PRIORITIZING EQUIPMENT FOR REPLACEMENT

Michael J. Capuano *CBET*
Hamilton Health Sciences

INTRODUCTION

Today, hospitals face many challenges, including the financial challenge of planning for the acquisition and/or replacement of their equipment. Decisions to replace medical devices are often a subjective process. Hospital administrators, medical staff, purchasing, capital development, and clinical engineering all provide input into recommendations to purchase and/or replace equipment based on several factors. Recommendations may then be adjusted by factors deemed more political, financial, and/or perceptual.[1] We then have a list of equipment targeted for replacement based largely on perception rather than factual data. This process can be made less subjective by assessing the existing inventory, assigning a score to each criterion, and then presenting it in order of replacement priority.

To date, several systems have been devised that incorporate quantitative and qualitative analysis to determine priority. These include scoring systems and elaborate schemes that utilize equipment databases and other information sources. The success of these systems varies based on the complexity and relevance of information. If the techniques were too complex, it would be difficult to manage, maintain on an ongoing basis, and to minimize bias.

This paper will describe the specific criteria developed to create a tool for a major academic teaching hospital to review their existing equipment and to make recommendations for the acquisition of replacement items.

BUILDING CRITERIA

When deciding on equipment for replacement, the ECRI Institute recommends consideration of factors such as use, physical condition, risk, and failure/repair history. They also recommend that only qualified individuals assess the condition of medical devices. These include clinical engineers, nurses, and physicians. Clinical engineering is best suited to assess most items because they have both technical and clinical knowledge. The process described in the case study utilizes this valuable resource.[5,6,7,8]

Presenting the data in a format that is easy to understand has been done before. An early pioneer in this regard is Larry Fennigkoh, PhD, CCE. He developed a scheme recommending and prioritizing equipment using a numerical output. Similar to the case study here, he warns that these models should not be used as absolute measures of replacement needs. They are simply frameworks or starting points for further evaluation and scrutiny. For example, from a subjective standpoint, two devices may appear to have equal justification for replacement. A prioritization scheme will, in most cases, distinguish the two. A combination of several factors must be taken into account in order to provide an accurate assessment.[6] Some have assigned 'current replacement cost' as a factor.[2] That information is not commonly maintained in an equipment database and therefore requires the task of working collaboratively with purchasing to obtain replacement quotes for all items on the list. Alternatively, using existing price values from the equipment database is close enough to determine category, urgency of funding, and priority.

Items with higher capital value should be flagged sooner since obtaining funding for these items may be particularly challenging. Higher capital values usually indicate higher levels of relative importance. Occasionally, a certain amount of funding is allocated to specific areas for capital. In these cases, a cumulative or accrued price value is beneficial. For those areas, it is just a matter of submitting all items from the top of the prioritized list down to the accrued amount that matches the allocation. Conversely, you can set your 'cut-line' below the top 20 items. The resulting amount (and its related devices) could roughly be a first pass request or starting point.[2]

When these priorities are presented, it is a good idea to segment the lists by price group based upon an institution's processes to obtain funding based on the acquisition cost. For example, items under $15,000 or over $100,000 may require that requests be sent to different committees.

Equipment condition is an accepted factor in most replacement prioritization schemes and is understandable to most non-technical individuals (primarily healthcare executive and finance).[1] For example, a score of 1 to 5 would satisfactorily represent the range of condition descriptions such as Very Good to Very Poor. Very Poor would usually indicate either an unsafe or poor performing device.

Support or product discontinuation is an important and well-accepted factor in determination of priority. This criterion is the most labour intensive as vendors must be contacted or searches performed for letters indicating end-of-support dates.[6] Some organizations stretch capital dollars by continuing to maintain equipment after product support has ended. If funding is an issue now, it is likely not going to get better later. Therefore, it is prudent to avoid this scenario where possible.

Age and vendor support are likely more relevant than a standardized lifespan indicator. Although an important criterion, 'Condition' may be too difficult to determine accurately. Therefore, age in years of a device becomes an important factor because components may fail based on wear and age.

Lifespan has been a factor included in several techniques.[1] Many consider this an exclusive indicator to prioritize equipment for replacement or to date its removal. However, it may not be clear as to what a piece of equipment's actual lifespan is. It is proposed here that vendor support life is a key factor in prioritizing replacement. Today's technology rarely allows for sustaining technologies with discrete or off-the-shelf components. The ability of the item's vendor to support the product's use, service, and parts availability determines the practical life expectancy.

Other factors that determine lifespan include identifying how the device is used, how much it is used, the quality of the product, whether it remains supported by the vendor, and whether it is similarly efficacious to new products on the market.[4,5,8,9] Increased efficacy or efficiency of new technologies may offer justification to replace.[3,8] These criteria add an element of subjectivity and are also labour intensive to determine. Failure rate is also an important factor. Since zero failures is the objective, replacing equipment may be the best way to achieve it. Developing criteria to include the number of repairs and/or hours spent on repair is relevant. [3]

Accumulated hours can identify devices that repeatedly cause frustration and consume human resources. Accumulated cost of parts will also raise the red flag.[3,5] It may be an indication of a poorly chosen device or an expensive device to fix. Continued use may be unjustified.

