Hydrogen Peroxide, a Point-of-Care Solution for Ultrasound Probe High Level Disinfection

Hydrogen peroxide (H_2O_2) is a well-established oxidising agent with broad-spectrum antimicrobial activity against bacteria, viruses, fungi and other clinically relevant microorganisms.[1,2] Its effectiveness, favourable safety profile and compatibility with automated systems have supported its widespread adoption across healthcare settings for disinfection, sterilisation and medical device reprocessing.[2–6]

Hydrogen peroxide has a long history of use in healthcare and consumer applications, including wound care, dentistry, contact lens disinfection, cosmetics and environmental decontamination.[1,7–11] This extensive experience, combined with a substantial body of scientific evidence, has established hydrogen peroxide as a trusted chemistry for medical device reprocessing.[2,10,12,13]

Clinical guidelines and professional societies recognise hydrogen peroxide as an effective option for high-level disinfection (HLD) of ultrasound probes.[2–6,14–16]

In addition, vapourised hydrogen peroxide is widely used for medical device sterilisation and is recognised by the U.S. Food and Drug Administration as a safe and effective sterilisation modality.[12,13]

Hydrogen peroxide is also a naturally occurring molecule that is produced within the human body and encountered through normal dietary and environmental exposure.[17,18] Following use, it rapidly decomposes into water and oxygen, leaving no persistent residues on disinfected devices or in the environment.[7,9,19,20]

When delivered via a closed automated system, hydrogen peroxide exposure is carefully controlled. Published evidence and occupational monitoring studies have demonstrated residual and airborne exposure levels well within established safety limits, supporting both patient and healthcare worker safety.[21–26]

trophon® technology provides automated hydrogen peroxide delivery within a closed system to enable point-of-care, near point-of-care, and centralised ultrasound probe reprocessing while minimising operator handling and supporting safe, consistent high-level disinfection outcomes.[21–26]

Hydrogen Peroxide

- *Broad-spectrum antimicrobial activity*[1,2]
- *Recommended for ultrasound probe HLD by major guidelines*[2–6,14–16]
- *Breaks down into water and oxygen*[7,9,19,20]
- *No persistent residues on disinfected devices*[7,9,19,20]
- *Controlled exposure in closed automated systems*[21–26]

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Clinical Guidelines Support the use of Hydrogen Peroxide for Ultrasound Probe HLD[2–6,14–16]

Selection of a HLD method requires consideration of antimicrobial efficacy, patient safety, occupational exposure and workflow requirements. Hydrogen peroxide is a well-established HLD chemistry that is recognised by clinical guidelines and professional societies for ultrasound probe reprocessing.[2–6,14–16]

The U.S. Centers for Disease Control and Prevention Guideline for Disinfection and Sterilization in Healthcare Facilities identifies hydrogen peroxide as a high-level disinfectant and notes that it is not toxic to staff, patients, probes or retrieved cells when used as intended.[2]

Similarly, the World Federation for Ultrasound in Medicine and Biology recognises hydrogen peroxide as an effective and widely accepted chemistry for ultrasound probe disinfection and highlights the environmental advantages of sonically activated hydrogen peroxide systems.[14]

HLD is particularly important for transvaginal ultrasound procedures and ultrasound-guided interventions, including assisted reproductive technology procedures where effective infection prevention is essential.[27–29]

The Society for Maternal-Fetal Medicine (SMFM) recommends HLD using disinfectants with proven efficacy against human papillomavirus (HPV), including hydrogen peroxide systems.[15,16]

SMFM Recommendation[15]

After each use, the transvaginal ultrasound probe should undergo high-level disinfection using one of the agents with proven efficacy against HPV, such as hydrogen peroxide (sonicated system), hypochlorite, or peracetic acid."

Hydrogen Peroxide: A Naturally Occurring Molecule in Human Physiology

Hydrogen peroxide is a physiologically relevant molecule that is produced naturally within the human body and encountered through normal dietary and environmental exposure. Most human tissues are exposed to low concentrations of hydrogen peroxide as part of normal cellular metabolism.[17,18]

In the female reproductive tract, certain *Lactobacillus* species naturally produce hydrogen peroxide, contributing to the maintenance of a healthy vaginal microbiome and supporting defence against potentially harmful microorganisms.[18,27,28] The presence of hydrogen peroxide-producing *Lactobacillus* species has been associated with protection against vaginal vaginosis and ascending genital tract infections.[18,30,31]

Hydrogen Peroxide Breaks Down into Water and Oxygen

Hydrogen peroxide is a broad-spectrum antimicrobial agent that inactivates microorganisms through oxidative damage to essential cellular components, including cell membranes, proteins and nucleic acids.[2,32]

A distinguishing characteristic of hydrogen peroxide is its degradation profile. Following use, hydrogen peroxide rapidly breaks down into water and oxygen, leaving no persistent chemical residues on disinfected devices or in the environment.[7,9,19,20]

This degradation pathway contributes to the favourable safety profile of hydrogen peroxide and differentiates it from disinfectants that may leave residual chemical by-products following use.[21]

Hydrogen peroxide breaks down into water and oxygen following use, leaving no persistent chemical residues on disinfected ultrasound probes.[7,9,19–21]

