



Medical Students' NBME subject exam preparation habits and their predictive effectson actual scores

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ABSTRACT

Background and Purpose: There is a paucity of empirical-based knowledge upon which medical students and clerkship directors in the US and Canada direct National Board of Medical Examiners (NBME) subject exam preparation. This study investigated NBME subject exam preparation habits and their predictive effects on actual scores. **Methods:** Sixty medical students from the University of Missouri-Kansas City were surveyed in six clerkships on preparation time, resources utilization, study strategies, and help-seeking trends when relating to NBME subject exam preparation. Multiple regression analyses were conducted to determine predictive effects of the constructs on actual scores. **Results:** Participants relied on rote-memorization and mock exam rehearsal more than cooperative learning and conceptualization. On average, 3-6 resources/clerkship were utilized with clear preference of question banks and review books over textbooks. Participants spent 11-20 hours/week/clerkship studying for NBME subject exams with a majority starting midway through the rotations. Despite observed positive correlations, none of the study variables significantly predicted actual scores. The full regression model, however, accounted for 32.2% of the variance in NBME subject exam scores. **Conclusions:** Exam preparation trends unveiled in this study may provide helpful insights to clerkship directors and medical students in making informed decisions on selection of preparatory resources and study strategies to best utilize time and funding.

KEY WORDS: NBME subject examinations; Study strategies; Resource usage.

INTRODUCTION

Medical schools across the US and Canada variably use National Board of Medical Examiners (NBME) subject examinations for summative assessment of students' learning outcomes. A cross-sectional study by Torre et al. [1] with 82 Internal Medicine clerkship directors revealed that NBME subject exam scores accounted for between 18 and 50% of students' final grades. In addition, some schools require certain scores in NBME subject exams as prerequisites for attaining an honors, which in turn is a requirement for placement in some residency programs [2]. Despite the afore-mentioned importance, discernable trends at most medical schools show that weighted scores of NBME subject exams tend to be lower as compared to other internal forms of assessment [2-4]. For example, a study by Hermanson et al. [3] revealed that the inclusion of NBME subject exams (weighted at 10%) as a component of the cumulative Surgery clerkship evaluation consistently lowered the final grades of 64% and improved the grades of only 11% of the students. In a related study across several clerkships, Veale et al. [4] unveiled higher failure rates on NBME subject exams, even when minimum cut-off values were used, as compared to internal forms of assessment.

According to DeZee et al., [5] most clerkship directors do not have empirical-based knowledge on how to direct

students' preparations for NBME subject exams. Against this background, we sought to explore medical students' preparation habits for NBME subject exams and how the preparation habits predict their actual scores. Our study seeks to provide preliminary data on potential approaches that may guide both students and clerkship directors on ways to improve performance in NBME subject exams.

Medical students use varied study approaches when studying for exams, which in turn influence the manner in which they process, encode, and retrieve information. Newble and Entwistle [6] postulated three approaches upon which medical students study, namely: *deep approaches*, where students seek meaning; *strategic approaches*, where studying is driven by desire for high achievement; and *surface approaches*, which relies on rote-memorization. Rendas et al. [7] identified conceptualization, which emphasizes structural organization of information as one *deep approach* strategy that enhances meaningful learning. Conceptualization, as Rendas et al. further reiterate, helps medical students integrate information and relate basic sciences concepts to clinical settings. Medical students also employ rote-memorization, which includes the use of repetition, flashcards, and mnemonics [8-9] to study for exams. Additionally, medical students use *strategic approaches*, which, according to Newble and Entwistle, [6] entail the use of practice test sessions to achieve highest

possible scores. Prior research has also shown consistent use of cooperative learning; where students work in small groups to help one another on exam preparation [10-11]. Study approaches are, however, not mutually exclusive; oftentimes, students choose different approaches at different times or a combination of approaches depending on the nature of the examination [6].

