

ADVANCED LIFE SUPPORT MONITORING SYSTEMS FOR EMERGENCY MEDICAL SERVICES

Advanced life support monitoring systems (ALSMS) are specialized medical devices used by emergency medical services (EMS) to continually monitor and analyze vital signs and body functions of patients in critical care situations. These systems give healthcare professionals immediate access to real-time data necessary for assessing and managing patient conditions. The various components of ALSMS include sensors that detect different bodily functions, a data collection and processing unit, and an alert system to notify healthcare workers of any abnormalities, as well as a user interface, pads for providing cardiac treatments, connectivity features to link with other medical devices or systems, and storage and analysis tools for patient data. This equipment falls under the AEL reference number 09ME-03-DEMP titled “Defibrillator/Cardiac Monitors/Pacing.”

Overview

ALSMS are used to help medical workers assess and provide care for patients in pre-hospital and hospital settings. Some systems use algorithms or artificial intelligence to help users make more informed decisions. Certain ALSMS products are designed for use by first responders in the field. These systems are typically more compact, portable, and rugged than those designed to be used within medical facilities.



Figure 1. Advanced Life Support Monitoring Systems
Image courtesy of Philips Health Care

ALSMS combine electrocardiography, pulse oximetry, noninvasive blood pressure, capnography, temperature, and other diagnostic sensor technologies. Patient data is displayed in real time and, with some systems, may be able to be viewed remotely. ALSMS can also integrate with electronic health record systems, facilitating the management and sharing of patient information among healthcare providers. [1]

Identify, Diagnose, and Help Treat Life-threatening Conditions

ALSMS can identify, diagnose, and help treat life-threatening conditions through several key capabilities:

- 1. High Frequency Monitoring of Physiological Indicators:** This includes monitoring heart rate, blood pressure, respiratory rate, oxygen saturation levels, and temperature.
- 2. Advanced Algorithms and Data Analysis:** The algorithms analyze the collected data in real time to detect patterns and trends that may signify the onset of a life-threatening condition.

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) program to inform emergency responder equipment selection and procurement decisions.

Under the Science and Technology Directorate, the National Urban Security Technology Laboratory (NUSTL) manages the SAVER program, which – with the participation of emergency responders – performs objective operational assessments of commercially available equipment.

SAVER publications provide information about equipment that falls under the DHS Authorized Equipment List (AEL) categories and focus on two questions for the responder community: “What equipment is available?” and “How does it perform?”

To explore the full library, visit SAVER online at www.dhs.gov/science-and-technology/saver.

For additional information on the SAVER program, email NUSTL at NUSTL@hq.dhs.gov.

3. **Therapeutic and Diagnostics:** Capability to support multi- and 12-lead EKG diagnostics, as well as automatic external defibrillator (AED).
4. **Treatment Recommendations and Records:** Recommendations facilitate the rapid administration of drugs, fluids, therapies, and other interventions by EMS, while this feature also adds those treatments to patient records.
5. **Alert Systems and Early Warning Alarms:** Alerts are triggered when specific physiological thresholds or criteria are met.
6. **Remote Monitoring:** This enables healthcare providers in the field to transmit patient data to hospitals, facilitating remote consultations and advice on interventions with medical authorities.
7. **Integration with Electronic Health Records:** Real-time updates being made by an ALSMS from the field to the treatment facility ensure seamless medical documentation. Integration capability with other digital records systems also ensures that access to patient records is similarly smooth.^[2]

Reduce the Risk of Complications

Having real-time data available to guide their treatment decisions may help medical workers avoid negative health outcomes for their patients. ALSMS may lower complication risks by identifying abnormalities early through continuous monitoring. Alerts notify healthcare providers immediately of critical changes, allowing them to swiftly intervene.

Improve Communication and Collaboration Among Healthcare Teams

ALSMS centralize patient data-sharing and enable remote monitoring, allowing teams to collaborate effectively when not physically together. EMS in a pre-hospital setting can transmit patient data remotely to healthcare professionals in hospital settings.^[3]

Cybersecurity Considerations

ALSMS that allow for networked connectivity, either wirelessly or wired, need appropriate access controls and encryption enabled to protect the medical information and life of the patient. Unauthorized access to medical records would result in a breach of patient privacy. Unauthorized interference or altering of monitoring alerts and dosage suggestions could endanger the life of the patient. Proper cybersecurity controls are necessary to prevent this from occurring. See the [FBI Criminal Justice Information Services Security Policy](#) for more information on implementing cybersecurity controls.^[4]

Relevant Standards/Regulations

The United States (U.S.) Food and Drug Administration (FDA) regulates medical devices sold in the U.S. to assure their safety and effectiveness. The FDA lists cleared monitoring systems on [FDA Premarket Notification Database](#); purchasers can verify that a system being considered for purchase is cleared by searching for the manufacturer name or product name. ALSMS may need to comply with standards that address monitoring system and connected device performance, interoperability, electromagnetic compatibility, and artificial intelligence algorithms. Additionally, ALSMS that store and transmit health information are subject to the [Health Insurance Portability and Accountability Act](#) (HIPAA) regulations in the U.S. to ensure patient privacy, secure data transmission, and data access controls.

REFERENCES

- [1] Phillips, "Advanced Life Support Solutions," 2024. <https://www.usa.philips.com/healthcare/solutions/emergency-care-resuscitation/advanced-life-support-solutions>.
- [2] One Beat Medical, "Defibrillators," 2024. <https://onebeatmedical.com/product-category/first-responders>
- [3] Zoll, "Zoll X Series for EMS," 2024. <https://www.zoll.com/products/defibrillators/x-series-for-ems>.
- [4] FBI.gov, "Criminal Justice Information Services (CJIS) Security Policy," 2020. https://www.fbi.gov/file-repository/cjis_security_policy_v5-9_20200601.pdf/view.