

RESEARCH BRIEF

Using Hand Signs to Teach HIV Medications

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Objective. To describe an innovative active learning strategy that uses students' hands to facilitate learning and retention of major concepts related to nucleotide/nucleoside reverse transcriptase inhibitors (NRTIs).

Methods. Students wrote the names of the NRTIs on their fingers, then an interactive activity used a variety of hand signs to teach the drugs. Focus groups were conducted with a total of 20 students one year after being exposed to the new teaching strategy. Students were asked five knowledge-based questions related to the subject matter to assess retention of the material.

Results. On average, students answered 64% of the questions correctly. Most students (95%) used their hands to answer the knowledge-based questions. There was a statistically significant association between using hands to answer the question and answering the question correctly. When asked which active learning method was most effective, 14 (70%) participants reported "hands."

Conclusion. Using students' hands was well received by this cohort of students. More research is needed to determine if this active learning method could be considered for use in other disease states to help students learn complex medications with many nuances.

Keywords: hands, active learning, innovative

INTRODUCTION

Medications used to treat human immunodeficiency virus (HIV) are difficult to learn – many of the names look similar and can be easily confused. None of the antiretrovirals are among the top 300 medications dispensed;¹ therefore, pharmacy students are expected to learn HIV despite lacking significant exposure to these medications in their experiential training. Students often use rote learning, a method that has been associated with poor long-term recall and inability to adequately prepare pharmacy students for their professional clinical roles.^{2,3}

The American College of Clinical Pharmacy (ACCP) didactic curriculum toolkit ranks HIV as a tier 2 topic, proposing all students should receive basic training and education in this area.⁴ As HIV continues to evolve into a chronic disease state impacting an aging population, pharmacists will play an increasing role in optimizing care for patients with HIV.⁵ The 2016 guidelines published by the American Society of

Health-System Pharmacists recognized the expanding role of pharmacists in HIV care, with an emphasis on testing, treatment optimization, managing treatment failure, adherence counseling, HIV prevention, and education.⁵ The importance of learning HIV for our students was heightened by the 2015 HIV outbreak in Scott County, Indiana, which occurred approximately 45 miles north of Sullivan University College of Pharmacy.⁶ As many of our students would be caring for these patients, we aimed to improve the delivery of HIV education in our curriculum. Additionally, the curriculum committee at Sullivan University College of Pharmacy identified infectious diseases, including HIV, as a target area for improving the structure and delivery of content in response to assessment data and preceptor feedback on student performance during advanced pharmacy practice experiences (APPEs).

The 2016 Accreditation Council for Pharmacy Education standards emphasize active learning in the curriculum, as well as using a variety of teaching techniques to engage diverse types of learners.⁷ It has been hypothesized that learning methods invoking a positive emotion may promote meaningful learning over rote memorization.⁸ Active learning strategies that keep learning fun and reduce stress, such as games, have proven effective at improving pharmacy students' attention, participation, and grades.^{9,10} Kinesthetic cues have been shown to aid in

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spatial memory;¹¹ however, there is a lack of research on the use of kinesthetic cues in pharmaceutical education.

Among the antiretroviral classes, the nucleotide/nucleoside reverse transcriptase inhibitors (NRTIs) are especially important to learn since most antiretroviral regimens consist of a dual NRTI backbone.¹² At the same time, this class is perhaps one of the most difficult classes to learn since, unlike the protease inhibitors which all end in “-navir,” NRTIs do not have common United States adopted name stems. Consequently, it was our aim to develop a novel active learning method for teaching the NRTIs. This method uses students’ own hands to teach the drugs in an effort to keep students participating and engaged in the lecture, keep learning fun, and provide students with kinesthetic cues to promote retention of knowledge related to NRTIs.

In this pilot study, focus groups were conducted one year post-classroom implementation to gain insight into their retention of NRTI material, as well as perceptions of this teaching method.

The primary objective was utilization of hands when answering knowledge-based questions. Secondary objectives included retention of material (measured by the number of questions answered correctly), and student perceptions of this teaching method.

