Microbe of the month

Breaking The Chain of Infection

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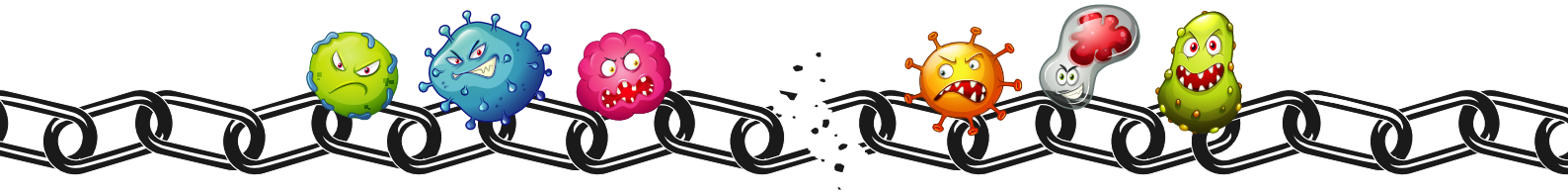
SEPTEMBER 2019

Newsletter

Compiled by Helen Loudon, Independent IPC Practitioner



Featured this month:

Back to Basics

All about SPORES – a formidable microbial survival strategy!

Hello readers!

The cleaning and disinfection of patient equipment and the healthcare environment is complex, given the myriad of chemical products available, inconsistencies in cleaning methods and a general lack of compliance with established and evidence-based infection prevention and control guidelines. [1,2,3,4,7,8]

This has resulted in many serious outbreaks – often as a result of a lack of knowledge and insight into the pathogenesis of ***spore-forming*** fungal and bacterial pathogens.

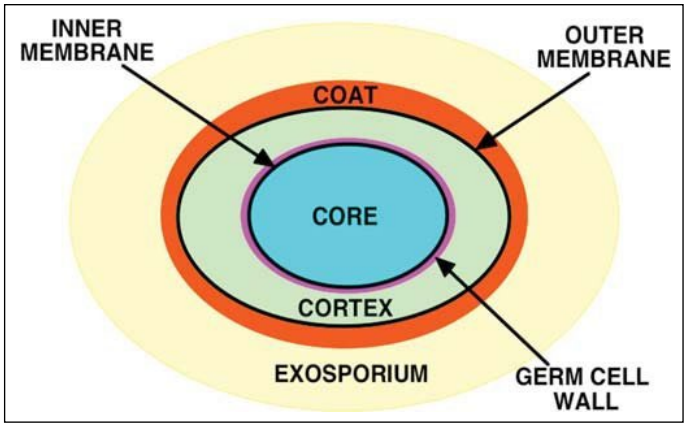
What exactly are spores?

Spores are highly-resistant dormant microbial structures (i.e., no metabolic activity), formed in response to adverse environmental conditions.

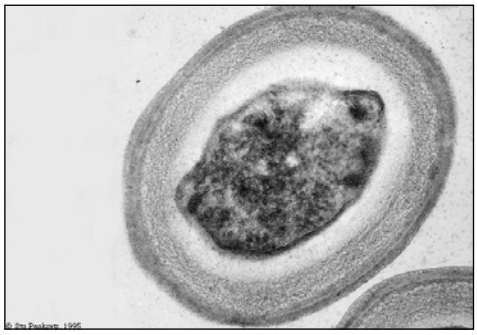
Bacterial spores serve mainly as a resting or dormant stage in the bacterial life cycle, helping to preserve the bacterium through periods of unfavourable conditions. Many bacterial spores are highly durable and can germinate after years of dormancy.

Among the fungi, spores serve a function similar to that of seeds in plants. Both yeasts and moulds form thousands of spores in the reproductive process, each of which is capable of germinating into new yeast cells and fungal hyphae.

Fungal spores are frequently disseminated via air currents and germinate – often after prolonged periods - once suitable conditions of moisture, temperature and food are available.



