

Antiseptics and Disinfectants

uses and mode of action



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Introduction :

Hospital, laboratory, और clinic जैसे healthcare settings में infection control के लिए antiseptics और disinfectants का use बहुत ज़रूरी होता है।

दोनों ही microorganisms को मारने या उनकी growth को रोकने वाले chemicals होते हैं – पर इनका use अलग-अलग जगहों पर किया जाता है:

- Antiseptics – ऐसे chemical होते हैं जो living tissues (जैसे skin, wounds, mucous membrane) पर लगाये जाते हैं ताकि infection न हो।
Example: Dettol (Chloroxylenol), Betadine (Povidone-Iodine), Savlon (Cetrimide + Chlorhexidine)
- Disinfectants – ये ऐसे agents होते हैं जो non-living objects (जैसे instruments, floor, walls) को साफ करने के लिए use होते हैं।
Example: Lysol (Phenol-based), Sodium Hypochlorite, Formaldehyde

Difference Between Antiseptics and Disinfectants:

Criteria	Antiseptic	Disinfectant
Application	Living tissues	Non-living surfaces
Concentration	Generally mild	Stronger
Purpose	Prevent infection	Kill or remove microbes
Example	Betadine	Glutaraldehyde



Uses of Antiseptics (Antiseptics के उपयोग):

1. Preoperative Skin Preparation (सर्जरी से पहले त्वचा की सफाई):

Purpose: Surgery से पहले patient की skin पर antiseptic apply किया जाता है ताकि skin पर मौजूद bacteria को हटाया जा सके और surgical site infection (SSI) न हो।

Common Agents:

- Povidone-Iodine (Betadine)
- Chlorhexidine Gluconate
- Alcohol-based antiseptics (Isopropyl alcohol 70%)

Example: Operation theatre में सर्जरी से पहले abdomen या limb को iodine से साफ करना।

2. Wound Cleaning (घाव की सफाई):

Purpose: Cuts, abrasions या open wounds में antiseptic लगाने से infection का risk कम होता है और healing तेज होती है।

Common Agents:

- Hydrogen Peroxide (H₂O₂) – for bubbling effect and removal of pus
- Cetrимide + Chlorhexidine (Savlon)
- Povidone-Iodine

Example: किसी person को चोट लगने पर doctor Betadine solution लगाते हैं।

3. Hand Hygiene (हाथों की सफाई):

Purpose: Doctors और healthcare workers अपने हाथों को antiseptic solutions या alcohol-based hand rubs से साफ करते हैं ताकि patient को infection न हो।

Common Agents:

- Alcohol-based hand rubs (Isopropyl or Ethanol 70%)
- Chlorhexidine hand wash solutions

Example: Operation theatre में जाने से पहले surgical hand scrubbing करना।

4. Mouth and Oral Cavity Cleaning (मुँह और गले की सफाई):

Purpose: Dental infections, gingivitis, और sore throat में antiseptic mouthwashes use किए जाते हैं।

- Common Agents:
- Chlorhexidine Gluconate (0.2%)
- Benzydamine hydrochloride

Hydrogen Peroxide (diluted)

Example: Mouth ulcers में Chlorhexidine mouthwash prescribed किया जाता है।

5. Vaginal and Perineal Cleaning (स्त्री जननांगों की सफाई):

Purpose: Delivery से पहले या gynecological procedures से पहले vaginal antiseptic solutions का use infection control के लिए किया जाता है।

Common Agents:

- Povidone-Iodine vaginal wash
- Chlorhexidine vaginal gel

Example: Normal delivery या C-section से पहले vaginal swab cleaning with Betadine.

6. Eye and Ear Antisepsis (आँख और कान की सफाई):

Purpose: Ophthalmic और ENT procedures से पहले और बाद में antiseptics use होते हैं।

Common Agents:

- Silver nitrate or Silver sulfadiazine – used for eye infections
- Boric acid solution – for eye wash
- Iodine ear drops

Example: Newborn बच्चों की आँखों में conjunctivitis से बचाने के लिए silver nitrate drops डाले जाते हैं।

7. Antiseptic Dressing (एंटीसेप्टिक पट्टियाँ):

Purpose: Post-surgical या infected wounds पर antiseptic-impregnated dressings apply की जाती हैं।

Common Materials:

- Iodine gauze
- Silver-impregnated dressing pads

Example: Diabetic foot ulcer patients में silver dressing लगाया जाता है।

8. Umbilical Cord Care in Newborns (नवजात की नाल की सफाई):

Purpose: Infection रोकने के लिए नवजात शिशु की नाल पर antiseptic लगाया जाता है।

Common Agents: Chlorhexidine 7.1% digluconate (delivering 4% Chlorhexidine)

Example: WHO recommend करता है chlorhexidine cord care for 7 days in high-risk areas.

