Research Paper

Development and Implementation of Pharmacology Museum as a Teaching-Learning Tool: A Prospective, Interventional Study

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Abstract

Objective: To evaluate the perception of 2nd-year medical undergraduates on pharmacology museum as teaching–learning (TL) tool. **Materials and Methods:** The Institutional Ethics Committee permission was taken before initiation of the study. After voluntary written consent, II MBBS students were enrolled in this study. An additional museum was created for easy visibility and access. The display cards with drugs about two finalized biological systems were displayed in the museum. The TL activity was planned for 2 phases; in Phase 1, students were mandatorily instructed to visit the museum and see the various dosage forms of drugs for a given period. A pretest and posttest, consisting of 21 validated multiple-choice questions on dosage forms, were conducted in Phase 1. Phase 2 comprised voluntary visits to the museum. Students were given the opportunity to clear their doubts with regard to dosage forms of drugs displayed. At the end of Phase 2, the perception of the student for the museum as a TL tool was recorded on a twenty-item perception questionnaire. **Results:** The performance of students was increased from pretest score of 7.59 ± 2.9 to 10.25 ± 3.03 ($P < 0.001$). Of 173 students, 85 felt that display information was adequate and 77 opined that this information brought clarity. Students ($n = 97$) felt that visualizing the drugs helped them to remember the various dosage forms better, museum-inspired them to read about the dosage forms ($n = 90$), and encouraged self-learning ($n = 107$). They expressed that they can score better in examinations ($n = 88$). **Conclusion:** Students perceived that the museum improved their knowledge regarding dosage forms. In spite of this, they did not appreciate museum as a teaching tool, which has posed a bigger challenge to the teaching faculty to make the museum interesting and resourceful.

Keywords: Display cards, drug display, museum, self-learning

Introduction

Museums in each discipline/specialty can supplement undergraduate medical teaching–learning (TL) activities and enable the teachers to help increase participation in the formal, structured, curriculum-driven model encountered in the classrooms.[1-3]

The Medical Council of India (MCI) mandates the presence of a museum for certain specialities in the medical curriculum such as pathology and pharmacology. The pharmacology museum displays various drug samples, system-wise as per the pharmacology syllabus. The II MBBS students are expected to study the drugs and the different dosage forms displayed in the museum from time-to-time during the course.

The Department of Pharmacology and Therapeutics at Seth GS Medical College, Mumbai, has a museum which is extended over an area of about 150 sq.m with 446 drug samples in it. While introducing the discipline of Pharmacology to the undergraduate students, they are made aware of this museum and students visit it as a part of the introductory session. However, later during the course, students hardly visit this museum.

The authors hypothesized if the museum is in an easy student access area (intervention), it will be more acceptable and can supplement the present pharmacology TL activity. The present study was planned with the objective to develop

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such easy accessible pharmacology museum and to evaluate the perception of 2nd-year medical undergraduates on pharmacology museum as TL tool.

Materials and Methods

This prospective interventional study was initiated at the Department of Pharmacology and Therapeutics after obtaining the permission from the Ethics Committee of Seth GS Medical College and KEM Hospital. The project was conducted in accordance with the Ethical Guidelines for Biomedical Research on Human Participants (ICMR, 2006) and the Declaration of Helsinki 2008. The students of II MBBS entering their third semester in August 2013 who provided written, informed, voluntary consent was eligible to participate in this study. The participants were recruited within a week. The total duration of the study was 6 months from August 2013 to January 2014.

Development of module

An additional museum in the corridor of the department was created for easy visibility and access to the students. The actual museum is in a dedicated place in the department. This is informed to the students at the beginning of the year in the introductory sessions. The actual museum is not located near the practical or theory class, and hence, the students have to go out of their way to visit this museum. The museum team took an extra effort to develop a corridor museum for the students so that the students can have a glance while walking for their practical and tutorial sessions. This museum consisted of two large glass door wooden cupboards of 6 × 10 ft. each. For the conduct of the project, the museum team was constituted of one professor, one associate professor, and two assistant professors of the department who explored the feasibility, implementation of the project, and subsequently, its various aspects with timelines. Prerequisites of the implementation of the museum as a TL tool were carried out, namely, selection of the topics from the curriculum of the II MBBS course, deciding contents and display of the drugs. The museum team finalized two systems: autonomic nervous system (ANS) and cardiovascular system (CVS) with around 100 drug samples together in both the systems. Both these systems were selected as they were taught at the beginning of the academic year, after General Pharmacology. Hence, sensitizing the students to the museum at the beginning would probably encourage them to visit the museum for the rest of their course.

