Abstract
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Introduction: A program was developed for incoming PGY-1 residents using the Accreditation Council for Graduate Medical Education milestones ratings. This program detects critical deficiencies and works to correct them as early as possible.

Methods: A one month period was used for this transition to discipline block to identify at-risk learners. The block utilized case-based discussions, interactive lectures, simulations, and clinical core rotations. All activities were tied to milestones measures to recognize deficiencies and provided a goal to correct the individual’s progression.

Results: Interns that completed the transition to discipline block were compared to the most recent previous class at the same institution. The same number of individuals with critical deficits were found in each class at first milestones rating (4 deficits per class, p value 1.0). The intervention classes had critical deficiencies recognized earlier and all identified deficiencies were extinguished earlier. Medical knowledge as compared by In-Training Examination percentile scores improved (Pre-Intervention Mean Percentile 28.9, Post-Intervention Mean Percentile 49.5, p value 0.005).

Discussion: A milestones-based transition to residency block identified critical deficiencies earlier, which allowed for earlier intervention and improvement in resident performance. A similar process may benefit other residency programs.

Keywords
Curriculum, Evaluation, Internal medicine, Remediation, Critical Deficits, ACGME, Milestones Ratings
Introduction
The American medical education system has transitioned towards a competency-based education as the foundation for undergraduate and graduate medical education (Accreditation Council for Graduate Medical Education, 2018; American Board of Medical Specialties, 2019). Despite a more unified framework for expectations and assessment, the transition from senior medical student to post-graduate year one (PGY-1) is complex and stressful for learners (Willcock et al., 2004). It may even be associated with higher mortality of patients (Young et al., 2011). As the breadth of medical knowledge medical schools are responsible for imparting continues to expand, schools must work even more diligently to address the needs of all of their graduates. However, many graduates lack the skills and knowledge necessary to succeed in residency (Langdale et al., 2003; Lyss-Lerman et al., 2009). In fact, only 53.8% of residents agree that their medical school prepared them to excel in residency (Chen, Kotliar, and Drolet, 2015). PGY-1 residents enter residency at different levels of competency in different areas due to their disparate medical school experiences. Often times, the program directors and faculty are not fully aware of the readiness level until several months into training.

The expectations program directors’ have of PGY-1 resident’s skills are often not reflective of the actual skills of new trainees (Raymond et al., 2011). To address these issues, The Royal College of Physicians and Surgeons of Canada launched their Competence by Design program in 2017, this program includes a mandatory transition to discipline block for new medical school graduates (Oswald and Abbott, 2017). No similar program is currently required in the U.S. Medical Education system.

Transition to residency curriculums for medical students have been shown to ease the transition into residency by helping learners understand their own shortcomings and develop self-guided learning to overcome deficits (Brownfield, Wong, and Blue, 2016; Laack, Newman, Goyal, and Toshler, 2010; Teo et al., 2011). These courses are becoming more common in medical schools, but are still not present as often among residency training programs. Immersion blocks to address gaps in perceived versus actual skills have been utilized by residency training programs. A meta-analysis (Blackmore et al., 2015) showed that such graduate medical education courses demonstrated large improvements in clinical skills and confidence. Other previous work has shown earlier competency in patient management and procedural skill within surgical residency with the inclusion of a preparatory course (Wunder, Brandt, and Lipman, 2018).

To assess the developmental outcomes of residents the Accreditation Council for Graduate Medical Education (ACGME) requires that programs evaluate their trainees semi-annually using a specialty specific competency-based rating system to track the resident’s progress, referred to as milestones ratings (Holmboe, Edgar, and Hamstra, 2016). Generally, Internal Medicine residents progress from lower to higher milestone ratings over the course of residency, but do not progress uniformly, or linearly over time (Warm et al. 2016). These ratings are given semi-annually by the program’s Clinical Competency Committee (CCC). Under current requirements, the first mandatory milestones rating report occurs after nearly 6 months of training (Holmboe, Edgar, and Hamstra, 2016). This lag can result in delayed identification of critical deficiencies among residents. Identification of critical deficiencies in ACGME Milestones ratings is not rare among medical trainees, and this identification is vital to the development of remediation plans (Kinnaer et al., 2017). Any delay in identification hinders effective implementation of a remediation process for struggling learners as, in our experience, bad habits often become ingrained behaviors after several months.

It has been demonstrated (Sozener et al., 2016) that a post-match milestones based assessment of medical students was valuable to Emergency Medicine program directors, as an “educational handover.” The value of early identification of deficits was of great interest to program directors. We are not aware of a publication wherein the residency program itself did this early assessment, coupled with training (including local culture and needs) of new trainees.

