

Risks Associated with Lithium Battery-Powered Mobile Carts in Health Care Settings

Prevention and Procedures

Effective November 9, 2018 – November 8, 2020

Disclosures to Participants

Successful Completion of this Continuing Nursing Education Activity

In order to receive full contact hour credit for this CNE activity, you must:

- * Carefully read the entire self study module.
- * Complete the evaluation form and post-test and indicate responses on the answer sheet. Submission instructions and links to the post test and evaluation are on the last page of this self study.
- * This CE is free for MNA members and \$20 for non-members.
- * Participants who achieve a minimum passing score of 80% will receive a certificate awarding 1.0 contact hours. Certificates will be mailed within six weeks of receipt of evaluation and post-test. Participants who do not achieve a passing score will have the option to retake the test at no additional cost.

Conflicts of Interest

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Outcomes

At the conclusion of this activity, participants will be able to:

1. Identify the concerns with lithium batteries in health care settings.
2. Determine necessary steps to take if a lithium battery begin to smoke or catches on fire.
3. Describe steps health care institutions should take to protect patients and health care workers in case of a lithium battery incident.

Case Study: Michigan Hospital

- A battery in a mobile charging cart overheated while located in a closet on the fourth floor in a cardiac care unit
- Nurses noticed smoke.
- Patients and staff were evacuated to other floors.
- Windows were opened and firefighters were called.
- Why did the battery overheat?

What kind of medical equipment uses lithium batteries?

- Crash carts
- Medication dispensing carts
- Barcode scanners
- Mobile computer workstations
- Electronic medical record carts
- Infusion pump stands
- Bladder scanners
- Portable X-ray machines
- Equipment that works in conjunction with colonoscopes, ultrasound equipment, and equipment that dispenses anesthesia

The advantages of lithium batteries

- Economical
- More power storage with less weight
- Longer life
- Low maintenance
- Several types of lithium batteries

(Electronicsnotes, 2018)

The disadvantages of lithium batteries

- Produce substantial quantities of energy.
- This energy is confined to a small space.
- Energy confined to a small space will try to escape its boundaries, sometimes explosively, such as the process of thermal runaway.

Thermal Runaway

- Process – lithium ions laid on the negative electrode (anode) lose electrons, which pass through an electrolyte and become attached to the positive electrode (cathode).
- Short circuits – caused by recharging too fast or too little, or damage to the battery:
 - Lithium ions become unstable on the anode and bridge the electrodes.
 - Heat causes the flammable electrolyte to react to other battery materials.
 - Once thermal runaway is initiated, it is extremely difficult to stop it.

(Eisler, 2016)

Lithium battery-powered equipment

- Two types of lithium batteries:
 - Lithium
 - Single use (not rechargeable)
 - Contain lithium metal
 - Extremely combustible
 - Lithium ion (Li-ion)
 - Rechargeable
 - No lithium metal but contain lithium ions and extremely flammable electrolytes
 - Should be stored with a partial charge in contrast to other battery types that are stored at full charge

(Advanced Medical Technology Associates, n.d.)

FDA regulates carts that are considered to be “devices”

- Section 201(h) of the Federal Food, Drug and Cosmetic Act
- Used for diagnostic or therapeutic purposes
- This includes:
 - Crash carts
 - Medication dispensing carts
 - Infusion pump stands

The FDA does not regulate

- Mobile computer workstations
- Electronic medical record carts

Even those these carts
also use lithium batteries.

What can happen when the battery overheats?

- Smoke
- Fire (battery itself and equipment around it including other batteries if stored nearby)
- Explosion
- Damage to the facility
- Need for evacuation
- Patient and staff exposure to toxic fumes

11 Toxic Gas Component Hazards

EU Regulation (EG) Act 1272/2008

- Ethyl methyl carbonate (flammable, eye/skin irritation)
- Diethyl carbonate (flammable, eye/skin irritation)
- Ethylene carbonate (flammable, eye irritation)
- Carbon monoxide (acute toxicity/reproductive toxicity)
- Carbonyl sulfide (acute toxicity/flammable, eye irritation)
- Benzene (aspiration hazard, carcinogenicity, germ cell mutagenicity)
- Toluene (aspiration hazard, reproductive toxicity)
- Styrene (acute toxicity, flammable, eye/skin irritation)
- Biphenyl (aquatic acute toxicity, aquatic chronic toxicity)
- Acrolein (acute toxicity, reproductive toxicity)
- Hydrogen fluoride (corrosive to the respiratory tract, skin corrosions)

(Nedjalkov, Meyer, Kohring, Doering, Angelmahr, Dahle, Sander, Fischer and Schade, 2016)

Exposure to Toxic Fumes in Battery Fires

- Hydrogen fluoride may be generated.
- Phosphoryl fluoride may also be present.