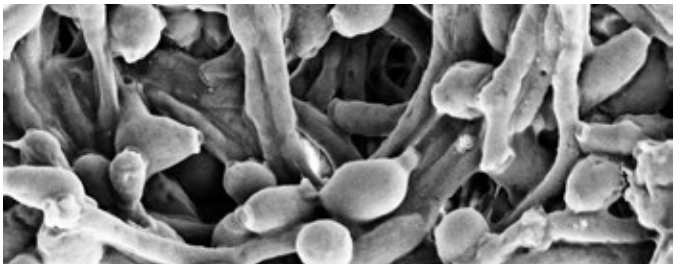
Structure of a bacterial spore



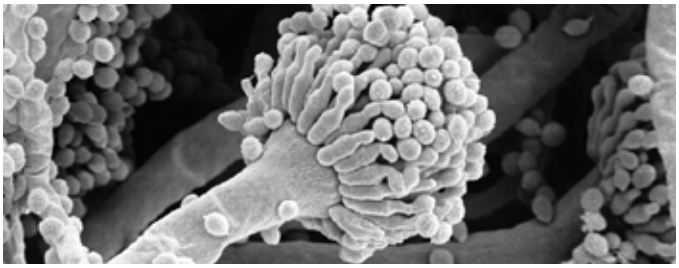
Bacterial Endospore

Spores are extremely hardy and are able to survive for long periods in the healthcare environment.

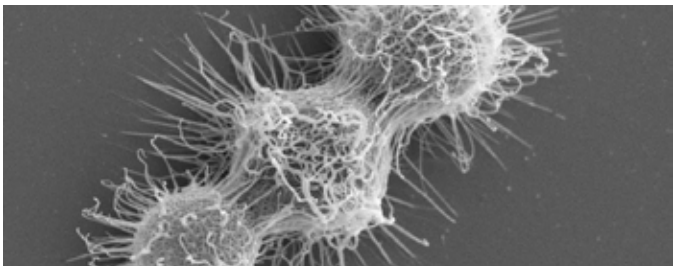
Medically important spore-forming (sporulating) FUNGI



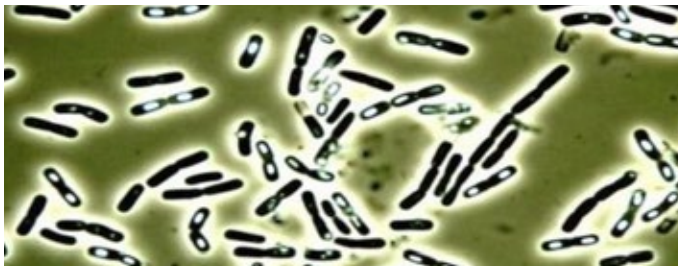
Branching 'hyphae' and spores of Candida albicans



Aspergillus fumigatus 'conidia' (budding spores)



Sporulating Cryptococcus neoformans



Bacillus cereus rods and spores (causes gastroenteritis, keratitis, wound, urinary and respiratory infections)

Scanning electron micrograph of Bacillus anthracis spores (Anthrax)

Clostridium difficile (antibiotic-associated diarrhoea and pseudomembranous colitis)

BASIC PRINCIPLES OF CLEANING AND DISINFECTION

First things first...

Thorough cleaning is essential before disinfection can take place because inorganic and organic material that remains on surfaces will interfere with the effectiveness of the decontamination method.

The basic aim of cleaning is to remove or lower the microorganism bioburden to such a level that patient-care / work surfaces are visibly clean and safe for use. There are basically three categories of clean surfaces:

- Visibly clean: surfaces free from obvious visual dirt and soil
- Chemically clean: surfaces free from organic and inorganic residues
- Microbiologically clean: surfaces having an acceptable level of microbial load

The Spaulding risk-based classification for environmental cleaning and disinfection [1]

Spaulding's classification is a strategy developed to assist healthcare personnel in deciding how to re-process contaminated medical devices.

The system classifies instruments, medical devices and surfaces as ***critical***, ***semi-critical***, or ***non-critical***, based on the infection risk posed to a patient from a contaminated device or surface.

Irrespective of the device or surface's classification, all decontamination processes must start with a basic cleaning phase

Critical Items
Devices and equipment that enter sterile tissue, joints, and the neurological or vascular systems must be **sterile**. Sterilisation is defined as the complete elimination of all living microorganisms (including spores) through the use of chemical disinfectant agents, heat, gas or radiation. This category includes all surgical instruments, sharps, vascular and urinary catheters, implants, and ultrasound probes used in sterile body cavities.

