# "Sterilization of Operation Theatre"

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**Introduction:**

Surgical site infections (SSIs) are the second most common cause of hospital acquired (Nosocomial) infections is accounting 20% to 25% of all Nosocomial infections worldwide and that 2–5% of all patients who undergo an operation will develop an SSI and patients who suffer SSI are twice as likely to die as other postoperative patients[1].Joseph Lister (1827–1912), a professor at London's King College Hospital was one of the first persons to realize the importance of sterilization. He applied Pasteur's germ theory of disease that invisible microbes caused disease to surgery, thus found modern antiseptic surgery. Aseptic technique is a set of specific practices and procedures performed under carefully controlled conditions with the goal of minimizing contamination by pathogens.

A study done at Boston revealed that surgical site infection accounts for 15% of all nosocomial infections and the most common nosocomial infection among surgical patients. Post-surgical infection can lead to increased length of post-operative hospital stay, increased cost, and increased rate of hospital re-admissions.[2]

Sterilization: Sterilization means eradicating germs completely, which is not 100% possible in an operation theatre. The sources of bacterial contamination are from air and the environment, infected body fluids, patients, articles, equipment etc.

Operation Theatre: An Operation Theatre (OT) complex is the heart of any surgical hospital.[3] Good surgical skills have to be supported by scientific design of OT in predicting good outcomes. A modern operation theatre must fulfil the basic architecture with four zones of Outer, Restricted, Aseptic and Disposal zones with adequate ventilation.[4]

**Fumigation Procedure**

Formaldehyde fumigation has long been an accepted method of sterilization for areas where microbiological cleanliness is required. Fumigation with formaldehyde vapor is the recognized and most commonly used method because of its cost effective procedure. Formaldehyde vapor is an extremely effective biocidal agent. It acts as an alkylating agent, inactivating micro-organisms by reacting with carboxyl, amino, hydroxyl and sulphydral groups of proteins as well as amino groups of nucleic acid bases. Fumigation is effective at above the temperature of 20ºC and relative humidity of 65%.

Formalin is commercially available as 40% solution of formaldehyde in water. When formalin is heated formaldehyde vapor is generated. Formaldehyde is a Schedule 1 chemical under the COSHH (Control of Substances Hazardous to Health) Regulations and has a Maximum Exposure Limit (MEL) of 2 ppm.

**Step 1: Preparation**

1. Thoroughly clean windows, doors, floor, walls, surgery table and all washable equipments with soap and water.
2. Close windows and ventilators tightly. If any openings found seal it with cellophane tape or other material to avoid the leak of fume.
3. Switch off all lights, A/C and other electrical & electronical items.
4. Calculate the room size (surgical theater only) in cubic feet (L×B×H) and calculate the required amount of formaldehyde.

**Step 2: Precaution**

1. Adequate care must be taken by wearing cap, mask, foot cover, spectacle etc.,
2. Formaldehyde is irritant to eye & nose; and it has also been recognized as a potential carcinogen.
3. So the fumigating person must be provided with the personal protective equipments (PPE).

**Step 3: Fumigation**

Aromol is used for dispersion of the formulate i.e. put the fluid in aromol and fumigate the O.T.

**1.Electric Boiler Fumigation Method:** For Each 1000 cubic feet, 500 ml of formaldehyde (40% solution) added in 1000 ml of water in an electric boiler. Switch on the boiler, leave the room and seal the doors. After 45 minutes (variable depending to volume present in the boils apparatus/its heating proficiency) switch off the boiler without entering in to the room (Switch off the main from outside).

2.**Potassium Permanganate Method:** For every 1000cu.ft. add 450 gm of potassium permanganate (KMNO4) to 500ml of formaldehyde (40% solution) take about 5-8 bowels (heat resistant; place it in various locations) with equally divided parts to cause auto boiling and generate fume from formaldehyde. After the initiation of formaldehyde vapor, immediately leave the room and seal it for at least 48 hours (minimum12-24 hour).

