POST EVALUATION OF MEDICAL DECISION USING AHP

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ABSTRACT

The paper is an outcome of the joint effort of a neurosurgeon and a decision analyst for post evaluation of medical decision. Here, a real life medical decision making situation is dealt and course of action taken by a neurosurgeon in Nepal is presented. The paper describes medical details of the situation, decision condition and alternative course of action available and also on the decision taken in the given socio-economic condition. We have jointly evaluated scenario based options available for treatment and selected course of action utilizing Analytic Hierarchy Process (AHP) based framework. The decision framework, pair-wise comparison of decision factors, initial outcome and sensitivity analysis of the decision problem are presented in the paper. The post medical decision analysis using AHP framework is conducted to get an insight of the medical decision problem to evaluate the rationality of the decision taken. The paper also demonstrates the need of a decision analyst to medical professionals on making informed critical decisions for the satisfaction of medical doctors as well as patient and his/her next to keens.

Keywords: AHP, medical decision, post evaluation

1. Introduction

Medical decision making is a complex process and requires in-depth analysis of conflicting objectives which not only involve medical views, but financial and social aspects are also to be considered. Medical doctors are bound to pass through very critical times in making decisions and sometimes in search of scientific assessment of the decision made by them, at least to justify themselves on the rationality of their decision.

The paper is authored jointly by a decision analyst and a medical doctor who are two diverse professionals. The joint outcome is need based assessment of decision made by a medical professional in general and a practicing neurosurgeon in particular, for assessment of rationality of decision made during the course of medical action. The work is evaluation of medical course of action taken in a real life situation by a neurosurgeon in Nepal. The paper describes medical details of the situation, decision condition, alternative course of action available with the medical doctor and decision evaluation is conducted by using analytic hierarchy process (Saaty, 1980). The analytic hierarchy process (AHP) is considered as one of the most widely used multi criteria decision making tool (Vaidya & Kumar, 2006), with review of 150 AHP applications and cited five in medicine & related field during 1990-2003.

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In an AHP application in health care and medicine specific literature review (Liberatore et. al, 2008), 8 out of 50 cases of reviewed applications ranging from year 1981 - 2006, are in therapy / treatment category. A systematic review of the AHP in health care decision making (Hummel & IJzerman, 2009) is the most recent review of AHP application in health care and medicine. Authors like Dolan JG, Hummel JM and Pecchia L. are quite active in contributing AHP application in medicine (see Google scholar, scholor.google.com, with the author name and AHP in the search field), more than 500 papers can be seen authored by the authors combined, starting as early as 1986. Several relevant literatures with this work are listed at the reference section of the paper.

In this work, scenario based option available for treatment and selected course of action for medical treatment is post evaluated jointly with the medical doctor and AHP based decision analyst. We have presented the decision evaluation framework, outcome of pairwise comparison of decision factors, initial outcome and sensitivity analysis of the decision problem.

The post decision analysis using AHP framework is conducted to get an insight of the medical decision problem. The result of the decision analysis justifies the rationality of the decision taken by medical doctor. The sensitivity analysis of the medical decision problem also justifies that the social and financial condition of a patient governs the treatment option and AHP can help to transparently demonstrate the fact. The case demonstrated also shows the need of decision analyst to medical professionals on making informed critical decisions not only for the satisfaction of medical doctors but also to justify patient or his/her next to keens. We have also noted during the process of evaluation that the AHP based decision analysis will also be maintaining the case based memory of the medical decision made.

2. The Medical Case

A 20 year old boy from the remote hills of Nepal with a very poor economic status, presented in the emergency department two hours after sustaining injuries to his neck on rehearsing stunts for a film. Immediately, after the injury he had a severe neck pain, was unable to move any of his limbs, had difficulty in breathing and had not passed urine till he presented to the emergency department.

On arrival, his level of consciousness was normal (GCS 15/15). He was afebrile, had pulse of 52/minute, blood pressure of 90/60, respiration 33/minute, shallow, laboured and abdominal only. The oxygen saturation by pulse oximeter was 86%. There were crepts all over the chest with intense conducted sounds. He had flaccid quadriplegia with absent sensation below clavicle and in all the limbs. The deep tendon reflexes were also absent.

