Choosing the Best Anesthesia for a Patient

By:
Anubhav Sethi
Murray Malin

Abstract

Physicians often make decisions regarding a person's care without adequate input from the patient. Patient and physician objectives for a treatment or procedure may differ, resulting in suboptimal satisfaction with the outcome for the patient. Anesthesiologists are faced with the task of choosing the "best" anesthetic for patient having a surgical procedure, balancing relative importance their own objectives with that of the patient and surgeon. The factors influencing this decision are different for every patient, surgeon, type of operation and anesthesiologist, limiting usefulness of standardized protocols. We have developed a model which will assist anesthesiologists in choosing which anesthetic is best for a patient about to undergo surgery. Studies show that communication between a patient and their physician is the most important factor in preventing malpractice suits. Our model will increase patient-physician dialogue, and provide a degree of accountability in the event that the objectives of the patient or surgeon compromises optimal care and lead to a bad outcome.

<u>Decision Problem:</u> Integration of patient and physician(s) objectives

<u>Objectives:</u>

1) Minimize patient morbidity and mortality
2) Minimize patient side effects
3) Provide optimal operating conditions for the surgeon
4) Take into account each patient's unique objectives
5) Provide superior pain management intra- and post-operatively

Alternatives:

1) General Anesthesia
2) Regional Anesthesia
3) Intravenous Sedation
4) Local Infiltration of an anesthetic

Introduction

Computerized decision making models have been used in medicine with varying degrees of success. Healthcare insurance providers would argue that these decision support systems have changed the practice of medicine for the better. They state that the rising cost of healthcare has forced the industry to examine at the data to determine if these increased expenditures resulted in better care. Many of the findings made as a result of these studies have indeed suggested that many medical procedures and tests did not significantly improve the morbidity and mortality rates of the population as a whole. Decision/business "rules" were developed, which forced American physicians and patients to come to terms with the concept of the allocation of healthcare resources.

As a population, allocation of resources makes sense. However, the American public's mindset is that each individual is entitled to any and all resources when it comes to their health, raising the question of whether Americans are entitled to the best care possible, or alternatively, a standard of care that is acceptable. Cost is, therefore, one of the factors that play a role in decision making in the healthcare system in the US. This example serves illustrate another challenge that has been a reality in the healthcare system for eons- how does a patient and physician make the best choices in the care of individual patients. As one can see, the definition of successful management of a patient may differ amongst participants of each decision. Insurance companies are motivated to allocate resources and cut costs. Physicians are motivated by giving each patient the best care money can buy. Patients, for the most part, also want the "Cadillac" treatment, however religious and social factors do play a part. For example, a patient that follows the Jehovah's Witness belief may forego procedures if blood products are mandated, even if their death were to be certain. Past bad experiences with spinal anesthetics may also influence patient care, and more risky anesthetic alternatives may be more desirable to such a patient. Objectives can even differ amongst physicians treating a patient, a common dilemma facing anesthesiologists and surgeons. The anesthetic thought to be associated with the lowest morbidity and mortality rates may not provide optimal operating conditions for a given operation.

Although the patient technically makes the ultimate decision, the anesthesiologist is bound to provide treatment that is considered "standard of care," and realistically determines the type of anesthesia a patient will get for their operation. Most of the time the patient, surgeon and anesthesiologist are in agreement for type of anesthesia, however the lack of uniformity occurs daily. Our model was developed with this in mind, and can be a powerful tool for anesthesiologists to make the best decision for individual patients. This model can also be used to defend their choice in the event that an anesthetic complication occurs, especially if surgeon or patient factors force the anesthesiologist to conduct an anesthetic of higher risk than necessary.

Diagnostic and treatment decisions made in medicine are not solely based on probabilities and statistics; i.e.- they are not always "cut and dry." If this were the case, rules could be made that would allow patients to guide medical care, and technicians could perform procedures and tests. The greatest value that a physician provides to the quality of care in the healthcare system is judgment, which is difficult to quantify. Every patient, medical condition, treating physician and situation is unique, requiring integration of the information available to reach the "best" plan of action for a patient.

Patients often have unique objectives and restrictions on their care, involving past experiences, religious beliefs, financial considerations and social circumstances. It would be naïve to believe that a patient has the ability to accurately weigh their preferences with the added risk they may impose upon, and be confident that their decision is best. One of the roles of an anesthesiologist is to supply information to the patient, and work with them to reach this objective. Even then, there are times in which a "stalemate" occurs, and suboptimal treatment is provided or procedures are canceled. These situations lead to medical malpractice lawsuits, which are difficult for an anesthesiologist to defend in court. It is human nature to better make decisions when the facts are displayed in black and white for them. It is also easier for a physician to defend undesirable outcomes if a jury can see how this decision was made, especially restrictions placed on the anesthesiologist by the patient (and surgeon).

Goal and Objectives

The goal of our model was to determine which type of anesthetic is the best choice for our patient. The choice of best anesthesia is not simple, as the patient, surgeon, and anesthesiologist each have their own objectives for the outcome of the operation. The anesthesiologist has several objectives whenever they care for a patient undergoing surgery, but the most important one is to limit patient risk, and make sure they get through the operation safely. The five objectives we chose are described below. (Note: The example used in our model is based on a fictitious patient, as described in Exhibit 1). A brief description of the ASA classification system can be seen in Exhibit 6.

1) <u>Limiting Risk</u>: Risk was used to represent both morbidity (complications) and mortality (death) rates associated with the particular anesthetic/surgery. Our model asks the anesthesiologist to prioritize the relative importance that risk plays anesthetic choice for each patient when compared against other objectives. This determination should be

based on actual data published in the anesthesia literature (American Society of Anesthesiologist annual guidelines) and the clinical judgment of the anesthesiologist. Although data is readily available to determine historic rates of morbidity and mortality for specific operations, the health status of each patient is unique, as are the circumstances surrounding the operation. This is what anesthesiologists get paid for- to make appropriate clinical judgments based on their experience and knowledge of the anesthesia literature. We believe our model will aid the anesthesiologist in their decision-making, support their decisions when problems occur, and provide a basis to learn from their choices.

The relative importance of the mortality rate to morbidity should not be surprising, and the priority derived for this sub-objective was high. Our second sub-objective, limiting morbidity, could not be ignored, as many complications can be life changing, including myocardial infarctions and cerebral vascular accidents. Our model allows the anesthesiologist to take into account both severity and incidence of potential complications when prioritizing relative importance with mortality rates.

