



**Homeland
Security**

Science and Technology

Summary

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Portable Medical Suction Units

(AEL reference number 09ME-02-SUCT)

In order to provide emergency responders with information on currently available portable medical suction units, Science Applications International Corporation (SAIC) conducted a comparative assessment of portable medical suction units for the System Assessment and Validation for Emergency Responders (SAVER) Program in April 2011. Detailed findings are provided in the Portable Medical Suction Units Assessment Report, which is available by request at <https://www.rkb.us/saver>.

Background

Portable medical suction units are used by certified emergency medical technicians to open airways and manage traumas. A number of different medical situations require suction units to enhance patient care and enable responders to complete life-saving procedures. Portable medical suction units are available in assorted styles, with various features and capabilities.

Assessment Methodology

Prior to the assessment, eight certified emergency medical response personnel and paramedics were chosen from various jurisdictions to participate in a focus group. The group's primary objectives were to recommend evaluation criteria, product selection criteria, products and vendors, and possible scenarios for the assessment.

Based on focus group recommendations, market research, and system availability, the following portable medical suction units were assessed:

- Laerdal Suction Unit (LSU), Laerdal[®] Medical;
- S-SCORT Jr.[®] Quickdraw[®] (Quickdraw), SSCOR Inc.;
- S-SCORT[®] VX-2[®] (VX-2), SSCOR Inc.;
- LSP Advantage[®] Emergency Portable Suction Unit (Advantage), Allied Healthcare Products Inc.; and
- Tote-L-Vac[®], Ohio Medical Corporation.

Eight responders served as evaluators for this assessment. All evaluators had at least 5 years of experience in emergency medical response, specifically advanced adult and pediatric airway management.

Evaluators were tasked to participate in two phases of the assessment: the specification assessment and the operational assessment. During the specification assessment, evaluators assessed the systems based on vendor-provided information and specifications. Hands-on experience suctioning the airways of adult- and child-sized mannequins served as the basis for the operational assessment.

Assessment Results

Evaluators rated the portable medical suction units based on the evaluation criteria established by the focus group. The focus group assigned each criterion to one of the five SAVER categories, and then assigned a weight for its level of importance. Once the criteria were weighted, the five SAVER categories were assigned a percentage value to represent the level of each category’s importance relative to the other categories.

Table 1 displays the composite assessment scores as well as the category scores for each product. Higher scores indicate a higher rating by evaluators. The advantages and disadvantages of each system, as identified by evaluators, are listed in table 2. To view how each portable medical suction unit scored against the evaluation criteria assigned to the SAVER categories, see table 3. For product specifications, see table 4.

The following paragraphs provide a brief summary of evaluator comments and feedback on each portable medical suction unit used during the assessment; the complete assessment report includes a breakdown of evaluator comments by evaluation criteria. The systems are listed from highest to lowest composite score.

LSU

The LSU received an overall composite score of 77. The suction unit is powered by an internal battery and can use either an alternating current (AC) or direct current (DC) power cord. It includes a test feature and a power save feature that ensure readiness of the equipment and extend the battery life. The LSU is a rugged, compact unit that secures the collection canister during transport and use. It includes a light-emitting diode (LED) control panel, adjustable carrying strap, and ribbed handle. The unit’s weight is evenly distributed, the housing is sealed, and the unit appears easy to clean. The manufacturer offers a 5-year warranty on the LSU and a 90-day warranty on the battery.



LSU

SAVER Category Definitions
Affordability groups criteria related to life-cycle costs of a piece of equipment or system.
Capability groups criteria related to the power, capacity, or features available for a piece of equipment or system to perform or assist the responder in performing one or more relevant tasks.
Deployability groups criteria related to the movement, installation, or implementation of a piece of equipment or system by responders at the site of its intended use.
Maintainability groups criteria related to the maintenance and restoration of a piece of equipment or system to operational condition by responders.
Usability groups criteria related to the quality of the responders’ experience with the operational employment of a piece of equipment or system. This includes the relative ease of use, efficiency, and overall satisfaction of the responders with the equipment or system.