9. Burn and Ulcer Management (जलन और घाव के इलाज में):

Purpose: Burns और ulcers में microbial colonization का खतरा होता है, जिसे antiseptics से control किया जाता है।

Common Agents:

- Silver sulfadiazine cream
- Iodine-based antiseptic creams
- Honey-based antiseptic gels

Example: **B**urn unit में patient को silver sulfadiazine cream apply की जाती है।

10. Catheter Insertion Sites (कैथेटर लगने वाली जगह):

Purpose: Urinary catheters, IV lines, और central lines लगाते समय skin को disinfect किया जाता है।

- Common Agents:
- Chlorhexidine + Alcohol solution
- Povidone-Iodine

Example: Central venous catheter लगाने से पहले skin को Chlorhexidine से साफ किया जाता है।

Summary Table – Common Uses of Antiseptics

Purpose	Common Antiseptic	Example
Skin Prep	Povidone-Iodine	Surgery से पहले skin scrubbing
Wound Care	Hydrogen Peroxide,	Cuts and abrasions
Oral Hygiene	Chlorhexidine	Mouthwash for gingivitis
Hand	Alcohol-based rubs	Doctors के लिए before patient
Vaginal Wash	Betadine	Delivery से पहले
Eye/Ear	Boric acid, Silver nitrate	Newborn eye care
Burns	Silver Sulfadiazine	Burn dressing in burn units

Uses of Disinfectants

Introduction (परिचय): Disinfectants ऐसे chemical substances होते हैं जो non-living surfaces और instruments पर microorganisms को नष्ट या निष्क्रिय करने के लिए use किए जाते हैं।

इनका मुख्य उद्देश्य है – hospital और laboratory environments को infection-free बनाना।

Disinfectants का use healthcare settings में बहुत जरूरी है, क्योंकि यह indirect infection transmission को रोकने में help करता है।

1. Sharp Containers and Injection Trays:

Purpose: Injection trays और sharps को temporary disinfect करना जब तक वे dispose न हों।

Common Agents: 1% Sodium Hypochlorite

Example: Injection tray में रखे cotton, syringes को use के बाद तुरंत soak किया जाता है।

2. Disinfection of Linen and Mattresses:

Purpose: Infectious disease ward या ICU के bed sheets और mattresses को disinfect करना।

Common Agents:

Chlorine-based disinfectants for linen

Spray disinfectants for mattresses

Example: Linen को autoclave से पहले chlorine soak किया जाता है।

3. Surface Disinfection (फर्श, टेबल, दीवार की सफाई):

Purpose: Hospital floors, operation theatres, ICU, और wards की surfaces को disinfect करना ताकि pathogens eliminate हो सकें।

Common Agents:

- Sodium hypochlorite (1%)
- Phenol-based solutions (Lysol)
- QACs (Quaternary Ammonium Compounds)

Example: Operation theatre को daily cleaning के लिए sodium hypochlorite से mop किया जाता है।

4. Instrument Disinfection (उपकरणों की सफाई):

Purpose: Surgical और diagnostic instruments को reuse करने से पहले disinfect करना आवश्यक है।

Common Agents:

- Glutaraldehyde (2%) – Cidex
- Hydrogen Peroxide (7.5% accelerated)
- Alcohol (Isopropyl 70%)

◆ Example: Endoscopes और cystoscopes को glutaraldehyde में 20 मिनट तक immerse किया जाता है।

5. Biomedical Waste Disinfection:

Purpose: Used syringes, catheters, gloves आदि को dispose करने से पहले disinfect करना ताकि कोई infection न फैले।

Common Agents: 1% Sodium hypochlorite soak for 30–60 minutes

Example: Yellow bag biomedical waste को treatment से पहले hypochlorite में डुबोया जाता है

6. Blood Spill Management:

Purpose: Hospital floor पर blood या body fluid गिरने पर तुरन्त उसे disinfect करना जरूरी होता है।