He was put on a Philadelphia collar and oxygen by mask. Through a wide bore cannula (16G) 1 litre of normal saline was rushed. An indwelling foley's catheter was inserted and only around 30 ml of dark coloured urine was drained. A central line catheter was inserted through right subclavian route. Central venous pressure (CVP) was 2 cm of saline. So, normal saline was continued to be rushed at 500ml/15min.

After initial resuscitation, pulse was still 56/mi, BP was 110/ 60 mm of mercury, CVP was 9 cm of saline and saturation was 94%. Respiratory pattern did not change. He was further investigated. X-ray showed C2-3 fracture subluxation. X-ray chest showed high lying dome of diaphrgm on the right side. MRI of cervical spine showed C2-3 fracture subluxation with evidence of cervical cord contusion at C2 level. Other required investigations like blood investigations, ECG, echocardiogram etc were carried out and the results were normal.

2.1 Patient's medical scenario coupled with socio-economic condition

This is a young man from a very poor family in the eastern hills of Nepal who had sustained a high cervical injury with a total inability to move his limbs and couldn't breathe adequately. With MRI findings of significant subluxation with cord contusion, the chance of the recovery of his limbs was very less. More importantly, he was unable to breathe adequately, and cough out sputum. So, it was vital to protect his airway. All the cost of the treatment had to be paid by his family itself.

The treatment was very long and was expensive and the ultimate outcome of the boy, even if he survived from the respiratory problem, was very poor. He would, for the rest of his life remains dependent on somebody else for all his activities of daily living including the care of his toilet functions. The cost of the urinary catheter, transportation to the hospital from his village and the prescribed medicines totaled a large amount.

2.2 Scenario based options considered

Considering the above scenario, the medical options considered under the circumstances were:

a. Leave him alone and let the nature take its course: The reason is that the patient came from a poor family and the family would have to bear the whole cost of treatment which would drain all the resources of his family whatever little they had, making it very difficult for the rest of the family members to survive.
b. Do the treatment aggressively as per the books and literature guides: Apply cervical traction, start Injection Methylprednisolone (US$ 350), prepare and perform surgery (cervical discectomy, fusion and fixation - US$ 6,850). Postoperatively he would need ICU care, tracheostomy and medicines including expensive antibiotics for the chest infection which he is bound to develop.
c. The middle path was to go step by step: watching the condition of the patient, financial and moral support of the family and development of the complications.

2.3 The Option opted and the course of action

The medical doctor opted for the third option described above, along with the following medical management process.

- He was not methylprednisolone, the only steroid which has shown some benefit in spinal cord injury presenting within 8 hours but is very expensive with its own complication which itself may lead to patient's death.
- Cervical traction was applied.
- Cervical discectomy, fusion and fixation were done.
- Postoperatively, he needed ICU care and ventilator support to maintain his gases, tracheostomy and strong antibiotics, which are fairly expensive, to control his chest infection.
- The attempts to wean him off the ventilator failed despite repeated attempts.
- The family gave up on the 7^{th} day and switched the ventilator off after giving informed consent.
- The patient died soon after switching him off the ventilator from respiratory failure on the 7^{th} postoperative day.

3. Post evaluation of the medical decision

Post evaluation of the decision is conducted using the Analytic Hierarchy Process (Saaty, 1980). The AHP based decision hierarchy is prepared jointly with medical doctor to map the decision scenario with factors considered earlier by the medical doctor. Initially all the decision factors under consideration are listed and then the factors were grouped to form the decision hierarchy in accordance to the AHP application practice. Details of the post decision evaluation framework are presented in the following section.

3.1 Decision evaluation framework

Course of action for the treatment of the patient is post evaluated by using six level hierarchy as presented in the Table 1 and Figure 1. The decision hierarchy is mapped including all the conflicting decision variables as considered by the medical doctor. The factors used in the decision hierarchy are defined briefly as follows:

Social: The social condition of patient, mainly availability support to take care, network of relatives and friends. The social factor is further sub divided into Long Term and Short Term, the long-term and short term social support availability and implication to patient and his family.