We ask the anesthesiologist to prioritize the relative contributions of ASA status, NPO status, patient anatomy and lab results to determine relative contributions of morbidity and mortality (risk). Although not all-inclusive, they take into account the vast majority of factors affecting risk. This simple model will reduce the investment in time required by the anesthesiologist, increasing the likelihood that it will be used.

2) Appropriate Pain Management: Appropriately managing pain is another important objective of the anesthesiologist. Pain management must address both the intraoperative and postoperative periods. Our sub-objectives, therefore, are to manage pain in these two periods. The importance of intraoperative pain management is obvious. Patients are generally not happy if they can feel the surgeon cutting them. Surgeons are not happy if their patients move around as a result of feeling pain, most likely resulting in a suboptimal surgical outcome.

The degree that pain can be managed during surgery depends on the choice of anesthetic, which will be discussed below under Alternatives. Each type of anesthetic is able to achieve adequate pain control during surgery, and the anesthesiologist can do little to enhance their pain profiles. Many operations can easily be performed with any type of anesthesia, and many cannot. It would be unheard of to choose sedation or a local anesthetic technique for many types of operations; however critically ill patients may not tolerate other alternatives, forcing the anesthesiologist to choose them anyhow. Inadequate intraoperative pain management may decrease the priority of this objective relative to risk. This can be seen in our model if one increases the importance of risk in the performance sensitivity graph.

Anesthesiologists typically manage postoperative pain for the first 48 to 72 hours after surgery. The anesthesiologist has many tools in their arsenal to reach satisfy this objective. Although any of the four choices listed in our model can be used for any type of anesthetic, there is some correlation between methods used and anesthetic type. If a patient already has an epidural catheter in place, administration of epidural narcotics is easy to implement. If this method were chosen for a patient that had general anesthesia, an additional procedure would need to be performed to place the catheter postoperatively, adding risk. These types of considerations can be taken into account by the anesthesiologist when prioritizing methods to control pain postoperatively.

3) <u>Side Effects</u>: Reducing the occurrence of side effects would be an objective of any anesthesiologist. Side effects differ from morbidity in that they tend to be self-limiting, and more of an inconvenience than a life-long problem. There are exceptions to this generalization, as delays in ambulation can be problematic in some patients, as this will greatly increase the chance that pneumonia and pulmonary embolism will occur in some patients. Reduction in the incidence of the most commonly seen side effects are listed as sub-objectives. Some of these side effects only occur with certain anesthetic types, such as the occurrence of spinal headaches with regional anesthesia. Derived priorities to these would be expected for minor operations carrying minimal risk to the patient, such as in a dilation and curettage of the uterus.

4) <u>Optimizing operating conditions for a particular operation</u>: Each operation requires certain operating conditions to be present in order to increase the likelihood for a successful outcome. Surgeons also have certain preferences in anesthetic type. This objective has four sub-objectives that represent these demands. The anesthesiologist must determine relative importance of this objective to that of the other objectives in this model, and assign relative importance of the sub-objectives. The sub-objectives include optimizing surgical exposure, providing an anesthetic that limits distractions to the surgeon, reduces downtime, and maximizing any conditions that are unique to the particular operation scheduled.

Providing adequate muscle relaxation and allowing the patient to be safely placed in the position dictated by the operation contributes towards increasing exposure. Keeping the patient still, and maintaining hemodynamic stability help to limit distractions to the surgeon, and these are our covering objectives. Timeliness is important, and the anesthesiologist must determine relative importance of several activities that take up time.

5) <u>Accommodating patient objectives</u>: Finally, each patient has his or her own objectives for the proposed operation, which are represented by our sub-objectives. Although there are a large number of variables that influence a patient, there were a few seen with regularity in my practice. These factors consist of unique patient fears/experiences with anesthesia in the past, religious beliefs and financial burden confronting them. Our model tries to quantify these factors by determining their importance relative to each other and to the other objectives. A fourth factor was included to account for other important personal considerations not included above, and labeled “other considerations.” One of the objectives of our decision model is to better understand each patient, weigh these and use this information to increase likelihood of all participants to achieve their objectives. Our model allows for varying degrees of importance/weight of risk factors and patient choice.

<u>Alternatives</u>

There are four types of anesthesia that can be performed. Although combinations of these forms are commonly performed, it is standard practice to designate one as the primary method, although there are occasions that combinations are used. Although this model does not provide the user the ability to combine methods, our model will provide useful information for the anesthesiologist about the all four types of anesthesia. These four types of anesthesia have different risks, complications, side effects, and degree of success in management of intraoperative and postoperative pain, which are summarized below.

1) Local Anesthesia: This type of anesthesia is the least invasive type of anesthetic used by the anesthesiologist. It entails the infiltration of a medication (local anesthetic) directly at the site where the surgical procedure occurs. Patient receiving this type of anesthesia do not receive any intravenous medication and are wide-awake during and after the operation, and are unlikely to experience any side effects or complications. Local anesthesia does not provide any muscle relaxation, and is most often used for peripheral operations that are of short duration.

2) Sedation: When relatively small amounts of intravenous (IV) anesthesia are given, this is referred to as sedation. The patient is awake, but relaxed and limited amounts of pain control can be provided to the patient. Sedation is often supplemented with local anesthesia, and for this model, we consider sedation alone or in combination with local anesthesia to be sedation. Similar to straight local anesthesia, muscle relaxation does not occur, and is best suited for peripheral surgery. Side effects are relatively uncommon, although introduction of IV opiates does increase the likelihood of itching, urinary retention, delayed ambulation and nausea post-operatively.

3) Regional Anesthesia: Regional anesthesia refers to the introduction of a local anesthesia at a major nerve root, which will anesthetize a region of the body. The most common regional anesthetics used clinically are spinals and epidurals. Local anesthetics are injected into the spine providing complete sensory loss in the abdomen and lower extremities for limited amounts of time. Spinals and epidurals do provide muscle relaxation. Hemodynamic stability (blood pressure changes) can be significant, however appropriate preoperative preparation can limit this problem. Surgeons often do not like regional anesthesia as preoperative preparation time can be greatly prolonged. Advantages of regional anesthetics include minimizing the likelihood of aspiration pneumonia, which is a significant problem mostly affecting patients undergoing emergency surgery or have had something within eight hours prior surgery. Spinal headaches occur in approximately 3% of all patients having spinals or epidurals, which can delay ambulation and discomfort to the patient, often requiring an additional procedure. Use of spinals and epidurals are limited to operations in the lower abdomen and lower extremities. Opiates can be injected into the spinal/epidural spaces, providing superior post-operative pain control.