Table 1. Portable Medical Suction Unit Assessment Results¹

System	Composite Score	Affordability (20% Weighting)	Capability (30% Weighting)	Deployability (15% Weighting)	Maintainability (10% Weighting)	Usability (25% Weighting)
LSU	77	58	85	79	80	89
Quickdraw	67	57	61	85	82	68
VX-2	66	62	61	72	67	75
Advantage	64	58	74	57	65	60
Tote-L-Vac [®]	54	60	53	51	45	55

Note:

¹ Scores contained in the assessment report may be displayed differently. For the purposes of the SAVER Summary, all SAVER category scores are normalized using a 100-point scale and rounded to the nearest whole number.

The LSU has a high initial cost. The manufacturer offers accessories to enhance the use of the unit; however, evaluators noted that the accessories are higher in cost than average. Operational concerns included the release arm of the collection canister and the tubing. According to evaluators, the release arm is not easily identified or seen and does not appear durable. They noted it can be broken easily if force is used to remove the canister without the release, and the release may become brittle after repeated exposure to extreme temperatures. Also, the tubing used to connect the pump to the canister is too long and easily crimps during operation.



Quickdraw

The Quickdraw received an overall composite score of 67. It uses an internal rechargeable battery; a replaceable alkaline battery pack is also an available power source that can extend the battery life or the run time of the unit to 180 minutes. The Quickdraw appears capable of being used in extreme temperatures and wet weather conditions. The compact unit features battery condition indicator lights, a hand strap, and finger grooves for deployment. It has a low initial cost, is easy to use, and can be easily cleaned.

According to evaluators, operation is not recommended while the unit is being charged. They noted that the unit does not include an AC power supply; an AC/DC converter must be ordered as an accessory. The Quickdraw utilizes a 300-cubic centimeter proprietary canister. When the canister is filled or if liquids contained within the canister contact the hydrophobic filter, the airflow will automatically shut off. According to evaluators, the unit does not feature a storage compartment or offer a storage strap for suction tubing or tips.



VX-2

The VX-2 received an overall composite score of 66. It is a durable, sealed unit with a 45-minute run time. The unit has a minimal number of components to connect, and it is simple to operate. An adjustable shoulder strap is available as an optional accessory; the strap features a storage pouch that can house accessories and consumables. Optional wall mounting brackets are also available to assist with charging and storage. This unit includes a training CD and a 1-year warranty; the battery comes with a 3-year warranty.

The manufacturer recommends not operating the unit while it is plugged in or being charged. Evaluators expressed concern that the grips within the canister holder could become brittle over time. Although five battery conditions are shown on the panel, only three LEDs are featured, making it difficult for evaluators to understand the remaining battery capacity. The regulator knob does not have level increments and can be accidentally increased or decreased during use. The storage pouch on the optional carrying strap cannot be adjusted or removed. The unit has a large footprint, and the weight is unevenly distributed. No filters are available for this equipment.



Advantage

The Advantage received an overall composite score of 64. The durable unit features a heavy-duty AC power cord and a sturdy metal tip for the tubing connection. It offers a wide vacuum range, a 75-minute run time, and wide operating and storage temperature ranges. The equipment is operable in wet weather conditions. It features LED battery condition indicators and a color-coded vacuum gauge. The accessories are reasonably priced, and the recharge time is minimal.

There is no DC charging option. The canister holder is not durable and cracks the canister when pressure is applied to securely seat the canister. The canister does not remain secure during transport or use. There are no demarcation lines on the regulator knob, and a couple of revolutions are required before the vacuum pressure

can be adjusted. The tubing strap is too loose; as a result, the tubing and tips do not remain secure. The unit features separate recessed buttons for powering the unit on and off. The Advantage has a large footprint and the excessive weight can cause fatigue when transporting long distances. There is no strap available for this piece of equipment; a carrying case, which has a strap, is the only option available to aid in transport. There is no padding on the strap of the carrying case, and evaluators noted that the grips of the strap were uncomfortable on their shoulders when carrying the unit.



Tote-L-Vac

The Tote-L-Vac received an overall composite score of 54. The unit has an internal rechargeable battery and will run with AC power as well. Evaluators noted that it offers the strongest suction of the assessed suction units. The compact unit is available at a low initial cost, is easy to deploy, and is simple to operate. The carrying strap can be configured into either a strap or handle. The manufacturer includes a 3-year warranty with the unit.

