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Prioritize Medical Equipment Replacement Using Analytical Hierarchy Process

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Abstract: *Clinical Engineering Department in hospitals need to take decision for Health Care Technology assessment which includes purchase, maintenance, use, and replacement. In this paper we proposed a analytical hierarchy processes -group decision making (AHP-GDM) model to prioritize the medical equipment for replacement. The model structure includes 11 quantitative and qualitative factors descending as main and sub criteria which can affect of the replacement decision. Each device should be assessed with respect to every covering criterion .and the devices ranking with respect to the criteria independent of other devices . the final score for each devices was calculated as replacement priority index(RPI) . the model was applied for 30 devices in ICU where devices with higher RPI take a higher priority for replacement according for available budget in hospital and Devices with lower RPI take a lower priority for replacement. This model can be integrated as an automated system for medical devices replacement in health care facilities.*
Keywords: *AHP, Criteria, Replacement, Medical Equipment*

I. Introduction

Advanced technology systems in hospitals requires high efforts of planning and management in purchase , maintenance , use and replacement or disposal , in order to Enables devices to do their functioning correctly to keep patient safety and prevents unexpected stop of devices would increase the downtime and maintenance repair cost .In order to enhancement customer clinical service and medical staff satisfaction .

In Egyptian country, there is a lack of actual , scientific, and inclusive assessment of medical equipment replacement decision. This is to the fact that replacement decisions of medical equipment are mainly based on inadequate reliable information and poor analysis of relative costs, age and condition of equipment, utilization levels, expected future service provision and benefits from new technologies.

There are few study proposed many techniques that have been developed to used for medical equipment replacement. most of these techniques only consider few factors , while several factors are difficult to considered .

A simple model used to identify and ranking of medical equipment for replacement was developed [1] another method was proposed a medical equipment replacement score system (MERS) as automated system designed based on technical, safety and mission critical rules, where weight and score have been assigned for each criteria . final score was calculated where the device which has higher scores has a high priorities to replacement [2].

developed an automated software program was proposed to identify equipment need of replacement , the system designed based on the factual, safety, technical, financial criteria and Rules have been developed to assist which equipment should be replacement. which produces relative replacement number (RRN) for each device[3] .

The fuzzy inference model was proposed to determined the equipment that need replace. The model considers both quantitative and quantitative factors that actually influence in replacement decisions[4] .

Fault Tree analysis (FTA) proposed to model the replacement decisions based on a set of indicators include the hazards and alerts, vendor support, cost, and the useful life ratio that impact on the replacement decision. and the proposed model priority equipment that should be replaced [5].

In this paper we proposed a analytical hierarchy processes AHP model to prioritize the medical equipment for replacement [6] .

The Analytic Hierarchy Process (AHP) consider as a multi-criteria decision making (MCDM) method, which is a flexible decision making tool for multiple criteria problems[6]. and its simplicity and its ability to deal with both quantitative and qualitative data[7] .

The AHP is a decision support method that can be used to resolve the complicated problems decision . It consist of a hierarchical structure of objectives, main criteria, sub criteria, and alternatives. a set of pairwise comparisons are used to get the weights values of importance of criteria, and the relative measures were applied to compared to alternatives with each other criterion. if the comparisons are not exactly consistent, should be used the mathematical way for improving consistency.

There are several studies have proven the effectiveness AHP method in health technology assessment , cite some of them: apply AHP method to support of selecting neonatal ventilators during purchase procedure for a new women's health hospital. Where the model can be updated or adapted to different medical technologies whenever needed [8].

Another study explained use of AHP to support the quality assessment for the purchase of pacemakers and implantable defibrillators and prove that the method is actual more suitable for this procedure. the AHP model permit us for make evaluation it is reliable [9] .

In [10] AHP model was proposed to prioritize medical devices according to the condition device in equipment management system in health care facilities . The model gives a actual evaluation of a total risk of the device by consideration of its different failure modes and evaluate their frequency, delectability and consequences ,this strategy is simple to implement and can decrease the device failure rate .

