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Editorial

Contents

Although the environment serves as a reservoir for a variety of microorganisms, it is rarely implicated in disease transmission except in the immune-compromised population. Inadvertent exposures to environmental opportunistic pathogens (e.g., Aspergillus spp. and Legionella spp.) or airborne pathogens (e.g., Mycobacterium tuberculosis and varicella-zoster virus) may result in infections with significant morbidity and/or mortality. Lack of adherence to established standards and guidance can result in adverse patient outcomes in health-care facilities. Moist environments and aqueous solutions in health-care settings have the potential to serve as reservoirs for waterborne microorganisms. Under favourable environmental circumstances, many bacterial and some protozoan microorganisms can either proliferate in active growth or remain for long periods in highly stable, environmentally resistant (yet infectious) forms. Modes of transmission for waterborne infections include- direct contact, e.g. that required for hydrotherapy; ingestion of water, e.g., through consuming contaminated ice; indirect-contact transmission, e.g. from an improperly reprocessed medical device; inhalation of aerosols dispersed from water sources; and aspiration of contaminated water. The first three modes of transmission are commonly associated with infections caused by gram-negative bacteria and non-tuberculous mycobacteria. Aerosols generated from water sources contaminated with Legionella spp. often serve as the vehicle for introducing legionellae to the respiratory tract. This will be discussed in the Best Practices segment.

In the section mini review, Fluid thioglycollate media is explained. Fluid thioglycollate media or thioglycollate broth is a multi-purpose enriched differentiating media used primarily to differentiate oxygen requirement levels of various organisms.

In current trends section WHO guidelines for safe surgery is covered. Complications of surgical care have become a major cause of death and disability worldwide. The aim is to develop potential standards for improvements in four areas: safe surgical teams, safe anaesthesia, prevention of surgical site infection and measurement of surgical services by creating public health metrics to measure provision and basic outcomes of surgical care.

In profile segment covers biography of Venkatraman "Venki" Ramakrishnan, an Indian-born American and British structural biologist, who shared the 2009 Nobel Prize in Chemistry with Thomas A. Steitz and Ada E. Yonath, for "studies of the structure and function of the ribosome". He currently works at the MRC Laboratory of Molecular Biology in Cambridge, England.

Micrococcus luteus is discussed in the Bug of the month segment. Micrococcus luteus is a Gram-positive, spherical, saprotrophic bacterium that belongs to the family Micrococcaceae. It is an obligate aerobe, and is found in soil, dust, water and air, and as part of the normal flora of the mammalian skin. It also colonizes the human mouth, mucosae, oropharynx and upper respiratory tract. M. luteus is bacitracin susceptible, and forms bright yellow colonies on nutrient agar.

Did you know emphasize on troubleshooting guide for disk diffusion susceptibility testing. Resistance to antimicrobial agents has resulted in morbidity and mortality from treatment failures and increased health care costs. Although defining the precise public health risk and estimating the increase in costs is not a simple undertaking, there is little doubt that emergent antibiotic resistance is a serious global problem. QC is performed to check the quality of and the potency of the antibiotic to check results.

JHS team thanks all our readers for the support and contribution. If you have any query about a topic, inform us. It will be covered in the coming issues. Feedback and suggestions are always invited.

Fluid Thioglycollate Media

Fluid thioglycollate media or thioglycollate broth is a multi-purpose enriched differentiating media used primarily to differentiate oxygen requirement levels of various organisms. Oxygen levels throughout the media are reduced via reaction with sodium thioglycollate. This produces a range of oxygen levels in the media that decreases with increasing distance from the surface. This allows differentiation of aerobic, anaerobic, microaerophilic, and facultatively anaerobic organisms based upon growth at various levels in the media. As an example, anaerobic Clostridium will be seen growing only in lower portions of the media. $O_2$is often indicated in the media by a pink color change.

Thioglycollate broth (Fluid Thioglycollate Medium) is a medium designed to test the aerotolerance of bacteria. Fluid Thioglycollate Mediuma general purpose liquid enrichment medium used in qualitative procedures for the sterility test and for the isolation and cultivation of aerobes, anaerobes and microaerophiles that are not excessively fastidious. Fluid Thioglycollate Medium was designed by Brewer for rapid cultivation of anaerobes as well as aerobes.Incorporation of casein peptone was introduced by Vera in 1944.This medium is capable of supporting good growth of a great variety of organisms, including strict anaerobes, without incubation in an anaerobic atmosphere.In clinical microbiology, it may be used as an enrichment medium for clinical specimens.

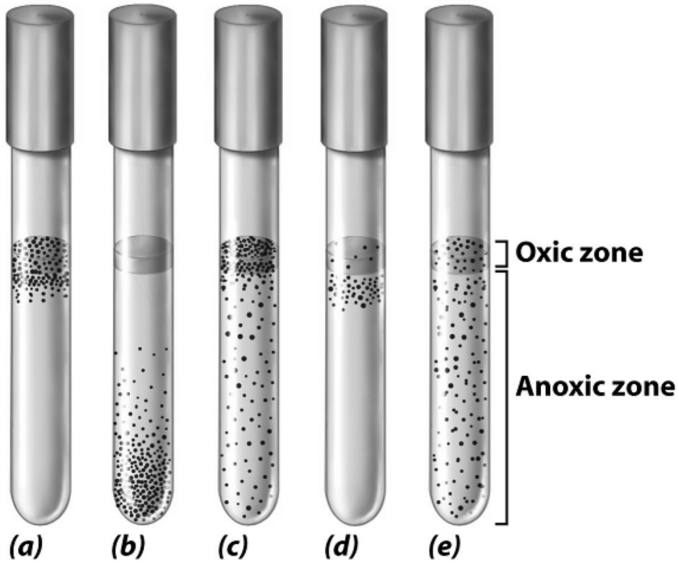
Thioglycollate broth is also used to recruit macrophages to the peritoneal cavity of mice when injected intraperitoneally. It recruits numerous macrophages, but does not activate them.

In Fluid Thioglycollate Medium, glucose, peptone, and yeast extract provide the growth factors necessary for bacterial growth. Sodium thioglycollate and L-cystine are reducing agent that prevents the accumulation of peroxides which are lethal to some microorganisms. reported the toxic effects of the indicator (methylene blue) on some organisms. The investigator suggested the use of resazurin in the Thioglycollate as an alternative to methylene blue. is an oxidation-reduction indicator, being pink when oxidized and colorless when reduced. The small amount of agar assists in the maintenance of a low redox potential by stabilizing the medium against convection currents, thereby maintaining anaerobiosis in the lower depths of the medium.Due to its agar content, Fluid Thioglycollate Medium often appears slightly opaque. is driven out of the broth by autoclaving, but as the broth sit at room temperature, oxygen begins to diffuse back into the tube. This is evidenced by the small layer of pink colour at the top of the broth.

The indicator resazurin will turn pink as oxygen is absorbed into the medium. If the upper 30% layer of broth turns pink (oxidized resazurin), the medium should be heated in boiling water or a steam bath, to drive off the absorbed oxygen. Resazurin is an indicator used for detecting changes in Eh. Increased oxidation raises the Eh, causing the resazurin to become pink. The indicator remains colorless if the Eh remains low. Caps should be loose during this process and tightenedimmediately after. Fluid Thioglycollate Medium, should not be heated again & again (should not be reheated more than once), as this may reduce the microbiological performance of the medium. Growth obtained in this medium must be subcultured onto appropriate solid media to obtain pure cultures which afterwards can be identified with methods appropriate for the isolate. Some Dextrose fermenting organisms, which are able to reduce the pH of the medium to a critical level, may not survive in this medium. Early subculture is required to isolate these organisms. Prepared medium has to be kept at room temperature way from sun light. Caution should be exercised in reporting direct Gram stain and/or other direct microbiological stain results on tissue specimens processed with this medium due to the possible presence of nonviable organisms in the culture medium.

Aerobic organisms such as Pseudomonas aeruginosa will grow in the upper, oxidized part of Fluid Thioglycollate Medium. Obligate anaerobes microorganisms such as Clostridium sporogenes will only grow in the lower, yellowish part of the broth medium. The growth of facultative or aerotolerant anaerobes such as Staphylococcus aureus is distributed in the complete broth medium but will primarily grow in the middle of the tube, between the oxygen-rich and oxygen-free zones. Microaerophiles will grow in a thin layer below the richly-oxygenated layer.

Although most obligate aerobes (e.g. Micrococcus, Pseudomonas



and related genera, and strictly aerobic sporeforming rods) will grow in this medium if the vials are vented during incubation (usually they grow as a thin film near its surface), Due to its low oxidation-reduction potential, Fluid Thioglycollate Medium is not the optimal medium for recovery of strict aerobes such as, nonfermenters, Micrococcus, and similar organisms. For such organisms recovery, Tryptic Soy Broth or Brain Heart Infusion Broth should be used.

A feature of sodium thioglycollate, in addition to lowering the oxidation-reduction potential, is its ability to neutralize the antibacterial activity of mercurial compounds. These characteristics make FTM particularly useful for determining the presence of contamination in biological and other materials. Because of its capacity for growth promotion, this formulation was adopted by The United States Pharmacopeia (USP) and the European Pharmacopeia (EP) as a sterility test and enrichment medium.Fluid Thioglycollate Medium is recommended by APHA and the AOAC International for the examination of food, and for determining the phenol coefficient and sporicidal effect of disinfectants. Fluid Thioglycollate Medium is also widely used as an enrichment medium in clinical microbiology, especially for specimens from primarily sterile body sites.Also used in sterility

testing on banked blood.

The reducing agents thioglycollate and cystine ensure an anaerobiosis which is adequate even for fastidious anaerobes. The sulfhydryl groups of these substances also inactivate arsenic, mercury and other heavy metal compounds. The thioglycollate media are thus suitable for the examination of materials which contain heavy metals or heavy metal preservatives. Any increase in the oxygen content is indicated by the redox indicator sodium resazurin which changes its color to red.

