Surgeons' Leadership Styles and Team Behavior in the Operating Room

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Abstract

Background—The importance of leadership is recognized in surgery, but the specific impact of leadership style on team behavior is not well understood. In other industries, leadership is a well-characterized construct. One dominant theory proposes that transactional (task-focused) leaders achieve minimum standards, whereas transformational (team-oriented) leaders inspire performance beyond expectations.

Study Design—We video-recorded 5 surgeons performing complex operations. Each surgeon was scored on the Multifactor Leadership Questionnaire, a validated method for scoring transformational and transactional leadership style, by an organizational psychologist and a

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surgeon-researcher. Independent coders assessed surgeons' leadership behaviors according to the Surgical Leadership Inventory and team behaviors (information-sharing, cooperative, and voice behaviors). All coders were blinded. Leadership style (MLQ) was correlated with surgeon behavior (SLI) and team behavior using Poisson regression, controlling for time and the total number of behaviors, respectively.

Results—All surgeons scored similarly on transactional leadership (2.38-2.69), but varied more widely on transformational leadership (1.98-3.60). Each 1-point increase in transformational score corresponded to 3× more information-sharing behaviors (p<0.0001) and 5.4× more voice behaviors (p=0.0005) amongst the team. With each 1-point increase in transformational score, leaders displayed 10× more supportive behaviors (p<0.0001) and 12.5× less frequently displayed poor behaviors (p<0.0001). Excerpts of representative dialogue are included for illustration.

Conclusions—We provide a framework for evaluating surgeons' leadership and its impact on team performance in the OR. As in other fields, our data suggest that transformational leadership is associated with improved team behavior. Surgeon leadership development therefore has the potential to improve the efficiency and safety of operative care.

Introduction

Interpersonal dynamics are critically important to operative performance. Many studies have confirmed the impact of intraoperative teamwork on patient outcomes (1-3). Leadership is an integral component of teamwork; it is a major component of all validated instruments assessing intraoperative team behavior (2, 4-6). A recent observational study using one such rating system found poor leadership to be highly correlated with avoidable intraoperative incidents (7). However, beyond a Likert-type scale (2, 4-6) and an inventory of behaviors (8), leadership has not been well characterized in the operating room. There is no evidence to guide surgeons in the cultivation of a particular leadership style or in the fostering (or inhibition) of specific behaviors. Moreover, no data exist to explain the mechanisms by which surgeon leadership drives team response.

In other industries, leadership is a well-studied and well-defined construct, understood to have a profound impact on team performance. One dominant leadership theory is that of transformational/transactional leadership. Transactional leaders are task-focused, typified by contingent reward (clear assignation of responsibility for performance targets and the rewards for achieving them) and management by exception (concentration of attention on mistakes/failures) (9). While such goal-focused leadership may achieve task performance, or "the transformation of inputs into outputs" (10), it may also predispose employees to exhaustion (11). In contrast, transformational leaders are characterized by idealized influence (emphasis on the collective mission), inspirational motivation (optimism/enthusiasm), intellectual stimulation (solicitation of other perspectives), and individual consideration (consideration of individual needs/abilities). They not only recognize their followers' needs, but strive to develop them; in doing so, they encourage others to evolve and perform beyond, rather than merely to, expectations (9). Only transformational leaders inspire contextual performance – discretionary behaviors that are not directly assigned to any one employee nor considered strictly necessary for task performance, but which

maintain the culture and environment required to achieve effective and efficient function (10, 12).

Using the Multifactor Leadership Questionnaire, the most commonly employed method for assessing transformational and transactional leadership (9), we sought to determine whether these models of leadership style are applicable to surgeons. We selected several behaviors exemplary of contextual performance from the organizational literature – voice (10), cooperation (10), and information sharing (13) – and investigated whether different leadership styles elicited different levels of these behaviors from their teams. Finally, to give surgeons actionable performance targets, we explored correlations between specific surgeon leadership behaviors, categorized according to the Surgeon Leadership Inventory (8), and their transactional or transformational leadership scores.

Methods

Data Collection

Five patients scheduled to undergo general surgical or oncologic operations at a single quaternary care hospital with expected complication rates exceeding 20% were formally consented for study participation during their preadmission testing appointments. The departments of surgery, anesthesiology, and nursing were consented via an opt-out process, and verbal assent was confirmed prior to each case. These operations, representing over 28 hours of intraoperative time, were audio- and video-recorded from nursing setup through patient exit. Two surgical research fellows transcribed the videos, using open access software developed by Guerlain et al (14). Videos were then deleted within 90 days as per protocol. These procedures were IRB approved. A more comprehensive description may be found in a prior publication (15).

