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Surgery clerkship offers greater entrustment of medical students with supervised procedures than other clerkships

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ABSTRACT

Background: Medical student procedural participation is increasingly limited, creating concerns over poor preparation for internship. Inadequate experiences may also compromise patient safety. This study explores variances in procedural entrustment of medical students between core clerkships during the first clinical year.
Methods: Students completing their first clinical year were surveyed on procedure participation. Holistic entrustment decisions are complex, thus participation was used as an objective proxy for entrustment.
Results: 138 students responded (66% response rate); 89% (123/138) wished they had performed more procedures. Students had higher participation rates during procedural clerkships (surgery, obstetrics/gynecology). Entrustment was highest during surgery, and lowest during pediatrics. Surgery gave statistically significantly higher entrustment for subcuticular suturing (compared to obstetrics/gynecology) and nasogastric tube removal (compared to internal medicine). Entrustment was generally inversely proportional to procedure complexity within each specialty.
Conclusions: Students encounter higher entrustment during procedural clerkships, especially surgery. Targeted areas for increased procedural involvement can be identified in all specialties.

Introduction

Procedures are an integral component of all medical specialties and student participation in them is an essential element of medical education, contributing to confidence and technical skill development. In both procedural and medical specialties, incoming interns are expected early on to independently perform bedside procedures.[1,2] Procedural exposure and participation during medical school is an important contributor to preparation for internship. Despite this, multiple studies have demonstrated that both graduating medical students[3] and program directors across specialties[4,5] lack confidence in new doctors' abilities to perform procedural skills. To exacerbate the situation, over the past 25 years, there has been a marginalization of medical students in all aspects of patient care, including a substantial decline in medical student participation in procedures.[6,7]

Ultimately, the decreased preparedness of medical students has long-term implications on patient care and safety. While reducing medical student active engagement with procedures may appear to leverage patient safety, this perspective fails to recognize the responsibility of physician educators to nurture safe future practitioners. Since new residents are expected to perform these procedures under indirect supervision in close proximity to graduation, the greater number of procedures a learner performs in a supervised environment, the less the risk for adverse events.

The primary factor in a student's participation in a procedure is the supervisor's entrustment decision.[8] Entrustment is the act of importing increasingly more trust and responsibility to the learner[9–11] granted through a complex decision making process which integrates supervisor, student, task, environment, and relationship variables into the ultimate determination of whether to entrust the learner with a given task.[12–15] While mechanisms have been generated to assess entrustment of residents, we were unable

Abbreviations: ER, exposure rate; PR, participation rate; M3, third year (first clinical year) medical students; M4, graduating/fourth year medical students.

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to identify an entrustment assessment for medical students.[9] For our study, the objective, measurable outcome of the decision to trust a student – their participation – was used as a proxy for student entrustment. The complexity of a procedure was also assessed. This objective and, therefore, measurable component of the task helps place procedures in perspective and facilitates comparisons between specialties.

Numerous studies have explored the current paucity of procedure exposure and participation in medical school.[3,6,16] However, there is poor understanding of how entrustment relates to medical student exposure and participation in procedures. This study sought to understand the entrustment of third year medical students with procedures across seven core clerkships. We hypothesized that entrustment would be inversely proportional to complexity and that entrustment between clerkships would be similar when procedures were normalized by comparing participation at each complexity level. Our results highlight the differences between clerkships and areas to target increased involvement.

Materials and methods

Study design

A preliminary survey was distributed to graduating (M4) medical students to generate a list of procedures performed in the 7 core clerkships (family medicine, internal medicine, neurology, obstetrics/gynecology – ob/gyn, pediatrics, psychiatry, surgery) during the first clinical year (M3). Using purposeful sampling of responses from 28 M4s a list of procedures was developed for each clerkship. This list of procedures was incorporated into the final survey, which was then validated by a small cohort of medical students who had completed their core training.

The data collection survey (see Supplementary Table 1) was developed to query M3 students for: 1) perceptions towards procedures generally; 2) procedures observed or performed; and 3) procedures performed by clerkship. Descriptive data was collected on a 5-point Likert scale. This electronic survey (Qualtrics, Provo, UT) was distributed to 210 M3s at the University of Michigan Medical School at the end of the academic year and completion of the 7 core clerkships. Non-respondents received a maximum of 3 reminders. Survey responses remained confidential. Respondents could participate in a drawing for a $50 Amazon gift card on an optional form available at the end of the survey. The study received IRB review and was considered exempt.

