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Editorial

Contents

A quick glance at this issue of **The Journal of Hygiene Sciences** shows our continued commitment to publish a journal of high standard which is devoted exclusively to the topics of Microbiology & Disinfection.

'Mini Review' section - Antimicrobial activity refers to the process of killing or inhibiting the microbes. Various antimicrobial agents are used for this purpose. In recent years, there has been a growing interest in researching and developing new antimicrobial agents from various sources to combat microbial resistance. Therefore, a greater attention has been paid to antimicrobial activity screening and evaluating methods. Antimicrobial may be anti-bacterial, anti-fungal or antiviral. In this article, a complete list of in vitro antimicrobial susceptibility testing methods and detailed information on their advantages and limitations are reported.

Current Trends section - Endoscopy procedures are well established in gastrointestinal (GI) endoscopy, playing an integral part in the prevention, diagnosis, and treatment of GI diseases. Endoscopy has significantly changed over the last 30 years, as technological developments have established a huge variety of diagnostic and therapeutic options. Flexible endoscopes are reusable sophisticated medical devices with multiple lumens and narrow channels. Their thermolabile nature and complex design demand a specialized approach to decontamination. Appropriate reprocessing of flexible endoscopes and endoscopic accessories are an essential part of patient safety and quality assurance in GI endoscopy.

In Profile Scientist - Sudhanshu Vrati (born 19 March 1960) is an Indian Immunologist, microbiologist and the director of the Regional Centre for Biotechnology. Known for his studies in the fields of RNA virus replication and vaccine development.

Bug of the month - *Thermus aquaticus* is a typical gram negative bacteria. When exposed to sunlight, Thermus can exhibit a yellow, pink, or red color due to pigments within the bacteria. *Thermus aquaticus* has proven to be quite a useful organism in the field of Biotechnology, as its enzyme Taq polymerase is harvested for use in polymerase chain reactions (PCR).

Did You Know - Clogged arteries happen when plaque builds up on the inner walls of the arteries and block blood flow, reducing the amount of blood and oxygen that moves throughout the body. A study leads researchers to conclude that the levels of LDL, although low, had a lasting impact on the heart health of these individuals. There are simple, natural and healthy remedies that can help, in doing this.

Best Practices - The provision of clean linen is a fundamental requirement for patient care. Incorrect procedures for handling or processing of linen can present an infection risk both to staff handling and laundering linen, and to patients who subsequently use it.

"Laughter is the music of the soul" so ease your mind with some light humour in our Relax Mood section.

Looking forward for your feedback & suggestions.

Methods for *In vitro* Evaluation of Antimicrobial Activity (Issue I)

Antimicrobial activity refers to the process of killing or inhibiting the microbes. Various antimicrobial agents are used for this purpose. In recent years, there has been a growing interest in researching and developing new antimicrobial agents from various sources to combat microbial resistance. Therefore, a greater attention has been paid to antimicrobial activity screening and evaluating methods. Antimicrobial may be anti-bacterial, anti-fungal or antiviral. They all have different modes of action by which they act to suppress the infection. In this article, a complete list of in vitro antimicrobial susceptibility testing methods and detailed information on their advantages and limitations are reported.

Introduction

After the revolution in the "golden era", when almost all groups of important antibiotics (tetracyclines, cephalosporins, aminoglycosides and macrolides) were discovered and the main problem of chemotherapy were solved in the 1960s, the history repeats itself and these exciting compounds are in danger of losing their efficacy because of the increase in microbial resistance. Currently, its impact is considerable with treatment failures associated with multidrug resistant bacteria and it has become a global concern to public health. For this reason, discovery of new antibiotics is an exclusively important objective.

An important task for the clinical microbiology laboratory is the performance of antimicrobial susceptibility testing of significant bacterial isolates. The goals of testing are to detect possible drug resistance in common pathogens and to assure susceptibility to drugs of choice for particular infections. The most widely used conventional methods include the disk diffusion method. Later generation testing methods include broth microdilution which include the use of rapid and sensitive instruments.

In general, current testing methods provide accurate detection of antimicrobial resistance. Use of instrumentation can standardize the reading of end points and often produce susceptibility test results in a shorter period. Sensitive optical detection systems allow detection of even subtle changes in bacterial growth.

A variety of laboratory methods can be used to evaluate or screen the in vitro antimicrobial activity of an extract or a pure compound. Methods such as disk-diffusion, well diffusion and broth or agar dilution are well known and commonly used, but others such as flowcytofluorometric and bioluminescent methods are not widely used because they require specified equipment and further evaluation for reproducibility and standardization.

1. Diffusion Methods

A. Agar disk diffusion method

Agar disk diffusion method is the official method used in many clinical Microbiology laboratories for routine antimicrobial susceptibility testing. Disc diffusion or the Kirby–Bauer test is one of the classic microbiology techniques, and it is still very commonly used. Because of convenience, efficiency, and cost, the disc diffusion method is probably the most widely used method for determining antimicrobial resistance around the world.

In this well known Procedure, agar plates (Mueller Hinton Agar Cat No.: 201130650100, is recommended) are inoculated with a standardized inoculum (0.5 McFarland) of the microorganism and spread plated on Mueller Hinton Agar medium. Then, antibiotic discs (Biogram™ Fig No.1) (about 6mm in diameter), containing the test compound at a desired concentration, are placed on the agar surface. The petridishes are incubated under suitable conditions. Antimicrobial agent diffuses into the agar and inhibits the test microorganism and then the diameters of inhibition growth zones are measured (Fig No 3.).

Mueller Hinton agar is considered the best medium to use for routine susceptibility testing of nonfastidious bacteria as 1) it shows acceptable batch-to-batch reproducibility for susceptibility testing. 2) It is low in sulfonamide, trimethoprim, and tetracycline inhibitors. 3) It supports satisfactory growth of most nonfastidious pathogens. 4) A large body of data and experience has been collected concerning susceptibility tests performed with this medium.

Although not all fastidious bacteria can be tested accurately by this method, the standardization has been made to test certain fastidious bacterial pathogens like Streptococci, *Haemophilus influenzae, Haemophilus parainfluenzae, Neisseria gonorrhoeae* and *Neisseria meningitidis*, using specific culture media, Various incubation conditions and interpretive criteria for inhibition zones.

Fig No. 1: Different Pack sizes of Antibiotic Discs

Antibiogram provides qualitative results by categorizing bacteria as susceptible, intermediate or resistant. Therefore, it is a typing tool based on the resistance phenotype of the microbial strain tested, its outcomes also guide clinicians in the appropriate selection of initial empiric treatments, and antibiotics used for individual patients in particular situations. However, since the bacterial growth inhibition does not mean the bacterial death, this method cannot distinguish bactericidal and bacteriostatic effects.

Moreover, the agar disk-diffusion method is not appropriate to determine the minimum inhibitory concentration (MIC), as it is impossible to quantify the amount of the antimicrobial agent diffused into the agar medium.

Nevertheless, disk-diffusion assay offers many advantages over other methods: simplicity, low cost, the ability to test enormous numbers of microorganisms and antimicrobial agents, and the ease to interpret results provided. Moreover, several studies have demonstrated the great interest in patients who suffer from bacterial infection of an antibiotherapy based on the antibiogram

of the causative agent. This fact is due to the good correlation between the *in vitro* data and the *in vivo* evolution.

