NONTECHNICAL SKILLS IN ANAESTHESIOLOGY
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Abstract

Crucial role of Non technical skills (NTS) in the dynamic environment of day to day anaesthetic practice is emerging. Rather than mere acceptance, efforts are being made world over to identify & assess them to overcome their negative effects by structured taxonomy both in real time & simulated conditions. Reduction in anaesthetic accidental mishaps & near misses is the prime concern from the point of patient safety & towards that end training & education have a pivotal role.

Key words: *Non technical skills, Anaesthesia, Errors, Education & Training.*

Introduction :

Anaesthesiology, a challenging & demanding speciality, is neither a diagnostic nor a therapeutic speciality. Progress & advances in various surgical specialities & super specialities would have been stunted but for the advances by leaps & bounds by this relatively young supporting speciality.

Anaesthesiology has remained in the forefront by quickly learning from the experiences of highly reliable organizations like civil aviation, nuclear power industries, off shore oil explorations etc. where safety concerns are paramount. These organizations have recognized the role of these NTS, by human factor research in the causation of mishaps & accidents during the last two decades or so. Safety & efficiency in any field of work is not limited to possession of thorough academic knowledge & skillful application of the technical skills needed in that particular area but it also encompasses the basic human behaviour & attitude of individuals during the course of performance of their duties. Detail investigations of adverse health care events (an event or omission arising during clinical care & causing physical or psychological injury to a patient) & near misses (a situation where events or omissions or sequences do not worsen further either due to a compensatory action or by good fortune) have shown that in almost eighty percent of the cases the underlying cause is poor application of NTS.

NTS have a vital role in anaesthetic practice but have not been addressed to during postgraduate training in Anaesthesiology which needs to be corrected at the earliest.

WHAT ARE NTS?

NTS are human behaviour which enhances safety & efficiency along side the knowledge & technical skills needed in any field of work. In the health care setting they are not directly related to medical expertise, drugs or equipment. Two categories of NTS have been recognized[1]:

1. Cognitive & Mental skills which include planning, decision making, situation awareness etc.
2. Social & Interpersonal skills like coordinated team work, leadership, communication etc.

Historically it is assumed that postgraduates would acquire these skills by 'osmosis', by experience & observing their role models during the training period.

ROLE & ASSESSMENT

Recognizing the gaps during training period various methods have been adopted by different researchers to delineate the role of NTS in anaesthetic practice. For better appreciation, data collection could be grouped under the following headings[2]:

1. Incident Reporting. 2. Observational studies in real life 3. Virtual observational studies in simulation centres. 4. Attitude Questionnaires & 5. Theoretical Models.

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Incident Reports

Cooper & Colleagues[3] while investigating the cause of preventable incidents involving human error or equipment malfunction found that eighty two percent of the incidents were due to human errors like poor communication, failure to recognize a developing problem (Inattention, Carelessness, Haste, Fatigue), failure to follow set personal routine or institutional practice, flawed decision making (Distraction, Insufficient preparation) & excessive dependency on. Different groups have collected data on different formats[4,5] but their analysis is more at a operational level & does not provide a finer grained level of information necessary to understand where the skills broke down & provide only a limited insight into NTS. More advanced techniques of analysis & data collection from incident reporting system would identify the limitations in human factors & deficiency in NTS which contribute significantly to adverse outcomes.

Observational Studies

These allow human behaviour to be examined in real operating environment & in Simulation centers.

In real time studies observations are made either directly or by setting up a number of video cameras for analysis at a later stage. Limitations of such studies include normal behaviour of the team is altered in the presence of the researchers, inability to directly observe the entire team all the time as well as the issues related to consent & confidentiality. Despite these limitations these studies have observed in twenty to forty percent of times the behaviour of the different teams was unsatisfactory & was below the set standard in the area of Communication & Coordination affecting the decision making process as well as affecting the overall clinical performance[6].

A pilot study into the NTS in operating rooms of our Institution done over a period of eight months has shown similar results leading to a number of preventable errors & mishaps. Salient points observed were carelessness, haste, inattention, distraction, failure to follow set routine institutional guidelines & excessive dependence on other personnel.

Simulator studies have shown more experienced anaesthetists have better situation awareness to recognize relevant clues & take early suitable corrective action. Junior members who are trained on simulators may perform better than inexperienced trainees[7, 8]. Skill to focus on information gathered & to integrate it with the existing knowledge to produce a solution comes with experience & training.

These observational studies show that key skills necessary for better performance are Verbal Communication, Individual & Team Situational Awareness, Problem Recognition, and Decision Making & Reevaluation.