Fluid Thioglycollate Medium can be used as an enrichment medium for all types of clinical and nonclinical specimens. Due to its strongly reducing properties, it provides anaerobiosis without incubating in an anaerobic atmosphere. Usually, enrichment cultures should only be inoculated if specimens are derived from primarily sterile body sites. Note that some strict anaerobes require hemin and vitamin K for optimal growth. If such organisms are likely to be encountered, the medium can be supplemented with 10 mg hemin hydrochloride and 1 mg vitamin K1 (menadione) per liter.

For use in clinical microbiology, the medium may be supplemented with 10 mg of hemin hydrochloride per liter (prepare a tenfold stock solution in 0.1 N NaOH, filter sterilize, and add the appropriate amount to the vial) and 1 mg vitamin K1 per liter (prepare a tenfold stock solution in absolute ethanol, filter sterilize, and add the appropriate amount to the vial). Hemin and vitamin K stock solutions may be kept refrigerated for 4 weeks in the dark. Supplementation is not necessary if a sufficient amount of blood or serum from the specimen is introduced into the vial during inoculation. Inoculate specimens directly into the medium and incubate tubes for up to 7 days at 35 ± 2°C. Note that specimens should also be inoculated directly onto solid media, such as Columbia Agar with 5% Sheep Blood Trypticase Soy Agar with 5% Sheep Blood , eventually, on additional selective and nonselective media.

For sterility testing, recommendations of the United States Pharmacopeia (USP) or European Pharmacopeia and various control agencies should be followed.These reference sources specify the ratio of medium to product that should be utilized in sterility tests as well as details of sampling and test result interpretation. If the test sample renders the medium so turbid that microbial growth cannot be easily recognized, transfers should be made to fresh medium.

After incubation, growth is evidenced by the presence of turbidity in the tubes. In case of doubt, appropriate samples should subcultured onto plated media. This procedure should also be followed if the isolated organism(s) shall be further identified. If vented before or during incubation, obligate anaerobes will grow only in that portion of the broth below the oxidized (pink) top layer.

Warnings and Precautions: For in vitro Use. Caution should be exercised in reporting direct Gram stain and/or other direct microbiological stain results on tissue specimens processed with this medium due to the possible presence of nonviable organisms in the culture medium. Pathogenic microorganisms, including hepatitis viruses and Human Immunodeficiency Virus, may be present in clinical specimens. “Standard Precautions” and institutional guidelines should be followed in handling all items contaminated with blood and other body fluids. Tubes with tight caps should be opened carefully to avoid injury due to breakage of glass.

Storage Instructions: On receipt, store tubes in the dark according to label directions. Avoid freezing and overheating. Do not open until ready to use. Minimize exposure to light. Tubed media stored as labeled until just prior to use may be inoculated up to the expiration date and incubated for recommended incubation times. Allow the medium to warm to room temperature before inoculation.

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WHO Guidelines for Safe Surgery

Continuing this topic from the previous segment, this issue will deal with the rest of the WHO Guidelines for Safe Surgery.

V. The team will avoid inducing an allergic or adverse drug reaction for which the patient is known to be at significant risk.

A medication error can be defined as an error in prescription, dispensing or administration of a drug. Medication errors are a major problem in every health system and every country and have featured prominently in studies of iatrogenic injury conducted in and many countries. Perioperative errors in drug administration contribute to this problem. In the Closed Claims Project of the American Society of Anesthesiologists, drug administration errors were found to result in serious problems, including death in 24% and major morbidity in 34% of the cases reviewed. Human error contributes substantially to injuries due to medication errors. In an early analysis of critical incidents in anaesthesia, Cooper et al. found that a common cause of such incidents was inadvertent Perioperative administration of medication is particularly complex. Drug infusions are another area of potential risk, as errors can occur during the mixing of solutions, in calculating concentration and infusion rates and from co-administration of incompatible drugs through in the same intravenous cannula. As with all drug errors, the consequences of these mistakes are sometimes serious; even infusions of common opioids have resulted in fatal errors. While it is difficult to provide a precise overall estimate of the extent of harm attributable to perioperative medication error, it is almost certain that harmful errors are grossly underreported. The barriers to reporting are significant.

Recommendations

- Anaesthetists should fully understand the pharmacology of the medication they prescribe and administer, including its toxicity.
- Every patient to whom any drug is administered must first be identified clearly and explicitly by the person administering the drug.
- A complete drug history, including information on allergies and other hypersensitivity reactions, should be obtained before administration of any medication.
- Medications should be appropriately labelled, confirmed and rechecked before administration, particularly if they are drawn into syringes.
- Before any drug is administered on behalf of another health provider, explicit communication should take place to ensure that the two have a shared understanding of the indications, potential contraindications and any other relevant information.
- Medication drawers and workspaces should be organized systematically to ensure consistent positions of medication ampoules and syringes, tidiness and separation of dangerous drugs or drugs with similar-sounding names.
- Labels on ampoules and syringes should be legible and include standardized information (e.g. concentration, expiration date).
- Similar packaging and presentation of different medications should be avoided when possible.
- Errors in intravenous drug administration during anaesthesia should be reported and reviewed.
- Drugs should be drawn up and labelled by the anaesthetist who will administer them.
- Medications in a similar class should be colour-coded according to an agreed system that is understood by all members of the operating team.

VI. The team will consistently use methods known to minimize the risk for surgical site infection.

An infection that occurs in surgical patients at the site of operation is known as surgical site infection. These infections occur after invasive procedures in the superficial or deep layers of the incision or in the organ or space that was manipulated or traumatized, such as the peritoneal space, pleural space, mediastinum or joint space. These problems are serious and costly, and are associated with increased morbidity and mortality as well as with prolonged hospitalization. Recently, their prevalence has been used as a marker for the quality of surgeons and hospitals. Surgical site infection accounts for about 15% of all health-care associated infections and about 37% of the hospital-acquired infections of surgical patients. Two thirds of surgical site infections are incisional and one third confined to the organ space. In western countries, the frequency of such infections is 15–20% of all cases, with an incidence of 2–15% in general surgery. Surgical site infections lead to an average increase in the length of hospital stay of4–7 days. Infected patients are twice as likely to die, twice as likely to spend time in an intensive care unit and five times more likely to be readmitted after discharge.

Microbial contamination during a surgical procedure is a precursor of surgical site infection. Most surgical wounds are contaminated by bacteria, but only a minority progress to clinical infection. Infection does not occur in most patients because their innate host defences eliminate contaminants at the surgical site efficiently. There are at least three important determinants of whether contamination will lead to surgical site infection: the dose of bacterial contamination, the virulence of the bacteria and the resistance of the patient. This is demonstrated in the following formula:

(Dose of bacterial contamination X Virulence of bacteria) / Resistance of host = Risk of surgical site infection

Other factors that affect the probability of infection are depicted in the following hypothetical equation:

(Inoculum of bacteria + Virulence of bacteria + Adjuvant effects)/ (Innate and adoptive host defence – Acute and chronic host liabilities) = Probability of infection

The Study on the Efficacy of Nosocomial Infection Control (SENIC) showed that about 6% of all nosocomial infections can be prevented with minimum intervention. Simple methods that can be used to limit risk include:

- complete assessment of all surgical patients preoperatively;
- reduced preoperative hospitalization;
- evaluation and treatment of remote infections;
- weight reduction (for obese patients);
- cessation of tobacco use;

- control of hyperglycaemia;
- restoration of host defences;
- decreased endogenous bacterial contamination;
- appropriate methods of hair removal;
- administration of appropriate and timely antimicrobial prophylaxis;
- confirmation of proper asepsis and antisepsis of skin and instruments;
- maintenance of meticulous surgical technique and minimization of tissue trauma;
- maintenance of normothermia during surgery;
- shortened operating time; and
- effective wound surveillance.

The principles of an effective surveillance system are:
- to maintain accurate, efficient, confidential data collection;
- to provide data on final infection rates stratified by multivariate risk for each surgeon and patient;
- to use clear, consistent definitions of infection; and
- to use standardized post-discharge follow-up protocols and proper maintenance of data.

Superficial incisional surgical site infection: Infection occurs at the incision site within 30 days of surgery and involves only skin or subcutaneous tissue at the incision and at least one of the following:
- purulent drainage from the superficial incision;
- an organism isolated by culturing fluid or tissue from the superficial incision;
- deliberate opening of the wound by the surgeon because of the presence of at least one sign or symptom of infection (pain, tenderness, localized swelling, redness or heat), unless the wound culture is negative; or
- diagnosis of superficial incisional surgical site infection by the surgeon or attending physician.

Recommendations:
- Prophylactic antibiotics should be used routinely in all clean–contaminated surgical cases and considered for use in any clean surgical case. When antibiotics are given prophylactically to prevent infection, they should be administered within 1 hour of incision at a dose and with an antimicrobial spectrum that is effective against the pathogens likely to contaminate the procedure. Before skin incision, the team should confirm that prophylactic antibiotics were given within the past 60 minutes. (When vancomycin is used, infusion should be completed within 1 hour of skin incision.)
- Every facility should have a routine sterilization process that includes means for verifying the sterility of all surgical instruments, devices and materials. Indicators should be used to determine sterility and checked before equipment is introduced onto the sterile field. Before induction of anaesthesia, the nurse or other person responsible for preparing the surgical trays should confirm the sterility of the instruments by evaluating the sterility indicators and should communicate any problems to the surgeon and anaesthetist.
- Redosing with prophylactic antibiotics should be considered if the surgical procedure lasts more than 4 hours or if there is evidence of excessive intraoperative bleeding. (When vancomycin is used as the prophylactic agent, there is no need for redosing in operations lasting less than 10 hours.)
- Antibiotics used for prophylaxis should be discontinued within 24 hours of the procedure.
- Hair should not be removed unless it will interfere with the operation. If hair is removed, it should be clipped less than 2 hours before the operation. Shaving is not recommended as it increases the risk for surgical site infection.
- Surgical patients should receive oxygen throughout the perioperative period according to individual requirements.
- Measures to maintain core normothermia should be taken throughout the perioperative period.
- The skin of all surgical patients should be prepared with an appropriate antiseptic agent before surgery. The antimicrobial agent should be selected on the basis of its ability to decrease the microbial count of the skin rapidly and its persistent efficacy throughout the operation.