Also application of AHP to purchase a new CT scanner according of user demands for use in a health care facilities . the AHP method describe how was appropriate to enhancement its effectiveness for application in healthcare facilities. The study also has a wider effect for manufacturing of medical devices as it describes a precise and effective method to selection of user demands and to benefit of it during development of new devices [11].

The objective of this paper to develop heath care technology assessment ,so we proposed AHP model for medical equipment replacement aims to enhancement heath care technology assessment in replacement processes, proposed model is ranking procedure for prioritizing criteria that may have impact for the replacement decisions of medical equipment that are in critical condition in a health care facilities to help the hospital administrative level management assessment in developed country. our model considers using two types of comparisons, relative and absolute measurements, and both quantitative and qualitative criteria , estimated in an objective method , for include many of the criteria that actually influence replacement decisions in the healthcare facilities .

II. AHP Group Decision Making Aggregation Methods:

The AHP Group Decision Making process use to combine the individual judgments in a group into a group's judgment and to construct a group preference from the individual preferences.

Consider an AHP group decision making problem. Let K={β_1, β_2,..., β_m}
be the set of decision makers, and W={w_1, w_1,,..., w_m } be the weight vector of
decision makers, where β_k>0 ,k =1,2,...,m, $\sum_{k=1}^{m} \beta_k$=1

Let $A^k = (a_{ij}^k)_{nXn}$ be the judgment matrix provided by the decision maker d_k(k=1,2,...,m). based on the above described , two most useful methods for AHP-group decision making can be used[12] [13] one of this method which be used in this paper the aggregation of individual judgments (AIJ), where in this method the decision makers use the weighted geometric mean method to aggregate individual judgement matrices to obtain a collective judgement matrix,

$$\mathbf{A^G} = (\mathbf{a_{ij}^k})_{\mathbf{nXn}} \quad (1)$$

where

$$\mathbf{A^G} = (\mathbf{a_{ij}^G}) \quad (2)$$

where $\mathbf{a_{ij}^G} = \prod_{\mathbf{k=1}}^{\mathbf{m}} (\mathbf{a_{ij}^k})^{\boldsymbol{\beta_k}}$ (3)

The Eigen value method (EVM) is :

$$AV = \boldsymbol{\lambda}_{\mathbf{max}} V ; \ \mathbf{e}^{\mathbf{T}} V = 1; \quad (4)$$

Where

A : the comparison matrix
V : the priorities vector
λ_{max} : the maximal eigenvalue

Then, using EVM to derive a collective priority vector $w^G = (w_1^G, w_2^G, \ldots, w_n^G)^T$ from A^G to order the alternatives.

the pairwise comparisons in a judgment matrix should be consistent ,this happens when the the consistency ratio (CR) is less than 0.1[6] . The CR is give as the follows :

$$CR = \frac{\mathbf{CI}}{\mathbf{RCI}} \quad (5)$$

Where RCI the Random Consistency index value which given by saaty [6] .

And

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (6)$$

Where λ_{max} : the maximal eigenvalue , n : is the criteria number .

III. Methodology

A. AHP Model Structure

prioritization medical equipment for replacement consider as a multi criteria decision making(MCDM) problem and we use the Analytical Hierarchy Process (AHP) to solve it. The structure of our proposed AHP model consist of three steps:

Step1: identified the goal which is prioritization of medical devices replacement .
step2: evaluation of devices criteria which must be identified and placed at the second level of the hierarchy .
Step 3: The alternatives (medical devices) placed in third level of the hierarchy structure.

To assign a score value for every device included in a model , two type of comparison would be used : Relative measurement and absolute measurement method .

