control committee.

## CONCLUSION

This brochure examined the proper ways to handle soiled and contaminated linen in a healthcare facility. What microorganisms are important and how they are removed were examined along with how they are killed by chemicals and hot water. A set of model guidelines for linen handling was proposed along with recommended washing parameters. Even the best laundering conditions do not guarantee microorganism-free laundry. But, proper control of the important parameters will consistently give sanitary linen. If you have questions or comments about this information, please contact the U S Chemical Training Department.

The information herein is, to the best of our knowledge, true and accurate. It should not be assumed that the information is 100% complete or that it will not change in the future due to conditions outside our control. This booklet is not to supercede any Federal, State or local regulations which may be in force.