The DC power cord must be purchased as an accessory. The unit is not sealed, and the internal components can be easily exposed to fluids and other contaminants. The case does not appear durable enough to withstand repeated use. The single stitching is not durable, and the Velcro® will wear over time. According to evaluators, the lowest vacuum range of the Tote-L-Vac is too strong for use on pediatric patients. There is no battery condition indicator, the canister does not remain secure, the carrying bag flap does not remain open, and the gauges cannot easily be read. The suction unit is heavy, the carrying strap is too short, and the unit is not vehicle-mountable. The manufacturer states that cleaning the pump head is required for maintenance.

Conclusion

Evaluators successfully completed the assessment with the LSU, Quickdraw, VX-2, Advantage, and Tote-L-Vac medical suction units. Analysis of evaluator comments and scores revealed the following common observations concerning the assessed portable medical suction units:

- Evaluators placed a high value on medical suction units that offer multiple power sources. Units with rechargeable batteries that can utilize both AC and DC power offer greater flexibility to medical professionals. Alkaline batteries and optional battery packs also increase the versatility of the equipment.
- Evaluators preferred medical suction units with a wide vacuum range. Wide vacuum ranges provide greater suction levels during aspiration tasks. They increase vacuum adjustment capabilities and enable medical professionals to establish adequate amounts of vacuum based on individual scenarios.
- Evaluators placed a high value on medical suction units with extended battery life. The operational time of a battery depends on the type of battery being used, as well as the amount of charge the battery has received before use. Evaluators preferred suction units that can operate for at least half an hour.
- Evaluators expressed a strong preference for durable medical suction units that can be operated in a wide range of operational environments. Sturdy housing capable of withstanding repeated use is essential. It is also beneficial for the units to be shock proof, impact resistant, and capable of use in wet weather conditions.
- Evaluators favored medical suction units that feature battery condition indicators. Medical response personnel rely on battery condition indicators to monitor the remaining battery capacity of the unit during response operations, as well as for charging and test status.
- Evaluators placed a high value on medical suction units that are intuitive and easy to use. Preferred features that increase the ease of use include regulator knobs with increments and demarcations, color-coded regulator gauges, secure canisters, and easy-to-read panels. Ease of access to charging outlets, controls, and battery compartments is also important.
- Evaluators favored compact medical suction units with small footprints. The user is often required to carry the unit long distances to perform response operations. Units that are heavy cause fatigue,

especially if the user is required to carry other pieces of response equipment as well. Weight distribution is also an important consideration.

- Evaluators placed a high value on medical suction units that are sealed and can easily be cleaned. It is imperative that the suction unit be sealed to protect the battery and internal components from fluids and other contaminants. It is also important for the unit to easily be cleaned and decontaminated so it can be returned to service.
- Evaluators expressed a strong preference for medical suction units that include an extended warranty for both the unit and the battery. Most suction units offer at least a 1-year warranty. However, warranties offered beyond that 1-year period are preferred, as well as separate warranties for the batteries.

All reports in this series, as well as reports on other technologies, are available in the SAVER section of the Responder Knowledge Base (RKB) Web site at <https://www.rkb.us/saver>.

Table 2. Portable Medical Suction Unit Advantages and Disadvantages

System	Advantages	Disadvantages
 <p>LSU Composite Score: 77</p>	<ul style="list-style-type: none"> • AC and DC power cord • Power save feature • Test feature • Rugged unit • Secure canister • Increments on regulator knob • LED lights on control panel • Compact design • Lightweight; even weight distribution • Adjustable carrying strap • Ergonomic, ribbed handle • Sealed unit; easy to clean • 5-year warranty on unit; 90-day warranty on battery 	<ul style="list-style-type: none"> • High initial cost • More expensive accessories • Release arm not durable • Tubing too long; easily crimps
 <p>Quickdraw Composite Score: 67</p>	<ul style="list-style-type: none"> • Alkaline or rechargeable battery • 180-minute run time for alkaline battery • Capable of operating in extreme temperatures and wet weather • Battery condition indicator lights • Low initial cost • Easy to use • Compact design • Finger grooves on unit • Easy to clean unit and strap 	<ul style="list-style-type: none"> • Operation not recommended with power cord • No AC power supply • Small proprietary canister • Cannot be tilted; liquid cannot contact hydrophobic filter; causes automatic shutoff • No storage for tubing or tips
 <p>VX-2 Composite Score: 66</p>	<ul style="list-style-type: none"> • Durable unit; sturdy handle • Sealed unit • 45-minute run time • Simple to operate • Minimal number of components; easy to change out • Adjustable shoulder strap; storage pouch worn on either side • Optional wall-mounting bracket available • Training CD included with unit • 1-year warranty on unit; 3-year warranty on battery 	<ul style="list-style-type: none"> • Operation not recommended with power cord • Grips within canister holder can become brittle over time • Five battery conditions shown; only three LEDs • Poor control panel configuration • Charging outlet in front • Accidental increase/decrease of vacuum settings • No adjustment or removal of storage pouch on accessory strap • Large footprint • Unbalanced weight distribution • No filters available

