HANDBOOK OF SOFT SKILLS TRAINING USING VIRTUAL REALITY AND SERIOUS GAMES FOR SURGICAL TEAMS IN THE OPERATING ROOM

S4Game Consortium

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6. DECISION MAKING

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THEORETICAL INTRODUCTION

Making decisions often cause serious problems in the everyday life. People must make several decisions per day ranging from trivial issues (e.g. what to have for breakfast) up to important decisions that determines one's own or others life. Before decision, some people search for more information or ask suggestions from elderly people, others decide to listen their feelings. Whatever mechanism is used to make decisions, they have severe impact in our future.

The word "decision" originated from the Latin word "decisio" which means "to cut from". The verb "to decide" means "to come to a conclusion" or "to pass a resolution". Trewatha & Newport (1982) defines decision-making process as follows: *"Decision-making involves the selection of a course of action from among two or more possible alternatives in order to arrive at a solution for a given problem"*.

Frequently, a lot of time is consumed while decision is taken, and it cannot be taken suddenly. A considered decision maker should follow the next six steps (Flin *et al.*, 2008):

1. Situation assessment - Defining the problem
2. Gathering information and collecting data
3. Developing and weighing the options
4. Choosing best possible option
5. Plan and execute
6. Outcome review

In surgery, doctors face a constant need for making decisions (in the OR, on the ward, bedside, in emergency situations) and often fast and immediate actions are needed. On the other hand, sometimes a deliberate decision is demanded where all factors should be carefully considered. Our decisions can be influenced by our profession, our relationship with colleagues and with patients, our performance and also the patient's outcome (Charalamborus, 2017).

Modern surgery requires that the whole surgical team make decisions according to their personal expertise. Studies mainly focusing on the background of the surgeon's and anaesthetist's decision-making skills in the operating room, especially in the intra-operative phase of surgery. However, scrub nurses are also key members of the team, who works directly with the surgeon and the assistant surgeons during the operation (Mitchel&Flin, 2008).

The traditional roles of the scrub nurse include ensuring that they are correctly 'scrubbed up', preparation of the instruments, trolleys and sterile supplies needed for the surgery, maintaining a sterile environment, providing skilled assistance to the surgeon during the operation, and performing the swab/instrument count at the end of the procedure. In the last decade the responsibilities of scrub nurse become the subject of debates because their duties and responsibilities have changed over the years (Taylor *et al.*, 2000).

While scrub nurses are involved into the intra-operative problem solving as a member of the surgical team, at the same time they cannot take part in decision-making process during surgery. This is because the surgeon has all the responsibility in the operating room, thus the surgeon makes the final decision all the time (Mitchel&Flin., 2008).

According to the literature, decision-making strategies of scrub nurses – including leadership skills – in the OR are rarely investigated, because it is not their main role in the surgical team. Generally, senior scrub nurses make decisions in nursing questions, organizing the whole team of nurses in the OR or in special cases an experienced scrub nurse trains a trainee or helps the work of an inexperienced young surgeon. Nursing soft skills are studied in other areas of healthcare like critical care or emergency departments (Bucknall *et al.*, 2003, Cesna *et al.*, 2004. Flin *et al.,* 2007, Nembhard *et al.*, 2006).

Anaesthesiologists and scrub nurses have managerial decisions in the OR. They are organizing the patient replacement; thus, they determine when surgeries should begin. From an economical point of view, scrub nurses are responsible for the proper operation of the OR, like performing all scheduled cases, reducing over-utilized OR time, reducing patient and surgeon waiting times and satisfying personal priorities (Dexter *et al.*, 2007).

The most important role of a well-organized anaesthesia team is the individual work in different ORs. A timely starts and brief times for patient awakening, turnover, and patient entrance to positioning are the basis of a well-organized surgical team. Wasting time can cause stress and disorders in communication, thus pulls back teamwork (Dexter *et al.*, 2007, Vitez *et al.*, 1998).

During the everyday surgical practice, patients should not be left out of the decision process. Generally, several therapies are available to treat the patient's disease (different types of surgery, no surgery, conservative therapy, endoscopy, etc.) and if none of these treatments is superior when weighing the benefits and possible harms, a treatment dilemma exists. Moreover, surgical techniques and its complications are not reversible, thus patient have to deal with potential harmful consequences (Barry *et al.*, 2012; de Mik *et al.*, 2018).

This chapter summarizes the background of decision making from surgical perspective. Surgery is a high-risk working environment, where real-time decisions made by front-line staff. Their decisions have a great impact, even being lethal if the decision is wrong. Examining how experienced surgeons decide in real situations have recently begun to be investigated. Several different methods and influencing factors of decision making are outlined, followed by practical suggestions for improving and assessing decision making skills.

The background of surgical decisions

Nowadays, surgical curricula are moving away from the traditional Halstedian apprenticeship model towards to a more formal, structured and mainly competency-based approach. On the early 2000s, doctor's weekly working hours have been regulated in all over the world by legislation directed at health and safety considerations for both doctors and patients. The reduction of work schedules and duty hours resulted on less time spent in the operating room, decreased exposure to clinical situations and also in the required number of operations (Poulose *et al.*, 2005). The loss of experience in decision making, both in the operating room and on the wards, needs to be compensated by improved training by expert surgical trainers and structured, competency-based practice in simulated environments (Flin *et al.*, 2007).