Three variables were collected/constructed for each procedure: 1) exposure rate; 2) participation rate; and 3) complexity. Exposure rate (ER) was calculated as the percentage of students exposed (i.e. answered as 'observed' or 'performed') from all students. Participation rate (PR) was calculated as the percentage of students that participated in the procedure from those exposed. To facilitate comparisons between clerkships and provide insight into each specialty's perceptions of a given procedure, clerkship directors were asked to consult their leadership and form a consensus, rating the "complexity" of procedures for their clerkship on a 10-point scale with 1 being the least complex and 10 being the most complex. All clerkship leaderships were given the same examples of low, medium, and high complexity procedures. For clerkships with responses from multiple directors, ratings were averaged.

Statistical analysis

Statistical analysis was performed using SPSS (IBM SPSS v22, Armonk, NY). Descriptive statistics were reported as mean ± standard deviation and categorical statistics as proportions. Relationships among categorical variables were assessed via Chi-square tests. Multiple comparisons between any two proportions were assessed via the Marascuilo procedure.[17] When comparisons were made between multiple clerkships, only students that observed or performed procedures in those clerkships were included in statistical testing. Statistical significance was set with a Type I error of $\alpha = 0.05$.

Results

Demographics

Of the 210 medical students, 138 responses were received (response rate 65.7%). 46% of respondents were male and 54% were female. 69% identified as White, 18% as Asian, 13% as Hispanic/Latino, and 2% as Black/African American. This distribution is similar to all matriculated students at the time of the survey.[18]

22% of respondents intended on applying to general surgery or a surgical specialty (orthopedics, urology, plastics, etc.), 14% to internal medicine or a medical subspecialty, 10% to emergency medicine, 9% to family medicine, 9% to pediatrics, 8% to ob/gyn, 7% to anesthesia, 4% to medicine/pediatrics, 4% to neurology, and 2% to psychiatry (Table 1). This distribution of interests is similar to previous graduating classes from 2011 to 2016.[19]

Student attitudes towards procedures

Based on a 5-point Likert scale (1 – strongly agree to 5 – strongly disagree), students reported they enjoyed performing procedures (1.48 ± 0.85) with 90% of students responding affirmatively. 89% of students wished they had performed more procedures (1.50 ± 0.83).

Entrustment with procedure participation

The participation rate of each queried procedure for each specialty was graphed by complexity level in Fig. 1. Entrustment trended highest for surgery and lowest for pediatrics. Procedural specialties (surgery and ob/gyn) trended higher than medical specialties. Psychiatry was left out of this analysis, as there was only one procedure.

Procedure participation in surgery

Select procedural data from high, medium, and low complexity tertiles of queried procedures for the surgery clerkship are represented in Fig. 2. While 25 procedures were queried, 12 procedures were selected for representation in Fig. 2 as they reflect variation in complexity, exposure rate, and participation rate of the procedures. Notably, ER was 90% or more for 22 of 25 queried procedures (10 of 12 presented in Fig. 2), including insertion of nasogastric tubes, venipuncture, and making an opening incision; PR was 90% or greater for 7 of 25 queried procedures (2 of 12 presented in Fig. 2) including subcuticular suturing and Foley insertion.

Procedure participation in other clerkships

Procedural data of select queried procedures (again from high, medium, and low complexity tertiles reflecting variation in exposure and participation rates) for the other 6 core clerkships are presented in Supplementary Figures 1-5. Table 2 shows procedures for which there are statistically significant differences in participation rates between clerkships (all $p < 0.05$). Despite similar rates of exposure, surgery gave higher entrustment with subcuticular

Table 1
Demographic and specialty interest.

