Journal of Contemporary Medical Education

available at www.scopemed.org

Original Research

Medical resident knowledge and comfort regarding HIV antiretroviral drug interactions

Bevin Hearn[1], Grace Huang[2,3], Jennifer Allen[2], Wendy Stead[2]

[1]The Mount Sinai Medical Center, New York, NY
[2]Beth Israel Deaconess Medical Center, [3]Carl J. Shapiro Institute for Education and Research at Harvard Medical School Boston, MA

Received: January 30, 2013

Accepted: February 19, 2013

Published Online: April 12, 2013

DOI: 10.5455/jcme.20130219010016

Corresponding Author:
Bevin Hearn,
The Mount Sinai Medical Center, New York, NY
bevin.hearn@mountsinai.org

Keywords: *Medical education, HIV/AIDS, curriculum/program evaluation, antiretrovirals, drug interactions*

ABSTRACT

Many residency programs lack dedicated HIV curricula and residents report discomfort caring for these patients. Antiretroviral medication interactions are particularly relevant as adverse events frequently occur. This study evaluated the impact of a didactic session regarding antiretroviral drug interactions on resident knowledge and comfort. We conducted a prospective cluster-randomized controlled trial of internal medicine residents at an urban academic medical center. The intervention was a case-based lecture explaining the pharmacologic mechanisms behind drug-drug interactions with HIV antiretrovirals. The control group did not receive this intervention. We assessed knowledge and comfort in all subjects before and two months after the intervention. We enrolled 74 residents (76% of those surveyed). Baseline knowledge scores did not differ between groups, and delayed post-test scores showed improvement in the intervention group compared with controls at a level approaching significance (p=0.1). Analysis of paired data found a statistically significant increase between pre- and post-test scores (p=0.0032) and in comfort levels with outpatient care (p=0.02), inpatient care (p=0.02), and starting new medications (p=0.026) in the intervention group compared with controls. Resident knowledge and comfort managing patients on HIV medications can be improved after a single targeted educational intervention. This topic should be prioritized within a broader HIV curriculum.

INTRODUCTION

As people with HIV lead longer lives due to highly active antiretroviral therapy, they will develop chronic illnesses like hypertension, hyperlipidemia and coronary artery disease [1]. Along with the CDC recommendation for universal HIV screening, this shift in focus will make the care of HIV patients more relevant to internists [2]. However, general internists and trainees lack comfort in managing this patient population and dedicated curricula are not widespread [3-5]. Moreover, this discomfort and lack of knowledge has led to preventable errors and may also result in an anticipated shortage of HIV care providers in the workforce [6].

Of particular relevance to generalists is the topic of medication interactions with antiretrovirals. Medication errors in both inpatient and outpatient settings are common, harming at least 1.5 million people in the United States and costing billions of dollars annually [7]. Previous studies have shown that up to 86% of patients on antiretrovirals had at least one medication-related adverse event during a hospital admission [8]. These errors were most commonly due to drug-drug interactions with the cytochrome P450 CYP3A metabolism [8-11]. The majority of all drugs, including HIV protease inhibitors, are metabolized at least partially through this pathway, leading to frequent drug-drug interactions [9-10]. Several studies point to inadequate medical knowledge as one of the leading causes of antiretroviral prescribing errors [8-15]. While some consider antiretrovirals to be the purview of infectious disease (ID) physicians alone, medical

residents and internists will undoubtedly care for patients already on these medications, and ID consultation or clinical pharmacist oversight is not always readily available [16].

Therefore, the goal of this study was to examine the impact of a didactic session regarding common antiretroviral drug interactions on knowledge and comfort among internal medicine residents. Our hypothesis was that our educational intervention would result in higher knowledge test scores in the intervention group compared to controls.

METHODS

We conducted a prospective cluster-randomized controlled trial at an urban-based academic medical center in Boston. Study subjects were internal medicine residents in their second and third years of training during academic year 2011-2012.

The educational intervention was an hour-long didactic session titled, "HIV antiretroviral drug interactions for the internist," administered by the author (BH) to three distinct groups of residents over a three-week period, which captured approximately half of the junior and senior residents in the internal medicine residency. The educational session was provided as part of an established ambulatory care curriculum and utilized case-based presentations to depict examples of drug-drug interactions from HIV antiretroviral medications with steroids, proton pump inhibitors, statins, and antifungals. The content also included the pharmacologic mechanism behind these drug class interactions. The residents not present in the ambulatory setting during those 3 weeks served as the control group; scheduling assignments are determined at the beginning of the year and are arbitrary with respect to the topic being examined here.

