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Technical skills in the operating room: Implications for perioperative leadership and patient outcomes

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Today's effective leaders create opportunities for their teams to develop both technical and non-technical skills. In the perioperative arena, the focus until now mainly has been on improving *non-technical skills*, with only few studies analyzing the relationship between *technical* skills and patient outcomes. Technical competence requires assessment of one's own strengths and weaknesses, inclusion of deliberate goal-oriented practice, objective structured feedback assessment, and a focus on best practice and improved patient outcomes. In this article, we address the prerequisites, assessment, and implications of technical skills for perioperative leadership, and provide key metrics impacting patient outcomes and leadership development.

Abbreviations: NTS, non-technical skills; OR, operating room; TS, technical skills; OSATS, objective structured assessment of technical skill.

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Introduction

Effective perioperative leadership requires mastery of both technical and non-technical skills [1,2]. These are prerequisites for effective collaboration and decision-making. In order to ensure optimal patient care and outcomes, there is a need for multidisciplinary and often subspecialized team that can adapt quickly and with an orchestrated approach: coordinating, collaborating, and focusing on multiple tasks in a timely manner [3]. Non-technical skills (NTS) such as teamwork, effective communication, organizational talent, and trust have increasingly emerged as critical factors improving team performance in the perioperative setting by preventing medical errors and enhancing patient safety [4–6]. Undoubtedly, teamwork is necessary to operate efficiently in the constant exchanges arising between surgeons, anesthesiologists, nurses, and surgical technicians [1–3,7–9]. Nevertheless, the technical skills (TS) of all different occupational groups are a strong predictor of patient outcome [10,11].

Every member of the team depends on his or her TS and superior manual dexterity in the management of even a simple procedure. TS are even more important in complex and often low-frequency high-risk procedures [12,13]. However, even in the case of routine, straightforward and frequent procedures, numerous steps are necessary in order to guarantee a successful patient outcome.[14] Mastering a procedure, be it in anesthesiology, surgery, or any other discipline, is a prerequisite for decision-making needed to ensure timely handling with sound medical judgment [15]. Every procedure, even a simple one, can become delicate, and patient outcome is highly dependent on the technological equipment, technique, and skill of the team [16,17]. Competent integration and the application of TS and NTS of all team members in the perioperative setting thus contributes to the optimization of perioperative leadership and patient care.

Until now, efforts to improve perioperative care have predominantly concentrated on NTS. Relatively, few studies have analyzed the relationship between TS and patient outcomes [11]. Although it is often assumed intuitively that good patient outcomes are linked with TS, data supporting such an association is lacking [10,11]. However, data are scarce and ambiguous with regard to this relationship, with weak or mixed results in the literature [18,19]. In addition, there is some debate whether it is appropriate to use TS to master one type of procedure and then use that as a marker for favorable outcome in other procedures [11]. Thus, measures that recognize the interconnectivity of NTS and technical performance have to be addressed in order to optimize outcome [20–26].

In this article, we address the prerequisites, assessment, and implications of TS for perioperative leadership and provide key metrics impacting patient outcomes and leadership development.

Prerequisites

Among the personal traits associated with effective perioperative leadership are intelligence, resilience, TS, knowledge, and competencies [2,27–29]. Effective performance both in surgery and anesthesiology is a function of personal TS and NTS [30,31]. Although NTS play a significant role in the systematic avoidance of medical errors [30,32], TS are a prerequisite for the development of leadership skills such as decision-making, communication, and situational awareness (Fig. 1).

Advances in technological innovation and training correlate with enhanced patient safety [33,34]. Thus, TS should be acquired as soon as possible in the training process in order for the trainee to be able to act with certainty in the operating room (OR). In the OR, technique has an effect on the duration of a procedure, shortening the time under anesthesia and preventing complications, including blood loss or need for coagulation [10]. Compared to attending physicians, trainee participation in surgeries did not directly correlate with an increased risk of infections, despite evidence of longer operative times [35].

