Effective Strategies in Improving Internal Medicine In-Training Exam Performance - A Systematic Review

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Abstract

Background: IM-ITE is a self-evaluation instrument administered annually to provide residents and program leadership with a measure of the residents' knowledge compared with that of their peers nationwide. Many approaches have been used to improve the IM-ITE scores as a means of achieving a higher first-time board examination pass rate. While these interventions helped improve outcomes in target programs, it remains unclear whether one approach was superior to another and how different program demographics may have played a role in the outcome of the intervention.

Objective: To identify the most effective methods used to improve IM-ITE scores in the literature.

Methods: We searched MEDLINE database on 12/4/2022, using the keywords: “internal medicine” AND “in-training exam” AND “performance”.

Results: A total of 35 articles were examined. Five articles met the inclusion criteria. Three of which were conducted in community-based residency programs. Two were conducted in university-based residency programs. None of these residency programs were new (established in the last 10 years) and all studies were carried out in a single institution. Interventions identified include creating a new curriculum, implementing a multiple choice-testing program, identifying learning styles associated with better IM-ITE performance, and transitioning to an academic half day (AHD) didactics structure.

Conclusion: We identified a myriad of interventions that were successful at improving IM-ITE performance in their target cohorts to variable degrees. Interventions summarized in this review can be utilized by residency programs to improve IM-ITE performance among their residents and provide guidance to their faculty members in the process.

Background

Healthcare in the US has been chronically afflicted by a physician shortage. One solution to meet the demand for physicians lies in increasing the number of graduate medical education positions. With the introduction of new residency programs, the number of practicing physicians in the US has steadily increased (1). A common model used to establish new residency programs is collaboration between a community hospital and a sponsoring medical school to build tertiary referral bases for the purpose of adequately meeting the needs of under-served areas (2). Unfortunately, in said under-served areas the process to establish resources and practices for optimal graduate medical education/physician training has remained arduous. This can be reflected in poorer average performance by smaller and under-resourced programs in both national standardized self-assessments, known also as in-service exams, and specialty board certification pass rates (3).

The Internal Medicine In-Training Examination (IM-ITE) is a self-evaluation instrument administered annually to provide residents and program leadership with a measure of the residents' knowledge compared with that of their peers nationwide. Furthermore, IM-ITE serves as a strong predictor of
American Board of Internal Medicine (ABIM) certification exam's first-time success rate, and several studies have identified cutoffs for IM-ITE percentile ranking as predictors of successful first-time ABIM certification exam pass (4). Newer residency programs especially have struggled to achieve IM-ITE results comparable to the national average. This under-studied phenomenon is likely due to a myriad of factors, including differences in test taking skills among recruited resident cohorts, under-utilization of individualized study plans and curricular interventions and a lack of experienced faculty members in new residency programs. Many approaches have been used and sought in the literature to improve the IM-ITE scores as a means of achieving a higher first-time board examination pass rate. While these interventions helped improve outcomes in target programs, it remains unclear whether one approach was superior to another and how different program demographics may have played a role in the outcome of the intervention.

Our goal of this systematic review is to identify the most effective methods used to improve IM-ITE scores in the literature. Furthermore, we also discussed the residency program's characteristics including the size of the resident's cohort, geographical makeup, hospital infrastructure (community vs university) and age of the program. In turn, we hope to offer a blueprint of evidence-based educational interventions that not only bolsters success for our program, but additionally for the benefit of other newer lower resource programs as well.

**Methods**

This study protocol was presented to the Cape Fear Valley Institutional Review Board (IRB) for review. The IRB met on February 7th, 2022 and the project was approved as a quality improvement project. To identify the most effective methods to improve performance on IM-ITE, we conducted a systematic review by searching the MEDLINE (PubMed) database on 12/4/2022, using the keywords: “internal medicine” AND “in-training exam” AND “performance”. A total of 35 articles were examined and uploaded to Covidence Software and two reviewers independently identified articles that fit our inclusion criteria. Included articles were then added to Covidence software to extract relevant information to achieve our objectives. Only articles with an identifiable intervention to improve IM-ITE scores were included. Studies conducted outside the US or involving specialties other than internal medicine were excluded. Furthermore, observational studies that only linked IM-ITE scores to other outcomes without applying an intervention were excluded.