**Step 4: Neutralization**

1. After the fumigation process neutralize the formaldehyde vapor with ammonia solution. On surgery day enter the operation theater at 7 a.m. with 150 ml of 10% ammonia (for 500 ml of formaldehyde used, i.e. for 1000cu.ft.).
2. Place the ammonia solution in the center of the room and leave it for 3 hours to neutralize the formalin vapor.

**Example:**

Surgical Theater Volume = L×B×H = 20 × 15 × 10 = **3000 cubic feet** Note: Make it into nearest 1000, if the volume is in fractions Formaldehyde required for fumigation = 500 ml for 1000 cubic feet= So, **1500 ml of formaldehyde** required (to be diluted in 3000 ml of distilled water) Ammonia required for neutralization = 300 ml of 10% ammonia for 500 ml of formaldehyde= So **900 ml of 10% ammonia** required.

**Guideline to be adhered for Surgical Theater Sterility:**

1. A **record (log book)** should be kept and properly maintained for all fumigations with following details- date& time of fumigation, date & time of neutralization, personnel involved, and the dates of "sterility test visits" & their results.
2. Construction **layout plan** of the surgical theater with measurement details should be attached with the log book.
3. The construction must have, a. Separate dressing room for medical officer and staff nurses, b. Patient waiting room, c. Surgical room, d. Veranda
4. Construction, carpentry, plumbing, electrical, cleaning and other works should be completed before the initiation of fumigation procedure.
5. Room allotted for surgery (as shown in the plan) should not be used for any other purposes.
6. Entire block should be thoroughly cleaned before fumigation. All apparatus such as suction, table, focus lights, A/C units, *etc.,* should be cleaned according to manufacturer instructions.
7. Surroundings should be clean and free from garbage, open drainage, bushes, shrubs, wastes, *etc.*
8. Warning notice should be pasted on the front door indicating fumigation is in progress.
9. Entry should be restricted to authorize persons (Label must be pasted on the main door).
10. Separate footwear should be kept at the entrance (inside) of surgical theater.
11. Theater dress (includes head cap, mask, apron, footwear, *etc.,*) should be made available for all persons who are entering into the surgical theater (surgeons, anesthetist, microbiologist team, nurses, theater assistants & helpers).
12. Surgical theater should be cleaned and fumigated periodically depending upon the case load.

**Emerging Compounds in use for Sterilization of Operation theatres:**

**1. Bacillocidrasant:**

A newer and effective compound in environmental decontamination with very good cost/benefit ratio, good material compatibility, excellent cleaning properties and virtually no residues. It has the advantage of being a Formaldehyde-free disinfectant cleaner with low use concentration.

**Advantages**

- Provides complete asepsis within 30 to 60 minutes.
- Cleaning with detergent or carbolic acid not required.

**Other Newer and Non Toxic compounds:**

A Chemical compound - **VIRKON** is gaining importance as non-Aldehyde compound. Virkon is proved to be a safe virucidal, bactericidal, fungicidal,

mycobactericidal and non-toxic compound. It contains oxone (potassium peroxymonosulphate), Sodium dodecyl benzene sulfonate, sulphamic acid; and inorganic buffers.[5,6]

ECOSHIELD is a non-toxic, environmental friendly disinfectant for critical area fumigation and surface disinfection. It is a complex formulation of Stabilized Hydrogen Peroxide (11%w/v) and Silver Nitrate solution (0.01%w/v).D-125 is a 3rd generation twin chain quaternary ammonium compound. D-125 is US EPA registered & also approved by FDA of many leading countries including India with claims of 148 micro-organisms including HIV, HBV, HCV, Polio, H1N1, H5N1 etc.

**Conclusion:**

In spite of brief stay of patients in the operation theatre, the environment of operation theatre plays a great role in the onset and spread of infections, because of multifactor causation of infections. **Fumigation is obsolete in many developed nations in view of toxic nature of Formalin.** Too frequent use and inhalation is hazardous. Several new safe chemicals are emerging but constrains of economy limit the use of these.

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