Clinical Engineering Electromechanical Program

Are Your Patients and Staff Safe Without One?

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Introduction

Sherry and Claire intended no harm when they entered Steven McNeil's 3rd floor room on medical in the late summer of 2002. In fact, the opposite was the case. Steven, a staff favourite and the only long term patient on the unit, was always upbeat despite the end stage ravages of muscular dystrophy accompanied by the constant puffing of 24/7 mechanical ventilation.

Their early morning task was to get Steven up out of bed and into his specially outfitted wheelchair. Sherry rolled him gently to position the lift's sling. Claire moved the lift to the side of the bed with the legs spread and locked to distribute the load. Sherry connected the sling loops correctly on the Hoyer lift's cradle and then Claire pumped the handle to raise Steven above the mattress surface. The women worked together to pull the lift away from the bedside and swing Steven toward the chair.

Steven fell 1.2 meters (four feet) to the linoleum covered concrete floor. His condition and the restriction of the sling did not give him any chance to break his fall. He landed on his back, his legs and head hitting the concrete almost instantly after. His ventilator tubing disconnected and machine flashed into noisy alarm. Sherry and Claire moved quickly to clear the lift out of the way and reconnect the ventilator. This was made especially difficult as the arm of the lift had come down on top of Steven, clearly no longer connected to the hydraulic cylinder dangling from the frame.

(Names of individuals changed at Risk Management's request)

Steven survived his fall with some serious bruising but thankfully no broken bones. He died a year later from complications of his disease; But not before setting in motion a series of events that would lead to the establishment of a multi-district Electromechanical Program (EMP), in the province of Nova Scotia.

Steven was smart. After his traumatic fall he requested the maintenance records for the lift that had failed and dropped him. The Health Authority could not produce any such records. Additionally, there was no record of their ownership of the lift or any information available on how long it had been in service. Certainly it had been in use for more than 15 years.

Investigation

The district health authority (DHA) launched an internal review of its technical support of lifts and other direct patient contact mechanical and electromechanical technology in the winter of 2002/2003. The investigation immediately spread to the two adjacent DHAs who's Vice Presidents of Operations met on a regular basis. The Nova Scotia Association of Health Organizations (NSAHO) Clinical Engineering Service (CES) received a request to undertake an independent review of the three DHAs (tri-district) periodic maintenance (PM) practices with respect to this technology. The review considered inspections completed on wheelchairs, pneumatic lifts, electric beds, and stretchers, with or without a paper or electronic record filed for the work, in 2002. The word of maintenance personnel was considered as evidence of work completion, where written records did not exist, for the purposes of the review.

The primary observations made during the investigation included;

1) The number of devices actually in service, with the exception of electric beds, was projected to be much higher than that reported by DHA staff.

2) Of the 1011 devices known to be in service only 25.3% received any type of inspection in 2002.

3) The inspections completed varied in complexity. In the case of beds the PM completion times varied from a low of 10 minutes to a high of 8 hours, for the same model bed, per year.

4) Documented inspection procedures for the devices inspected generally did not exist.

5) Of the 1011 known devices in service less than 50% were actually included in a written scheduled maintenance program.

6) The requirements detailed in Canadian Standards Association (CSA) Canadian standard Z32-99 (now Z32-04), *Electrical Safety and Essential Electrical Systems in Health Care Facilities*[1], had not been considered by any of the DHAs maintaining this technology. The standard requires that this type of equipment be inventoried and routinely inspected.

7) Anecdotal evidence collected during the review, from four other DHAs outside the tri-district group, suggested that the amount of routine maintenance being completed on this technology in their facilities was similar.

8) The amount and quality of other services provided for this technology (i.e. repair, incoming inspection, and acquisition support) was determined to be approximately on par with preventative maintenance.

9) The maintenance personnel responsible for maintaining this equipment were generally aware that the work was not being completed and consistently indicated that they were being reassigned to support increasingly complex building systems. Service for this technology was generally considered a very low priority and they were too busy with other tasks to follow-up on it.

[1] Canadian Standards Association, *Z32-04 Electrical Safety and Essential Electrical Systems in Health Care Facilities,* Mississauga, Ontario, 2004

Program Launch

In the late summer of 2003 Phil Langford, VP of Operations, and Wendy King Risk Manager, for South Shore District Health Authority, requested NSAHO Clinical Engineering launch a five month pilot Electromechanical Program founded on the same asset management and maintenance processes used to support electromedical (biomedical) devices (i.e. defibrillators, monitors, incubators). The pilot program was designed to focus on support for electric beds, wheelchairs and stretchers. All hydraulic lifts in the DHA's three facilities were replaced with new electric lifts as an outcome of the incident investigation.