Relative measurement method is applied for pairwise comparison each criterion with other criteria in order to determining their weights priority with respect to our goal (prioritization of medical equipment for replacement). If we have large number of devices then , the pairwise comparison for all criteria seen as impossible . furthermore , medical equipment are added or removed from the database dynamically with over time . So ,to resolve this problem, we used an absolute measurement method for ranking the medical equipment . Each device was compared with each criterion used for evaluation and assigning a score for each device , and give a device score corresponding to its description grade without comparing with other devices .

The criterion description and associated grades should be defined advance . The grade are the expectation categories of a criterion. For example, the device function could be take one of the next categories : life support , diagnosis , treatment and analysis .

The grades of description criterion are qualitative ,so , should be assigned an score value denote to its importance with respect to the criterion . quantify the description grades an important step , to evaluation of device with respect to criterion by assigned the score of descriptive grade, which contribute in the prioritization of devices replacement in a model .

we suggest to applied the relative measurement method for pairwise compare the description grades with respect to their criterion for obtain more accurate score values for the description grade of criterion . using this method it acceptable to avoid assigning arbitrary score for the device grade and give the more consistent scores values for devices. consequently each device is assessed independently of other devices , so each device grade should be assigned an score value indicating its importance with respect to the criterion . The devices are evaluation with each criterion and is assigned the suitable description grade which determined in the our model . After determine the description and score for all criteria, the proposed model is ready to evaluation the devices. where each device is compared for each criterion and determine their score value .

The next steps show the summary of the proposed model :

- determine the effective and independent criteria and sub-criteria for evaluation devices.
- using relative measurement method to calculate the weights values for all criteria and sub-criteria .
- prepare description grades for each criterion and calculate their score value by using relative measurement method.
- the equipment are evaluation with respect to each criterion and is set the suitable score using absolute measurement method;
- Calculate the total score for each device as follows:

$$TS_i = \sum_{j=1}^{m} w_i \, s_{ij} = 1 \quad (7)$$

TS_i : is the total score for the i-th device .
i =1,...,n, n : is the total number of devices .
j =1,...,m , m is the number of criteria .
w_j is the weight of the-j criterion, and the s_{ij} is the score value of the-i device with respect to the-j criterion,
Where $\sum_{j=1}^{n} w_i = 1$

- Finally, Priority devices according to their total scores value.

The proposed hierarchy structure contains of seven criteria are identified at the top level , where Some of these divided to sub-criteria .The hierarchy structure for prioritization of medical equipment replacement shows in Figure.1