In addition to varying study approaches, prior research on different clerkships has also shown variations on medical students' resource usage when studying for NBME exams [5,10-15]. For example, a study by Briscoe et al. [10] with six medical schools identified step/prep books as most frequently used for Psychiatry shelf exams followed by handouts and assigned textbooks. From a related study, DeZee et al. [5] identified the Up-To-Date, *Harrison's Principles of Internal Medicine*, and review books as most frequently used for Internal Medicine exams. Additionally, prior research has shown medical students' preference of digital as compared to print resources when studying for NBME subject exams [5]. Although prior research has unveiled interesting trends on medical students' study habits when preparing for NBME exams, we sought to expand on existing literature by exploring the following research questions:

1. How much time do medical students expend studying for NBME subject exams?
2. Which study strategies do medical students use to prepare for NBME subject exams?
3. Which resources do medical students use to study for NBME subject exams?
4. Where do medical students seek advice on how to study for NBME subject exams?
5. Are there biases in preparation for NBME subject exams across clerkships?
6. Do exam preparation habits predict actual performance in NBME subject exam?

METHODS

This study was conducted at the University of Missouri-Kansas City (UMKC) School of Medicine during the 2014-2015 academic year. UMKC is one of the few public universities in the United States that offer an accelerated combined Bachelor/MD program based on a six-year curriculum. Typically, students take NBME subject exams during their 5th and 6th years. Overall, about 100 students were enrolled in each of the two curriculum years. However, only students who had already completed rotations and had taken NBME subject exams for the following clerkships: Surgery, Pediatrics, Psychiatry, Obstetrics and Gynecology (OB/GYN), Internal Medicine and one basic science course;

Behavioral Science participated in the study. Students who were still completing their rotations in these course/clerkships at the time of data collection were excluded from the study. Students were contacted about the survey through email and participation was voluntary. Participants were further asked to provide their student IDs at the end of the survey as an identifier to link their survey responses to their actual NBME subject exam scores. To protect the confidentiality of the students, all identifiers were removed immediately after matching the survey responses to the actual NBME subject exam scores.

Survey items were drawn from literature on NBME exam preparation as well as from the interviews we conducted with several students about their NBME exam preparation habits prior to the study. In addition to demographic questions, survey items asked how far in advance participants had started preparing for the NBME subject exams, average study time, as well as the overall feelings of preparedness. Responses were specific to each course/clerkship. We further asked the extent to which participants had used a series of resources and how helpful they had found the resources to be. Some of the outlined resources were similar across clerkships; for example, Blueprints, Case files, USMLE World, and Pre-test Series. A few other resources were clerkship specific. We also asked participants to outline the study strategies they had employed to prepare for the exams. Additionally, we asked them to rate the degree of influence of certain people (i.e. peers, residents, clerkship directors) on their preparation habits. Lastly, we asked the degree of influence of potential choice of specialty and placement of the clerkship in relation to relevant National Resident Matching Program (NRMP) MATCH dates and deadlines (e.g. MSPE Release, Interview Season, and MATCH Day) on participants' study time and effort. Following approval by the UMKC Institutional Review Board, we administered the survey online.

Data analysis

Data were analyzed using Statistical Package for Social Scientist (SPSS) version 22. We excluded a few missing values, therefore, statistical analyses are based on non-missing values. We first calculated frequency distributions in relation to our research questions and obtained data are presented as means and percentages. Survey responses were then linked to NBME subject exam scores. Thereafter, we conducted bivariate correlations and regression analyses to examine the relationship and predictive effects of the study constructs on actual scores.

RESULTS

A total of 60 students, 22 (37%) male and 38 (63%) female, completed the survey. We first calculated frequency

distributions in relation to our research questions and obtained data are presented in the following sections.

How much time do medical students expend studying for NBME subject exams?

Cumulative research has linked preparedness to academic success and to that effect, we asked how far in advance participants had started preparing for NBME subject exams for each clerkship. Response formats were: *At the beginning of the clerkship*=3; *Towards the middle*=2; and *Towards the end*=1. A majority of our participants started preparing for the exams midway through the rotations with study times of 11-20 hours per week per clerkship outside of clerkship time. We further asked for participants' overall ratings of their study effort and a majority attested that they had studied hard or harder for all clerkships with mean ratings ranging from 3.19 to 3.84 on a 5-point scale.

