Effect of a High Value Care Curriculum on Standardized Patient Exam in the Core Clerkship in Internal Medicine

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Abstract

Background: While there are increasing curricula on high value care, little is published on the effectiveness of curricula on medical students' ability to practice high value care.

Methods: In addition to the standard curriculum, the intervention group received two classroom sessions and three virtual patients focused on the concepts of high value care. The primary outcome was number of tests and charges for tests on standardized patients.

Results: One hundred forty-one students enrolled in the Core Clerkship in Internal Medicine and 69 completed the high value care curriculum. There were no significant differences in ordering of appropriate tests (3.1 vs. 3.2 tests/students, $p = 0.55$) and inappropriate tests (1.8 vs. 2.2, $p = 0.13$) between the intervention and control. Students in the intervention group had significantly lower median Medicare charges ($287.59 vs. $500.86, $p = 0.04$) and felt their education in high value care was appropriate (81% vs. 56%, $p = 0.02$).

Conclusions: This is the first study to describe the impact of a high value care curriculum on medical students' ordering practices. While number of inappropriate tests were not significantly different, students in the intervention group refrained from ordering expensive tests.

Background

Compared to other developed countries, the United States has inferior health outcomes despite having the highest health care expenditure per capita in the world.(1) While some of the health expenditures could be attributed to higher prices, almost 20% is considered unnecessary spending.(2, 3) Because of this, there has been a movement to increase high value care (HVC), which is defined by the Institute of Medicine as the best care for the patient, with the optimal result for the circumstances, delivered at the right price.(4)

Understanding the importance of high value care education in medical school, the American Association of Medical College recommended that medical students demonstrate proficiency in the concepts of cost-effective clinical practice upon graduation.(5) As a result, most medical schools have required coursework on costs of care.(6) Yet, students and internal medicine clerkship directors feel education in these concepts is inadequate, and only 30% of internal medicine clerkships have a formal HVC curriculum(7, 8). Additionally, most of the HVC curricula developed for clinical clerkships do not have an assessment, and institutions that have developed assessments do not have curricula.(8–11)

This mismatch between assessments and curricula as well as the paucity of effective HVC curriculum still needs to be addressed. We proposed to study the effectiveness of a high value care curriculum in the Core Clerkship in Internal Medicine (IM Clerkship) using a randomized control trial and an outcome directly controlled by medical students.

Methods

The study was conducted during the IM Clerkship at Johns Hopkins University School of Medicine (JHUSOM) from October 2014 – December 2015. The IM Clerkship at JHUSOM is a nine-week course that is offered five times in an academic year (blocks 1, 2, 3, 4, 5). The study began in block 2 of academic year 2015 (AY15). For purposes of randomization, blocks were grouped into two groups of three (Group 1: B2-AY15, B4-AY15, B1-AY16, Group 2: B3-AY15, B5-AY15, B2-AY15). Group 2 was randomly selected to be the intervention group. All students who were enrolled in the IM Clerkship during the intervention quarters received the curriculum. Enrollment is done through JHUSOM registrar's office, which was not involved in the study. All students in the intervention group participated in the curriculum. The control and intervention groups were compared using several types of demographic data. Comparisons of gender, ethnicity, race, and undergraduate major between control and intervention groups were made using chi-square or Fisher's exact tests, as appropriate. Comparisons of undergraduate grade point average (GPA) and age between control and intervention groups were made using the Mann-Whitney *U* test. Comparisons of Medical College Admission Test→ (MCAT→) scores were made using an independent samples *t* test. All tests were two-sided, and *p*-values < 0.05 were considered statistically significant. Analyses were conducted using SAS Enterprise Guide 6.1 (SAS Institute Inc.; Cary, NC).

The high value care curriculum consisted of two classroom sessions and online modules. One classroom session focused on cost-effective analyses (CEA). Students were first introduced to the concept and basic terms of CEA and then participated in a small group discussion on a cost-effective analysis of noninvasive cardiac stress testing. The second classroom session focused on hospital charges. In small groups, students wrote hospitalization orders for a patient with history of congestive heart failure presenting with shortness of breath. Once completed, they were given the Johns Hopkins Hospital (JHH) charges for each of their orders. Each group was then compared to each other for amount and appropriateness of charges. Each of the classroom sessions had a post-session evaluation that contained common questions for all sessions in the clerkship as well as questions specific to the individual session.

Lastly, students were given online modules that consisted of managing three patients with common symptoms derived from the Clerkship Directors of Internal Medicine (CDIM) – Society of General Internal Medicine (SGIM) Core Medicine Clerkship Curriculum Guide 3.0.(12) For each of the patients, students had a fixed budget to care for them. After placing an order, the program deducted the 2014 Medicare allowable fee from the budget. Upon completion of the modules, the program displayed the appropriateness and charges of the students' management plans. Four internal medicine faculty and one subspecialist (in the area of the patient's symptoms) a priori through the Delphi method determined the appropriateness of the answer choices available to students. None of these faculty were involved in development of the HVC curricula.