Methods
Mount Carmel’s Internal Medicine Faculty developed an immersive, intensive, one month long transition to discipline block as the initial rotation for our new PGY-1 residents. We began utilizing this block in July of 2017 and have continued annually through July 2019, as the first rotation for our new PGY-1 residents.

This block is designed to reinforce knowledge with an emphasis on urgent and emergent situations, while also specifically addressing important psychosocial, cultural and professional issues. Skills addressed include dealing with the death of patients, developing rapport with patients, and time management. These skills reflect topics residents have reported feeling less prepared for after medical school (Young et al., 2011).

During this time we also build in several wellness half-days, during which the new residents are given recommendations for and encouraged to seek primary care, dental care, or encouraged to complete their move-in process with utilities, driver’s license change, etc. During this block, our new residents also have the opportunity to begin to participate in
Simulated environments have demonstrated improvement in medical knowledge, increased comfort in procedures, and enhanced performances during retesting in simulated scenarios. Simulation has also been shown to be a reliable tool for assessing learners for teamwork and communication skills (Okuda et al., 2009). Performing this assessment in a simulated patient environment allows for direct manipulation of single variables to assess sub-competencies of internal medicine that are not often directly observed during early stages of residency. These sub-competencies include: working effectively with multidisciplinary team (SBP1), learning and improving via feedback (PBLI3), learning and improving at the point of care (PBLI4), and communicating effectively in inter-professional teams (ICS2). The simulated environment provided another unique feature by allowing new residents to give each other feedback while permitting us to see the learner’s response to feedback and future incorporation.

Simulations allow us to observe the reaction of our learners, providing faculty the opportunity to engage in mentoring and advice for future real world situations. Each session, classroom-based and simulation-based, was tied to 6-10 of the Internal Medicine milestone sub-competencies. Over the course of the block, 477 total sub-competency ratings on each individual learner were compiled. For each activity, the faculty member leading the session was asked to record in a spreadsheet whether a critical deficiency was or was not present for each PGY-1 resident for each associated sub-competency linked to the activity. A critical deficiency is defined by the ACGME as a rating of 1 on a sub-competency (Oswald and Abbot, 2017). Written feedback was compiled for below expectations or exceeding expectations ratings during these activities. For a sample feedback form please see Supplementary File B.

Learners in whom a critical deficiency was identified were given formative feedback for each deficiency. Every deficiency was tied to a specific activity, allowing the feedback to include the precise action which caused a below expectations rating for their level of training. For any critical deficiency discovered, an individualized action plan was developed to address the deficiency. Faculty were informed of all deficiencies and subsequent action plans. This process occurred during the introductory block resulting in development of remediation plans prior to residents beginning their first full clinical rotation.

Six months after intern school we evaluate the curriculum again. This evaluation timing coincides with the CCC requirement for the first competency evaluation of residents. This evaluation involves a team-based review of milestones achieved by PGY-1 learners as rated by the CCC which is based on a review of the summative narrative evaluation as well as review of quantitative data. The goal of this session is to evaluate the effectiveness of newly introduced topics and changes made to the curriculum. Changes made to the curriculum are based on the reflection of areas of positive improvement and areas where opportunities to improve still exist. An effort is made to eliminate material that has shown to have negligible improvement or, in rare cases, regression. After this six month evaluation, planning for the upcoming year and changes to the curriculum begin.

We tracked the findings of critical deficiencies among the intervention classes against matched classes prior to the intervention. The intervention classes had their initial milestones rating at one month, while the control class had their initial milestones rating at 6 months, in line with usual ACGME requirements. We assessed the control class at six month intervals per usual ACGME requirements. The intervention classes were assessed at the usual ACGME required six
month intervals in addition to the initial assessment during the first month. The differences were analyzed by Chi-
Square analysis. The control class had all ratings done by the CCC, the membership of which remained consistent for the
ratings of the intervention classes as well. Ratings performed prior to this class were performed by different faculty
members and discarded due to concern for inter-rater reliability.

In an effort to assess whether this program objectively impacted medical knowledge, we also tracked the PGY-1 Internal
Medicine In-Training Exam (ITE), administered by the American College of Physicians. This examination is admin-
istered in August and September nationally to all Internal Medicine residents. It provides and unbiased comparison of
their medical knowledge to their peers nationally. The PGY-1 ITE scores were then analyzed by student’s T-test for
comparison. The first two matched classes before intervention were compared to the two intervention classes for this
comparison.