Which study strategies do medical students use to prepare for NBME subject exams?

In line with prevailing literature, we grouped the study strategies outlined in the survey into four categories, namely: *Conceptualization* (concept mapping, graphic representation, writing in own words), *Rote-memorization* (repetition, mnemonics), *Mock exam rehearsal* (practice tests/question and answer practice sessions) and *Cooperative learning* (small group discussions, peer quizzing, and peer teaching). Our results indicated that a majority of the participants used mock exam rehearsal and rote-memorization. About 40% of the respondents used cooperative learning strategies whereas conceptualization strategies were least used with the exception of writing in own words (See Table 1). All participants employed more than one study strategy whereas 68% invoked at least one strategy from all four categories.

Which resources do medical students use to prepare for NBME subject exams?

The main goal of this study was to determine resource usage among medical students when studying for NBME subject exams. We, therefore, asked participants to indicate the extent to which they had used outlined resources and responses were: *Primary*=3; *Secondary*=2; *Tertiary*=1; and *Did not use*=0. We further asked them to rate the helpfulness of the resource and responses ranged from: *Very helpful*=3, to *Not helpful*=0. Frequency distributions for resource usage are reported in percentages whereas ratings for helpfulness are reported as means. It emerged that non-usage of outlined resources was a personal choice rather than inaccessibility with the exception of OB/GYN where 8% of the participants could not use the USMLE World because of inaccessibility. Overall, USMLE World was used consistently across all clerkships with more than half of the participants using it as a primary resource (See Table 2).

More than half of the participants reported using internal lecture materials (e.g. lecture notes, PowerPoints, handouts) in all clerkships. In addition, a considerable number accessed lecture materials from other medical schools. Internal and external lecture materials were, however, mainly used on secondary or tertiary basis and received moderate to high ratings with regards to their helpfulness (See Tables 2).

About 45% and 25% of the participants used textbooks that were deemed "required" by course/clerkship directors as primary resources for Behavioral Science and Psychiatry respectively. In other clerkships, however, required textbooks were used mainly on secondary or tertiary basis. We observed similar trends with the use of non-prescribed textbooks except that more participants used non-prescribed textbooks for Surgery and Internal Medicine. Both required and non-required textbooks received moderate to high mean ratings with regards to their helpfulness (See Table 2).

Table 1. Study Strategy Employed to Prepare for NBME Subject Exams

Strategy	Not at all (%)	Sometimes (%)	Often (%)	Very Often (%)
Conceptualization				
Concept mapping	43	27	19	12
Graphic representation	39	27	19	14
Writing in own words	17	19	43	21
Rote Learning				
Mnemonics	2	32	34	34
Repetition	0	18	33	49
Cooperative Learning				
Peer quizzing	28	33	23	16
Peer teaching	26	32	35	7
Rehearsal				
Question and answer practice sessions	2	12	22	64

Table 2. Percentages of Primary and Secondary/Tertiary Resource Usage and Mean Ratings of Helpfulness