Table 2. Portable Medical Suction Unit Advantages and Disadvantages (Continued)

System	Advantages	Disadvantages
 <p>Advantage Composite Score: 64</p>	<ul style="list-style-type: none"> • Heavy-duty AC power cord • Durable unit • Sturdy metal tip for tubing connection • Wide vacuum range • 75-minute run time • Wide operating and storage temperature ranges • Operable in wet weather conditions • LED lights for battery condition • Reasonable accessory prices • Color-coded vacuum gauge • Minimal recharge time 	<ul style="list-style-type: none"> • No DC charging • Canister holder not durable; cracks canister with applied pressure • No demarcation line for regulator knob; too many revolutions required for adjustment • Canister not secure • Tubing strap too loose; tubing not secure • Separate recessed on/off buttons • Large footprint • Weight • No strap available; carrying bag with strap is only option • No padding on carrying bag strap; grips uncomfortable on shoulder
 <p>Tote-L-Vac® Composite Score: 54</p>	<ul style="list-style-type: none"> • Will run with AC power • Strongest suction of assessed units • Low initial cost • Easy to use; simple to operate • Small footprint • Easy to deploy • Two strap configurations • 3-year warranty on unit 	<ul style="list-style-type: none"> • DC cord is an added cost; not included with initial cost • Unit not sealed; exposure of unit to moisture • No protection of unit • Single stitching on case not durable; Velcro® wears over time • Low vacuum range not low enough for pediatric patients • No battery condition indicator • Canister not secure or viewable • Flap on case does not remain open • Loud noise level • Gauges not easily viewed; not color coded • Weight • Carrying case strap too short and narrow • Unit not mountable • Cleaning of pump head required for maintenance

Notes:

- AC = alternating current
- DC = direct current
- LED = light-emitting diode

Table 3. Portable Medical Suction Unit Criteria Ratings¹

KEY									
Least Favorable					Most Favorable				
					LSU	Quickdraw	VX-2	Advantage	Tote-L-Vac®
Affordability									
Initial cost									
Cost of consumables									
Service life									
Cost of accessories									
Capability									
Power source									
Vacuum range									
Durability									
Battery life									
Operational environments									
Battery condition indicator									
Deployability									
System configuration									
Size									
Carrying options									
Storage for deployment									
Maintainability									
Restoration									
Recharging time									
Long-term storage									
Usability									
Ease of use									
Easy-to-read display									

Note:

¹ Averaged criteria ratings for each assessed product are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.

Table 4. Portable Medical Suction Unit Specifications¹

Specifications	LSU	Quickdraw	VX-2	Advantage	Tote-L-Vac®
Performance	≥500 mmHg ≥25 lpm	0 to 500 mmHg ≥30 lpm	50 to 525 mmHg ≥30 lpm	25 to 550 mmHg 30 lpm	0 to 550 mmHg 36 lpm
Charge time	24 hours	0.5 hours	4 to 6 hours	6 hours	8 hours
Run time	30 minutes	30 minutes	45 minutes	75 minutes	30 minutes
Dimensions	13.0 x 12.4 x 6.3 inches	4.0 x 4.0 x 15.0 inches	9.0 x 5.3 x 17.0 inches	9.4 x 7.5 x 16.8 inches	7.0 x 12.0 x 6.5 inches
Weight	8.9 pounds	2.6 pounds	10.5 pounds	10.6 pounds	9.0 pounds

Notes:

¹ Information listed in table 4 was provided by manufacturers and has not been independently verified by the SAVER Program.

lpm = liters per minute

mmHg = millimeters of mercury