Surgical blocks and wards are risky environment where surgeons must make decisions under time pressured and unexpected

conditions. In emergency cases, unforeseen situations require new decisions or even changing the normal way of intervention. Surgeons often make individual decisions or consult with colleagues and make collective decisions with patients and relatives. They must either decide in the spot, within tight deadlines or they may have ample time for consideration (Hall *et al.*, 2003).

Naturalistic decision making

Classical (rational/normative) decision theory – developed by economists and business analysts - deals with selecting the optimal solution based on mathematical formulas for choosing between possibilities. However, these derived methods are too complex and impractical in time consuming situations and risky environments (Conolly *et al.*, 2000).

In emergency work situations, instead of making an optimal or perfect decision, reaching a satisfactory solution to gain control of a problem is often the main priority. In the early 1990s, researchers have begun to investigate the professionals' decision-making techniques in their normal environment, where decisions have to be made quickly under high risk and accuracy. Hence, naturalistic decision making (NDM) has emerged, where psychologists studied expert decision makers (firefighters, pilots, surgeons, militarists) in operational environment (Flin *et al.*, 1997; Lipshitz *et al.*, 2001).

NDM researchers aim to describe how experts make decisions in conditions of high uncertainty, inadequate information, shifting goals, high time pressures and risk, usually working in teams and subject to organisational constraints. These are all conditions experienced in the operating room, and it is likely that surgeons use similar cognitive techniques to make decisions during operations. This naturalistic approach has also been applied to other fields of medicine where uncertainty, suboptimality and value-based judgements are common (e.g. emergency units) (Flin *et al.*, 2008; Falzer, 2004; Zsambok *et al.*, 1997).

Model of decision making

In high risk work environments, a continuous cycle of monitoring is required. The model of dynamic decision making consists of three main levels:

- to assess the situation,
- taking appropriate actions,
- re-evaluating the results.

The model is adapted from a research with pilots and also well applied to surgery. The model shows the two-stage process of decision making:

1 **SITUATION ASSESSMENT.**

This is the first and the most critical stage of decision making and differs from situation awareness which means a continuous cognitive monitoring of our environment. Here we are not only a participant of a case; it is a much more conscious presence to identify and understand the new situation. When cognitive monitoring detecting changes, then a more focused assessment takes place. It involves attending to a selection of the available cues, assembling them into a mental pattern and searching long-term memory to recognise the problem. This is called "problem recognition". Often this assessment reaches only that the situation can be fatal, and a remedial action is needed without solving the problem. Situation assessment involves anticipating how the current state of events could change in the immediate future. Diagnosing the current situation requires a significant level of expertise and often a team involved to build a mental model to solve the situation. (Flin *et al.*, 2008; Gaba, 1992).

Sometimes situation assessment is incorrect, so the response will not result on the expected change. Faulty assessment depends on several factors, risk levels may be miscalculated, or the assessing time is not enough. Decision failures can also occur when conditions change, or the decision maker did not update his/her assessment often enough. Orasanu *et al.,* (1997) investigated airline pilots problem solving techniques and they found that the available time and the level of risk during a situation assessment phase is critical and determines the type of decision method. Experienced professionals are more accurate at estimating the available time and create better and more strategies in a current case than younger colleagues.

2 USAGE OF A DECISION-MAKING METHOD FOR CHOOSING THE APPROPRIATE ACTION.

After assessing the changes in the environment, the possibly correct action is chosen according to the actual needs. The four principal decision-making models are:

Recognition-primed (intuitive) – solution is chosen based on the previously recognized pattern (previous experience).

Rule-based – applying recalled rules to the situation, this type of technique requires awareness of the rules and also knowledge to how to apply them.

Analytical – different and alternative options identified and the preferable one is carefully selected.

Creative – faced with unusual problem, improvisation is necessary.

The type of the decision strategy is determined by the available time and the degree of the risk. In case of emergency and high risk, the decision maker uses fast intuitive or rule-based decision strategies **(Figure 6.1)**. With more time, the decision maker evaluates the alternatives in a slower and more rigorous, analytical manner. In the intuitive and rule-based methods, only one response option is considered at a time. In analytical decision making, several optional actions are generated and then compared simultaneously. In the creative option, the situation is judged to be totally unfamiliar and requiring a novel response (Flin *et al.,* 2008; Charalamborus, 2017).

Figure 6.1. *Decision-making techniques depending on the level of risk and the available time.*

Recognition-primed decision making (RPD)

This decision-making technique relies on remembering the responses to previous situation of the same type. The solution quickly recalled from the long-term memory or a personal/observed technique used in a previous case with a similar situation. In this method, choosing a course of action is likely to be experienced as an automatic process, with little conscious deliberation. It is used mainly in situations where decision needed under uncertainty with quick action to prevent a catastrophic outcome. This method is used by experts working with routine cases, especially under high time pressures, and it may be reasonably resistant to the effects of stress. It is unlikely to be used by novices, as by definition they have limited domain experience and thus possess fewer memories of relevant events (Klein, 1993; Flin *et al.*, 2007).

Rule-based decision making

The rule-based method involves identifying the encountered situation and looking up a manual to apply onto the particular case. In medicine, it means the usage of an evidence base reference or the implementation of guidelines from an established authority. This process requires more mental effort than RPD. The decision maker is continuously searching his/her memory to recall the matching rule, or physically consulting a procedures manual/checklist to find the given response. Rule-based decision making is mainly used by novices who learn standard procedures for frequent or high-risk situations. With practice, this becomes automatic and the rule can be retrieved from memory with little conscious effort compared to recognition primed technique. Over-reliance on rule-based decision making may cause a degree of skill decay. It is not sure, if an unfamiliar situation arises and no guideline exists, a novice decision maker will be able to find an appropriate action to solve the problem (Flin *et al.*, 2007).