	Beha. Sci.			Int. Med			OB/GYN			Psychiatry			Surgery			Pediatrics		
	Prim (%)	Sec/T (%)	Help (x)	Prim (%)	Sec/T (%)	Help (x)	Prim (%)	Sec/T (%)	Help (x)	Prim (%)	Sec/T (%)	Help (x)	Prim (%)	Sec/T (%)	Help (x)	Prim (%)	Sec/T (%)	Help (x)
Assigned texts	25	32	2.16	10	20	2.06	7	21	2.8	45	25	2.56	8	44	2.26	12	20	2.27
Non-assigned texts	32	22	2.28	38	12	2.70	17	3	2.73	22	12	2.45	28	7	2.67	17	13	2.68
Int. lecture materials	10	50	2.15	5	60	2.03	10	20	2.38	32	50	2.43	12	65	2.46	15	47	2.71
Ext. lecture material	25	38	2.16	2	27	2.18	10	8	2.89	0	32	2.27	7	25	2.09	12	23	2.41
Com. test prep. courses	25	10	2.75	7	10	2.80	5	3	3.00	7	5	2.33	15	7	3.00	3	7	3.00
USMLE World	27	25	2.85	57	18	3.00	37	22	2.97	70	10	2.95	67	27	2.97	25	20	2.97
Blueprints				7	3	2.50	18	15	2.63	8	15	2.75	7	0	NR	15	32	2.63
Pre-test series				18	5	2.00	5	5	2.6	8	12	2.83	3	20	2.34	50	20	2.79
Case files				12	10	2.25	47	13	2.86	8	15	2.92	27	22	2.2	22	37	2.7
First Aid				20	3	2.7	27	10	2.9	78	22	2.91	17	42	2.47	17	13	2.83
NMS				5	0	2.67	10	0	2.56	0	12	2.00	12	25	2.77	3	2	NR
BRS Behavioral	78	2	2.94															
High Yield Behavioral	17	33	2.52															
USMLE Step1 FirstAid	27	30	2.84															
Deja Review	0	10	2.67															
Rapid Review Beh. Sci.	2	8	2.75															
Step Unto Medicine				58	22	2.68												
Master Wards Int. Med.				5	10	2.75												
Harrison's Int. Med.				10	2	2.5												
Obst. & Gynecology							7	10	2.5									
Williams Obstetrics							2	3	2.67									
Lange Qamp Psychiatry										12	22	2.27						
Interview Guide Psych.										8	8	2.33						
Pestana Surgery Notes													95	7	3.0			
Essentials of Gen. Surg.													8	3	2.27			

Notes

Prim=Percentage of primary resource usage. Sec/T=Percentage of secondary and tertiary resource usage; Help=Mean rating of helpfulness of resource.

Beha. Sci=Behavioral Science. Int. Med=Internal Medicine. Comm. test prep=Commercial Test Preparation Course. NMS= National Medical Series for Independent Study. NR=Not rated.

Other resources outlined in the survey were used selectively. For example, while 47% of the participants used Case Files as a primary resource for OB/GYN, only 27% and 22% used them for Surgery and Pediatrics respectively. On the other hand, only 18% and 15% of the participants used Blueprints as a primary resource for OB/GYN and Pediatrics respectively. Half of the participants used Pretest Series as a primary resource for Pediatrics while 18% used them for Internal Medicine. Pretest Series were, however, barely used for other clerkships. While nearly 80% of the participants used First Aids as a primary resource for Psychiatry, very few participants used them for other clerkships. Similarly, National Medical Series for Independent Study (NMSs)

were moderately used for Surgery but barely used for other clerkships (See Table 2).

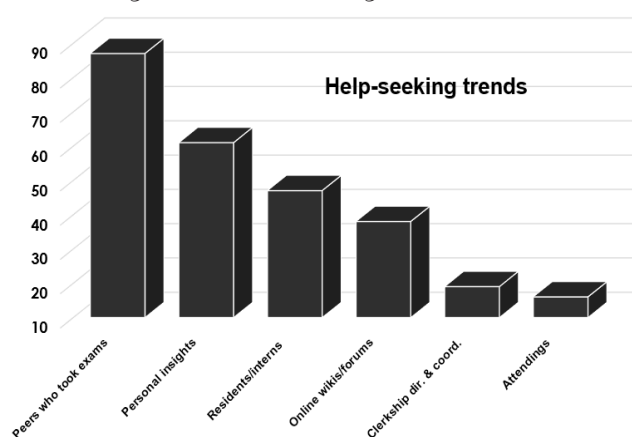
A few other resources specific to each course/clerkship were also variably used. For example, 95% of the participants used Pestana Surgery Notes as a primary resource. Similarly, 78% used BRS Behavioral Science whereas 58% used Step-Up-To Medicine as primary resources for Behavioral Science and Internal Medicine respectively (See Table 2). Journal articles and private tutors were barely used; as such, we removed them in our subsequent inferential analyses. On average, participants used 3-6 resources per clerkship. No significant differences were, however, observed between quantitative resource usage and study time ($p>0.05$).