Semi-critical Items
Semi-critical items come into contact with exposed mucous membranes or non-intact skin, and examples include respiratory therapy and anaesthesia equipment (e.g., face masks, nebulisers), colonic endoscopes, laryngoscope blades, oesophageal and rectal manometry probes, bedpans and cystoscopes.

Although all medical devices should be as free from microorganisms as possible, in this category the presence of small numbers of spores are acceptable. Cleaning followed by high-level disinfection eliminates enough pathogens to prevent transmission of infection.
High-level disinfection is thus defined as complete elimination of all microorganisms in or on an instrument, except for small numbers of bacterial spores.[3]

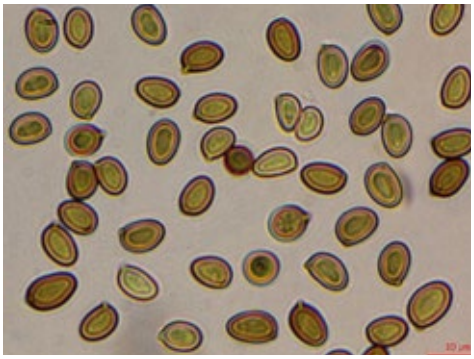
Non-critical Items
Non-critical items are those that come into contact with intact skin but not mucous membranes. Examples of non-critical patient-care items are blood pressure cuffs, crutches and computers; while non-critical environmental surfaces include bed rails, some food utensils, bedside tables, patient furniture and floors. The use of a pH neutral, hospital-grade detergent is usually considered sufficient.

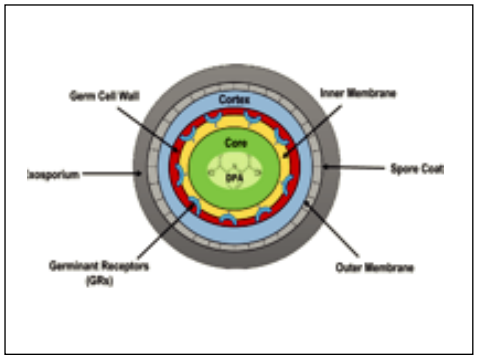
Note: *Non-critical environmental surfaces which are **frequently touched by hands**, or surfaces where **blood / body fluid spills** have occurred, will require thorough cleaning and disinfection with a detergent-based low-level disinfectant. (e.g., chlorine-based cleaners).*

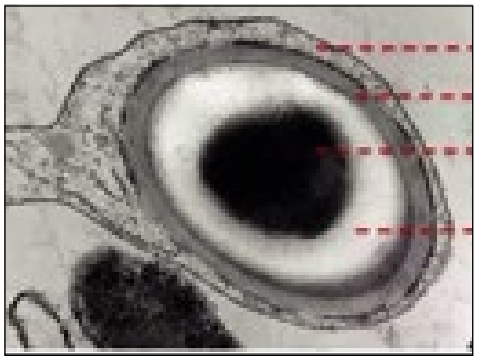
There are many factors that affect the efficacy of disinfection and sterilisation methods:

- poor or inadequate disassembly and cleaning of the object beforehand
- the structure of the device or equipment (crevices, hinges, lumens)
- presence of organic and inorganic soiling
- the type and level of microbial contamination
- the presence of microbial biofilms
- the concentration of the disinfectant and appropriate exposure time
- the temperature and pH of the disinfection process
- water hardness
- relative humidity (e.g., ethylene oxide sterilisation)

