Assessment of surgical autonomy: in support of aspirational goals
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Introduction
For residency programs with a surgical component, the Accreditation Council for Graduate Medical Education (ACGME) sets forth case minimums for core procedures. These case minimums numerically define the minimal surgical experience required for a resident to graduate and that must be offered by a program. Thus, determining whether residents in a particular program meet the case minimums reflects an assessment of the program itself.1,2 These case numbers do not necessarily reflect the optimal target for graduating residents nor does completion of the necessary minimal number of cases automatically indicate competency.1,2 The main goal of surgical education is to graduate residents who can operate independently; however, providing sufficient opportunity to build skills in a safe and efficient way can sometimes be difficult to achieve.3,4

Adult learning and assessment scales
Several scales were developed to assess resident autonomy for operative procedures and allow faculty to use this assessment information to help build and grant increasing resident autonomy.3,4 Many of these assessment scales build off of earlier models of adult skills acquisition such as the classic theory described by Fitts and Posner,5 in which learners are characterized as progressing through cognitive, associative, and autonomous phases.4,5 The cognitive phase is thought to require significant cognitive input and involves identifying the skills goals and the cognitive and motor steps necessary to achieve these goals.5,6 The associative phase builds on the cognitive phase, as the learner focuses more specifically on the details of the steps.5,6 Finally, in the autonomous phase, learners continue to practice the skills to achieve a more automated level of performance.5,6 As learners advance through the phases, progressively less cognitive input is required, there is increasing automatic control of motor movements (as opposed to conscious control), and the movements improve from slow and inefficient to fluid, consistent, and efficient.5 Numerous skill-based tasks have been studied, and the learning curves have generally been found to fit this model.5 Unsurprisingly, progression through these phases is not uniform. Initial performance improvements are often achieved more quickly, then followed by a plateau, and later interval improvements occur more slowly.6

Two models are used frequently in the assessment of resident surgical autonomy: the 4-point Zwisch scale (Appendix A)8 and the 5-point Dreyfus scale (Appendix B),9 both of which generally map to the described phases. The Zwisch scale includes 4 levels, moving from “show and tell,” which reflects the cognitive phase, to “active help” and then “passive help,” which both reflect the associative phase, and finally “supervision only,” which reflects the autonomous phase.4 The Dreyfus scale similarly builds on a model of adult skill acquisition, the Dreyfus model, with progression through 5 levels including “novice,” “advanced beginner,” “competent,” “proficient,” and finally “expert.”5,7 The terminology of the 5-point Dreyfus scale was adapted using the labeling of the 4 levels of the Zwisch scale, but also including a higher level of “expert.”8,9

In review of the literature, the use of...
these scales does vary somewhat across surgical programs, although a 5-point scale modeled on the Dreyfus scale using numeric designations is used for ACGME milestones across specialties.10 There are also a number of platforms that present these surgical autonomy scales as digital evaluation tools, such as the System for Improving and Measuring Procedural Learning, which integrates the Zwisch scale and is used in general surgery,11 and the myTIPreport platform, where TIP stands for Training for Independent Practice, which integrates the Dreyfus scale and is used in obstetrics and gynecology for surgical skills assessment.12 There is existing evidence supporting the construct validity for the use of both of these scales in general surgery and obstetrics and gynecology.13 Previous studies, for example, have demonstrated high interrater reliability,3,8 the ability of each assessment scale to differentiate between junior and senior learners,3,8 and for the Zwisch scale specifically, agreement with existing scales such as the Operative Performance Rating System and the Ottawa Surgical Competency Operating Room Evaluation (O-SCORE).3 Despite this evidence, there is a debate about the use of these scales, primarily focused on whether the expert level is achievable during residency,14 and the crux of this debate centers on the concept of aspirational goals in surgical education and the description of the expert level. In addition, although these scales are frequently used in surgical residency programs, how they are incorporated into assessment of resident surgical competency may vary significantly between programs.