The various dosage forms of the drugs included in the systems were acquired through either by buying the drugs from the pharmacy or through drug sample donations from pharmaceutical company. Subsequently, there was a discussion among the museum team to arrive at a consensus about the display of the various dosage forms of the drug and the information alongside for both the systems. Thus, display cards [template presented in Table 1] were prepared which stated the importance of different dosage forms of a given drug, its utility, and precautions. These cards with drugs were displayed in the corridor museum.

Table 1: Template of display card kept in the museum

Drug name: _____
Category: _____
Pharmacological action: _____
Dosage forms available: _____
Precautions to be taken with various dosage forms: _____
Indication: _____
Contraindications: _____
Adverse effects: _____

Instruments

To evaluate the performance of students, a pretest and posttest, consisting of 21 multiple choice questions (MCQs) of single best response type on dosage forms, were prepared by the museum team. MCQs focused on the dosage forms of various drugs and related indication, contraindications, and adverse effects. Of the 21 MCQs, five were of application variety, 3 of analysis variety, 12 of recall variety, and 1 of evaluation variety [sample MCQ depicted in Table 2]. Two such pretests were prepared for various dosage forms of drugs acting on ANS and CVS drugs. These MCQs were validated by the faculty of the department. Each MCQ carried one mark; the maximum score that a student could achieve was 21. Students who scored more than 75% marks in the pretest were excluded from the study. The answer key was given to the departmental faculty who corrected the pretest and posttest answer sheets of the students. The students were exposed to the same set of questions in the pretest and the posttest.

To evaluate the students' perceptions regarding museum as a TL technique, a student perception questionnaire (20 items) was developed with closed questions, and responses were scored on three-point Likert scale (wherein each item was rated as 3 – agree, 2 – neutral, and 1 – disagree). It also included open-ended questions inquiring about the opinions of students regarding advantages, disadvantages, and suggestions to improve the museum usage as a TL technique. The questionnaire had items related to display of drugs and the information related to the drugs, clarity of concepts, remembrance, stimulation to read and ask questions, clinical curiosity and correlation, self-learning and satisfaction, scoring in examinations and benefits experienced due to TL, and relevance of the technique. Face and content validity of the questionnaire was checked by experts in medical educational research (n = 6) of the institute and also by senior faculty members (n = 6) in the Department of Pharmacology and Therapeutics.

Teaching–learning activity

The TL activity was planned for two phases. In Phase I, the various dosage forms of drugs belonging to the systems ANS and CVS along with their display cards were arranged in the corridor museum after the lectures of the respective systems were over. The pretest was conducted separately for each of the two chosen systems. After the pretest on ANS

Table 2: Sample multiple choice questions on the dosage forms of drugs acting on autonomic nervous system and cardiovascular system

Drugs acting on ANS
1. Which of the following drugs is a prodrug of adrenaline and is instilled topically in the eye in the concentration of 0.1%?
a) Dipivefrin
b) Ephedrine
c) Amphetamine
d) Phenylephrine
2. Which one of the following specialized doxazosin once daily formulation is used in benign hyperplasia prostate?
a) Rotacap
b) Gastrointestinal therapeutic system
c) Autoinjector
d) Spansule
3. Which of the following atropine substitute is instilled topically in the eye before fundoscopy?
a) Glycopyrrolate
b) Tiotropium bromide
c) Tropicamide
d) Dicyclomine
Drugs acting on CVS
1. Which of the following drug is given by rapid intravenous infusion for the treatment paroxysmal supraventricular tachycardia?
a) Verapamil
b) Adenosine
c) Diltiazem
d) Lidocaine
2. Nitroglycerine is available in the market in all of the following dosage forms except
a) Spray
b) Sublingual tablet
c) Ointment
d) Inhaler
3. Mukesh, a 45-year-old male comes to the casualty with symptoms of the chest pain along with pain in the shoulder and arm. Which of the following dosage forms of isosorbide dinitrate will be preferred for this patient?
a) Sustained release tablets
b) Buccal spray
c) Sublingual tablets
d) Oral tablets

ANS=Autonomic nervous system, CVS=Cardiovascular system

was administered, the drugs related to ANS were displayed in the corridor museum. The students were instructed to visit this corridor museum within the next 15 days after which a posttest was administered. Subsequently, after a pretest on CVS was administered, the drugs related to CVS were displayed in the corridor museum and students instructed to visit the museum within the next 15 days after which a posttest was administered. There were no assessments (either formative or summative) conducted in between these pre and posttest in the given topics. The dates of the pre and posttest were informed 1 week before the conduct of the tests. Thus, there were two pretests and two posttests, and average marks were considered.