Analytical decision making

The decision maker investigates a number of actions and compares them simultaneously to determine the best one that the situation requires. Comparing options is often also called rational choice decision making. Several statistical and mathematical formulas give possibilities to help the selection of the optimal choice (e.g. Bayesian modelling), however the analytical comparison requires enough time and huge mental efforts to make correct decisions.

Creative decision making

An unfamiliar case indicates a brainstorming under high time pressure environments and requires a novel action to solve the problem. This technique in surgery mainly used in extremely high-risk situations without any logical alternatives by experienced experts. (Flin *et al.,* 2007.)

Table 6.1 summarizes the advantages and disadvantages of the different decision-making techniques.

DECISION MAKING TECHNIQUE	ADVANTAGES	DISADVANTAGES
Intuitive	» Rapid » Requires conscious thought » Useful in routine if applied by experts » Resistant to stress » Provide satisfactory	» Requires experienced user » Difficult to justify » Can encourage to support one model, rather than considering evidence that may not support that model
Rule-based	» Appropriate for novices » Rapid, if the rule learnt » Give a pool of determined actions by experts » Not necessary to know the background of each steps » Easy to justify the next step	» Time-consuming » Usually not written » If interrupts, easy to skip steps » Rule/guideline may be inaccurate » Wrong guideline may be selected » Not improve skills
Analytical	» Compares all possibilities » Justified » May chose the optimal solution	» Requires time » Difficult in distracting environment » Can be affected by stress » Can cause cognitive overload
Creative	» Solving unfamiliar problems » Helps innovation	» Time-consuming » Untested » Difficult under stress » Difficult to justify

Table 6.1. *Comparison of advantages and disadvantages of decision-making techniques.*

Factors influencing decision making

Understanding the factors that influence decision-making process is important to understand how decisions are made. Several factors influence decision making, like past experience, cognitive biases, age and individual differences, belief in personal relevance, and an escalation of commitment, influence what choices people make. Factors that influence the process may impact the outcomes (Dietrich, 2010).

Positive decisions increase satisfactory, which help people to make decisions quickly and with ease. Heuristics serve as a framework in which satisfactory decisions are made quickly and with ease. Many types of heuristics have been improved to explain the decision-making process; their main aim is to reduce the effort they need to expend in making decisions and heuristics offer individuals a general guide to follow, thereby reducing the effort they must disburse. Together, heuristics and factors influencing decision making are a significant aspect of critical thinking (West *et al.*, 2008; Shah *et al.*, 2008).

Future decisions mainly based on past experiences however are not necessarily the best decisions. If a decision had positive results, people are more likely to decide in a similar way in a similar situation. On the other hand, people are afraid of repeating past mistakes, thus rather than examining the background of negative outcomes, successful people investigate the current possibilities without any regard of past experiences (Juliusson *et al.*, 2005).

Research has indicated that age, socioeconomic status, and cognitive abilities influence decision making. A significant difference certified in decision making across age; that is, as cognitive functions decline as a result of age, decision making performance may decline as well. In addition, older people may be more overconfident regarding their ability to make decisions, which fits to the situation. Finally, with respect to age, there is evidence to support the notion that older adults prefer fewer choices than younger adults (de Bruin *et al.*, 2007; Reed *et al.*, 2008).

Heuristics are general decision-making strategies people use that are based on little information, yet very often correct; heuristics are mental short cuts that reduce the cognitive burden associated with decision making Heuristics reduce work in decision making in several ways. Heuristics offer the user the ability to scrutinize few signals and/or alternative choices in decision making. In addition, heuristics diminish the work of retrieving and storing information in memory; streamlining the decision-making process by reducing the amount of integrated information necessary in making the choice or passing judgment (Shah *et al.*, 2008; Dietrich, 2010).

As a cognitive skill, decision making is also depending on the following factors:

- Stress.
- Fatigue.
- Noise.
- Distraction.
- Interruption.

If time and mental effort are required to assess a situation, decision-making process may be vulnerable. The two main factor of decreasing decision-making ability are the stress and the fatigue.

Stress may influence decision-making abilities both positively (information process) and negatively (over selective attention, decreased memory capacity, retrieval from long term memory). Among the four main decision-making techniques, stress affects the analytical and creative methods the most, because they use actively use cognitive resources. RPD as a method that is relatively light on cognitive processing, is less affected by stress **(Figure 6.2)** (Flin *et al.*, 2008; Orasanau *et al.*, 1997).

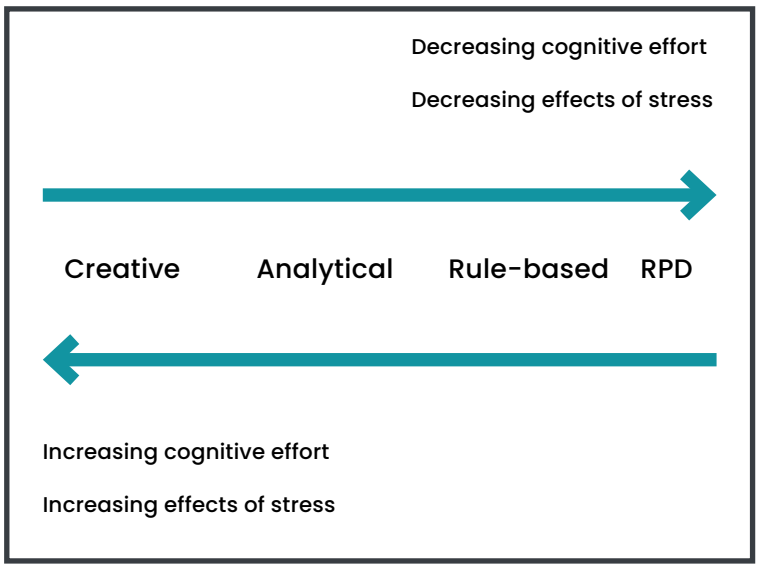


Figure 6.2. *Effects of stress on decision making.*

Another common factor that can influence decision making is fatigue. Only one night of sleeping loss can cause impair flexibility, decrease perseveration and the adaptation to updated situations.

