# Optimization of Clinical Engineering in Private Healthcare

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## About the Speaker:

James Herbert has held positions in Clinical Engineering in both the public and private sectors in South Africa over the last 17 years. He is currently a technical specialist for the Medi-Clinic Group comprising of 52 private hospitals and his responsibilities include all aspects of Clinical Engineering. He joined the Group in 1997 and his duties include general hospital support, training of clinical technicians, developing planned maintenance policies, conducting audits and managing cost of ownership of medical devices.

He obtained a National Higher Diploma in Electrical Engineering (low current) at the Freestate University of Technology during 1992 and a Management Diploma at the University of the Freestate during 1999.

James is the current vice president of CEASA (Clinical Engineering Association of South Africa) and also the chairman of the CEASA Western Cape branch.

## Abstract:

It is the responsibility of clinical engineering practitioners and hospital technical management to develop maintenance policies and procedures at hospitals to ensure reliable medical devices that contribute to patient safety. Internationally accepted standards like ECRI and the manufacturer's recommendations are used as reference to develop maintenance policies. In many instances the preventive maintenance and repairs are outsourced and over servicing is mostly applied due to the emphasis placed on risk management.

Being a developing country, clinical engineering practitioners in South Africa have an important contribution to make towards the provision of cost effective healthcare. Specialists in the various fields should take up the responsibility in striving for cost effective maintenance policies applicable to the local and international healthcare environment.

We will discuss the policies applied in Medi-Clinic's private hospitals highlighting the value of preventive maintenance programmes in ensuring safe equipment. The cost implication of excessive preventive maintenance policies will also be considered. Reliability centred maintenance can be applied successfully on a number of medical devices as an alternative to preventive maintenance. This paper will look at the procedure used in developing alternative maintenance protocols without creating risk to patients.

A balanced training ethic for clinical engineering staff members is essential in developing a cost effective mix between in-house and outsourced work. Practical examples and results of savings achieved will be discussed.

# Optimization of Clinical Engineering in Private Healthcare

## Introduction:

Hospitals are more and more under pressure to spend the allowed maintenance and capital budgets wisely by making the correct decisions on what to maintain at which intervals and when to replace equipment.

Cost effective maintenance starts at procuring the correct product. The correct capital procurement decision balances price considerations against all other costs incurred during a device's lifetime to aim for the lowest total cost of ownership (TCO). A definition for TCO is the total cost of acquiring, installing, using, maintaining, changing, upgrading and disposing of equipment over its predicted useful lifespan.

Once the correct procurement decision has been made from the available information, the facility or organisation must decide on the applicable maintenance policies relevant to the specific device. This paper will share the efforts by our group of 52 private hospitals in our strive to finding the optimum maintenance mix.

## What is maintenance?

Maintenance was traditionally seen as actions associated with equipment repair after it has failed. According to the dictionary it is an activity involved in keeping something in good working order. The maintenance philosophy at Medi-Clinic is to extend the life of our equipment and plant to its maximum economic potential by restoring equipment to its original condition every time maintenance is performed on it.

The four main types of maintenance as we interpret it are as follows:

1. Reactive maintenance
2. Preventive maintenance
3. Predictive maintenance
4. Reliability centred maintenance

### 1. Reactive maintenance

This is typically a run to failure strategy where equipment is repaired once it stops working. There will always be a large portion of reactive maintenance applied by hospital maintenance teams. This would typically include failure of lamps, cables, probes and accessories. At Medi-Clinic, based on a count of job cards, at least 50% of maintenance performed on medical devices is reactive maintenance and there is no problem with that. Reactive maintenance remains a cost effective maintenance strategy on a large portion of the installed base of equipment in a hospital. These are devices that do not provide life support to patients and back-up devices are freely available in the facility. Failure of these devices has a low impact on the operation of the hospital.

### 2. Preventive maintenance

This is maintenance actions performed on a time or equipment run based schedule. In the hospital environment this mode of maintenance has become increasingly popular due to the risk management approach. If performed correctly on medical devices, preventive maintenance could prevent most failures and breakdowns.

The advantages of preventive maintenance are as follows:

- Increased equipment reliability and expected life cycle.
- Risk management – should a device fail on a patient, the facility would argue that they have taken all reasonable precautions to prevent it from happening.
- Better spares inventory management due to scheduled services.

There are also disadvantages with preventive maintenance as a main strategy:

- Preventive maintenance is labour intensive, especially when applied across a large portion of the asset register in the hospital.
- There is the risk of over servicing when spares that are 100% functional and within specifications are replaced during routine maintenance.