The students were mandatorily instructed to visit the museum when they came to the department during their practicals during this period. The number of additional visits to the corridor museum by the II MBBS students was noted down by one of the museum team members. The information displayed on the display cards was also e-mailed to all the students.

In the Phase 2, drugs of another system, i.e., chemotherapy were displayed in the corridor museum after the lectures of that particular system were over, and display card content was e-mailed to all students. In this phase too, the students were instructed to visit the museum though the visits were not made compulsory as in the 1st phase. The number of visits to the corridor museum by the students in this phase was also noted by the team members.

In both the phases, the students were given an opportunity to clear their doubts with regard to the drugs displayed in the museum and also on the display card information.

At the end of Phase II, the perception of the student for the museum as a TL tool was recorded using a 20 item prevalidated questionnaire. Students' responses to feedback questionnaire, and performance scores were kept anonymous.

Indicators

The following indicators were chosen as they reflect the outcome of TL activity, namely, the improvement in performance, interest in the participant, and increase in curiosity.

Phase I:

- Number of students asking doubts/clarification on the dosage forms
- Pre and posttest scores indicating student performance.

Phase II:

- Number of students visiting the corridor museum
- Number of students asking doubts/clarification on the dosage form
- Feedback of students on the museum as TL tool.

Statistical analysis

The student's perception questionnaire was analyzed using descriptive statistics. Pre and posttest scores were compared using paired Student *t*-test.

Results

Of 180 students, a total of 173 students consented to the study. These 173 students had an average age of 19.5 years ±1 with M:F ratio (1:0.8). No student scored above 75% in the pretests, and hence, no student was withdrawn from the study.

In Phase I which lasted over 2 months, few students asked doubts or clarification on the dosage forms ($n = 30/173$). The performance of students was increased from pretest score of 7.59 ± 2.9 to 10.25 ± 3.03 ($P < 0.001$).

In Phase II which lasted over 1 month (display for 15 days and then perception), only 15 students visited the corridor museum,

and none of the students came to ask doubts about dosage forms. The student feedback on the museum as teaching tool is presented in Table 3.

More than 75% of students had stated that the museum was attractive, nameplates, and display cards were legible. However, only 85/173 felt that display information was adequate and 77/173 opined that this information brought clarity. Students did feel that visualizing the drugs in the museum helped them to remember the various dosage forms better (97/173), it inspired them to read about the dosage forms (90/173), encouraged self-learning (107/173), check the same in case record forms of the patients (80/173), and expected to score better in their examinations (88/173). In addition, 16 students had stated that their awareness of different brand of drugs increased after observing the museum from time to time.

About six students opined that information about the fixed-dose combination should have been displayed alongside the dosage forms. More frequent visits to the museum-enhanced learning and hence visits to the museum should be made compulsory was stated by four students. Only three students felt that it increased student–teacher interaction.

Discussion

MCI has recommended that training in pharmacology should include a developed museum extending over an area of 150 sqm. At the Department of Pharmacology and Therapeutics at Seth GS Medical College and KEM Hospital, Mumbai, there is an emphasis on value-added training which will help the students in learning the subject better and hence apart from being just an MCI requirement the team made efforts in developing museum as an effective learning tool.

In this study, we evaluated a strategy based around an integrated medical curriculum, which maximizes student learning by correlating basic science pharmacology with the actual clinical application of drugs. Students appreciated the spacing of the drugs, legible, clear nameplates, and the practical orientation of the information displayed through the cards kept near the drug samples. Learning pharmacology after display of drug samples creates students with higher levels of visual literacy.[4] Students could remember the formulations and dosage forms of the displayed drugs better due to visual memory and appreciated the time given to them to see the drugs and read the information. However, only 55% of students felt that the information displayed on the cards was adequate and 49% felt that reading this drug information has failed to bring