Attitude Questionnaire

Questionnaire based surveys have shown similar findings in respect of importance of Communication & Coordination in addition to technical proficiency. But contrary to observational studies of analysis of mishaps & near misses, many anaesthetists felt that their performance was unaffected by stress & fatigue.

Training

Based on a number of incident reports, simulator studies, and cognitive psychological theories & on experience of other high reliability domains like aviation, Gaba & colleagues[9,10] have developed a comprehensive cognitive model for dynamic decision making & crisis management which is used as a framework for Gaba's simulator training programme in Anaesthesia Crisis Resource Management (ACRM) course which emphasizes NTS. Aim of this course is to prevent, ameliorate & resolve critical incidents. This course is conducted over three years of postgraduate training & the scenarios become more complex as it progresses. Key points are given in Table-1. In this table the first model of activity is at 'sensory motor level' wherein the anaesthetist is engaged in basic observation & verification (checking the details of the patient, checking the machine & monitors & observing the activity of other team members) giving him a good level of situation awareness. Subsequently he confirms & crosschecks the information gathered, the absence of which may contribute to unforeseen incidents occurring. Next stage is the 'procedural level' wherein from the information gathered, the Anaesthetist tries to identify & anticipate problems to formulate a course of

COGNITIVE LEVEL LOWEST TO HIGHEST	MENTAL ACTIVITY	ACTIVITIES
Sensorimotor level	Processing sensory data and managing routine tasks	Observation, verification, problem recognition and assessment. routine physical activities such as drug administration
Procedural level	Solving problems by applying rules	Identify and solve problems by applying precompiled responses
Abstract level	Solving problems by reasoning	Use mental resources to create mental model of problem and to work out solution from first principles
Supervisor level	Supervisory control	Allocates attention and mental resources
Resource management tool	Resource management	Uses available resources, information equipment and personnel to manage perioperative care of patient

Table 1: Framework for Gaba's simulator training programme in Anaesthesia Crisis Management (ACRM)

action in respect of a particular patient on a particular day. The formulated plan of action may be on the lines of a routine activity or if the identified problem is novel the model moves to the next 'Abstract level' where in based on basic principles of medical knowledge & step by step reasoning activity a gross alteration in the plan of action is done. This alteration is used alongside of precompiled responses & is time consuming. Next step is the implementation of plan of action developed during the problem solving level. Execution of tasks like administering drugs, variation of dosages & concentration or adjusting settings on the anaesthesia machine or changing circuits gets again included in the sensory motor level of activity. If suitable corrective action & effective implementation of the alternative action is not taken errors / slips are likely to crop up. 'Supervisory cognitive level' is responsible for coordination of tasks, allocation of time & attention for problem recognition, making observation & for implementing the action plan. This level varies with the experience of the anaesthesiologist & it may be partly automatic & partly under conscious control. This important level has potential for errors/ failures unless suitable modifications are done by constant appreciation & reevaluation of the situational changes. The highest 'Resource management level' is under conscious deliberate control, & it coordinates the activities necessary for leadership, monitoring, crosschecking,

communication & interpersonal relations with all team members.

This course has been accepted world wide with great interest & in some countries it is a legal requirement. This course is run in a mock up OT using high fidelity Simulator & the scenarios include reading, didactic presentation, video analysis etc. where participants are exposed to critical clinical incidents & debriefed later on their knowledge, technical skills & NTS. During debriefing it was found that the scores of the participants strongly correlated with leadership, communication & distribution of workload. It was also seen that there great variability in the scores given by different assessors in respect of behaviour performance highlighting the difficulties in identifying & measuring NTS.

Introduction of computer driven patient simulators has enhanced the interest in NTS with at least fifty percent of emphasis on critical resource management behaviour[11]. What is interesting is that significant number of adverse events (up to 5%) have been reported when the participants are experts[12].

Team Oriented Medical Simulation (TOMS) course with similar curriculum was developed at Basel but the emphasis is on social psychology of team interactions rather than cognitive model of ACRM course. Team model proposed by Helmreich & Schefer[13] is shown in Table-2. Focus of attention in the team model is the

Inputs	Team performance function	outcome
Organizational factors Resources, organization and practices Cultural issues, Patient	Interaction with colleagues Same specialty Different specialty	Team Patient safety Team performance
Team factors Composition Familiarity Group and intergroup norms	Task type Case management Technical Cognitive Social/interpersonal	Individual and organizational Attitudes Job satisfaction Personal development
Individual factors Attitudes, personality and motivation Knowledge and training Stress and fatigue		

Table 2: Team model by Helmreich & Schefer

entire operating room team rather than individual anaesthetist's mental processes. Components of the model are 'Team input factors'(Organizational, Team & Individual) 'Team performance factors' (Interaction & Task type) & 'team outcome factors'(Team & Organizational) in a feed back loop.