Surgical hand antisepsis should be assured with an antimicrobial soap. The hands and forearms should be scrubbed for 2–5 minutes. If the hands are physically clean, an alcohol-based hand antiseptic agent can be used for antisepsis.
- The operating team should cover their hair and wear sterile gowns and sterile gloves during the operation.
- 'On call' orders for administration of antibiotic prophylaxis should be discouraged.
- If hair is to be removed, the use of depilatories is discouraged.
- Tobacco use should be stopped at least 30 days before elective surgery if possible.
- Surgical patients should take a preoperative shower with antiseptic soap.
- Prior infections should be eliminated before a scheduled operation.
- The operating team should wear masks during the operation.
- Surgical drapes that are effective when wet should be used as part of the sterile barrier.
- Sterile dressing should be maintained over the surgical wound for 24–48 hours.
- Active surveillance for surgical site infections should be conducted prospectively by trained infection control practitioners.
- Information on the surgical site infection rate should be provided to surgeons and appropriate administrators.
- A high fraction of inspired oxygen (80%) should be administered throughout the operation, and supplemental oxygen should be administered for at least two hours postoperatively.
- Positive pressure air flow should be maintained in the operating room.
- The operating room should be cleaned thoroughly after 'dirty' or 'infected' cases and at the end of each operating day.
- Standardized infection control policies should be implemented.
- Surgical teams should be educated about infection prevention and control at least annually.

VII. The team will prevent inadvertent retention of instruments and sponges in surgical wounds

Inadvertently leaving a sponge, needle or instrument in a patient at the end of an operation is a rare but persistent, serious surgical error. Because of its rarity, it is difficult to estimate the frequency with which it occurs; the best estimates range from 1 in 5000 to 1 in 19,000 inpatient

operations, but the likelihood has been estimated to be as high as 1 in 1000. Retained sponges and instruments tend to result in serious sequelae, including infection, re-operation for removal, bowel perforation, fistula or obstruction and even death.

A number of factors contribute to this error, but the evidence points to three clear risk factors: emergency surgery, high body mass index and an unplanned change in the operation. Other risk factors that may contribute are high-volume blood loss and the involvement of multiple surgical teams, although these factors did not reach statistical significance in the study. Sponges and instruments can be retained during any surgical procedure on any body cavity, regardless of the magnitude or complexity. Manual counting methods are not fool-proof, as they are subject to human error. Newer techniques, which include automated counting and tracking of sponges, appear to increase the accuracy of counting and the detection of inadvertently retained sponges. New methods include use of bar-coded sponges and sponges with radiofrequency identification tags. A randomized trial of a bar-coded sponge system showed a threefold increase in detection of miscounted or misplaced sponges.

A specific procedure for counting should be established to ensure that the protocols are standardized and familiar to operating room personnel. Specific low-risk procedures (e.g. cystoscopy, cataract surgery) can be exempted from the counting protocols, but they should be exceptions rather than a general rule. Most established protocols include all or nearly all the recommendations listed below. A full count of sponges, sharps, miscellaneous items (especially small items such as tapes, clips and drill bits) and instruments should be performed when the peritoneal, retroperitoneal, pelvic and thoracic cavities are entered. Counts should also be done for any procedure in which these items could be retained in the patient, and must be conducted at least at the beginning and end of every eligible case. A tally of all counted items should be maintained throughout the operation. Any items designated as part of the counting protocol that are added during the procedure should be counted and recorded upon entry onto the sterile field. Ideally, pre-printed count sheets for sponges, sharps and instruments should be used and included in the patient's record whenever possible. Other recording strategies, such as using whiteboards to track counts, are also acceptable, in accordance with hospital protocol.

Counting should be performed by two persons, such as the scrub and circulating nurses, or with an automated device, when available. When there is no second nurse or surgical technician, the count should be done by the surgeon and the circulating nurse. If a count is interrupted, it should be started again from the beginning. Ideally, the same two persons should perform all counts. When there is a change in personnel, a protocol for transfer of information and responsibility should be clearly delineated in hospital policy.

Sponge count (e.g. gauze, laparotomy sponges, cotton swabs, dissectors): An initial sponge count should be done for all non-exempt procedures. At a minimum, sponges should be counted before the start of the procedure, before closure of a cavity within a cavity, before wound closure (at first layer of closure) and at skin closure. When available, only X-ray-detectable sponges should be placed in body cavities. Sponges should be packaged in standardized multiples (such as 5 or 10) and counted in those multiples. Sponges should be completely separated (one by one) during counting. Packages containing incorrect numbers of sponges should be repackaged, marked, removed from the sterile field and isolated from the other sponges. Attached tapes should not be cut. Non-X-ray-detectable gauze used for dressing should be added to the surgical field only at skin closure. When sponges are discarded from the sterile field, they should be handled with protective equipment (gloves, forceps). After they have been counted, they should be organized so as to be readily visible (such as in plastic bags or the equivalent) in established multiples. Soiled dissecting sponges (e.g. peanuts) should be kept in their original container or a small basin until counted. Sharps count (e.g. suture and hypodermic needles, blades, safety pins): Sharps should be counted before the start of the procedure, before closure of a cavity within a cavity, before wound closure (at first layer of closure) and at skin closure. Suture needles should be counted according to the marked number on the package. The number of suture needles in a package should be verified by the counters when the package is opened.

Needles should be contained in a needle counter or container, loaded onto a needle driver or sealed with their package. Needles should not be left free on a table. Instrument count: Instruments should be counted before the start of the procedure and before wound closure (at first layer of closure). Instrument sets should be standardized (i.e. same type and same number of instruments in each set) and a tray list used for each count. Instruments with component parts should be counted singly (not as a whole unit), with all component parts listed (e.g. one retractor scaffold, three retractor blades, three screws). Instruments should be inspected for completeness. All parts of a broken or disassembled instrument should be accounted for. If an instrument falls to the floor or is passed off the sterile field, it should be kept within the operating room until the final count is completed. No instrument should be removed from the operating room until the end of the procedure.

Recommendations:

- A full count of sponges, needles, sharps, instruments and miscellaneous items (any other item used during the procedure that is at risk of being left within a body cavity) should be performed when the peritoneal, retroperitoneal, pelvic or thoracic cavity is entered.
- The surgeon should perform a methodical wound exploration before closure of any anatomical cavity or the surgical site.
- Counts should be done for any procedure in which sponges, sharps, miscellaneous items or instruments could be retained in the patient. These counts must be performed at least at the beginning and end of every eligible case.
- Counts should be recorded, with the names and positions of the personnel performing the counts and a clear statement of whether the final tally was correct. The results of this tally should be clearly communicated to the surgeon.
- Validated, automatic sponge counting systems, such as barcoded or radio-labelled sponges, should be considered for use when available.

VIII. The team will secure and accurately identify all surgical specimens.

While there are considerable data on processing and diagnostic errors associated with surgical specimens, there is scant evidence about the incidence and nature of errors due to inadequate or wrong labelling, missing or inadequate information and 'lost' specimens, all of which can potentially hinder patient care and safety. An analysis of medico-legal claims for errors in surgical pathology revealed that 8% were due to 'operational' errors. Such incidents are accompanied by delays in treatment, repeated procedures and surgery on the wrong body part. Such incidents occur in all specialties and all types of tissue.

Errors in labelling laboratory specimens occur because of mismatches between the specimen and the requisition and unlabelled or mislabelled specimens. Patient identification on specimens and requisition forms are critical in any attempt to prevent laboratory errors. The Joint Commission made 'accurate patient identification' one of their laboratory patient safety goals. Improved identification is crucial to preventing errors in laboratory specimen labelling. Rechecking wrist identification bands can decrease specimen labelling error rates and blood grouping errors. Mislabelling of surgical pathology specimens can have more severe consequences than other laboratory errors that occur before specimen analysis. A recent study by Makary et al. showed that errors occur in 3.7 per 1000 specimens from operating rooms and involve the absence of accurate labelling, omission of details regarding tissue site and the absence of patient name.

Several simple steps can be taken to minimize the risk of mislabelling. First, the patient from whom each surgical specimen is taken should be identified with at least two identifiers (e.g. name, date of birth, hospital number, address). Second, the nurse should review the specimen details with the surgeon by reading aloud the name of the patient listed and the name of the specimen, including the site of origin and any orienting markings. When required by a facility, the surgeon should complete a requisition form labelled with the same identifiers as the specimen container. This requisition form should be cross-checked against the specimen by the nurse and surgeon together before it is sent to the pathology department and should include the suspected clinical diagnosis and the site (and side or level when applicable) from which the sample was taken.

Recommendations:

- The team should confirm that all surgical specimens are correctly labelled with the identity of the patient, the specimen name and location (site and side) from which the specimen was obtained, by having one team member read the specimen label aloud and another verbally confirming agreement.

IX. The team will effectively communicate and exchange critical information for the safe conduct of the operation.

"The pursuit of safety … is about making the system as robust as practicable in the face of human and operational hazards" wrote James Reason, one of the pioneers of human error evaluation. Failures within a system, particularly catastrophic ones, rarely happen as a result of a single unsafe act. Rather, they are the culmination of multiple errors involving the task, team, situation and organization.