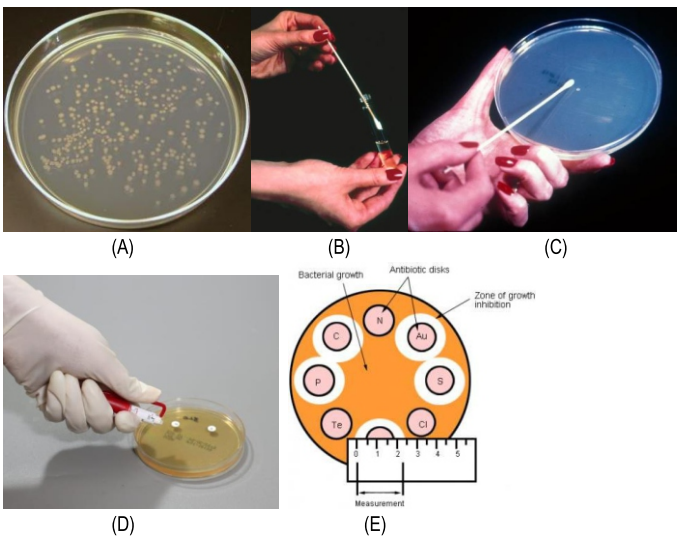
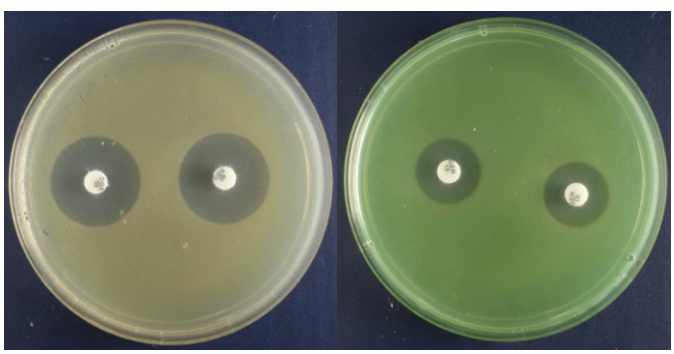


Fig No. 2: Disk diffusion or Kirby Bauer Method (A) 2-3 identical colonies are picked from the plate and transferred to the broth for inoculum preparation (B) the cotton swab dipped in the inoculum suspension (C) swabbed over the entire surface of agar to give a lawn culture (D)with the help of Microxpress disc dispenser disc containing known antibiotic in known concentration is placed on the surface of inoculated agar (E) zone of inhibition is measured.



(A) (B)

Fig No. 3: Zone of inhibition on Mueller Hinton Agar Plates (A) Escherichia coli with Doxycycline 30mcg disc concentration (B) Pseudomonas aeruginosa with Gentamicin 10mcg disc concentration.

The advantages of this method, mainly simplicity and low cost, have contributed to its common use for the antimicrobial screening of plant extracts, essential oils and other drugs.

B. Antimicrobial gradient method

The antimicrobial gradient method combines the principle of dilution methods with that of diffusion methods in order to determine the MIC value. It is based on the possibility of creating a concentration gradient of the antimicrobial agent tested in the agar medium. In this procedure, a strip impregnated with an increasing concentration gradient of the antimicrobial agent from one end to the other is deposited on the agar surface, previously inoculated with the microorganism tested.

This method is used for the MIC determination of antibiotics, antifungals and antimycobacterials. MIC value is determined at the intersection of the strip and the growth inhibition ellipse.

Several previous studies have shown a good correlation between the MIC values determined by Antimicrobial gradient method and those obtained by broth dilution or agar dilution method. This technique can also be performed to investigate the antimicrobial interaction between two drugs. To study the combined effect of two antibiotics, a strip impregnated with a first antibiotic, is placed on a pre-inoculated agar plate surface. After one hour, the strip is removed and replaced by another one impregnated with a second antibiotic. The synergy is detected by a decrease of the MIC of the combination by at least two dilutions compared to that of the most active antibiotic tested alone. Also for the same purpose, the strips can be deposited on the agar medium in a cross formation with a 90°C angle at the intersection between the scales at the respective MICs for the microorganism tested. Then, after incubation, the fractional inhibitory concentration index (FICI) can be calculated using the following formula:

Σ FICI= FIC (A) + FIC (B)

Where FIC (A) = MIC(A) in combination/MIC(A) alone

and FIC (B) = MIC(B) in combination/MIC(B) alone

Synergy was defined by FICI $\leq$0.5 and antagonism by FICI >4. The FICI between 0.5 and 1 was interpreted as addition and between 1 and 4 as indifference.

Fig no.4: Antimicrobial gradient method

C. Other diffusion methods

Further diffusion methods are used in the microbiology research laboratories to screen extracts, fractions or pure substances for their antimicrobial potency or to investigate the antagonism between microorganisms. Among these methods, the most common are:

i. Agar well diffusion method

Agar well diffusion method is widely used to evaluate the antimicrobial activity. Similarly to the procedure used in disk-diffusion method, the agar plate surface is inoculated by spreading a volume of the microbial inoculum over the entire agar surface. Then, a hole with a diameter of 6 to 8 mm is punched aseptically with a sterile cork borer, and a volume (20–100 µL) of the antimicrobial agent or extract solution at desired concentration is introduced into the well. Then, agar plates are incubated under suitable conditions depending upon the test microorganism. The antimicrobial agent diffuses in the agar medium and inhibits the growth of the microbial strain tested.

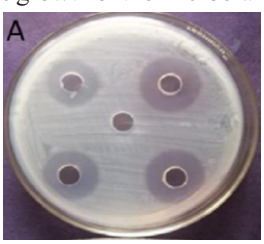


Fig No. 5: Agar well diffusion method

II. Agar plug diffusion method

This method is commonly used to study the antagonism between microorganisms and the procedure is similar to that used in the disk-diffusion method. First bacterial strain is inoculated onto agar plates in tight streaks. During their growth, microbial cells secrete molecules which diffuse in the agar medium. After incubation, an agar-plot or cylinder is cut aseptically with a sterile cork borer and deposited on the agar surface of another plate previously inoculated by the test microorganism. The substances diffuse from the plug to the agar medium. Then, the antimicrobial activity of the microbial secreted molecules is detected by the appearance of the inhibition zone around the agar plug.

iii. Cross streak method

Cross streak method is used to rapidly screen microorganisms for antagonism. The microbial strain of interest is seeded by a single streak in the center of the agar plate. After an incubation period depending upon the microbial strain, the plate is seeded with the microorganisms tested by single streak perpendicular to the central streak. After further incubation, the antimicrobial interactions are analyzed by observing the inhibition zone size.

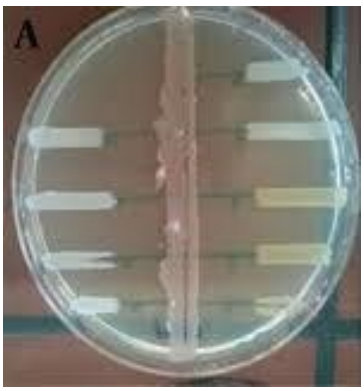


Fig No. 6: Cross streak method

Currently, microbial infections have become an important clinical threat, with significant associated morbidity and mortality which is mainly due to the development of microbial resistance to the existing antimicrobial agents. Therefore methods for antimicrobial susceptibility testing and discovering novel antimicrobial agents have been extensively used and continue to be developed.

Automated Endoscope Reprocessors

ABSTRACT

European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastroenterology Nurses and Associates (ESGENA) sets standards for the reprocessing of flexible endoscopes and endoscopic devices used in gastroenterology. An expert working group of gastroenterologists, endoscopy nurses, chemists, microbiologists, and industry representatives provides updated recommendations on all aspects of reprocessing in order to maintain hygiene and infection control.

ABBREVIATIONS

ADD - Automated Disinfection Device, CRE - *Carbapenem-Resistant Enterobacteriaceae,* CSSD - Central Sterilization and Supply Department, EWD - Endoscope Washer Disinfector, IFU - Instructions for Use (Manufacturer's), ISO - International Standard (International Organization for Standardization), OPA – Ortho-phthalaldehyde, PAA - Peracetic Acid, PPE - Personal Protective Equipment, PTC - Percutaneous Transhepatic Cholangiography, RPE - Respiratory Protective Equipment

DEFINITIONS OF TERMS

Automated Disinfection Devices (ADDs) - These are intended to disinfect loads containing flexible endoscopes and their accessories in a closed system after manual cleaning; thus their cycle includes disinfection and rinse steps but not cleaning.

Bedside Cleaning (Precleaning) - Rinsing and flushing of scope channels and wiping of the outer surfaces of the endoscope insertion tubes with dedicated detergent solution, at the examination site.

Cleaning - Removal of blood, secretions, and any other contaminants and residues from endoscopes and accessories.

Clinical Service Provider - An organization, person, or persons legally responsible for the provision of a clinical service. This could be an institution (such as a health service), a hospital or department, or a doctor working in their own premises.

Detergent - A compound or a mixture of compounds intended to assist cleaning of medical devices (e. g. endoscopes).

Disinfection - Reduction of microorganisms present on a product to a level previously specified as appropriate for its intended further handling or use (EN ISO 15883).

Endoscope Components - Detachable/removable parts of endoscopes (valves, distal caps, balloons for echoendoscopes, etc.).