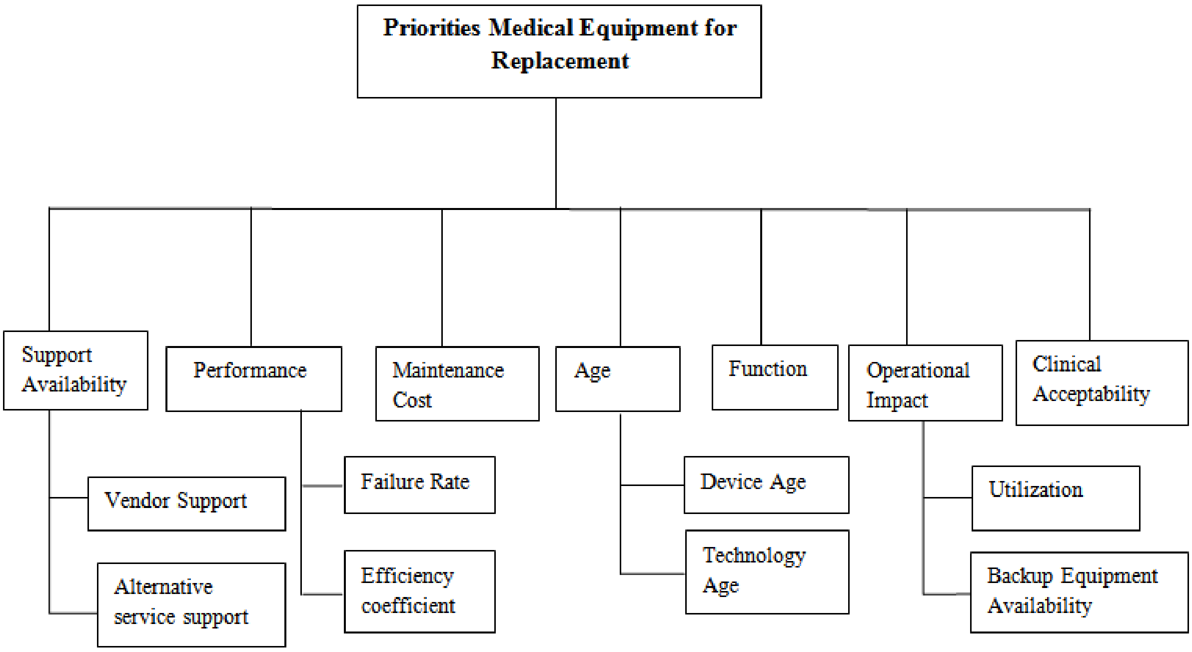

Figure.1: Hierarchy Structure For Prioritization Devices Of Replacement

B. Identification of Criteria :

1. Support availability(SA):

Support availability is the more important indicator in develop country for replacement decision making .in our model proposed the vendor support criterion to include :

a) Vendor support (VS) : This criterion include warranty, maintenance contracts , documentation , and training .The device can stay long time in service but then begin to reach the end of manufacturer service supported life and thus need to be replaced ,devices that were no longer service supported should have highest priority for replacement .

b) Alternative service support(ASS): Reach the end of manufacturer service supported life Departments often prefer to keep existing equipment for back-up manufacturer support availability of spare parts can expand the usage of medical equipment a long time .where the parts availability indicator reflects Stop working of any medical equipment

2. Performance :

There are many factor that indicator for equipment performance ,in our model failure rate and efficiency coefficient used as a proposed indicator factors .

a) **Failure rate (FR):** The Failure rate consider as a number of repairs per year ,and it was calculated as a total number of repairs/(Age of device(number of years being considered)) [3] .

b) **Efficiency coefficient(CE) :** We defined Efficiency coefficient as

$$\mathbf{EC = 1 - \frac{2 * t_d}{t_o}} \qquad (8)$$

where $\mathbf{t_d}$ is downtime , $\mathbf{t_o}$ is operation time

3. Maintenance cost (MC)

Maintenance cost is the total cost value of maintenance and repair for each device compared with its purchase cost. The maintenance costs over the past three years should not exceeding 25% of the purchase cost of a device [14] .

4. Age

In our model this indicator criterion include the tow sub criteria :

a) Device Age (DA) : The life span was identified for all equipment and compared to their actual age.

b) Technology Age(TA) : Technology Age is the time period since the appearance of the device in market

5. Equipment Function(EF) :

The equipment function or application can have a high effect on decision replaced. Life support devices, regardless of need, always, classified as more important than the other devices in the replacement process. equipment function classified to the following categories:

Life support devices, Therapeutic devices, Diagnostic devices and analytical support devices

6. Operation impact

Operation impact describe the ability of a device in process of care delivery in hospital [15]. in our model Operation impact depends on usage rate (UR) and availability of similar or alternative devices .

a) Backup Equipment Availability (BE) :

With decreasing the number of backup and similar equipment available in the hospital . The state of device in the delivery of health care becomes more critical , particularly When it is in a high level of use and there is no similar device in the hospital . Presence many similar devices does not mean high Backup Equipment Availability , the request per unit time of these equipment is also significant . in case there were many similar equipment in a hospital but Using heavily, and if the device is fails, it has a less opportunity that others can be used as alternative . Therefore, Backup Equipment Availability can be defined in term of the number of similar or backup equipment that required for per unit time .

b) Usage Rate (UR) : The usage rate is the length time of device operating in hospital as the average of working hours (hours per day ,days per week or weeks per year) . we considered the average working device hours per day in our model.