Table 3. Hierarchical Linear Regression Results on Predictive Effects of the Constructs on NBME Exam Scores

Study Construct	R ²	Change in R ²	β	Sig
Model 1-Help-Seeking	.042	.042	.203	.277
Model 2-Preparedness	.101	.065	.256	.172
Model 3-Resource Usage	.164	.057	.239	.195
Model 4-Study Strategies	.327	.163		
Mock Exam Rehearsal			.336	.141
Rote Memorization			.194	.321
Conceptualization			.162	.469
Co-operative Learning			.042	.829

Where do medical students seek advice on how to study for NBME subject exams?

We also investigated the extent to which different people influenced participants' exam preparation habits. Results showed that 87% of the participants were influenced by peers who had already taken the exams whereas 60% relied on personal insights. On the other hand, 47% were influenced by advice from residents/interns whereas 38% were influenced by online forums. Clerkship directors, coordinators and attendings had the least influence on participants' preparation habits with less than 20% seeking and/or using their advice (See Figure 1).

**Figure. 1.** Help-seeking Trends on NBME Exam Preparations

Are there biases in preparation for NBME subject exams among clerkships?

We investigated if biases existed among clerkships during NBME subject exam preparation depending on participants' potential choice of specialty and placement of the clerkship in relation to MATCH milestones (MSPE Release, Interview Season, MATCH Day). More than 60% of the participants attested that both factors had significant influence whereas the remaining attested that the factors had a slight or no influence on their study time and efforts.

Do exam preparation habits predict actual performance in NBME subject exam?

To test the predictive effects of preparation habits on actual scores, we grouped survey items into the following variables: Preparedness, Help-Seeking, Resource Usage, and Study Strategies. *Preparedness* was the cumulative score of the three items pertaining to study time and effort whereas *Help-seeking* was the composite score of the number of people and their degree of influence (*No influence*=1, *High influence*=4) on participants' preparations for the exams. Similarly, *Resource Usage* was the cumulative score of the number of resources used and the degree of usage (*Primary*=3, *Secondary*=2, *Tertiary*=1). As stated earlier, *Study Strategies* was further divided into Conceptualization, Rote-memorization, Cooperative Learning, and Mock Exam Rehearsal. *NBME Subject Exam Score* was a sum score of the six studied course/clerkships.

Bivariate correlations were determined as an initial step to examine the association among the constructs. *Mock Exam Rehearsal* was positively correlated with *Co-operative Learning* ($r = .388$, $p=0.034$) and *NBME Subject Exam Scores* ($r=.385$, $p=0.036$). No other significant correlations were observed. To test predictive effects of the study constructs on actual scores, the constructs were entered successively into regression models starting with variables deemed to be least predictive. *Help-seeking* was first entered and the model was insignificant ($p>.05$), accounting for only 4.2% of the total variance in NBME subject exam scores. In step 2, *Preparedness* was entered and likewise, the model was insignificant ($p>.05$), accounting for 10.1% of the variance. In step 3, *Resource Usage* was entered and the model was insignificant ($p>.05$), accounting for 16.4% of the variance and in Step 4, *Study Strategies* was entered and the model was still insignificant ($p>.05$). The full regression model explained 32.2% of the variance in NBME subject exam scores. None of the individual study strategies (Conceptualization, Rote-memorization, Cooperative Learning, and Mock Exam Rehearsal) was a significant predictor of NBME exam scores; nonetheless, Mock Exam Rehearsal had strongest effect ($\beta=.335$) followed by Rote

Memorization ($\beta=.194$) and Conceptualization ($\beta=.162$) (See Table 3).

DISCUSSION

Participants in this study exhibited several trends in their preparations for NBME subject exams, which potentially have important implications for medical education. Consistent with findings by DeZee, et al., [5] observed high ratings in *Preparedness* suggest that participants expended a lot of time and effort studying for NBME exams. However, contrary to Baker and Olsen's [16] findings that study time predicts performance, *Preparedness* neither correlated with nor accounted for the variance in NBME subject exam scores. This probably suggests that NBME exam preparation, although it obviously requires time, the amount of time on its own without other factors may not necessarily result in higher performance.