**Results**

Upon MEDLINE search, 35 total articles were resulted. One article was irrelevant to the purpose of this review. 29 articles were excluded due to not meeting inclusion criteria (Fig. 1.). Five articles met the inclusion criteria and were included in the final analysis (Table 1.). Of these five articles, three were conducted in well established, community-based residency programs. Two were conducted in large university-based residency programs. The number of participating residents varied from 27 to 164. None of these residency programs were new (established in the last 10 years) and all studies were carried out
in a single institution. Articles identified and included interventions such as creating a new curriculum, implementing a multiple choice-testing program (either NEJM Knowledge plus or MKSAP), identifying learning styles associated with better ITE performance, and transitioning from didactics conducted as a noon conference to an academic half day (AHD) structure. One article used Kolb learning style inventory to identify learning methods associated with higher IM-ITE performance. All interventions succeeded at improving IM-ITE performance among target cohorts to variable degrees.

Table 1. Studies aiming to improve performance on IM-ITE among internal medicine residents. The table also highlights the setting of residency programs, intervention implemented in the study, number of residents involved, and outcome measured in the study.

<table>
<thead>
<tr>
<th>Source</th>
<th>Setting</th>
<th>Intervention</th>
<th>No. of Residents</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dokmak et. al</td>
<td>Community</td>
<td>Implement an AEP that entailed a multipronged approach, including strengthening and tailoring of the didactic curriculum, establishment of a minimum conference attendance rate, and adoption of the New England Journal of Medicine Knowledge-Plus Internal Medicine Board Review platform.</td>
<td>164</td>
<td>Mean (± SEM) IM-ITE percentile for the 12 content areas increased significantly from calendar years 2011–2014 to 2015–2018</td>
</tr>
<tr>
<td>Muganlnskaya et. al</td>
<td>Community</td>
<td>Determine residents’ preferred learning style, based on Kolb learning style inventory, and their PGY1 and PGY2 IM-ITE performance score difference, and then find the correlation between PGY2s’ IM-ITE score and preferred learning styles based on the Kolb learning style inventory.</td>
<td>68</td>
<td>Mean scores of PGY1 and PGY2 IM-ITE results from PGY1 to PGY2, which revealed a statistically significant improvement in IM-ITE score from PGY1 to PGY2 in all groups, however, with a larger difference in assimilating (ASM) and overall non converging (CNV) groups.</td>
</tr>
<tr>
<td>Chau et. al</td>
<td>Community</td>
<td>Implement a multimodal curriculum that targets specific drivers of low-value care that includes online interactive worksheets, lectures, and faculty buy-in to target specific skills, knowledge, and culture deficiencies.</td>
<td>27</td>
<td>Outcome measured were annual surveys of perceived drivers of utilization at our institution as well as performance on the high-value section of the Internal Medicine In-Training Exam (ITE) over three years.</td>
</tr>
<tr>
<td>Mathis et. al</td>
<td>University</td>
<td>Implement a comprehensive, multiple-choice testing program (rotation specific) and a separate board review program, both administered during a continuous long-block elective experience during the twelve months between the second post-graduate year (PGY-2) and PGY-3 in-training examinations.</td>
<td>104</td>
<td>Comparing the change in median individual percent correct and percentile scores between the PGY-1 and PGY-2 IM-ITE and between the PGY-2 and PGY-3 IM-ITE in both control and study cohorts.</td>
</tr>
<tr>
<td>Latif et. al</td>
<td>University</td>
<td>Transition from daily noon conference to an academic half day (AHD) curriculum divided into three major parts: July was dedicated to the intern transition curriculum, August to October was composed of core curriculum lectures, and the remainder of the academic year covered more advanced medical topics and a variety of resident-led creative learning activities</td>
<td>73</td>
<td>Comparing in-training exam (ITE) and American Board of Internal Medicine (ABIM) certifying exam scores of residents before and after implementation of AHD. Averages of three consecutive years of NC (2016–2018) and AHD (2019–2021) were used for statistical testing to determine ITE and ABIM score changes.</td>
</tr>
</tbody>
</table>

A forest plot is an essential tool to provide a visual that summarizes information in individual studies and show the estimated common effect in one figure (5). In the forest plot, the effect sizes of all included studies, as well as the pooled effect size, are graphically presented. In an attempt to create a forest plot, we reached out to corresponding authors of all five articles identified above to obtain raw data from prior studies to calculate the effect size. Efforts to obtain raw data were unsuccessful due to lack of responses from corresponding authors.