Instruments—For a summary of the coding instruments and schema, please see Table 1.

Multifactor Leadership Questionnaire: The applicability of the Multifactor Leadership Questionnaire (MLQ) has been verified across a diverse range of organizational structures and domains, including military, government, education, manufacturing, and hospitals, in multiple countries. Its 45 items measure key leadership and effectiveness behaviors that are associated with individual and organizational success on a frequency scale. Thirty-six of the items are grouped into 9 subscales: 1) idealized attributes, 2) idealized behaviors, 3) inspirational motivation, 4) intellectual stimulation, 5) individual consideration, 6) contingent reward, 7) active management by exception, 8) passive management by exception, and 9) laissez-faire. The first 5 subscales represent transformational qualities, while the following 2 represent transactional, and the final 2 passive leadership. The remaining 9 items represent leadership outcomes and fall into 3 categories: extra effort, effectiveness, and satisfaction with leadership. The MLQ's structure has been previously validated with both discriminatory and confirmatory factor analysis (9).

Team Response Behaviors: Voice behavior is defined as "constructive change-oriented communication intended to improve a situation" (10). Speaking up (e.g. about an unsafe condition, or with a suggestion for improvement) has clear potential for improving safety

and efficiency in the OR. However, despite its benefits, voice behavior is not consistently present. It requires psychological safety; team members must perceive interpersonal trust and mutual respect in order to be comfortable expressing opinions that differ from the prevailing thought or situation. Leaders may set the tone to encourage or discourage their team members to speak up; idealized influence (a component of transformational leadership) has been previously correlated with both psychological safety and voice behavior (16).

The reliability of a system is rarely due to any one component of a system (people, equipment, rules, procedures); rather it is determined by the **cooperative behavior**s and active engagement of people across the system. In the interdisciplinary OR environment, mere task performance requires a high degree of cooperation. As such, we counted only extra-role cooperative behaviors – those that were discretionary, beyond the requirements of any job, and therefore consistent with contextual performance (10). For example, although the count requires two nurses to work together, it is a prescribed task that nurses are expected to complete. In contrast, if nurses come from other ORs to help the assigned nurses set up a case, this extra-role work does not benefit the extra nurses; in fact, it increases their workload. It does, however, promote throughput of the entire department and perpetuate a culture of collaboration.

Individuals may exchange their implicit and explicit knowledge by either donating or collecting information to jointly create new knowledge (13). As with cooperative behavior, such **knowledge sharing** may be mandated as part of task performance (e.g. the surgical safety checklist) or volunteered by different team members as contextual performance; thus, we only included knowledge sharing behaviors that were discretionary or extra-role. Knowledge sharing behaviors have been previously correlated to leadership style – specifically, human-oriented leadership, which is conceptually related to the individual consideration subscale of transformational leadership (13).

Surgical Leadership Inventory (SLI): The SLI is a taxonomy of surgeons' intraoperative leadership skills based on 1) the surgical and psychological literature about leadership (17), 2) observations of surgeons (18), and 3) OR focus groups queried about intraoperative leadership behaviors. Only behaviors expected to impact patient safety and team performance are included. The SLI has eight domains: communicating, coping with pressure, maintaining standards, decision making, managing resources, directing, training, and supporting others. Face validity was established by review of the SLI by subject matter experts familiar with nontechnical skills. Inter-rater reliability is estimated at $\kappa=.70$ (8).

Coding—To minimize subject recognition which may introduce bias, de-identified transcripts rather than the primary videos were analyzed. A surgeon (CCG) and an organizational psychologist (SY) independently reviewed each de-identified transcript and rated the attending surgeon using the MLQ. For each rater, subscale scores were calculated as a mean of the component items' scores. Within the transactional, transformational, and passive leadership categories, the relevant subscales were averaged to yield a rating for each. The mean of the two raters' scores was taken as the final transactional, transformational, and passive leadership scores for each surgeon-leader.

