POWER LIFE-CHANGING CARE WITH SAFE BATTERY TECHNOLOGY

How to navigate the battery technology landscape

ergotron®
HEALTHCARE

TABLE OF CONTENTS

Introduction

Hospitals and clinics are designed as healing environments, with patient and caregiver safety a key aspect of fulfilling that mission. With the increased use of battery-powered medical equipment across systems, it's crucial that all equipment is designed and tested to the highest safety standards to protect both users and patients, while supporting the best care.

Ongoing news reports have highlighted the dangers of battery-powered devices from mobile phones to hoverboards, which can have catastrophic results when battery safety is ignored. In a healthcare environment, battery-involved fires have required facility evacuations and led to toxic fume exposure. In a 2016 U.S. Food and Drug Administration (FDA) study, half of hospital respondents said they had experienced a cart battery or electrical-related problem during the previous two years, most of which were related to battery issues. Even one issue was too many, and the industry took note.

With evidence of the frequency and prevalence of this issue, the FDA released a memo in December 2016, "Potential Problems with Battery-Powered Mobile Medical Carts in Health Care Facilities that May Result in Fire." The memo confirmed the potential safety risks of mobile medical carts and recommended the inspection of current systems. It also highlighted the variety of battery-powered systems available and the importance of understanding the key factors when selecting the best fit.

Of the options available, Lithium Iron Phosphate, often referred to as LiFe, batteries offer features ideal for healthcare organizations. Compared to other technologies, LiFe batteries are safer, last for more charge/discharge cycles, and can be discharged fully without complications. Stakeholders should also look beyond battery chemistry when choosing a power system. System load, desired runtime, workflow, time to charge and access to system information all impact usability. Understanding these factors and selecting the best power system helps ensure IT equipment effectively assists caregivers in providing life-changing care—and keeps everyone safe through it all.

FDA recommendations

The recommendations outlined in the FDA's 2016 memo centered on the importance of preventative maintenance to inspect batteries for signs of damage and inspect battery chargers and carts for overheating components. It also reiterated general safety recommendations for battery-powered mobile medical carts, such as not blocking charging station vents, not attaching objects to a battery charger and storing the battery charger outside of a patient room.

The role of battery-powered medical carts

The equipment powered by batteries, including mobile computing carts used for electronic medical records, is critical to providing patient care. An on-cart battery allows nurses and physicians to care for patients without having to rely on an outlet to plug in, which can often be stressful to locate. These power systems may have a battery built into the base of the cart that's occasionally plugged in to charge, or it may require the ability to hot swap a battery pack to provide around-the-clock critical care. These mobile carts provide access to the technology caregivers need, while offering the flexibility to easily move from room to room or complete documentation on-the-go.

Common battery types

LiFe has become a popular option in healthcare due to its key advantages like safety and longevity, but there are other options on the market.

- The most common type of lithium battery known as **Lithium Cobalt Oxide** (LiCoO2), or **Li-Co**, uses cobalt as a cathode. These batteries are commonly found in laptops or mobile phones and are often selected due to their power density that can provide a longer runtime for its size and weight.
- Less common in today's healthcare environments, **Sealed Lead Acid** (SLA) batteries were historically used in older medical carts and **Uninterruptable Power Supply** (UPS).

When compared to Li-Co and SLA battery chemistries, the LiFe battery offers several overall advantages: improved safety, longer cycle life, better depth of discharge, charge rate and energy density.

	LiFe	Li-Co	SLA
Safety	✓✓✓	✓	✓✓
Cycles	✓✓✓	✓✓	✓
Depth of discharge	✓✓✓	✓✓	✓
Charge rate	✓✓✓	✓✓	✓
Energy density	✓✓	✓✓✓	✓

Lithium Iron Phosphate, Lithium Cobalt and Sealed Lead Acid battery comparison

THE LIFE BATTERY TECHNOLOGY DIFFERENCE

Improved safety

Of all the benefits related to using LiFe batteries for healthcare equipment, safety is arguably the most important. In addition to the highly publicized fires with consumer goods, Li-Co batteries have also been associated with fires in hospitals. Most of these incidents were attributed to small defects introduced during the manufacturing process. While those manufacturing issues have been resolved, the lithium ion chemistry remains susceptible to spontaneous combustion when damaged. To date, there are no known incidents of fires involving LiFe batteries in hospitals.

▶ The cause of many battery fires?

*The battery's thermal runaway temperature. Batteries with higher thermal runaway temperatures lead to a safer battery. For Li-Co batteries, the thermal runaway temperature is 150°C (302°F), while **LiFe** batteries have a higher thermal runaway temperature of 270°C (518°F)* [i].

Depth of discharge

Battery technology also varies by the depth of discharge that it can tolerate. SLA batteries generally do not tolerate a full depth of discharge, and the system may be limited to protect the battery from reaching a low level. LiFe batteries can handle a full discharge and are not impacted by a partial discharge.