**Discussion**

While many program administrators use IM-ITE data to predict residents’ future performance in the ABIM, very few studies have utilized IM-ITE scores to develop educational interventions (6). This review
summarizes available evidence to guide initiatives at programs struggling to achieve goal IM-ITE results in their resident cohorts.

Our systematic review identified five studies with distinct interventions implemented. A variety of geographical regions were represented in this review. One study was conducted in the Northeast, one in the Atlantic South, one in the Pacific Northwest, one in the Midwest and another in the South (Texas). Studies identified also represent a variety of training settings. Three studies were conducted in community-hospital based programs while two were conducted in university-hospital based programs. It is of note that none of the programs studied was new, meaning it was established in the last 10 years. This is particularly important to new internal medicine residency programs trying to identify effective interventions to improve their IM-ITE results, including our residency program at Cape Fear Valley Health System, which was established in 2017. New residency programs are subject to close monitoring of ABIM (American Board of Internal Medicine) board pass rates and frequent visitation by the ACGME. Furthermore, clinicians at community hospitals without an existing GME infrastructure tend to lack competency-based clinical training, knowledge of modern educational approaches to learning, collaboration, reflection, feedback, and evaluation, and may be prone to drifting toward valuing service over education (7). These factors combined pose additional challenges to new residency programs, especially those based in community hospitals and may further hinder their efforts to improve IM-ITE performance in resident cohorts.

The struggle of service vs education is an ongoing issue that plagues many newer and lower resource programs. Of the articles reviewed, several interventions were identified to effectively optimize resident learning process: stronger didactic sessions, requirement of minimum conference attendance, online education tool with question/case-based assessment, individualized study plans, and involvement of core faculty in curriculum formulation. Of these interventions the highest utilized were the stronger didactics, minimum conference attendance and question/case-based assessment (4 out of 5 studies for all). As expected, interventions implemented by Mathis et. al and Latif et. al, both of which conducted at university-based programs, were very specific about strengthening their didactics with the former changing their elective rotation curriculum to pre and post-rotation learning sessions with specialist faculty and the latter changing from noon conference to an academic half day style. As both programs are large with an extensive number of dedicated core and subspecialty faculty, this approach would be more challenging to implement for community-based programs such as ours, along with other smaller programs that lack a large pool of faculty numbers.

What is reassuring is that the other two studies (Dokmak et. al, Chau et. al) that implemented these interventions in community-based programs were able to achieve similar success despite a smaller teaching faculty pool. Dokmak et. al were able to bolster their didactic curriculum by giving outlines to faculty that emphasized areas of weakness based on the subcategory breakdown on previous IM-ITE results. Chau et. al followed a similar approach and focused on improving lectures on the high-value care (HVC) section of the ITE. For stronger didactics to make an impact several of the other interventions must be implemented as well. A minimum conference attendance seems to naturally fit into this, as in order for
resident learning to occur it is important that they are present and involved. Finally, most programs that we reviewed had implemented a question/cased based assessment approach via use of online questions banks. Majority appear to adopt either the Medical Knowledge Assessment Program (MKSAP) sponsored by the American College of Physicians (ACP) or the New England Journal of Medicine (NEJM) Knowledge Plus online platforms. Both platforms are still relatively new in medical education, with smaller studies (8, 9) done showing both are effective in improving board certification pass rate performance.

With our program, we have been able to adopt some of the interventions listed above. For a large program of 58 total residents, we have a relatively small core faculty of 10 inpatient attendings and 2 outpatient attendings in addition to a number of teaching faculty. Despite being a part of a large health system, our tertiary referral network of specialty providers remains relatively small. This has recently begun to improve after adding several fellowship programs to the Cape Fear Valley Health umbrella. Utilizing several interventions that fit seamlessly into a regular workday has become paramount in the slow improvement of IM-ITE performance. Concerning improving our didactic curriculum, this first started with a transition from noon conferences to an academic half day. As the years have progressed the didactic topics have moved to faculty/specialist driven as compared to resident driven. Within the past 2 years there was also the establishment of an online curriculum with additional required case/question-based assessment adopted via subscription to the MKSAP platform - and even additionally to that over the past year also holding monthly quizzes during didactic sessions that reflect assignments through MKSAP. Likely, though, the most important intervention that we have been able to institute was increasing involvement and responsibilities of our core faculty. We have found that this can create continuity of learning from residents by both learning from that faculty during patient care, as well as in lecture. This can also help foster relationships among residents and faculty that allow the natural formation of mentor and student to take shape, and can at times aid in the individualization of resident education when needed.