The zone of proximal development and aspirational goals

The use of a small gap between the current level of expertise and aspirational goals fits with key concepts in learning theory, particularly Vygotsky’s theory about the zone of proximal development (ZPD).14,15 Although first discussed in childhood education and development, this theory has also been described for use in adult education.14,15 The ZPD describes the zone between the existing skill or development level and the potential or aspirational level.14 Use of this concept requires that a teacher recognizes the current skill level of the learner and sets an appropriately challenging aspiration, such that this provides motivation rather than discouraging the learner.14,15 Teaching strategies that use the ZPD rely on the use of a technique called “scaffolding,” which is a form of assisted learning in which the teacher plays a key role in supporting the trainee throughout the learning process and results in a transfer of control from the teacher to the student.14,15 Arguably, this learning theory closely matches the process of surgical skill acquisition and the type of surgical instruction used in surgical residency programs. Because this type of educational strategy necessarily involves some degree of aspiration to support continued learning, it highlights the importance of setting the highest assessment level above the expected level of achievement, albeit with reasonable selection of that aspirational category. An aspirational level allows further differentiation of senior-level residents and provides an opportunity for residents that are exceeding expectations to demonstrate that skill level. Previous work evaluating the use of aspirational goals indicates that if aspirations far outweigh expectations, this can lead to negative consequences, particularly increased likelihood of depression.16 The major concern is not the use of aspirational goals themselves, but rather when a significant mismatch exists between expectations and aspirations. Within the general surgery literature, there has been an argument that a resident would be unable to achieve the expert level because this requires completion of large numbers of a particular case type and more closely matches the level of an attending in practice.4 This highlights the importance of selecting reasonable levels for expectations and aspirations and clearly communicating the expectations.

Comparison with Accreditation Council for Graduate Medical Education milestones

The ACGME’s current approach to milestone assessment offers an example of appropriate inclusion of aspirational goals and provides a strategy that could be similarly applied to surgical skills. This would fill an existing gap with the addition of much needed ACGME-directed guidance that could focus on the expectation of resident progression of surgical skills during training, rather than measures such as case minimums that do not serve this purpose. Milestones were developed through the ACGME to define the knowledge, skills, and qualities necessary to achieve competency in 6 core areas: patient care, medical knowledge, systems-based practice, practice-based learning and improvement, professionalism, and interpersonal skills and communication.10,12,17–19 Milestone levels map to the Dreyfus scale, ranging from level 1 (novice) to level 5 (expert) (Appendix C).10,19 The description of level 5 indicates that this is an “aspirational goal” that few residents will achieve.10,19 Thus there is clear precedent in the ACGME for inclusion of these types of aspirational goals. An important distinction, however, is that the ACGME also includes clear notation of the target level to achieve by graduation, which is level 4.10,19 Although the patient care milestone area does contain certain specialty-specific technical skills that can be evaluated, the assessment is a basic commentary on whether the resident performed the skill or not, rather than a more nuanced assessment of the resident’s technical ability and degree of surgical autonomy, such as that assessed using a surgical autonomy assessment scale. In addition, these technical skills are frequently grouped by route rather than describing individual surgical procedures. Thus, with respect to surgical skill assessment, milestones alone are insufficient. Unlike with milestones, the ACGME does not provide guidance about the use of assessment scales for surgical autonomy or about the target level of surgical autonomy that residents should strive for by graduation.1,2 Thus, aside from assessing case minimums, which again evaluate the program and not the individual resident, and broadly assessing technical skills through the platform of milestone assessment, the ACGME leaves it to the individual programs to determine surgical competency.
Indirect supervision only would then describe the aspirational goal and would indicate a situation in which direct attending presence is no longer necessary, but the attending is available to provide remote guidance or direct supervision if called on. This sets the aspirational goal as one that is more achievable by a resident before graduation.

This type of model for assessing surgical autonomy would allow both formative and summative assessment of resident performance, and in this manner, could be used in a similar fashion to milestone assessment. The ACGME describes use of the current model for milestone assessment for semiannual reviews of residents.10,19 The model recognizes that any semiannual reviews evaluating a resident’s progression should be taken in the context of the individual program’s rotation schedule.10,19 Residents may have a different time frame for exposure to certain clinical areas depending on the program structure,10,19 and this would be a very similar situation for surgical skill assessment. Ultimately, use of a structured model for surgical autonomy assessment that corresponds to ACGME-specific level definitions and targets would allow greater consistency across programs and improved transparency for residents and programs alike.

Conclusion

Learning theories support the use of aspirational goals in education, particularly in acquisition of technical skills that require autonomy, such as surgical training. To make appropriate use of aspirational goals, it is critical that they are set at an appropriately challenging level and that expected targets are clearly communicated. Future endeavors by the ACGME could therefore better define targets for surgical autonomy, such as those proposed here, with improved terminology and definitions that accurately reflect the expectations for residents. Identification of the core surgical procedures for a given specialty and then the use of an updated surgical autonomy assessment scale would permit the development of surgical graduation target levels. This necessary ACGME level guidance would provide programs with a clearer model to use for resident assessment with respect to surgical skill and would offer improved consistency, transparency, and understanding of expectations for both residents and programs.