Risk factors have, in some cases, been used to prioritize equipment for replacement. The risk level of devices in the hospital environment is usually documented in the equipment database. At HHS, it is derived using factors such as function, consequence, lethality, frequency of use, required maintenance, and protective safeguards. A score of 1 to 5 where 5 indicates very serious injury or death may be used.

The amount of use or utilization a piece of equipment receives should be proportional to its priority of replacement. More use adds wear and tear, demand for use, and better justifies money spent to replace it.

There are certain factors that are not time-dependent. They are Price, Labour, Parts, Risk, and Utilization. By eliminating these, a strictly practical method of prioritization can be realized. This might be suitable for those individuals who are more skeptical of the numerical approach and focus only on Condition, Support, and Age (CSA).

Using equipment replacement to recruit and retain clinicians has become a common practice amongst institutions. When capital funds are scarce, this paradox is sometimes the only justification or driver used to replace equipment. Boosting an institution's image might also be a factor. These are political factors and have no place in an objective prioritization scheme and therefore are omitted in this case study's scoring method.[5,6,8]

CASE STUDY

Hamilton Health Sciences (HHS) is a teaching hospital affiliated with the McMaster University Faculty of Health Sciences in Hamilton, Ontario. It operates close to 1,000 beds serving approximately 2.3 million people in the region. Specialties include cardiovascular surgery, trauma, neurosurgery, comprehensive children's hospital, orthopedic surgery, regional cancer centre, long-term rehabilitation, research, and comprehensive geriatric care. The hospital operates 4 acute care tertiary centres and works with 6 smaller associate hospitals. The HHS Biomedical Technology department has a staff of 25 (21 BMETS) supporting close to 15,000 devices including equipment in 30 ORs at HHS. The operating rooms, along with Same Day Surgery (SDS), and Post Anesthetic Recovery Unit (PACU); belong to the Perioperative Services Program. This program operates within a 53 million dollar budget treating approximately 24,000 patients per year.

The issue of capital equipment funding for Perioperative Services required the director to determine the priority of all equipment in the program. Discussions with the director resulted in an agreement to conduct a comprehensive review of all medical devices including those not supported in-house. Along with this, a method of prioritizing was to be developed and applied to the list as well. After a period of approximately 2 months, the task was completed. The work resulted in the creation of what we call the Periop Master Equipment List. This could not have been accomplished without the assistance of the biomedical staff assigned to the ORs.

The Periop Master Equipment List provides replacement priority guidance for the Periop program. It contains 50 fields of information on 1,883 devices. The inventory included a review of the condition of each device. The equipment database was then updated to provide better and more accurate baseline data. The review also included efforts to obtain information from vendors regarding out-of-support dates and information related to prices and acquisition dates. The database was then exported to a spreadsheet file.

The Periop Master Equipment List serves as a simple tool to determine the order of priority based on the criteria used in this document. In order to provide guidance on replacement planning, an indexing scheme called the Priority Index was devised. The Priority Index (PI) is a relative number used to compare the priority of replacement between one device and another among a total of 1,883 devices in the Perioperative Services program.

WEIGHTING CRITERIA

The Priority Index number assumes a linear distribution of equally weighted criteria related to importance. If one assumes that this is not so and wishes to apply relative importance to each criterion, the tool is included. There are 8 criterions. With equal importance applied to all of them, a portion the equivalent of .125 is assigned to each criterion by default ($1/8^{th}$). In order to apply weight, each contributing factor (score) is multiplied by this decimal value (e.g. .125). The resulting product becomes the Weighted Contributing Factor (e.g. Weighted Risk). The sum of all of the Weighted Contributing Factors is the Weighted Priority Index (WPI). The Priority Index number assumes a linear distribution of equally weighted criteria related to importance.

<u>Factor</u>	Avg	Weight Multiplier
Risk	20.7	0.207
Condition	18.9	0.189
Age	13.6	0.136
Support	16.1	0.161
Freq of Use	15.4	0.154
Price	5.4	0.054
Ltd Parts	5.4	0.054
Ltd Hours	4.6	0.046
Total %	**100**	**1.000**

Table 1. Criteria Weighting

CONDITION, SUPPORT, AND AGE

There are certain factors that are not time-dependent. They are Price, Labour, Parts, Risk, and Utilization. By eliminating these, a strictly practical method of prioritization can be realized. This might be suitable for those individuals who are more skeptical of the numerical approach. The remaining time-dependent factors such as Condition, Support, and Age; are used exclusively. It is useful in determining what needs to be replaced regardless of its value, work performed, risk level, and usage. It places all devices in order based on the practical wear and tear factors (CSA).