7. Clinical Acceptability :

The Clinical Acceptability(CA) criteria indicator for the medical staff satisfaction , where medical staff members need to using high new technological devices to improve the efficiency and the effectiveness performance .

C. Weighting and scoring calculation for all Criteria

The questionnaire was prepared to obtain the comparative matrics of all criteria for getting weight grade scores of alternatives(devices) , Using saaty scale 1-9 to building pairwise comparative matrix [6]. we form a set of four decision makers working in this field where their chosen based on of their knowledge (clinical engineering, technicians , and physicians) .

Each decision maker was made pairwise comparison matrices between main criteria was done to obtain the preferential degrees weights used a relative measurement method , this method also used to provide the preferential degrees weights for the sub criteria . and pairwise comparison matrices by using the Absolute measurement method was applied to prioritize devices replacement .

Therefore , from each decision maker , we have one comparison matrix for main criteria weights in addition to four comparison matrices of the sub criteria ,eleven comparison matrices for getting scoring for each criteria in model . therefore we became have four comparison matrices to main criteria and 16 comparison matrix to sub-criteria for priority weights , and 44 comparison metrics for all criteria in order to calculate the scoring for each criterion .

Aggregation each Individual decision maker comparison matrices to get the group comparison matrix and then calculate the priorities weights and score value . this process done by used one of most useful methods for AHP-group decision making as we explained previous .

D. Replacement Priority

After calculate weights and score criteria based on previous methodology by using matlab program , now the model is ready to priority Alternative (devices) . Each device should be evaluation with respect to all criterion, and assigned an suitable score. Finally , by apply Equation (1) we obtain the total score for each device ,then normalization the total score value as a replacement priority index by use the follow equation:

$$\text{Normalization score value} = \frac{\text{Score Value} - \text{Minimum Value}}{\text{Max Value} - \text{Minimum Value}} \qquad (9)$$

.

IV. Results

According to the AHP - Group Decision Making(AHP-GDM) , we applying the aggregation of individual judgments(AIJ) method which was explain previously to calculate weights criteria as follow:

Lets (GI, GII, GIII and GIIII) the pairwise comparison matrices of the four group decision makers resulting of evaluation main criteria to get its weights priority.

Table.1 Pairwise Comparative Matrix For Priorities Weights GI

	Support Availability	Performance	Maintenance Cost	Age	Function	Operational impact	Clinical Acceptability
Support Availability	1	2	3	4	5	6	7
Performance	0.5	1	3	3	5	6	8
Maintenance Cost	0.33	0.33	1	1	4	5	7
Age	0.25	0.33	1	1	3	4	7
Function	0.2	0.2	0.25	0.33	1	2	3
Operational impact	0.17	0.17	0.2	0.25	0.5	1	3
Clinical Acceptability	0.14	0.12	0.14	0.14	0.33	0.33	1

Table.2 Pairwise Comparative Matrix For Priorities Weights GII

	Support Availability	Performance	Maintenance Cost	Age	Function	Operational impact	Clinical Acceptability
Support Availability	1	1	2	3	5	6	7
Performance	1	1	3	3	5	6	8
Maintenance Cost	0.5	0.33	1	2	5	6	7
Age	0.33	0.33	0.5	1	5	6	7
Function	0.2	0.2	0.2	0.2	1	2	3
Operational impact	0.17	0.17	0.17	0.17	0.5	1	2
Clinical Acceptability	0.14	0.12	0.14	0.14	0.33	0.5	1