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## APPENDIX A

### Zwisch Scale\textsuperscript{3,4}

| Zwisch Scale level | Attending behaviors                                                                 | Resident behaviors                                                                 |
|--------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Show and tell      | 1) Performs >50% of the critical portion(s)                                         | 1) Opens and closes                                                                 |
|                    | 2) Demonstrates key concepts, anatomy, and skills                                    | 2) Observes and listens during the critical portion(s)                               |
|                    | 3) Narrates/explains case                                                           |                                                                                     |
| Active help        | 1) Leads the resident for >50% of the critical portion(s) / actively assists         | The above, plus                                                                      |
|                    | 2) Optimizes the field/exposure                                                     | 1) Actively assists (ie, anticipates surgeon’s needs)                                |
|                    | 3) Demonstrates plane/structure                                                     | 2) Practices component technical skills                                              |
|                    | 4) Coaches technical skills                                                         |                                                                                     |
|                    | 5) Coaches next steps                                                              |                                                                                     |
|                    | 6) Identifies key anatomy                                                           |                                                                                     |
| Passive help       | 1) Follows the lead of the resident for >50% of the critical portion(s) / passively assists | The above, plus                                                                      |
|                    | 2) Acts as a capable first assistant                                                | 1) Can “set up” and accomplish next steps                                           |
|                    | 3) Coaches for polish, refinement of skills, safety                                 | 2) Recognizes critical transition points                                             |
| Supervision only   | 1) Provides no unsolicited advice for >50% of the critical portion                  | The above, plus                                                                      |
|                    | 2) Monitors progress and patient safety                                             | 1) Mimics independence                                                               |
|                    |                                                                                     | 2) Can work with a less experienced assistant                                      |
|                    |                                                                                     | 3) Can safely complete the case without faculty guidance                           |
|                    |                                                                                     | 4) Recovers from most errors                                                        |
|                    |                                                                                     | 5) Recognizes when to seek advice / help                                           |

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## APPENDIX B

### Dreyfus Scale (from the myTIPreport platform)\textsuperscript{8}

| Dreyfus Scale level | Description                                                                 |
|--------------------|-----------------------------------------------------------------------------|
| Show and tell      | The teacher performs the critical step while explaining the step to the learner. |
| Active help        | The teacher actively guides the learner through the critical step of the procedure. |
| Passive help       | The learner performs the critical step independently while the teacher passively provides skilled assistance and intervenes only when necessary for an important teaching point or to optimize patient safety. |
| Supervision only   | Teacher presence is necessary only to guarantee patient safety. At this level, the learner has enough proficiency to perform the step independently using a less skilled assistant, while the teacher does not need to be directly involved in the procedure other than to provide close supervision. |
| Expert             | Learner performs procedures and manages complications independently            |

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## APPENDIX C

### Accreditation Council for Graduate Medical Education milestone level descriptions\textsuperscript{10,19}

| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---------|---------|---------|---------|---------|
| Expectations for a beginning resident | Milestones for a resident who has advanced over entry but is performing at a lower level than expected at mid-residency | Key developmental milestones that a resident should be able to do well at mid-residency | Target for graduation / what a graduating resident looks like | Stretch goals — exceeds expectations |

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August 2022 AJOG Global Reports 5
## APPENDIX D

### Proposed scale changes

| Adapted Scale level     | Description                                                                 |
|-------------------------|-----------------------------------------------------------------------------|
| Show and tell           | The teacher performs the critical step while explaining the step to the learner. |
| Active help             | The teacher actively guides the learner through the critical step of the procedure. |
| Passive help            | The learner performs the critical step independently while the teacher passively provides skilled assistance and intervenes only when necessary for an important teaching point or to optimize patient safety. |
| Direct supervision only | The teacher is physically present or immediately available only to guarantee patient safety. At this level, the learner has enough proficiency to perform the step independently using a less skilled assistant, while the teacher does not need to be directly involved in the procedure other than to provide close supervision. |
| Indirect supervision only | Direct teacher presence is no longer necessary, but the teacher remains available to provide remote guidance or direct supervision if called on. The learner can perform the procedure independently using a less skilled assistant. |

Husk. Assessment of surgical autonomy. Am J Obstet Gynecol Glob Rep 2022.