Results
At initial assessment of the control class (time six months), we found that four of the eight (50%) PGY-1 residents had
critical deficiencies found. Some residents were found to have multiple critical deficiencies. Overall, there was at least
one critical deficiency in each of the five competency areas. No specific pattern of deficiencies was noted.

At initial assessment for the intervention classes (time one month) we found that eight of 16 (50%) PGY-1 residents in the
two separate intervention classes had critical deficiencies. Again, some residents were found to have multiple deficien-
cies, and four of the five areas of competency were found to account for at least one critical deficiency. No pattern of
critical deficiencies was noted, and there was a disparate assortment of critical deficiencies found in each class.

Despite similar initial assessments, interns in the control class were found to have critical deficiencies persisting in future
milestones ratings, including to as far out as 18 months into training, with extinguishing of critical deficits not being
realized until 24 months of training. Those learners in the intervention classes, however, extinguished all critical
deficiencies by their 6 month rating (see figure 1). The intervention classes have not had a recurrence of any critical
deficiencies to date, however they are still in training at the time of writing of this manuscript.

At initial assessment the same number of residents from each class were found to have critical deficiencies. Those in the
intervention group extinguished critical deficiencies by their 6 month rating and they did not re-emerge.

The two control classes had a mean PGY-1 ITE percentile of 28.9 (range 3-61). The two intervention classes had a mean
ITE percentile of 49.5 (range 14-86) (See figure 2 for all scores). The difference of those mean scores are statistically
significant with a p-value of 0.005. There was no change during this interval in our programmatic board preparation or
education for standardized exams.

Discussion
Our results show that a transition to discipline introductory rotation block can identify critical deficiencies early in
training. We have also shown that this early identification of critical deficiencies can lead to earlier correction. We
hypothesize that this is because the behaviors leading to critical deficits have not had time to become entrenched or
routine. Such critical deficits are relatively common among internal medicine trainees, and identification is critical in
developing a plan for eradicating the deficits. By showing learners as early as possible in the course of their residency
training that these deficits exist and by developing individualized remediation plans for them, we have found deficits can
be successfully extinguished early in training.

We built upon existing literature showing medical knowledge and its application can be improved by an introductory or
“bootcamp-style” block. We believe that when tied to a milestones based assessment, and provided by the residency
faculty, this transition to discipline block is more supportive of residents advancing in milestones sub-competency rating.
Our intervention classes showed significant improvement in ITE scores as compared to the control classes, showing that
they retained the educational component of our introductory block for at least several months. This enhanced medical
knowledge and application could possibly also mitigate the “July effect,” by improving patient care and potentially
reducing medical errors.

As the curriculum for medical schools must continue to expand with time and advancement in medical science, it will
likely become increasingly difficult for medical schools to meet all challenges that will face new physicians in residency.
We believe that this introductory transition to discipline block represents an immense opportunity for residency programs
to change the trajectory of milestone ratings for new residents. By identifying deficits early, prompt corrective plans can
be put in place, which will facilitate residents’ progression through the milestones at a faster rate.
There are several limitations to our work. Milestones ratings were done by the same Clinical Competency Committee across this project, but milestones ratings can be seen as subjective. We attempted to limit subjectivity as possible by using milestones ratings only from the same CCC with an established protocol.

We also used the In-Training Exam results as an objective measure of medical knowledge, however the American Board of Internal Medicine (ABIM) exam passage rate may be a better measure. At the time of the writing of this manuscript, however, the classes enrolled in this program are still in training and not yet eligible to take the ABIM exam.

This project was done at a single academic medical center, within a single specialty, and within a relatively small program, which could bring into question the applicability to other specialties or academic centers and significantly limits statistical power.

**Figure 1.** Graph of Residents with critical deficiency ratings over time in training.

**Figure 2.** Individual and mean percentiles of the two most recent pre-intervention (control) classes compared to the two intervention classes.
As there are differing gaps among individual students entering residency, there is a broad spectrum of areas in which education must be given. We have very little literature to use to determine the curriculum. Our curriculum is reflective of the tasks and medical knowledge asked of incoming interns at our institution. We do believe this curriculum is reflective of most Internal Medicine programs and the gaps seen most often from the medical schools. We are limited in the scope of our results by the selection of our learners being from the limited population of medical schools that we recruit from most heavily.

