*International Journal of Pharmaceutical Science Invention*
*ISSN (Online): 2319-6718, ISSN (Print): 2319- 670X*
*www.ijpsi.org Volume 15 Issue 4 ǁ Jul. – Aug., 2026 ǁ PP. 06-10*

# Povidone Iodine in Wound Healing: A Review of Current Concepts and Applications

Kaushiki Mishra, Mrs. Shilpi Mishra, Dr. Anurag Mishra
*Dept. of Pharmaceutics, Shree Krishna College of Pharmacy, Sitapur, Uttar Pradesh, 261001*

***ABSTRACT***
*Povidone-Iodine (PVP-I) is a broad-spectrum antiseptic widely used in modern healthcare for the prevention and treatment of infections associated with wounds, surgical procedures, and skin injuries. It is a chemical complex of polyvinylpyrrolidone (povidone) and elemental iodine that acts by gradually releasing free iodine, the active antimicrobial agent. This sustained release mechanism provides effective activity against a wide range of microorganisms, including Gram-positive and Gram-negative bacteria, fungi, viruses, spores, and protozoa, while reducing the irritation commonly associated with elemental iodine. PVP-I possesses excellent antiseptic, anti-inflammatory, and biofilm-penetrating properties, making it highly valuable in wound care, surgical antisepsis, ophthalmology, oral hygiene, and infection control practices.*
*The present review discusses the chemical structure, physical and chemical properties, mechanism of action, pharmacokinetic profile, therapeutic applications, and clinical significance of Povidone-Iodine. Special emphasis is placed on its oxidative mode of microbial destruction, broad-spectrum efficacy, and lack of documented microbial resistance despite decades of clinical use. The review also highlights current healthcare applications, including chronic wound management, respiratory hygiene, and surgical disinfection, particularly following the COVID-19 pandemic. Although generally safe for topical use, excessive or prolonged exposure may result in systemic iodine absorption and thyroid-related complications, necessitating cautious use in sensitive populations. Overall, Povidone-Iodine remains an indispensable and evolving antiseptic agent in contemporary medicine due to its versatility, safety, and sustained antimicrobial effectiveness.*
***Key word: - Povidone Iodine, Iodophor, Antiseptic, Betadine.***

---

Date of Submission: 09-07-2026 Date of acceptance: 20-07-2026

---

## I. Introduction: -

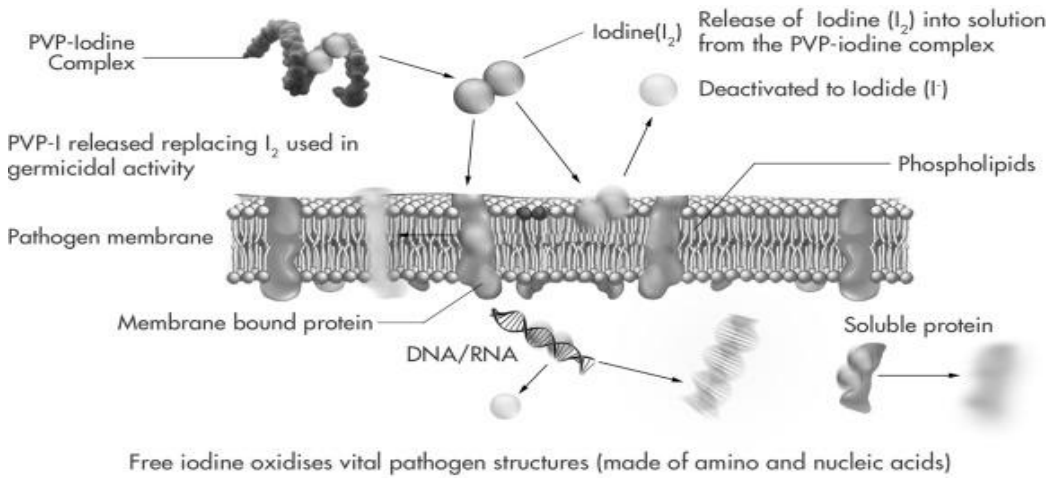
Povidone-iodine is a versatile antiseptic used to treat and prevent skin infections in minor wounds, such as cuts, scrapes, and small burns. It works by slowly releasing iodine, which kills a broad spectrum of bacteria, viruses, fungi, and protozoa. Commonly known by the brand name **Betadine**, it is available over the counter in various forms, including liquids, ointments, powders, and gargles.