In workplace environment decision, makers are faced with

multiple, conflicting factors that can influence the decision-making process. Recognising and accepting these contradictions could help to understand ourselves and improve our decision making. Leung *et al.* (2012) categorized these factors into three groups:

- Un-avowed factors - that serve the interest of the healthcare system, but not the patient (teaching, research, relationship).
  - Allow residents to operate.
  - Participation in surgical trials.
  - Change the surgical management plan.
- Dis-avowed factors – serve the interest of the surgeon (monetary, personal incentive aspects).

Assessment of decision-making skills

Assessing cognitive skills sometimes poses a challenge to the researchers and trainers. Generally, decision-making skills are carried out in non-operating conditions by written or oral examination. Situational judgement questionnaires and methods present a case study and offers several alternative answers. This test investigates how candidates decide among the possible options comparing with the answers of experts of the exact case. Psychometric questionnaires also give possibilities to assess soft skill, however it reveals nothing specially of decision-making skills (Flin *et al.*, 2007; Motowidlo *et al.*, 1990).

Simulators and Tactical Decision Games (TDG) offer an objective and entertaining approach to assess decision-making skills. These ICT-based serious games have special scenarios with avatars of the surgical team and simulates real cases from the everyday surgical practice. Subjective observation of the cognitive part of the performance may be used, but it is not always practical, except if more trainees play at the same time, because through teamwork skills decision making behaviours may also be assessed.

Oxford Non-technical Skills System (NOTECHS)

Originally, NOTECHS is developed during the 1990s to assess the soft skills of cabin crew members. While operating staff also working as a team and surgery is also a high-risk environment NOTECHS adapted to understand the influence of behaviour on outcome in the OR. Decision-making process is individually assessed in a 4-point numeric scale to afterwards obtain a summation of scores per sub-team (surgical, anaesthetic and nursing teams) for which a list of modifiers, both positive and negative, have been defined (Mishra *et al.*, 2009).

A Modified Room Team Non-Technical Skills Scoring System (Oxford-NOTECHS II.)

15 years after the NOTECHS released, a need appeared for clearer difference between levels of performance within the normal range. To facilitate differentiation, a modified Oxford-NOTECHS II. scale have been improved in 2014. The new system uses an eight-point scale instead of four-point scale to measure each soft skill and default rating of six for each element. The main aim of this development was to improve scalability, enabling a richer understanding on the impact of each soft skill, including decision-making skills (Robertson *et al.*, 2014).

Miller's Pyramid

Traditionally, the model has been used to match assessment methods to the competency being tested. In the pyramid, the lower two levels only test cognition (or knowledge) and this is the area where inexperienced trainees (or novices) usually sit: for example, they either 'know' something about a surgical examination or they 'know how' to do a surgical examination. The upper two levels test behaviour: can they apply what they know into practise? Going back to the previous example: can they 'show' how to do a surgical examination or do they actually 'do' a surgical examination in practise? (Miller, 1990) **(Figure 6.3)**.

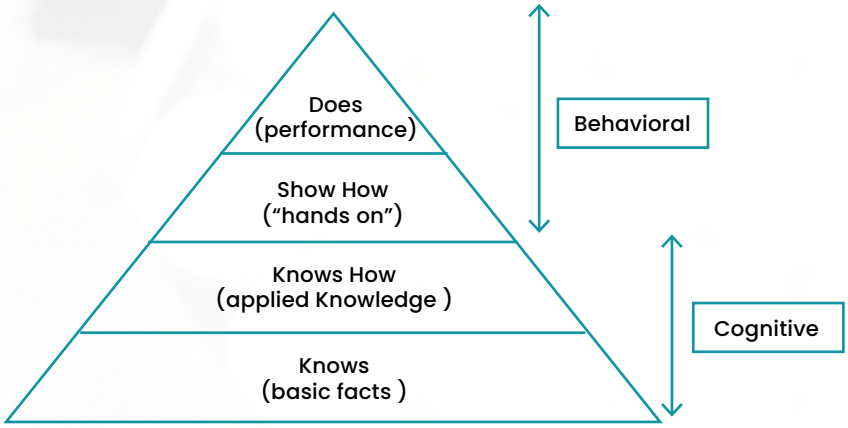


Figure 6.3. *Miller's pyramid (Miller, 1990).*

Training of decision-making skills

Classic method of training of decision-making skills is based on choice methods. While these methods are very effective in theoretical environment, in high-risk and stressed working environment tend to be irrelevant to assess the necessary skills (Klein, 1998).

To better memorize the necessary steps, several sequence or acronyms are used by experts in aviation. The best-known acronym is DODAR used by British Airways:

- D – Diagnosis — What happened?
- O – Option — What are the possible options?
- D – Decision — What are we going?
- A – Assign the tasks — Who does what?
- R – Review — What changed after the action?

