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Creating a safer operating room: Groups, team dynamics and crew resource management principles

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ABSTRACT

The operating room (OR) is a special place wherein groups of highly skilled individuals must work in a coordinated and harmonious fashion to deliver optimal patient care. Team dynamics and human factors principles were initially studied by the aviation industry to better understand and prevent airline accidents. As a result, crew resource management (CRM) training was designed for all flight personnel to create a highly reliable industry with a commitment to a culture of safety. CRM has since been adapted to health care, resulting in care improvement and harm reduction across a wide variety of medical specialties. When implemented in the OR, CRM has been shown not only to improve communication and morale for OR staff, but also reduce morbidity and mortality for patients. As increasing focus is placed on quality, safety, and high-reliability, surgeons will be expected to participate and lead efforts to facilitate a team approach in this new era of patient care.

A three-year-old girl presents to the emergency room with hematuria. Overnight, she fills multiple diapers with bloody urine and ultimately requires blood transfusion for anemia. Cross-sectional imaging demonstrates a large right-sided kidney tumor consistent with a Wilms tumor with no evidence of metastases. She is taken to the operating room for a right radical nephrectomy. Due to the urgent nature of the case, the operation takes place with an inexperienced nursing team that rarely performs general surgical cases. The case bridges a shift change for nurses and anesthesiologists. Additional hand-offs for work breaks occur during specimen removal. Ultimately, the patient makes an uneventful post-operative recovery. Pathologic examination of the specimens confirms a Wilms tumor with favorable histology that does not extend beyond the renal capsule. However, no lymph nodes are received. This finding potentially upstages the patient's disease from stage 1 to stage 3, which would mandate escalation of chemotherapy and the addition of abdominal radiation. The surgeon recalls providing additional tissue to be separately sent as nodes but this is not documented in the nursing flow sheet or dictated operative report. The general surgery nurses usually help remind the surgeon to remove lymph nodes during nephrectomy for Wilms tumors. No surgical sign out or debriefing was performed during the operation.

- *What factors contributed to this error?*
- *How can this be prevented?*

Background

Pediatric surgeons have multifaceted responsibilities for patients with problems that range from common to exceedingly rare. Beyond creating a therapeutic atmosphere for the patient and family, surgeons are constantly interacting with other healthcare providers, each of whom has his or her own perspective and background. The complexities of these interactions are often coupled with critical time constraints of delivering high acuity care. Although every effort is made to provide responsible, comprehensive, safe, and efficient care to our patients, there are unlimited opportunities for conflict, misunderstanding, or unintentional failures as in the case described. Over the past decade, a growing body of evidence has emerged surrounding the importance of human factors in high-stakes, high acuity settings such as the operating room (OR).

The perioperative experience brings together multiple people with different backgrounds toward a common goal – to bring a patient through an operation as effectively, efficiently, and safely as possible. This requires coordination among providers with different expertise and skill sets. The pre-operative phase begins with a surgeon recommending a specific operation to the patient and their family. The risks and benefits of surgical intervention are reviewed, and informed consent is obtained. Depending on operative and patient factors, careful coordination between physicians, nurses, and administrative support staff in the surgeon's, anesthesiologist's, and primary care provider's offices may be required to optimize a patient's medical comorbidities before an operation.

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Crew: A crew refers to a group of people who work together in shared activity toward a common goal, often in a structured or hierarchical organization.

Team: A team is a group of people linked in a common purpose. Human teams are especially appropriate for conducting tasks that are high in complexity and have many interdependent subtasks.

Flash Mob: A flash mob refers to an assembly of individuals who gather quickly in public to carry out a brief, unusual act, and then quickly disband.

Fig. 1. Defining types of group interactions in operating rooms.

A successful operative experience requires synchronization of safe transitions through phases of care from admission, to pre-anesthesia, to the OR, to the post-anesthesia recovery unit (PACU), to the intensive care unit or floor, and, lastly, to home.

ORs were created in the 1800s as advances in anesthesia allowed surgery to be performed for a wider variety of more complex indications. ORs have evolved in lock step with the evolution of surgical specialties incorporating advances in technology, equipment, and safety standards. ORs are usually staffed by skilled groups of healthcare professionals performing specific tasks. In the United States, a Doctor of Allopathic or Osteopathic Medicine must be involved, in at least a supervisory manner, for the performance of the procedure and the provision of anesthesia.[1] Nurses may plan, implement and evaluate treatment of the patient.[2] The professional requirements and scope of practice for surgical technologists varies considerably and include creating, maintaining, and monitoring aseptic surgical techniques; anticipating the instruments and supplies needed for a procedure; and ensuring the efficient conduct of the procedure is possible. Custodial staff usually maintain a clean, safe environment as required by the Joint Commission. An efficient supply chain is essential for stocking thousands of instruments, devices, and medications used during an operation.