4) General Anesthesia: General anesthesia (GA) refers to any type of anesthesia in which the patient is completely unconscious. GA provides the best operating conditions for the surgeon in most every situation as profound muscle relaxation is achieved with drugs that completely paralyze the patient for limited amounts of time. GA is optimal for long and extensive operations that are extremely stimulating. Major operations above the lower abdomen usually are done with general anesthesia. Relatively higher risk and complication rates tend to occur with this methodology when compared to other types of anesthesia, especially in patients who have significant health problems. Patients requiring surgery on an emergency basis have a high risk of aspiration pneumonia if they have GA. Studies show that if a patient aspirates (stomach contents get into lungs) one tablespoon of their gastric contents into their lungs, over 50% will die.

Explanation of the Modeling Process

The goal of our model was to determine which alternative is the best for an ASA 3 patient about to have an emergency exploratory laporatomy. This particular surgery can theoretically be done using any of the four alternative types of anesthesia described above. The decision maker who would be using this model is the anesthesiologist. Thus, all the pair wise comparisons have been made from the perspective of the anesthesiologist after interviews were done with the patient and surgeon.

As mentioned earlier, the five main objectives of the anesthesiologist are: minimizing side effects, pain management, unique patient objectives, risk factors, and optimize conditions for surgeon/specific operation. Each of these has its various sub-objectives. In the process of making this model, we first came up with this basic structure of objectives and the sub-objectives. Having done so, we then derived priorities for the five main objectives. This was done of making pair wise comparisons of the five main objectives with respect to the goal (Exhibit 7). We then did the pair wise comparisons of the various sub-objectives with respect to their parent objectives. For example, under 'Risk Factors', one of the sub-objective is 'Mortality' (Exhibit 8). The various sub-objectives/factors relating to mortality are ASA status, Anatomy, NPO Status, and Laboratory Results. ASA 3 patient implies a relatively good state of the patient. Thus, in doing the pair wise comparisons, ASA status was relatively less important (Exhibit 9). Resultantly, on synthesis of the comparisons ASA status received a weight of only 38.4%. Had the patient been ASA 5, we would have given more importance to ASA status which would then have got a higher weight vis-a-vis Anatomy, NPO Status, and Lab Results.

Following the pair wise comparisons of the objectives, we then did the pair wise comparison of the four alternatives- general anesthesia, regional anesthesia, sedation, and local anesthesia, with respect to each of the objectives and sub-objectives. Having recorded all the judgments, we then did a synthesis with respect to the goal. The result that we came up with was that for this particular patient local anesthesia is the best alternative.

Analysis of Results

An analysis of the results reveals two of the four alternatives found to be more satisfactory than the others. Exhibit 2 shows that general anesthesia was the best alternative, followed by regional anesthesia. Sedation and local anesthesia were least preferred, mostly as a result of failure to fulfill the objectives of providing optimal operating conditions for the surgeon and allowing for adequate intraoperative pain management. Our model suggest that any additional factor increasing this patients risk would likely choose regional anesthesia as the best option. If this patient's risk were significantly greater (ASA 4 or 5), local anesthesia would be the best choice (Exhibit 3). Although local anesthesia and sedation would not provide operating conditions that increase the likelihood of an optimal outcome, morbidity and mortality rates for these patients can reach 50% or more. Relative importance of minimizing risk would override the four other objectives. Varying relative importance of our objectives appropriately changes the preferred alternative.

The surgery planned for this patient requires a high priority be assigned to optimization of operating conditions. If this patients' operation was different, the choice of best anesthetic might be expected to change too. A major vascular operation on the lower extremities would be expected to alter the priority assigned to the objective of providing superior muscle relaxation, hence operating conditions. Exhibit 4 shows that the change in operation would indeed change the best anesthetic to sedation. This is in fact consistent with our experience as anesthesiologists.

Although the primary objective of our model was to provide assistance to the anesthesiologist in choosing the best anesthetic for a patient, many interesting questions came to mind when analyzing sensitivity graphs. For instance, Exhibit 5 shows that the relative priority assigned to this patient's objectives would need to be considerably greater to alter the best choice of anesthetic to be used. Future studies evaluating the correlation between this difference and patient perception of a successful outcome (and malpractice lawsuits) would be interesting.

Surgeons often disagree with anesthesiologists on the relative priorities assigned by to various objectives, specifically those given to maximization of operating conditions and risk. Future studies might look at these differences, and identify physicians that might not fit the "typical" profile of their colleagues. Those surgeons that differ most with anesthesiologists in assigning relative priorities are often thought to be "too demanding" or "unyielding," however there may be something to be learned if the short and long-term outcomes of these patients are different than those surgeons thought to be "normal." Exhibit 6 illustrates this point, as an increase in the priority assigned for risk of .035 requires an increase of .075 in the objective of optimizing operating conditions for general anesthesia to still be the best choice. A study of the elasticity of this relationship would be interesting.

<u>**Conclusion**</u>

The structure of our model takes into account the various situations anesthesiologists face daily. The choices made also reflect reality. The best choice of anesthesia to use usually is clear-cut. However, very few days pass in which an anesthesiologist is not faced with the type of difficult decision that our model addresses. Statistical data can be found in the anesthesia literature regarding such things as potential morbidity, mortality and complication rates, however anesthesiologists only use these as guidelines to make decisions. AHP appropriately allows the anesthesiologist to prioritize the five objectives based on clinical acumen and judgment, as all patients and situations are unique. Under such conditions of tough decision-making, we hope that the use of our model will provide anesthesiologist with a tool will assist them in choosing the best anesthetic for a particular patient. This model may prove valuable to the anesthesiologist in the event of an untoward outcome, as it can explain how the decision was made to those questioning the choice.

Exhibit 1

Our patient is a 62 year old male who presented to the Emergency Room of a local hospital with the chief complaint of "stomach pain." This patient has had this pain for several hours, and has been steadily getting throughout the day. He has not exhibited any vomiting, although he is nauseous and has no appetite. He did have a very small breakfast, consisting of a few bites of toast and a glass of juice.

Past Medical History:

Moderate to severe hypertension, poorly controlled with medication
Myocardial Infarction in 1997, ejection fraction of 37%
Angina, stable and controlled with medication
Chronic Obstructive Pulmonary Disease (COPD) as a result of a 45 pack-year History of smoking, quit in 1996
Peripheral vascular disease

Past Surgical History:

Coronary Angioplasty with placement of a stent in 1997
Bowel Resection in 1999 secondary to diverticulosis

Allergies:

None

Laboratory Results:

Hemoglobin/hematocrit	Within Normal Limits (WNL)
WBC	Mildly elevated

Radiology Results:

Air in large intestine, otherwise WNL

Physical Examination:

Blood Pressure	160/95
Pulse	110
Abdomen	Distended, with rebound tenderness

Clinical Impression:

Bowel obstruction secondary to adhesions, possible infarction of large bowel
ASA 3E

Plan: ??