A surgical research resident (YYH) and a second organizational psychologist (SHP) independently reviewed each de-identified transcript and identified 1) instances of voice, cooperative, and information sharing behaviors, 2) purely social interactions, i.e. chitchat with no impact on patient care, initiated by the team, as we thought these might ultimately reflect a more open environment, 3) SLI behaviors, and 4) social interactions initiated by the surgeon, as we thought such leader behavior might support a more collaborative environment and hence encourage teamwork. Instances of SLI behaviors conducted poorly (e.g. being unsupportive of others) were coded as "negative" and analyzed in aggregate. Discrepancies were resolved by discussion and consensus.

Prior to conducting this analysis, all coders trained and calibrated themselves in the use of their respective instruments by coding and discussing three transcripts of OR videos that were not included in this analysis. Each pair of coders was blinded to the other's scores.

Statistical Analysis—Inter-rater correlation of the transactional, transformational, and passive leadership scores was assessed with Pearson's coefficient. We performed Poisson regressions to assess the predictive value of each leadership style score with each team behavior. To control for the impact of operative time on the number of team behaviors (i.e. that more behaviors would be observed in longer cases), we offset the regression by the log of the number of hours in each case. We then performed Poisson regressions to assess the predictive value of each leadership style score with each SLI behavior. Because we felt the distribution of behaviors among the SLI categories would be more important than the absolute number of any particular behavior, we offset the regression by the log of the total number of each leader's SLI behaviors. Due to the small sample size, we also performed the analyses using exact Poisson regressions; as the results were similar, only the original (non-exact) Poissons are presented here. Significance was defined as a two-sided p-value <0.05. All analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, North Carolina).

Results

The inter-rater correlation between MLQ raters was high at 0.95, p<0.0001. The final leadership style scores for each surgeon are displayed in Table 2. Passive leadership scores tended to be low, ranging from 0.63 – 1.56 on a scale ranging from 0 – 4. Transactional scores also varied little between surgeons: 2.38 – 2.69. Surgeons were more distinguishable by their transformational scores, which varied between 1.98 and 3.60.

The surgeon with the highest transformational score (surgeon E) demonstrated transformational qualities as early as during patient set-up. Upon entering the OR, s/he purposefully engaged every member of the team (individual consideration), down to the nursing student, and emphasized a collective sense of mission (idealized influence):

> RN: Got your big basin there?
>
> Surgeon: We have a very big basin, thank you. It's essential equipment for this room, right? (Laughs.) You ready for this one? (All laugh.)
>
> Scrub tech: I told her she'd have the best case of the day out of all the students.

Surgeon: Oh, there you go! Ok! Have you done this kind of surgery before?

Scrub tech student: I've never done anything with the [organ] before, no.

Surgeon: Happy to be part of your first [operation]!…So this is one of the things. If you prepare for things to happen, then maybe they won't. If you don't, you get burned, right?

Anesthesia resident: Absolutely – we always have to prepare for the worst and hope for the best, right?

Surgeon: Exactly…Did we get our table fixed?

Scrub tech: Yes.

Surgeon: So you don't have to get down on your knees in this case?

Anesthesia resident: Yeah, hopefully not.

S/he further engaged his/her team members by seeking their perspectives (intellectual stimulation):

Surgeon: You guys are going to put in a central line? Or what do you want to do?

Anesthesia attending: Well, we…I need to talk to you about it. Her INR's 1.4. I'm not a big fan of sticking her neck.

Surgeon: Sounds fair to me.

Anesthesia attending: So if we do…I'm wondering if we can put in a groin, like if you guys put in a groin line in.

Surgeon: So I'll tell you what…Why don't we see what you get here? This is going to be one of those situations where we could make an incision and know whether this is going to be hard or not. We wouldn't want to do anything like a big groin line.

Anesthesia attending: Right, and I think that's right.

Surgeon: But we'll prep everything out and…then if we get in and we decide, "Yeah, this is going to be scarier than we wanted," we'll put in a groin line.

Anesthesia attending: That sounds great.

Surgeon: Sound good?

Anesthesia attending: I think that's the perfect plan.

Surgeon: Okay, perfect.

…

Surgeon: Should we take all that [cancer] sitting there on top of that…[organ] out?

Surgical resident: I don't think we should be compelled to. I think we should take a look.

If it's easy to take out, yes, but it's not a curative operation, so I don't think we want to start looking around and putting her at additional risk.

Surgeon: Agreed.