The relationship between high-volume procedures and favorable patient outcomes has been attributed to high-end procedures, where technical competence is a strong marker for patient outcome [36–43]. Birkmeyer et al. reported that technical proficiency strongly influences morbidity and mortality in patients [10]. Gladwell popularized the idea that people are not born as geniuses (i.e., natural ability), but rather that 10,000 h of practice is necessary to achieve excellence [44,45]. As the saying goes, “practice makes perfect.” Hard work may be required, especially in cognitively demanding fields like medicine, anesthesiology, and surgery [44]. Therefore, the concept that practice is the mainstay of

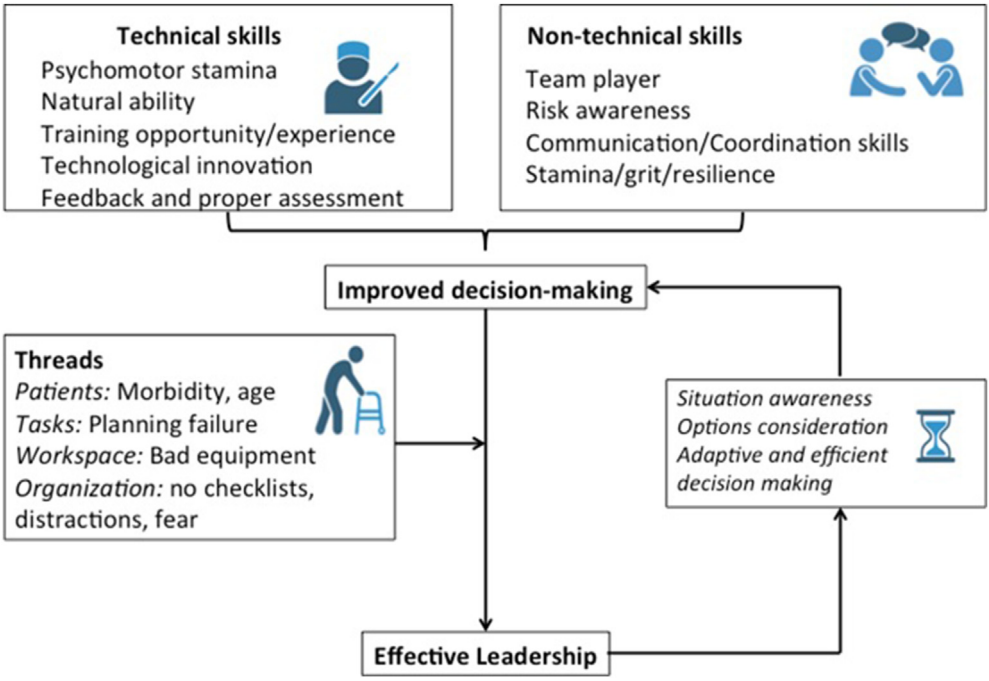

Fig. 1. Roles of technical and nontechnical skills in development of perioperative leadership. Effective leadership is forced to create platforms to enhance and develop both technical and non-technical skills, to guarantee best practice and patient outcome. Technical competence necessitates inclusion of deliberate goal-oriented practice and objectively structured feedback assessment (*figure created with BioRender.com*).

proficiency is valid in any surgical specialty [46]. The psychologists William Chase and Herbert Simon were the first to postulate that for cognitively complex tasks, years of training are necessary in order to master the task itself, given that different situations and possible scenarios have to be experienced and processed along the way [47]. On the other hand, greatness and mastery cannot be attained without innate talent. "Low-volume" surgeons likewise are able to provide excellent outcomes that has led to disagreement over the role of an individual clinician's knowledge and judgment [48]. Namely, the link between natural ability and performance fortifies the debate about the potential importance of skill development and knowledge acquisition [49,50]. Innate talent is often a prerequisite to endure the amount of tedious practice hours necessary for exceptional performance [45]. While cognitive ability was the strongest indicator of academic grades, non-cognitive attributes such as grit have been shown to be an important factor in the ability to persist over an extended period of time in order to guarantee a successful outcome [51]. In a recent survey, neurosurgical residents in the U.S. assessed the prevalence of burnout and the variables associated with it, and discovered an inverse correlation between resilience and burnout [52,53]. Namely, the ability of a person to focus on a single task with fierce concentration, and to persevere in the face of hardships and setbacks, is strongly dependent on cognitive natural ability [51,54,55]. After all, as TS improve, resilience in self-care, setting boundaries, self-compassion, and self-awareness are optimized, leading at least to perceived improvement in patient care [56].

Interestingly, confidence in the TS and abilities of other team members also affects interpersonal behavior [57]. This has been noted when non-specialty technicians or nurses had to assist in other subspecialty teams. Less experience – and thus less technical competence – is associated with instability between team members and a tendency toward micromanagement, both of which can threaten autonomy and trust [58]. Lack of trust in the TS of non-specialists has been observed in

combination with a more authoritarian leadership style in some settings [26].