Common Agents: 0.5% to 1% Sodium Hypochlorite

Example: Patient के IV cannula से blood गिरने पर nurse तुरंत hypochlorite से area clean करती है।

7. Laboratory Surface Disinfection:

Purpose: Lab benches, biosafety cabinet, incubator, और centrifuge जैसे instruments को microbes से मुक्त रखना।

Common Agents:

- 70% Ethanol or Isopropyl Alcohol
- QACs
- Hydrogen Peroxide spray

Example: Microbiology lab की टेबल को ethanol से daily wipe किया जाता है।

8. Air and Room Disinfection:

Purpose: Closed rooms जैसे operation theatre या isolation room में air में मौजूद microbes को kill करना।

Common Agents:

- Formaldehyde gas (fumigation)
- Hydrogen Peroxide vapor (HPV)
- UV light (though not a chemical disinfectant)

Example: Monthly OT fumigation using formaldehyde + potassium permanganate

9. Water Tank and Pipeline Disinfection:

Purpose: Hospitals और labs के पानी की supply को bacteria-free बनाना।

Common Agents:

- Bleaching powder (Calcium Hypochlorite)
- Chlorine tablets

Example: OT के handwash basin pipelines को chlorine flushing से disinfect किया जाता है।

10. Disinfection of Patient Care Equipment:

Purpose: BP instruments, thermometer, stethoscope जैसी चीजें patient से patient पर use होती हैं – इन्हें disinfect करना जरूरी होता है।

Common Agents:

- 70% Isopropyl Alcohol wipes

Example: हर patient checkup के बाद stethoscope को alcohol swab से साफ किया जाता है।

Summary Table – Common Uses of Disinfectants

Use Area	Common Disinfectant	Purpose
Operation theatre	Sodium Hypochlorite, Formalin	Surface and air disinfection
Instruments	Glutaraldehyde, Alcohol	High-level disinfection
Waste	Hypochlorite 1%	Pre-treatment before
Lab Benches	70% Alcohol	Daily surface disinfection
Blood spills	1% Hypochlorite	Emergency cleaning
Endoscopes	Cidex (Glutaraldehyde)	Instrument soaking
Air	Formaldehyde gas, HPV	Fumigation
Water	Bleaching Powder	Sterilization
Thermometers	70% Alcohol	Between-patient safety

MODE OF ACTION

ये agents कैसे काम करते हैं, यह उनके chemical class और formulation पर depend करता है। कुछ common mechanisms of action नीचे दिए गए हैं:

1. Disruption of Cell Membrane (सेल झिल्ली को नुकसान):

यह mechanism सबसे common है।

यह microbial cell की membrane को damage करता है जिससे cell अंदर से leak हो जाता है और मर जाता है।

🧴 Examples:

Alcohol (70%) – Denatures membrane lipids and proteins

Phenol – Disrupts lipid layer and precipitates cell proteins

Chlorhexidine – Strongly binds to cell wall and disrupts it

2. Protein Denaturation and Coagulation (प्रोटीन को जमाना और बिगाड़ना):

Microbial enzymes और structural proteins को denature कर देता है।

इससे bacteria metabolically inactive हो जाते हैं।

🧴 Examples:

Iodine and Povidone-Iodine (Betadine) – Oxidizes sulfhydryl groups of proteins

Alcohols – Rapid denaturation of cytoplasmic proteins

Formaldehyde – Cross-links proteins irreversibly

3. Oxidative Damage (ऑक्सीडेटिव डैमेज):

Reactive oxygen species (ROS) बनते हैं जो microbial DNA, lipids और proteins को oxidize करके damage करते हैं।

🧴 Examples:

Hydrogen peroxide (H_2O_2) – Releases free radicals like hydroxyl ($OH\bullet$)

Sodium hypochlorite (bleach) – Releases chlorine which is a strong oxidizing agent

4. Alkylation of Nucleic Acids (DNA को नुकसान):

DNA के structure को बदलकर microbial replication को रोक देते हैं।

🧴 Examples:

Glutaraldehyde (Cidex) – Alkylates DNA and enzymes

Formaldehyde – Cross-links DNA and prevents transcription

Mode of Action of Antiseptics

Introduction (परिचय): Antiseptics ऐसे chemical agents होते हैं जो living tissues (जैसे skin, mucous membranes, wounds) पर use किए जाते हैं microorganisms को मारने या उनकी growth को रोकने के लिए। इनका mechanism अलग-अलग हो सकता है depending on their chemical nature.