We developed a 10-item multiple-choice knowledge test on HIV antiretroviral drug interactions, based on a prior study [13] to assess physician knowledge of these interactions. We used a modified Delphi method [17] to assess the content validity of the instrument and sent the initial survey to 15 HIV expert providers and pharmacists for comments. Their feedback was incorporated into an updated draft that was again distributed anonymously for suggestions. After two iterations, the final instrument was established. Along with the pre-test we also solicited basic demographic information, future career plans, and perceived comfort caring for patients on antiretroviral medications on a 4-point scale (1 = "very comfortable" to 4 = "very uncomfortable").

We administered the knowledge test to all junior and senior residents electronically one month prior to the intervention ("pretest"). Residents received weekly reminders for completion. We administered the knowledge test immediately after the educational intervention to the study group ("immediate posttest"), and we surveyed both control and intervention groups two months later to assess knowledge retention ("delayed posttest"). Subjects reported the last four digits of their cell phone numbers, which we employed as nonconfidential identifiers to link pre- and post-test data. This study was considered exempted from further review by our hospital's institutional review board.

We tabulated subject characteristics (age, gender, post-graduate year, future career plans, clinic locations, and prior didactic exposure to ARV interactions) by group. We compared group characteristics to confirm equivalence, using Chi-square/Fisher's exact test for analysis of proportions and Wilcoxon rank sum for ordinal data. The primary outcome was knowledge test scores, and secondary outcomes were comfort with HIV meds in the outpatient and inpatient settings and comfort with starting new HIV medications. We compared outcomes between the control and intervention groups in aggregate (all resident data).

We conducted two sensitivity analyses. We examined the subset of study subjects who had completed both the pre- and posttests and compared change in knowledge test scores from baseline between intervention and control groups, using Wilcoxon signed rank tests for paired ordinal data. We repeated the analyses for comfort scores. We additionally performed multiple logistic regression using a perfect test score (i.e., 10 points) as the outcome and including group assignment, intended career in primary care, and clinic at an HIV specialty site as predictors.

We used Stata 12 (College Park, TX) for all analyses. We assumed two-tailed hypotheses with a threshold of significance set at $p \leq 0.05$.

RESULTS

Of 98 survey recipients, 45 completed the pre-test, 47 completed the post-test and 27 completed both. A total of 27 were in the control group and 47 were in the intervention group. Subjects in both groups did not statistically differ in relation to age, sex, post-graduate year, or career plan expressed as a dichotomous variable (Table 1).

Pre-test knowledge scores did not differ between the groups at baseline, and delayed post-test scores showed improvement in the intervention group compared to the controls, though the p-value was not significant ($p=0.10$) (Table 2). Comfort scores were lower at baseline for the intervention group compared to the controls for managing patients on HIV medications in

the outpatient setting (p=0.016), managing patients on HIV medications in the inpatient setting (p=0.016), and initiating new medications in HIV patients (p=0.012).

The vast majority (98%) of both groups agreed that it was important to learn about HIV antiretroviral medications regardless of their future career plans.

When we examined available paired data for the difference between pre- and post-test scores, there was a statistically significant increase (p=0.0032) in the intervention group (17 matched pairs) but not in the controls (10 matched pairs) (Table 2). This observation was likewise true for comfort rating with outpatient care (p=0.02), inpatient care (p=0.02) and starting new medications (p=0.026), which were statistically different after the intervention compared to before, for the intervention group only. The second sensitivity analysis did not show a relationship between having a clinic with a higher HIV population (Fenway and Dimock) or an interest in a primary care career with a perfect test score of 10 points.

Table 1. Baseline characteristics, by group

			Control		Intervention		P-value
Total			N=27		N=47		
PGY year							0.36
	JAR		10	37%	24	51%	
	SAR		17	63%	23	49%	
Age							0.62
	25-29		17	63%	31	66%	
	30-34		9	33%	12	26%	
	>35		1	4%	4	9%	
Gender							0.84
	Male		15	56%	25	53%	
	Female		12	44%	22	47%	
Career plan							
	Primary care		4	15%	14	30%	0.24[a]
	Hospitalist		7	26%	5	11%	
	ID		1	4%	1	2%	
	Other subspecialty		10	37%	23	49%	
	Other		5	19%	4	9%	
Clinic site[b]							
	HCA		22	81%	40	85%	0.75[c]
	Dimock		3	11%	6	13%	
	Fenway		2	7%	1	2%	
	VA		5	19%	3	6%	
	Other		5	19%	7	15%	
	Prior exposure to content (# of lectures)						
	Med school						0.97
		None	1	4%	3	6%	
		1-2 sessions	18	67%	28	60%	
		3-4 sessions	5	19%	10	21%	
		>4 sessions	3	11%	5	11%	
	Residency						
		None	7	26%	1	2%	0.32
		1-2 sessions	13	48%	29	62%	
		3-4 sessions	5	19%	13	28%	
		>4 sessions	2	7%	1	2%	