During the clerkship, students could rotate at three different sites but all students were assigned to JHH at some point during the clerkship. While at JHH, they have an assigned teaching attending who conducts sessions with them at various times during the rotation. These faculty were given specifics about the curriculum and encouraged to incorporate high value care into their sessions with the students. At the end

of each rotation students completed a survey assessing their perception of education in high value care as well as their experiences on the clerkship. This survey was used as part of a needs assessment in a previous study.(7)

The primary outcome of curricular efficacy was student performance on a standardized patient exam (SPE) at the end the clerkship including appropriate and inappropriate orders as well as the Medicare allowable fees for each test. The SPE is part of the summative assessment for the clerkship that was created prior to the study. Student's management choices were assessed on appropriateness for the clinical presentation. Secondary outcome was performance on the National Board of Examiners (NBME) subject exam.

Statistical analysis of assessment and survey data was performed with SAS 9.4. Two sample t-tests were run comparing the number of inappropriate tests as well as the number of appropriate tests between control and intervention groups. Additionally, a Kruskal-Wallis test was run to compare the total cost of these tests (which was not normally distributed) between the intervention and control group and a Wilcoxon Rank-Sum test was run to compare the total cost of these tests and NBME percentile scores (which was not normally distributed) between the intervention and control group.

Results

During the study period, 141 students completed the IM Clerkship. Of those 141, 72 received the standard education and 69 received the high value care curriculum. There were no significant differences between the two groups with respect to gender, ethnicity, race, undergraduate major, undergraduate GPA, or MCAT→ score (Table 1). Students in the intervention group were older compared to the usual education group (26 vs 24.5 years old, $p = 0.002$). Including classroom time, the total curriculum time was less than four hours. Assessment data for six students (3 in intervention and 3 in control) who opted out of the analysis were not included.

Characteristic[1]	Control (*n*=72)	Intervention (*n*=69)	*p*-value
Gender	35 (48.6)	37 (53.6)	0.55
Female	37 (51.4)	32 (46.4)	
Male			
Ethnicity	7 (9.7)	5 (7.3)	0.60
Hispanic	65 (90.3)	64 (92.8)	
Non-Hispanic			
Race[2]	2 (2.8)	1 (1.5)	1.00
American Indian or Alaska Native	28 (38.9)	23 (33.3)	0.49
Asian	11 (15.3)	4 (5.8)	0.10
Black or African American	0 (0.0)	0 (0.0)	–
Native Hawaiian or Other Pacific Islander	29 (40.3)	36 (52.2)	0.16
White			
Undergraduate Major[3]	15 (20.8)	16 (23.2)	0.74
Non-Science	57 (79.2)	53 (76.8)	
Science			
Undergraduate GPA[4]	3.90	3.92	0.33
Biology, Chemistry, Physics, and Math Courses	(3.77-3.97)	(3.81-3.98)	
	3.90	3.91	0.40
Total	(3.79-3.97)	(3.81-3.96)	
MCAT^{Ò} Scores[5]	34.7	35.6	0.07
	(31.8-37.7)	(32.5-38.7)	
Age[6] (years)	24.5	26.0	0.002
	(24.0-26.0)	(24.0-27.0)	

GPA = grade point average, MCAT^{Ò} = Medical College Admission Test^{Ò}

[1] Values for gender, ethnicity, race, and undergraduate degree are presented as *n* (%). Values for undergraduate grade point average and age are presented as median (inter-quartile range). Values for Medical College Admission Test scores are presented as mean (95% confidence interval).

[2] Students were permitted to select all that apply, such that the sum of within-cell sample sizes may

exceed the total group sample size.
[3] Undergraduate major was categorized as either non-science or science.
[4]Ungraduate grade point average from the students' American Medical College Application Service® (AMCAS®) application.
[5]All students in this sample completed the test prior to the current version released in 2015. The scores presented represent the sum of the biological science, physical science, and verbal reasoning domain scores.
[6]Age was defined as the students' age at start of the clerkship.

Table 1
Student characteristics by control and intervention groups

There were no significant differences in ordering of appropriate tests (3.1 vs. 3.2 tests/students, $p = 0.55$) and inappropriate tests (1.8 vs. 2.2, $p = 0.13$) between the intervention and control. Students in the intervention group had significantly lower Medicare allowable fees ($287.59 vs. $500.86, $p = 0.04$). For secondary outcomes, students in the intervention achieved higher percentiles on the NBME subject exam (78% vs. 67%, p = 0.10), but this was not statistically significant (Table 2).

Assessment		Control (66)	Intervention (69)	p
Standardized patient				
	Appropriate tests/student (SD)	3.2 (0.94)	3.1 (0.90)	0.55
	Inappropriate tests/student (SD)	2.2 (1.5)	1.8 (1.3)	0.13
	Median Medicare allowable fees/student (IQR)	$500.86 ($227.90 – $870.33)	$287.59 ($169.87 – 681.18)	0.04
Median NBME percentile (IQR)		67 (42-88)	78 (59-92)	0.10
SD: Standard Deviation IQR: Interquartile Range NBME: National Board of Medical Examiners				

Table 2
Student performance on end of clerkship assessments

Overall, more students in the intervention group felt their education in HVC was appropriate (81% vs. 56%, $p = 0.02$). There were no significant differences in how often students perceived unnecessary ordering of tests, their comfort level speaking up about an unnecessary test, or how often they witnessed discussion of costs, praise for not ordering an unnecessary test, or guidance to order tests that will not change management (Table 3).