Emergency exploratory laporatomy, possible bowel resection, possible colostomy

Exhibit 2

Original Performance Sensitivity Graph

This graph clearly shows that the best choice of anesthetic for our patient is general anesthesia, with regional anesthesia running a close second. This can be explained by the determined relative importance of providing superior operating conditions and intraoperative pain management when compared with the objectives of limiting side effects and accommodating the patients objectives. The importance of risk in this patient was paramount, the marginal increase in risk from general and regional anesthesia over sedation and local anesthesia were not great enough to overcome differences in pain management and operating conditions.

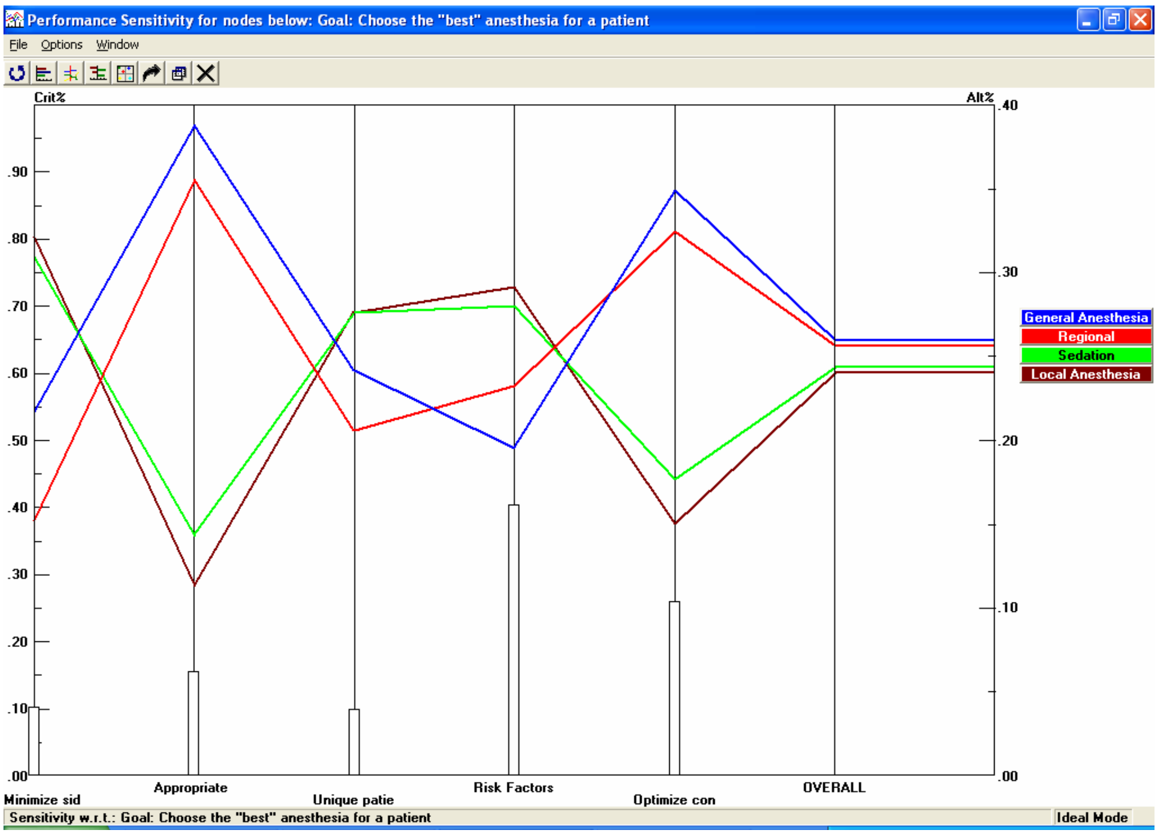


Exhibit 3

Performance Sensitivity Graph In a Higher Risk Patient

If our patient were thought to be a greater risk than he was, the choice of anesthetic would have changed. A small increase in risk would have pointed to regional anesthesia as the best option, whereas our model would have chosen local anesthesia for more significant increases in risk. This increase in risk would most likely be the result of a patient with more significant medical problems, abnormal laboratory results, or presence of anatomical abnormalities that would increase technical difficulties in performing general and regional anesthesia.

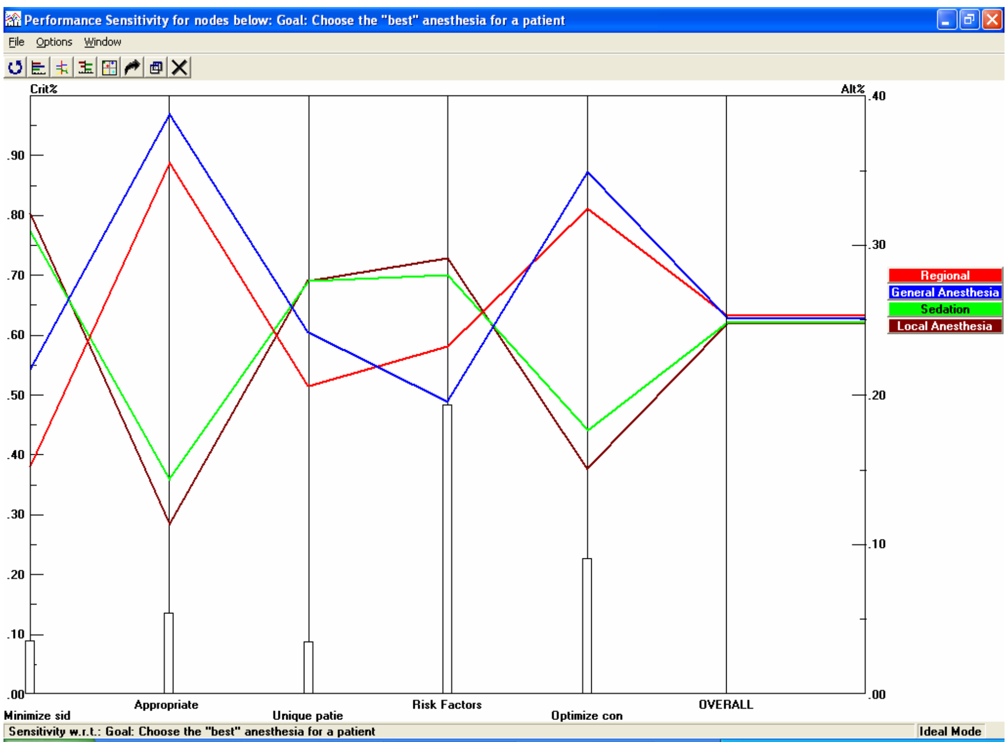


Exhibit 3 (Continued)