[a]Comparison between primary care vs not primary care
[b]Percentages>100% as residents may have >1 clinic
[c]Comparison between Dimock/Fenway (higher HIV population) vs other

Table 2. Comparison of intervention and control groups in aggregate and paired samples

	All Control	All Intervention	P-value comparing control to intervention group	Paired control	Paired Intervention
	n=27	n=47		n=10	n=17
Test scores[a] (mean, median)					
Pretest	7.9, 8	7.7, 8	0.97	7.8. 8	7.4, 8
Delayed post	8.1, 8	8.5, 9	0.10	7.8, 8	8.8, 9
P-values comparing delayed post- to pre-tests				0.87	0.0032
Comfort levels[b] with outpt HIV care					
Pretest	2.8, 3	3.3, 3	0.016	3.0, 3	3.4, 3
Delayed post	2.9, 3	2.8, 3	0.60	2.7, 3	2.9, 3
P-values comparing delayed post- to pre-tests				0.18	0.020
Comfort levels[b] with inpt HIV care					
Pretest	2.3, 2	2.8, 3	0.016	2.2, 2	2.9, 3
Delayed post	2.3, 2	2.4, 2	0.84	2.3, 2	2.5, 2
P-values comparing delayed post- to pre-tests				0.65	0.020
Comfort levels[b] with starting meds in HIV pt					
Pretest	2.7, 3	3.2, 3	0.012	2.8, 3	3.4, 3
Delayed post	2.8, 3	3.0, 3	0.43	2.7, 2.5	3.0, 3
P-values comparing delayed post- to pre-tests				0.65	0.026

[a]Maximum score of 10
[b]Range of 1 "very comfortable", 2 “comfortable, 3 “uncomfortable” to 4 "very uncomfortable"

DISCUSSION

As the HIV population ages, they will develop more chronic medical conditions that will require the internists who care for them to understand possible interactions between antiretrovirals and other commonly used medications. While our study did not show differences in test scores between the intervention and control groups, it did show significantly increased test scores and comfort with antiretrovirals after the intervention compared to prior.

We had hypothesized that knowledge scores would increase more significantly after the intervention. We suspect the ceiling effect in scores (due to higher than expected baseline knowledge among the residents) reduced the sensitivity of our instrument to detect change. We did find that comfort increased compared to baseline, which suggests that providing a brief exposure to a topic often overlooked in broad-based HIV curricula is sufficient to result in increased confidence about antiretrovirals.

Our findings of low baseline comfort with antiretrovirals and with providing outpatient HIV care are consistent with prior studies. Initially, only 23% of our control group and 9% of the intervention group reported feeling very comfortable or comfortable providing outpatient HIV care. This was similar to 39% of medical residents from four different internal medicine residency programs who reported feeling incompetent providing outpatient HIV care [3]. Similarly, at baseline only 29% of our control group and 14% of the intervention group felt comfortable initiating new medications in patients on antiretrovirals which supports a prior study finding that less than 25% of internal medicine residents and attending physicians felt comfortable managing HIV-infected patients [13].

Limitations in this study include its single-institution setting, small sample size, and select population of internal medicine residents in an urban location. Our residents may have a different baseline level of knowledge and educational exposure to HIV medication management than other populations of relevant providers, limiting our study’s generalizability. Our instrument, as mentioned previously, was constrained in its ability to demonstrate a greater degree of improvement. We also acknowledge that comfort and knowledge may not be proxies for resident behavior regarding HIV medication interactions.

In conclusion, as HIV prevalence increases and the population with this disease ages, there will be an increased need for generalist physicians to provide care to patients on antiretrovirals as they develop other

comorbid chronic medical conditions. Many internal medicine residency programs do not currently have dedicated HIV curricula, and as a result, many residents feel uncomfortable caring for this population. Our study suggests that resident knowledge and comfort level managing patients on HIV medications can be improved after a single targeted educational intervention. This topic should be prioritized within a broader internal medicine resident HIV curriculum. However, as the majority of residents remained uncomfortable prescribing new medications to patients on antiretrovirals, further work needs to be done in this area to assess their knowledge deficiencies and create educational tools to bridge these gaps.