Throughout the case, s/he continued to convey enthusiasm (inspirational motivation) to all parties:

> Surgeon: Okay, my friend, what's that? We are so happy! You know what we're looking at? We are looking at the vessels, just *sitting* underneath us.
>
> Anesthesia attending: It's beautiful.
>
> …
>
> Surgeon: Oh my goodness. This is when surgery is fun. Look at this beautiful anatomy. You got to come over here and see this. It's so pretty.
>
> …
>
> Surgeon: I'm excited! You see it?
>
> Medical student: Yeah, it's…cruising right along.
>
> Surgeon: I know – isn't it great? Look at this [organ] artery.
>
> …
>
> Surgeon: Wait, wait – this is going to be really cool…Now that we got rid of the artery, when we take off this retractor, you're actually going to see it…
>
> Surgical resident: Smaller.
>
> Surgeon: You're going to see it smaller, and you're going to see it a totally different color…Hopefully she's autotransfusing now.

In contrast, the surgeon with the lowest transformation score (surgeon A) entered the OR and immediately confronted the anesthesiologist with the assertion that the six units of blood ordered for his/her case was "ridiculous" and "a waste of resources." As the amount of blood had been ordered as per hospital protocol, this comment was not constructively directed and set an accusatory/antagonizing tone (management by exception). Similarly, after a surgical resident briefly entered the room to run the patient census with the resident who was scrubbed, s/he said, "You should remember: I don't care about any patients but mine," again reinforcing a constrained work environment.

The results of the Poisson regressions correlating MLQ scores to each team response behaviors, controlling for operative time, are shown in Table 3. Transactional score had no impact on team response. The teams of leaders with high transformational scores, however, demonstrated increased information sharing and voice behaviors; each one-point increase in the transformational score correlated with a 300% and a 542% increase in the team's information sharing and voice behaviors, respectively.

In the case of our most transformational surgeon (surgeon E), everyone spoke up throughout the case, both to ask for or provide clarification (information sharing) and to warn others (voice behavior). In the following excerpt, the surgeon warned the anesthesia resident about impending bleeding and check that s/he was prepared. The anesthesia resident in turn asked for further clarification about the degree of bleeding at the end of this dialogue:

Surgeon: We have some backbleeding from the [organ]. It is absolutely disconnected, but the big vessel that it was going to has decided to backbleed.

Anesthesia resident: Okay, I will just…

Surgeon: Okay? Are you okay with…about that?

Anesthesia resident: Mhmm. I think I'm just going to start with…just give her one unit because I started with just one unit. So she'll need some anyway.

Surgeon: Yeah, absolutely.

[intervening conversation]

Anesthesia resident: It's like oozing or like really bleeding?

Given the difference in discipline and experience level, the anesthesia resident might have been less inclined to question a less transformational surgeon. We see evidence for this assertion in the case of our least transformational surgeon (surgeon A), who refused to engage when the anesthesiologist queried him/her about whether any recently placed retractors or packing could be responsible for "a little of a sag in pressure and rising CVP." S/he responded by stating only, "It's been a while in," and proceeding to operate. The anesthesia attending and resident continued troubleshooting amongst themselves and did not seek further input or participation from the surgeon. Higher passive leadership scores were associated with fewer instances of information sharing among the team.

Table 4 contains the results of the Poisson regressions correlating MLQ scores to each type of leader (SLI) behavior, controlling for the total number of SLI behaviors observed from each surgeon. Surgeons with higher transactional and passive scores more frequently displayed negative behaviors, while surgeons with higher transformational scores less frequently exhibited them. Surgeon A, the surgeon with the highest transactional score (and lowest transformational score) didn't think to ask the medical student, "So what's your name?" until 5 hours, 45 minutes, and 22 seconds after incision (negative social). S/he also simply refused to answer a question s/he felt that s/he had already addressed (negative communicating):

Scrub technician: What do you want this specimen labeled?

Surgeon: We already talked about it.

Surgeons with transformational tendencies supported others with significantly greater frequency. As we saw in the preceding vignette of backbleeding, the surgeon with the highest transformational score (surgeon E) ensured the anesthesia resident was informed and prepared to resuscitate. S/he also expressed gratitude and complimented the OR team throughout the case:

Scrub technician: I'm getting the local while you're (closing).

Surgeon: Oh, you're so good.

…

Surgeon: Can I have a big needle? Even a blunt is fine.

> Scrub technician: Yeah, I have one.

> Surgeon: You have it already? Oh, you're so good.