Endoscope Product Family - This refers to commercially available thermolabile endoscopes. Selection criteria for the endoscope product family are based on the principal endoscope characteristics, including the number, construction, and purpose of the different endoscope channels and their clinical applications.

Endoscope Washer-Disinfector (EWD) - Device intended for cleaning and disinfection of flexible thermolabile endoscopes and their endoscope components within a closed system (according to EN ISO 15883 – 4).

Endoscopes - In this Position Statement, the thermolabile flexible endoscopes used in gastroenterology.

Endoscopic Accessories - All devices used in conjunction with an endoscope to perform diagnosis and treatment, excluding peripheral equipment.

Compressed Air for Drying - Compressed air for drying purposes with the following minimum specifications:

- No oil content;
- No dust or particle content;
- Low residual humidity (i. e., dew point lower than – 40 °C).

Process Chemicals - All chemicals used during reprocessing procedures, including detergents, disinfectants, etc.

Shelf-Life of Endoscopes - Longest storage time that can safely elapse between the last reprocessing and use on the next patient without any further reprocessing.

Sterilization - Complete destruction of all microorganisms including bacterial spores; also a validated process used to render a device free from all forms of viable microorganism (EN ISO 11139).

Storage Cabinet - Equipment designed to provide a controlled environment for the storage of endoscope(s) and, if specified, drying of the endoscope including the endoscope(s) channels (EN 16442).

Type Test - Testing to verify conformity of washer-disinfectors or EWDs to standards, and to establish reference data in subsequent tests (EN ISO 15883).

User - Person or department using equipment; organization(s) or persons within those organization(s) who operate and/or use the equipment.

Validation - Documented procedure for obtaining, recording, and interpreting the results required to establish that a process will consistently yield products/outcomes complying with predetermined specifications (EN ISO 15883).

Washer-Disinfector - Device intended to clean and disinfect medical devices within a closed system (EN ISO 15883); typically applying thermal disinfection methods (e. g. 90 °C).

1. Introduction and Scope

Endoscopy procedures are well established in gastrointestinal (GI) endoscopy, playing an integral part in the prevention, diagnosis, and treatment of GI diseases. Endoscopy has significantly changed over the last 30 years, as technological developments have established a huge variety of diagnostic and therapeutic options. The increasing number of invasive procedures entails substantial infrastructure and specialized, trained, and competent staff.

Flexible endoscopes are reusable sophisticated medical devices with multiple lumens and narrow channels. Their thermolabile nature and complex design demand a specialized approach to decontamination. Appropriate reprocessing of flexible endoscopes and endoscopic accessories are an essential part of patient safety and quality assurance in GI endoscopy.

Since 1994, the Guideline Committee of the European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastrointestinal Endoscopy Nurses and Associates (ESGENA) has developed a number of guidelines and position statements focused on hygiene and infection control in endoscopy.

The aims of this updated ESGE – ESGENA document are:

- To set standards for the reprocessing of endoscopes and endoscopic devices prior to each individual endoscopic procedure, whether performed in endoscopy centers, hospitals, private clinics, ambulatory health centers, medical offices, or other areas where flexible endoscopes are used;
- To support individual endoscopy departments/healthcare providers in developing local standards and protocols for

reprocessing of endoscopic equipment;
- To support national societies and official bodies in developing national recommendations and quality assurance programs for hygiene and infection control in GI endoscopy.

This Position Statement focuses only on flexible endoscopes, endoscope components, and endoscopic accessories used in gastrointestinal endoscopy.

It is important to follow the manufacturer's instructions for use (IFU) at all times.

The recommendations in this Position Statement should be adapted locally to comply with local regulations and national law.

2. Method

This ESGE-ESGENA Position Statement is based on a multidisciplinary consensus from an expert working group, consisting of gastroenterologists, endoscopy nurses, chemists, microbiologists, and industry representatives, with experience in developing national and international recommendations for hygiene and infection control.

Most recommendations on reprocessing of endoscopes are based on expert opinions, in turn based on evaluation of national guidelines available in English, German, and French. Recommendations are also established on the basis of microbiological studies, reviews, or conclusions from case reports. Clinical trials in the field of endoscope decontamination are scarce because of the reluctance to expose any control arm patients to a potential infection risk.

A literature search was carried out that evaluated publications during the period 2008 – 2018. Based on the assessment of the literature reviews and advice from various official national bodies, this Position Statement reflects expert opinion on what constitutes good clinical practice. The quality of evidence and strength of recommendations were not formally graded as they were generally low.

The authors met three times during 2016 – 2018. A consensus document was agreed upon in 2018. The manuscript was sent to all ESGE and ESGENA member societies and individual members and to two ESGE Governing Board members for approval, resulting in this final version, agreed by all authors.

3. Endoscopy-Related Infections

Since the late 1970s there have been sporadic reports of nosocomial infections linked to endoscopic procedures. The majority of documented cases were caused by noncompliance with national and international guidelines (including inadequate reprocessing, drying, or storage of endoscopes and endoscopic accessories). Damage, design limitations, contaminated water, and contaminated endoscope washer-disinfectors (EWDs) were also reported.

Endoscopy-related infections are categorized as follows:
- Endogenous infections from the patient's own microbial flora;
- Exogenous infections caused by inadequately reprocessed equipment. Endoscopes, endoscope components, and reusable endoscopic accessories can be vehicles for pathogenic or opportunistic microorganisms that are transmitted from previous patients or water.

Detailed information about endoscopy-related infections is given in Appendix 1.

4. Classification of endoscopic equipment

Noncritical: According to the Spaulding classification (Table 1), reusable medical devices that come into contact only with the skin and mucosa are defined as noncritical devices (e. g. mouthguards, blood pressure cuffs, finger tips, or electrodes), and must undergo cleaning and disinfection but do not need to be sterile.

Table 1 Spaulding classification and reprocessing of medical devices.

Spaulding Classification	Examples in GI Endoscopy	Reprocessing
Noncritical devices	▪ Fingertip for pulse oximetry ▪ Blood pressure cuff ▪ Electrodes for high frequency surgery and ECG ▪ Mouthguard	▪ Manual cleaning and disinfection attaining at least a given level of bactericidal and yeasticidal activity
Semicritical devices	▪ Flexible endoscopes and their endoscope components	▪ Thorough manual cleaning including brushing is mandatory, followed by: Reprocessing, including cleaning, disinfection (attaining at least a given level of minimum bactericidal, fungicidal, mycobactericidal, and virucidal activity), and rinsing ▪ Automated reprocessing in an EWD is strongly recommended ▪ Thorough drying before storage in closed cabinets or storage cabinets with a drying function Competent staff specially trained in endoscope reprocessing (in line with national laws and regulations) are required.
Critical devices	▪ Endoscopic accessories, e. g. biopsy forceps, polypectomy snares, ERCP accessories, etc. ▪ Flexible endoscopes only if medical indication for sterilization is given	For reusable devices, validated and standardized reprocessing, preferably in a CSSD is strongly recommended, including: ▪ Thorough cleaning ▪ Automated reprocessing systems ▪ Sterile packages ▪ Sterilization Proof of structured training for reprocessing medical devices (in line with national laws and regulations)
GI, gastrointestinal; ECG, electrocardiogram; EWD, endoscope washer-disinfector; ERCP, endoscopic retrograde cholangiopancreatography; CSSD, central sterilization and supply department.		

Semicritical: Most flexible endoscopes used in GI endoscopy are classified as semicritical devices, as they come into contact with intact mucous membranes and do not ordinarily penetrate sterile tissue. Semicritical devices require cleaning and disinfection with bactericidal, fungicidal, mycobactericidal, and virucidal activity.

Critical Devices: Endoscopic accessories that penetrate the mucosal barrier (e. g. biopsy forceps, guidewires, polypectomy snares, injection needles, etc.) are classified as critical devices and must be sterile at the point of use.

Flexible endoscopes used in sterile body cavities such as laparoscopic endoscopes should be sterile at the point of use.

Endoscopes inserted through natural orifices into sterile cavities (e. g., during natural orifice transluminal endoscopic surgery [NOTES], peroral endoscopic myotomy [POEM], peroral choledochoscopy) enter via naturally colonized body cavities. Endoscopes used during percutaneous cholangioscopy enter the biliary system via a stable track previously established during a percutaneous transhepatic cholangiography (PTC). Currently the minimum requirement is that freshly reprocessed endoscopes should be used for these purposes. The question of whether these endoscopes should be sterilized has not yet been answered. National regulations should be followed. Single-use devices should not be reprocessed at any time.