POVIDONE IODINE (poe-vee-don ahy-uh-din) prevents skin infection. It is often used to clean and disinfect the skin after an injury or before a procedure. It works by killing or preventing the growth of bacteria on the skin. It belongs to a group of medications called antiseptics.

Povidone-iodine (PVP-I), also known as iodopovidone, is an antiseptic used for skin disinfection before and after surgery. It may be used both to disinfect the hands of healthcare providers and the skin of the person they are caring for. It may also be used for minor wounds. It may be applied to the skin as a liquid, an ointment or a powder.

**Povidone-iodine is a chemical complex composed of the polymer polyvinylpyrrolidone (PVP) and elemental iodine. In its pure form, it is most commonly encountered as a reddish-brown amorphous powder.**

**CHEMICAL STUCTURE OF POVIDONE IODINE :-**




Free iodine oxidises vital pathogen structures (made of amino and nucleic acids)

**PHYSICAL PROPERTIES OF POVIDONE IODINE:-**the primary physical properties of povidone-iodine include:

- **Appearance:** A yellowish-brown to reddish-brown amorphous, free-flowing powder**.**
- **Odour:** Slight characteristic odour (faintly iodine-like).
- **Physical State:** Solid at room temperature.
- **Melting Point:** Generally reported around **$300^0$ C,** though some sources indicate decomposition occurs above **$200^0$ C**
- **Solubility:** Freely soluble in water and alcohols such as ethyl alcohol and isopropyl alcohol. It is also soluble in polyethylene glycol and glyceroland practically insoluble in organic solvents like chloroform, carbon tetrachloride, ether, hexane, and acetone**.**
- **pH Level:** An aqueous solution (typically 1 in 100) is acidic, with a pH ranging from 1.5 to 3.5 or approximately 5 depending on concentration.
- **Hygroscopicity:** The solid powder is hygroscopic, meaning it readily absorbs moisture from the air and must be stored in well-sealed containers.
- **Vapor Pressure:** Negligible **(0.01 torr at $56^0$ c),** which prevents the iodine from subliming even at elevated temperatures, unlike pure elemental iodine**.**
- **Stability:**Highly stable in typical storage conditions when protected from light and moisture.
- **Iodine Content:** Contains between 9.0% and 12.0% available iodine on a dry basis. Molecular Weight: Approximately **364.95 g/mol.**

**CHEMICAL PROPERTIES: -**

**Povidone-iodine is a chemical complex (specifically an iodophor) that functions as a reservoir for elemental iodine. Its chemical behaviour is defined by the slow release of free iodine, which provides its powerful antiseptic effects while reducing the toxicity and irritation typical of pure iodine.**

**Reactivity and Interactions: -**

- **Incompatibilities:** It reacts with several substances, rendering both itself and the reacting agent ineffective. Notable examples include:
  - Hydrogen peroxide and silver-based products.
  - Mercury compounds, which can lead to the formation of corrosive mercury iodide.
  - Metals such as iron, copper, and silver, which it can oxidize or corrode.
- **Oxidizing Power:** It is a strong oxidizing agent. Its antimicrobial action stems from its ability to oxidize and iodinate essential bacterial components like lipids, nucleotides, and amino acids (specifically those with -SH or -NH2 groups).
- **Stability:** Unlike iodine tincture, povidone-iodine is chemically stable in solution. In solid form, it loses less than 1% of its available iodine even when stored at $65^0$C for three years.

**The Iodine Equilibrium :**

The chemical effectiveness of povidone-iodine relies on a dynamic equilibrium between the complexed form and "free" iodine:

- **Available Iodine**: Typically makes up **9% to 12%** of the dry weight of the complex.

