DEVICE MANAGEMENT DOWN UNDER

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Abstract: This paper presents an Australian hospital's approach to biomedical device management. The main objective of the device management programme was to obtain a more accurate picture of the state of equipment in the hospital. This would assist in securing greater funding and help in ranking devices to be replaced. A network of device managers was established throughout the hospital. The device managers were asked to conduct an audit of biomedical devices in their area and rate these devices on their physical condition, compliance, utilisation and importance. To assist device managers in keeping track of their devices a simple, easy to use database was set up. Tools were added for division heads and the biomedical engineers to rank device replacement priority using the information gathered from the audit. The device manager role has been well accepted and this programme has improved the effectiveness of biomedical device management in the hospital.

Introduction

Around the world each year, hospitals struggle to secure sufficient funding for purchasing new and replacement equipment. Each hospital needs to set priorities so that they can make the most of limited funds. Good device management and an ability to justify need, for replacement or additional items, improves the likelihood of receiving available funding.

Flinders Medical Centre (FMC) is a 500 bed public teaching hospital in South Australia. Flinders Biomedical Engineering (FBE), a joint department between FMC and Flinders University, is currently responsible for approximately 10,000 biomedical devices. In 2003, the Biomedical Engineering Department revised its programme for managing biomedical devices in the hospital. The main objective of this programme was to obtain and maintain a more accurate picture of the state of equipment in the hospital. This in turn could be submitted to government to support requests for greater funding.

Table 1: Device Life-Cycle

Stage \ Party	Device Manager	Division Head	Biomedical Engineering	Acquisition Authorisers
Device Selection	I	A-R	C	
Procurement		A	C	R
Installation/Commissioning		A		R
Acceptance Testing		A	R	
Registration		A	R	
Prior Use Planning	I	A-R		
Maintenance Planning	C	A	R	
Warranty Management	C	A	R	
Use		A-R		
Ensure Proper and Safe	I	A-R		
Operator Maintenance and Cleaning	R	A		
Awareness of Hazard Reports	R	A	C	
Initiation to Rectify Known Hazards	R	A	C	
Transfer of Devices	R	A	I	
Auditing of Asset Registers	I	A-R	I-R	
Assessment of Condition	R	A	I	
Assessment of Utilisation	R	A	I	
Assessment of Importance	R	A	I	
Assessment of Compliance	R	A	R	
Assessment of Risk	I	A	R	
Planned Maintenance		A-R		
Planning/Scheduling	I	A	R	
Performing		A	R	
Breakdown/Repair	I	A	R	
Modification	I	A	R	
Disposal	R	A	I	

A = Accountable, R = Responsible for action, I = Involved, C = Consulted

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Methods

The device management programme began with the adoption of the Biomedical Device Management Policy formulated by the Biomedical Engineering Department. This required divisional heads to nominate people to take up the role of device manager for their area. These device managers were asked to attend an orientation session where they were made aware of the background to their position and what was required of them. Table 1 was supplied to the device managers, summarising their responsibilities and those of others involved in the life-cycle of a device.

The first task for the device managers was to conduct an audit of biomedical devices in their area. Each device manager was allocated a starting list of devices based on what was owned by their department or ward according to the hospital asset system at the time. As well as checking basic information such as location, the audit included the addition of new information which the device managers were in the best position to supply. They were asked to rate each device on its physical condition, compliance, utilisation and importance, with a value from 1 to 4 (or 5), according to the guidelines supplied in Table 2.

Biomedical Engineering rated maintenance effort. This, together with the audit results and pre-existing, risk and location information, was used to develop an algorithm useful in ranking devices for replacement.

As a general concept, parameters were divided into those which indicated a likelihood of exposing the organisation to a safety, legal, financial or business failing and those that indicated a consequence of such an outcome. A total risk score consisted of likelihood x consequence

A database of devices managed by each device manager was developed by FBE and made available over the hospital network allowing the audit process to be paperless and on-going. This database gives the device managers access to information from the hospital's asset system without the security issues that direct access would create. It is simple and friendly to use by device managers with limited computing experience.