5. Preconditions and General Issues

RECOMMENDATION

Patients undergoing digestive endoscopy should be examined and treated without risks of transmission of infection or of side effects that may result from inadequate reprocessing of endoscopes and endoscope components.

5.1 Principles of Infection Control

RECOMMENDATION

As the carrier status of patients is often unknown, all patients should be treated as potentially infectious.

RECOMMENDATION

All endoscopes and reusable endoscopic accessories should be reprocessed with a uniform, standardized reprocessing procedure following every endoscopic procedure (universal precautions).

RECOMMENDATION

A traceability system should be in place to allow recall of patients in the case of an outbreak.

RECOMMENDATION

The endoscopy department should be informed about the carrier status of the patient, so any pertinent precautions can be taken.

In daily routine, patients with known infections or special risks are often scheduled to undergo their procedure at the end of the daily patient list. However, given the universal endoscope reprocessing regime, which presumes that all patients are potentially infectious, it is no longer recommended that patients with known infections should be examined only at the end of the endoscopy list. Nevertheless, infection control policies often include this recommendation in order to make staff aware and to ensure appropriate cleaning and disinfection of the working environment.

5.2. Health and Safety Aspects of Endoscope Reprocessing

RECOMMENDATION

Endoscopy staff should be protected against infectious material during the endoscopic procedure as well as against direct contact with contaminated equipment or potentially harmful chemicals during the reprocessing procedures.

RECOMMENDATION

A department-specific health and safety policy as well as appropriate equipment should be available regarding spillages, handling of sharp instruments, chemicals, and body fluids.

RECOMMENDATION

All staff involved in the reprocessing procedure should wear appropriate personal protective equipment (PPE) including:

- Chemically resistant single-use gloves (EN 374);
- Protective eyewear (glasses or visors), face masks, and surgical scrub cap-type hair covering;
- Respiratory protective equipment (RPE) when handling chemicals, especially disinfectants containing respiratory sensitizers;
- Long-sleeved, moisture-resistant protection gowns (EN 14126).

Splashing should be avoided throughout the entire reprocessing procedure in order to avoid contact with infectious material, detergents, and disinfectants.

RECOMMENDATION

Regular health surveillance is recommended for all staff working with potentially sensitizing or allergy-inducing chemicals.

RECOMMENDATION

It is recommended that all staff should be offered appropriate vaccination against infectious agents.

RECOMMENDATION

Staff known to be disease carriers should avoid duties that could transmit their disease to patients. Treatment should be offered if applicable.

Reprocessing staff are exposed to the following health and safety hazards while reprocessing endoscopic equipment:

- Biological hazards (direct contact with body fluids, contaminated equipment, and potentially infectious material);
- Chemical hazards (contact with process chemicals as liquids and vapors, drugs, and potential allergens such as latex);
- Ergonomic and physical hazards (e. g. working in standing and bending positions, with risk of musculoskeletal disorders);
- Risk of injuries (e. g. from needles or other sharp instruments);
- Psychological hazards (e. g., noise, workload).

The implementation of health and safety policies is as mandatory for endoscopy as it is for surgery or ambulatory care. Regular health checks as well as staff protection measures are essential to ensure a safe working environment.

General infection prevention principles are essential to maintain a safe environment and prevent the spread of disease to patients and endoscopy personnel. The ESGE-ESGENA statement on health and safety issues should be followed.

5.3. Staff requirements

RECOMMENDATION

To ensure appropriate and adequate reprocessing, the following requirements should be considered:

- Sufficient numbers of trained, dedicated, competent staff and sufficient time are prerequisites for correct reprocessing of endoscopes and endoscopic accessories.
- As the design of endoscopes varies depending on the type of endoscope and on manufacturer, it is essential that staff are familiar with the design and construction of all equipment used in their departments. This also includes any loan endoscopes.
- Endoscopy and reprocessing staff should follow a formal officially recognized endoscopy reprocessing training program, followed by regular practice and periodically updated training to maintain competency.
- Regular audits should be performed in order to assess compliance with guidelines and recommendations and to identify any noncompliance or lack of competence at an early stage. If any bad practice or lack of knowledge is identified, immediate action should be taken (e. g. practice corrections, additional training) followed by a reassessment of competence.

Shortage of staff increases the risk of nosocomial infections, as data from hospital infections and from intensive care units have shown. Hugonnet et al. found that higher staffing levels were associated with a > 30% reduction of infection risk. In a systematic review Erasmus et al. showed that lower compliance with hand hygiene guidelines is associated with heavy workload. Santos et al. evaluated hand hygiene compliance in endoscopy and showed the positive effect of staff training in hand hygiene.

In a survey, 75% of reprocessing staff reported on time pressure, noncompliance with guidelines, and occupational health problems related to reprocessing. The survey also reported on the positive effect of staff training and regular audits to ensure compliance with guidelines.

Systematic reviews of endoscopy-related infections showed that the majority of reported outbreaks originated from noncompliance with existing national and international guidelines. In a recent outbreak of multidrug-resistant Klebsiella pneumoniae related to endoscopic retrograde cholangiopancreatography (ERCP), insufficient cleaning and drying of endoscopes were identified as the responsible factors. Additional training followed by strict adherence to guidelines could stop any such outbreak.

Reprocessing of endoscopes requires specialized knowledge and skills. Formal training has been established in several European countries. ESGENA has developed a European Curriculum for Reprocessing in GI endoscopy based on the European job profile for endoscopy nurses.

5.4 Design of Endoscope Reprocessing Area

RECOMMENDATION

Reprocessing of endoscopic equipment should only be performed in a separate purpose-designed reprocessing room, in order to:

- Minimize the risk of infection and contamination for other personnel and the general public;
- Protect from chemicals used in cleaning and disinfection procedures;
- Protect from cross-contamination with potentially infectious material, blood, and other body fluids.

RECOMMENDATION

The room should have:

- Appropriate size and lighting, and ventilation and fume extraction in order to minimize the risks from chemical vapors;
- Appropriate technical equipment and protective measures in order to ensure safe reprocessing following standardized and validated reprocessing procedures;
- Strict spatial or at least operational separation of dirty and clean/storage areas, in order to avoid recontamination of reprocessed endoscopes and endoscopic accessories.

This should be supported by the room architecture and design as well as by the one-way workflow from dirty to clean areas. Ideally, the standards should comply with those of the central sterilization and supply department (CSSD) in the particular country.

RECOMMENDATION

It is the responsibility of the clinical service provider to ensure that adequate facilities for reprocessing are available.

RECOMMENDATION

Independently of the distance between endoscopy rooms and reprocessing area, the workflow should ensure immediate reprocessing of used equipment.

The size and design of the reprocessing area depend on several factors. Some of these are:

- Workload (number of patients and procedures managed);
- Number and types of endoscopes reprocessed in this area;
- Number and types of EWDs/washer-disinfectors, storage, and/or drying cabinets.

Irrespective of the size and design of the reprocessing area, and depending on the set-up of the reprocessing workflow, the following should be present:

- Personal protective equipment (PPE);
- Separate dedicated hand-washing basins and hand-disinfection facilities in dirty and clean working areas;
- Separate sinks of adequate size for cleaning, disinfection, and rinsing, ideally height-adjustable (even though an EWD is being used);
- Protection lids at sinks and purpose-designed fume extraction facilities in order to minimize the risks from chemical vapors;
- Adequate equipment for manual cleaning steps (e. g., brushes, cleaning adapters, endoscope leak test units);
- EWD;
- Appropriate storage of process chemicals;
- Compressed air with suitable technical specifications, for drying;
- Storage facilities for endoscopes, ideally storage cabinets with/without a drying function;
- Transport facilities between clinical areas and reprocessing, and vice versa, for endoscopes in closed containers;
- Documentation and traceability equipment.

There is a trend from one-room to two-room reprocessing concepts with separate rooms for dirty and clean work zones and the use of "pass-through" EWDs.

Centralized reprocessing areas can be either located in the endoscopy units or in the CSSD. The Dutch and British guidelines provide helpful diagrams and flowcharts showing the

design and organization of reprocessing units, adapted to the available space and the workload.