❖ **Free Iodine ($I_2$)**: The active bactericidal agent. Surprisingly, as the solution is **diluted**, the concentration of free iodine increases (reaching a peak at about **0.1% dilution**) before decreasing again. This makes dilute solutions paradoxically more rapidly bactericidal than concentrated ones.

❖ **Fundamental Atomic Properties of Iodine :-** The iodine within the complex (Atomic Number 53) retains its inherent halogen characteristics.

❖ **Electronegativity**: 2.66 on the Pauling scale (the lowest among stable halogens).

❖ **Oxidation States**: Commonly exhibits states of **-1, +1, +3, +5, and +7**.

❖ **Electron Configuration**: $(Kr)4d^{10}5s^25p^5$possessing seven valence electrons and seeking one more to reach a stable octet.

**MECHANISM OF ACTION:-**

The mechanism of action for povidone-iodine (**PVP-I**) centers on a dynamic equilibrium where the polymer carrier (povidone) slowly releases **"free" elemental iodine ($I_2$)**, the active microbicidal agent.

❖ **Microbicidal Mechanism:-** The primary killing action is identical in both *in vitro* and *in vivo* settings:

- **Rapid Penetration**: As a small molecule, free iodine quickly penetrates the cell walls of bacteria, fungi, and viruses.
- **Oxidative Attack**: Iodine acts as a powerful oxidizing agent, targeting multiple molecular sites simultaneously:
- **Proteins**: It reacts with amino acids like **tyrosine** and **histidine**, denaturing critical cytosolic enzymes and structural proteins.
- **Lipids**: It oxidizes and iodinates unsaturated fatty acids in cell membranes, causing destabilisation and leakage.
- **Nucleic Acids**: It interferes with DNA and RNA, inhibiting replication and causing chain breaks.
- **Metabolic Blockage**: Iodine deactivates enzymes involved in the respiratory chain, effectively "suffocating" the cell's energy production.

❖ **In Vitro vs. In Vivo Differences** :- While the basic chemical attack remains the same, the environment significantly alters how it manifests:

**Anti-Inflammatory Action (Host Interaction)**:-*In vivo*, PVP-I acts as an anti-inflammatory agent through several multifactorial pathways:

- **Redox Modulation**: It acts as a scavenger for free radical oxygen species.
- **Immune Potentiation**: It enhances healing signals by activating **T-lymphocytes**, **monocytes**, and **macrophages**.
- **Toxin Neutralization**: It inhibits the release of bacterial exotoxins (like - **α**hemolysin) and enzymes that destroy tissue

❖ **Pharmacokinetic Profile of Povidone-Iodine**

- **Absorption:** Intended for topical application and is generally not absorbed.
- **Volume of Distribution:** No volume of distribution as it acts locally.
- **Protein Binding:** No plasma protein binding reported.
- **Metabolism:** Not absorbed or metabolized,
- **Elimination & Half-life:** Not eliminated or excreted, as it acts on the skin surface.

❖ **Clinical Considerations**

- **Systemic Absorption:** While primarily non-absorbed, significant absorption can occur with extensive application, large burns, or on mucus membranes.
- **Toxicity:** Excessive use may cause systemic toxicity, including thyroid dysfunction (hyper/hypothyroidism) or renal impairment.
- **Contraindications:** Avoid in neonates, patients with thyroid disease, and use caution during pregnancy,

❖ **THERAPEUTIC USES :-**Povidone-iodine (PVP-I) is a broad-spectrum topical antiseptic primarily used to treat and prevent skin and wound infections. It is an "iodophor"—a complex of iodine and the polymer povidone—which acts as a reservoir to release active "free" iodine gradually to the site of application.