Acknowledgements

The authors would like to thank Robin Wigmore, MD and Anna Johansson, MD for their contributions towards this manuscript.

Conflicts of interest

All authors report no conflicts of interest.

REFERENCES

1. New Estimates of US HIV Prevalence. Available via http://www.cdc.gov/hiv/topics/surveillance/resources/factsheets/pdf/prevalence.pdf (Accessed 11 January 2012).
2. Branson BM, Handsfield HH, Lampe MA, Janssen RS, Taylor AW, Lyss SB, Clark JE. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep 2006;55(RR-14):1–17; quiz CE11-14.
3. Phillips KA, Confrancesco J, Sisson S, Wu AW, Bass EB, Berkenblit G. A multicenter study of internal medicine residents' perceptions of training, competence, and performance in outpatient HIV care. AIDS Patient Care STDS 2010;24(3):159-64.
4. Feldman J, Miner M, Millis M. Training family practice residents in HIV care. AIDS Patient Care STDS 2004;18(7):395-404.
5. Adams J, Chacko K, Guiton G, Aagaard E. Training internal medicine residents in outpatient HIV care: a survey of program directors. J Gen Intern Med 2010;25(9):977-81.
6. Carmichael JK, Deckard DT, Feinberg J, Gallant JE, Hoffman-Terry ML, Lee SD, Sosman JM, Squires KE. Averting a crisis in HIV care: A Joint Statement of the American Academy of HIV Medicine (AAHIVM) and the HIV Medicine Association (HIVMA) on the HIV medical workforce. Available via http://www.idsociety.org/uploadedFiles/IDSA/Policy_and_Advocacy/Current_Topics_and_Issues/Workforce_and_Training/Statements/AAHIVM%20HIVMA%20Workforce%20Statement%20062509.pdf (Accessed 11January 2012).
7. National Research Council. Preventing Medication Errors: Quality Chasm Series. The National Academies Press, Washington, DC, 2007.
8. Mok S, Minson Q. Drug-related problems in hospitalized patients with HIV infection. Am J Health Syst Pharm 2008;65(1):55-9.
9. Cupp MJ, Tracy TS. Cytochrome P450: new nomenclature and clinical implications. Amer Fam Phys 1998;57(1):107-12.
10. Josephson F. Drug-drug interactions in the treatment of HIV infection: focus on pharmacokinetic enhancement through CYP3A inhibition. J Intern Med 2010;268(6):530-39.
11. Pau AK, Boyd SD. Recognition and management of significant drug interactions in HIV patients-challenges in using available data to guide therapy. Clin Pharmacol Ther 2010;88(5):712-19.
12. Purdy BD, Raymond AM, Lesar TS. Antiretroviral prescribing errors in hospitalized patients. Ann Pharmacother 2000;34(7-8):833-38.
13. Arshad S, Rothberg M, Rastegar DA, Spooner LM, Skiest D. Survey of physician knowledge regarding antiretroviral medications in hospitalized HIV-infected patients. J Int AIDS Soc 2009;12:1.
14. Schmidt GA, Hoehns JD, Purcell JL, Friedman RL, Elhawi Y. Severe rhabdomyolysis and acute renal failure secondary to concomitant use of simvastatin, amiodarone, and atazanavir. J Am Board Fam Med 2007;20(4):411-16.
15. Kedem E, Shahar E, Hassoun G, Pollack S. Iatrogenic cushing's syndrome due to coadministration of ritonavir and inhaled budesonide in an asthmatic human immunodeficiency virus infected patient. J Asthma 2010;47(7):830-31.
16. Heelon M, Skiest D, Tereso G, Meade L, Weeks J, Pekow P, Rothberg MB. Effect of a clinical pharmacist's interventions on duration of antiretroviral-related errors in hospitalized patients. Am J Health Syst Pharm 2007;64(19):2064-68.
17. Turoff M. The Policy Delphi. In: Linstone HA, Turoff M (ed) The Delphi Method: Techniques and Applications. Addison-Wesley Publishing Company, USA, 2002. Available via http://is.njit.edu/pubs/delphibook/delphibook.pdf (Accessed 21 February 2012).