The separation into dirty and clean reprocessing rooms reduces the risks of recontamination of reprocessed equipment and reduces risks of environmental contamination. The spread of contaminated aerosols, droplets, and dust particles can be minimized by using negative pressure ventilation.

Standards for CSSDs are available in all European countries. As endoscopy requires a level of safety similar to that of a CSSD, the long-term aim is to translate CSSD standards into those of endoscope reprocessing units. These standards cover the material used for working surfaces, sinks, and cleaning accessories, the electrical systems, floors, walls, ceilings, doors, lighting, temperature, humidity, and ventilation.

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Sudhanshu Vrati

SudhanshuVrati (born 19 March 1960) is an Indian immunologist, microbiologist and the director of the Regional Centre for Biotechnology. Known for his studies in the fields of RNA virus replication and vaccine development, Vrati is an elected fellow of the National Academy of Sciences, India and the Indian Academy of Sciences. The Department of Biotechnology of the Government of India awarded him the National Bioscience Award for Career Development, one of the highest Indian science awards, for his contributions to biosciences in 2003.

Born on 19 March 1960 in the Indian state of Uttarkhand,[2] SudhanshuVrati earned an MSc in microbiology from G. B. Pant University of Agriculture and Technology and did a DIIT in biochemical engineering at the Indian Institute of Technology, Delhi. Subsequently, he moved to Australia for his doctoral studies and secured a PhD in biochemistry from the Australian National University. His post-doctoral work was at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) center in Sydney and on his return to India, he joined the National Institute of Immunology as a scientist. He was working as a senior scientist when he was appointed as the dean at the Translational Health Science and Technology Institute(THSTI) in 2005. In October 2015, he was transferred, on deputation, to the Regional Centre for Biotechnology (RCB) as its executive director, a position he holds to date. He is also a visiting scientist at the Pasteur Institute, Paris and an executive director of Bharat Immunologicals and Biologicals Corporation, a Government of India undertaking involved in the manufacture of vaccines and immunizers. rati resides at National Institute of Immunology campus inside the Jawaharlal Nehru University complex in New Delhi.

RESEARCH

Vrati's early researches at THSTI focused on JEV life-cycle like receptor binding and entry mechanisms, molecular mechanisms of virus replication, assembly, egress as well as the clinical development of an oral rotavirus vaccine. Later, he concentrated on the development of DNA vaccines and the details of the work has since been published as an article, DNA vaccines: Getting closer to becoming a reality, in 2013.His work on rat brains help identify Mov34 protein which has assisted in the development of vaccines for flaviviral diseases like Japanese encephalitis and Dengue. His studies have been documented by way of a number of articles and Research Gate, an online repository of scientific articles has listed 99 of them. Besides, he has contributed chapters to books edited by others. He holds several patents for the process he has developed and chairs the Institutional Animal Ethics Committee of the Translational Health Science and Technology Institute.

AWARDS AND HONOURS

It was during his days at the National Institute of Immunology, Vrati received the 2001 VASVIK Industrial Research Award. The Department of Biotechnology of the Government of India awarded him the National Bioscience Award for Career Development, one of the highest Indian science awards in 2003; the elected membership of the Guha Research Conference reached him the same year. He was elected as a fellow by the National Academy of Sciences, India in 2004; the same year as he received the elected fellowship of the Indian Academy of Sciences. The Indian National Science Academy selected him for the Professor KP Bhargava Memorial Medal and the Association of Microbiologists of India chose him for the Alembic Award, both in 2005. The National Academy of Sciences, India honored him again in 2006 with the NASI-Reliance Platinum Jubilee Award. He received the Tata Innovation Fellowship of the Department of Biotechnology in 2009 and the High Commission of Australia in India awarded him the Australian Alumni Award in 2010. The award orations delivered by him include the 2003 edition of the Dr. J. B. Srivastava Oration of the Indian Council of Medical Research.

Who's the fastest

Three kids argue, whose father is the fastest. One says:
- My father is the fastest, he can overtake the arrow that he shooted with the arch.
The second one:
- My father is even faster - when he hunts, he can gunshoot an animal and run up to the animal before it fells down.
The third:
- You actually don't understand what speed is. My father works in municipality. He finishes work at 4:30 pm, but he's back home by 3:45 pm already.

The teacher asks the children:
- Every who thinks he is stupid, please stand up. After a while Peter stands up and the teacher asks:
- Peter why you stood up?
- Well you know, teacher, for me became deeply ashamed, when you're standing itself alone...

"My Darling," said a husband to his wife, "I invited a friend for lunch."
"What? Are you crazy?" The wife replied. The house is a mess, I haven't been shopping, and I am not going to prepare any meal."
"I know that" husband replied.
"So why did you invite him then"? She asked.
"Because the poor fool is thinking about getting married."

A boss took one of his employees to show his new sports car.
"That is amazing" the employee was fascinated. "That is true" replied boss "and if you set your new goals higher and work even harder I can get an even better car next year".

"Sam walks into his boss's office and says 'Sir, I'll be straight with you, I know the economy isn't great, but I have over three companies after me, and I would like to respectfully ask for a raise.'
After a few minutes of haggling the boss finally agrees to a 5% raise, and Sam happily gets up to leave. 'By the way,' asks the boss, 'Which three companies are after you?'
'The electric company, water company, and phone company!'

Quiz

1. Name of the mission to moon, that is set to be achieved by National Aeronautics and Space Organization (NASA) in the year 2024.
   A. Artemis B. Voyager C. Pioneer D. Chandra

2. The first nuclear test Pokhran was codenamed as;
   A. Crystal clear Vision B. The Vision C. The Mahavir D. Smiling Buddha

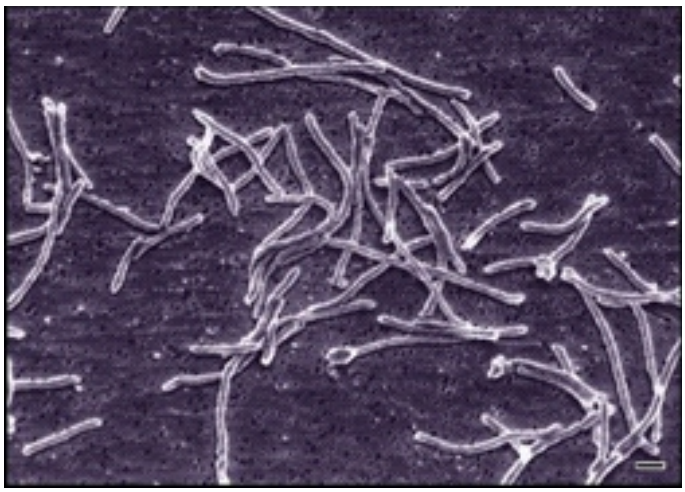
3. FDA approved first Dengue vaccine for the prevention of dengue disease. It's named as;
   A. TetraVax-DV B. DENVax C. CYD-TDV D. Dengvaxia

4. Name the combined immune deficiency disorder which is cured by gene therapy developed by HIV(Human Immunodeficiency Virus).
   A. Lupus B. Inflammatory bowel disease C. Bubble boy D. Multiple sclerosis

5. Name the enzyme discovered by Center for Cell and Molecular Biology (CCMB) scientists which helps to cut bacterial cell walls.
   A. Xanthine dehydrogenase B. Ribonucleotide reductase C. Firefly luciferase EC D. Murein EndopeptidiaseK

Answers: 1. A, 2. D, 3. D, 4. C, 5. D.

Thermus aquaticus



Domain: Bacteria
Phylum: Deinococcus-Thermus
Class: Deinococci
Order: Thermus
Family: Thermaceae
Genus: Thermus
Species: T.aquaticus

Description and significance

Thermus aquaticus is a typical gram negative bacteria, meaning that its cell walls contain much less peptidoglycan than their gram positive cousins, and unlike gram positive bacteria, gram negative bacteria contain lipoproteins. *Thermus aquaticus* appears as either a rod or short filaments, and the rod-shaped cells will tend to form either a rosette or a linear pattern [1]. When exposed to sunlight, Thermus can exhibit a yellow, pink, or red color due to pigments within the bacteria. Along with the coloration, *Thermus aquaticus* can either have flagella or be immotile.