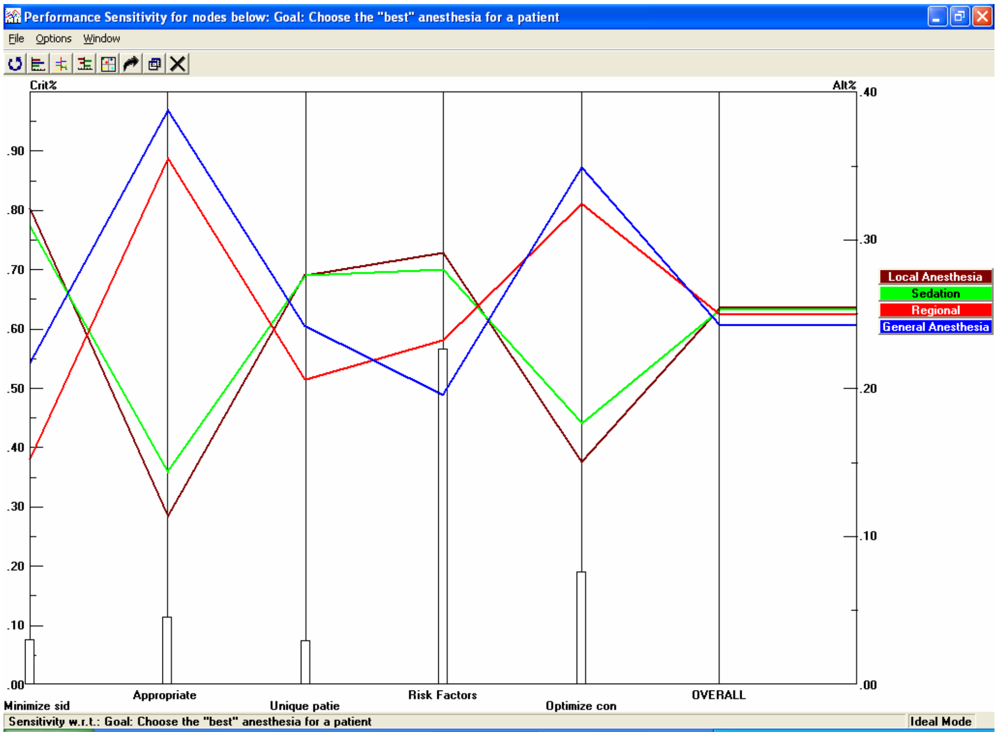


Exhibit 4

Change in Type of Operation

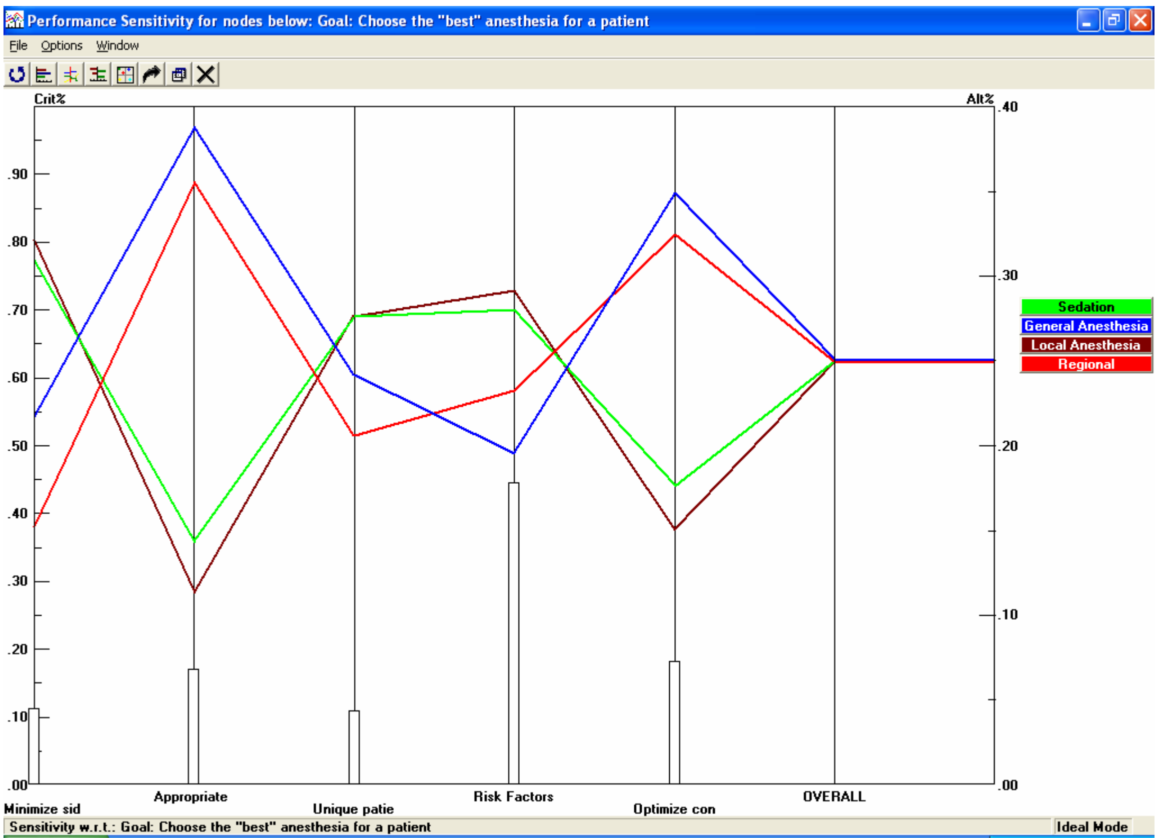


Exhibit 5

Required Priority of Patient Objective to Alter Choice

Our model demonstrates that this patient's objectives were not a significant factor in choosing the best anesthetic. Correlation between this difference and patient perception of outcome could be interesting.