Table 3 Pairwise Comparative Matrix For Priorities Weights GIII

	Support Availability	Performance	Maintenance Cost	Age	Function	Operational impact	Clinical Acceptability
Support Availability	1	2	3	3	5	6	7
Performance	0.5	1	3	3	5	6	8
Maintenance Cost	0.33	0.33	1	1	5	6	7
Age	0.33	0.33	1	1	5	6	7
Function	0.2	0.2	0.2	0.2	1	2	3
Operational impact	0.17	0.17	0.17	0.17	0.5	1	2
Clinical Acceptability	0.14	0.12	0.14	0.14	0.33	0.5	1

Table 4 Pairwise Comparative Matrix For Priorities Weights GIIII

	Support Availability	Performance	Maintenance Cost	Age	Function	Operational impact	Clinical Acceptability
Support Availability	1	1	2	3	5	6	8
Performance	1	1	3	3	5	6	8
Maintenance Cost	0.5	0.33	1	1	5	6	7
Age	0.33	0.33	1	1	5	6	7
Function	0.2	0.2	0.2	0.2	1	2	3
Operational impact	0.17	0.17	0.17	0.17	0.5	1	3
Clinical Acceptability	0.12	0.12	0.14	0.14	0.33	0.33	1

Then Aggregation the previous four comparison matrix By applying the weighted geometric mean method (WGMM) Equation (3)

Where , β_i the experts weights ,we assign the equal weights for all expert where β_1 =0.25, β_2 =0.25 , β_3 =0.25, β_4 =0.25 . Then ,from WGMM we get the Group comparative matrix as show in Table 5 .

Table 5 Group comparative matrix and priorities weights and Consistency ratio for main criteria

	Support Availability	Performance	Maintenance Cost	Age	Function	Operational impact	Clinical Acceptability
Support Availability	1	1.41	2.45	3.22	5	6	7.24
Performance	0.71	1	3	3	5	6	8
Maintenance Cost	0.41	0.33	1	1.19	4.73	5.73	7
Age	0.31	0.33	0.84	1	4.40	5.42	7
Function	0.2	0.2	0.21	0.23	1	2	3
Operational impact	0.17	0.17	0.18	0.19	0.5	1	2.45
Clinical Acceptability	0.13	0.12	0.14	0.14	0.33	0.41	1

By applying the eigenvector method (EGVM) on the previous Group comparative matrix to obtain the group Judgments priorities weights . The weights resulting and Consistency index(CR) from this process are present in the Table.6 .

Table 6 criteria weights and Consistency index

Criteria	weights	CR
Support Availability	0.3005	0.079
Performance	0.2813	
Maintenance Cost	0.1606	
Age	0.1443	
Function	0.0522	
Operational impact	0.0376	
Clinical Acceptability	0.0234	

Also we Apply the same method used to calculate main criteria weights for calculating the sub criteria weights and scores values for each criterion . the weights(w) and scores values of all main and sub-criteria show in Table.7 .

Table 7 criterion weights and scores values

Main criteria	**Sub criteria**	**Alternative grade**	**score**
Support Availability (W= 0.3005)	service support availability (w=0.75)	Vendor Support <2 Years	1
		2≤Vendor Support <5 Years	0.2291
		Vendor Support ≥5 Years	0.0884
	Alternative service availability (w=0.25)	Parts are not readily available	1
		Some parts are hard to find	0.3233
		All parts are readily available	0.0918
Performance (W=0.2813)	Efficiency coefficient (W=0.66)	EC <50%	1
		50%≤EC <70%	0.4244
		70%≤ EC <90%	0.2182
		EC ≥ 90%	0.0716
	Failure rate (w=0.34)	RF>2	1
		1.5<RF≤2	0.4521
		1.5 <RF≤1	0.1740
		0<RF<1	0.0630
Maintenance Cost (W=0.1606)		Maintenance Costs≥25%	1
		10%≤Maintenance Costs<25%	0.2643
		Maintenance Costs<10%	0.0884
Age (w=0.1443)	Device Age (w=0.80)	Old Actual	1
		Almost old	0.7088
		Average	0.1923
		Almost new	0.1061
		New	0.0736
	Technology Age (w=0.20)	TA ≥10yrs	1
		5< TA ≤10 yrs	0.4498
		3< TA ≤5 yrs	0.2152
		TA ≤2 yrs	0.0906
Function (w=0.0522)		Life support	1
		Therapeutic	0.3524
		Diagnostic	0.2151
		analytical support	0.1452
		Other	0.0492
Operational impact (w=0.0376)	Backup Equipment Availability (w=0.65)	No of Backup equipment ≤1	1
		1< No of Backup equipment ≤4	0.3263
		No of Backup equipment >4	0.1055
	Usage Rate (w= 0.35)	U>8h(per day)	1
		6 ≤U≤ 8h(per day)	0.3364
		U<6 h(not daily use)	0.1018
Clinical Acceptability (w=0.0234)		Unacceptable	1
		Adequate	0.2837
		Ok	0.0799