Thermus aquaticus has proven to be quite a useful organism in the field of Biotechnology, as its enzyme Taq polymerase is harvested for use in polymerase chain reactions (PCR). The reason Taq polymerase is used in PCR, as opposed to other forms of the polymerase enzyme is because *Thermus aquaticus*' form of the enzyme is well-suited for the repetitive heating involved in PCR and will not denature. Taq polymerase's resistance to heat is an adaptation to its environment, but is not the only reason it is the choice for use in PCR. Taq polymerase is also chosen because it is incredibly accurate, at 1x10^-4 to 2x10^-5 errors per base pair [2], and does not need to be completely pure to be effective [3]. These properties of Taq polymerase- it's heat resistance, accuracy, and potency- make PCR, and technologies that utilize PCR, such as DNA fingerprinting, enzyme production, and medical diagnoses possible.

Genome structure

Several studies have agreed that the base pair composition of an average *Thermus aquaticus* DNA molecule is between 57 - 65% for G + C meaning that the corresponding base pairs of A+T, have a composition of 35 - 43%. DNA strains for *T. aquaticus* are naturally transferable which means that, under normal physiological conditions, they can be directly incorporated after they are taken up. The distinguishing feature of *T. aquaticus*'s genomic structure is the 16s rRNA gene III. This is what differentiates it from all other thermophiles. Two studies have demonstrated that *T. aquaticus* has 4 plasmids (plasmids are circular DNA rings that contain the genetic instructions for the cell) while another study claims it to have 5 but the results differed between the colonies. In any case "coherent circular restriction endonuclease maps have been published for only 4."

Cell structure, metabolism & life cycle

The bacterial species *Thermus aquaticus* is heterotrophic in nature and, consequently, needs organic compounds from the surrounding environment in order to grow and sustain life. Some of the most common sources for organic material are as follows: the algal-bacterial mat, other heterotrophs, chemoautotrophs, and the surrounding soil. The algal-bacterial mat is an area at the surface of a hot springs environment containing decomposing organic matter, and is thought to be a major source of organic compounds for *T. aquaticus*. Another source is that of dead heterotrophs and chemoautotrophs already present in the bacteria's environment. It is also believed that organic matter is present in the runoff of the surrounding soil [6]. *Thermus aquaticus* belongs to the Deinococcus-Thermus group. It is one of the first hyperthermophilic organisms to be discovered. Their adaptation to high temperature may resemble that of ancient microorganisms, which existed in the first stages of the earth's history.

Thermus aquaticus' structure resembles that of other gram-negative bacteria. It has a three layered membrane composed of an inner plasma membrane, an intermediate and a rougher outer layer. Along the inner membrane usually lies a series of rod like structures that resemble individual cells, which are called rotund bodies. These cell like structures are the most unique characteristic of *Thermus aquaticus*. The rest of its anatomy is just like other bacteria. However, there are no flagella or cilia present in *Thermus aquaticus*, suggesting that this bacterium is immotile.

The life-cycle of this bacteria is just like the life-cycles of other bacteria. *Thermus aquaticus* reproduces asexually via mitosis which is a multiple step process in which the cell's organelles are duplicated and divided.

Ecology (including pathogenesis)

The temperature of an environment can be considered one of the most influencial factors in determining the composition of the specific ecosystem. For example geothermal springs have a very high temperature range, and, as a result, the organisms that live there must be able to cope with such conditions. *Thermus aquaticus* was first found in several of the Yellowstone National Park hot springs. It can survive at temperatures of 55-100 degrees Celsius in weakly acidic to alkaline (pH 5-9) waters. It was also discovered in marine thermal springs, low saline solfataric springs and thermally polluted waters. The ideal conditions for this organism to grow are around 70 to 75 degrees Celsius at a pH of 7.5 to 8 [4]. There are also some other environmental factors to consider, such as: the oxygen and nitrate concentration and the effects of light and salinity. Since these organisms exist at high temperatures, there is only a small amount of dissolved oxygen in the water. Because of this it is assumed that Thermus can use

nitrate as their terminal electron acceptor instead of oxygen. It seems as though high concentrations of sulfide do not greatly affect the number of organisms. The degree of salinity does seem to affect them though. While there are some strains of Thermus that are halotolerant, there are none that are halophillic, and *T. aquaticus* is very sensitive to changes in salinity. Its growth is inhibited even if there is a 0.5% concentration of NaCl and cannot grow in any system with NaCl concentrations above 1% [6].

Interesting feature

The enzyme Taq polymerase is found in the bacterial species *Thermus aquaticus*. It is a class 4 enzyme, which is the Lyase class of enzymes. A lyase is an enzyme that catalyzes the lyses of a substrate generating a double bond. Taq polymerase is a DNA polymerase that allows the bacteria to replicate at the high temperatures of its environment due to its thermo stability. It is because of this property that makes Taq polymerase such an important commodity. Every organism contains DNA polymerase enzymes vital to their replication, but most will be denatured at high temperatures due to their protein composition.

The DNA polymerase found in *Thermus aquaticus* remains stable even at very high temperatures. Because of this stability it can be used in the process known as the polymerase chain reaction, or PCR. PCR is a technique used to amplify a piece of DNA by in vitro enzymatic replication. During PCR the DNA that is supposed to be replicated serves as the template, it can be of various lengths, and in different forms, it is also possible to achieve genetic manipulations. To complete a Polymerase chain reaction one has to add primers (the starting and ending units), a DNA polymerase, the building blocks called Deoxynucleotide triphosphates, a buffer solution (to establish a chemical environment the polymerase will function in) and various cations. Once all these components are mixed together, the reaction tube is placed in a thermal cycler, which heats and cools the sample to achieve the various steps in the PCR process. First the temperature is brought up to 94 to 98 degrees Celsius, to split the DNA into single strands. After a cooling period, during which the primers are attached to the DNA and the polymerase to the primers, the reaction tube and its content is reheated to about 75-80 degrees Celsius, a temperature at which the polymerase is most active. It works from the 5' to the 3' end of the DNA to synthesize a new DNA strand at about a thousand base-pairs per minute. After the process is completed the sample is cooled to accomplish elongation, and can be stored at about 4 to 15 degrees Celsius. If one were to use any other polymerase, it would be destroyed during the extreme temperatures necessary to split the DNA in half. This is why Taq polymerase is so important; it can be used over and over again in this chain reaction.

The technique of PCR was developed by Kary Mullis in 1983. He received the Nobel Prize for this accomplishment ten years later. The first time Taq polymerase was purified was in 1976 by Chien et al. The first time it was successfully cloned and expressed in another organism was in 1989 by Lawyer et al in a strain of *E. coli*. PCR is today widely used in DNA cloning and manipulation, the analysis of gene functions and mutations, for the diagnosis of hereditary and infectious diseases, and identification of genetic fingerprints as used in forensic science and paternity testing.

Just 3 Ingredients will Unclog Your Arteries without Medication and Reduce Cholesterol Fast

Arteries carry blood and oxygen to different parts of the body from your head all the way down to your toes. You need to have healthy arteries to carry that blood and oxygen throughout the body. However, many people develop clogged arteries. In fact, according to the Centers for Disease Control and Prevention, every 40 seconds, someone in the United States has a heart attack, which could be due to clogged arteries.

Clogged arteries happen when plaque builds up on the inner walls of the arteries and block blood flow, reducing the amount of blood and oxygen that moves throughout the body. Due to this, parts of your body can't function well and your organs are also damaged as a result.

Good cholesterol (HDL) helps control the levels of the bad cholesterol (LDL), and it is important to be able to keep these levels balanced. In fact, high levels of bad cholesterol has been known as the silent killer because it often goes undetected until it's too late.

A study that examined the data on 36,375 adults with no history of heart disease or diabetes and a low risk for events like heart attacks or strokes was conducted over a 27 period of time. Most of the adults in the study were found to have levels of LDL, however the levels were not high enough to be prescribed cholesterol-lowering medication. After 27 years, 1,086 people in the study died of cardiovascular disease and 598 died from coronary heart disease. This lead researchers to conclude that the levels of LDL, although low, had a lasting impact on the heart health of these individuals.

All studies aside, all is NOT lost, even if you have history of clogged arteries. There are simple, natural and healthy remedies that can help, including these three ingredients: garlic, turmeric and oatmeal.

Garlic has been found to help lower LDS levels by preventing cholesterol from sticking to the artery walls. This prevents the arteries from clogging, prevents blood clots and in turn reduces blood pressure.