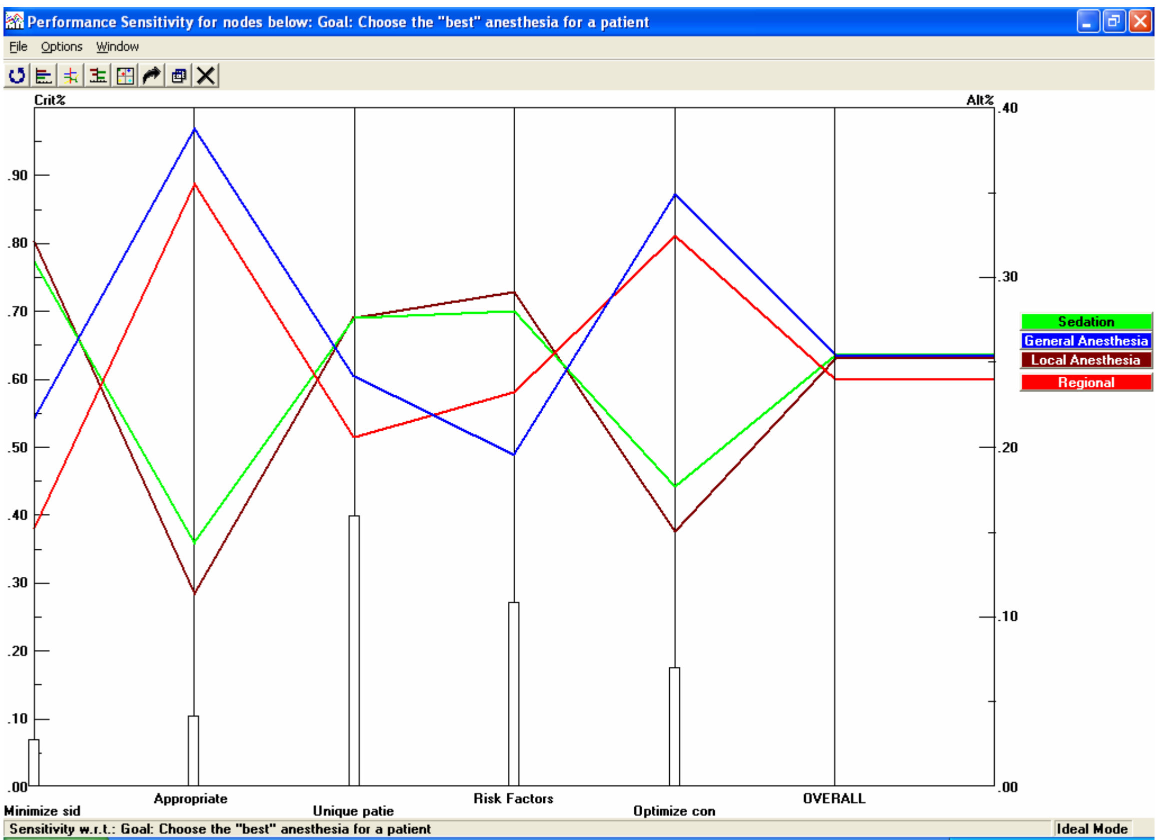
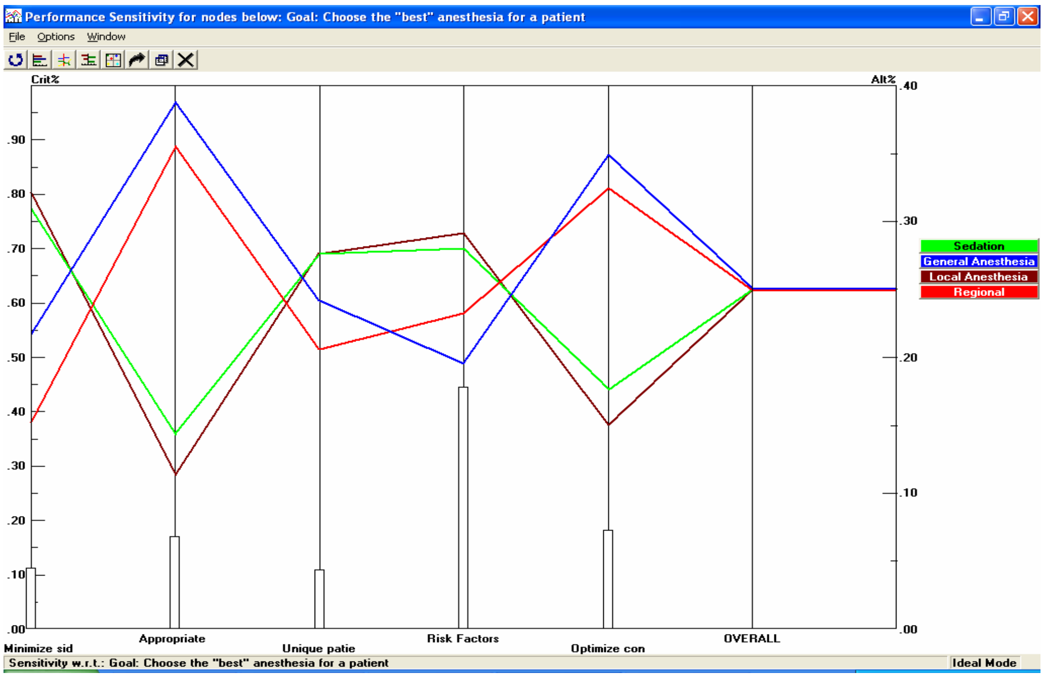


Exhibit 6



Performance Sensitivity for nodes below: Goal: Choose the "best" anesthesia for a patient
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Exhibit 6 (Continued)