This technique allows decision makers to follow a "guideline" and avoid missing steps during the process. However, in stressful environment, under time pressure it could be very difficult to follow (Flinn *et al.*, 2007; Walters, 2002).

Tactical decision games (TDG) are computer-based approaches to improve professional group's soft skill, especially decision-making skills. TDG contains small simulated scenarios and usually 4 to 10 participants are presented in a session, whom are asked to assign roles of the surgical team. Scenarios presents a case of real surgical problem and give information to help the decision, however important

information may be missing or misleading, or ambiguous information may be contained. The time is limited in each decision to simulate the real time-consuming situations and increase the stress factor. After each scenario, a brief discussion organized by a facilitator to analyse the similarities and differences of actions (Flin *et al.*, 2007.)

Story telling is a natural and ancient method of improving soft skills. In several workplaces (e.g. pilots, police officers, military officers, surgeons, nurses, etc.) "war stories" are the most interesting and exciting way of exchange of expertise. This happens in canteens, during lunch or after work and significant learning in this occupation is achieved by this way of experience sharing. According to Flin *et al.* (2007): *"Experienced professionals store these anecdotal accounts and use them to enrich their own memorised patterns of significant event for their work settings"*. Storytelling helps novices to understand better the background of situations and make sense of events.

After making a decision

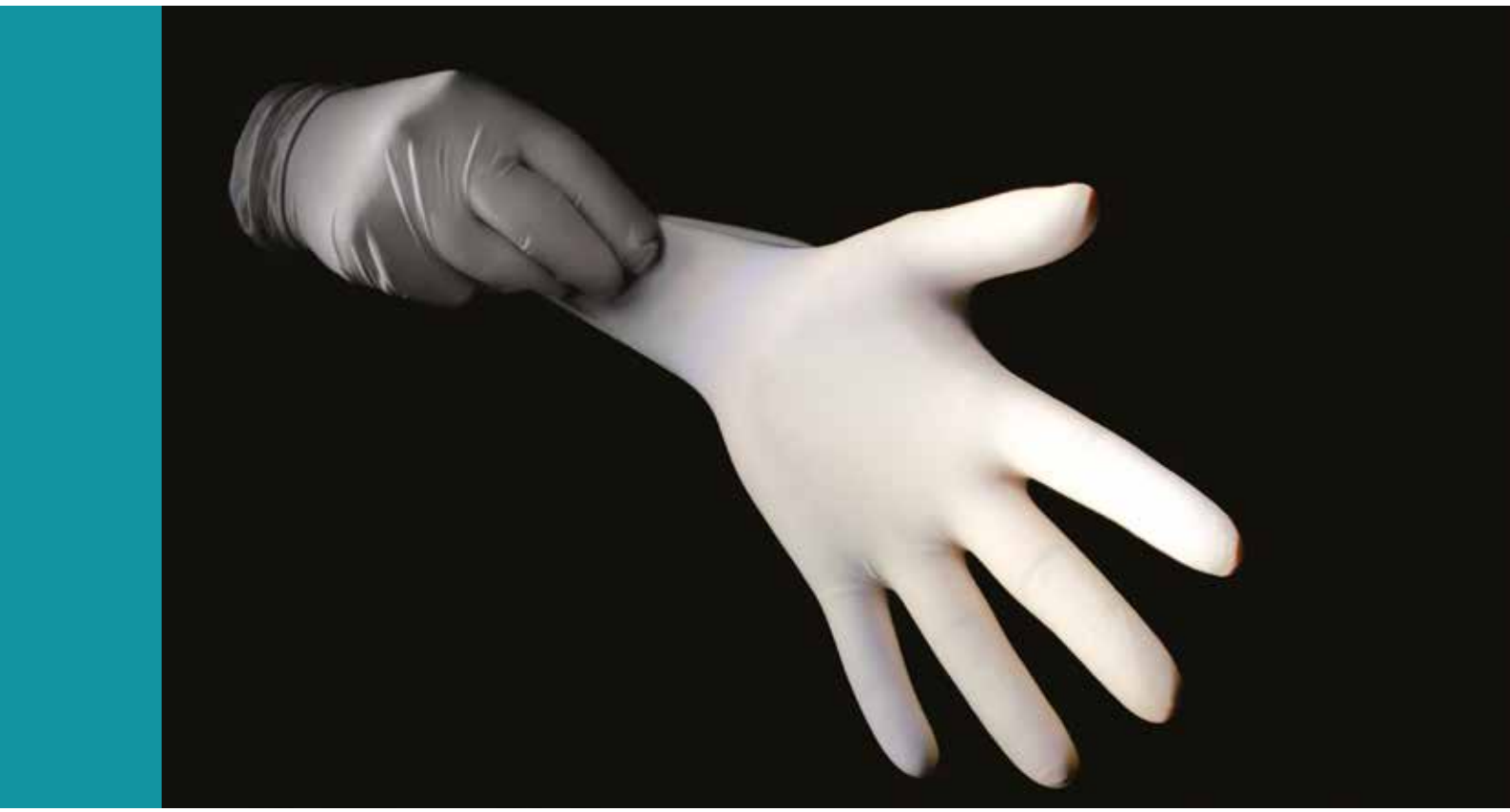
After a decision is made, people may experience a variety of reactions. Different outcomes may result different feelings like regret or satisfaction, however all may influence our upcoming decisions.