Simply take 2-4 cloves of raw garlic a day. And chile consuming them fresh daily will yield the best results, if raw garlic is too hard to eat, you can include 5-7 cloves in your daily meals. Perhaps add it to sauce, a salad or rub it on whole wheat toast. Garlic can also be found in tablet and capsule form as well as in an extract or powder.

Turmeric is a spice that can help treat clogged arteries, lower bad cholesterol and make your heart work better. The curcumin contained in turmeric has anti-inflammatory and antioxidant properties that prevent blood platelets from forming clots. It can also relax blood vessels and reduce the risk of heart attack or stroke.One way to take turmeric is by taking 1 teaspoon of the powder and add a little honey inside some warm milk. Drink it 1-2 times daily. Turmeric powder can also be included in your cooking, perhaps in a sauce or soup. You can also take turmeric supplements (400-600 mg 3 x daily). However, it is best to consult a doctor before beginning any supplement regimen.

Oatmeal is a great heart-healthy meal due to its high soluble fiber content. It has been recommended by The American Heart Association that the total dietary fiber intake for adults should be 25 to 30 grams a day from food, not supplements. This is why oatmeal is a fantastic option.

In fact, a bowl of oatmeal made from 3/4 cup of dry oats contains 3 g of soluble fiber which is easier to digest than insoluble fiber. Soluble fiber binds to the cholesterol in the body, helping you to digest it rather than having it get absorbed into the bloodstream. This helps lower the LDL levels in your blood.

To get the best benefits from oatmeal, eat 1-2 bowls of cooked oats each day. You can also add fresh fruits, nuts and even honey to enhance the flavor in a more healthful way.

Other tips for reducing the risk for clogged arteries and high cholesterol levels:

- Avoid smoking
- Avoid drinking alcohol
- Maintain a healthy weight
- Stay away from bad stress/anxiety
- Do yoga and meditation regularly
- Laugh a lot or participate in laughter therapy
- Get regular blood tests done

Best practices for Linen Management in Hospitals

QUICK REFERENCE GUIDE

1. It is the responsibility of the person disposing of the linen to ensure that it is segregated into the 3 correct categories.
2. It is the responsibility of both the laundry contractor and hospital staff to ensure linen is clean and in a good state of repair.
3. Linen must be stored in a dedicated closed cupboard or fully enclosed mobile linen trolley secured from unauthorized persons.
4. Specific ward/department items must be appropriately labeled before sending to contracted laundry service.
5. It is staff responsibility to ensure instruments, sharps and non-laundry items such as pillows, disposable curtains and patient belongings are not disposed of with linen.
6. Patients' relatives and carers should be encouraged to wash all personal laundry at home and correct washing instructions provided.
7. Advice should be requested from Infection Prevention and Control team regarding infected linen being placed in the infectious waste stream.
8. Infection Prevention and Control policy must be adhered to when handling both clean and soiled linen.
9. Linen items should not be used for other than the intended purpose i.e. not used to mop up spills.

1. INTRODUCTION

The provision of clean linen is a fundamental requirement for patient care. Incorrect procedures for handling or processing of linen can present an infection risk both to staff handling and laundering linen, and to patients who subsequently use it.

2. PURPOSE

This policy defines the responsibility of managers and staff to ensure correct, safe handling and disposal of contaminated laundry, and the correct, safe distribution and storage of clean linen to minimise infection risk throughout hospitals.

3. SCOPE

This Policy applies to all staff, both clinical and non-clinical, employed by hospitals, who handle linen and also to all visiting staff including tutors, students and agency/locum staff, who handle linen.

'In the event of an infection outbreak, flu pandemic or major incident, the hospital recognizes that it may not be possible to adhere to all aspects of this document. In such circumstances, staff should take advice from their manager and all possible action must be taken to maintain ongoing patient and staff safety'

4. DEFINITIONS

Clean / Unused Linen: Any linen that has not been used since it was last laundered and that has not been in close proximity to a patient or stored in a contaminated environment.

Used Linen: All linen used in the ward/department setting that is not contaminated with either blood or body fluids.

Infected linen: Any used linen that is soiled with blood or any other body fluid or any linen used by a patient with a known infection (whether soiled or not).

5. DUTIES AND RESPONSIBILITIES

Infection Prevention Team:

- Review and update the Linen Handling and Laundry policy
- Give additional advice regarding laundry and risk assessments
- Include safe linen handling in all induction and update training for clinical staff
- Promote good practice and challenge poor practice

Matrons / Senior and Ward Sisters:

- Must establish a cleanliness culture across their units and promote compliance with infection prevention guidelines, including linen handling and laundry
- Promote good practice and challenge poor practice

All Healthcare Staff:

- Must be familiar with and adhere to the relevant infection prevention policies to reduce the risk of cross infection of patients
- Must adhere to the full terms and conditions of the linen handling and laundry policy
- Promote good practice and challenge poor practice
- Refer to the infection prevention team if unable to follow the policy guidelines

6. PROCESS

6.1 Segregation of Linen:

It is the responsibility of the person disposing of the linen to ensure that it is segregated appropriately. All linen may be segregated into the following three categories:

- Clean / Unused Linen
- Dirty / Used Linen
- Soiled / Infected Linen

6.1.1 Clean / Unused Linen:

Clean linen must be in a state of good repair, as tearing or roughness can damage the patient's skin. The condition of the linen in use should be monitored by the laundry contractor and by staff. Linen should also be free from stains and excessive creasing and should be acceptable to both patients and staff. See Section 6.7 for procedure on clean linen not fit for use

6.1.2 Handling of Clean Linen:

Once laundry has been decontaminated, every effort must be made to maintain its quality and cleanliness.

6.1.3 Delivery:

Laundry should be delivered to the wards/departments in clean covered containers. Clean laundry should not be transported in containers used for used / soiled laundry.

6.1.4 Storage:

All clean linen **must** be:

- stored in a clean, closed cupboard (either a dedicated linen cupboard or dedicated, fully enclosed mobile linen trolley). **Not** on top of a trolley as it is a potential fire risk.
- stored off the floor
- stored with the linen cupboard/trolley doors closed to prevent airborne contamination
- stored in a clean, dust free environment
- segregated from used / soiled linen.

Clean linen **must not** be stored in unsuitable areas e.g. the sluice, bathrooms, in bed spaces or in corridors.

6.1.5 Local Use:

- Clean linen should not be decanted onto open trolleys unless for immediate use
- Linen taken into an isolation room/cohort area and not used must be treated as used linen and laundered before use.
- Linen items should not be used for other than the intended purpose i.e. not used to mop up spills

6.1.6 Dirty / Used Linen:

Linen which is used but dry: Dirty / Used linen **must not have been:**

- visibly soiled with blood or bodily fluids
- used on source-isolated patients.

Dirty / Used linen should be placed directly into a clear plastic laundry bag.

- Linen bags should be no more than 2/3 full.

6.1.7 Soiled / Infected Linen:

Any used linen that is soiled with blood or any other body fluid or any linen used by a patient with a known infection (whether soiled or not).

This includes patients with or suspected:

- MRSA
- Extended Spectrum beta-lactamase (ESBL) or Carbapenemase producing organisms
- Human Immunodeficiency Virus (HIV)
- Hepatitis A, B or C
- Draining Tuberculosis (TB) lesions and open pulmonary TB
- Enteric Fever
- Dysentry (Shigella spp)
- Salmonella
- Norovirus
- Clostridium difficile
- Chickenpox
- Head or body lice, scabies
- Other notifiable diseases

Soiled / Infected linen should be placed directly into a RED water-soluble alginate bag and secured, then placed into a WHITE (hire items), BLUE (hospital owned items), GREEN (Surgical gowns/drapes) or BROWN (curtains) outer bag.

- Linen bags should be no more than 2/3 full
- Never rinse or sluice contaminated laundry

- Dirty or soiled linen bags should be stored in 'dirty' linen cages and not on floors or obstructing public thoroughfares or the ward/department environment.

6.2 Trust Owned Return to Sender Items:

- Return to Sender items that belong to specific wards/departments (e.g. slings, slide sheets, duvets, neonatal/paediatric blankets, posy mitts, dressing gowns etc) must be placed in a BLUE bag
- All items must have the hospital and ward/department name on them.
- All return to sender items should be listed on the laundry triplicate tickets (supplied by Linen Rooms). The sender should keep the bottom copy of the ticket and send the top 2 copies to the laundry in the bag. The laundry will then return the item with a copy of the ticket for matching
- Soiled / Infected return to sender items should be placed as normal directly into a RED water-soluble alginate bag and secured, then placed into a BLUE bag.