METHODS

In our three-year accelerated pharmacy curriculum, HIV is taught during the pharmacotherapeutics course sequence in the second (P2) year. Students complete APPEs during the third and final year of the curriculum. All P2 students in this class were asked to write the names of the NRTI drugs on their fingers (Figure 1). The interactive activity used a variety of hand signs to teach the drugs. For example, students were asked to make a “c” with their left hand and a “d” with their right hand. This was to remind them that the left hand contained the “clean” NRTIs, most frequently used in practice due to

fewer side effects. The right hand contained the “dirty” NRTIs, less frequently used due to their significant adverse effect profile (Figure 2).

To teach the analog of each drug (cytosine, adenosine, guanine, thymidine), students were asked to make a “W” with each hand by crossing their middle and ring fingers, then lean the W’s in until their pointer fingers touched (Figure 3). It was noted that abacavir is “special” for many reasons, such as being the only guanine analog, requiring HLA-B*5701 testing prior to initiation, and lack of renal dosing adjustments needed. To help students remember the class-wide toxicities of the NRTIs, they were asked to make two “L’s” with their hands (Figure 4). Each “L” stood for a side effect, including Lactic acidosis and Liver (hepatomegaly with steatosis). Students were asked to hold up the three fingers on their left hand like the character Katniss Everdeen does in *The Hunger Games* to help them remember which drugs have both HIV and hepatitis B activity (Figure 5). To learn which NRTIs were available in combination with each other, students were asked to make the “Nanu Nanu” hand symbols from the sitcom *Mork & Mindy* or like Spock from *Star Trek* (Figure 6a). The top two fingers on the left hand are the components of Truvada (“T” for Truvada and on “Top”), while the bottom two fingers are the components of Epzicom. They were then asked to bring the right hand to meet the left hand; the ring fingers combined make up Combivir, while the ring fingers plus the left pinky finger make up the components of Trizivir (“Tri” for “Trizivir” and the “Triangle” shape your hands make) (Figures 6b and 6c).



Figure 1. Students Write the Names of the NRTIs on their Hands.

Disclaimer: This figure is only intended for instructional goals and not reflective of other meanings.

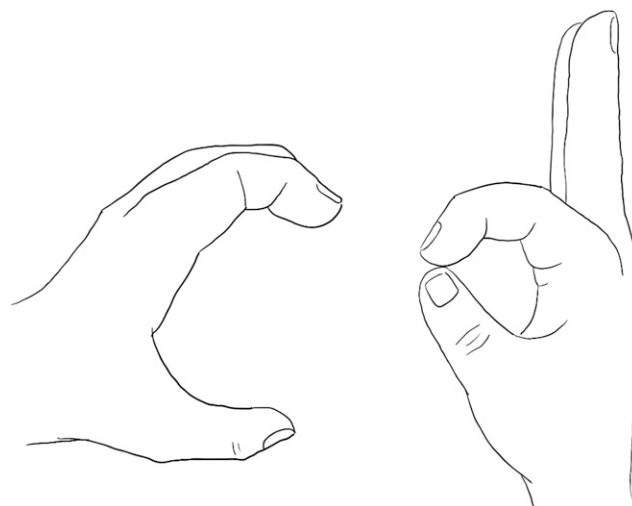


Figure 2. Clean vs. Dirty NRTIs.

Disclaimer: This figure is only intended for instructional goals and not reflective of other meanings.

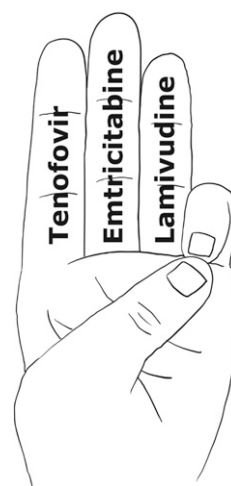
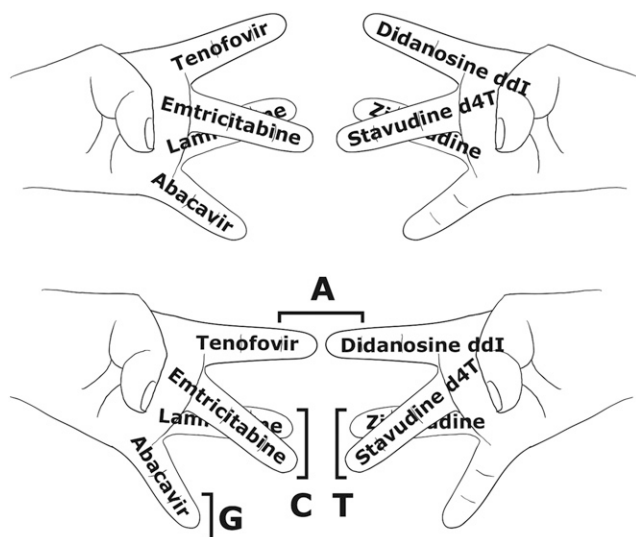


Figure 5. NRTIs with Both HIV and Hepatitis B Activity.