DEMOGRAPHIC INFORMATION			
	ALL RESPONDENTS	MEN	WOMEN
	138	46% (64)	54% (74)
White*	69% (94)	58% (37)	77% (57)
Black or African American	2% (3)	5% (3)	0% (0)
American Indian/Alaska Native	1% (1)	2% (1)	0% (0)
Asian	18% (24)	19% (12)	16% (12)
Native Hawaiian/Pacific Islander	1% (1)	2% (1)	0% (0)
Hispanic or Latino	13% (17)	16% (10)	9% (7)
Other	3% (4)	3% (2)	3% (2)
Prefer not to answer	7% (10)	9% (6)	5% (4)
SPECIALTY OF INTEREST			
PROCEDURAL SPECIALTIES	47% (65)	53% (34)	42% (31)
Anesthesiology	7% (10)	11% (7)	4% (3)
Emergency Medicine	10% (14)	13% (8)	8% (6)
Obstetrics and Gynecology	8% (11)	3% (2)	12% (9)
Surgery or Surgical Subspecialty	22% (30)	27% (17)	18% (13)
MEDICAL SPECIALTIES	41% (57)	33% (21)	49% (36)
Family Medicine*	9% (12)	3% (2)	14% (10)
Internal Medicine or Subspecialty	14% (20)	19% (12)	11% (8)
Medicine-Pediatrics	4% (5)	5% (3)	3% (2)
Neurology	4% (5)	2% (1)	5% (4)
Pediatrics	9% (12)	3% (2)	14% (9)
Psychiatry	2% (3)	2% (1)	3% (2)
OTHER SPECIALTIES	12% (16)	14% (9)	9% (7)

*men v. women, p<.05.

suturing than ob/gyn (96% versus 82%, $p < 0.01$). Surgery also provided more entrustment with nasogastric tube removal compared to internal medicine (86% versus 74%, $p < 0.05$) and venipuncture compared to pediatrics (40% versus 15%, $p < 0.05$).

Entrustment for procedures most commonly associated with a given specialty (e.g. pap smear/pelvic exams in ob/gyn; nasogastric tubes in surgery) was highest when performed on that rotation. The order of specialty rotation was not correlated to procedural entrustment rate.

Discussion

Our study corroborates previous findings of low student participation/entrustment in procedures.[1,6,16,20,21] Furthermore, our study shows that medical students enjoy performing procedures and wish they had increased participation. Contrary to our hypothesis, it became apparent that procedural specialties (surgery and ob/gyn) had increased entrustment with procedures at each difficulty level.

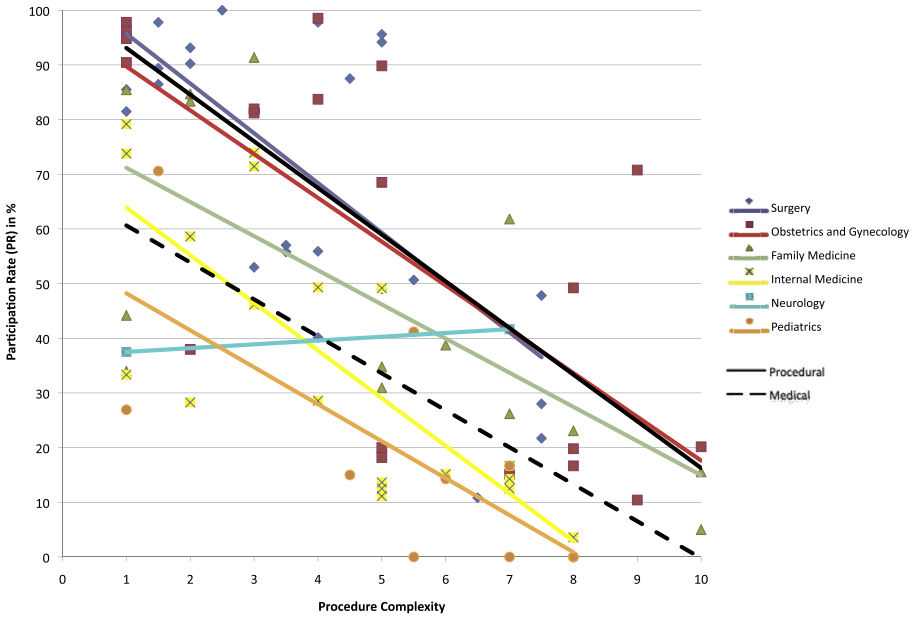

Fig. 1. Entrustment as Measured by Participation Rate for each Clerkship by Procedure ComplexityParticipation rate (PR) is graphed by complexity level for every procedure queried for each clerkship. Best-fit lines were generated for every clerkship as well as procedural (surgery and ob/gyn) and nonprocedural (all others) clerkships. In general, surgery had the highest level of entrustment for each complexity level, while pediatrics had the lowest entrustment.