Patient Safety Considerations in Reproductive Health

Transvaginal ultrasound-guided oocyte retrieval (TVOR) is an invasive procedure that carries recognised risks of microbial contamination and infection transmission, highlighting the importance of effective HLD of transvaginal ultrasound probes.[27–29]

Available toxicological evidence has not identified reproductive or developmental hazards associated with hydrogen peroxide exposure under intended healthcare use conditions. Hydrogen peroxide is rapidly degraded in biological systems and does not accumulate within the body.[20,33–35]

Effective HLD is essential for transvaginal ultrasound procedures, including assisted reproductive technology applications. Available evidence does not indicate reproductive or developmental toxicity associated with hydrogen peroxide used under intended healthcare conditions.[20,27–29,33–35]

trophon Technology: Automated HLD with Controlled Hydrogen Peroxide Delivery

trophon technology is an automated sonicated hydrogen peroxide system that enables point-of-care, near point-of-care, and centralised ultrasound probe reprocessing. The system incorporates multiple containment and exposure-control features that minimise disinfectant handling and support consistent reprocessing workflows.[21–26]

Key Design Features[21–26]

- **Sealed automated disinfection cycle:** Hydrogen peroxide remains contained within the system throughout the disinfection process, helping minimise operator exposure.
- **Closed cartridge system:** The disinfectant cartridge remains sealed and is only activated when correctly loaded within the device.
- **Minimal chemical handling:** Users do not come into contact with hydrogen peroxide during routine operation and only replace cartridges when required.
- **Automated dosing and delivery:** Hydrogen peroxide is automatically dispensed, eliminating the need for manual mixing or dilution.
- **Residual management:** Residual hydrogen peroxide is removed from the chamber and converted into water and oxygen as part of the process.
- **Validated safety testing:** Extensive residual and exposure testing has been conducted to assess patient and operator safety.

Key Benefits of Automated Sonicated Hydrogen Peroxide Systems[21–26]

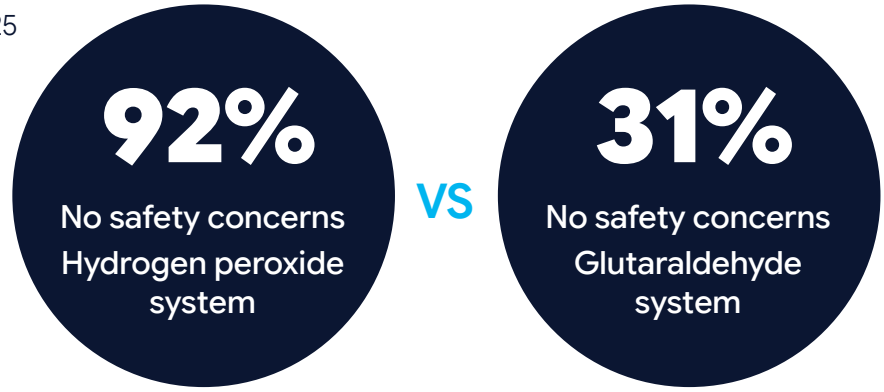
Published evidence and validation studies have demonstrated several advantages of automated hydrogen peroxide-based systems, including:

- Reduced chemical handling compared with open or manual disinfection processes.
- Reduced potential for workflow variability associated with manual reprocessing.
- Controlled residual hydrogen peroxide levels following disinfection.
- Reduced personal protective equipment requirements compared with certain alternative HLD chemistries such as glutaraldehyde and ortho-phthalaldehyde.
- Positive user perceptions of safety and ease of use.

User-Perceived Safety[25]

≈ 3x more sonographers reported no safety concerns with hydrogen peroxide (p = 0.0026)

Results from a small, published survey; n=13



Safety and Exposure Assessment: Worst-Case Testing Conditions[22,23]

Exposure monitoring and leak testing demonstrated low potential for operator exposure to hydrogen peroxide vapour during routine operation.[22] Under worst-case conditions and chronic exposure, no harmful residuals were detected on probes or chemical indicators following disinfection. Testing demonstrated that probes were suitable for subsequent patient contact following completion of the disinfection cycle.[22,23]

Occupational Exposure Monitoring

Measured exposure levels remained within established occupational exposure limits, including:[21,22]

- 8-hour time-weighted average (TWA): <1 ppm
- 15-minute short-term exposure: <2 ppm

For context, 1 ppm is equivalent to approximately 32 seconds of a year

Residual testing

Residual testing conducted under conditions designed to exceed routine clinical use, including:[23]

- Five consecutive disinfection cycles without probe wiping
- Elevated hydrogen peroxide concentration (50% versus standard 35%)
- Maximum hydrogen peroxide output conditions
- Reduced chamber evacuation performance

trophon technology combines automated hydrogen peroxide delivery, sealed cartridge handling and validated exposure controls to support effective ultrasound probe HLD while maintaining operator exposure within established occupational limits.[21–23]

Hydrogen Peroxide: A Smart Choice for Ultrasound Probe HLD

- Effective HLD[1–6]
- No persistent chemical residues[7,9,19–21]
- Breaks down into water and oxygen[7,9,19–21]
- Controlled exposure with trophon technology[21–26]
- Supports both patient and operator safety[21–26,33–35]

Scan the QR code to access information about trophon and HLD educational resources.

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