Several other interventions that were not explicitly mentioned in the studies identified are improving the outpatient clinic curriculum with a dedicated clinic week, along with the addition of 4th year chief residents. The adoption of what is known as an “X + Y” schedule design has only been more recently implemented among residencies nationwide within the past decade but has shown to be a more effective way of balancing inpatient and outpatient education (10). To continue to improve our own outpatient curriculum, we adopted a 4 + 1 schedule over the last academic year. This has been highly beneficial, allowing residents to fully focus on their learning and growth in the inpatient setting without the distraction of outpatient obligations - with similar dynamics when they are on their single week of clinic. This dedicated week of clinic also allows for further educational opportunities such as separate clinic topics/discussions and ancillary staff service shadowing such as physical/occupational therapy, respiratory therapy and inpatient/outpatient wound care that an internal medicine resident wouldn't typically be exposed to while on their regular duties on the floor. We have also found this dedicated week as an opportunity for resident wellness as well, with a dedicated weekend off and a wellness half day during the week in addition.
A final thought, another intervention not mentioned by our review but worth considering, especially to smaller programs, is the importance of adding 4th year chief(s). This role has been adopted as almost a “junior faculty” or clinical instructor position in which they serve as a teaching attending, while still developing their skills as a physician leader and have been found to be highly effective in improving resident education (11). Having one or several that serve in this capacity is instrumental in resident education as they can serve as liaison to the rest of the GME department, are also the most experienced in how the residency program is run as more often than not the promotion is internal among graduating PGY3s. They also serve as an important focal point of improving curriculum to reflect topics assessed on the ABIM as they would have taken the most recent version of the exam. Interestingly, there is scant literature about their impact on internal medicine programs; however, there are several studies that mention benefits among surgery (12) and psychiatry programs (13). As our program is still in its infancy, we have only just recently been approved to have three chief residents who will assume their roles in the coming academic year.

Limitations:

This review has several limitations. First, lack of access to raw data from studies identified has limited our ability to calculate the effect sizes of different interventions, generate a forest plot or investigate heterogeneity. Secondly, all the studies identified in this review have achieved their primary objective related to improving IM-ITE performance. Lack of studies with negative results is strongly suggestive of publication bias. The proportion of positive results in scientific literature has increased significantly over the last four decades, reaching 85.9% in 2007 (14). Reporting interventions that produce negative results can help steer programs away from implementing ineffective measures. Finally, none of the studies identified in this review was conducted in a new residency program or a program with an osteopathic school affiliation. Therefore, it remains unclear whether implementing these interventions in new programs or those with osteopathic background would yield results similar to the studies discussed in this review.

Declarations

-Ethics approval and consent to participate: This study protocol was presented to the Cape Fear Valley Institutional Review Board (IRB) for review. The IRB met on February 7th, 2022 and the project was approved as a quality improvement project.
-Consent for publication: Not applicable
-Availability of data and materials: The datasets and articles identified in the literature search during the current study are available in the supplementary material. The results/data/figures in this manuscript have not been published elsewhere, nor are they under consideration (from you or one of your Contributing Authors) by another publisher.
-Competing interests: I declare that the authors have no competing interests as defined by BMC, or other interests that might be perceived to influence the results and/or discussion reported in this paper.
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Authors' contributions (This statement must exactly match on Editorial submission system and in the manuscript): All of the material is owned by the authors and/or no permissions are required. Clar, McNeal and Ilaiwy prepared the manuscript text. Juneau prepared the methods including data entry to covidence. Patel and Patel helped prepare the figures. All authors reviewed the manuscript.

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References


Figures

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- MicrosoftWordPRISMA2009Checklist.doc.pdf
- PUBMEDsummary1242022.txt