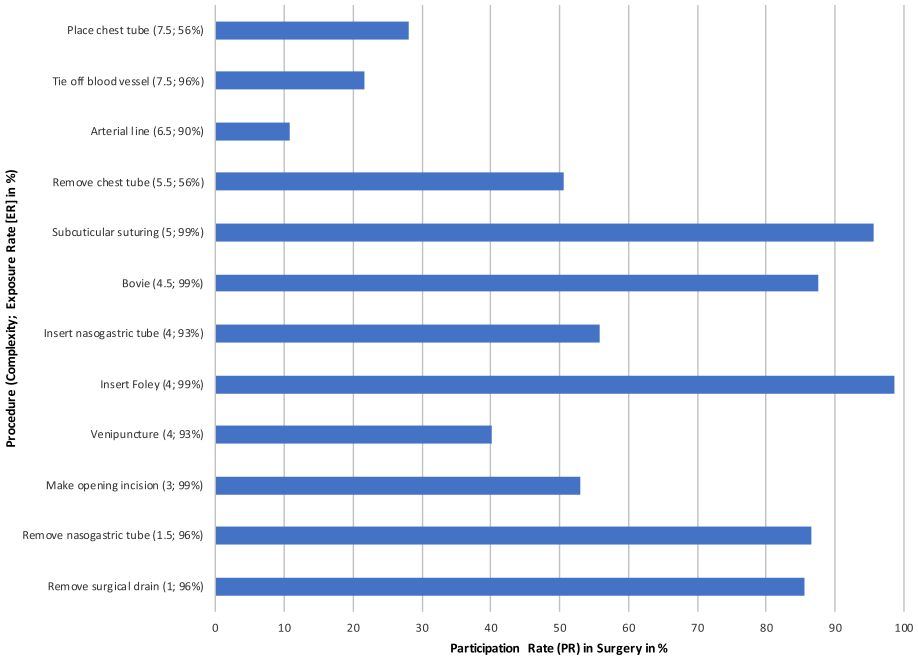

Fig. 2. Procedure Participation in the Surgery Clerkship
Selected procedure participation rates for the surgery clerkship are graphed by increasing procedure complexity (noted in parenthesis). Exposure rate is also noted within parenthesis. Low complexity, high exposure procedures that currently have low participation rates, such as inserting a nasogastric tube, making an opening incision, or venipuncture are viable targets for increased student involvement. Procedures such as inserting a Foley catheter and subcuticular suturing should continue to have high student participation.

This study is the first to our knowledge to compare procedural entrustment between clerkships/specialties. Furthermore, it is unique in that it placed procedures within the context of their complexity when querying participation. As expected, entrustment was generally inversely related to procedure complexity when compared to other procedures within that specialty (Fig. 1). While it might be expected that procedures with the same complexity level might have similar entrustment rates across specialties, this was not the case. Our study demonstrated that even at the same complexity level, entrustment of students with procedures varied across clerkships; procedural specialties – surgery and ob/gyn – provided students with higher entrustment. Many procedures were specialty specific, but a few procedures crossed specialties. Subcuticular suturing was performed on both ob/gyn and surgery. While surgery rated this skill as being a higher level of complexity (5 for surgery versus 3 for ob/gyn), they granted more entrustment with the procedure. These differences in entrustment should challenge clerkships to identify areas for increased participation and also explore how other specialties are facilitating increased involvement.

Over the past few decades, the marginalization of medical students to "observerships"[22] has compromised graduate preparation and thus patient care. Billing, liability, efficiency pressures, and lack of continuity with supervisors are only a few of many barriers[23] to students' meaningful participation resulting in inadequate preparation for internship. With the national curricular shift to competency based medical education, underprepared graduates are no longer an option. Procedures are risk-inherent components of patient care that require exposure and practice in a safe, supervised environment to obtain proficiency. It is, therefore, imperative that

Table 2
Comparisons of procedure participation between clerkships.

Procedure Performed	Family Medicine	Internal Medicine	Neurology	OB/Gyn	Pediatrics	Surgery
Biopsy	39%[a]	17%	–	18%[a]	0%	–
Cryotherapy	85%[a]	79%[b]	–	20% [a,b,c]	71%[c]	–
Lumbar puncture	-	15%[d]	42%[d]	-	17%	-
NG tube removal	-	74%	-	-	-	86%
Pap smear	83%[a]	71%[b]	-	96% [a,b]		
Pelvic exam	85%[a]	74%[b]	-	99%[a,b]	-	-
Interrupted sutures	62%[e]	33%[e]	-	-	41%	-
Subcuticular suturing	-	-	-	82%	-	96%
Venipuncture	-	-	-	-	15%	40%

Marascuilo procedure, $p < 0.05$.
[a] Family medicine versus ob/gyn.
[b] Internal medicine versus ob/gyn.
[c] Ob/gyn versus pediatrics.
[d] Internal medicine versus neurology.
[e] Family medicine versus internal medicine.

entrustment with observation and direct supervision occur during medical school, prior to internship. Ways to increase student involvement need to be explored.