Higher transactional scores were also correlated with increased training and decreased decision-making behaviors. Passive leadership scores were correlated with more resource management.

Discussion

Surgeons clearly value leadership. Over the past few years, the American College of Surgeons has dedicated several Bulletins (19-24) to surgical leadership, stating, "It is the surgeon's responsibility to lead the team…Basic principles of leadership transcend the OR and are important in all aspects of a surgeon's professional life." Mrkonjic and Grondin (25), Schwartz and Pogge (26), Jain et al (27), and Chaudry et al (28) have published similar articles in the surgical literature, providing justification for leadership development among surgeons, and, to some extent, describing the qualities a good leader should and should not have. However, as physician leadership has thus far been little studied, these publications are predominantly theoretical. Most focus on physician leadership as a skill useful to the select few destined for administrative or managerial positions, rather than clinicians, all of whom must interact with complex teams daily in order to deliver care.

Few have studied surgeon leadership in the OR. Hjortdahl's (29) interviews with trauma nurses, surgeons, and anesthesiologists revealed only that leadership is critical to team function. From their observations of ORs and structured interviews of OR teams, Leach et al conclude that surgeon leadership "set(s) the tone" in the OR; good leaders create an environment that encourages others to manifest extra-role cooperative behavior and thus allows the team to dynamically respond to various perturbations in the system (30). Edmondson et al (31) interviewed OR teams to find that surgeon-leader behavior impacts the success of new technology implementation.

We sought to better characterize – indeed, quantify – surgeon leadership style, using the MLQ, a previously validated instrument, and its impact on team response in the OR. The MLQ has been used before to characterize surgical trainees' leadership; Horwitz et al (32) administered the self-report portion of the MLQ to Baylor surgical residents and found an association between transformational leadership and self-ratings of effectiveness, subordinate satisfaction, and subordinate extra effort. By giving the MLQs to submanagers of CEOs at 5 Pennsylvanian hospitals, Spinelli (33) found that transformational score was most highly correlated with effectiveness, subordinate satisfaction, and subordinate extra effort scores; however, it is unclear if these CEOs were all physicians. Xirasagar et al (34) used an adapted MLQ to query non-clinical executive directors of community health centers about their supervising medical directors. An increase in the transformational score was associated with increased scores in effectiveness, subordinate satisfaction, and subordinate extra effort, as well as clinical goal achievement (35). In all of these prior studies, items were reported rather than observed, and both predictors and outcomes were assessed by the same individual; this single source bias may have inflated the association. Moreover, none attempt to explain the mechanism by which leadership style manifested in team behavior.

Our study therefore adds to and improves upon the existing body of knowledge. To our knowledge, we are the first to study surgical leadership by directly observing intraoperative interactions between surgeons and their teams, using validated measures of leadership style and behaviors, as well as established markers for team performance. To minimize bias, our assessments of leaders and their teams were performed by separate, blinded sets of raters using de-identified transcripts. Both of our MLQ raters had extensive expertise in intraoperative team dynamics and a high level of familiarity with the concepts measured by the MLQ. Our Pearson's coefficient of 0.95 implies our use of the MLQ was indeed reliable. Because our raters have different backgrounds (one is a surgeon who has published extensively about intraoperative performance, the other is a leadership psychologist who specializes in OR teamwork, and this project was their first collaboration), their codes were unlikely to reflect shared biases. Three of the four coders have never practiced clinically at the study institution and therefore did not have preconceived notions about the surgeons or OR staff under study.

Our data demonstrate that existing constructs of transactional and transformational leadership are indeed applicable to surgeons. The 5 surgeons studied ranged widely in their transformational scores, but less so in their transactional scores, supporting the existing hypothesis that transformational leadership is additive, rather than inversely correlated, to transactional leadership (9, 35). Transactional leaders clearly delineate their expectations for their teams, as well as the rewards and/or corrective actions that will be exchanged for meeting or failing to meet these standards. While it may achieve task performance, such leadership promotes self-interest and performance to the bare minimum. In contrast, transformational leaders access the intrinsic motivation of their team members; they intellectually stimulate them to continue achieving beyond expectations to fulfill their own personal goals. They articulate an overarching vision and foster team identification with it, such that team members affiliate their own needs with the organizational mission. By demonstrating a high moral standard, these leaders gain the respect and trust of their team, and thus inspire people to transcend self-interest for the good of the group (9).