The factors responsible for these errors may be broadly categorized in the following seven ways: high workload; inadequate knowledge, ability or experience; poor human factor interface design; inadequate supervision or instruction; stressful environment; mental fatigue or boredom; and rapid change. The greatest threats to complex systems are the result of human rather than technical failures. And while human fallibility can be moderated, it cannot be eliminated. Thus complex systems such as aviation and the nuclear industry have come to accept the inevitability of human error and built mechanisms to reduce and manage it. These mechanisms include technological innovations such as simulations, team training initiatives and simple reminders such as checklists. Team communication is a central component of managing and averting errors. There is growing evidence that communication failures among team members are a common cause of medical errors and adverse events. The Joint Commission reported that in the United States communication was a root cause of nearly 70% of the thousands of adverse events reported to the organization between 1995 and 2005. Furthermore, operating teams seem to recognize that communication breakdowns can be a fundamental barrier to safe, effective care. In one survey, two thirds of nurses and physicians cited better communications in a team as the most important element in improving safety and efficiency in the operating room. Pre-procedural briefings are critical safety component of other highly complex industries. Briefings facilitate the transfer of critical information and help create an atmosphere of shared learning and responsibility. The Joint Commission recommends use of a 'time out' or 'surgical pause' to allow the team to confirm the patient, the procedure and the site of operation before the incision.

Recommendations:

- Before skin incision, the surgeon should ensure that team members, in particular nurses, anaesthetists, and surgical assistants are aware of the critical steps of the procedure to be performed, the risk for heavy blood loss, any special equipment needed (such as instruments, implants, intraoperative imaging, frozen section pathology) and any likely deviation from routine practice. The nurse(s) should inform the team members about any critical safety concerns and the lack of availability or preparation of any special equipment. The anaesthetist should inform the team about any critical safety concerns, in particular any difficulty in preparing for resuscitation after heavy blood loss or patient comorbidities that add risk to the anaesthesia.
- In cases of bilaterality, multiple body parts (e.g. fingers or toes) and multiple levels (e.g. spine) or when intraoperative decisions on the extent of surgical resection are to be made in conjunction with radiographic imaging, the team should confirm that the necessary imaging is available and displayed in the operating room.
- Before the patient leaves the room, the surgeon should inform team members of any alterations that were made to the procedure performed, any problems that may occur in the postoperative period and essential postoperative plans (which might include antibiotics, venous thromboembolism prophylaxis, oral intake or drain and wound care). The

anaesthetist should summarize the clinical condition of the patient during the operation and any other instructions needed to ensure a safe recovery. The nurse should notify the team of any additional concerns recognized during the operation or for recovery.

- An accurate, complete, signed surgical record should be maintained. All patient records should be:
  - clear: the patient clearly identified by his or her name and hospital number on each page, written legibly or typed and each entry signed, dated and timed;
  - objective: opinions should be based on recorded facts;
  - contemporary: notes should be written as soon as possible after an event;
  - tamper-proof: attempts to amend records should be immediately apparent; if computerized systems are used, they should record the date and author of any notes and track any amendments;
  - original: records should not be altered or amended once an entry is complete. If a mistake is noticed, amendments or corrections may be added and clearly identified as such. If a change is made to the record, it should be signed and dated, and a note should explain why the change was made.
- Information recorded by the surgeon in the operation note should include, at a minimum, the name of the main procedure performed and any secondary procedures, the names of any assistants, the details of the procedure and the intraoperative blood loss. The information recorded by the anaesthetist should include, at a minimum, intraoperative vital sign parameters recorded at regular intervals, medications and fluids administered intraoperatively and any intraoperative events or periods of patient instability. The information recorded by the nursing team should include, at a minimum, sponge, needle, sharps and instrument counts, the names and positions of the personnel performing the counts, instruments and sponges specifically left inside the patient, any action taken in the event of a count discrepancy, and, if no count was performed, the reasons for not conducting a count. The complete operation record should therefore include the names of all team members involved.

X. Hospitals and public health systems will establish routine surveillance of surgical capacity, volume and results.

Assessment of success, failure and progress in the provision and safety of surgical care relies on information on the status of care. Practitioners, hospitals and public health systems require information on surgical capacity, volume and results, to the extent practicable. Success in other fields of public health, such as the safety of childbirth, reduction of HIV transmission and the eradication of poliomyelitis, has been shown to depend on surveillance. Improvement of surgical safety and access is no different.

The current model for measuring health-care delivery is the Donabedian framework. First introduced in 1966, this framework is based on three levels of measures: those of structure, process and outcome. Structure metrics allow assessment of the infrastructure of a health system. Process metrics allow assessment of how well a health-care protocol is carried out or delivered. Outcome metrics allow assessment of the results or impact on a population's health. The strength of the Donabedian framework lies in the relations between these measures. Structure influences process and process in turn influences outcome. A comprehensive assessment of health-care delivery requires understanding of all three elements individually and the relations among them.

Recommendations

- For surgical surveillance at the national level, the following data should be collected systematically by WHO Member States:
  - number of operating rooms,
  - number of surgical procedures performed in an operating room,
  - number of trained surgeons and number of trained anaesthetists,
  - day-of-surgery mortality rate and
  - postoperative in-hospital mortality rate.
- For surgical surveillance at hospital and practitioner levels, the following data should be collected systematically by facilities and clinicians:
  - day-of-surgery mortality rate,
  - postoperative in-hospital mortality rate.
- As a more detailed measure of surgical surveillance in WHO Member States with more advanced data capability, the following data should be collected systematically:
  - number of operating rooms by location: hospital or ambulatory, public or private;
  - number of trained surgeons by specialty: general surgery, gynaecology and obstetrics, neurosurgery, ophthalmology, otorhinolaryngology, orthopaedics and urology;
  - number of other surgical providers: residents, unaccredited physicians, medical officers;
  - number of trained anaesthetists by level of training: physician anaesthesiologists, nurse anaesthetists, anaesthesia officers;
  - number of perioperative nurses;
  - number of surgical procedures performed in operating rooms for the 10 most frequent procedures in the country, emergent or elective;
  - proportion of deaths on the day of surgery by procedure for the 10 most frequent procedures in the country; and
  - proportion of in-hospital deaths after surgery by procedure for the 10 most frequent procedures in the country.
- For more detailed surgical surveillance at the hospital and practitioner level, the following data should be collected by facilities and clinicians:
  - surgical site infection rate and
  - surgical Apgar Score.
- In WHO Member States with the resources and capability to conduct risk-adjusted evaluations, countries should adjust outcome data for case mix and extend outcome measures to include morbidity by defining complications and conducting independent clinical surveillance for follow-up and detection of complications.

Venkataraman "Venki" Ramakrishnan

Venkatraman "Venki" Ramakrishnan is an Indian-born American and British structural biologist, who shared the 2009 Nobel Prize in Chemistry with Thomas A. Steitz and Ada E. Yonath, for "studies of the structure and function of the ribosome". He currently works at the MRC Laboratory of Molecular Biology in Cambridge, England.

Early life

Ramakrishnan was born in Chidambaram in Cuddalore district of Tamil Nadu, India to C. V. Ramakrishnan and Rajalakshmi. Both his parents were scientists and taught biochemistry at the Maharaja Sayajirao University in Baroda. He moved to Vadodara (previously also known as Baroda) in Gujarat at the age of three, where he had his schooling at Convent of Jesus and Mary, except for spending 1960–61 in Adelaide, Australia. Following his Pre-Science at the Maharaja Sayajirao University of Baroda, he did his undergraduate studies in the same university on a National Science Talent Scholarship, graduating with a BSc degree in Physics in 1971.

In a January 2010 lecture at the Indian Institute of Science, he revealed that he failed to get admitted at any of the Indian Institutes of Technology, or Christian Medical College, Vellore, Tamil Nadu.

Immediately after graduation he moved to the U.S.A., where he met Vera Rosenberry and married her in 1975. He obtained his PhD degree in Physics from Ohio University in 1976. He then spent two years studying biology as a graduate student at the University of California, San Diego while making a transition from theoretical physics to biology.

Career

Around his time in University of California, he read an article in Scientific American by Don Engelman and Peter Moore about their ribosome work, and became interested in it. Thus, he began work on ribosomes as a postdoctoral fellow with Peter Moore at Yale University. He worked in a long term project of mapping the spatial location of the proteins in the 30S subunit, which involved reconstituting ribosomes in which a specific pair of proteins were replaced by their deuterated counterparts. This was followed by small-angle neutron scattering experiments at Brookhaven National Laboratory, which would yield the distance between the centers of mass of the two deuterated proteins. He managed to map about a third of the proteins during his stay there. After his post-doctoral fellowship, he initially could not find a faculty position even though he had applied to about 50 universities in the U.S. This was partly because of my rather unusual career path, the fact that my degrees were from less than first-rate institutions, and perhaps more importantly, universities did not know what to think of a physicist turned biologist using an esoteric technique like neutron scattering.

He continued to work on ribosomes from 1983-95 as a staff scientist at Brookhaven National Laboratory. In 1995 he moved to the University of Utah as a Professor of Biochemistry, and in 1999, he moved to his current position at the Medical Research Council Laboratory of Molecular Biology in Cambridge, England, where he had also been a sabbatical visitor during 1991-92.

In 1999, Ramakrishnan's laboratory published a 5.5 Angstrom resolution structure of the 30S subunit. The following year, his laboratory determined the complete molecular structure of the 30S subunit of the ribosome and its complexes with several antibiotics. This was followed by studies that provided structural insights into the mechanism that ensures the fidelity of protein biosynthesis. More recently, his laboratory has determined the atomic structure of the whole ribosome in complex with its tRNA and mRNA ligands. Ramakrishnan is also known for his past work on histone and chromatin structure.

Honours

Ramakrishnan is a Fellow of the Royal Society, a member of EMBO and the U.S. National Academy of Sciences and a Fellow of Trinity College, Cambridge. He was awarded the 2007 Louis-Jeantet Prize for Medicine, the 2008 Heatley Medal of the British Biochemical Society and the 2009 Rolf-Sammet Professorship at the University of Frankfurt. In 2009, Ramakrishnan was awarded the Nobel Prize in Chemistry along with Thomas A. Steitz and Ada Yonath. He received India's second highest civilian honor, the Padma Vibhushan, in 2010.

Ramakrishnan was knighted in the 2012 New Year Honours for services to Molecular Biology.