Disclaimer: This figure is only intended for instructional goals and not reflective of other meanings.

Figures 3a, 3b. Analogs. Students Make a “W” with Both Hands (3a), and Then Lean Their Pointer Fingers in Toward Each Other to Remember the Analogs (3b).

Disclaimer: These figures are only intended for instructional goals and not reflective of other meanings.

Some of the hand signs were also taught in combination with short songs or rhymes. For example, when the students held up the Katniss Everdeen symbol (Figure 5), they were asked to sing *We kill hep B* to the tune of the whistle from *The Hunger Games* movie.

The “hands on” approach was used as a type of active learning throughout the lecture, but other active learning strategies were also included. Role-play was used to teach the mechanism of action of maraviroc, a song was used to teach the non-nucleotide reverse transcriptase inhibitors, a music video to teach the protease inhibitors, and “knowledge checks” were incorporated throughout. All active learning was incorporated using the “pause” approach;¹³

active learning was inserted into the formal lecture-style presentation approximately every 10-15 minutes.

This observational pilot study was approved by the Sullivan University institutional review board and used focus groups, conducted one year after implementation of the “hands on” method into the didactic course. Each focus group consisted of 2-4 APPE students. To ensure that selected students were representative of the class as a whole, the class was divided into four quartiles, based upon how they scored on the therapeutics exam containing HIV. Eight students from each quartile (n=32) were selected using an online random name selector and invited to participate in the focus group. A sample size of approximately 18 students (25% of the class) was chosen a priori, with a goal of interviewing until no new or relevant information was discovered.¹⁴ Of the 73 students in the class, 20% (15) of APPE students were assigned a rotation within an HIV clinic; therefore, we aimed to survey no more than 15% to 20% of APPE students that had completed an HIV-focused rotation in order to limit this as a confounder. To maintain consistency, one trained moderator conducted all of the sessions and had a script of 10 open-ended questions to ask the students. Each session was audio recorded.

Students were provided a structured introduction in each session, explaining the purpose and scope of the study, followed by open-ended questions such as “How do you learn best?” and “Since you have been on rotation, how much HIV have you encountered?” Students were then asked five knowledge-based questions about the NRTIs (Table 2) to assess their retention of the information. Students were not allowed to write the drug

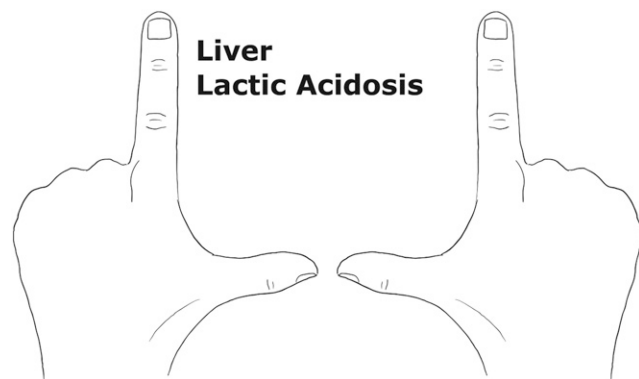
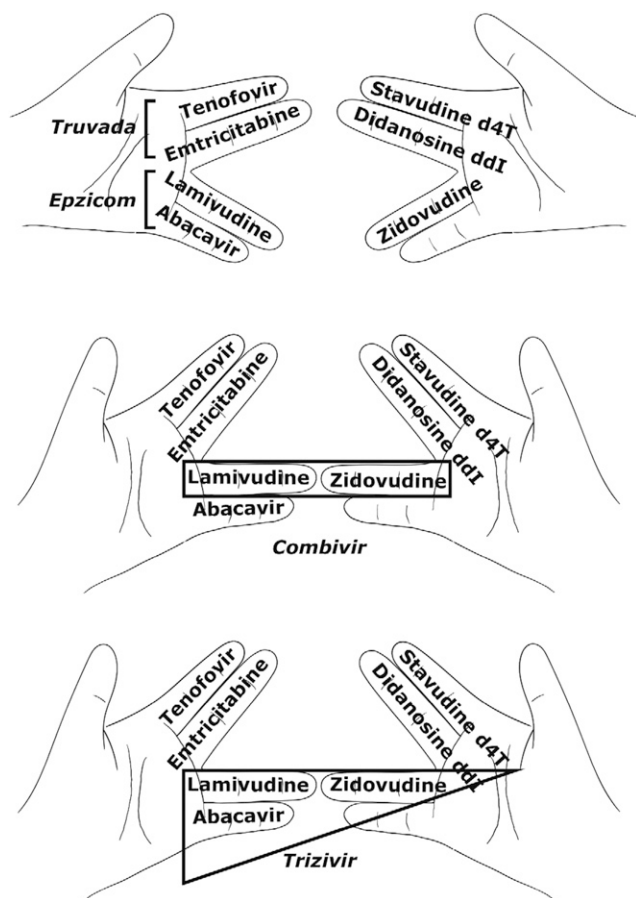