Management: This criterion is the major concern and all dealing with the medical management aspects of patient treatment. The management factor is further divided into two parts, namely Investigation and Patient. Investigation factor consists of Radiological and Blood investigation results. Radiological investigation factor is further divided into Bone and Soft Tissue investigation results. The other main factor under the investigation is Patient represented by the Physical Fitness, Consent and Clinical Condition of the patient.

Financial: Under the financial criteria, two factors are considered, the Immediate and the Future financial considerations relating to financial resource needed for treatment and financial implication to family of the patient.

Table 1: The patient treatment decision evaluation framework

<table>
<tr><th>Objective
Level 1</th><th colspan="4">Factors</th><th>Alternatives
Level 6</th></tr>
<tr><td></td><td>Level 2</td><td>Level 3</td><td>Level4</td><td>Level 5</td><td></td></tr>
<tr><td rowspan="8">Evaluation of

Course of Action for

Patient Treatment</td><td rowspan="2">Social</td><td colspan="3">Long Term</td><td rowspan="2">Nature take the course</td></tr>
<tr><td colspan="3">Short Term</td></tr>
<tr><td rowspan="5">Management
Medical management for patient treatment</td><td rowspan="3">Investigation</td><td colspan="2">Blood</td><td rowspan="4">Aggressive treatment</td></tr>
<tr><td rowspan="2">Radiological
X-Ray, CT Scan, MRI</td><td>Bone</td></tr>
<tr><td>Soft Tissue</td></tr>
<tr><td rowspan="3">Patient</td><td colspan="2">Fitness</td></tr>
<tr><td colspan="2">Consent</td></tr>
<tr><td colspan="2">Clinical Condition</td><td rowspan="2">Step by step treatment</td></tr>
<tr><td>Financial</td><td colspan="3">Immediate</td></tr>
<tr><td></td><td colspan="3">Future</td></tr>
</table>

The six level decision evaluation framework consisting of three main factors, namely Social, Management (medical) and Financial. All together sixteen factors constituted the evaluation framework, out of which six (three each under social and financial) factors were non medical and rest ten factors are in relation to the medical management to decide the alternative course of action for the treatment of the patient.