In our institution, surgery is the only clerkship with required procedures collected on a self-reported checklist. Representative comments from our study showed that students found this to be a helpful tool to initiate opportunities for participation. Targets for procedural checklists can be easily identified as low complexity, high ER procedures (Fig. 2, Supplementary Figures 1-5). Examples include arterial blood gas draws and nasogastric tube placement or removal for internal medicine students; intrauterine device removal for ob/gyn students; injection for pediatrics students; and making an opening incision, nasogastric tube placement, or venipuncture for surgery students. Creating checklists for each clerkship has been shown to be a simple mechanism to encourage participation in more procedures.[24] Simulation and rotations on procedural teams (e.g. IV placement, preoperative procedures, intubations) could also increase student involvement.

Our study has several limitations. Students surveyed were within a single institution limiting the generalizability of our findings. However, multiple other studies report similar insufficiencies in student procedural experiences lending support to the broader application of our results.[4–6,16,20,25,26] While attempts to minimize recall bias were made, students were asked to reflect back on procedures of clerkships they had completed over an entire academic year. We would expect that this would cause underreporting of procedures. While students will have further exposure over the final clinical year, the timing of our study was deliberately selected to explore procedural experiences across clerkships and thus was performed closest to the completion of core rotations. Comparable studies have queried students at the end of their M3[26] and M4 year[6,25] and still found deficits in procedural experience. Simulation, while promoted as a way to facilitate student participation,[27] was not queried by our survey. This was due to limited simulation requirements by clerkships at our institution and the concern that including simulation would unnecessarily inflate exposure and participation rates without requiring an entrustment decision. Finally, some procedures queried were nonspecific and open to interpretation (e.g. injection and biopsy). While this limited precision of complexity designation for clerkship directors the decision was made to keep the query broad to maximize the number of procedures captured.

Future directions for the study include investigating attitudes and cultures within specialties that may promote or inhibit student participation. Analyzing student and supervisor perceptions of entrustment theory factors in influencing student participation will help define the priorities of supervisor and trainee.[12,28] Additionally, it would be of interest to examine whether student entrustment is influenced by factors such as gender, intended specialty, or personality. Ultimately, the implications of greater student entrustment on patient safety, as well as, other outcomes such as knowledge examination scores and/or grades should be studied.

Conclusions

While medical students have been faced with decreased procedural entrustment, our study shows that surgery clerkships provide students with the most opportunities. Areas for increased student involvement should be identified and prioritized to facilitate graduate preparation for internship and optimize patient care.

Declaration of competing interest

The authors of no conflicts of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjsurg.2020.02.052.