Question	Answer	Control (37)	Intervention (42)	p
HVC Education	Appropriate	21 (57%)	34 (81%)	0.02
	Inadequate	16 (43%)	8 (19%)	
How Often Unnecessary Tests Ordered	Frequent/Often	10 (27%)	15 (36%)	0.41
	Sometimes/Rarely/Never	27 (73%)	27 (64%)	
Comfort Level Speaking Up Against Ordering Perceived Unnecessary Tests	Comfortable	16 (43%)	17 (41%)	0.80
	Uncomfortable	21 (57%)	25 (60%)	
How Often Discuss Costs	Frequent/Often	6 (17%)	9 (21%)	0.59
	Sometimes/Rarely/Never	30 (83%)	33 (79%)	
How Often Praised for Not Ordering an Unnecessary Test	Frequent/Often	16 (44%)	15 (36%)	0.43
	Sometimes/Rarely/Never	20 (56%)	27 (64%)	
How Often Team was Guided to Order More (unnecessary) Tests	Frequent/Often	8 (22%)	3 (7%)	0.07
	Sometimes/Rarely/Never	29 (78%)	38 (93%)	
HVC: High Value Care				

Table 3
Student perceptions of high value and low value care during the clerkship

Most students rated the classroom sessions very good or excellent (75% for CEA and 90% for hospital charges session). Most students felt that the classroom sessions increased skills related to the topic somewhat or a lot (90% for CEA and 93% for hospital charges session) and prepared them to be a medical student on the IM clerkship. After the hospital charges sessions, most students would consider charges somewhat/a lot for labs (90%), medications (91%), and radiologic procedures (93%).

For the web-based modules, 88% of students rated them as good or excellent. For each individual module, students rated the following modules as good or excellent: acute kidney injury (85%), acute chronic obstructive pulmonary disease exacerbation (83%), acute deep vein thrombosis and pulmonary embolus

(85%). Most students felt the virtual patients were similar to patients that they care for during the clerkship yet only half (50%) felt virtual patients should be a part of the clerkship.

Discussion

This is the first study to describe the impact of a high value care curriculum on medical students' ordering practices as opposed to monitoring others' care practices.(13) Students were highly satisfied with the curriculum and report improved confidence in the adequacy of their high value care education. Students agreed that the sample patients and topics had fidelity and were similar to what they see on the clerkship. The curriculum is also aligned with the CDIM-SGIM Core Medicine Clerkship Curriculum. Given the limited curriculum time and resources, implementation of the curriculum at other schools is feasible. The use of virtual patients and small group learning as the main educational methods promotes active learning and limits the need for faculty time, which was cited as a barrier to curriculum implementation by clerkship directors.(8)

Students in high intensity regions are more likely to display low-value behaviors thus high value care should be taught as early as possible.(14) This study demonstrated that medical students can apply concepts taught to them in simulated clinical scenarios which are not part of the formal curriculum. Because of this finding we have broadened our curriculum to include an intersession for first year medical students in an effort to inculcate students in HVC principles at an earlier stage.(15)

The study did have some limitations. As with many educational interventions it was a single site study thus we are unsure if this curriculum would succeed at another medical schools. The assessment was not actual patient care but simulated patients, and students often report standardized patient encounters feel unrealistic, which may lead them to behave differently than they do with real patients. (16) Therefore it is unknown how students would incorporate this on actual patients.

Conclusions

A curriculum in HVC can increase the perception of appropriateness of HVC education, and teach students to spend less on patient care. While there is a need for curriculum in HVC in medical school, assessment of formal curriculum should always be performed. Having a repository of curricula and assessment tools for HVC will help medical schools in this regard. (17–19) Future studies will need to better delineate methods for measuring impact of HVC curricula at multiple institutions as well as beyond medical school.

Abbreviations

CDIM: Clerkship Directors of Internal Medicine

CEA: cost-effective analysis

GPA: grade point average

HVC: high value care

IM Clerkship: Core Clerkship in Internal Medicine

JHUSOM: Johns Hopkins University School of Medicine

JHH: Johns Hopkins Hospital

MCAT®: Medical College Admission Test®

NBME: National Board of Medical Examiners

SGIM: Society of General Internal Medicine

SPE: standardize patient exam

Declarations

Ethics approval and consent to participate:

This study received approval from the Johns Hopkins Medicine Institutional Review Board. During consent process, students could opt out of having their data analyzed.

Consent for publication:

Not applicable

Availability of data and materials:

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors declare that they have no competing interests.

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Authors contributions:

AKP and DC conceived and designed the study, acquired and interpreted the data, and drafted the manuscript. KE helped with conception of the study and substantially revising the manuscript. AA, AB, and RR analyzed and interpreted the data. All authors approved the submitted version.

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Not applicable

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