Table 3: Students perception regarding museum as teaching learning tool

Questionnaire item	Number of respondents		
	Disagree (%)	Neutral (%)	Agree (%)
Display in museum			
The drug samples were appropriately spaced in the corridor museum	8 (5.13)	14 (8.97)	134 (85.90)
The name plates of drug samples were legible and clear	7 (4.50)	24 (15.38)	125 (80.12)
Display of the drugs in the museum was attractive	13 (8.48)	63 (41.18)	77 (50.34)
The information displayed through cards was concise	12 (7.84)	31 (20.27)	110 (71.89)
The information displayed through cards were legible	17 (10.91)	27 (17.30)	112 (71.79)
The information displayed through cards were practically oriented	13 (8.45)	43 (27.93)	98 (63.62)
The information displayed on the cards was adequate	23 (14.93)	46 (29.88)	85 (55.19)
The time allotted to see the drugs and read information was adequate	20 (12.99)	33 (21.42)	101 (65.59)
Effect in learning			
Reading the information displayed on the cards brought clarity to my concepts	15 (9.68)	63 (40.65)	77 (49.67)
The display of drugs in the museum helped in remembering the formulations and dosage forms of the drugs better	9 (4.77)	50 (32.05)	97 (63.18)
This tool inspired me to ask questions	27 (17.66)	65 (42.48)	61 (39.86)
This tool inspired me to read more about drugs from books	11 (7.2)	52 (33.97)	90 (58.83)
This tool inspired me to look at the case record forms of the patients in the wards to check drugs and formulations administered	19 (12)	44 (28)	80 (60)
I expect to score better in the examination after going through the drug information that was displayed in the museum for a particular system	18 (12)	44 (29.33)	88 (58.67)
This teaching technique encouraged self-learning	15 (9.75)	32 (20.78)	107 (69.47)
Satisfaction and future use			
As an undergraduate student, I was comfortable with this teaching method	12 (7.84)	36 (23.53)	105 (68.63)
As an undergraduate student, I was overall satisfied with this teaching method	13 (8.54)	38 (25)	101 (66.46)
This pattern of teaching should be continued in the future	10 (6.5)	33 (21.42)	111 (72.08)
It would have been beneficial if the drugs would have been displayed in the museum for all the systems	13 (8.5)	19 (12.41)	121 (79.09)
The concept of display of drugs in the museum and viewing their information is an effective teaching learning tool which would help to corelate the same information we get in the clinical postings	10 (6.71)	33 (22.15)	106 (71.14)

clarity to their concept. The possible reasons for the failure of the display cards to bring clarity to their concept can be numerous. Students are exposed to the systemic pharmacology and drug names for the first time as they were in their third semester when this project was conducted, and the discipline of pharmacology is taught over 3–5 semesters. The systems chosen also had numerous drugs, and the information provided through display cards was enormous. Apart from students being exposed to multiple drugs, the display cards did not explain the concepts in detail as given in textbooks.

Pharmacology can be best learned if the students associate the information learned in the classrooms and from the book with the actual clinical application. Many studies have shown that students grasp and learn pharmacology better if teachers use different teaching techniques. A study conducted by Bhosale *et al*. revealed that students felt that demonstrations on manikin and museum studies are good adjuvants to routine teaching.[5] In our study, the students appreciated the fact that the museum as a TL tool has helped them to correlate the information, they get from the clinical postings, and they also felt that the museum did inspire them to look at the case record forms of patients and to check drugs and formulations administered. As per the feedback, the students (107/173) had appreciated the concept of display of drugs in the museum, and viewing their information is an effective TL tool which would help to correlate the same information received in the clinical postings. The striking point evident from the feedback questionnaire is that students had perceived partly the benefits of the museum as TL tool. In addition, even if the museum was perceived as beneficial aid, the students visited the museum only when it was made mandatory to them. In the second phase when it was not compulsory, only 15/173 visited the museum and not a single student came forward for any clarification about the dosage forms of the drugs displayed in the museum. This reflected that this TL tool does not attract them or does not motivate them to self-learn though they have realized that it contributes to their learning through their own experience of Phase I. There exists a possibility that they get the necessary knowledge/benefits through other TL methods such as tutorials and case studies.

Students in pharmacology consider information about the mechanism of action, pharmacological effects, uses, and adverse drug reactions of any drug as vital with least emphasis to the dosage forms of various drugs and their utility. The assessment pattern credits only 5 marks of 150 marks on the dosage forms (in practical examination under pharmacy viva). Hence, the students are more interested in memorizing the theoretical facts of drugs as it will help them to score in the examination with much lesser importance to the dosage forms. There are no questions which pertain to what are the dosage forms of a particular drug (even for common drugs) either in theory or practical examinations, resulting in students being less interested in knowing the various dosage forms or formulations. This is also evident from the posttest scores though there is a statistical improvement, mean score is 10.27 marks of total 21 marks.