Personal life

Ramakrishnan is married to Vera Rosenberry, an author and illustrator of children's books. His stepdaughter Tanya Kapka is a doctor in Oregon, and his son Raman Ramakrishnan is a cellist based in New York.

Reconnecting with India

Since Ramakrishnan left India at the age of 19, he had been back only three times in about 28 years. One of his travels was that in early 2002, when he was asked to give the first G.N. Ramachandran Memorial Lecture in Chennai. On this trip, he also visited the Indian Institute of Science in Bangalore for a day. This was his first visit to India in 13 years, and his first ever interaction with the Indian scientific community. It started a process by which he not only became more familiar with scientific research at a few institutions in India, but also got to know individual scientists well. In the last few years, he has had a G.N. Ramachandran visiting professorship at the Indian Institute of Science in Bangalore, and has used it to escape the dark and dreary late December – early January period in Cambridge and work in Bangalore on papers and reviews, give lectures and talk to colleagues and especially young scientists there. This reconnection with his got him elected as a foreign fellow in 2008 by the Indian National Science Academy.

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Enjoy the humour

1) A physicist, biologist and a chemist were going to the ocean for the first time.
The physicist saw the ocean and was fascinated by the waves. He said he wanted to do some research on the fluid dynamics of the waves and walked into the ocean. Obviously he was drowned and never returned.
The biologist said he wanted to do research on the flora and fauna inside the ocean and walked inside the ocean. He too, never returned.
The chemist waited for a long time and afterwards, wrote the observation, "The physicist and the biologist are soluble in ocean water".

2) Doctor: I have some bad news and some very bad news.
Patient: Well, might as well give me the bad news first.
Doctor: The lab called with your test results. They said you have 24 hours to live.
Patient: 24 HOURS! Thats terrible!! WHAT could be WORSE? What's the very bad news?
Doctor: I've been trying to reach you since yesterday.

3) A man goes into a pet shop to buy a parrot. The shop owner points to three identical looking parrots on a perch and says, "the parrot on the left costs 500 dollars".
"Why does the parrot cost so much," asks the man.
The shop owner says, "well, the parrot knows how to use a computer".
The man then asks about the next parrot to be told that this one costs 1,000 dollars because it can do everything the other parrot can do plus it knows how to use the UNIX operating system.
Naturally, the increasingly startled man asks about the third parrot to be told that it costs 2,000 dollars. Needless to say this begs the question, "What can it do?"
To which the shop owner replies, "to be honest I have never seen it do a thing, but the other two call him boss!"

4) A new manager spends a week at his new office with the manager he is replacing. On the last day the departing manager tells him, "I have left three numbered envelopes in the desk drawer. Open an envelope if you encounter a crisis you can't solve."
Three months down the track there is a major drama, everything goes wrong - the usual stuff - and the manager feels very threatened by it all. He remembers the parting words of his predecessor and opens the first envelope. The message inside says "Blame your predecessor!" He does this and gets off the hook.
About half a year later, the company is experiencing a dip in sales, combined with serious product problems. The manager quickly opens the second envelope. The message read, "Reorganize!" This he does, and the company quickly rebounds.
Three months later, at his next crisis, he opens the third envelope. The message inside says "Prepare three envelopes".

5) Caller: Hello, is this the Help Line?
HelpLine: Yes, it is. How may I help you?
Caller: The cup holder on my PC is broken and I am within my warranty period. How do I go about getting that fixed?
HelpLine: I'm sorry, but did you say a cup holder?
Caller: Yes, it's attached to the front of my computer.
HelpLine: Please excuse me if I seem a bit stumped, it's because I am. Did you receive this as part of a promotional, at a trade show? How did you get this cup holder? Does it have any trademark on it?
Caller: It came with my computer, I don't know anything about a promotional. It just has '4X' on it.
At this point the HelpLine operator realized that the caller had been using the load drawer of the CD-ROM drive as a cup holder, and snapped it off the drive.

TechStuff

Four generations in the mobile industry
In the present time, there are four generations in the mobile industry. These are respectively 1G the first generation, 2G the second generation, 3G the third generation, and then the 4G the fourth generation. Ericson a Swedish company has launching this high tech featured mobile into the market. It is being first introduced in the Swedish Capital city, Stockholm.

What is 2G?
Second Generation (2G) wireless cellular mobile services was a step ahead of First Generation(1G) services by providing the facility of short message service(SMS) unlike 1G that had its prime focus on verbal communication. A typical 2G G.S.M network service ranges from 800/900MHz or 1800/1900 spectrum. The bandwidth of 2G is 30-200 KHz.

Analysis of 1G and 2G services
In 1G, Narrow band analogue wireless network is used, with this we can have the voice calls and can send text messages. These services are provided with circuit switching. Today's the usual call starts from the beginning pulse to rate to the final rate. Then in case of 2G Narrow Band Wireless Digital Network is used. It brings more clarity to the conversation and both these circuit-switching model. Both the 1G and 2G deals with voice calls and has to utilize the maximum bandwidth as well as a limited till sending messages i.e. SMS. The latest technologies such as GPRS, is not available in these generations. But the greatest disadvantage as concerned to 1G is that with this we could contact with in the premises of that particular nation, where as in case of 2G the roaming facility a semi-global facility is available.

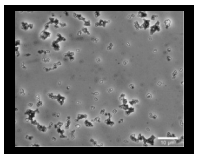
2.5 Generation
In between 2G and 3G there is another generation called 2.5G. Firstly, this mid generation was introduced mainly for involving latest bandwidth technology with addition to the existing 2G generation. To be frank but this had not brought out any new evolution and so had not clicked to as much to that extend.

What is 3G Generation?
But to overcome the limitations of 2G and 2.5G the 3G had been introduced. In this 3G Wide Brand Wireless Network is used with which the clarity increases and gives the perfection as like that of a real conversation. The data are sent through the technology called Packet Switching .Voice calls are interpreted through Circuit Switching. It is a highly sophisticated form of communication that has come up in the last decade. In addition to verbal communication it includes data services, access to television/video, categorizing it into triple play service. 3G operates at a range of 2100MHz and has a bandwidth of 15-20MHz. High speed internet service, video chatting are the assets of 3G.

How is 2G different from 3G?
In comparison to 2G customers will have to pay a relatively high license fee for 3G. The network construction and maintenance for 3G is much expensive than 2G. From the point of view of customers, expenditure will be excessively high if they make access to various facets of 3G.

Main 3G Services
With the help of 3G, we can access many new services too. One such service is the GLOBAL ROAMING. Another thing to be noted in case of 3G is that Wide Band Voice Channel that is by this the world has been contracted to a little village because a person can contact with other person located in any part of the world and can even send messages too. Then the point to be noted is that 3G gives clarity of voice as well can talk without any disturbance. Not only these but also have entertainments such as Fast Communication, Internet, Mobile T.V, Video Conferencing, Video Calls, Multi Media Messaging Service (MMS), 3D gaming, Multi-Gaming etc. are also available with 3G phones.

Main 4G Features
When It is still to estimate as to how many number of people have moved on from 2G to 3G , technology has come up with the latest of its type namely 4G. A successor of 2G and 3G, 4G promises a downloading speed of 100Mbps and is yet to shower its wonders on. then with the case of Fourth Generation that is 4G in addition to that of the services of 3G some additional features such as Multi-Media Newspapers, also to watch T.V programs with the clarity as to that of an ordinary T.V. In addition, we can send Data much faster than that of the previous generations.



Micrococcus luteus

Micrococcus luteus is a Gram-positive, spherical, saprotrophic bacterium that belongs to the family Micrococcaceae. It is an obligate aerobe, and is found in soil, dust, water and air, and as part of the normal flora of the mammalian skin. It also colonizes the human mouth, mucosae, oropharynx and upper respiratory tract. M. luteus is bacitracin susceptible, and forms bright yellow colonies on nutrient agar. To confirm it is not Staphylococcus aureus, a bacitracin susceptibility test can be performed.

Scientific classification

Kingdom:	Bacteria
Phylum:	Actinobacteria
Order:	Actinomycetales
Family:	Micrococcaceae
Genus:	Micrococcus
Species:	luteus
Binomial name:	Micrococcus luteus

Micrococcus luteus was originally isolated by Alexander Fleming in 1929 as Micrococcus lysodeikticus. It was the primary experimental microbe used in Fleming's discovery of lysozyme. The microbe can be found in a variety of environments including soil, water, animals, and some dairy products. Micrococcus is generally thought to be a saprotrophic or commensal organism, though it can be an opportunistic pathogen. This is particularly true in hosts with compromised immune systems. Micrococcus species may cause intracranial abscesses, meningitis, pneumonia, and septic arthritis in immunosuppressed or immunocompetent hosts. In addition, strains identified as Micrococcus spp. have been reported recently in infections associated with indwelling intravenous lines, continuous ambulatory peritoneal dialysis fluids, ventricular shunts and prosthetic valves. Altuntas et al. (2004) reported the first case study of a catheter-related bacteremia caused by Kocuria rosea, a gram-positive microorganism belonging to the family Micrococcaceae, in a 39-year-old man undergoing peripheral blood stem cell transplantation (PBST) due to relapsed Hodgkin disease. Hence, a clinician is advised not to underestimate the importance of the repeated isolation of a Kocuria rosea from blood cultures. Although uncommon, the possibility that a central venous line may be the portal of entry should be evaluated. Adherence of bacteria to the silastic tube would possibly explain the failure of treatment by antibiotics alone. The report emphasizes that Kocuria rosea should be considered as a nosocomial pathogen, which may be the cause of catheter infections in febrile neutropenic patients. In these patients, persistent Kocuria rosea bacteremia unresponsive to medical management should be treated by catheter removal.