❖ **Therapeutic Properties**

- **Broad-Spectrum Antimicrobial Activity**: It is highly effective against a wide range of pathogens, including:
- **Bacteria**: Both Gram-positive and Gram-negative organisms, such as *S. aureus* (including MRSA), *E. coli*, and *P. aeruginosa*.
- **Viruses**: Enveloped and non-enveloped viruses, including influenza, SARS-CoV, MERS-CoV, and HIV.
- **Other Microbes**: Effective against fungi (like *Candida*), spores, and protozoa.

❖ **Biofilm Penetration**: PVP-I can penetrate and eradicate biofilms, which are bacterial colonies often found in chronic wounds that are resistant to many other treatments.
❖ **Anti-Inflammatory Effects**: It has been shown to reduce excessive inflammation in wounds by scavenging free radicals and inhibiting inflammatory mediators like neutrophil elastase.
❖ **Wound Healing Support**: In some clinical studies, it has been shown to improve healing times for chronic venous leg ulcers and pressure sores by reducing bacterial load and promoting neovascularization.
❖ **Lack of Resistance**: Unlike many antibiotics, there is no documented acquired bacterial resistance or cross-resistance to iodine, even after decades of clinical use.

**Common Medical Applications**

- **Surgical Preparation**: Used extensively to disinfect the hands of healthcare providers and to decontaminate a patient's skin before surgical incisions.
- **Wound Management**: Applied to minor cuts, burns, grazes, and abrasions to prevent infection.
- **Oropharyngeal Care**: Used in gargles and mouthwashes to treat sore throats, mouth ulcers, and to reduce viral load in the mouth and throat.
- **Ophthalmic Use**: Diluted solutions are used for neonatal conjunctivitis prevention and to prepare the eye for surgery.
- **Specialty Procedures**: Employed in intraoperative irrigation (flushing wounds during surgery) and pleurodesis (fusing the lung lining).

❖ **Safety and Considerations**

- **Skin Irritation**: While generally well-tolerated, it can cause mild skin irritation, redness, or allergic contact dermatitis in some individuals.
- **Iodine Absorption**: Large or chronic applications can lead to significant iodine absorption, which may cause thyroid dysfunction (hyper- or hypothyroidism), particularly in patients with pre-existing thyroid conditions.
- **Contraindications**: Typically not recommended for use in pregnant or breastfeeding women (due to potentialfatal thyroid effects), infants under six months, or patients with thyroid disease or those taking lithium.

❖ **CURRENT SCENARIO OF POVIDONE IODINE IN HEALTH CARE :-**

Povidone-Iodine (PVP-I) remains a cornerstone antiseptic, though its role is being redefined by competition with chlorhexidine and new applications in viral prevention.

**Current Clinical Applications**

- **Wound Care and Biofilm Management**: PVP-I is increasingly preferred for chronic wounds because it can penetrate **biofilms**—protective bacterial layers that often resist standard antibiotics. It is used for diabetic foot ulcers and pressure sores to prevent infection and support healing.
- **Ophthalmology**: It is the gold standard for **intraoperative ocular antisepsis**. 5% PVP-I solutions are used before cataract surgery and intravitreal injections to significantly reduce the risk of endophthalmitis.
- **Respiratory and Oral Hygiene**: Since the COVID-19 pandemic, 0.5%–1% PVP-I mouthwashes and nasal sprays have become standard prophylactic tools to reduce viral loads of SARS-CoV-2 and influenza in both patients and healthcare workers.
- **Obstetrics**: Recent World Health Organization (WHO) guidelines advocate for PVP-I vaginal washes before caesarean sections to lower the risk of maternal and neonatal infections, especially in low-resource settings.

## II. CONCLUSION:-

In conclusion, Povidone-Iodine (PVP-I) remains a cornerstone of modern antiseptic therapy, balancing broad-spectrum microbicidal power with a high degree of clinical safety. Unlike many modern antibiotics, its multi-target mechanism—driven by the slow release of free iodine—prevents the development of bacterial resistance, making it an indispensable tool in an era of rising "superbugs."

