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Review article

Team based performance – key for good airway management in children

MARIJANA KARIŠIK[1,2]*

[1] Faculty of Medicine, University of Montenegro, Podgorica, Montenegro

[2] Clinical Centre of Montenegro, Institute for Children Disease, Department of Anaesthesia and Intensive Care, Podgorica, Montenegro

***Correspondence:**
Marijana Karišik
E-mail address: marijana.karisik@gmail.com

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Abstract

Background and purpose: *Good quality healthcare is unimaginable without proper patient safety. Which is why securing the airway is undoubtedly the most important lifesaving skill any prehospital and hospital emergency medical service provider possesses, including the anaesthesiologists. Children underlying a procedure needing anaesthesia, especially toddlers and neonates, have a high risk of critical airway incidents. Unfortunately, delayed management of compromised paediatric airway still causes significant perioperative morbidity and mortality.*

Materials and methods: *MEDLINE is used to search the English language literature for articles using the following search terms: "human factors", "paediatric airway", "preoperative assessment", "preparation for airway management", "difficult intubation", "difficult airway prediction in children", "paediatric emergency", "oxygenation", "patient safety".*

Results: *Managing critical/accidental situations with good coordination and cooperation by applying the training received through simulations.*

Conclusions: *The human being may err, and technical skills training is not enough to ensure the desired outcomes. There is a need to develop non-technical skills such as teamwork capabilities. Leadership and teamwork play a vital role in increasing the capacity of paediatric anaesthesiology educators and training the paediatric anaesthesia workforce, essential for patient safety and patient outcomes in airway management during anaesthesia, perioperative and postoperative care.*

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INTRODUCTION

Promoting teamwork in the operating theatre has been associated with lower mortality and morbidity according to publication data *(1,2)*. The team in the operating room consists of anaesthesiologist/s and surgeons, anaesthetic nurse/s and scrub nurse/s, circular nurses, and depends on the type of surgery, technicians for extracorporeal blood circulation machine *(3,4)*. This teamwork requires sharing common goals and specific roles for each team member during dynamically changing perioperative conditions *(5,6)*. The complexity of surgical interventions demands increasing technical skills *(3,7,8)*. Thus, scientific, technical skill training is not enough to ensure the desired outcome, there is a need to develop non-technical skills such as teamwork and leadership *(9,10)*. Team training programs to enhance team performance and improve leadership have proven to be important in both, during routine daily work and in unexpected serious events in the operating room and emergency ward *(11,12)*. Numerous strategies for improving

non-technical skills have been recommended, but they can only work if clinicians manage to practice them under real conditions *(13,14,15).* Scientific evidence shows the benefits of coordinating leadership and behaviour in anaesthesia, taking the anaesthesiologist's perspective to improve clinical anaesthetic and perioperative patient outcomes in airway management *(16).* The real progress in the management of paediatric airway, and changes in paediatric anaesthesia altogether, started in the first decade of the 21st century (with EXIT procedure, fibreoptic and video laryngoscopy intubation as a golden standard) then, over the following years, the guidelines were, at first, a modification of adult based approaches, and only later on were the guidelines made specifically for paediatric patients *(17).* After that, the neuromuscular blocker was added to the guidelines, the ultrasound and apnoeic oxygenation started being used in airway management and now the ECMO is incorporated in airway management guidelines in paediatric patients *(18).* Framework to guide us in practicing safe and secure control of the paediatric airway should be as follows: good knowledge of anatomical and physiological paediatric airway specificity, good airway assessment, planning, minimum standard of equipment, accepted difficult airway algorithms combined with personnel-dedicated teaching, training and practice *(19,20).* Ultimately and always, the primary goal is to provide child's oxygenation and ventilation *(21,17).* And so, the aim of this review is to discuss recent scientific literature and provide a comprehensive approach to the team based performance as a key for good airway management in children.

MATERIAL AND METHODS

The databases Ovid Medline, PubMed, Web of Science, and Embase were searched independently by AKH and AT. The search was limited to English language. Comprehensive literature review on paediatric airway management was conducted. Search terms included: "human factors", "paediatric airway", "preoperative assessment", "preparation for airway management", "difficult intubation", "difficult airway prediction in children", "paediatric emergency", "oxygenation", "patient safety". I placed no date restriction on the literature search. All sources were screened and selected for inclusion to determine their relevance in the framework of the current report. I determined that 617 articles were relevant from the abstracts. After screening these abstracts, 34 studies were considered appropriate to the current review.