Participants in this study exhibited a great reliance on rote-memorization to study for the exams. Their perceptions of what it takes to pass NBME subject exams were generally consistent with previous findings [7]. Ling et al. [17] contend that NBME subject exams require mastery of large volumes of factual material; as such, repetition and mnemonics may substantially aid retention. The use of rote-memorization can help the formation of an information base upon which students articulate a broader understanding of the content material [18]. Consistent with prior findings [11,19], participants also exhibited great reliance on practice test sessions, which positively correlated with NBME subject exam scores. Practice test sessions help students activate previously acquired information, making it more accessible for retrieval in new but conceptually related questions [19].

Despite their relative use of a combination of study strategies, the fact that significantly fewer participants used conceptualization, which enhances meaningful learning and integration of concepts [7], is a cause of concern. Our findings, thus, unveil a necessity for medical students to invoke deep study approaches that promote development of conceptual frameworks and structural organization in addition to commonly used strategic and surface learning approaches.

On average, participants in this study used 3-6 resources per course per clerkship to study for NBME subject exams and this is consistent with prior findings [5,10,12]. Contrary to findings that resource usage is dependent on accessibility [20], non-usage of outlined resources in this study was, in most cases, a personal choice rather than inaccessibility. Moreover, our expectation that multiple resource usage predicts higher performance was not confirmed by both correlations and regression analyses, implying that the performance of participants who used multiple resources was equally the same with those who used fewer resources. Moreover, the fact that there were no significant differences

on study time as a function of the number of resources used implies that those who selected and used fewer resources intensively utilized them.

Except for the USMLE World that was consistently used across clerkships, most resources were selectively used. As prior research has previously shown [11], no one series of question banks or review books is a one-size-fits-all for all clerkships when relating to NBME subject exam preparation.

The observed substantial use of test review books and question banks over textbooks probably reflects the pragmatism of students especially in view of the fact that they must pass NBME subject exams in order to pass the clerkships [2,21]. Multiple-choice questions in NBME subject exams require test-taking skills than clinical skills; as such, test review books and question banks may be more helpful in improving test-taking skills as compared to textbooks, which sometimes may be too detailed and lengthy. However, as DeZee, et al. [7] recommend, review books and question banks cannot replace textbooks in terms of content; therefore, students should be encouraged to also use textbooks in order to acquire baseline knowledge of the content material.

Contrary to previous findings that clerkship directors are most influential on students' NBME exam preparations [21], participants in this study preferably sought advice from peers who had already taken the exams and from residents/interns. UMKC follows a special curriculum in which students are assigned into learning communities known as docent teams where more-advanced and less-advanced students are paired in Junior-Senior partnerships. This, as Sirridge [22] attests, may have fostered the student-to-student role-modeling exhibited in this study. The finding that participants were influenced by online forums highlights the increasing influence of social media in medical education. Online forums allow students to share ideas and experiences, ask questions, offer and obtain solutions, and provide support to each other [23]. However, contrary to prior findings that students who seek help from social sources perform better academically than those who do not [24], in this study, help-seeking was neither correlated with nor predicted NBME subject exam scores.

Our findings further showed that choice of specialty and placement of a clerkship in relation to MATCH dates and deadlines influences medical students' study time and effort expended on different clerkships. As Arcidiacono [15] argues, medical students are clearly aware of how competitive certain specialties are by the time they take NBME exams and how well they need to score in order to have a good chance of entering these specialties; not surprisingly, differential biases in preparations among clerkships were noted in this study.

CONCLUSIONS

Findings from this study should be considered in light of potential limitations. The study was conducted at one medical school with a sample of 60 participants, which potentially limits the generalizability of the findings. Despite the sampling limitations, descriptive exam preparation trends exhibited in this study potentially have important implications for medical education. In view of the limited influence of clerkship directors on students' NBME subject exam preparations reported both in this and previous studies [5], trends unveiled in this study can potentially help both clerkship directors and future students in making decisions on their selection of preparatory resources and study strategies when they prepare for NBME subject exams. Given the exorbitant cost of exam preparation materials, research-based information about popularity and perceived usefulness of the resources may be helpful when considering how to best use available time and funding.

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