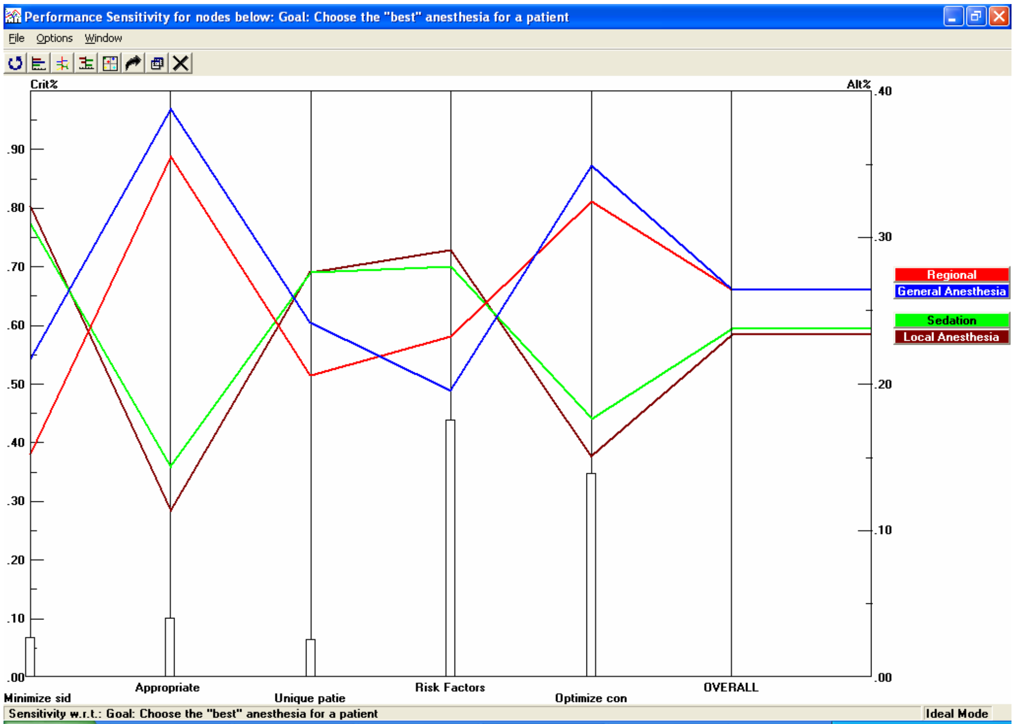
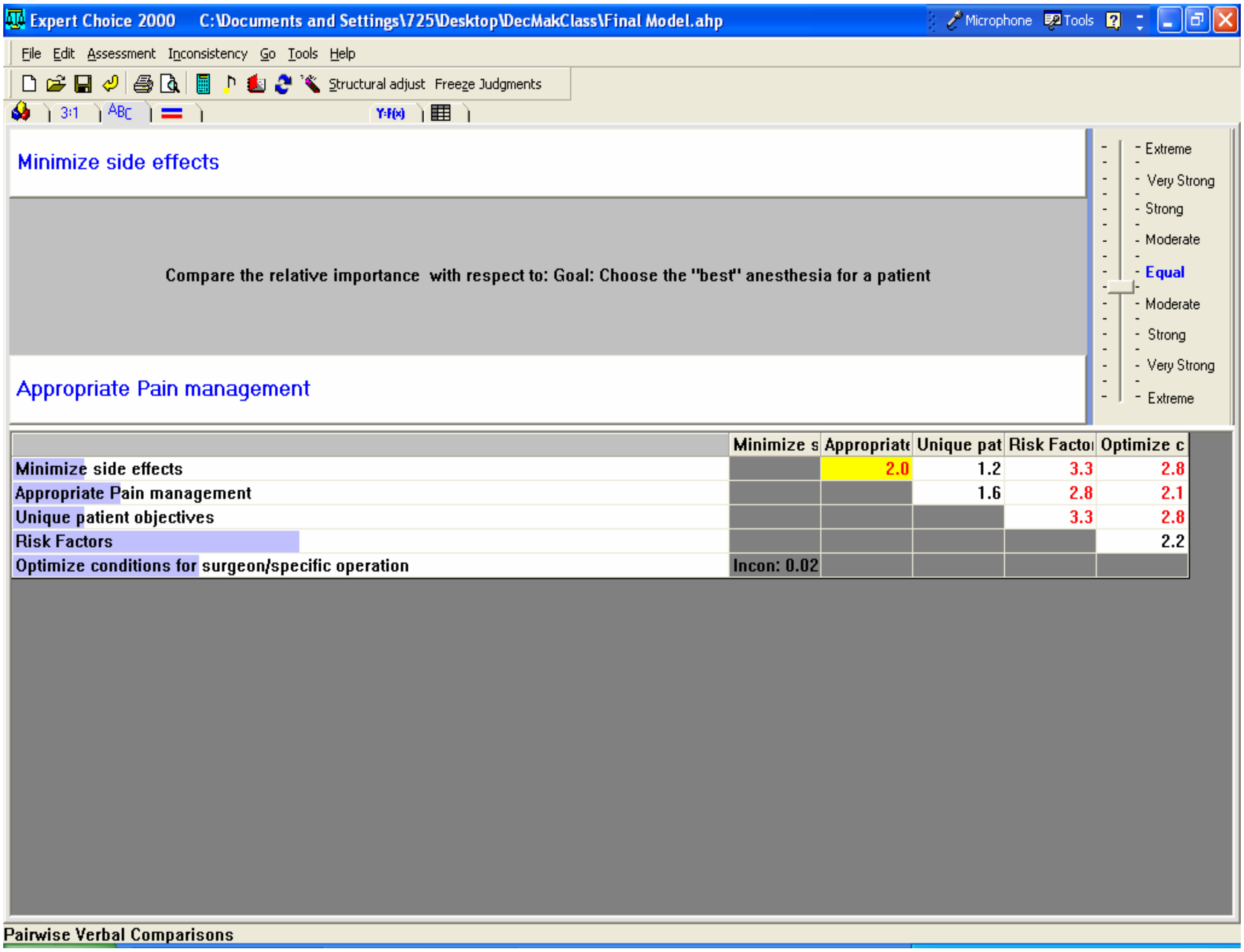