(Larsson, Andersson, Bomqvist, Mellander 2018)

Preventive Care of Batteries

- Use batteries that match the specifications of the cart manufacturer.
- Maintain the batteries per the cart manufacturer's specifications.
- Examine batteries for wear (cracks, swelling, rust).
- Replace batteries according to manufacturer's specified time intervals.

Storage of Lithium Batteries

- Keep flammable material such as dust and lint away from the chargers and carts.
- Make sure chargers are located where they can be seen easily.
- Keep away from sources of oxygen and patient care areas.
- Storage areas must be fire retardant.
- Primary lithium batteries can be stored up to 10 years, secondary batteries have a maximum of 3 years. Always follow manufacturer guidelines.

(Advanced Medical Technology Associates, n.d.)

Storage of Lithium Batteries (cont.)

- Chargers and charging carts should not be kept in closets or any other confined spaces.
- The hospital should use and frequently review preventive maintenance information from the battery manufacturer to make sure battery procedures are in compliance.
- Not following battery storage/usage instructions is quite often the source of smoke/fire incidents.

In Case of Smoke/Fire

- Pull the fire alarm and evacuate all personnel and patients from the area.
- Don't touch the battery.
- Unplug the machine if possible.
- Seal off the area by closing the doors behind you as you exit the area.

Fire Extinguishers

- Only certain fire extinguishers will put out a lithium battery fire (CO₂ or ABC) depending on the type of battery. Only trained personnel should attempt putting out a lithium battery fire.
- If the first use of the extinguisher does not work, do not try it a second time.
- Even if the fire has been extinguished:
 - The fumes are toxic if water is poured on the battery to cool it.
 - Until the battery is discharged, it can still reignite hours or days after the initial impact/accident.

(Lithium Ion Battery Safety Guidance, 2017)

NOTE: In several reports, fire fighters had to bury the battery or throw it into a snow drift to extinguish it. It is better to get everyone away from the battery safely then try to put it out, unless trained personnel are present quickly.

In Case of Contact – Fumes/Smoke

- Remove workers and patients from contaminated area into fresh air.
- Evaluate airway breathing and administer oxygen as needed.
- Be prepared to administer CPR.
- Do not touch contaminated garments; remove from victim as soon as possible.

In Case of Contact – Eyes

- Rinse using a continuous water stream for at least 15 minutes.
- Firmly hold eyelids apart so that all eye and lid tissue is irrigated.
- Seek medical attention.

In Case of Contact – Skin

- Remove electrolyte using cool water or a shower for at least 15 minutes.
- Seek medical attention.

In all cases, seek immediate medical attention if there are signs of any complications or if the victim was exposed to a significant amount of electrolyte. (Lithium Ion Battery Safety Guidance, 2017)

Battery Checklist

- Batteries and chargers need airflow – keep vents open and free from paper.
- Observe where chargers and carts with chargers are used and stored; make changes as necessary for patient and visitor safety.
- Review battery upkeep and fire safety procedures for your unit – does everyone know the plan if a battery starts smoking?

Play It Safe

- Know the procedures for battery upkeep.
- Review where chargers and carts with chargers are used and stored; make changes as necessary for patient and visitor safety.
- Is there a plan in place if a lithium battery starts smoking or catches fire?
- Train all personnel on the plan, make sure materials are accessible, and refresh training at regular intervals.

Case Study: Michigan Hospital Revisited from Slide 4

- The wrong battery for the cart was being used.
- The cart was stored in a closet.
- Batteries were to be taken out at the end of the shift, but personnel had not been properly instructed to do so.
- Batteries from one unit were being moved to another unit without charge levels being checked.
- New procedures are now in place to make sure batteries are properly stored and maintained.

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POST-TEST DIRECTIONS

Complete the evaluation and post-test response form and make your payment online by clicking [HERE](#).

OR

Download and complete the evaluation and post-test response [PDF FORM](#) and send to:

By mail: Michigan Nurses Association, 2310 Jolly Oak Road, Okemos, MI 48864

By fax: 517-349-5818

AWARDING OF CE

Participants who achieve a minimum passing score of 80% will receive a certificate awarding **1.0 contact hour**. Certificates will be mailed within six weeks of receipt of evaluation and post-test.

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