Figure 4. Toxicities of NRTIs.

Disclaimer: This figure is only intended for instructional goals and not reflective of other meanings.



Figures 6a, 6b, 6c. Combination Products. Truvada and Epzicom (6a); Combivir (6b); Trizivir (6c).

Disclaimer: These figures are only intended for instructional goals and not reflective of other meanings.

names on their hands. While they were answering, the moderator was instructed to watch and determine how many of the students used their hands to help them answer the questions. The last two questions were related to the students' perceptions of active learning, as well as the effectiveness of using their hands to learn the NRTI drugs. Students were given time to provide additional comments at the end.

Descriptive statistics were utilized for outcomes; Chi-square or Fisher's exact and Student's *t* test were used to assess for potential confounders, with alpha set a priori at less than $p < .05$. A post-hoc Bonferroni correction was applied to minimize false positives from multiple comparisons.

RESULTS

The P3 class consisted of 73 students (56% were female and 20% were assigned an APPE rotation within an HIV specialty clinic). The moderator sent email invitations to 32 students, inviting them to participate in the focus groups; among these, 20 students participated and

12 declined or did not respond to the invitation. Baseline characteristics for the focus group participants are found in Table 1.

Of the 20 participants, 19 (95%) used their hands to answer at least one of the five knowledge-based questions (Table 2). Ten participants (50%) used their hands to answer three or more questions and all learners identified as kinesthetic and/or visual learners. Completion of an HIV-focused rotation did not statistically impact the participants' likelihood of using their hands to answer the question.

Participants that did not use their hands often to answer the questions were examined to see which questions they were most likely to use their hands to answer (Table 3). Those participants that only used their hands to answer 1-2 questions were most likely to use them to answer questions 1, 2, or 4. These questions all pertained to a concept that was taught using popular culture references; the significance of using popular cultural references as a teaching strategy will be discussed in greater detail in the discussion.

On average, students answered 64% of the knowledge-based questions correctly. Participants who identified as kinesthetic learners scored slightly higher than participants who identified as non-kinesthetic (72.5% vs 58.3%); however, this difference was not statistically significant. There was a significant association between using hands to answer the question and answering the question correctly (risk ratio 1.67; 95% confidence interval 1.21-2.30; $p = .0009$).

Themes from the open discussion provided both positive and constructive feedback of the "hands on" teaching method. Several students reported "feeling more comfortable with HIV than [APPE] students on rotation from other schools." When asked "How did you feel about using your hands to learn the NRTIs?" all participants with the exception of one reported feeling positively about learning using their hands (eg, "I liked it," "I thought it was creative," or "It really helped me recall information on the test."). When asked which active learning method (hands, role play, song, music video, knowledge checks) was most effective in teaching the HIV medications, 14 (70%) participants reported "hands." However, two students also reported they "remembered the hands tricks, but forgot which drugs were on each finger" and expressed a desire to have "more focus on brand names of drugs." Four students used the word "fun" when discussing the teaching method and those same students said, "I will never forget it."