Some Interesting Genes:

Micrococcus luteus is able to survive in the environment for long periods. It is very capable of survival under stress conditions, such as low temperature and starvation. However, M. luteus does not form spores as survival structures, as is common in other bacteria. Instead, M. luteus undergoes dormancy without spore formation. Its unique ability to undergo resuscitation from dormancy seems to be connected to the Rpf gene (resuscitation promoting factor). Genes similar to rpf are widely distributed throughout the Actinobacteria. Many related bacteria, including M. tuberculosis, contain multiple gene homologs. In this regard, Rpf-like proteins are essential for bacterial growth. M. luteus is unusual in that it contains a single rpf-like gene. Studies have demonstrated that M. luteus secretes an Rpf protein which has specific signaling functions required for its resuscitation from dormancy. The microbe can adopt a state of low metabolic activity when environmental conditions are not conducive for sustained growth. This would obviously permit survival for prolonged periods until optimal environmental conditions are restored

More recently, a non-spore forming cocci, identified as Micrococcus luteus, was isolated from a 120 million year old block of amber. Although comparison of rRNA sequences from other isolates is unable to confirm the precise age of the bacteria, it is estimated that Micrococcus luteus has survived for at least 34,000 to 170,000 years on the basis of 16S rRNA analysis. It seems that M. luteus and other related modern members of the genus have numerous genetic adaptations for survival. This includes extreme, nutrient-poor conditions. These phenotypes have assisted the microbe in persistent and prevalent dispersal within the environment. This species has an ability to utilize succinate and terpinerelated compounds (which themselves are major components of natural amber) to enhance and ensure its survival in oligotrophic environments.

Micrococcus luteus is an organism that is capable of growth on pyridine. Pyridine is a natural byproduct of coal and oil gasification. It is also mobile in soil and is considered an environmental teratogen. M. luteus contains a gene that codes for the enzyme succinate-semialdehyde dehydrogenase. Although the mechanism is not completely understood, the enzyme is actually induced by pyridine. It permits the oxidation of pyridine as a metabolic carbon source and thereby provides cellular energy. In the process it releases the nitrogen contained in the pyridine ring as ammonium (NH_3). M. luteus, like species of Bacillus and Corynebacterium, require the amino acids arginine, valine, leucine and methionine for enhanced growth on pyridine.

Miccrococus luteus contains two structural genes (hex-a, hex-b) that encode two essential components of Hexaprenyl disphosphate synthase (HexPS). When these two components are combined, they mechanize prenyl transferase activity. This enzyme complex will produce the precursor of the prenyl side chain of menaquinon-6 (HexPP; C30). Terpenoid-Menaquinon biosynthesis in prokaryotes function as electron carriers within the cytoplasmic membrane, and each is required for respiration using different, although overlapping subsets of terminal electron acceptors. Menaquinone is also known as the essential Vitamin K-2, because it is a nutrient that cannot be synthesized by mammals.

Biotechnology Applications:

Micrococcus luteus has important biotechnology applications, especially in the chemical and pharmaceutical industries. M. luteus may be potentially exploited for its capability in isoprene and terpene synthetic reactions. These reactions are the chemical foundation of many important organic compounds. M. luteus has been the platform for isolation of the cis-prenyltransferase gene (a Rer2 gene homolog first found in S. cerevisiae). Cis-Prenyltransferase catalyzes the sequential condensation of isopentenyl diphosphate with allylic diphosphate to synthesize polyprenyl diphosphates that play vital roles in cellular activity. Sequence analysis revealed that the protein is highly homologous in several conserved regions in M. luteus, E. coli, and yeast. The enzyme is able to catalyze the formation of polyprenyl diphosphates ranging in carbon number from 100 to 130. This is an essential step in the biosynthesis of terpenes, major components of a number of commercial, carbon-based organic products.

Even earlier studies have shown that the membranes of M. luteus are rich in enzymes that catalyze the synthesis of prenyl pyrophosphates (small molecules required to make compounds such as cholesterol, carotene and alkylamines). Prenyl pyrophosphates are currently being looked at as possible non-peptide antigens that stimulate

certain T-cells as vaccines to prevent human infections and to treat cancer. T-cells (Vγ2Vδ2) can recognize and kill malignant B-cells and other tumor cells. These T-cells represent the most abundant population of T-lymphocytes (gamma-delta) in human blood. They produce and promote strong cytotoxic activity against many pathogens that are implicated in several human infectious diseases. Their activation requires their exposure to small phosphorus-containing antigens in the family of prenyl pyrophosphates and their related biosynthetic precursors such as isopentenyl pyrophosphate (IPP) and dimethylallyl pyrophosphate (DMAPP), which are naturally occurring metabolites in Micrococcus luteus as well as several microbial pathogens. Various prenyl pyrophosphate and diphosphonate compounds are being tested to find new vaccine candidates and thus invite the potential use of isoprenoid-pyrophosphonates as specific immunoregulatory molecules.

Bioremediation:

The fundamental idea behind biodegradation and/or bioremediation is to find bacteria that are capable of using the pollutant or contaminant as a food source. The toxin might also be a source of some essential compound like an ammonia molecule (nitrogen in the form of NH_3) and therefore used up while the microbe grows on it. Most organisms do not have enzymes that can degrade the longer chained molecules, like those found in crude oil, or the aromatic circularized ones. The toxic effects of crude oil and petroleum by-products are well documented. There are a few bacteria that do have those enzymes. In this way, they can degrade the molecules found in crude oil by cutting them and converting them to simpler compounds. These are then broken down again by continued enzymatic action and eventually converted to a sugar (or something similar) and used by the bacteria as an energy source. Usually a number of specialized enzymes (3-10) are required. Numerous studies have demonstrated that Micrococcus luteus is such a bacteria. It is also possible to use a bacterium like M. luteus as a type of sensitivity index for various concentrations of petroleum oils in the environment. In addition, there are marine strains of Micrococcus luteus. It has been shown that marine M. luteus K-3 constitutively produces two salt-tolerant glutaminases. These are designated simply as glutaminase I and II. Maximum activity of glutaminase I was observed at pH 8.0, 50°C and 8-16% NaCl. The optimal pH and temperature of glutaminase II were 8.5 and 50°C. The activity of glutaminase II was not affected by the presence of 8 to 16% NaCl. The presence of 10% NaCl enhanced thermal stability of glutaminase I. Both enzymes efficiently catalyzed the hydrolysis of the amino acid L-glutamine. Once again, this demonstrates the versatility of M. luteus to function as a potential bioremediator in fresh and salt water habitats.

It is highly likely that strains of Micrococcus luteus are involved in detoxification and biodegradation of many other environmental pollutants. It has been discovered that most strains of the bacteria contain a plasmid capable of degrading pesticides such as malathione and chlorpyriphos. Chlorpyrifos, in particular, is one of the world's most widely used organo-phosphorus pesticides in agriculture. Exposure to chlorpyrifos and its metabolites have been related to a variety of nerve disorders in humans. Chlorpyrifos, which was previously thought to be immune to enhanced biodegradation, has now been shown to undergo enhanced biodegradation by some bacteria using the organo-phosphorus hydrolase enzyme. Two plasmid-harboring strains of Micrococcus (M-36 and AG-43) degrade both malathion and chlorpyriphos. Agarose gel electrophoresis of cell extracts of M-36 and AG-43 revealed the presence of the plasmids in M. luteus. Future studies on the genes responsible for enhanced biodegradation are expected to elucidate the precise degradative pathway involved in such microbial biodegradation.

While Micrococcus luteus possesses unusual abilities to use toxic organic molecules as metabolic carbon sources, it also displays a significant tolerance to metals (i.e. gold, copper, strontium, zinc, nickel, lead). For example, cells of Micrococcus luteus have been shown to remove strontium (Sr) from dilute aqueous solutions of $SrCl_2$ under neutral pH conditions. Studies have indicated that the rapid removal of Sr^{++} from solution is consistent with the hypothesis that diffusion is a major determinant of the rate of binding. Experiments done with M. luteus and other bacterium, show that equilibrium exists between bound and dissolved strontium in batch systems, indicating that binding is reversible. Cells cultured under conditions optimal for growth (using fertilizers and biosurfactants) exhibited optimal binding activity, suggesting that the strontium receptor(s) is a normal component of the growing cells. At least a portion of this binding activity is due to an ion exchange mediated by acidic components of the cell envelope. The kinetics of strontium-binding by M. luteus at various temperatures and pH's has not yet been determined. However, the fact that cells bound similar amounts of strontium over a temperature range of 4 to 35°C suggests that the binding reaction is not endothermic. The use of immobilized cells of an M. luteus culture for the treatment of nuclear industry waste waters is promising, since strontium is an end product of uranium nuclear decay. The ability of this organism to bind strontium in the absence of cofactors, its high affinity for the metal, and the enhanced stability of strontium-binding in the presence of other metals encourages further study.

Plasmid-Borne Resistance:

Some strains of M. luteus contain a plasmid that appears to confer resistance to erythromycin and other macrolides. A large number of these erythromycin resistant M. luteus strains have been isolated from human skin. Further studies have demonstrated that this antibiotic resistant phenotype is linked to a plasmid designated as pMEC2. There are suggestions that an indigenous M. luteus antibiotic resistance plasmid may have genetically engineered uses. Attempts have been made to transform plasmid-free strains of M. luteus with pMEC2, purified from those strains which possess it. This has been done with proper inducible expression. Further insertion of this plasmid into C. glutamicum also resulted in erythromycin resistance. Using various restriction enzymes, hybrid plasmids of pMEC2 were successfully transformed and expressed in heterologous hosts. Experiments of this kind have identified the 1163 bp fragment of the erythromycin gene. In light of this, it is thought that plasmid pMEC2 may be a suitable and useful cloning vector for M. luteus. Although M. luteus is generally understood to be non-pathogenic in individuals with otherwise healthy immune systems, its antibiotic resistance determinants may be clinically useful, since these determinants can be transferred to other bacteria.