Interestingly, regret shapes better the decision-making process. Regret, feelings of disappointment or dissatisfaction with a choice made is one potential outcome of decision making. Anticipated regret is the belief that the decision is the result of inaction. Anticipated regret may prompt behaviour; that is, when a person indicates they will not do something, such as take the pills, nonetheless they do to avoid regret. Once the decision is made and if the impact of the decision is regret, it will impact future decisions (Abraham *et al.*, 2003).

People feel regret in accordance with how the decision was made; regret may be dependent on the number of options that were available during the decision-making process; and how varied the options were may impact how regret is experienced after the decision was made. People feel remorse because they feel they were able to make a better choice by looking at more information, previously disregarded, and carefully weighing the pros and cons of each choice. In addition, regret is magnified when individuals revisit the other available options and considering what satisfaction the other option would have brought them. Interestingly, people who are dissatisfied with their decision feel obligated to embrace the decision, as a means to reducing anxiety regarding the quality of the decision (Sagi *et al.*, 2007).

Individuals may also experience satisfaction with their decisions. Satisfaction means how pleased the decision maker is with the outcome of the decision. Evaluating the positive and negative aspects of choices is also an interesting decision-making strategy (Botti *et al.*, 2004).

If younger and older adults use this strategy at the same time in the same question, older adults tend to list more positive and fewer negative aspects of each choice, and older adults register more satisfaction with their choices when they use this evaluative strategy. One interesting



finding was that when people did not evaluate the options by listing the positive and negative features, there is no age difference in satisfaction (Kim *et al.*, 2008).

Besides past decisions, satisfaction or regret, future decision-making strategy is depending on the reversibility factor. The opportunity that people change their minds is significant to individual's satisfaction, while this ability decreases the satisfactory factor of their decision (Gilbert *et al.*, 2002).

CONTEXTUAL INFORMATION

Managing acute appendicitis

In a surgery department of a city hospital, two operating rooms (OR) and two surgical teams are working during the night shift. The surgical team consists of 3 general surgeons (a specialist – chief and 2 residents – PGY 4 and 5), an anaesthesiologist, 4 nurses with three different functions (2 instrumentalist/1 circulating/1 anaesthesia). Another specialist is "on call" duty at home.

In OR "A" an open laparotomy is performed by the surgeon with the older resident (PGY 5) as first assistant. The anaesthesiologist with the anaesthesia nurse, a circulating and an instrumentalist nurse are also present at this OR. The younger resident (PGY 4) is on the ward.

At 11 pm, 35-year-old male patient arrived at the surgery department with abdominal pain, nausea, and low-grade fever. Pain started in the mid-abdominal region 2 days ago and is now in the right lower quadrant of the abdomen. The pain was sharp and steady in nature and aggravated by coughing. The

younger resident examined the patient and physical examination reveals a low-grade fever (38,4ºC), pain on palpation at right lower quadrant. No diabetes mellitus, hypertension or any other chronic disease or blood transfusion present in the patient's history. No allergies and do not take medicines. The abdomen is soft and lax, no organomegaly, right iliac fossa tenderness. McBurney and psoas signs are positive. The resident took blood sample for laboratory and the patient has leucocytosis (11,800/microlitre).

The young doctor first impression is appendicitis, however several diseases may mimic the same symptoms, such as testicular torsion, urinary tract infection, right side ureteric colic or Crohn's disease. The differential diagnosis based on the following symptoms:

Testicular torsion – swelling of the scrotum:

- Painful urination.
- Fever.
- Urine microbiology is negative.

Urinary tract infection – a burning feeling during urinating:

- Cloudy/bloody urine.
- Fever.
- Pain.
- Urine microbiology is positive.

Right side ureteric colic:

- Haematuria.
- Pain radiation to the scrotum.

Crohn's disease:

- Age.
- Fever.
- Diarrhoea.
- History.

According to the lab findings, the positivity of physical examinations sings and the resident's previous experience, he/she has the impression of appendicitis. The resident doctor discusses the case with the surgeon who decided to have surgery immediately. Here the resident used the rule-based decision-making techniques.

Appendicitis is the acute inflammation of the vermiform appendix. Typically presents as acute abdominal pain starting in the mid-abdomen and later localizing to the right lower quadrant. Associated with fever, anorexia, nausea, vomiting, and elevation of the neutrophil count. In patients with acute peritonitis, appendectomy should be performed without delay. Complications of acute appendicitis occur in 4% to 6% of patients and include gangrene with subsequent perforation or intra-abdominal abscess.

Thus, the resident was faced with the following issues to be resolved:

- Is there surgical capacity for immediate surgery? (anaesthetists, assistant surgeon, nursing).
- Open or laparoscopic appendectomy should be performed? If laparoscopic, he/she needs a specialist's assistant, because he/she have performed only 3 laparoscopic appendectomy previously and a competent help is needed.
- Is the previous surgery finish and the surgeon can help him/her? Should the other specialist - who is at home – call?
- Has the resident the necessary skills to perform this surgery?

The resident calls the OR to ask the surgical team about the possibilities. The specialist stated that the previous surgery (in room "A") would not be completed within 2 hours, however the appendectomy should be performed as soon as possible. The surgical specialist suggests to the resident to call the other specialist at home, to join the surgery as soon as possible.

According to the anaesthetist, the patient is eligible for laparoscopic intervention (age, cardiovascular status, etc.) and also the patient will have better outcome. The two specialists used the recognition-primed decision (RPD) making technique.

According to the responsible shift nurse, an instrumentalist nurse can join to the whole appendectomy, however only one nurse can be provided for circulating and anaesthetics issues. Here the creative decision-making technique is used.