6.3 Theatre Linen:

- Dirty / Used Operating Theatre staff clothing should be placed into a GREEN plastic laundry bag
- Soiled / Infected Operating Theatre linen and staff clothing should be placed into a red water-soluble alginate bag, then placed into a GREEN outer bag
- Care should be taken to ensure that theatre instruments and sharps are not accidentally disposed of in linen.

6.4 Patient's Personal Laundry:

- Safe return of personal laundry processed off site cannot be guaranteed
- Patients / Relatives / Carers should be encouraged to wash personal laundry at home
- Many micro-organisms will be physically removed from linen by detergent and water, and most are destroyed by a high temperature wash. Any remaining micro-organisms are likely to be destroyed by tumble drying and ironing
- Patient's personal laundry should be placed in a clear plastic bag, not a water-soluble alginate bag (as private laundry facilities will not reach the required temperature to melt the bag, which may lead to damage or blocking of the domestic washing machine). The clear plastic bag should then be placed into a patient's property bag to protect the patient's dignity
- Laundry should be taken home and placed directly into a washing machine
- Clothes should be processed at the hottest wash recommended by the manufacturers' instructions
- Persons handling the laundry must be advised to wash their hands after handling the pre-washed laundry
- Relatives / carers must be advised before they take home personal laundry if it is heavily contaminated.

6.5 Infested Laundry:

Laundry that is potentially infested with parasites (e.g. bed or body lice, scabies).

- Place into a RED water-soluble alginate bag and secure, then place the alginate bag into a WHITE plastic bag

Marking of laundry as infested is not required.

6.6 Laundry which would remain hazardous following normal processing or for which additional precautions are required:

Laundry thought to be contaminated with any of the following micro-organisms must be placed in the i-hazardous waste stream in double bags and incinerated and **not** sent to the laundry service. Advice should be requested from the Infection Prevention Team.

- Bacillus anthracis (Anthrax)
- Viral Haemorrhagic Fevers (e.g. Lassa fever, Marburg disease, Ebola fever)
- Rabies
- Tropical pyrexia of unknown origin
- Lepromatous Leprosy
- Bioterrorism agents e.g. Smallpox
- CJD where CSF or other body fluids have leaked onto laundry items

6.7 Linen Unfit for Use

Linen deemed not fit for purpose (heavily stained, torn, rough) should be placed in a separate rejected Item pink plastic bag, labelled as 'unfit for use' and returned to the hospital laundry. Linen deemed not fit for purpose should **not** be placed in the same bag as other linen for laundry as it will remain in general use and the hospital will be recharged for its handling.

6.8 Procedure for Water-soluble Alginate Bags:

This procedure is to be used in all situations where linen is placed in water-soluble alginate bags.

1. Place the linen inside the alginate bag
2. Items that are soaking wet should be wrapped inside drier dirty laundry
3. Do not overfill the water-soluble alginate bag
4. Seal the alginate bag using the neck tie – do not knot the bag
5. Place the water-soluble alginate bag inside the appropriate coloured outer linen bag.

6.9 General Principles:

These general principles should be adhered to when handling all linen and laundry.

6.9.1 Handling Linen:

All dirty linen must be handled with care, to minimise transmission of micro-organisms via dust and skin scales.

- All dirty linen must be placed carefully and directly into the appropriate laundry bag on removal from the bed or patient. Bags should be no more than two-thirds filled
- The used linen skip should be at the bedside. **Used linen should not be carried to avoid contamination of uniforms**
- Dirty linen must never be transported around the care environment unless within an appropriately colour coded linen bag
- Vigorous, enthusiastic bed stripping and changing of curtains is microbiologically hazardous as large numbers of organisms (mainly skin flora) are dispersed. Care should be taken to minimise contamination of equipment and the near patient environment
- **Do not place used linen on the floor** or any other surfaces e.g. a locker/table top
- When beds or curtains are changed all open wounds/drains etc need to be temporarily covered during linen changes.

- Do not shake linen into the environment
- Do not change linen during wound dressings in the same area
- **Use PPE when handling dirty linen.**

Care must be taken to ensure that **no sharps** or non-laundry items are included with dirty linen before it is placed ready for laundering. Such items are potentially dangerous to staff handling the laundry.

6.9.2 Hand Hygiene:
- Hands should be decontaminated before handling clean linen and after handling used laundry.

6.9.3 Personal Protective Equipment:
- Plastic aprons should be worn by all HCWs for all bed making – this includes beds where the patient has been discharged and patient occupied beds. Plastic aprons must be changed between beds.
- Gloves must be worn when handling laundry from an infected patient or laundry contaminated with blood and body fluids
- Face protection / eye protection must be worn where there is significant contamination with blood and body flushes likely to cause a splash injury.

6.9.4 Accidental Spillage from Used Linen:
- Gloves and apron must be worn
- Re-bag into the appropriate bag. If the appropriate bag is not obvious then the linen should be treated as infected and placed in a red alginate bag, then into a white outer bag and tied securely.
- Clean area with appropriate disinfectant if necessary.

6.9.5 Local Cleaning:
- All hospital linen should be laundered by an external laundry contractor (with the exception of specific wards authorised to have industrial washing machines)
- The washing process should have a disinfection cycle in which the load temperature is maintained at 65°C for not less than 10 minutes or preferably at 71°C for not less than 3 minutes
- Manual soaking / washing / sluicing of soiled items must never be carried out in the clinical areas by staff. This is a contamination and splash injury risk. Solid contaminants should be disposed of in the appropriate clinical waste stream and laundry bagged as per policy
- Patient's personal clothing should be bagged and sent home for cleaning. (See Section 6.4 Patients Personal Laundry)

6.9.6 Storage and Removal:
- All dirty/used linen should be removed from clinical areas as frequently as circumstances demand
- Soiled linen must be kept away from public areas
- Storage areas must remain closed and kept secure from unauthorised persons

6.9.7 Curtains:
- Curtains require washing when visibly dirty, or at least every six months.
- Curtains should be routinely changed when discharging or transferring a patient with a known transmissible infection from the area or during outbreaks
- Removal and changing of curtains result in aerosolisation of ingrained organisms which may be harmful to patients and contaminate the near patient environment. For this reason, curtains should not be changed at key times e.g. during wound dressing changes.
- Disposable curtains should not be sent for laundering but should be disposed of in the appropriate waste stream (i.e. offensive or infectious).

6.9.8 Pillows:
- All pillows used in clinical areas must have sealed intact impermeable covers
- All pillows used in clinical areas can be cleaned with chlorine-based disinfectant and re-used providing there is no tear, split or staining.
- Any pillow torn, split or stained must be discarded into the appropriate waste stream. Discarded pillows should never be placed with dirty laundry items
- New pillows can be ordered.
- Spare pillows must be returned to the pillow store.

7. TRAINING REQUIREMENTS

It is individual ward's/department's responsibility to ensure all staff have read and adhere to the linen handling and laundry policy

8. REFERENCES AND ASSOCIATED DOCUMENTATION

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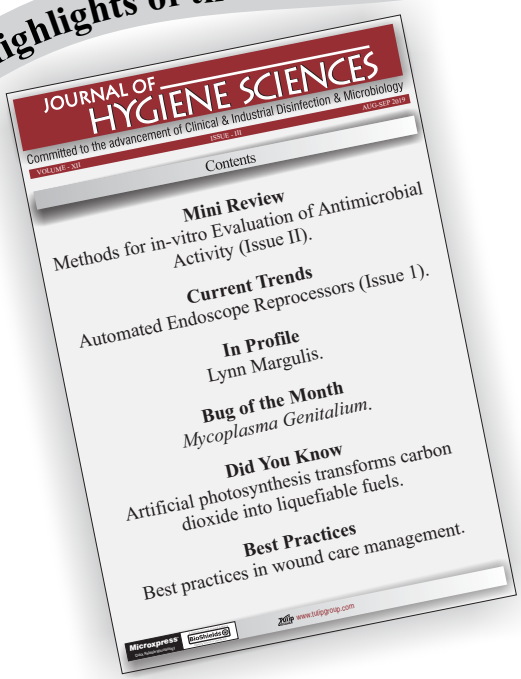
Highlights of the coming issue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