Charge rate

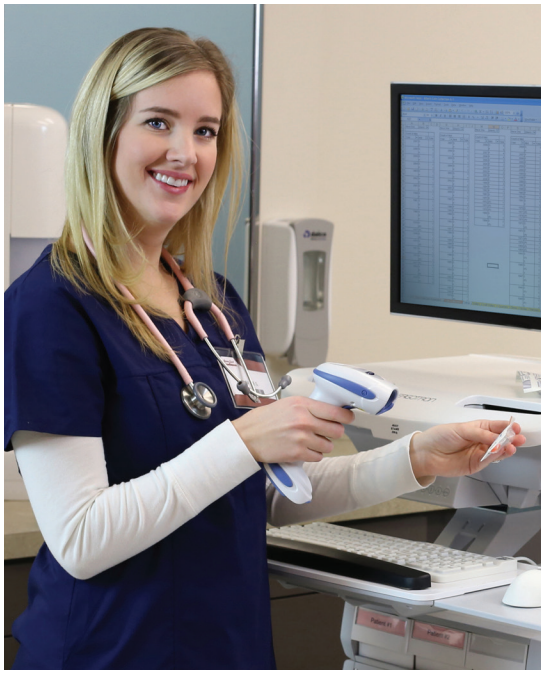
The LiFe battery's ability to handle the higher charger currents represents another advantage. LiFe batteries can charge up to a one-hour charge rate with little impact on its overall life cycle. High rates of currents can cause other battery chemistries to become hot when charging, which lowers the overall cycle life.

▶ The impact of thermal runaway

*Thermal runaway is the spontaneous combustion that occurs when a battery is damaged, which can result in a battery fire. Cells within the battery may experience damage, such as puncturing or cracking, which exposes the cells to oxygen. When the damaged cell heats up, nearby cells are also exposed to the increased temperature. Once those cells reach their thermal runaway temperature, they can also catch fire. This chain reaction continues until the entire battery pack has burned. Due to less reactive chemistry, **LiFe** batteries can sustain severe physical damage without fire risk.*

Please note, due to the hazardous material used in the battery and lithium's reactiveness with water, only a Class D fire extinguisher should be used.

[i] *Battery University - http://batteryuniversity.com/learn/article/types_of_lithium_ion*



Long cycle life

LiFe batteries also offer a longer cycle life. As all batteries are charged and discharged over time, the battery capacity declines. But for LiFe batteries, the cycle life degrades much slower and at a steady rate. The cycle life of common battery types varies widely:

- **SLA:** These batteries only have a usable life of approximately 300 cycles. Depending on usage, this type of battery may require replacing every six to 12 months or less.
- **Li-Co:** This type of battery can achieve up to 1,000 cycles before reaching end of life.
- **LiFe:** With the ability to support more than 2,000 cycles before replacement, LiFe batteries require less maintenance and workflow disruption. With fewer batteries to dispose, LiFe batteries have a lower environmental impact and a lower cost of ownership.

Energy density

When comparing these three battery chemistries, Li-Co has a slight advantage compared to LiFe. For equivalent power, the Li-Co battery will be slightly smaller and lighter, but this applies to new batteries only. The LiFe battery can maintain its initial capacity for more cycles over its lifetime. In many cases, users would need to replace a Li-Co battery several times due to diminished capacity before replacing a LiFe battery.

KEY CONSIDERATIONS FOR BATTERY SELECTION

Documentation carts on hospital campuses are in constant use, with caregivers moving them from room to room to capture electronic medical records and easily transport computer equipment, medication and supplies to patients. With a lengthy list of job demands, healthcare professionals should spend their time caring for patients—not worrying about finding a place to plug in and charge their documentation cart.

A reliable, on-cart battery system provides more flexibility and mobility for caregivers to work wherever they need to, from a patient's bedside to hallways.

External chargers allow users to quickly hot swap fully-charged batteries for continuous use.

But as we've learned, not all batteries are created equal. Here are the key factors to consider when choosing a battery to power your mobile medical carts:

Runtime

For any battery type, the system runtime depends on the load of the equipment. For everyday documentation using an efficient small form factor CPU and one monitor, a typical load could be 30 to 40 watts. For a more demanding case using additional equipment, the load could be 75 watts or more. To calculate the amount of runtime from a single charge, take the size of the battery in watt-hours divided by the load of the system in watts.

$$\textit{Runtime (hours)} = \frac{\textit{Battery capacity (Wh)}}{\textit{IT system load (W)}} \times \textit{Power system efficiency}$$

Carts with integrated batteries typically have larger batteries. For smaller loads such as 30 watts, this could mean a runtime of more than 12 hours on a single charge compared to less than six hours for a heavier load (75W).