A. Correlation of criteria

The criteria in our study an independent of each other . For example, if a device was assigned a high score as a poor performance , this may exist regardless of maintenance cost , age, Function , support, etc . also device may be an old (high age for device) but actually it have a good performance . so , we must apply other criteria to help ranking devices for replacement. as well, if a device has a height failure rate , and other factors is lower, we have to understand that there are probably other devices that may be have height failure rate especially if there are a large number of devices . If there are other devices that exhibit height failure rate but with other factors scoring higher (negative effect), then their Priority Indexes will be higher with respect to those that have the same height failure rate . So, this illustrates the relative nature in the process of evaluation the equipment with each other.

B. Results of prioritize the replacement of medical equipment:

We applied the proposed model on 30 device data in ICU of 5 different types . Due to limited access to equipment of data along equipment life cycle; the equipment included in this study only along last 3 years after warranty years . the Table.8 shows sample of result of various types of the equipment with the final score value as a priority index replacement .

Table 8 Sample Result of Criteria and RPI Scores FOR Equipment Replaement

Equipment Name	Vendor Support	Alternative support Availability	Efficiency Coefficient	Failure Rate	Maintenance Cost	Device Age	Technology Age	Function	Backup Equipment Availability	Usage Rate	Clinical_ Acceptability	Total Score	RPI
Monitor	0.225	0.024	0.023	0.055	0.281	0.115	0.029	0.052	0.008	0.014	0.023	0.85	0.83
Ultrasound	0.225	0.024	0.023	0.01	0.281	0.115	0.029	0.011	0.024	0.014	0.007	0.76	0.74
syring pump	0.052	0.024	0.045	0.055	0.281	0.082	0.029	0.018	0.008	0.005	0.007	0.61	0.57
Ventilator	0.225	0.007	0.023	0.025	0.025	0.082	0.029	0.052	0.024	0.014	0.007	0.51	0.46
Infution pump	0.052	0.075	0.008	0.025	0.074	0.082	0.029	0.018	0.024	0.005	0.007	0.4	0.34
syring pump	0.052	0.007	0.023	0.055	0.074	0.082	0.029	0.018	0.008	0.005	0.007	0.36	0.30
Ventilator	0.052	0.007	0.008	0.01	0.025	0.082	0.029	0.052	0.008	0.014	0.002	0.29	0.22
Ultrasound	0.052	0.075	0.008	0.025	0.025	0.022	0.013	0.011	0.024	0.014	0.002	0.27	0.20
Monitor	0.052	0.024	0.008	0.01	0.025	0.022	0.029	0.011	0.024	0.014	0.002	0.22	0.14
Ultrasound	0.02	0.075	0.008	0.01	0.025	0.022	0.013	0.011	0.024	0.014	0.002	0.22	0.15

As show us , the output final score of our proposed model between (0.09 - 1.0) .where the highest score is 1.00 and 0.09 is the lowest score , we can get a total score in this range for each device when a device evaluation against each criterion .The rating of all 30 device was performed with respect to all quantitative and qualitative criteria. based on existing data collected from hospital. Normalized scores values in the last column of Table.8 used for get the replacement priority index of devices. normalization final score in range (0, 100%) by using the Equation (8).