Due to the iterative nature of the curriculum, there is a constant shift towards varying areas of competency. In our third year, there has been a relative stabilization of topics, but there continues to be year-to-year changes for improvement. There is also a trend to ongoing entropy with an ever expansion of topics. This increasing amount of education has led to concern about the efficient frontier. There may be a point in which marginal gain in education and skill come at a high cost of lack of clinical exposure. Determination of this point has been difficult as there are no available studies to help guide this evaluation. We understand that we may, even at this time, have too many topics or cover a topic too thoroughly with time being better spent on teaching other aspects.

Conclusion
Dedicated transition to discipline blocks can be used to address gaps in perceived versus actual skills, identify and begin correcting critical deficiencies at the beginning of residency, and improve baseline medical knowledge. We believe such a block would benefit residency training programs at large. This innovation could create a solid foundation for education and feedback, which can improve an entire generation of physicians.

Take Home Messages

- Critical deficiencies in milestones ratings are common among internal medicine trainees. Their identification is critical to any remediation of the deficiency.
- An introductory transition to discipline block can be used for PGY-1 trainees to evaluate their knowledge, skills, and attitudes and identify critical deficiencies at the beginning of residency.
- Earlier identification of critical deficiencies leads to earlier correcting of these deficits, as behaviors do not become entrenched this way.
- A similar transition to discipline block in other programs or other institutions may improve the difficult evolution from medical student to resident, with improved resident outcomes.

Notes On Contributors

Robert Battisti is an Assistant Program Director and Core Faculty member for Mount Carmel Grove City’s Internal Medicine Residency Program in Ohio.

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Declarations
The author has declared that there are no conflicts of interest.

Ethics Statement
There is an institutional exemption for QI projects. This is an educational QI project. Our policy states: “QI projects whose main purpose is to evaluate, improve, or monitor healthcare or other processes using existing scientific knowledge, established professional standards or guidelines, or internal performance information do not meet the federal definition for research in 45 CFR 46.102 and thus do not require prior IRB approval.” This project has been determined to be QI, not research by the Mount Carmel Office of Research Affairs -- and thus not subject to Institutional Review Board review.

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Figure 1. Source: the authors. Figure 2. Source: the authors. Supplementary Files A1-A5. Source: the authors. Supplementary File B. Source: the authors.

Bibliography/References

Accreditation Council for Graduate Medical Education (2018). ACGME common program requirements. Available at: Reference Source (Accessed: 9/12/2019).

American Board of Medical Specialties (2019). Based on core competencies. Available at: Reference Source (Accessed: 9/12/2019).

Blackmore, C., Austin, J., Lopushinsky, S., Donnon, T. (2014). Effects of Postgraduate Medical Education “Boot Camps” on Clinical Skills, Knowledge, and Confidence: A Meta-Analysis. Journal of Graduate Medical Education. 643–652. Reference Source

Brownfield, E., Wong, J. G. and Blue, A. V. (2010) Transition to Residency: Simulated Internship Course Helps Prepare Medical Students for Psychiatric Morbidity in New Medical Graduates. Med J Aust. 193(7): 357–360. Reference Source

Brownfield, E., Wong, J. G. and Blue, A. V. (2010) Transition to Residency: Simulated Internship Course Helps Prepare Medical Students for Psychiatric Morbidity in New Medical Graduates. Med J Aust. 193(7): 357–360. Reference Source

Chen, C., Kotliar, D. and Drolet, B. C. (2015) Medical education in the United States: do residents feel prepared? Perspectives on Medical Education. 4(4), pp. 215–217. Reference Source

Holmbom, E., Edgar, L., Hamstra, S. (2016). The Milestones Guidebook. Available at: Reference Source (Accessed: 9/15/2019).

Kang, S. H. K. (2016) Spaced Repetition Promotes Efficient and Effective Learning. Policy Insights from the Behavioral and Brain Sciences. 3(1), pp. 12–19. Reference Source

Kinnear, B., Bensman, R., Held, J., O’Toole, J., et al. (2017) Critical Deficiency Ratings in Milestone Assessment. Academic Medicine. 92(6), pp. 820–825. Reference Source

Laack, T. A., Newman, J. S., Goyal, D. G. and Torsher, L. C. (2010) A 1-Week Simulated Internship Course Helps Prepare Medical Students for Transition to Residency. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare. 5(3), pp. 127–132. Reference Source

Langdale, L. A., Schaad, D., Wipf, J., Marshall, S., et al. (2003) Preparing Graduates for the First Year of Residency. Academic Medicine. 78(1), pp. 39–44. Reference Source

Lyss-Lerman, P., Teherani, A., Aagaard, E., Loeser, H., et al. (2009) What Training Is Needed in the Fourth Year of Medical School? Views of Residency Program Directors. Academic Medicine. 84(7), pp. 823–829. Reference Source

Okuda, Y., Bryson, E. O., Demaria, S., Jacobson, L., et al. (2009) The Utility of Simulation in Medical Education: What Is the Evidence? Mount Sinai Journal of Medicine: A Journal of Translational and Personalized Medicine. 76(4), pp. 330–343. Reference Source

Oswald, A., Abbott, C. The Meantime Guide - You asked, we listened (2017). Available at: Reference Source (Accessed: 19/09/2019).