RESULTS

Raising awareness of human errors in hospital staff (operating room and intensive care units) practising and managing them in critical/accidental situations by applying the training received in non-technical skills and improving that management with training programs which include simulations, workshops, different topics and online modules for developing proper attitude, behaviour, leadership abilities and above all, how to be a team player in operating rooms and intensive care units. Such education should be mandatory for all anaesthesiologists and intensivists and periodically refreshed because their designated roles put them on the forefront of every such situation, not only in the OR or ICU, but in other emergency cases as well.

DISCUSSION

All humans make mistakes, traditionally in healthcare, the bridge between providing skilled service in a high stress situation and defence mechanisms against mistakes is fragile *(22,23).* Anaesthesiologists, like other human beings, may have physical and cognitive limitations regarding their workload capacity and amount of stress *(22,23).*

Approximately 50% of hospital errors occur in the OR or in the Resuscitation suites *(5,10).* Most of them due to poor communication *(11,24).* Hospitals are evaluated not just in terms of production, but also in terms of quality and outcomes (25). Patient must be core of our activities and patient safety must be our number one concern *(7,8).* Defence mechanism against human mistakes can't be perfect but it's a goal we must strive to reach.

The medical practice today is changing; meaning that technical skills must go hand in hand with proper teamwork *(25).* And working as a team in the OR requires sharing common goals and having a specific role for each team member, including: briefings before surgery, debriefings after procedures, a positive attitude towards other team members, shared information and analysis of the patent's diagnosis, sound communication, ability to assist, adequate preoperative preparation of the patients and all team members (anaesthesiologist, surgeons, anaesthetist, scrub nurses), checking of the equipment, preparation of instruments and drugs, coordination between words, ICU, blood bank, laboratory *(4,23,25).* However, training in this area has not been traditionally encouraged.

Example, WHO surgical checklist is the best example of using "briefings" in the operating room (26). The first two phases, "sign-in" and "time-out" must be completed before the surgical procedure begins, the third phase "sign out" just before the patient leaves the OR. The WHO surgical checklist has proven to reduce perioperative morbidity and mortality, with particular impact on laterality errors, wrongful identification, antibiotic prophylaxis, preoperative evaluation check, and the need for blood by-products *(26).* But it is still not used in all public healthcare systems *(26).*

So, in order to improve teamwork, there are programs, valuable tools, to train the OR/ICU staff in non-technical

skills and to assess the impact of such training *(25).* Each team member of OR/ICU must be a part of the training program and thus create a systematic approach in accordance to their own possibilities and other templates, to ensure a patient safety *(8).* Simulation of different scenarios, practising communication, cooperation, coordination, leadership and situational awareness, as parts of this training are essential for developing experience, proper attitude and behaviour needed to solve the problems during a crisis. Before the beginning and after completing the non-technical skills training course, tools for evaluation should be used *(9,26).*

Literature has shown some interesting data related to teamwork and the need for education in managing *(8,25,26).* One of them is from the US aviation, I chose it to make an analogy between the anaesthesia team effort and the crew during an airplane ride. So, at the end of the last century, air crush investigations showed that airline accidents due to a human error are mostly associated with poor crew communication *(26).* Since then, the program is based on the fact that, in addition to technical training, good coordination, communications and cooperation are required to prevent such disasters *(26).* Anaesthesia needs to extend this list with organisation and working environment field *(5).*

The second story is from the same period (end of the last century) in the Great Ormond Street Hospital for Children (GOSH). There was very high mortality rate in handover patients after cardio surgery form OR to ICU *(27).* Dr Alan Goldman and dr Martin Elliot (Professor of Cardiothoracic Surgery, University College London, and Chairman of Cardiothoracic Services) benchmarked its handoff from cardiac surgery to the intensive care unit against pit stop techniques of the Ferrari Formula One race car team *(27).* So, they realized that the pit stops where they changed tyres and topped up the fuel was well identical in concept to what they do in a handover *(27).* The two doctors recognized the importance of teamwork in transforming the highly risky pit stop operation into one that was both safe and quick. They implemented the same principle to the team effort of surgeons, anaesthesiologists, and ICU staff during the transfer of patients, equipment, and information safely and quickly from the OR to ICU *(27).* It has grown into a new handover protocol where each member of the team had precisely defined obligations *(27).* After that, the mortality rate caused by inadequate handover in GOSH was zero *(27).*