After the call with the duty team, the solution is found. The resident calls the specialist at home to join him/her and help to perform laparoscopic appendectomy, then he/she begins to prepare the patient for immediate surgery. Parallelly an instrumentalist nurse starts to prepare the room "B" for surgery.

The anaesthesiologist in room "A" adapts to this situation and indicates the general anaesthesia in room "B" (during this

period the anaesthetist nurse observe the surgery in room "A"), than the anaesthesiologist goes back to room "A" and the anaesthesia nurse leave room "A" and accumulate the functions of circulating and anaesthesia works in room "B".

PROBLEM RESOLUTION:

- Room "A" – 2 surgeons (1 surgeon, 1 first assistant PGY5), an instrumentalist nurse, a circulating nurse and an anaesthesiologist.
- Room "B" – 2 surgeons (1 resident PGY4, specialist), an instrumentalist nurse and an anaesthetic nurse (functioning as circulating and anaesthetic nurse).
- Anaesthesiologist is circulating between the 2 OR.

Finally, after inducting pneumoperitoneum and entering the abdomen, no perforation or complication found, laparoscopic appendectomy is successfully performed. After surgery the patient got antibiotics and non-steroidal anti-inflammatory drugs for 3 days intravenously.

KEY CONCEPTS

Dynamic decision making is a two-stage process, assessing and diagnosing the situation, and then choosing one or more decision making methods to select a course of action. Correct identification of the situation is essential to solve the problem. Pilots make more decision errors by way of misidentifying the situation and applying the stipulated procedure than they do in correctly identifying the situation, but then taking the wrong actions (Orasanau *et al.*, 1997). Dynamic decision makers will typically switch between the different decision-making methods (intuition, rules, analysis, creative) depending on the available time, routine and situation demands. (Hamond, 1988). Crosskerry (2005) compared the intuitive and analytical methods with clinical decision making, *"the trick is in matching the appropriate cognitive activity to the particular task"*.

Some form of fusion of the different types of decision making may also probably take place, depending on context (e.g., elective vs emergency, familiarity of the procedure, predictability of events). In the case of a sudden bleeding, the first intuitive decision will be to secure haemostasis by achieving proximal and distal control, and thus create time to assess the situation and to identify the available options. Experienced surgeons are using more the intuitive, pattern-matching techniques than trainees, who will have to make more analytical comparisons of optional courses of action for a given problem (Flin *et al.*, 2007).

Regardless the selected method of decision making, it is advisable that a review stage is included after implementation, to ensure that the chosen course of action resolves the problem as anticipated. Discussion of intraoperative decisions should be included during post-case debriefing, although this safety procedure seems to be used far less frequently in medicine than in other safety-critical professions (Flin *et al.*, 2007).

VISUAL ABSTRACT

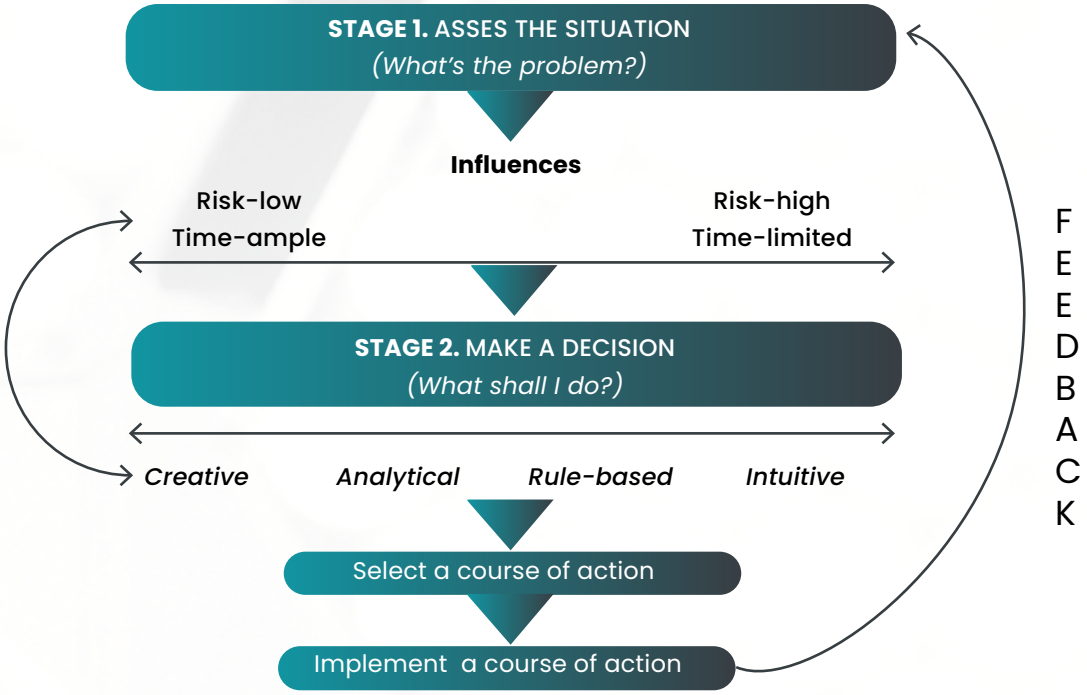


Figure 6.4. *Model of decision making after (Flin et al., 2008).*

EXAMPLE IN PRACTICE

Small bowel lesion during open abdominal hernia repair

A 57-year-old male was presented on surgical ambulance with 6-month history of a painless irreducible lump in the abdomen. He had a long history of constipation but no recent change in his bowel habit, nausea, vomiting, or pain. The patient's medical history included hypertension treated with ACE-inhibitors, hypercholesterolaemia treated with statins, Type 2 diabetes treated with metformin and diet and deep vein thrombosis for which he was on enoxaparin. He had no known allergies.