While some strains of Micrococcus luteus show antibiotic resistance, studies show that the microbe is sensitive to bicyclomycin (a cyclic dipeptide sulfathiazole antibiotic). Bicyclomycin works to inhibit the activity of the M. luteus transcription termination factor Rho. The result is a halt in RNA synthesis. In M. luteus, the Rho gene is essential for viability. Studies demonstrate that the Rho protein factor functions as a transcription terminator. This termination function has been found in a variety of highly divergent gram-negative organisms and is highly conserved. While bicyclomycin is an antibiotic that is known to be effective against several gram-negative bacteria, it does not inhibit the growth of some gram-positive bacteria like Bacillis subtilis and Staphylococcus aureus. The case of Micrococcus luteus is the first time that a gram-positive bacterium has been shown to require factor Rho for viability and is inhibited by bicyclomycin. Since M. luteus is phylogenically related somewhat to Mycobacterium tuberculosis (which is not sensitive to bicyclomycin), it is suggested that developing a derivative of bicyclomycin might be very effective in fighting tuberculosis. Continued study of Micrococcus luteus sequencing and the comparative genomics of bacterium will certainly yield more useful information concerning this microbe.

Troubleshooting Guide for Disk Diffusion Susceptibility Testing

Resistance to antimicrobial agents (AMR) has resulted in morbidity and mortality from treatment failures and increased health care costs. Although defining the precise public health risk and estimating the increase in costs is not a simple undertaking, there is little doubt that emergent antibiotic resistance is a serious global problem.

QC is performed to check the quality of and the potency of the antibiotic, to check results. On the basis of results probable cause and their corrective action.

ABERRANT RESULT	PROBABLE CAUSE	CORRECTIVE ACTION
Tetracycline zone too large & clindamycin zone too small with E. coli or S. aureus control strains.	pH of medium too low.	Adjust pH to 7.2 to 7.4 before pouring media. Commercial media should not have pH problems. Report to manufacturer.
Tetracycline zone too small & clindamycin zone too large with S. aureus or E. coli control strain.	pH of medium too high	Get a new lot. (Incubation in CO_2 may alter agar surface pH)
Aminoglycoside zone too small with P. aeruginosa Acinetobacter control strain.	Ca_2 and/or Mg_2 too high in medium	Acquire a new lot of agar medium that will meet QC criteria.
Aminoglycoside zone too large with P. aeruginosa control strain.	Ca_2 and/or Mg_2 too low in medium	-
Zones universally too large on control plates.	Inoculum too light. Nutritionally poor medium. Slow-growing organism. (not seen with controls) Improper medium depth (too thin)	Adjust inoculum to a McFarland 0.5 turbidity standard. Use only Mueller Hinton Agar medium Use minimum inhibitory concentration (MIC) procedure only. Use 4-5mm depth.
Zones universally too small on control plates	Inoculum too heavy. Agar depth too thick. (minor)	Adjust inoculum to a McFarland 0.5 turbidity standard. Use 4-5mm depth.
Methicillin zone decreasing over days or weeks with control organisms.	Methicillin degrading during refrigerator storage	Change methicillin disks or use oxacillin or nafcillin as the routine disk.
Methicillin zone indeterminate in disk test.	Methicillin being degraded by strong beta-lactamase producing staphylococci.	-
Carbenicillin zone disappears with Pseudomonas control.	Resistant mutant has been selected for testing.	Change Pseudomonas control strain every two weeks & when ever resistant mutants appear within the carbenicillin zone.
S. aureus from a patient was resistant to methicillin one day and sensitive the next.	May be two different organisms. Temperature shift from 37 to 35 degrees C. can dramatically alter the zone size in this case.	Check testing temperature. Test must be performed at 35 or 30 degrees C. for methicillin (oxacillin or nafcillin) and S. aureus.
A single disk result above or below the control limit.	Error in reading. Fuzzy zone edge. Transcription error. Bad disk. Disk may not be pressed firmly onto the agar surface. (Bad disks usually demonstrate a trend toward being out of control.)	Note error. Recheck error and ask for a second opinion Statistically, one may expect an occasional out-of-range result. Values usually fall within range on retesting
Colonies within zone of inhibition.	Mixed culture. Resistant mutants within zone.	Isolate, identify and retest pure cultures only. Gram stain or do another test to rule out contamination.
With colistin, growth seen immediately adjacent to disk, then larger zone at endpoint (Occurs with colistin when testing Serratia spp. and some Enterobacter spp.).	"Prozone-like" phenomenon.	Confirm with MIC.
The methicillin disk test shows "resistant" but an MIC shows "sensitive" for S. aureus.	Mueller Hinton Broth is inadequate in this case. A modified broth used in some commercial MIC systems frequently eliminates this problem. Low methicillin content in disk.	No action necessary with disk test. To be expected if Mueller Hinton Broth is used in MIC test. Use broth with 2% NaCl if MIC testing is necessary. Use new disks
Zones overlap.	Disks too close together.	Use no more than 12 disks on a 150mm plate and 4 to 5 disks on a 100mm plate. Place disks no closer than 15mm from the edge of the plate.
"Zone within a zone"	A swarming Proteus spp. Feather edges of zones around penicillin or ampicillin disks usually occur with beta-lactamase-negative strains of S. aureus. Sulfonamides Beta-lactamase-positive Haemophilus influenzae with penicillin or ampicillin.	Read the wide distinct zone and disregard the growth that swarmed over. Take half the distance from the inner zone to outermost zone as measure mark. Disregard growth from disk margin to the major inner zone. Use inside zone.
Zones indistinct with single colonies noted on the plate.	Poorly streaked plate. Inadequate inoculum.	Use properly adjusted inoculum and repeat test.
Indistinct zones with sulfamethoxazole with or without trimethoprim or with trimethoprim alone.	Thymidine in medium inhibits the action of these antimicrobics.	Use commercial thymidine-free plates. Disregard small amount of growth within the zone as with sulfonamides.

Management of Water Systems in Health-Care Facilities

I. Controlling the Spread of Waterborne Micro-organisms

A. Practice hand hygiene to prevent the hand transfer of waterborne pathogens, and use barrier precautions (e.g., gloves) as defined by other guidelines.

B. Eliminate contaminated water or fluid environmental reservoirs (e.g., in equipment or solutions) wherever possible.

C. Clean and disinfect sinks and wash basins on a regular basis by using product as set by facility policies.

D. Evaluate for possible environmental sources (e.g., potable water) of specimen contamination when waterborne microorganisms (e.g., NTM) of unlikely clinical importance are isolated from clinical cultures (e.g., specimens collected aseptically from sterile sites or, if post-procedural, colonization occurs after use of tap water in patient care).

E. Avoid placing decorative fountains and fish tanks in patient-care areas; ensure disinfection and fountain maintenance if decorative fountains are used in the public areas of the healthcare facility.

II. Routine Prevention of Waterborne Microbial Contamination within the Distribution System

A. Maintain hot water temperature at the return at the highest temperature allowable by state regulations or codes, preferably >124°F (>51°C), and maintain cold water temperature at <68°F (<20°C).

B. If the hot water temperature can be maintained at >124°F (>51°C), explore engineering options (e.g., install preset thermostatic valves in point-of-use fixtures) to help minimize the risk of scalding.

C. When state regulations or codes do not allow hot water temperatures above the range of 105°F - 120°F (40.6°C–49°C) for hospitals or 95°F–110°F (35°C–43.3°C) for nursing care facilities or when buildings cannot be retrofitted for thermostatic mixing valves, follow either of these alternative preventive measures to minimize the growth of Legionella spp. in water systems.

   a. Periodically increase the hot water temperature to >150°F (>66°C) at the point of use.

   b. Alternatively, chlorinate the water and then flush it through the system.

D. Maintain constant recirculation in hot-water distribution systems serving patient-care areas.

III. Remediation Strategies for Distribution System Repair or Emergencies

A. Whenever possible, disconnect the ice machine before planned water disruptions.

B. Prepare a contingency plan to estimate water demands for the entire facility in advance of significant water disruptions (i.e., those expected to result in extensive and heavy microbial or chemical contamination of the potable water), sewage intrusion, or flooding.

C. When a significant water disruption or an emergency occurs, adhere to any advisory to boil water issued by the municipal water utility.

   1. Alert patients, families, staff, and visitors not to consume water from drinking fountains, ice, or drinks made from municipal tap water, while the advisory is in effect, unless the water has been disinfected (e.g., by bringing to a rolling boil for >1 minute).

   2. After the advisory is lifted, run faucets and drinking fountains at full flow for >5 minutes, or use high-temperature water flushing or chlorination.

D. Maintain a high level of surveillance for waterborne disease among patients after a boil water advisory is lifted.

E. Corrective decontamination of the hot water system might be necessary after a disruption in service or a cross-connection with sewer lines has occurred.

   1. Decontaminate the system when the fewest occupants are present in the building (e.g., nights or weekends).

   2. If using high-temperature decontamination, raise the hot-water temperature to 160°F–170°F (71°C–77°C) and maintain that level while progressively flushing each outlet around the system for >5 minutes.

   3. If using chlorination, add enough chlorine, preferably overnight, to achieve a free chlorine residual of >2 mg/L (>2 ppm) throughout the system.

   4. Flush each outlet until chlorine odor is detected.

   5. Maintain the elevated chlorine concentration in the system for >2 hrs (but <24 hrs).

   6. Use a very thorough flushing of the water system instead of chlorination if a highly chlorine-resistant microorganism (e.g., Cryptosporidium spp.) is suspected as the water contaminant.

F. Flush and restart equipment and fixtures according to manufacturers' instructions.

G. Change the pre-treatment filter and disinfect the dialysis water system with an EPA registered product to prevent colonization of the reverse osmosis membrane and downstream microbial contamination.

H. Run water softeners through a regeneration cycle to restore their capacity and function.

I. If the facility has a water-holding reservoir or water-storage tank, consult the facility engineer or local health department to determine whether this equipment needs to be drained, disinfected with an EPA-registered product, and refilled.

