



DoD PATIENT SAFETY CENTER ALERT

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MEDICAL GAS SENTINEL EVENT

Recently, the DoD Patient Safety Center was informed of a sentinel event that occurred in one of our major military medical centers involving the mix-up of portable carbon dioxide (CO₂) and oxygen (O₂) tanks. During a routine cesarean-section an infant was put on what was thought to be supplemental O₂ because of weak spontaneous cry and poor muscle tone. Unfortunately, the portable tank connected to the O₂ tubing was not O₂ but CO₂. The infant received CO₂ for over 40 minutes before the mix-up was detected, resulting in severe and permanent brain damage.



Figure: Implicated CO₂ tank on the left and O₂ tank on the right with gas-specific regulators and flow meters. Note the common green "Christmas tree" adaptors attached to the flow meters.

Medical grade gases, incorrectly administered, can be hazardous and even cause significant harm. The Food and Drug Administration considers them prescription drugs and they must be handled accordingly. Medical gas-associated errors and harm events are well documented in the literature¹⁻⁹.

The resultant assessment of the event found a number of knowledge, technical, and process issues. While these issues have been addressed by the facility involved, it is essential that all military medical facilities take *immediate* steps to minimize the risk of similar events.

Consider the interventions listed below as the MTF performs the review. This **review and assessment of the associated risks** should include:

- All medical gases used in the facility to include central (piped-in) and tank, the locations and purpose of use, the policies regarding the handling and use of medical gases, and compliance with service regulations related to medical gases,
- Storage, marking/labeling clarity, handling/transport of all medical gas tanks,
- Policies and procedures regarding the use of medical gas tanks as an alternative to central/piped-in medical gas,
- Medical gas regulators and adaptors used for each of the gases, including the number of available regulators and the potential for errors in their use (mistaken coupling),
- Operating room (OR) turnover procedures (tear-down and set-up), with special attention to the handling of medical gas tanks, and
- Orientation and periodic refresher training.

Interventions should be tailored to the particular vulnerabilities found in your facility. The interventions **to be considered** include, but are not limited to:

- Control and limit the access to CO₂ tanks so that no one except authorized personnel can access them. Separately store CO₂ tanks, CO₂ regulators, and CO₂ tank-related equipment.
- Review where all medical gas tanks are stored. Check to ensure appropriate lighting, labeling, storage, access, and security.
- Implement policies that require the facility piped-in O₂ system to serve as the primary source for O₂. Staff should only use portable O₂ tanks for patient transport and, if needed, to back up failure of the central piped-in system.
- If portable O₂ is needed, for example an Ohio bed, consider attaching a regulator and O₂-specific hose to the bed which stays with the bed at all times. Although this regulator and hose can be removed, it is designed specifically to stay on this bed.
- Develop a template for the standardization of set-up in all ORs. Use daily or case-specific checklists signed by staff member performing the checks and endorsed by attending physician.
- Revise local policy to reflect changes to medical gas procedures and inform staff of the changes. Ensure all staff are appropriately trained to include both orientation and refresher sessions.
- Provide staff with in-services on their responsibilities related to OR set-up and handling of medical gases. Emphasize using only central piped-in oxygen in the OR, using the “Five Rights” of medication administration during medical gas handling and the nurse’s responsibility for directly supervising the set-up of operating rooms for surgery.
- Contact the medical gas company for training resources they may have to assist the MTF on the safe handling of medical gases for the OR and other staff, as appropriate (potential items include a video, lecture, and/or demonstration). Work with Respiratory Therapy, Critical Care, and or Facility staff to develop training specific for the unit or work area. In-service training should be provided with sufficient frequency to maintain currency and include the “Five Rights” of medication administration.
- Coordinate with the medical gas supplier to have medical gas names stenciled in large letters on all portable gas tanks and implement a 360-degree wrap-around label to clearly identify the contents of the gas tanks. Labels and placards are more reliable and a far better source of identification.
- Do not accept the tank simply because it’s painted green or grey. Lighting conditions and wear and tear (e.g., rust) on the tank make color-coding a less reliable source of identification.
- Replace all green and other colored “Christmas Tree” adaptors with ones that are clear to avoid reliance on adapter color to identify the gas type (e.g., green may be associated with O₂.)
- Replace regulators and flow meters used for air and O₂ that are nearly identical. Ensure that the regulators are gas-specific and cannot be interchanged between tanks of different contents. Flow meters should also be easily identified by shape and color. If CO₂ flow meters are not required to deliver CO₂ eliminate their use with CO₂ tanks in the OR altogether.
- Assure that gas connections are observable (not hidden under a table or behind a drape) and that the labeling of all gas connections and sources is prominent and visible under the conditions that are actually present during use (e.g. dim lighting, crowded spaces).
- Use an O₂ analyzer or inspired O₂ (FiO₂) monitor to check delivered medical gas.
- If a patient doesn't respond as expected to the treatment with supplemental O₂, consider the possibility that the wrong gas (or no gas) is being administered and check the tank, flow meter and tubing connections.

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