While it faces competition from agents like chlorhexidine in specific surgical settings, PVP-I's unique ability to penetrate biofilms, its potent antiviral properties, and its versatility across liquid, ointment, and powder forms ensure its continued relevance. Its expanding role in respiratory hygiene and chronic wound management underscores its status not just as a traditional disinfectant, but as an evolving therapeutic agent capable of meeting contemporary global health challenges.

## References:-

[1]. World Health Organization. *WHO Guidelines on Hand Hygiene in Health Care*. Geneva: World Health Organization; 2009.Pages: 135–152.
[2]. Bigliardi PL, Alsagoff SAL, El-Kafrawi HY, et al. “Povidone Iodine in Wound Healing: A Review of Current Concepts and Practices.” *International Journal of Surgery.*2017;44:260–268.Article No.: S1743-9191(17)30545-9.

[3]. Lachapelle JM.“A Comparison of the Irritant and Allergenic Properties of Antiseptics.” *European Journal of Dermatology.* 2014;24(1):3–9.Pages: 3–9.

[4]. Eggers M.“Infectious Disease Management and Control with Povidone Iodine.” *Infectious Diseases and Therapy.* 2019;8(4):581–593.Pages: 581–593.

[5]. Kariwa H, Fujii N, Takashima I. “Inactivation of SARS Coronavirus by Means of Povidone-Iodine.” *Dermatology.* 2006;212(Suppl 1):119–123.Pages: 119–123.

[6]. United States Pharmacopeia.*United States Pharmacopeia and National Formulary (USP–NF).* Monograph: Povidone-Iodine Solution.Pages: 5290–5293.

[7]. Martindale: The Complete Drug Reference.39th ed. London: Pharmaceutical Press; 2017. Pages: 209–212.

[8]. Durani P, Leaper D.“Povidone-Iodine: Use in Hand Disinfection, Skin Preparation and Antiseptic Irrigation.”*International Wound Journal.* 2008;5(3):376–387.Pages: 376–387.

[9]. Centers for Disease Control and Prevention.*Guideline for the Prevention of Surgical Site Infection.* 2017.Pages: 78–85.

[10]. Kanagalingam J, Felix A, et al.“Practical Use of Povidone-Iodine Antiseptic in the Maintenance of Oral Health and in the Prevention and Treatment of Common Oropharyngeal Infections.” *International Journal of Clinical Practice.* 2015;69(11):1247–1256. Pages: 1247–1256.

[11]. Reimer K, Wichelhaus TA, Schafer V, et al.“Antimicrobial Effectiveness of Povidone-Iodine and Consequences for New Application Areas. *“Dermatology.* 2002;204(Suppl 1):114–120. Pages: 114–120.

[12]. CooperRA.“IodineRevisited.”*International Wound Journal.* 2007;4(2):124–137.Pages: 124–137.

[13]. Fleischer W, Reimer K.“Povidone-Iodine in Antisepsis—State of the Art.” *Dermatology.*1997;195Pages: 3–9.

[14]. Muller G, Kramer A.“Biocompatibility Index of Antiseptic Agents by Parallel Assessment of Antimicrobial Activity and Cellular Cytotoxicity.”*Journal of Antimicrobial Chemotherapy.* 2008;61(6):1281–1287.Pages: 1281–1287.

[15]. Vermeulen H, Westerbos SJ, et al.“Topical Silver for Treating Infected Wounds.” *Cochrane Database of Systematic Reviews.* 2007;(1):CD005486.Article No.: CD005486.

[16]. Lineaweaver W, Howard R, et al.“Topical Antimicrobial Toxicity.”*Archives of Surgery.* 1985;120(3):267–270.Pages: 267–270.

[17]. Eggers M, Koburger-Janssen T, et al.“In Vitro Bactericidal and Virucidal Efficacy of Povidone-Iodine Gargle/Mouthwash.”*Infectious Diseases and Therapy.* 2018;7(2):249–259.Pages: 249–259.

[18]. GoldenheimPD.“An Appraisal of Povidone-Iodine and Wound Healing.” *Postgraduate Medical Journal.* 1993;69(Suppl 3):S97–S105.Pages: S97–S105.