Exhibit 7



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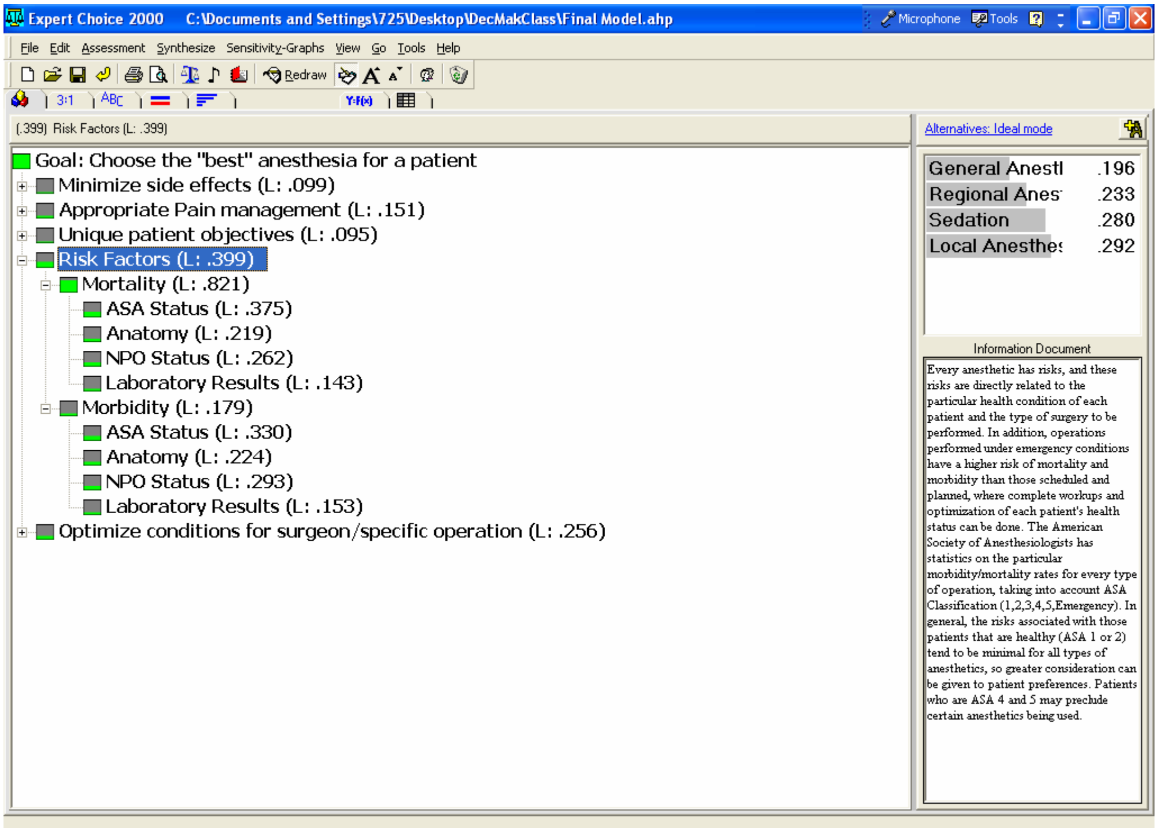
Pairwise Verbal Comparisons

Exhibit 8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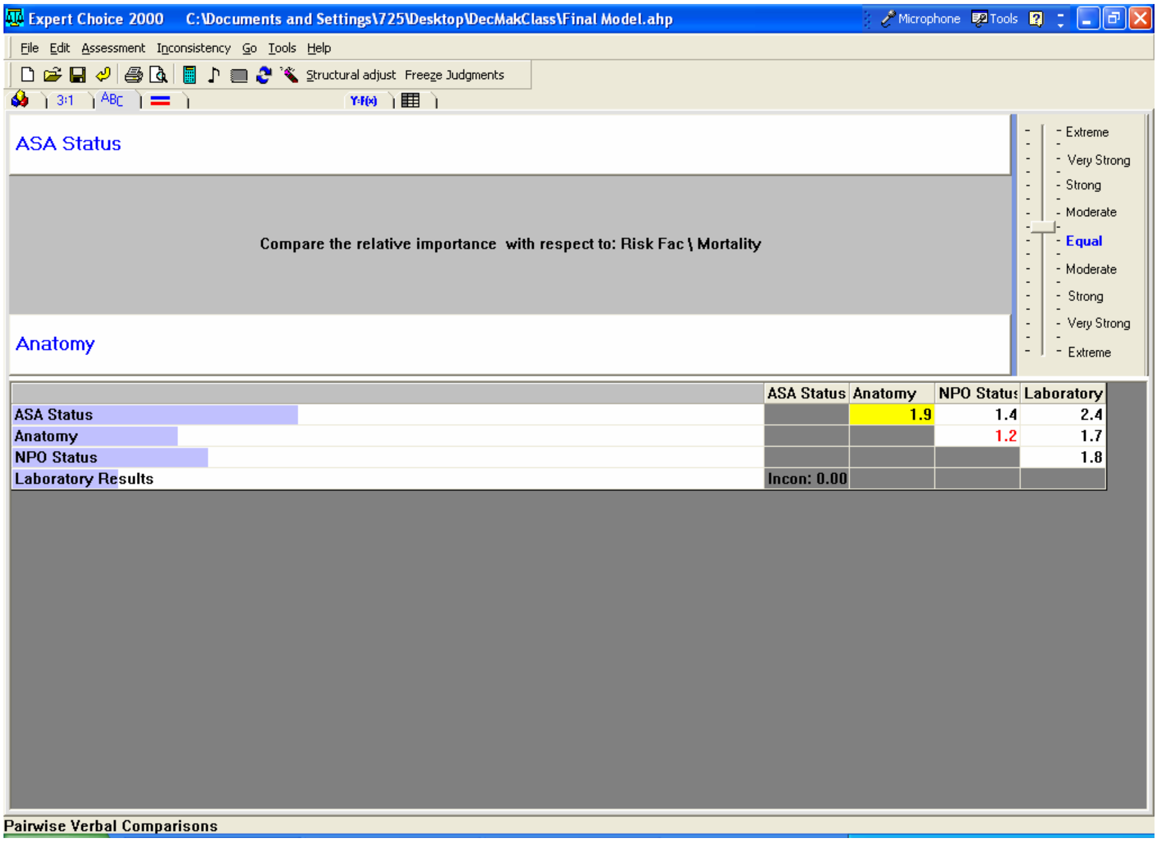
Unique patient objectives (L: .095)
Risk Factors (L: .399)
Mortality (L: .821)
ASA Status (L: .375)
Anatomy (L: .219)
NPO Status (L: .262)
Laboratory Results (L: .143)
Morbidity (L: .179)
ASA Status (L: .330)
Anatomy (L: .224)
NPO Status (L: .293)
Laboratory Results (L: .153)
Optimize conditions for surgeon/specific operation (L: .256)
Alternatives: Ideal mode
General Anestl .196
Regional Anes .233
Sedation .280
Local Anesthe .292
Information Document
Every anesthetic has risks, and these risks are directly related to the particular health condition of each patient and the type of surgery to be performed. In addition, operations performed under emergency conditions have a higher risk of mortality and morbidity than those scheduled and planned, where complete workups and optimization of each patient's health status can be done. The American Society of Anesthesiologists has statistics on the particular morbidity/mortality rates for every type of operation, taking into account ASA Classification (1,2,3,4,5,Emergency). In general, the risks associated with those patients that are healthy (ASA 1 or 2) tend to be minimal for all types of anesthetics, so greater consideration can be given to patient preferences. Patients who are ASA 4 and 5 may preclude certain anesthetics being used.

Exhibit 9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Pairwise Verbal Comparisons