References

1. Raymond MR, Mee J, King A, Haist SA, Winward ML. What new residents do during their initial months of training. *Acad Med*. 2011. https://doi.org/10.1097/acm.0b013e31822a70ff.
2. Langdale LA, Schaad D, Wipf J, Marshall S, Vontver L, Scott CS. Preparing graduates for the first year of residency: are medical schools meeting the need? *Acad Med*. 2003. https://doi.org/10.1097/00001888-200301000-00009.
3. Dehmer JJ, Amos KD, Farrell TM, Meyer AA, Newton WP, Meyers MO. Competence and confidence with basic procedural skills. *Acad Med*. 2013. https://doi.org/10.1097/acm.0b013e31828b0007.
4. Lindeman BM, Sacks BC, Lipsett PA. Graduating students' and surgery program directors' views of the association of American medical colleges core entrustable professional activities for entering residency: where are the gaps?. In: *Journal of Surgical Education*. 2015. https://doi.org/10.1016/j.jsurg.2015.07.005.
5. Dickson GM, Chesser AK, Woods NK, Krug NR, Kellerman RD. Family medicine residency program director expectations of procedural skills of medical school graduates. *Fam Med*. 2013;45(6):392–399.
6. Barr J, Graffeo CS. Procedural experience and confidence among graduating medical students. *J Surg Educ*. 2016. https://doi.org/10.1016/j.jsurg.2015.11.014.
7. Fincher RM, Lewis LA. Learning, experience, and self-assessment of competence of third-year medical students in performing bedside procedures. *Acad Med*. 1994. https://doi.org/10.1097/00001888-199404000-00012.
8. Sandhu G, Thompson-Burdine J, Nikolian VC, et al. Association of faculty entrustment with resident autonomy in the operating room. *JAMA Surg*. 2018. https://doi.org/10.1001/jamasurg.2017.6117.
9. Sandhu G, Nikolian VC, Magas CP, et al. OpTrust: validity of a tool assessing intraoperative entrustment behaviors. *Ann Surg*. 2018. https://doi.org/10.1097/SLA.0000000000002235.
10. Sandhu G, Magas CP, Robinson AB, Scally CP, Minter RM. Progressive entrustment to achieve resident autonomy in the operating room. *Ann Surg*. 2017. https://doi.org/10.1097/sla.0000000000001782.
11. Sandhu G, Thompson J, Matusko N, et al. Greater faculty familiarity with residents improves intraoperative entrustment. *Am J Surg*. 2019. https://doi.org/10.1016/j.amjsurg.2019.06.006.
12. Cate O Ten, Hart D, Ankel F, et al. Entrustment decision making in clinical training. *Acad Med*. 2016. https://doi.org/10.1097/ACM.0000000000001044.
13. Sterkenburg A, Barach P, Kalkman C, Gielen M, Ten Cate O. When do supervising physicians decide to entrust residents with unsupervised tasks? *Acad Med*. 2010. https://doi.org/10.1097/ACM.0b013e3181eab0ec.
14. Hauer KE, Oza SK, Kogan JR, et al. How clinical supervisors develop trust in their trainees: a qualitative study. *Med Educ*. 2015. https://doi.org/10.1111/medu.12745.
15. Choo KJ, Arora VM, Barach P, Johnson JK, Farnan JM. How do supervising physicians decide to entrust residents with unsupervised tasks? A qualitative analysis. *J Hosp Med*. 2014. https://doi.org/10.1002/jhm.2150.
16. Engum SA. Do you know your students' basic clinical skills exposure? *Am J Surg*. 2003. https://doi.org/10.1016/S0002-9610(03)00182-X.
17. Marascuilo LA, McSweeney M. Nonparametric post hoc comparisons for trend. *Psychol Bull*. 1967. https://doi.org/10.1037/h0020421.
18. University of michigan office of the registrar ethnicity reports. https://ro.umich.edu/reports/ethnicity. Accessed August 20, 2019.
19. University of michigan medical school match list search. https://medicine.umich.edu/medschool/education/match-list-search. Accessed April 15, 2017.
20. Gliatto P, Masters P, Karani R. Medical student documentation in the medical record: a liability? *Mt Sinai J Med*. 2009. https://doi.org/10.1002/msj.20130.
21. Friedman E, Sainte M, Fallar R. Taking note of the perceived value and impact of medical student chart documentation on education and patient care. *Acad Med*. 2010. https://doi.org/10.1097/ACM.0b013e3181eac1e0.
22. Scally CP, Minter RM. Medical school training for the surgeon. *Surg Clin North Am*. 2016. https://doi.org/10.1016/j.suc.2015.08.007.
23. Luhoway JA, Ryan JF, Istl AC, et al. Perceived barriers to the development of technical skill proficiency in surgical clerkship. *J Surg Educ*. 2019. https://doi.org/10.1016/j.jsurg.2019.03.020.
24. Read TE. Clinical skills passport: a method to increase participation in clinical skills by medical students during a surgery clerkship. *J Surg Educ*. 2017. https://doi.org/10.1016/j.jsurg.2017.05.015.
25. Wu EH, Elnicki DM, Alper EJ, et al. Procedural and interpretive skills of medical students: experiences and attitudes of fourth-year students. *Acad Med*. 2008. https://doi.org/10.1097/acm.0b013e318183c5a7.

26. Wu EH, Elnicki DM, Alper EJ, et al. Procedural and interpretive skills of medical students: experiences and attitudes of third-year students. *Acad Med*. 2006. https://doi.org/10.1097/ACM.0b013e318183c5a7 [References] 2004.
27. Nestel D, Groom J, Eikeland-Husebø S, O'Donnell JM. Simulation for learning and teaching procedural skills: the state of the science. *Simulat Healthc*. 2011. https://doi.org/10.1097/SIH.0b013e318227ce96.
28. Karp NC, Hauer KE, Sheu L. Trusted to learn: a qualitative study of clerkship students' perspectives on trust in the clinical learning environment. *J Gen Intern Med*. 2019. https://doi.org/10.1007/s11606-019-04883-1.