In addition, advances in information technology and web-based learning are mainly responsible for the diminishing role of the museum as a teaching tool in pharmacology training.[3] All the images of various dosage forms of all drugs are easily available on the internet that actual visualization is not required. For many departments, maintaining museums have been difficult due to lack of facilities, workforce, and adequate funds for the maintenance of the museum.[3]

Thus, pharmacology museum today is present to satisfy the MCI requirement without much utility value to students in contrast to other discipline such as pathology and forensic medicine wherein museums display rare specimens, weapons, toxins, etc. Museums could be great environments for independent and self-directed learning which is evident even in the feedback given by our students. For better student utility, institute and pharmacology departments have to take the initiative to convert museums into interactive museums wherein students get all the information. Efforts are required by the faculty of pharmacology to develop the museum and make it more interesting to invoke interest among the future students.[6]

Recently, there has been emphasis to develop eMuseum to make pharmacology interesting for the students to learn. Online museum resources offer teachers access to content that enhances planning and can appeal to various learning styles.[6-8] Interactive museums can engage students; they can be used to reinforce material covered in other media; and they can connect students with their own environment and culture, as well as with other cultures. Teaching pharmacology with display of drugs creates a direct, sensory connection between learners and their discipline that result in new levels of interest and attention.[9-10] In a study conducted by Oshikoya *et al*., it was suggested that changes in the pharmacology curriculum and program are needed for students who are willing to learn pharmacology from theoretical and clinical angles.[11] Curricular reforms need special emphasis here wherein the assessment is modified to assess clinical practice-driven information, namely, dosage forms, color, labels, and strength of any given dosage form during practical examination in pharmacology.[6-8] As assessment drives learning, pharmacology museum in this context can emerge as an effective teaching tool to provide information on the dosage forms.

Limitations

This study was a pilot study in our setting hence cannot be generalized. The authors focused on the acceptability of the museum as TL tool. To establish the museum as supplemental/reinforcing tool was not achieved in the study. There is a need to conduct such studies with more robust study design, interventions, and selection criteria for participants. The authors did not attempt randomization or the design as one group exposed to the corridor museum and another group

unexposed to this strategy. In addition, the increase in student performance cannot be attributed exclusively to the museum as students did have clinical postings and other discipline lectures too.

Conclusion

Thus, we conclude that students did perceive that visiting museum improved their knowledge of various dosage forms of the drugs, and the display card information did aid in understanding practical aspects of pharmacology. However, the museums are nonappealing to the students, and the teaching faculty has a bigger challenge in making the museums interesting and resourceful to the students.

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Conflicts of interest

There are no conflicts of interest.

References

1. Peter C, Diana FW, editors. ABC of Learning and Teaching Medicine. 3rd ed. BMJ Books; 2017.
2. Ma J, Liao I, Ma KL, Frazier J. Living liquid: Design and evaluation of an exploratory visualization tool for museum visitors. IEEE Trans Vis Comput Graph 2012;18:2799-808.
3. Marreez YM, Willems LN, Wells MR. The role of medical museums in contemporary medical education. Anat Sci Educ 2010;3:249-53.
4. Available from: http://www.mathers.indiana.edu/Tops.pdf. [Last accessed on 2018 Aug 26].
5. Bhosale UA, Yegnanarayan R, Yadav GE. Attitude, perception and feedback of second year medical students on teaching-learning methodology and evaluation methods in pharmacology: A questionnaire-based study. Niger Med J 2013;54:33-9.
6. Available from: http://www.files.eric.ed.gov/fulltext/ED517713.pdf. [Last accessed on 2018 Aug 26].
7. Diaz-Perez JA, Raju S, Echeverri JH. Evaluation of a teaching strategy based on integration of clinical subjects, virtual autopsy, pathology museum, and digital microscopy for medical students. J Pathol Inform 2014;5:25.
8. Mahfoudh AM, Abdulghani, Al-Naggar RA. Students' perceptions about learning pharmacology at a single private institute in Malaysia. J Taibah Univ Med Sci 2015;10:40-4.
9. Vasundara K, Kanchan P, Pundarikaksha HP, Girish K, Prassana S, Jyothi R, *et al*. An imperative need to change pharmacology curriculum: A pilot survey. Indian J Pharmacol 2010;42:420.
10. Rao KY. Undergraduate pharmacology: Student's view – A questionnaire study. Phys Pharm Adv 2013;3:27-32.
11. Oshikoya KA, Bello JA, Ayorinde EO. Medical students' view on the methods of teaching pharmacology at the Lagos state university college of medicine, Nigeria. Nig Q J Hosp Med 2007;17:101-7.