	Integrated battery (512 Wh)	**Add-on power** (245 Wh)
Light Load – 30W	12.8 hours	6 hours
Heavy Load – 75W	5.6 hours	2.7 hours

Impact of load sizes on battery runtime

Charge time

Charge time is another important consideration. You may assume that a system with a larger battery would take longer to charge, but it all depends on the charger. A higher charging current is proportional to the time it takes to recharge a battery. The amount of time the cart is in-use while charging and the amount of load will also impact the charge time. For some systems, the battery may be unable to charge while the cart is in use, so the cart would have to sit idle to recharge. An additional power system or battery would be needed for this downtime, unlike carts with power systems that can charge while in use.

Workflow

In healthcare environments where uptime is crucial, hot swap power systems represent a reliable option for providing continuous care. Compared to an integrated power system where the battery always resides on the cart where it also must charge, a hot swap system uses a removeable battery that powers up on a separate centralized charger. Some organizations adopt a hybrid approach to adapt to changing workflows. In this case, common batteries are the best option to maximize equipment efficiency.

When comparing systems, check if power cords are provided and review the cable management. Is the power supply included for charging on the cart or is this separate? Even if the primary workflow will be to hot swap the batteries, it can be beneficial to have the option to also charge on the cart. Will there be multiple outlet cords running from the power system or can you consolidate to one cord and an outlet strip for a cleaner look? Be sure to check if this is included with the product.

AC vs. DC power

Batteries produce DC power, however, most computer equipment is designed for AC power available through a wall outlet. To ensure you can produce AC power from the battery, an inverter must be part of the power system. The inverter slightly reduces power efficiency, but it creates a more flexible system that can adapt to changes in equipment—saving costs and time for your IT team. DC systems require special equipment and proprietary cables, and they can quickly become complicated if your cart uses equipment with different voltage requirements. The system may then require the power system to support dual voltage output or require organizations to purchase a separate power converter.

Total cost of ownership

In any environment, cost is top-of-mind for executives and budget holders, including in healthcare. While LiFe battery technology potentially has a higher initial cost, fewer replacement batteries and reduced maintenance costs equate to a lower total cost of ownership in most cases. Organizations should look beyond the initial purchase price and consider other factors that impact long-term costs, such as runtime, charge time, warranty, cost and frequency of battery replacement, frequency of service and cost of a service call. Weighing all these criteria will provide a holistic picture of the total financial investment.

A cooling fan supports a safe system with venting and airflow.

Warranty

When comparing various systems, be sure to decipher the specifics included in the warranty language, especially how the battery warranty is measured. Many vendors will promote a set number of years for a warranty but if you look closer, they may include a cycle count clause, like car manufacturers who state years or miles. Make sure you understand what constitutes a cycle, as one manufacturer might count any partial charge or discharge as one cycle, while another may treat partial cycles cumulatively. This can significantly affect the warranty if a cart is regularly plugged in for short periods of time.

The warranty should also specify the guaranteed percentage of original capacity or battery health during the warranty period. The battery health can have a big impact on actual runtime. For instance, a 245 Wh battery with a battery health of 80% could have an hour or more additional runtime than the same battery at 60% battery health.

Safety controls and testing

To select the safest medical cart, choose an option with redundant controls in the power module to control the charging process and detect battery temperature and voltage—an especially important feature for lithium cells. The overall cart system is also closely tied to battery safety. Adequate venting and airflow, electrical wiring systems, and fusing are all critical to the safety of the cart.

All batteries should undergo aggressive testing by the manufacturer, including puncturing or shorting the battery to ensure it does not experience thermal runaway. This condition has been associated with some laptop batteries, which commonly use Li-Co battery chemistry. Be sure not to overlook your current fleet when evaluating overall safety. All organizations should confirm with their cart and battery supplier that the battery technology is as safe as possible.

Certifications

When in doubt, look for proper certifications related to the safety of the entire power system. Testing also ensures electrical safety, mechanical safety and electromagnetic interference issues that can impact uptime, along with patient and caregiver safety. Certifications vary by country, but common standards include:

SAFETY CERTIFICATION	
Battery cells	UL1642
Battery pack	IEC 62133 UN/DOT 38.3
Power module/ Powered cart (with integrated battery)	UL/IEC 60601-1
External charger	UL/IEC 60601-1

CONCLUSION

Selecting a battery-powered system for your line of mobile medical carts should be thoughtfully researched to ensure the safest and most efficient system for your organization. While each system offers unique features, LiFe battery technology is an ideal fit for healthcare environments due to its overall safety and reliability. Mobile medical carts with the right battery system allow physicians and nurses to spend less time focused on the technology and more time on what's most important—the patient.

Caring for the caregiver, along with patients, starts with safe technology that you can depend on. To learn about Ergotron's safety tested and reliable battery-powered solutions for healthcare, including our LiFeKinnex™ Power System, visit www.Ergotron.com/CareFit.

Helping you navigate the battery technology landscape

ergotron®
HEALTHCARE

Download additional resources at ergotron.com.
For more information:
NORTH AMERICA: 800.888.8458 / +1.651.681.7600 / sales@ergotron.com
EMEA: +31.33.45.45.600 / info.eu@ergotron.com
APAC: apaccustomerservice@ergotron.com
OEM: info@oem.ergotron.com