Table 2: Audit Parameter Guidelines

Parameter	Rating	Definition
Physical Condition	1	Unacceptable (i.e. unfit/unsafe for use, or maintenance costs too high)
	2	Poor
	3	Fair
	4*	Good
	5	Excellent (i.e. as new condition)
Compliance	1	Unacceptable i.e. does not comply with current standards or alerts, and unable to perform required tasks
	2	Poor i.e. does not comply with current standards or alerts, or unable to perform required tasks
	3*	Good i.e. Complies with all current standards, alerts & able to perform all required tasks
	4	Excellent i.e. Exceeds all current standards, alerts & ability to perform all required tasks
Utilisation	1	Excessive i.e. used much more than it should be
	2*	Optimal i.e. suitable workload for device
	3	Under-used i.e. not used as much as it could be
	4	Never used i.e. backup
Importance	1	Crucial i.e. critical to Division's operation
	2	Important i.e. important to Division's operation
	3*	Necessary i.e. generally needed for the Division to operate
	4	Handy i.e. Division could operate without the device
	5	Unimportant i.e. Not important
* = default value		

Results

Initially 87 device managers were nominated across more than 100 departments. They came from a range of positions including Clinical Nurse Consultants, Laboratory Managers and Patient Services Assistants. Some were only assigned a few devices while others had hundreds. In total they covered 9022 of 9740 biomedical devices in the hospital, with around 3500 owned by Flinders University. 63 device managers attended an orientation session and 50 participated in the first audit, returning results on 4935 devices. The University decided not to fully participate in the device manager programme and instead nominated two device managers to cover the 150 devices which were either on the current preventative maintenance schedule, worth more than an agreed value, or had a high risk rating.

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Over the past year some device managers have changed due to people changing positions. We have also gained some new device managers and are continuing to enlist people for this role. Orientation training is provided individually as positions are filled.

This year we conducted our second audit. Results for this audit began to be returned the day after the audit lists were sent out to device managers. To date, results have been received on 1,964 devices. 36 device managers contributed results, 10 for the first time. This year we focussed more on getting results from those with more than 10 devices who had not completed the first audit. The Intensive and Critical Care Unit (ICCU) has a very large list, comprising over 800 devices which was only partially audited the first time. To make ICCU's task more manageable, their list was divided by selecting device categories such that all of the devices would be audited over 3 years. For this year it was devices with a high to medium risk rating (e.g. resuscitators, infusion pumps and defibrillators).

The database available for device managers was originally developed as a tool to help them manage their devices. It allows the user to view lists of equipment and to search for items in various ways as well as generating reports. About 20 people have been given access to the biomedical device database. The data is updated monthly (or more often if required) to reflect changes submitted by device managers and biomedical engineering staff. The database has gradually been enhanced to have features for division heads and the Biomedical Device Advisory Committee (which recommends how funding for equipment should be allocated). One of its features is a risk management tool for biomedical engineering.

An algorithm for determining a replacement ranking for devices was developed by assigning a weighting to the various parameters collected and trialling different formulae. The database performs calculations "while you wait" making it easy to see the effect of different weightings. Results were compared to the subjective methods previously used and the weightings were adjusted to give similar results. Our current algorithm is given in equation (1) below.

$$\text{Risk Score} = (10 \times \text{condition} + 5 \times \text{utilisation} + 7 \times \text{compliance}) \times (1 \times \text{location} + 1 \times \text{risk} + 1 \times \text{importance} + 2 \times \text{maintenance}) \quad (1)$$

The total risk score was found to give a good indication of replacement priority and was useful as a first level tool for ranking of devices. It was also found possible, by changing the weightings, to develop a preventative maintenance ranking and a repair ranking.

Since the device manager training was conducted Clinical Engineering staff have noticed that more equipment is being sent down as requested by the preventative maintenance schedules and their involvement in technology issues has increased. Clinical Engineering staff have also experienced greater inter-communication with device users.

Discussion

Division heads were asked to nominate people because it was expected that they would know who would be appropriate for the role in each department or ward. In a few cases the nominated person did not feel suitable for the role but was able to suggest someone else. To make the role as simple as possible it was decided that device managers should be responsible for equipment in their area rather than those owned by their department. Over time devices tend to move around so they are not always in the location of the department that purchased it. Making the role as easy as possible was important because staff were already very busy and were not necessarily going to be paid more for taking on these extra responsibilities. It should be noted (from Table 1) that although device managers were given responsibilities, the accountability for actions and processes remained with division heads.

It was good that 72% of nominated device managers attended the orientation sessions. The remainder either had too many other commitments or did not see the value of participating.