Organizational team input factors (how a dept. is organized, coordinated, what are the interpersonal relations/ communication, how the reserves are utilized) are those which are considered to produce system errors. Operating room team members have a different background (medical / surgical / paramedical, nursing, Anaesthesia & so on) & have different expectations though working towards one aim. The group expectations, capabilities & ways of practice will vary & unless coordinated, is likely to lead to adverse events/ slips/near misses. Here in the individual's attitude, aptitude, personality & motivation, physical fitness etc. will be a vital input for the entire team.

Team performance will be affected by interaction of team members of the same speciality/ other speciality as well as by the different types tasks (Cognitive, technical, non technical tasks etc). Focus of this model is on the identification of these factors & how they are maintained rather than on descriptive details. Non technical tasks identified are forming & maintaining a leadership, communication & decision making, situation awareness, monitoring for changes needed & maintaining the load of work.

Final component of the model is multiple outcomes related to the team/individual/ organizational. Patient safety is the most important outcome which in turn has an impact on the morale & job satisfaction of team members as well as on the achievement of organizational goals.

Debriefing & discussion of reported incidents aids in intervention needed to modify performance by training & safety reporting systems. Here Anaesthetist's performance is considered as a part of the performance of the entire surgical team & the various external factors which influence it.

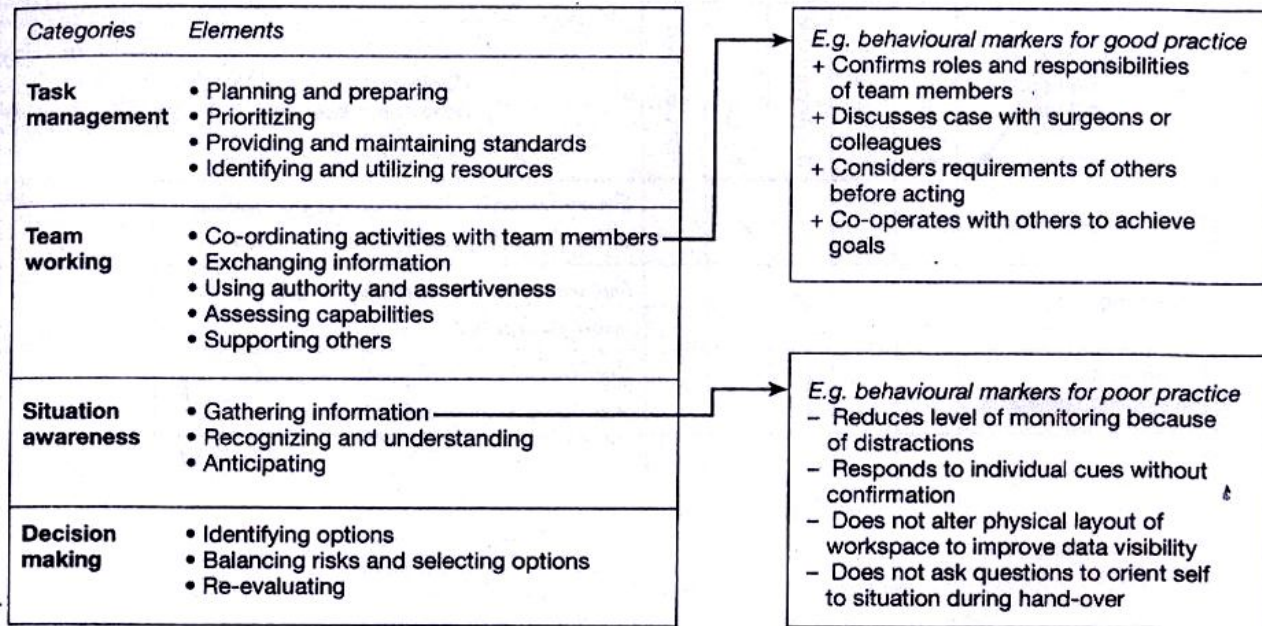Integration of Gaba's ACRM Cognitive model & Helmreich's TOMS would lead to better understanding of Anaesthetists performance. Significant points realized during the conduct of these courses are:- a) Leadership in OT environment is ill defined b) Several teams (Nursing, Anaesthesia, Surgical & Paramedical) with different levels of knowledge, technical & NTS are working together with ultimate goal of patient safety but with disagreement about over all priority, sequence in which they are to be tackled c) Each patient has a unique set of problems & the impact of anaesthesia & surgery on his/her pathophysiology is not well understood[9].