However, the total scores of devices in last column table.8 can be used as absolute measurements for replacement . The thresholds of replacement priority index(RPI) was determined by 0.50 which category the device belong it and have high score its take the priority for replacement or disposal according available budget in hospital, While residual devices who did not covered by the budget available could be put under surveillance The RPI result for all devices show in Figure.2

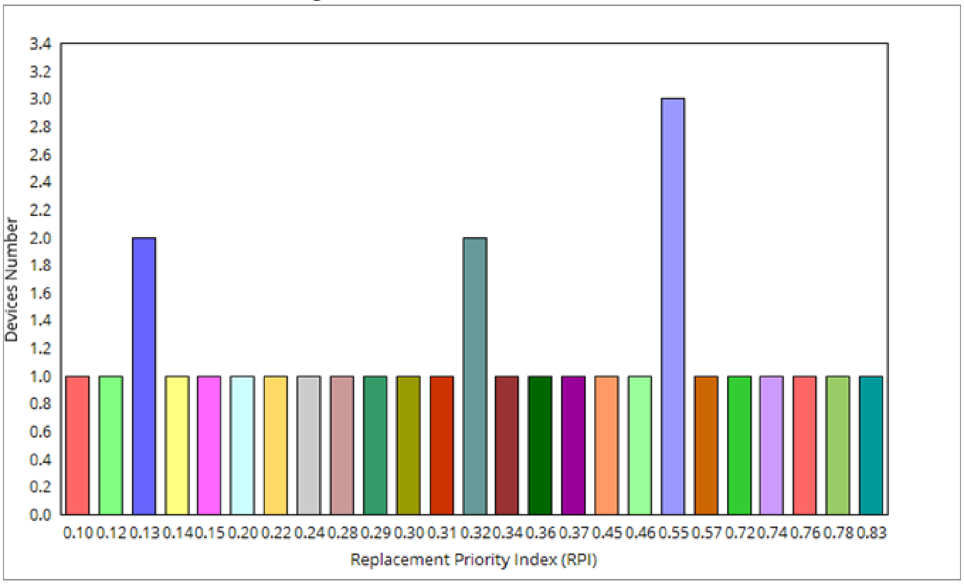

Figure.2. RPI result for all devices

thresholds are based on the devices score values that obtained in the our study model .and it can be set after applying the model for the devices inventory in a hospital and investigating of scores values that obtained . Also the threshold are set according to our understanding of the studied equipment during analysis criteria , in particular that have the high weights which have the high effect in replacement decision . and that take maximum score value which equal one . If this model is just applied only to a group of devices in a hospital and not all equipment ,the output decisions might be inaccurate ,because the managers may specialization the budget only to this group and decide to apply replacement threshold only for this group .

V. Conclusion

Our AHP-GDM model proposed to prioritization medical equipment for replacement ,the model include the more critical devices in the equipment management program of a hospital . our proposed model uses both relative and absolute measurement to determine weighting and scores values for all criterion for evaluate devices (alternatives). The score that are obtained for all criterion are also more consistent by using the relative measurement method . our model can be integrated as a medical equipment management system in hospitals to prioritize medical devices for replacement . Devices which have scores less than 0.50 was assigned a lower replacement priority . However, the devices which have scores more than 0.50 should be replacement according for available budget in hospital . we see that the Analytic hierarchy process is a reliable tool to assess the quantity and quality factors in the decisions replacement of medical equipment . use of analytic hierarchy process help the engineering management department in hospital to structuring of their decision-making and evaluation of all devices systematically through a combination of factors selected . AHP -GDM that has been used improved the precise evaluation results . the systematic approach of the AHP allowed the managers to comprehensive understanding of processes they used in reaching replacement decisions .

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