Although a time frame was set for the initial audit, results were received throughout the year and entered, in the interest of keeping the asset register up to date. Results for the second audit began to be returned quite soon after the audit sheets were distributed demonstrating a good acceptance of the device manager role.

Since the device manager programme began, the profile of the biomedical engineering department has been raised. Other hospital staff have become more aware of procedures related to the life-cycle of biomedical devices. As Hansen and Hansen also found [1] communicating with end-users leads to process improvements. FBE has been better informed about the movement of equipment into, around and out of the hospital.

There has also been an improvement in the amount of equipment coming to Clinical Support Group of FBE for preventative maintenance as requested. This can also be attributed to staff in user departments better understanding BME processes [1, 2]. We do agree with other authors [1-3], who encourage working closely with other hospital staff, that there are great benefits to be obtained. With our device manager programme, especially the yearly audits, we get information about the condition, usage and suitability of equipment for their needs from the people who use it. This means that the information is more appropriate and it is a more effective way of gathering information [2] than sending BME staff around the hospital checking each device. It also means that the hospital's asset register can be kept up-to-date much more easily, and so be more accurate.

The database that was initially developed for the device managers has been an ongoing project. It is continuing to be improved. There are various reasons why many device managers still do not use this database. For some it is because they have so few devices that they aren't interested in it. Others are waiting to get software issues resolved so that they can

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use it. Those device managers who have accessed the database have found it reasonably simple and straightforward to use.

Division heads, business managers and members of the Biomedical Device Advisory Committee are able to use the database to assist them in making decisions about how to allocate finances for purchasing new and replacement equipment. It allows them to see what equipment is currently in each division. They can see lists filtered by a particular purchase price range which gives an idea of how much replacement items will cost. A tool which is particularly useful ranks the items by replacement priority. This uses the algorithm (see Equation (1)) formulated by FBE which takes into account information supplied by the device managers. As Table 2 shows, the ranges for the values of the parameters supplied by the device managers vary (i.e. for some it is 1-4, while for other 1-5). Also the values of some parameters went in opposite directions. For example, as physical condition deteriorated, the value assigned decreased, but for importance, as the criticality increased, the value assigned increased. They work in opposition to each other. For calculation purposes, values for some parameters were inverted so that the formula could yield meaningful results. This means that a device which is critical to a department, and in poor condition is ranked higher for replacement than a device which is in a fair condition and only handy for a department. In the future it would be good to set the values for the parameters such that they all work in a way which is consistent with each other.

Other authors have also formulated medical equipment replacement score systems [4, 5] and methods for replacement planning [6]. The FBE algorithm is different because it takes into account information from the users of the equipment and not just from management or biomedical engineering staff. Some device managers have been able to see how their participation in the audit, or lack thereof, has affected where their equipment comes on the replacement list. This has encouraged participation in the audits. The FBE formula is also reasonably simple without missing out on important factors such as usage and condition. For the final ranking in the database, age-to-life ratio (age of the device relative to its expected life span) is also taken into account. In each case, the aim is the same, to make the most of limited funds [4-6].

Another problem many biomedical engineering departments face is that of prioritising preventative maintenance. The database for device managers already has tools for adjusting formulas to see the effect that they have on the ranking of devices for preventative maintenance and repair. It also uses the information supplied by device managers and that already in the hospital's asset system.

Conclusions

This is a worthwhile programme and one that will be continued at Flinders Medical Centre. The existence of device managers has been the most significant outcome. Many device managers see its importance and are willing to put in the extra effort to keep track of their devices. By having nominated people in the hospital divisions with delegated responsibility for a group of devices the overall effectiveness of device management has improved and clinical engineers are more involved.

With input from the device managers, the hospital's asset database is able to stay more up-to-date and so more accurate, giving a clearer picture of equipment in the hospital. Prior to this system being developed, FBE had a very limited overview of the devices being utilised in the hospital, and therefore made it more difficult to gain an understanding of how best to utilise our human resources.

The biomedical device database for device managers will continue to be used and improved.

The process of selecting and justifying devices for replacement has improved and now includes a more objective approach.

It is still too soon to tell if efforts to justify greater funding for purchasing equipment for public hospitals have been successful. However, with more information about the equipment that we do have and the state that it is in, we are in a better position to make submissions to the government for more funding. It is possible to show to the government in a simple way, what is required and to back up our requests with evidence.

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