Airway-associated adverse events shown us that human factors significantly affect personal and team performance, patient outcomes and safety *(10,28).* For this reason, concerns about human factors were introduced in the 2015 Difficult Airway Society Guidelines for adults and reinforced in the 2023 British Journal of Anaesthesia and European Society of Anaesthesiology and Intensive Care joint guidelines for neonatal airway management (8,28). Anaesthesiologists often deal with different team compositions, high time pressure, workload, and fatigue, especially during night shifts *(22,23).* Faced with critical airway events, airway management should be separated from team leading and allowing one doctor to have an overview of the patient *(10).* Checklists, uniformly color-coded medications, airway trolleys and algorithms are recommended as a cognitive aid, as they can help to prevent and to solve critical events in airway management *(29,30).* Airway checklist (fields: **equipment** – checking of anaesthesia machine, CO2 monitor, suction, completeness of airway materials basic/advance, medications and IV line, **patients** – history reviewed, airway assessment, positioning and preoxygenation, **communication** – task distribution, plan B, C, D and anaesthetic strategy) should be filled before airway management and induction of anaesthesia, for every patient *(30,31,32).* Communication between team members should be open, bidirectional, concerns regarding the role of individuals must be resolved before the procedure, after procedure debriefings or feedback should be done to learn what went well or wrong and why, and most importantly, what can be improved *(23,33,34).*

My experience should properly show how incorporating multidisciplinary teamwork ensures comprehensive and coordinated care, further reducing the risk of life-costing complications.

Our patient was female, 16 years old, and weighted 80 kg. Significant patient history included a brain tumour operation 6 years ago, and she was now scheduled for elective surgical correction tracheostomy (she grew up and needed a larger trach cannula). The team consisted of two ENT surgeons, one anaesthesiologist, one anaesthesia technician and one scrub nurse. We completed the airway checklist before the induction of anaesthesia, and at the time everything was okay. Our original plan was to intubate the patient conventionally, but with scar tissue around the larynx this option turned out to be difficult. Our plan B was to put armoured (reinforced) tube through the tracheostomy in distal part of trachea and position its tip above bifurcation (this decision was crucial for the positive outcome of patient, as you will find out in the following text). The ventilation of the patient was perfect, and the surgeons started the operation. However, during the preparation of soft tissue around the existing tracheostomy they damaged the wall of the brachiocephalic artery. In that moment the entire operative field was filled with seemingly never-ending flow of blood. As we all know, brachiocephalic (innominate) artery haemorrhage is a life-threatening complication. The ENT surgeon reacted quickly and digitally compressed the bleeding vessel. Consultants were called immediately, firstly another ENT surgeon, then a thoracic surgeon, then a vascular surgeon and at the end, a cardiac surgeon who reconstructed the wall of the artery and finally did definitive haemostasis. To maintain hemodynamic stability of our patient, we had to do an aggressive compensation

of circulatory volume with crystalloids, colloids and blood products. Consequently, perfect communication and coordination between OR and surgical ward, laboratory, bank of blood and ICU was crucial at that moment. During the operation, the cuffed ETT № 6 was sutured in lace via the tracheostoma and replaced by uncuffed trach cannula on the third postoperative day. Postoperatively, the patient was breathing spontaneously, and there was no need for prolonged mechanical ventilation. She was discharged from the hospital on the tenth day after the operation without any neurological damage (which could have been caused by the lesion of brachiocephalic artery).

CONCLUSION

Both, technical and non-technical skills significantly affect personal and team performance and, therefore, patient outcomes and safety. Because of the anaesthesiologist's technical training and his/her non-technical skills, including the development of leadership and communication abilities with the OR staff, the anaesthesiologist plays a key role in achieving the desired patient outcomes. Educational courses for non-technical skill improvement should be made mandatory and included in congresses and other anaesthesiology educational gatherings, as much as the technical skill courses are.

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