Preventive maintenance is popular due to the ease of set-up and implementation. The maintenance manager covers his risks by performing preventive maintenance schedules based on the manufacturer's recommendations and internationally accepted standards. At Medi-Clinic we agree with this strategy, but mainly on life support devices. We categorise equipment in the hospital as follows:

- **Category 1: life support** - All the equipment or service where a failure would create a risk to the patients' life whether directly or indirectly. The agent or an authorised representative or a person appointed by Medi-Clinic maintains category 1 equipment according to the manufacturer's instruction. This could be time based or usage (hour meter) based.
- **Category 2: strategic** - All the equipment or service that a failure would cause gross inconvenience to our clients, have a large negative financial impact on our business or lower the quality of service we provide. Category 2 equipment is maintained according to Medi-Clinic policy by our staff or the agent or a contractor appointed by Medi-Clinic.
- **Category 3: general** - All equipment or service not falling in the above categories. Failure of this equipment still has an overall effect on the service provided, but the impact is low. Category 3 equipment is maintained according to Medi-Clinic policy by our staff or the agent or a contractor appointed by Medi-Clinic.

On life support devices the manufacturer's recommendations are followed to the letter in line with our risk management philosophy. Preventive maintenance on category 2 and 3 devices should be applied only if the following criteria are met:

- The equipment has an increasing failure rate over time, i.e. components wear out.
- The cost of the preventive action must be less than the cost of corrective action. (The cost of corrective action should include downtime costs, lawsuits, safety, etc.)

### 3. Predictive maintenance

This is maintenance based on the actual condition of the asset. It implies that you can analyse and measure components and if they are no longer within specification you

replace them. In our environment of sophisticated medical devices it is very difficult to find equipment suitable for this maintenance tactic, but there are some.
The advantages of predictive maintenance are, if applied effectively, there will be decreased cost and downtime. The following disadvantages however exist:

- Increased investment in diagnostic equipment.
- Increased investment in staff training.

### 4. Reliability centred maintenance (RCM)

This is an analytical process used to determine the appropriate maintenance requirement that would ensure safe and cost effective operation of a physical asset in its specific operating context. The aim is to maximise the effectiveness of an asset while minimising the effects and/or the likelihood of failure.

RCM is a common sense evidence based approach to maintenance with the potential to be the most efficient maintenance programme. When applied correctly it eliminates unnecessary maintenance and costs. A possible disadvantage could be high start-up and training costs.

In the hospital environment the following should be considered as a starting point to implement RCM:

- There are many items in the hospital for which there is no effective form of scheduled maintenance.
- A preventive maintenance programme cannot prevent all failures.

## Support for reliability centred maintenance (RCM) in healthcare

Due to the risky hospital environment we operate in, it is impossible for some people to accept that maintenance policies not complying with the manufacturer's recommendations should be developed. At a time where there is increasing pressure on the cost of the provision of healthcare, we argue that we cannot afford to take the easy way out any longer and blindly apply the recommendations from the manufacturers regarding maintenance intervals. These intervals are developed for worst case scenarios and, in many instances, lead to over servicing.

There is room to consider the location and usage of certain devices and handle a device in a busy theatre or ICU different than the same device in a quiet ward. According to an article on the European Biomedical and Clinical Engineering website, RCM is becoming the industry standard and has been adopted by many large organisations.

The following is a quote from the Joint Commission on Accreditation of Healthcare Organisations (JCAHO): *"Hospitals are allowed to not schedule inspection and maintenance tasks for certain pieces or types of medical equipment if they determine these tasks are not needed for safe and reliable operation"*

An article published by the World Health Organisation (WHO) supports productive preventive maintenance as follows:

- Productive preventive maintenance refers to proper selection of equipment to be included in planned preventive maintenance – what to include/exclude to reduce costs.
- The WHO comments that actual usage rather than manufacturer's manual should be considered to determine maintenance procedure and interval.

It is however emphasized that the one aspect of critical importance to the success of the above philosophy is participation and commitment of the user. The compilation of data and analysis of this data is to be used to substantiate why deviations from recommendations are made.

## RCM – Where to start in the healthcare environment

Applying the following steps will assist you in implementing a cost effective reliability centred maintenance program without creating unacceptable risk to patients and staff:

### 1. Develop a master maintenance significant equipment list

Many facilities do not have an asset register of maintenance significant items. This is a list of all the items under the responsibility of the head of the maintenance department that require technical support and maintenance. You need to know what you have to maintain before you can decide on how to maintain it and where to best allocate available resources.

It is of vital importance that condemned or excess equipment is removed from service. In many instances in hospitals a device is replaced and the old one is kept in storage for "in case". If there is the possibility that a device could be placed in use during a crisis it should be maintained, especially life support devices. Otherwise it should be removed from service and de-commissioned. Maintenance costs should not be wasted on old and condemned devices.