Administrative staff responsible for handling the complexity and human resources aspects of the OR environment are most often recruited from a nursing background, while scheduling and daily workflow is usually handled by an anesthesiologist. While physicians may practice at several hospitals or surgical centers, other OR staff are usually full-time at a specific geographic location. Within a large, multi-specialty OR, groups of healthcare professionals may be aligned or assigned into various types of working groups depending on the type of procedure being performed and the specific context within which it is being conducted. Group interactions are of at least 3 types: Crew, Team, and Flash Mob (Fig. 1).

Hospitals often provide a continuum of patient care that includes peak hours with full OR staffing and capability to provide emergent services 24-hours a day throughout the year. To maintain this level of availability, staffing models for anesthesiologists, nurses and other personnel are generally based on shifts worked for specific durations. Beyond maintaining an elective practice during normal working hours, most surgeons provide emergency coverage for their institutions on a rotating basis, and are available for required operative procedures at night, on weekends, and during holidays. Staff sizes can be quite large resulting in an astronomical possible combinations of individuals working together on a case (Table 1).

It is out of necessity that ***crews*** perform most operations. Historically, the structure of the OR is hierarchical with the surgeon as the sole leader. While decisions about preparation and timing of operations are usually shared with an anesthesiologist, once the operation begins, the surgeon's role is primary. While other members of the crew may come and go during the operation, the surgeon is the constant presence and leader. Hierarchy is vital for effective crew work, but must not be confused with the abusive behaviors often associated with the term. An important aspect of crews is an acceptance of new crewmembers who have limited experience. As long as the individual is qualified and competent, his or her presence has little negative impact on crew function. The level of comfort with inexperienced crewmembers may be highest with common operations and lowest in tense situations or technically difficult operations.

Table 1
Staffing at a hypothetical Children's Hospital demonstrating the possible number of staff combinations assuming one individual from each group. (CRNA = Certified Registered Nurse Anesthetist. OR = operating room).

Surgeons	Anesthesiologists	CRNAs	OR Nurses	Scrub Technicians	Potential Combinations
8	16	20	50	45	5,760,000

Though being part of a high functioning surgical team is rewarding, ***teams*** are talked about in surgery more often than they actually exist. The more complex an operation, the more likely an institution is to create a team. Examples are Cardiac surgical teams, Transplant teams and special teams such as those created to separate conjoined twins. Within the team setting there is limited acceptance for team members to rotate in and out during an operation, or to leave before the operation is completed. While it is normal for the primary surgeon to serve as leader, teams tend to be less hierarchical, with more comfort and social equality between members. In turn, teams often have better interpersonal communication. Teams are especially good at learning highly complex, time sensitive, coordinated procedures. They have real advantages over crews in the realm of collective learning and rapid process improvement. They are, however, less flexible from a scheduling standpoint, and are, generally, more expensive.

While not routine for surgical teams, one fundamental of the team dynamic is the importance of a coach. The coach's role observing the team's performance, and adjusting roles and responsibilities based on these observations is accepted by the team. This allows the coach to lead individual and group learning. Most often a senior surgeon, who may or may not be doing most of the technical part of the procedure, assumes this role. Inherent in the position is responsibility for administrative oversight of the team and accountability for the team's results.

Flash mobs are assembled rapidly during unexpected events that may include loss of an airway, cardiopulmonary arrest during an operation, unexpected massive blood loss, or a mass casualty event. The make-up of flash mobs is highly variable depending on the event. Typically, mobs devolve into subgroups performing specific tasks. Leadership is often uncertain or shared. Recruits from outside the OR may be pulled into service such as Emergency Department personnel or intensive care providers. At the end of the event, the mob disperses quickly, often without a collective debrief. Record keeping is typically problematic and group learning requires a forensic reconstruction of the event, often with incomplete information.

Any successful operation requires all stakeholders working together and communicating. Much of the current medical literature uses the term "team" broadly and does not differentiate between crews, teams, and flash mobs. In this review we will focus on teams and crews, with specific emphasis on human factors principles that underlie most of this work.

Introduction to team dynamics

Team dynamics describe how unconscious, psychological forces affect the behavior and impact performance of groups of people working together. The landmark Institute of Medicine report *To Err is Human* declared the need to "promote effective team functioning" as one of five values for creating safe hospitals.[3] In the OR, teamwork is fundamental to patient safety and a culture of open communication.[4]