SORTING BUTTONS

The buttons shown in Figure 1 are used to easily sort the spreadsheet. By clicking on the appropriate button, the spreadsheet will sort according to the heading of the associated column. Although the index ranges and decimals are different, this is irrelevant. The indexes are relevant only within their own sorted column.

	A	B	C	D	
1	Sort PI Priority Index	Sort WPI Weighted Priority Index	Sort CSA Condition, Support, & Age Factor Avg	Site	Dept
2	32	4.218	4.0	Henderson	Operat
3	32	4.111	3.7	McMaster	Operat
4	32	4.111	3.7	McMaster	Operat
5	32	4.111	3.7	McMaster	Operat

Figure 1. Sort Categories

ACCRUAL COLUMN

An Accrual column appears just right of the Price column on the 'Over $15K Periop - All' spreadsheet. This addresses the scenario where a funding amount might be known and you want to find out what devices populate the range between the highest priority index to the accumulated funding threshold point (cut-line).[2] This is a useful tool for areas that are allocated a certain funding amount for capital equipment replacement. The column accrues from top to bottom regardless of which sort button is clicked. Arbitrarily selecting a Priority Index number as a cut off point can also be undertaken. However, as the list is relative and not absolute, it may be difficult to decide where to place it. Accrual cut-line would be the more legitimate cut-off option.

ACCURACY

Initially, the list was used to affirm current notions regarding equipment needing replacement. This provided a method to test its accuracy. In other words, how close to the top would devices that we initially thought needed replacement appear? We selected those items and did the analysis. They included an image guidance system, two lasers, and two electrosurgical units. The exact items appeared in relative positions based on PI index as listed in Table 2.

Device	Rank	#Devices	%Ratio
IGS	69	1883	3.6
Laser (1)	72	1883	3.9
Laser (2)	24	1883	1.2
ESU (1)	38	1883	2.0
ESU (2)	43	1883	2.2
Avg	49	1883	2.6
Accuracy			**97.4**

Table 2. Determination of Accuracy

The sequential ranking number (line number on spreadsheet) divided by the total number of devices provides a ratio indicating how close to the top (highest priority) relative to the range between top and bottom. The Accuracy indicator is derived by subtracting the average % Ratio (2.6 %) from 100%. The result is 97.4 %. This provided the evidence required to trust the criteria and begin analysis.

CORRELATION FACTORS

The criteria studied here are assumed to be independent of each other. For example, if a device was assigned a rating of poor condition, this may exist regardless of risk, age, utilization, support, etc. An old device (high age factor) may indeed be in good condition. The device's condition is a subjective judgment. Therefore, we must apply other criteria to help assign a replacement rating (Priority Index). Additionally, if a device sees much support cost in parts and hours, this again can occur completely independent of any of the other factors. This can occur in something that is old but not exclusively. In other words, if a device's condition is poor, and other factors are positive, we have to realize that there are likely other devices that may be in poor condition especially in a list of great numbers. If there are other devices that exhibit poor condition but with other factors scoring higher (negative effect), then their Priority Indexes will be higher in relation to those that have the same condition.

DATA ANALYSIS

The distribution of data generated by each of the criteria can reveal the current state of the equipment and identify possible trends. Almost 80% of items are valued at $10,000 or under and only 1% (19 devices) are valued at over $100,000. Only 6% are considered to be in Poor to Very Poor condition. However, this represents 108 devices, which is not insignificant. 30% are either near or completely out of support from the OEMs; a startling figure considering that it represents 460 devices. 65% of all items are 5 or more years old (over 1000 items). 3% are over 20 years old (57 items). Only 8% of items have seen over 4 hours repair service per year while 68% have seen none. Only 4% of items have seen greater than 4% of the capital value spent on parts while 71% have seen 0%. 46% of items are in the category of Risk Factor 2 out of a range of 5 while 13% are seen as Risk Factor 5 (high risk). 80% of items are used very frequently. Overall, the snapshot captures the need for improved and more proactive purchasing in order to catch up with the age and support issues revealed in the analysis.

SUMMARY

It is suggested that clinical engineers take the lead in formulating evaluation processes to recommend equipment replacement. Their skill, knowledge, and experience, combined with access to equipment databases, make it a logical approach.[6,7]

Based on ideas from Fennigkoh's scheme, elements such as age, vendor support, accumulated maintenance cost, and function/risk were used.[8] Other more subjective criteria such as cost benefits and efficacy of newer technology were not used. The element of downtime was also omitted due to the data element not being available.

The Periop Master Equipment List and its rationale were presented to the Perioperative Services Program Council. They deemed the criteria to be robust and provided overwhelming acceptance of the list. It was quickly put to use to estimate required capital funding, justify items already thought to need replacement, and identify high-priority ranked items for replacement.

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