### 2. Determine priority

You need to have an inclusion plan. This would be the list of items that you see as priority to start with. Priority should be based on the following:

- Life support devices should be priority number one and not negotiable.
- Items that will have a significant impact on the service you deliver should be included.
- High cost items where you are likely to spend large amounts of money to maintain should be included.

Once your programme has matured, you can make a decision on the balance of the devices.

### 3. Determine the planned maintenance interval

All the criteria below should be used as a base to determine maintenance intervals on the devices you have prioritised during the previous step:

- The manufacturer's recommendation
- International standards i.e. ECRI
- Maintenance history of these devices
- Root cause and MTBF analysis findings
- Good engineering judgement – RCM logic.

### 4. Assess maintenance staff's hours and skills available

At Medi-Clinic we strive for a cost effective balance between in-house and out sourced work. Sub-contracting all services is not cost effective and neither is aiming to perform all work in-house. In our larger hospitals where sufficient skills are available between 70% and 80% of all work is performed by in-house staff.

### 5. Streamline and improve over time

The above steps will provide you with a starting point without increased risk. There should be a continued drive to question the service intervals and as you gather history and experience, you should aim to stretch and extend the maintenance intervals to even further cost effective levels.

The maintenance manager should also constantly evaluate the number and type of services that you allocate to external contractors with the aim to reduce unnecessary and costly outsourcing.

## Scheduled maintenance services

Reliability of medical devices improved over the last 10 years and this dramatically reduced the requirement of planned maintenance. It is important to differentiate between planned maintenance and performance verification.

### 1. Planned/Preventive maintenance

As mentioned earlier, planned maintenance is the scheduled replacement of wearable parts. This includes service kits, filters, tubing, etc. These services are important and should be preformed by a suitable qualified and trained person.

### 2. Performance inspection procedure (PIP)

This is a scheduled action to verify that equipment is functional and performing within original specifications. The aim would be to identify hidden failures or identify potential failures.

Equipment covers are not removed to perform a PIP and this can be performed very cost effectively by in-house staff with basic test equipment. Large portions of medical devices today only require a PIP service with no preventive maintenance.

At Medi-Clinic we developed a course where in-house staff is trained to perform the PIP services on a numbers of devices at their hospitals. Typical equipment are infusion devices, blood pressure apparatus, vital signs monitors, blenders, humidifiers, theatre lights, incubators, infant care centres, tourniquets, portable vacuum pumps, pacemakers, vaporisers and many more.

The focus of the training programme is to train and equip staff to perform the PIP services at their hospitals. The training is practical with formal assessment and certification. Staff leaves the course fully equipped with the correct test equipment and instruction/result sheets to perform the services effectively at their hospitals.

## Service agreements

We have developed a unique approach to service agreements that aligns with our optimum maintenance mix strategy. Standard service contracts offered is like an insurance policy where the supplier covers all the risks and the contract fee is set accordingly. The main benefit for the client is predictable monthly instalments for improved budgeting.

We base service agreements on a shared responsibility concept where both parties i.e. the service provider and the hospital can gain. The following has been developed into a winning formula:

- Hospitals are grouped together in one service agreement to share the risk over a larger installed base.
- Every hospital makes a financial contribution to the service agreement based on their installed base of the specific device.
- Our in-house technical staff receives comprehensive training by the service provider once a year.
- The hospital technical staff handles the first line response to problems.
- The second line of support is by telephone where the service provider guides hospital staff regarding a suitable course of action.
- The service provider sends a technician to attend to the problem on site as a last resort.
- All transactions are logged and head office specialist staff analyses the expenditure data on a monthly basis and responds accordingly to address problem areas identified. Where modules or large spares are replaced, the service provider is challenged to break the components down.
- Once a year an open book review is held where profit or losses against the contribution to the service agreement is split 50/50 between the service provider and the client. This ensures that both parties remains interested and contribute to the most cost effective solution.
- New instalments are based on the expenditure profiles of the previous period and hospitals that abuse the system are penalised through their monthly contribution to the contract.

On a major installed base valued at R70 million (6 million Euro) the total annual contribution to the service agreement were reduced or kept the same over the last six years despite an increase in the installed base. This was also achieved during periods where the exchange rate deteriorated by more than 50%.

## Conclusion

- Evidence from the manufacturing, extractive, transport, and process industries prove the value of RCM.
- It is however a sharp tool, best applied in selected areas rather than across the board.
- The process must be carried out with the commitment of the operators of the equipment.

- It is not a quick fix system. RCM is an ongoing process that gathers data on performance and uses evidence to improve planning for future maintenance.
- The effectiveness of existing maintenance policies should be under constant review and adjusted in the light of experience gained.
- Time and effort needs to be invested on training, raising awareness, execution and implementation.

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