Technical ability often coincides with interpersonal and leadership skills that are related to superior surgical safety and outcome [59]. Sustainable organizations thus support the development of both TS and NTS in order to create resilience and thus avoid either technical or human failure. This approach, avoiding the so-called “line-up of unfortunate series of opportunities for failure”, was popularized by James Reason in his “Swiss cheese model” [60].

Assessment of technical skills

Patient safety during surgery can be improved by adequate training and proper assessment of one's own TS [61]. Therefore, an objective assessment of mastery of technical competence is needed [62]. Fecso et al. reviewed databases reporting on the association of intraoperative TS on patient outcome, showing that superior performance was positively associated with improved patient outcome in 21 out of 24 studies, with all but one study using objective methods to assess this relationship [63]. Proper assessment is critical. To address this, a video-based peer scoring system was introduced to assess surgeons' TS. Intraoperative videos were analyzed using a structured, objective scoring tool. The involved raters—generally peers or experts in the field—were blinded, and the evaluation was provided as written comments, entailing guided, formative feedback that is essential for quality improvement [64]. Using this approach, Stulberg et al. confirmed that better TS were significantly associated with better patient outcomes, whereas surgeons with limited skills had demonstrated significantly higher morbidity rates (i.e., postoperative bleeding, return to the operating room, and wound dehiscence) than highly skilled surgeons [11]. In terms of effective numbers, the authors noted a 26.6% relative morbidity reduction for highly skilled surgeons versus those with limited skills [11]. Interestingly, a better technical skills score was not only related to fewer complications in the procedure performed and rated but similarly associated with fewer complications for other procedures performed by the same surgeon [11]. Fabri et al. reported that the most frequent type of error contributing to complications was an error in surgical technique (65%), while errors in judgment (30%), inattention to detail (29%), and incomplete understanding of problem (23%) were less frequent. Interestingly, the authors noted that system errors (2%) and communication errors (2%)—both attributed to NTS—were rarely reported as being components of surgical complications at all [65]. As a result, clinicians must enhance their TS through structured, objective assessments in order to improve their quality of patient care.

Guided, formative feedback requires a culture of trust that allows for constructive engagement and accountability [66]. The objective structured assessment of technical skill (OSATS) has been validated and indicated to be a reliable evaluation tool for assessment of technical competence [67,68]. However, recently concerns were raised questioning its adequacy in evaluating the quality of the surgical result in its entirety [69]. In particular, when the technical performance was assessed using surrogate markers (i.e., the level of training, operative time, surgeon's experience, or case volume), outcome results became ambiguous, with no evidence of a correlation between the surgeon's performance and postoperative complications [63,70].

Also, TS assessment using self-selected or edited videos excluding relevant material, or evaluation by an untrained non-expert, can confound outcome results. Instead, technical performance has to be assessed in a direct manner to allow for targeted feedback on the relevance of these deficiencies [63]. Besides direct observation and feedback, assessment of video-recorded procedures using objectivized evaluating criteria, which includes the analysis of the consequences of the rating process itself, provide a more valid examination of the true technical performance status and its development [71].

When using adequate evaluation and feedback tools, steep learning curves have been described both in surgical and anesthesia procedures [72,73]. Some authors advocate for a U-shaped learning curve of development, which contradicts the idea that the procedural technique develops in a cumulative process involving progress and repetition with a direct link to time [14,74]. U-shaped learning patterns have been described in combination with improvements in designated cognitive and physical skills [75,76], particularly for fine motor skills [77], such as hand-eye coordination [78], but also in developing creativity [79] or perception-related abilities [80], representing prerequisites for the learning and performing high-end interventional procedures.

Improvements in technical skills

Patient outcome is dependent on a series of complex interlinked actions involving the surgeon, anesthesiologist, patient, medical staff team, crisis management, and technological equipment provided by the hospital [81,82]. To improve individual performance metrics such as adaptation and acquisition of motor skills, focused training, and repetitive practice are important elements to implement [83,84]. Atul Gawande et al. reported that the majority of surgical errors still can be explained by the absence of TS, experience, and competence [85]. Apart from surgical technique, most errors are due to human factors such as poor judgment, lack of attention to detail, and imperfect understanding, and not to organizational or communication errors [65].

To minimize adverse outcomes, many opportunities for skill development have been implemented, both in medical care and education [86]. Simulators have been introduced to increase trainees get experience and prepare for the skill set required to perform delicate procedures on patients [87,88].