DISCUSSION

Results from this pilot study suggest students were receptive to using their hands to learn about NRTIs, as

Table 1. Baseline Characteristics of Focus Group Participants

	All Participants N=20 (%)
Gender	
Male	8 (40)
Female	12 (60)
Self-identified learning modality ^{a,b}	
Kinesthetic	8 (40)
Visual	15 (75)
Auditory	4 (20)
Writing/Reading	1 (5)
Mixed	5 (25)
Performance quartile ^c	
Top 25%	6 (30)
Second 25%	4 (20)
Third 25%	5 (25)
Fourth 25%	5 (25)
Prior HIV experience	
None or minimal ^d	16 (80)
Some experience via specialty pharmacy rotation ^e	1 (5)
Vast experience via HIV clinic rotation ^f	3 (15)

^aRepresentative of the students' answers to the question, "How do you learn best?"

^bPercentages do not add up to 100% since some identified more than one predominant preferred learning modality

^cStudents were divided into quartiles based on how they initially performed on the pharmacotherapeutics exam

^dMinimal experience was defined a priori as having encountered fewer than five patients with HIV while on rotations or at their workplace

^eThis student was from the second 25% quartile

^fIncluded one student from the top 25%, one from the third 25%, and one from the fourth 25% quartiles

HIV=human immunodeficiency virus

evidenced by the fact that 95% still used the method one year after the initial lecture to recall information. All students were able to answer at least two of the knowledge-based questions correctly. As anticipated, participants identifying as "kinesthetic learners" scored the best, suggesting students who learn via the kinesthetic modality may benefit most from this approach; however, this difference was not found to be statistically significant. It is possible a significant relationship may exist, but was not found due to small sample size and lack of power.

There was a statistically significant positive association between using the hands and answering the question correctly. The authors' hypothesis as to why this was seen is related to the Loci Method of memorization, which

focuses on memorizing new facts based upon their location in space.¹⁵ For example, memorizing a random set of words (wagon, cabinet, orange, spoon, elephant) can be made easier by picturing these items placed in five locations throughout a very familiar room.¹⁵ Since the students were taught to associate the names of the drugs with something they were extremely familiar with (their hands), this may have helped them when they used this same learning tool to recall the information a year later.

Students were likely to use their hands to answer the Truvada, hepatitis B, and cytosine analog questions (1, 2, and 4). Table 3 demonstrates that even among the students that infrequently used their hands to answer the questions, they were most likely to use them on questions 1, 2, and 4. These three concepts, when taught in class, were all linked to a popular cultural reference. Questions 2 and 4 also incorporated a rhyme/song to accompany the hand signs. Prior literature suggests integrating popular culture into in-class lectures may be beneficial in helping students relate material learned to real-life situations.¹⁶ Specifically, Sapinoro used popular culture to teach pharmacy students about infectious diseases by incorporating "House, M.D." television episodes into the lectures; 94% of respondents stated "they learned new and valuable information from viewing House, M.D. episodes."¹⁶ Additionally, linking new pharmaceutical material to song has proven effective in prior literature in other disease states, such as substance abuse.¹⁷ Whether it was the popular culture reference, the song/rhyme, or the combination of both that was most helpful in this study is unclear; however, our results support conclusions from the aforementioned trials that suggest linking the material to popular culture or song is beneficial. Therefore, it is likely that adding a cultural reference and/or a rhyme/song to the entire method would lead to improved outcomes.

Strengths of this study include use of a standardized script for conducting the focus group. Additionally, the focus group cohort was determined to be a fair representation of the class as a whole considering gender, academic performance, and exposure to HIV while on APPE rotations. There is a scarcity of data to guide how HIV should best be taught; this study presents one way of teaching the NRTIs that could be considered for other lecturers. To our knowledge, this is the first research focusing on using students' hands as an active learning strategy.