Our data suggest that, as in other fields, transformational leadership in the OR is associated with improved teamwork, specifically by increasing information sharing and voice behaviors. There is a small body of data in the surgical literature that suggest the clinical significance of these teamwork behaviors. Decreased intraoperative information sharing has been associated with increased odds of complications or death (1). A Harvard Business School study of cardiac surgery teams found the ease of speaking up to be associated with the successful implementation of new technology (31).

We correlated leadership style with specific leadership behaviors, as delineated by the SLI, another previously validated instrument. Consistent with the transformational subscale of individual consideration, we found that highly transformational leaders exhibit more behavior supporting others. They also were less frequently observed demonstrating negative behaviors from the SLI, e.g. failure or refusal to communicate. To our knowledge, there is only one other study of surgeon-leader behaviors and its impact on team performance: In a study of new technology adoption in the OR, Edmonson et al (31) found that effective

surgical leaders explicitly supported change, encouraged speaking up, and acted consciously to diminish the power differential between surgeons and other members of the team.

Limitations

The MLQ classically consists of two parallel questionnaires – one for self-assessment by the leader, and one for assessment by his/her subordinates. In our analysis, two observers used the MLQ to obtain leadership style scores for surgeons. Although the MLQ was not specifically constructed for such use, there is a precedent for observational use of the MLQ: Xirasagar et al (34, 35) surveyed non-clinical executive directors of community health centers about their medical directors. Their factor analysis was largely consistent with the original MLQ structure; differences were attributed to the lack of opportunities that a non-clinical supervisor may have in observing behavioral items that are directed towards subordinates. In contrast, we applied the MLQ to verbatim transcripts of the interactions of leaders and their teams. Because we wanted to capture our study subjects behaving as naturally as possible, we did not attempt to collect surveys or otherwise directly query them.

The total number of surgeons studied was small; however, there were numerous observations per surgeon. Exact Poisson regressions, used for small sample sizes, were also performed and produced results consistent with those that we report here. All operations were performed at a single institution, which may limit generalizability. However, even in this limited setting, we demonstrate significant variability in leadership style and team response. Therefore, the effect we measured is most likely biased in a conservative direction.

It has been argued that leadership styles and behaviors may change depending on the situation. Using simulated clinical scenarios, Skog et al (36) found that internal medicine residents who more frequently adjust their leadership style to changes in patient acuity scored higher on a measure of the likelihood of achieving a favorable patient outcome. We chose cases in order to maximize the likelihood of capturing stressful situations, in which leadership would be most needed. We did not attempt to measure or control for the familiarity of the OR team members with one another. At the study hospital, OR staff regularly work within subspecialty "pods." However, the delivery of care in this large, quaternary care institution demands flexibility, often requiring teams to be formed ad hoc. Therefore, it is theoretically possible that the cases we observed were situationally anomalous, causing surgeons to react atypically, and were therefore misrepresentative of the surgeons' baseline leadership styles.

Because we intentionally selected high-risk and generally lengthy procedures for observation, we believe we observed a full range of patient acuities, OR staffing and cross-coverage arrangements, and leader behaviors; we therefore believe our MLQ scores to accurately represent our surgeons' leadership styles. In another study using the SLI, surgeons were noted to make no changes in their leadership behaviors despite the occurrence of unanticipated events, aside from decreasing the training directed at their residents (37), suggesting that surgeons' leadership behaviors are consistent despite situational changes. Finally, in the leadership psychology field, while leadership *behaviors* may theoretically change according to the context, leadership *style* is considered a more stable and enduring

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construct akin to personality (38). Further study should be conducted to clarify the role of the environment in shaping leadership style – and vice versa. Leadership becomes of paramount importance in stressful situations (high patient acuity, unfamiliar staff, etc); surgeons need to develop their leadership skills in order to respond effectively to such perturbations in their operating rooms.

Conclusions

This exploratory study provides an important first step towards a more comprehensive understanding of surgical leadership and its contribution to operative performance. We provide a framework for evaluating leadership and team performance in the OR. Teams led by transformational surgeons demonstrate a statistically significant increase in information sharing and voice behaviors, which may improve both safety and efficiency in the OR. Surgeons interested in fostering transformational leadership qualities may consider focusing greater attention on supporting others and avoiding negative behaviors. As we studied a small number of surgeons at a single institution, further study is needed to confirm generalizability as well as an impact on patient outcomes. Such work holds great potential to advance the quality of surgical care.