A variety of qualities contribute to the development of technical excellence. Some are qualities to strive for; others are qualities to avoid.

Learners can benefit from self-reflection, humbleness, self-appraisal, and a culture of constructive feedback provided by peers in the field [89]. However, even with countless hours of practice, a trainee can still fail to attain sufficient results, let alone adequate patient outcomes.

Reluctance to develop a plan for implementing constructive criticism may prevent technical skills from being attained. This may be the reason why two acute care clinicians with similar training and experience have such disparate outcomes [46]. Technical difficulties can have a negative effect on interpersonal behavior if not mastered appropriately. The learning process involves switching the task from analytical or conscious (intraoperative) decision-making to intuitive or subconscious decision-making [90]. This can lead to increase efficiency over time and thus minimize fatigue and potentially burnout [91]. Prevention of unnecessary movements or switch of instrumentation rather than hasty movements makes it possible to minimize operative time and promote a safe procedure [91]. Effective leaders recognize and incorporate these factors into daily practice [26]. Moreover, effective leaders support trainees in the development of "grit" by providing guidance for the development of strategies on effectively using feedback [92]. It is a necessity not only to guarantee reliable, objective, and well-structured feedback but also to optimize periodicity [93]. Enough time should be allowed for growth, from acceptance of input to dealing with emotions related to feedback (positive or negative) to the processing of an implementation plan, reevaluation, and the development of the drive to become not only good but also proficient in TS [94]. Coaching in these areas can even increase patient satisfaction, a key metric in hospital quality [95].

Implications of technical skills development

Efforts to attain technical proficiency are an understudied aspect of outcomes research in healthcare. Perioperative patient care and outcomes are associated with high quality and safety. Mastery of technical skills makes it possible to remain calm in stressful situations, while maintaining constructive communication with all players in the operating room. Leadership approaches that are uniquely adapted to the development of NTS among health professionals may thus miss out on the opportunity to create highly efficient, competent, and functioning teams. Leadership instead is forced to create platforms to enhance and develop TS and knowledge in order to optimize trust, efficacy, best practice, patient safety, and outcomes. The duration of training, moving deliberately in the direction of goal-oriented practice, and assessment tools to provide structured feedback may contribute to trainees' development toward mastery. Adequate feedback instruments, including video recordings of cases, can document the performance status of each team member. Following cultural assessment, it is important to reward competence [96]. This can increase interpersonal team trust and fortify good outcomes. However, it is also important to learn from technical failures as well, through peer-to-peer observation and feedback—which involves both leaders and teams [97].

There are numerous ways to improve intraoperative patient care, including clinical reasoning, decision-making based on clinical knowledge even in ambiguous situations, and individual strategies for managing time and the approach to learning. The development of all these qualities should be institutionally supported with reflection and mentoring options [98]. Adequate preparation, interdisciplinary discussions,

briefings, case presentations, checklists, and debriefings can further increase the quality of care and patient safety [99]. It has become standard practice to use a preoperative safety checklist in medicine in order to reduce morbidity and mortality. The call for proper objectivized skill assessment with guided feedback on a routine basis is becoming imperative in best patient care leadership development.

In conclusion, acute care clinicians must enhance TS to improve the quality of care and ensure effective leadership. Effective leadership entails creating quality improvement programs, focusing on efforts to create technically competent team members, and working to achieve favorable patient outcomes in the perioperative setting.

Practice points

- Errors contributing to complications in the operating room are frequently of a technical nature.
- Safety, efficiency, and technical skills all play a role in improving the quality of perioperative care.
- Staff members who lack cognitive ability, manual dexterity, and stamina/grit should make technical skills training a priority.
- Effective leadership entails developing programs on quality improvement, with implementation of objective structured feedback assessments.
- Competent integration and application of mastered clinical skills will lead to improvements in perioperative leadership practice and optimal patient care.

Research agenda

- To identify prerequisites for technical skills training in the perioperative setting.
- To describe ways to objectively assess and validate technical competence.
- To evaluate the effectiveness of technical skills training in improving patient outcomes.
- To ensure the best patient care by supporting the development of effective leaders.

Attestation

All authors have seen, reviewed and approved the final manuscript.

Contributions

Lukas Andereggen, Stefan Andereggen, Corina Bello, Richard Urman, and Markus M. Luedi wrote the article.

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Declaration of competing interest

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