Information gathered from these courses led to the beginning of a project on Anaesthesiologists Non Technical Skills (ANTS) for developing a Behavioural Marker System which ultimately could be grounded into routine anaesthetic practice. Taxonomy of ANTS will provide a frame work for further development of an integrated model.

TAXONOMY OF ANTS

Though it is clear NTS play a central role in anaesthetic practice, full realization of which skills are important & how they are used in daily practice is hitherto not understood. Efforts for developing a validated Behavioural Marker System (BMS) under ANTS project has been taken up by National Health Service in UK & by other workers. Experience from industrial field & from observations made during anaesthesia both in real life & in simulator studies forms the basis of this project. It is well known that BMS is context specific & varies in different professions as well varies in different cultures & within the same profession as well.

A prototype BMS was developed to investigate its experimental validity, reliability & usability by observing & rating a target of 50 trained Consultants[14]. Results have been encouraging .This hierarchical system has four skill categories (Task Management, Team working, Situation Awareness & Decision Making) which are further divided into observable 15 elements (Table-3). Each element has linked observable behaviour markers of both good & bad practice. Assessment is made at both these levels on a four point scale with an option for indicating the non observed skill for that particular scenario. Stress Management which is difficult to observe & Communication which is the means for

Categories	Elements
Task management	• Planning and preparing • Prioritizing • Providing and maintaining standards • Identifying and utilizing resources
Team working	• Co-ordinating activities with team members • Exchanging information • Using authority and assertiveness • Assessing capabilities • Supporting others
Situation awareness	• Gathering information • Recognizing and understanding • Anticipating
Decision making	• Identifying options • Balancing risks and selecting options • Re-evaluating

E.g. behavioural markers for good practice
+ Confirms roles and responsibilities of team members
+ Discusses case with surgeons or colleagues
+ Considers requirements of others before acting
+ Co-operates with others to achieve goals

E.g. behavioural markers for poor practice
– Reduces level of monitoring because of distractions
– Responds to individual cues without confirmation
– Does not alter physical layout of workspace to improve data visibility
– Does not ask questions to orient self to situation during hand-over

Rating label	Description
4 = good	Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others
3 = acceptable	Performance was of a satisfactory standard but could be improved
2 = marginal	Performance indicated cause for concern, considerable improvement is needed
1 = poor	Performance endangered or potentially endangered patient safety, serious remediation is required
not observed	Skill could not be observed in this scenario

Table 3: Prototype of Behavioural Marker System (BMS)

inferring other skills have not been separately identified in this system. The ANTS project was the first empirically derived & validated investigation of NTS required for the health profession. Resulting taxonomy can form the basis for hospital based teaching & simulated teaching despite its limitations which can be overcome as experience is gained.

Training & assessment of performance in clinical anaesthesiology is controversial & has seen many changes with the experience gained at different stages. Whatever the methodology adopted, it is essential not to divert from the primary aim of improving clinical performance by preventing & managing adverse clinical events.

Yee & colleagues[15] have confirmed that performance of trainees improves with repeated training. Integration of NTS training with or without the ANTS system is still at an early stage & lot more needs to be done.

Following the lines of ANTS system a prototype BMS of NTS for Surgeons (NOTSS) has been developed & is under investigation. Similarly research into the role human factors & NTS in Intensive care Unit is underway[16]. Obstetrics, Acute General Medicine & Emergency Medicine have also shown interest & would

not like to lag behind in the training of their postgraduates.

Conclusion

Good performance in Non technical skills is important in the reduction of errors & also in mitigating the effects of these errors in the areas where SAFETY is a paramount concern. ANTS development has been very significant in the last decade or so. Explicit developments in Simulator centre training have been made but much more is in the offing before being embedded into Anaesthesiology training curriculum. Training material & trainers are to be developed & prepared. Integrated programmes for the entire operating room team offer exciting opportunity of team training with targeted feedback for individual members as NTS is evolving for various surgical disciplines.

Future generation of Anaesthesiologists have to horn in not only fast changing advances in the knowledge of Anaesthesia but also sharpen their technical skills to fully exploit the advances in the technological field. They need to Armour themselves with evolving changes be it in the academic field or in the arena of NTS which hitherto have been given only a passing glance, to ensure their survival & success in the scenario of tremendous challenges which they will have to face.

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