Acknowledgments

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Table 1

Instruments

Concept, instrument	Summary	Focus	Theoretical basis
Leadership			
Multifactor Leadership Questionnaire (9)	Survey: 45 items, 9 subscales	Self reported, observed	Transformational • Idealized attributes • Idealized behaviors • Inspirational motivation • Intellectual stimulation • Individualized consideration Transactional • Contingent reward • Management by exception, active Passive • Management by exception, passive • Laissez faire
Surgical Leadership Inventory (8)	Observation scale: 8 discreet behaviors	Observed behavior	Task-focused leadership • Maintaining standards • Decision making • Managing resources Team-focused leadership • Communicating • Coping with pressure • Directing • Training • Supporting others
Team response			Task performance: activities that directly contribute to or support the transformation of inputs into outputs Contextual performance: activities that maintain or improve the organizational, social, or psychological environment necessary for the technical core to function effectively and efficiently (12)
Voice (10)	Constructive change-oriented communication intended to improve a situation	Observed behavior	
Cooperation (10)	Working together with other team members	Observed behavior	
Knowledge Sharing (13)	Information donating and/or collecting; process by which individuals mutually exchange their tacit and explicit knowledge and jointly create new knowledge	Observed behavior	

Table 2

Multifactor Leadership Questionnaire Scores

	A	B	C	D	E
Transactional	2.69	2.38	2.63	2.44	2.63
Transformational	1.98	2.88	3	3.28	3.6
Passive	1.19	1.06	1.56	0.63	0.75

Table 3

Multifactor Leadership Questionnaire Scores as Predictors of Team Behavior, Controlling for Time, Univariates

	Transactional		Transformational		Passive	
	Rate ratio (95% CI)	p Value	Rate Ratio (95% CI)	p Value	Rate ratio (95% CI)	p Value
Cooperation	0.58 (<0.01, 156.02)	0.85	2.61 (0.50, 13.74)	0.26	11.94 (0.79, 181.27)	0.07
Information Sharing	1.30 (0.24, 6.96)	0.77	3.00 (1.79, 5.00)	<0.01[*]	0.23 (0.11, 0.49)	<0.01[*]
Voice	0.23 (0.02, 3.53)	0.29	5.42 (2.10, 14.01)	<0.01[*]	0.45 (0.14, 1.49)	0.19
Social	<0.01 (<0.01, 396,329.02)	0.51	20.91 (0.03, 15,367.34)	0.37	-	-

[*] Significant.

Table 4

Multifactor Leadership Questionnaire Scores as Predictors of Surgical Leadership Inventory, Controlling for Total Number of Behaviors, Univariates

	Transactional		Transformational		Passive	
	Rate ratio (95% CI)	p Value	Rate ratio (95% CI)	p Value	Rate ratio (95% CI)	p Value
Communication	0.24 (0.05, 1.14)	0.07	1.31 (0.90, 1.90)	0.15	0.75 (0.43, 1.28)	0.29
Coping with pressure	2368.47 (<0.01, 6.64x10^{14})	0.56	0.84 (0.02, 28.22)	0.92	-	-
Decision making	<0.01 (<0.01, <0.01)	<0.01*	1.30 (0.59, 2.83)	0.51	0.50 (0.15, 1.70)	0.26
Directing	0.29 (0.08, 1.02)	0.05*	1.12 (0.84, 1.49)	0.43	0.70 (0.44, 1.08)	0.11
Maintaining standards	2.12 (<0.01, 5767.53)	0.85	0.90 (0.18, 4.53)	0.91	0.83 (0.06, 11.25)	0.88
Managing resources	0.21 (<0.01, 6.17)	0.36	1.07 (0.51, 2.27)	0.86	3.32 (1.13, 9.78)	0.03*
Negative	3327.58 (32.46, 344,551.90)	<0.01*	0.09 (0.04, 0.18)	<0.01*	5.81 (2.27, 14.88)	<0.01*
Social	11.25 (0.61, 206.44)	0.10	1.20 (0.66, 2.16)	0.57	1.58 (0.68, 3.71)	0.29
Supporting others	7.17 (0.37, 139.77)	0.19	10.07 (3.13, 32.14)	<0.01*	0.41 (0.15, 1.17)	0.10
Training	4.57 (1.25, 16.61)	0.02*	0.93 (0.73, 1.22)	0.64	1.12 (0.74, 1.67)	0.61

* Significant.