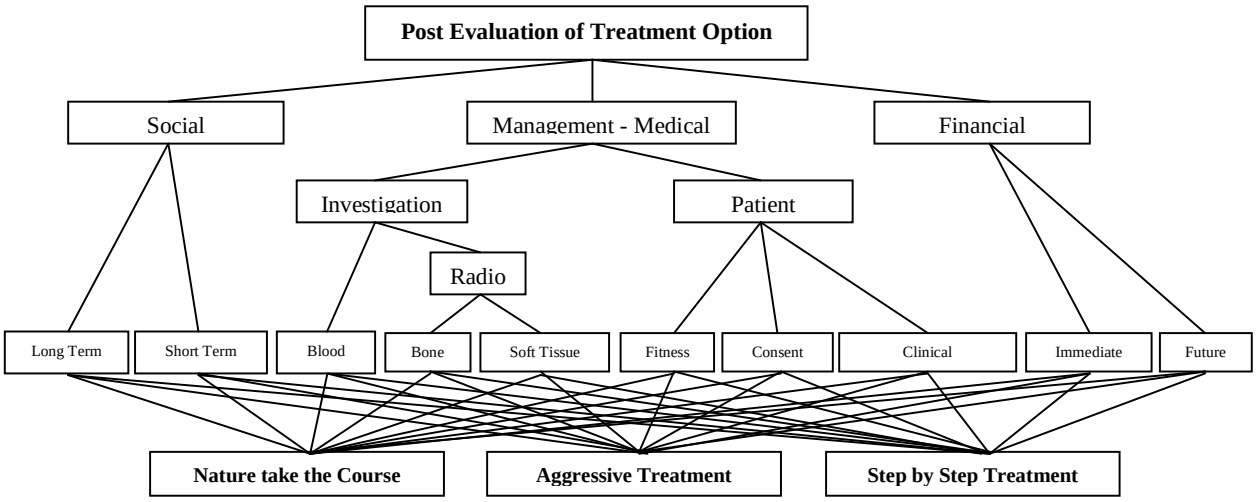

Figure 1: AHP Framework for Post Medical decision Evaluation

3.2 Assessment of alternative course of medical action

Based on the post medical decision evaluation framework discussed above an AHP based computer software is used for further process of evaluation. Sessions of pair wise comparisons were conducted by AHP application expert involving the medical doctor as decision maker. The sessions of pairwise comparison among the decision factors were conducted very carefully following the guidelines given in the AHP literature (Saaty, 1980). The environment of pairwise comparison was duly created so that the medical doctor could reflect his professional judgment made actually during the initial decision to arrive at the course of action taken. Table 2 presents the priority weights generated after the pairwise comparison sessions.

Table 2: Results of pairwise comparison sessions

Weights Generated				
Factors	Criteria	Sub-criteria	Sub-subcriteria	Ranking of Alternatives
Social (0.164)	Long Term (0.072)			Nature take the course (0.199)
	Short Term (0.092)			
Management (0.476)	Investigation (0.238)	Blood (0.058)		
		Radiological (0.180)	Bone (0.118)	Aggressive treatment (0.378)
			Soft Tissue (0.062)	
	Patient (0.238)	Fitness (0.096)		
		Consent (0.057)		
		Clinical Condition (0.091)		Step by step treatment (0.423)
Financial (0.360)	Immediate (0.209)			
	Future (0.150)			

Graphically the result of the post medical decision evaluation is presented in Figure 2. The result represents as synthesis of evaluation giving the priority ranking of the treatment option.

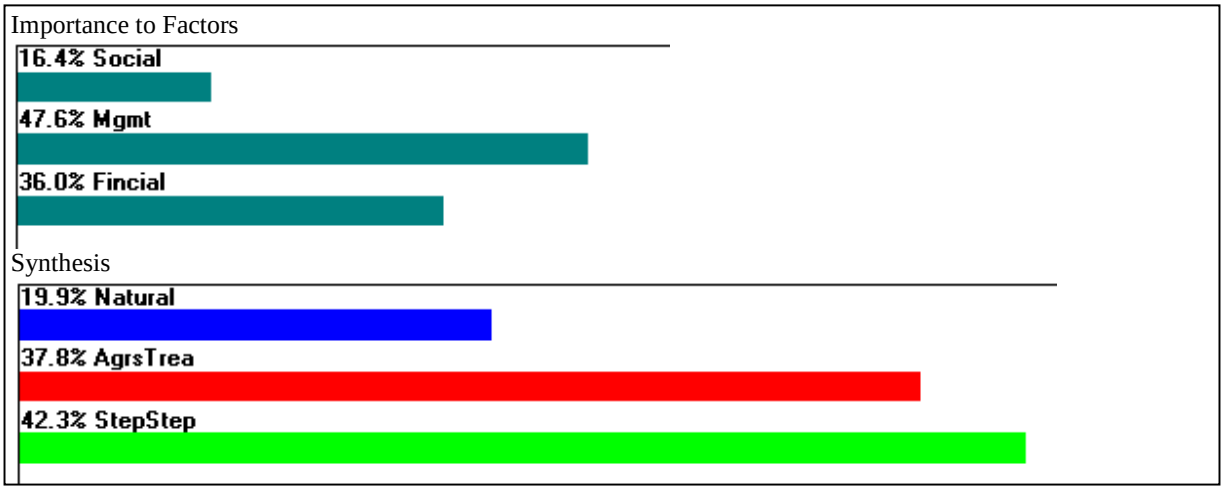

Figure 2: Outcome of decision evaluation in AHP framework

Further, the sensitivity analysis was conducted to see "what if" scenario and to identify the governing factor to arrive at the selected option of treatment. The sensitivity analysis also helped the doctor to get insights of the medical decision evaluation process. The sensitivity was conducted by reducing the Importance of Social factor to 10% from 16.4%, Financial factor is reduced to 5% from 36.0% and much of the importance is given to Medical management factor i.e.85% increased from 37.8%. The result of sensitivity analysis is presented in Figure 3.