MICROBIAL SPORES ARE RESISTANT TO MANY SURFACE DISINFECTANTS AND STERILISATION METHODS







SPORICIDAL (spore-killing) DISINFECTANTS [1,3,4]	Special comments
Sodium hypochlorite (chlorine) applied at 1:1000 dilution after cleaning	Recommended for routine environmental disinfection to control C. difficile spores. Unstable once diluted, and rapidly inactivated once contaminated with organic matter. Solution should be discarded immediately after use. Inexpensive, but corrosive. PPE required.
NaDCC (sodium dichloroisocyanurate) granules or tablets mixed with lukewarm water	Strong odour, airway irritant. Less corrosive to steel and galvanized surfaces. Handle with caution; PPE is required.
Glutaraldehyde 2%	The solution only becomes sporicidal once it is "activated" to pH 7.5–8.5. Once activated, these solutions have a limited shelf-life of 14-28 days and microbicidal activity of the solution should be tested daily before use. Strong odour, toxic airway irritant. PPE required.
Ortho-phthaladehyde (OPA)	Slower sporicidal activity than glutaraldehyde; test efficacy daily before use. Toxic, handle with caution; PPE is required. Stains skin, fabrics and surfaces grey.
Peracetic acid	Expensive, highly volatile and unstable once activated. Requires special administration cabinets; irritant to eyes and mucous membranes; PPE required.
Hydrogen peroxide 35% gas vapour	Used as micro-condensation after terminal cleaning. Expensive, requires specialised equipment and extended contact time for optimum microbicidal and sporicidal efficacy. Synergistic sporicidal effects have been observed with a combination of hydrogen peroxide (5.9%–23.6%) and peracetic acid.
Ultraviolet light technology (UV-C)	Light in the ultraviolet 'C wavelength' of 200-320 nanometres demonstrates broad spectrum microbicidal properties; however, studies are conflicting regarding the degree of sporicidal efficacy. Used after terminal cleaning.

Lessons learned for infection prevention and control

Spores are resistant to heat, dehydration, radiation and most chemical disinfectants!

Alcohol-based hand rub will not kill C. difficile spores.	In the case of known C. difficile patients, the use of gloves and hand-washing with soap and water is more effective at reducing spore carriage.
Spores are highly resistant to heating – they are not killed by boiling (100°C), but only at a temperature of 121°C.	Medical equipment must be heated to 121°C for several minutes in an autoclave to be rendered sterile.
Spores do not exhibit measurable metabolic activity.	Antibiotics are ineffective against spores.
Spores survive for many years in soil and on inanimate objects.	Wounds contaminated with soil may become infected with spores, causing diseases such as tetanus and gas gangrene.
Spores are usually only formed when nutrients are insufficient.	Microbial spores are not often found at the site of infection due to availability of nutrients.
Spores are resistant to alcohol and most chemical disinfectants.	Only disinfectant agents which have undergone independent laboratory sporicidal efficacy testing and are registered with the Medicines Control Council (MCC) should be accepted for use in areas where bacterial or fungal spores present a risk.
The different types of disinfectants are loosely categorised according to their degree of microbicidal efficacy (i.e., low level, intermediate level or high-level disinfectants) on the surfaces and medical equipment for which they are formulated.	ALL antiseptics and disinfectants used in healthcare are now required to undergo independent laboratory microbiological efficacy testing according to the S.A. National Standard/s applicable to the clinical area of proposed use and the type of pathogen/s most likely to be encountered.
There are many factors that affect the efficacy of disinfection and sterilisation methods.	Chemical disinfectants are not compatible with some materials and may damage delicate and expensive equipment. If unsure, consult the equipment supplier or manufacturer to ensure that you are using an appropriate agent.

Break The Chain Of Infection!

Your input is important to us

Your feedback helps us make this newsletter a valuable resource for healthcare practitioners. Please send all queries, comments or requests for future topics to

askcutimed@essity.com

and we will do our best to address them in the next issue!

REFERENCES

1. Centers for Disease Control (CDC)/ Healthcare Infection Control Practices Advisory Committee (HICPAC) 2007. Guidelines for Disinfection and Sterilization in Healthcare Facilities
2. CDC/ HICPAC 2007. Guidelines for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings
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4. Boyce, J.M. 2016.Modern technologies for improving cleaning and disinfection of environmental surfaces in hospitals. Antimicrobial Resistance and Infection Control. https://aricjournal.biomedcentral.com/articles/10.1186/s13756-016-0111-x
5. Occupational Health and Safety Act 85 of 1993
6. Hazardous Biological Agents Regulations 2001
7. Hazardous Chemical Substances Regulations 1995
8. KZN Dept of Health 2018. Decontamination Policy

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* P. J. Stanirowski, et al. Dialkylcarbamoyl chloride-impregnated dressing for the prevention of surgical site infection in women undergoing cesarean section: a pilot study. Arch Med Sci 2016; 12, 2

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