1. Alcohols (Ethanol, Isopropyl Alcohol – 70%)

Mechanism:

- Protein denaturation: Alcohols bacterial proteins को denature करते हैं जिससे उनका structure बिगड़ जाता है और वे काम नहीं कर पाते।
- Lipid membrane dissolution: Alcohols microbial cell की lipid membrane को dissolve करके उसे leak कर देते हैं।

Effect:

- Rapid bactericidal action
- Virucidal (lipid-enveloped viruses)
- Not effective on spores

Example Use:

- Skin disinfection before injection
- Hand sanitizers

2. Iodine & Iodophors (Povidone-Iodine – Betadine)

Mechanism:

- Iodine oxidizes –SH (sulfhydryl) groups in proteins and enzymes → denaturation
- Disrupts cell wall and membrane
- Binds to nucleotides and fatty acids

Effect:

- Broad-spectrum antimicrobial: Bacteria, fungi, viruses, protozoa
- Limited action on spores unless prolonged contact

Example Use: Pre-operative skin preparation and Wound care

3. Hydrogen Peroxide (H₂O₂)

Mechanism:

- Produces reactive oxygen species (ROS) like hydroxyl radicals
- These ROS cause oxidative damage to proteins, DNA, and cell membranes
- Bubble formation (oxygen release) helps in physical cleaning of wounds

Effect:

- Kills bacteria and fungi
- Can inactivate viruses
- Not effective against spores at low concentrations

Example Use: Cleaning infected wounds, Oral rinse (in diluted form)

4. Chlorhexidine (Cetrimide + Chlorhexidine – Savlon)

Mechanism:

- Cationic agent that binds to negatively charged bacterial cell wall
- Disrupts membrane integrity → leakage of cell contents
- Coagulates cytoplasmic contents

Effect:

- Bactericidal (Gram-positive > Gram-negative)
- Less effective against fungi and viruses
- Residual effect (longer lasting)

Example Use: Antiseptic creams and solutions, Oral rinses, surgical scrubs

5. Phenol Derivatives (Low Concentration)

Mechanism:

- Denature proteins and disrupt cell membranes
- Precipitate cell proteins

Effect:

- Effective against bacteria and some viruses
- Not used commonly now due to toxicity

Example Use: Historically in skin antiseptics (now replaced by safer agents)

6. Biguanides (Chlorhexidine – also listed above)

Mechanism:

- Binds to bacterial membrane → alters permeability
- Causes cell leakage and death
- Coagulates intracellular components

7. Silver Compounds (Silver Sulfadiazine)

Mechanism:

- Releases silver ions which bind to bacterial DNA and proteins
- Disrupts replication and enzyme functions

Effect:

- Bactericidal
- Used in burn treatment to prevent infection

Example Use:

Burn wound dressing

Summary Table – Mode of action of Antiseptic

Antiseptic Agent	Mode of Action	Target Microbes	Special Note
Alcohol (70%)	Protein denaturation, membrane lysis	Bacteria, some viruses	Rapid, evaporates quickly
Iodine (Betadine)	Protein oxidation, cell wall disruption	Broad-spectrum	Brown stain, mild irritation
Hydrogen	ROS-mediated damage	Bacteria, fungi, viruses	Foaming helps debris
Chlorhexidine	Membrane disruption, protein	Gram+ > Gram-	Long residual effect
Silver Sulfadiazine	DNA and protein interference	Bacteria	Topical for burns
Phenol (mild)	Membrane damage, protein denaturation	Limited use	Toxic on large areas

Mode of Action of Disinfectants

Introduction (परिचय):

Disinfectants ऐसे chemical agents होते हैं जो non-living surfaces या objects (जैसे hospital floors, medical instruments, lab benches) पर microorganisms को मारने या उनकी संख्या कम करने के लिए use किए जाते हैं। इनका target होता है – bacteria, viruses, fungi, spores, depending on the agent used.

