Introduction Virtual Reality Video on Student Pharmacists' Performance in a USP <797> Skills Laboratory Activity

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Background & Objectives

- ACPE guidance suggests students shall demonstrate accurate preparation, labeling, dispensing, and distribution of prescriptions and medication orders prior to completion of the didactic Doctor of Pharmacy curriculum.[1]
- The use of virtual reality (VR) in preparation for sterile compounding is a relatively novel concept. Quantitative evidence regarding student performance is minimally reported in the literature.[2] Standardized performance rubrics should be utilized to ensure equitable assessment of all pharmacy students.[3]
- Objective: This study aims to assess the impact of an introductory VR cleanroom video on second-year pharmacy students' performance in a USP <797> cleanroom activity.

Methods

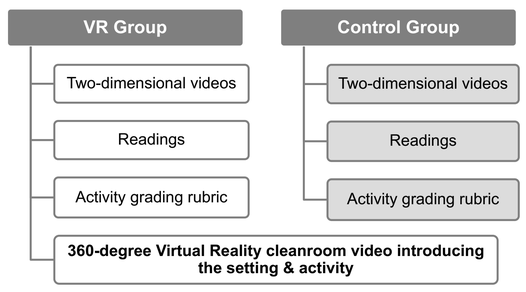

Figure 1. Materials provided to students prior to live skills laboratory

- All second-year student pharmacists (n=98) were invited to take part in the VR study.
- Those who consented (n=19) were randomized into two groups: VR group and Control group. The pre-laboratory materials varied with only the addition of the VR introduction video (Figure 1).
- Students were assessed in two different sequential weeks of their skills laboratory activities using a standardized USP <797> Sterile Compounding[4] 24-question performance rubric based on four themes presented in Table 1.

Demonstration of the Virtual Reality video:
https://youtu.be/sejhdWy_Usw

Methods

Table 1. Standardized performance rubric based on USP <797> Sterile Compounding[4]

Personnel Preparation	Sterile Compounding Technique
1. Student removes all jewelry & makeup 2. Student properly dons shoe covers 3. Student applies face mask, hair cover, and beard cover (if applicable) 4. Student cleans underneath fingernails under warm running water using a disposable nail cleaner 5. Student washes hands & forearms up to elbows w/ soap & water for at least 30 seconds 6. Student dries hands & forearms up to the elbows completely with low-lint disposable towels 7. Student properly dons low-lint gown 8. Student applies alcohol-based hand rub to dry skin. Apply product to one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry. Allow hands to dry thoroughly. 9. Student correctly applies sterile gloves and applies sterile IPA to gloves prior to entering laminar air flow hood (LAFH)	14. Student minimizes movement into and out of LAFH. Student applies sterile IPA to gloves each time before entering LAFH. Student avoids creating excessive zone of turbulence. 15. Student wipes all critical sites with alcohol swab prior to use (vial tops and bag ports) 16. Student properly removes syringe and needle by peeling back overwraps and affixes syringe to needle without blocking first air 17. Student verifies drug, base solution, and volumes 18. Student injects proper amount of air into vials before withdrawing drug volume and injecting into base solution. First air is maintained at all times. 19. Student properly manipulates IV bag to maintain first air over critical sites.
Preparation of Primary Engineering Control	**Final Compounded Preparation Visual Inspection & Verification**
10. Student cleans/disinfects LAFH using correct technique (top to bottom; back to front with overlapping strokes at 90 degrees from airflow) 11. Student utilizes proper cleaning agents when cleaning LAFH (1st Sterile Water, 2nd Cleaning Agent (i.e., Peroxigen), and 3rd Sterile Isopropyl Alcohol) 12. Student wipes all items for compounding with sterile IPA before placing into LAFH 13. Student arranges compounding material in LAFH to ensure items receive first air at all times and are more than 6 inches within aseptic work area and 3 inches from each side	20. Student inspects final preparation for visual particles 21. Student disposes of waste in appropriate receptacles & cleans work area with sterile water for any medication spills as needed followed by sterile IPA upon completion of compounding procedure 22. Student verbally confirms correct elements on label 23. Student correctly assesses beyond-use dating and auxiliary labels 24. Student properly doffs clean room garb (clean into dirty)

- Data was analyzed utilizing SPSS 28.0.1.1. Student performance was scored equally per rubric question. Total scores were averaged with standard deviations presented. Each theme was also totaled with descriptive statistics to present the data. Analysis to compare the teaching tools was not possible due to low response rate.

Results

- Nineteen students consented to the study and completed the in-class cleanroom USP <797> activities. Most students had no IV room experience (89.5%). The majority were female (63.2%) with reported racial backgrounds of Asian (31.6%), Black or African American (21.1%), White (36.8%), or other (5.3%). The mean (+/- SD) age was 24.7 (2.7) years.

Table 2. Performance assessment comparison

	VR Group (n=7)		Control Group (n=12)	
	First IV activity (Small IV)	Second IV activity (Large IV)	First IV activity (Small IV)	Second IV activity (Large IV)
Total Assessment Score (of 24 points)	23.71 (0.3)	23.64 (0.9)	22.96 (0.9)	23.08 (0.9)
Personnel Preparation (of 9 points)	8.86 (0.2)	8.79 (0.6)	8.33 (0.6)	8.50 (0.6)
Preparation of Primary Engineering Control (of 4 points)	3.93 (0.2)	4.00 (0.2)	3.92 (0.2)	3.92 (0.2)
Sterile Compounding Technique (of 6 points)	5.93 (0.2)	5.86 (0.6)	5.79 (0.5)	5.67 (0.6)
Final Preparation Visual Inspection & Verification (of 5 points)	5.00 (0.0)	5.00 (0.0)	4.92 (0.4)	5.00 (0.0)

Discussion & Limitations

- Students first cleanroom activity scores were similar in the VR and Control group. The VR group had slightly higher mean with the first activity with scores becoming more similar with the second cleanroom activity (Table 2).
- Similarity in scores on the second activity may be due to all groups having had some exposure to the environment within the class.
- Considering the standard deviations in the mean scores and small student numbers, no such assumptions can be made to the effect of VR.
- This study is limited by the low response rate to optional activity.
- Future researchers may consider including this as a requirement for a cohort to allow for true analysis of the activity benefits.
- This study's findings are descriptive of a single cohort and institution that cannot be extrapolated to other institutions or other years at this time.

Implications

- This study is a proof of concept that students can be exposed to a cleanroom through VR prior to their classroom activity.
- Student assessments were performed, and all students performed quite well in both groups with averages in the upper 90% of the assessment.
- Additional cohorts and institutions will be enrolled in future studies for stronger data and in-depth analysis.

References

1. American Council for Pharmacy Education. Guidance for the accreditation standards and key elements for the professional program in pharmacy leading to the doctor of pharmacy degree. 2015.
2. Patel S, Vincent AH, Abel SR, Jacobs CM, Dunlop SR, Seibert M. A virtual clean room to teach USP 797 regulations for intravenous medications. *Am J Pharm Educ.* 2011;75(1):7.
3. Brown MC, Conway J, Sorensen TD. Development and implementation of a scoring rubric for aseptic technique. *Am J Pharm Educ.* 2006;70(6):133.
4. United States Pharmacopeia and National Formulary. USP-NF <797> Pharmaceutical Compounding - Sterile Preparations. United States Pharmacopeial Convention; 2022.

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