J. Implement facility management procedures to manage a sewage system failure or flooding (e.g., arranging with other health-care facilities for temporary transfer of patients or provision of services), and establish communications with the local municipal water utility and the local health department to ensure that advisories are received in a timely manner upon release.

K. Implement infection-control measures during sewage intrusion, flooding, or other waterrelated emergencies.

   1. Relocate patients and clean or sterilize supplies from affected areas.

   2. If hands are not visibly soiled or contaminated with proteinaceous material, include an alcohol-based hand rub in the hand hygiene process 1) before performing invasive procedures; 2) before and after each patient contact; and 3) whenever hand hygiene is indicated.

   3. If hands are visibly soiled or contaminated with proteinaceous material, use soap and bottled water for handwashing.

   4. If the potable water system is not affected by flooding or sewage contamination, process surgical instruments for sterilization according to standard procedures.

   5. Contact the manufacturer of the automated endoscope reprocessor (AER) for specific instructions on the use of this equipment during a water advisory.

L. Remediate the facility after sewage intrusion, flooding, or other water-related emergencies.

   1. Close off affected areas during cleanup procedures.

   2. Ensure that the sewage system is fully functional before beginning remediation so contaminated solids and standing

water can be removed.

3. If hard-surface equipment, floors, and walls remain in good repair, ensure that these are dry within 72 hours; clean with detergent according to standard cleaning procedures.
4. Clean wood furniture and materials (if still in good repair); allow them to dry thoroughly before restoring varnish or other surface coatings.
5. Contain dust and debris during remediation and repair as outlined in air recommendations.

M. Regardless of the original source of water damage (e.g., flooding versus water leaks from point-of-use fixtures or roofs), remove wet, absorbent structural items (e.g., carpeting, wallboard, and wallpaper) and cloth furnishings if they cannot be easily and thoroughly cleaned and dried within 72 hours (e.g., moisture content <20% as determined by moisture meter readings); replace with new materials as soon as the underlying structure is declared by the facility engineer to be thoroughly dry.

IV. Additional Engineering Measures as Indicated by Epidemiologic Investigation for Controlling Waterborne, Health-Care–Associated Legionnaires Disease.

A. When using a pulse or one-time decontamination method, superheat the water by flushing each outlet for >5 minutes with water at 160°F–170°F (71°C–77°C) or hyperchlorinate the system by flushing all outlets for >5 minutes with water containing >2 mg/L (>2 ppm) free residual chlorine using a chlorine-based product registered by the EPA for water treatment (e.g., sodium hypochlorite [chlorine bleach]).

B. After a pulse treatment, maintain both the heated water temperature at the return and the cold water temperature as per the recommendation wherever practical and permitted by state codes, or chlorinate heated water to achieve 1–2 mg/L (1–2 ppm) free residual chlorine at the tap using a chlorine-based product registered by the EPA for water treatment (e.g., sodium hypochlorite [bleach]).

C. Explore engineering or educational options (e.g., install preset thermostatic mixing valves in point-of-use fixtures or post warning signs at each outlet) to minimize the risk of scalding for patients, visitors, and staff.

D. No recommendation is offered for treating water in the facility's distribution system with chlorine dioxide, heavy-metal ions (e.g., copper or silver), monochloramine, ozone, or UV light.

V. General Infection-Control Strategies for Preventing Legionnaires Disease

A. Conduct an infection-control risk assessment of the facility to determine if patients at risk or severely immunocompromised patients are present.

B. Implement general strategies for detecting and preventing Legionnaires disease in facilities that do not provide care for severely immunocompromised patients (i.e., facilities that do not have HSCT or solid organ transplant programs).

1. Establish a surveillance process to detect health-care–associated Legionnaires disease.
2. Inform health-care personnel (e.g., infection control, physicians, patient-care staff, and engineering) regarding the potential for Legionnaires disease to occur and measures to prevent and control health-care–associated legionellosis.
3. Establish mechanisms to provide clinicians with laboratory tests (e.g., culture, urine antigen, direct fluorescence assay [DFA], and serology) for the diagnosis of Legionnaires disease.

C. Maintain a high index of suspicion for health-care–associated Legionnaires disease, and perform laboratory diagnostic tests for legionellosis on suspected cases, especially in patients at risk who do not require a PE for care (e.g., patients receiving systemic steroids; patients aged >65 years; or patients with chronic underlying disease [e.g., diabetes mellitus, congestive heart failure, or chronic obstructive lung disease]).

D. Periodically review the availability and clinicians' use of laboratory diagnostic tests for Legionnaires disease in the facility; if clinicians' use of the tests on patients with diagnosed or suspected pneumonia is limited, implement measures (e.g., an educational campaign) to enhance clinicians' use of the test(s).

E. If one case of laboratory-confirmed, health-care–associated Legionnaires disease is identified, or if two or more cases of laboratory-suspected, health-care–associated Legionnaires disease occur during a 6-month period, certain activities should be initiated.

1. Report the cases to the state and local health departments where required.
2. If the facility does not treat severely immunocompromised patients, conduct an epidemiologic investigation, including retrospective review of microbiologic, serologic, and postmortem data to look for previously unidentified cases of healthcare– associated Legionnaires disease, and begin intensive prospective surveillance for additional cases.
3. If no evidence of continued health-care–associated transmission exists, continue intensive prospective surveillance for >2 months after the initiation of surveillance.

F. If there is evidence of continued health-care–associated transmission (i.e., an outbreak), conduct an environmental assessment to determine the source of Legionella spp.

1. Collect water samples from potential aerosolized water sources (Appendix C).
2. Save and subtype isolates of Legionella spp. obtained from patients and the environment.
3. If a source is identified, promptly institute water system decontamination measures per recommendations.
4. If Legionella spp. are detected in >1cultures (e.g., conducted at 2-week intervals during 3 months), reassess the control measures, modify them accordingly, and repeat the decontamination procedures; consider intensive use of techniques used for initial decontamination, or a combination of superheating and hyperchlorination.

G. If an environmental source is not identified during a Legionnaires disease outbreak, continue surveillance for new cases for >2 months. Either defer decontamination pending identification of the source of Legionella spp., or proceed with decontamination of the hospital's water distribution system, with special attention to areas involved in the outbreak.

H. No recommendation is offered regarding routine culturing of water systems in health-care facilities that do not have patient-care areas (i.e., PE or transplant units) for persons at high risk for Legionella spp. infection.

I. No recommendation is offered regarding the removal of faucet aerators in areas for immunocompetent patients.

J. Keep adequate records of all infection-control measures and environmental test results for potable water systems.

References:

Guidelines for Environmental Infection Control in Health-Care Facilities ecommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC),U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), Atlanta, GA 30333.

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Historically pharmaceutical, biotechnology and medical device manufacturers have been using disinfectants and filter through 0.22 micron filter for further usage. Lack of availability of good quality sterile disinfectants is a major hurdle facing GMP plants today, which is being overcome on an ad hoc basis by taking recourse to 0.22 micron filtration of available disinfectants, solutions and products. Such ad hoc methods give rise to the issue of credibility of the performance of such products and require ongoing validation of process that are used to aseptically filter the disinfectants through 0.22 micron filter. Thus gamma sterilized products takes care of the aforesaid procedures and guarantees availability of sterile, effective and proven products for clean room usage.

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Cat No.	Products	Activity	Application
ANX0750	Alconox	Bactericidal, fungicidal and virucidal	Personal hand hygiene
PLG0750	Purellium Gel - C	Bactericidal, fungicidal and virucidal	Personal hand hygiene
TST0750	Triosept	Bactericidal, fungicidal and virucidal	Personal hand hygiene

Environment and Surface Disinfection

Cat No.	Products	Activity	Application
AST0750	Aerosept – C	Bactericidal, fungicidal and virucidal	For disinfecting laminar hoods, table tops, workstations, air and surface disinfection in ciritcal areas.
MLE0750	Microlyse – C	Bactericidal, fungicidal and virucidal	For floor mopping and surface disinfection
NST0750	Nusept – C	Bactericidal, fungicidal and virucidal	For surface disinfection and general purpose disinfection
NVC0750	Novacide	Bactericidal, fungicidal and virucidal	For surface disinfection
ATR0750	Acitar	Bactericidal, fungicidal and virucidal	For environment (fumigation) and surface disinfection

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Composition - 1% w/v Poly (hexamethylene biguanide) hydrochloride, Perfume, Fast green FCF as color.

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ACTIVITY : Broad spectrum: Bactericidal, Fungicidal & Virucidal.

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APPLICATIONS :
Medical: In Hospitals, Nursing homes, Medical colleges, Pathological laboratories for Inter-operative irrigation. Pre & post surgery skin and mucous membrane disinfection. Post-operative dressings. Surgical & non-surgical wound dressings. Surgical Bath/Sitz bath. Routine antisepsis during minor incisions, catheterization, scopy etc. First aid. Surface disinfection.
Industrial: In Pharmaceutical industry, Food & beverage industry, Hotel industry etc. General surface disinfection. Eliminating biofilms.

USAGE	DOSAGE AND ADMINISTRATION
Pre & post-surgery skin cleaning & disinfection	Use undiluted
Surgical, post operative, non surgical dressing	Use undiluted, once a day/alternate day
Surgical bath/Sitz bath	Add 50 mL of NUSEPT™ in 1 L of water & use
Antisepsis during minor incisions, Scopy, Catheterization, first aid, cuts, bites, stings etc	Use undiluted
Chronic wound management (diabetic foot, pressure and venous leg ulcers)	Use undiluted
Burn wound management (Only for 1st and 2nd Degree burns, chemical burns)	Use 100 mL NUSEPT™ in 1 L sterile water for both washing (with 1 minute contact time) and dressing of burn wound (Dressing must be changed everyday/ alternate days or as directed)
Midwifery, nursery & sickroom	Use undiluted
Intra-operative irrigation	Use 50 mL NUSEPT™ in 1 L sterile water
General hard surface disinfection	Add 100 mL of NUSEPT™ in 1 L of water and gently mop the floor or surfaces

Highlights of the coming issue

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