Raymond, M. R., Mee, J., King, A., Haist, S. A., et al. (2011) What New Residents Do During Their Initial Months of Training. Academic Medicine. 86. Reference Source

Sozener, C. B., Lypson, M. L., House, J. B., Hopson, L. R., et al. (2016) Reporting Achievement of Medical Student Milestones to Residency Program Directors. Academic Medicine. 91(5), pp. 676–684. Reference Source

Teo, A. R., Harleman, E., O’ Sullivan, P. S. and Maa, J. (2011) The Key Role of a Transition Course in Preparing Medical Students for Internship. Academic Medicine. 86(7), pp. 860–865. Reference Source

Warm, E. J., Held, J. D., Hellmann, M., Kelleher, M., et al. (2016) Entrusting Observable Practice Activities and Milestones Over the 36 Months of an Internal Medicine Residency. Academic Medicine. 91(10), pp. 1398–1405. Reference Source

Willcock, S. M., Daly, M. G., Tennant, C. C., Allard, B. J. (2004) Burnout and Psychiatric Morbidity in New Medical Graduates. Med J Aust. 181(7): 357–360. Reference Source

Wunder, J. A., Brandt, C. P. and Lipman, J. M. (2018) A surgical residency preparatory course for senior medical students leads to earlier independence in ACGME competencies. The American Journal of Surgery. 215(2), pp. 309–314. Reference Source

Young, J. Q., Ranji, S. R., Wachter, R. M., Lee, C. M., et al. (2011) “July Effect”: Impact of the Academic Year-End Changeover on Patient Outcomes. Annals of Internal Medicine. 155(5), p. 309. Reference Source
Louise Baird  
St George Hospital

This review has been migrated. The reviewer awarded 4 stars out of 5

This was a well written manuscript describing a new educational intervention addressing identified deficiencies in your recent PGY-1 cohorts. The methodology used sound educational pedagogy, aligning the learning activities to your educational objectives. The results showed the program was not only successful at identifying areas where new graduates were underperforming, but showed the remediation plans were successful very quickly. These findings will be of interest to those involved in training who struggle to implement rapidly successful remediation. More detail of these implementation plans could be described in this paper, or even form a separate paper. I agree with the other reviewers that medical schools need greater information on what their graduates are underperforming in to improve their programs. Miller's pyramid describes competency - 'shows how', but what we really what to know is that this is what a graduate 'does' in a real world setting. This research highlights the gaps between a medical school certifying competency and a graduate doing this in practice.

**Competing Interests:** No conflicts of interest were disclosed.

Balakrishnan Nair
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This review has been migrated. The reviewer awarded 4 stars out of 5

I enjoyed reading this article. Medical Schools should have outcome based curriculum and then design down this in a spiral manner. Often, as the authors state, residents are not prepared to meet the expectations. Many schools, including mine, are trying to introduce the final year as a clinical clerkship year and embed the student into the workplace for appropriate learning. If we do not do this, the patient will not get the care they need and the program directors will have to pick up the challenge, to get the residents up to speed. It is good to see the positive outcome of this boot camp approach. I am not sure who did the work when the residents were away learning. I note the small sample size too. It will be good to replicate the study and look at the long term outcome of this intervention as the authors state.

**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 07 April 2020

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This review has been migrated. The reviewer awarded 3 stars out of 5

I enjoyed reading this article and it's a good example of timely remediation plan for critical deficiencies before it causes medical errors during residency. However, as medical education is a continuum, I then wonder when is the best timing for picking up the deficiencies and fix it even earlier before it's late. If only 53.8% of residents feel they are well prepared for residency, is there anything wrong and fixable in the undergraduate level, when problems can be addressed in a relatively cost-effective way without stressing both the tutors and students/residents later on in residency, when it's perhaps more difficult to balance work and study. Is it possible for clinical exposure and spaced repetition to start earlier, so that when they graduate, medical students are more prepared and longer term learning effect can be achieved?

**Competing Interests:** No conflicts of interest were disclosed.