On assessment the patient appeared well, his vital signs were stable, and his abdomen was soft and tender. A child's head large lump was in his right anterior abdominal wall and was tender and irreducible. The patient signed light abdominal pain when coughing, exercising or bending over. The patient's inflammatory markers and renal and liver function tests were within normal limits.

An ultrasound scan showed hernia a size of a child's head measuring 14.6 x 26.9 cm on the right abdominal wall **(Figure 6.5)**.

Abdominal CT reported a right abdominal hernia measuring 15.5 × 30.0 cm, containing fluid, fat, and a small bowel junction.

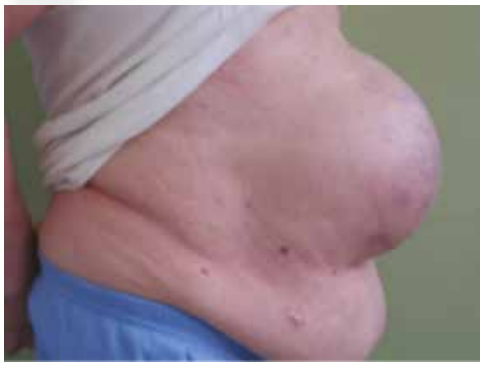


Figure 6.5. *Patient with a 30 cm diameter of abdominal hernia.*

Surgical decisions:

- Is it an emergency case?
- What type of surgical method is needed? Open or laparoscopic abdominal hernia repair should be performed?
- Surgical indication – absolute, vital or relative?
- If open hernia repair: direct suture or implantation of the mesh?
- Implantation of the mesh: what type of mesh do we use?
- Implantation of the mesh: small bowel lesion during the laparotomy?
- Continue surgery: significantly increased risk of implant infection?
- Give up the reconstruction of the abdominal wall: e.g. discomfort, etc.?
- Risk of recurrence in the scar?
- Risk of recurrence on the abdomen?
- Advising weight loss to the patient?
- Diet restrictions?

Anaesthesiologic decisions:

- Are there anaesthesiologic risk factors?
- Laparoscopic technique is an appropriate choice for the patient?
- Cardiac risk of laparoscopic technique?
- Is the patient anaesthetically suited for surgery?
- Surgery can be postponed until the patient is cardiologically fit for laparoscopic surgery?
- Whether the patient gains laparoscopic technique?

Nurse decisions:

- If the surgical indication is absolute, when the patient is introduced into the schedule?
- Will he be placed on the recovery service?
- What type of instruments are needed to this surgery?
- What type of hernia meshes are available? Which one is suitable for the patient?
- Is there enough large size to cover the abdominal wall deficiency?

SUMMARY

Decision making during surgery, particularly in emergency cases, is a key element in clinical practice that merits better preparation than is currently delivered. Current techniques in surgical training allow little opportunity for reflection, and perhaps there is now place for a more careful scrutiny of surgeons' cognition, using the naturalistic decision research methods.

Investigating decision-making techniques on the surgical team's level (surgeon, anaesthesiologist, scrub nurse) is a major challenge, because for centuries the surgeon has all the responsibilities in the operating room. Anaesthesiologists may have an influence on the timing and invasiveness of surgery depending on the patient's cardiovascular status, however only in vital cases they may make decisions related to the patient's outcome. Nurses (scrub-, circulating-, anaesthesia nurse) may have only suggestions during surgery, only in few cases may have significant impact on surgery or patient outcome, e.g an instrument missing or there is problem during swab counting.

Decision making is triggered by a change of the working environment followed by situation awareness, selecting a course of action and finally revise the effect of our decision. Four main decision-making methods were described: intuitive, rule-based, analytical and creative. The choice of decision-making methods depends on the previous experiences of the decision maker and the situational constraints (stress, fatigue, age, etc.). Techniques are being developed to enhance situation awareness and decision-making skills using low-fidelity methods and these could be easily adapted for surgeons. Decision training is based on strengthening the situation assessment skills with the help of different low- and high-fidelity simulators, which has large impacts also in assessing decision making skills. Besides, situational judgement questionnaires or interviews may help assessing the surgical team's performance.

In other high-risk professions (e.g. aviation, military), where situation awareness and decision making are regarded as critical skills, which are addressed explicitly in basic training. Surgical teams also could profit from decision training to be more effective. If clinical decision making is to be valued as highly as technical skills, then a better understanding of surgeons' cognitive skills must accrue, so that the processes can be studied, and reconstituted as a skill that can be applied by the practising surgeon. This learning must be applied with a sense of expediency, given the rapidly changing educational environment for future cadres of surgical specialties.

(Table 6.2.) shows the main learning objectives which highlight some of the most important competencies and skills related to decision making in the operating room.

LEARNING OBJECTIVES	EVALUATION
» To recognize the level of competencies » To identify the decision-making techniques used so far » To analyse the changes of the environment » To determine the problem to be solved » To recall the main decision-making methods » To utilize the proper technique and react » To revise the effect of the decision	» Select the right method for make appropriate decision » Sequentially choose at least one method that may influence the decision-making techniques » Select options that result in adequate decision-making processes (assessment checklist)

Table 6.2. *Learning objectives and evaluation for decision making.*