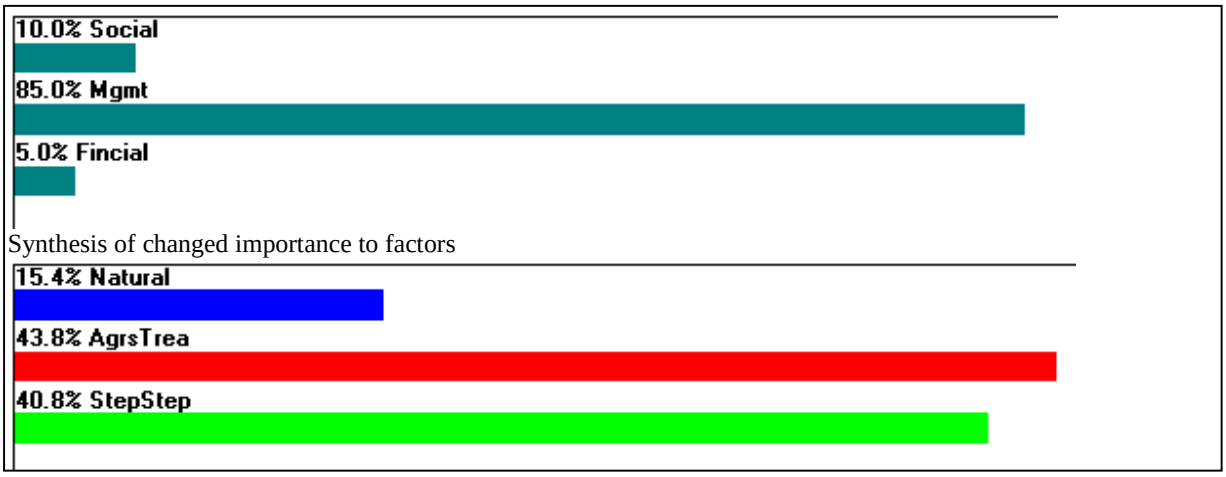

Figure 4: Result of Sensitivity Analysis

3.3 Results and discussion

The result of the AHP based analysis gets highest rank to the Step by step treatment process, which was actually adopted for the treatment of the patient. The step by step treatment alternative adopted is out-weighted by 4.5 percent than the aggressive treatment option. The sensitivity analysis shows that, if importance to management factor is increased, the aggressive treatment options comes to first priority, showing the treatment option adopted is tread-off with the social and financial factor.

The result justifies that the given financial and social situation of the patient; the treatment option adopted is a rational decision; however the outcome of the adopted decision was not positive. It is also evident that, if somehow financial and social limitation was overcome, the treatment option would be "Aggressive" and positive outcome would still remain uncertain.

The result analysis from the case further contributes to the AHP application in health care focusing on medical management (Hummel JM & IJzerman MJ, 2009) and this is being one more addition on the literature on the case of AHP application for holistic medical decision management.

4. Concluding remarks

During the joint exercise of the medical decision evaluation, we have come to the following conclusion:

a. AHP based decision analysis on medical treatment option is observed as a strong tool to judge the rationality of medical decision taken.
b. Insights of AHP based decision evaluation are perceived to be wisdom to medical professionals.
c. AHP would be a basis for informed medical decision-making and maintaining decision memories for case handling in the future.
d. It has been observed that mapping of decision environment in AHP framework is quite compatible with medical doctors with given learning and judgment capacity within their profession.

Integration of patient's socio economic condition to the medical management used in this case is consistent with the discussion from Danner et. al 2011. The work has been reflected more from medical prospective in Sharma & Bhattarai, 2011.

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