This pilot study is not without limitations. It lacked a control group; therefore, there is no justification that this method of teaching NRTIs is any better than another. Future studies evaluating this teaching method should consider including a control group. Although 70% of the students reported "hands" as being the most

Table 2. Responses to Knowledge-Based Questions and Utilization of Hands to Recall Information (N=20)

Questions Asked to Participants	Participants Who Answered Correctly N (%)	Participants Who Used Hands to Answer N (%)
Q1. Which medications are in Truvada?	18 (90)	13 (65)
Q2. Which of the NRTIs have both HIV and hepatitis B activity?	15 (75)	16 (80)
Q3. What are some black box warnings of NRTIs?	4 (20)	3 (15)
Q4. Which NRTIs are cytosine analogs?	11 (55)	10 (50)
Q5. Which drug requires HLA-B*5701 testing prior to initiation?	16 (80)	4 (20)

NRTIs=nucleotide/nucleoside reverse transcriptase inhibitors; HIV=human immunodeficiency virus; HLA=human leukocyte antigen

effective form of active learning used in the HIV lecture, it is also possible this answer was influenced by recall bias, since they were being asked knowledge-based questions about NRTIs. While the “hands on” method was shown in this study to be a potentially valuable memorization tool in building foundational knowledge, it is unknown if it is useful in promoting higher-level learning. The students in this study were simply asked to recall facts about the medications and were not asked to apply their knowledge; therefore, it is unfair to say that this method promotes meaningful learning. However, given that HIV is a tier 2 topic in the ACCP toolkit, perhaps this is a sufficient depth of knowledge for graduating practice-ready pharmacists.⁴ Learning to care for patients with HIV requires a complex, multifaceted, collaborative approach to patient care, which likely requires post-graduate education and training.^{4,5}

There are costs associated with any type of active learning. For this activity, the main cost is time, both in preparing and presenting the activity. Pre-lecture time spent on this activity was 4.5 hours. The author spent approximately 3 hours developing the hands activity, and another 1.5 hours preparing handouts for the students that included drawings of the hand symbols (handout was composed of images 1-6). Once in class, students needed time to write the medication names on their hands, which took approximately 3-5 minutes. Presenting the material took approximately 10-15 minutes. Another limitation to this method would be if students did not want to write on their hands or use their hands to learn the material, although this concern was not supported in our study or observed by the lecturer. Additionally, since the hand signs referencing American popular culture were deemed to be most utilized by the students, it should be noted that international students or

Table 3. Analysis of Participants Who Used Their Hands to Answer Questions Infrequently^a

	Used Hands to Answer Question 1	Used Hands to Answer Question 2	Used Hands to Answer Question 3	Used Hands to Answer Question 4	Used Hands to Answer Question 5
Participant 1	1	0	0	1	0
Participant 2	0	1	0	0	0
Participant 3	0	0	0	1	0
Participant 4	0	1	0	1	0
Participant 5	1	1	0	0	0
Participant 6	0	1	0	1	0
Participant 7	1	1	0	0	0
Participant 8	0	0	0	0	0
Participant 9	1	1	0	0	0
TOTAL	4	6	0	4	0

^aInfrequently was defined as using their hands to answer less than half of the knowledge-based questions
0=Did not use hands to answer this question; 1=Did use hands to answer this question

non-traditional students may not benefit as much, unless they are familiar with culture references.¹⁸ Furthermore, popular culture references may require updating over time as the references may become irrelevant.

This teaching method could be applied to other disease states that students commonly struggle with due to minor nuances existing within the classes of medications, such as hepatitis, oncology, infectious disease, or psychiatry. Visual cues and mnemonics, such as “Chemo Man” have been used as a valuable memorization tool for remembering the adverse effect profiles of oncologic agents.¹⁹ The author suggests the “hands on” method could be used similarly, with kinesthetic cues acting as a memorization tool for building foundational knowledge in other disease states. For example, if this method were used to teach schizophrenia, the most common first generation antipsychotics could be written on the left hand and most common second generation antipsychotics written on the right hand. Using both hands to make a heart shape could help students remember that both generations pose a cardiovascular risk. With some time and creativity, the “hands on” method could be used to teach a variety of different drug classes; however, the author recommends limiting the “hands on” method to one disease state or class of drugs for a particular cohort of learners to avoid overuse and/or confusion.

CONCLUSION

Using students’ hands to teach the NRTIs was an innovative teaching method that was well received by this cohort of students. More research is needed to determine if this active learning method could be considered for use in other disease states to help students learn complex medications with many nuances.

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