# Dangerously Low Default Alarm Limits on Anesthesia Units

## Hazard #6—2025 Top 10 Health Technology Hazards

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Guidance

## Executive Summary

Certain anesthesia units can be configured such that the default alarm limits (those active whenever a new surgical case is started) will be set to zero or a similarly unsafe lower limit. In effect, this disables the alarm at the start of the case. ECRI has investigated numerous incidents in which inappropriate default alarm limits caused dangerous conditions to go undetected, in some cases leading to brain damage or death.

While anesthesia providers can set lower alarm limits to zero when needed during a procedure, ECRI recommends against configuring the unit such that the lower limit *defaults* to zero (or some other unsafe lower limit).

## Full Text

See the full 2025 list of Top 10 Health Technology Hazards

## Problem

Anesthesia units are equipped with alarms to warn clinicians when problems related to anesthesia gases arise. For alarm systems to be effective, the alarm limits need to be set to clinically relevant values. Some anesthesia units can be configured such that certain *default* alarm limits—that is, the values that will be active whenever a new surgical case is started—will be set to zero (or a similarly unsafe lower limit). This functionally disables the alarm unless the anesthesia provider changes the setting to a clinically relevant value during the case. ECRI has investigated numerous incidents in which inappropriate default alarm limits caused dangerous situations to go undetected, leading to patient harm, including instances of brain damage and death.

Alarm limits define the top and/or bottom of an acceptable range of values for a given parameter (e.g., minute volume); reaching the upper or lower limit triggers an alarm. Anesthesia providers can change these limits during a procedure as circumstances warrant, and at times during a procedure it may be appropriate to set the lower alarm limits to zero. What ECRI recommends against, however, is configuring the unit such that the lower limits *default* to zero (or some other unsafe lower limit) whenever a new case is started.

Default alarm limit values are initially set by the manufacturer before the unit is shipped from the factory. The healthcare organization then can customize the default settings to align with the organization's policies.

The risk of patient harm or distress is highest if inappropriate default settings are used for the following alarms:

- Low minute volume alarm. This alarm alerts the anesthesia provider if the patient's respiratory rate, tidal volume, or both are too low for oxygenation and ventilation. Minute volume alarms are critical because they alert providers to any gaps in breathing as patients transition between spontaneous and mechanical ventilation during induction of and emergence from anesthesia (i.e., the changeover from wakefulness to unconsciousness and vice versa). ECRI has investigated numerous incidents in which the low minute volume alarm limit was left at the default setting of zero and patients suffered significant harm.
- Low agent concentration alarm. This alarm alerts the anesthesia provider if the patient is not receiving a sufficient concentration of volatile anesthetic agent, a circumstance that can lead to hypertension, tachycardia, intraoperative awareness, and patient movement. ECRI has investigated incidents in which patients experienced intraoperative awareness because of some complication with the agent (e.g., the vaporizer was empty of liquid agent) and the provider was not alerted in time to intervene because the agent concentration alarm limit was left at the default setting of zero. Patients who experience intraoperative awareness can have complications such as post-traumatic stress disorder.

Anesthesia providers can and should adjust alarm values according to the needs of the patient and the procedure; however, alarm limits should default to values that protect the patient from conditions that could reasonably be expected to cause harm.

## ECRI Recommendations

### Anesthesia and Risk Management

Ensure that department policies call for appropriate default values for all anesthesia alarms.

1. ECRI strongly encourages facilities to determine and set safe default lower alarm limits for minute volume as well as for each anesthetic agent used in the facility. Also consider that most anesthesia units maintain different default alarm limits for different patient types (adult, pediatric, neonate). The default alarms for each patient type should be appropriate for those patients.
2. Some anesthesia providers may be resistant to raising default lower limits for alarms because of a perception that it will lead to more non-actionable alarms and thus contribute to alarm fatigue. In reality, such a policy should not lead to significantly more non-actionable alarms, for the reasons explained below. Lingering concerns raised by anesthesia providers may be addressed in a simulation lab or with a pilot program.
    a. The only time in a procedure when it may be appropriate for a patient to have a very low minute volume is during emergence. At that stage of the procedure, the anesthesia provider can easily set the low minute volume alarm limit to zero, which will prevent non-actionable alarms for the remainder of the case.
    b. Anesthesia units with integrated gas analyzers suppress all agent concentration alarms until agent is detected in the sample line (this is similar to the way carbon dioxide and apnea alarms work). This means that there will be no non-actionable agent alarms during induction. And, as with the low minute volume alarm, it is appropriate for the anesthesia provider to set the low agent alarm to zero during emergence to prevent non-actionable alarms.

### Health Technology Management

Ensure that all anesthesia unit default alarm limits are set according to hospital and anesthesia department policy.

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1. Default alarm limits should be configured to match policy during acceptance testing.
2. In addition, default alarm limit settings should be checked during preventive maintenance.
3. If the anesthesia department adopts a new policy regarding default alarm limits, health technology management staff may need to modify the limits outside the normal preventive maintenance cycle.
4. Written authorization from the facility and/or the anesthesia department should be obtained to make any changes to anesthesia unit default limits.
5. A record of any changes to anesthesia unit default limits should be maintained.

### Challenge to Industry

1. ECRI strongly encourages anesthesia unit vendors not to set the factory defaults for critical alarms, including low minute volume and low anesthetic agent, to zero or a similarly unsafe lower limit.
2. Some vendors have already adopted this practice for the default low minute volume alarm, as we've reported in our Evaluations of anesthesia units for general-purpose and low-acuity/ambulatory surgery applications. Of the models we've tested to date: The Draeger Perseus A500 sets the initial low minute volume limit automatically based on breath settings and patient size; and all Getinge and Mindray models available in the United States use a non-zero default limit for the low minute volume alarm. ECRI applauds such changes and will continue to update its reports as product improvements are made.

## Related Resources

2025 Solutions Kit | Executive Brief (PDF) | Full Report (PDF; Coming Soon)

## Member Resources

*The following resources are accessible to members of ECRI's Device Evaluation, Device Evaluation Plus, and Capital Guide programs.*

Appropriately set inspired and end-tidal anesthetic agent alarms can help prevent intraoperative awareness [ECRI Exclusive Hazard Report]. *ECRI Alerts.* March 19, 2019. Accession No. H0501.

Awareness during anesthesia. *Health System Risk Management.* June 25, 2014.

ECRI Evaluation spurs anesthesia machine safety fix. *Device Evaluation*. June 16, 2021.

Evaluation background: anesthesia units for general-purpose and low-acuity/ambulatory surgery applications. *Device Evaluation*. Updated June 28, 2023.

## Additional Resources

Anesthesia Patient Safety Foundation. APSF-endorsed statement on revising recommendations for patient monitoring during anesthesia. *APSF Newsletter* 2022;37(1).

## Citation

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## Classifications

**CARE SETTINGS**
Ambulatory Surgical, Chronic Disease Hospital, General Acute Care Hospital, Long Term Care Hospital, Military General Acute Care Hospital, Military General Acute Care Hospital. Operational (Transportable), Psychiatric Hospital, Rehabilitation Hospital, Special Hospital, Emergency Care

**HEALTH CARE**
Safety Management, Safety Management, Technology Assessment, Biomedical, Technology Assessment, Biomedical

**PERSONS**
Health Personnel

**SPECIALTIES**
Biomedical Engineering

**UMDNS**
Anesthesia Units [10134], Infusion Pumps, Multitherapy, Large Volume [28057], Intravenous Administration Sets [12157], Infusion/Monitoring Line Organizer Systems [17793]

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