Pilot Project Service Findings

A number of observations were made during the five month pilot project;

Workload

1) A complete preventative maintenance inspection on technology that has not been recently serviced and has been in service for a number of years is a fairly time consuming undertaking;
    a. Electric Beds - Average 6.3 hours
    b. Wheelchairs - Average 1.4 hours
    c. Stretchers - Average 1.7 hours

2) Subsequent inspections, once the equipment is brought back up to specifications, were forecast to take significantly less time;
    a. Electric Beds - Predicted at 2.25 hours
    b. Wheelchairs - Predicted at 0.5 – 1.0 hours
    c. Stretchers - Predicted at 1.0 hours

Failure Statistics

1) Electric Beds (in service for 14 years)
    a. 100% of the beds inspected suffered from corrosion (rust) on one or more components within the patients reach.
    b. 100% of the beds inspected revealed broken or cracked plastic hand grips and top rails which had admitted patient and cleaning fluids into the mechanical and electronic subassemblies.
    c. 100% of the beds were found to have motors leaking flammable lubricants into the electrical compartment
    d. More than 25% of the beds suffered from either defective clutches and/or faulty side rail latches.
    e. More than 50% of the beds had defective wheels with resulting steering lock/and or faulty brakes. (the Maintenance department had recently begun a wheel exchange on the beds before the pilot launch)
    f. Defective bed exit systems, communications cables, and trendelenburg controls and indicators were found on more than 25% of the beds.

2) Wheelchairs (years in service – varied)
    a. More than 50% found with torn upholstery and open to patent fluid entry.
    b. More than 50% found with defective wheels and or wheel bearings

3) Stretchers (years in service – varied)
    a. More than 25% found with wheel, axle, brake, and or steer problems.
    b. More than 10% found to have misadjusted hydraulic cylinders creating tilting patient surfaces.
    c. More than 25 % found to have defective side rail latches.

<u>Successes, Growth, and Lessons Learned</u>

The pilot project wrapped up at the end of March in 2004. It was widely recognized as exceeding expectations and a great success. The electromechanical program was launched on April 1st of 2004 as a full time offering to NSAHO members through Clinical Engineering. The improvement to the general condition and functionality of the electromechanical equipment in service became very apparent early on, word spread, and other DHAs became interested in the program. Within three years the program has grown to employ five technicians, servicing 3800 devices, and is now well established in the Pictou County, South West Nova, South Shore, and Annapolis Valley District Health Authorities of Nova Scotia.

As core technologies were brought under comprehensive preventative maintenance, repair, and consultation support efficiencies were realized through the reduction of workload required to complete subsequent PMs and repairs. These efficiencies have resulted in freeing previously committed resources and allowing for the expansion of the program's scope without adding a significant number of additional people. The DHAs that adopted it early in its development have requested and seen the list of equipment supported grow to include flow meters, suction regulators, OR tables, OR lights, sterilizers, cart washers, washer disinfectors, pasteurmatics, sonic washers, uninterruptible power supplies, IV poles, carts, geri-chairs and blanket warmers. Some of the devices added were previously under third party service. The list continues to grow as do the number of DHAs on board. Three more are currently considering opting into the program.

The success and growth of the program has come with very few trials and tribulations. Lessons have been learned however;

1) Communication with Clinical Engineering staff needs to be as comprehensive as that undertaken with maintenance personnel. The program crosses the normal boundaries of "Clinical Engineering" and was perceived as a threat to the integrity of the profession by some.

2) The rapid and somewhat unexpected growth of the program placed great strain on existing service personnel, as well as clerical support and management staff. These pressures might have been better managed if growth was restricted (difficult to do) or better predicted and planned for.

3) The cost of service provision (i.e. staffing and travel) is now well established. However, with each service launch there were surprises around the cost of parts to bring technology back into peak condition. These costs can be quite high and need to be considered in advance by departments who will be billed through their cost centers. This can be a significant budget issue.

Safer Patients and Staff

The growth of the program continues to be driven by a number of factors. Unfortunately one of them has been patient and staff occurrences. Since 2003, and Steven's fall, a number of incident, technical, and operational investigations have placed the Electromechanical program under pressure to grow rapidly in response to real system needs.

Risk and Nursing managers are the primary supporters for the launch and growth of the service in successive DHA's. In the words of Wendy King "It is a model that we can all be proud of. The outcome of this program certainly has made my life as a risk manager for SSH much more comfortable. I can rest easier knowing that our equipment is receiving regular maintenance and that equipment is not so old that it is placing patients at risk."[2]

Conclusion

The Electromechanical Service won the South Shore Health (SSDHA) Outstanding Quality Initiative Award in June of 2005. Also, in the fall of 2005 the program was recognized as one of the top five finalists in the country for the Canadian Healthcare Excellence in Quality Award (CHEQA)[3]. Team Members traveled to Toronto for the Quality Healthcare Network (QHN) awards ceremony. Kevin McNamara, CEO of South Shore Health, has labelled it a "great work and innovation"[4]. It is NSAHO's hope that other hospitals and continuing care facilities will adopt similar programs and bring high quality safety oriented programs into being in support of these technologies.

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[3] Quality Healthcare Network, *Canadian Healthcare Excellence in Quality Award*, http://www.qhn.ca/, Accessed Jan 8, 2008

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