1. Phenol and Phenolic Compounds (Lysol, Cresol, Hexachlorophene)

Mechanism of Action:

- Cell membrane को disrupt करते हैं, जिससे leakage of intracellular contents होता है।
- Proteins को denature करके microbial metabolism को बंद कर देते हैं।

Effectiveness:

- Bactericidal (especially Gram+ bacteria)
- Limited virucidal and fungicidal
- Not sporicidal

Examples:

- Lysol: Used for surface disinfection in labs and hospitals
- Cresol: Used in toilets and public sanitation

2. Alcohols (Ethanol, Isopropyl Alcohol – 70%)

Mechanism of Action:

- Protein denaturation
- Cell membrane dissolution
- Works rapidly but evaporates quickly

Effectiveness:

- Effective against bacteria, enveloped viruses
- Not effective against spores or non-enveloped viruses

Examples: Used for disinfection of thermometers, stethoscopes, and skin before procedures

3. Aldehydes (Formaldehyde, Glutaraldehyde)

Mechanism of Action:

- Cross-links with amino and sulfhydryl groups in microbial proteins and DNA
- Causes alkylation of nucleic acids and enzymes, leading to cell death

Effectiveness:

- Broad-spectrum – kills bacteria, viruses, fungi, and spores
- Sporicidal (with adequate contact time)

Examples:

- Formaldehyde gas – used in OT and lab fumigation
- Glutaraldehyde (Cidex) – used for high-level disinfection of endoscopes, surgical tools

4. Halogens (Chlorine Compounds and Iodine)

a) Chlorine (Sodium Hypochlorite, Bleaching Powder)

- ◆ Mechanism of Action:
 - Releases hypochlorous acid (HOCl) in water
 - Strong oxidizing agent – destroys proteins, enzymes, and nucleic acids
- ◆ Effectiveness:
 - Kills bacteria, viruses, fungi, and spores (at high concentration)
 - Fast acting, cost-effective
- ◆ Examples:
 - 1% sodium hypochlorite – used for biomedical waste and surface disinfection
 - 0.5% chlorine – used in blood spill cleanup

b) Iodine (in stronger form than antiseptic use)

- Stronger concentrations used as disinfectants for some surfaces or instruments
- Protein oxidation and enzyme inactivation

5. Gaseous Disinfectants (Ethylene Oxide – ETO)

Mechanism of Action:

- Alkylates DNA and RNA, stops cell replication
- Penetrates deep into crevices and porous materials

Effectiveness:

- Kills all forms of microbes including spores
- Used for heat-sensitive instruments

Examples:

- Sterilization of surgical catheters, heart valves, plastic syringes

6. Hydrogen Peroxide (H₂O₂ – 3% to 30%)

Mechanism of Action:

- Generates reactive oxygen species (ROS) like hydroxyl radicals
- Causes oxidative damage to proteins, lipids, and DNA
- Disrupts cell membrane and internal structures

Effectiveness:

- Bactericidal, fungicidal, virucidal
- Sporicidal at high concentrations (≥6%)

Examples:

- Surface and instrument disinfection
- Vaporized form used in room sterilization

7. Quaternary Ammonium Compounds (QACs – Benzalkonium Chloride, Cetrимide)

Mechanism of Action:

- Positively charged compounds bind to negatively charged bacterial membranes
- Disrupts lipid bilayer, leads to leakage and lysis of cells

Effectiveness:

- Effective against Gram-positive bacteria, enveloped viruses
- Not effective on spores, tuberculosis, or non-enveloped viruses

Examples:

- Used in mop solutions, low-risk surface cleaning, and instrument trays

Summary Table – Mode of Action of Major Disinfectants

Disinfectant	Chemical Class	Mode of Action	Spectrum
Phenol	Phenolic	Membrane damage, protein coagulation	Bacteria, some fungi
Alcohol	Alcohol	Membrane disruption, protein denaturation	Bacteria, viruses
Formaldehyde	Aldehyde	Alkylation of proteins/DNA	Broad + Sporicidal
Glutaraldehyde	Aldehyde	Enzyme and DNA alkylation	Broad + Sporicidal
Sodium Hypochlorite	Halogen	Oxidation of cell components	Broad + Sporicidal
Hydrogen Peroxide	Oxidizer	ROS damage to DNA/proteins	Broad + Sporicidal (high conc.)
QACs	Ammonium Compounds	Membrane lysis	Gram+ bacteria, enveloped viruses
ETO Gas	Alkylating gas	DNA alkylation	All microbes + Spores