

## INSTRUCTIONAL DESIGN AND ASSESSMENT

### Implementation of an Integrated Longitudinal Curricular Activity for Graduating Pharmacy Students

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**Objectives.** To evaluate whether a novel integrated longitudinal curricular activity to prepare graduating doctor of pharmacy (PharmD) students for 2 comprehensive examinations was successful, and to assess whether it engaged other pharmacy students in curricular discussion and learning.

**Design.** Thirty-eight of 91 graduating third-year (P3) students in a PharmD program formed 11 teams to create and present pharmacotherapeutic posters to their peers. The impact of the novel activity on graduating students' performance on the North American Pharmacist Licensure Examination (NAPLEX) and a comprehensive commercial examination was assessed. All first-year (P1), second-year (P2), and P3 students reviewed and discussed the content of each poster.

**Assessment.** Participants in the integrated longitudinal curricular activity performed better than non-participants on the commercial examination ( $p=0.023$ ) and NAPLEX ( $p=0.033$ ). However, regardless of participation, commercial examination scores predicted a significant amount of variance (ie, 34%) in NAPLEX scores. The P3 participants (83%) believed the curricular activity assisted them in their NAPLEX preparation, while 75% of P1 students, 79% of P2 students, and 80% of P3 students agreed that poster review provided an effective summary of different disease states. Ninety percent of faculty poster evaluators reported that the posters were professional, and all evaluators agreed that participants effectively conveyed their message to the intended audience.

**Conclusion.** The integrated longitudinal curricular activity provided a positive learning environment for all pharmacy students and may have better prepared graduating students' for the NAPLEX.

**Keywords:** NAPLEX, student learning, curricular activity, posters

## INTRODUCTION

Students graduating from a PharmD program accredited by the Accreditation Council for Pharmacy Education (ACPE), must pass the NAPLEX and Multistate Pharmacy Jurisprudence Examination (MPJE) to receive their pharmacist license. The NAPLEX assesses candidates' knowledge in the areas of pharmacotherapy, dispensing and preparing medications, and healthcare information.<sup>1</sup> The MPJE assesses candidates' knowledge in the areas of federal and state law.<sup>2</sup> The National Association of Boards of Pharmacy (NABP) oversees registration and implementation of both examinations.

The ACPE annually receives and reviews NAPLEX results directly from NABP for all accredited colleges and schools of pharmacy.<sup>3</sup> While ACPE uses NAPLEX re-

sults as one of its quality measures, the accrediting agency is not prescriptive in directing pharmacy programs in preparing their students for NAPLEX. As a result, there is little consistency among programs regarding the magnitude of their involvement in student preparation for NAPLEX. Various tools have been used by PharmD degree programs to prepare students for NAPLEX, including a progress test, NAPLEX review textbooks, NABP's pre-NAPLEX or other mock examinations,<sup>5</sup> and live or electronic NAPLEX review programs.<sup>6</sup>

Few publications have described the impact of poster presentations on students' performance on national examinations. Limited pharmacy literature suggests poster presentations benefit student learning in the areas of pharmaceutical, clinical, and social sciences. Poster presentations positively influenced student learning in public health,<sup>7</sup> advanced pharmacy practice experience (APPE) research projects,<sup>8</sup> elective research projects,<sup>9</sup> projects linking pharmaceutical sciences to patient care,<sup>10</sup> and awareness and reduction of medication errors in pharmacy

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practice settings.<sup>11</sup> In addition, other health professions have used student posters effectively. Student posters have been used as a teaching strategy to promote student learning in pathology for first-year medical and dental students, and to encourage medical students to identify areas of need for health promotion during clinical practice experiences.<sup>12,13</sup> Similarly, nursing faculty members have used student poster presentations to gauge student knowledge and skills in pediatric nursing, promote student interest in research, encourage networking, and develop skills to effectively communicate with other healthcare professionals.<sup>14-16</sup> Posters have also been used in an interprofessional course to facilitate communications among professional students from 7 different healthcare professions.<sup>17</sup>

The 3-year PharmD degree curriculum at the School of Pharmacy at Pacific University consists of traditional classroom content and introductory pharmacy practice experiences in the first and second years of study. Students' participate in APPEs during their third year. An integrated longitudinal curricular activity was implemented to encourage P3 students to generate and present pharmacotherapeutic topics as posters. The desired outcomes were: (1) to determine whether the integrated longitudinal curricular activity better prepared graduating students for both a commercial examination and the NAPLEX, and whether this affected examination results; and (2) to assess whether the P3 student poster presentations effectively engaged all pharmacy students (P1 through P3) in integrated curricular topic review and discussion. The desired outcomes aligned with the most recent American Association of Colleges of Pharmacy's Center for the Advancement of Pharmacy Education (CAPE 2013), particularly related to domain 1, Foundational Knowledge, and ACPE guideline 10.2, to integrate and reinforce curricular content.<sup>18,19</sup>

## **DESIGN**

The Pacific University Institutional Review Board reviewed the study and granted it exempt status. The cohesive curricular process was implemented in the following order: (1) introduction of P3 students to the integrated longitudinal curricular activity and its criteria; (2) formation of 11 poster teams by interested P3 students; (3) selection of pharmacotherapeutic poster topics; (4) preparation of posters (during a 7-month time period while participating in APPEs); (5) presentation of posters to peers; (6) evaluation and review of posters by all P3 students and faculty evaluators, and (7) evaluation, discussion, and review of the displayed posters by all P1 and P2 students.

The integrated longitudinal curricular activity began with the faculty developing a list of disease state topics and criteria to assist participating P3 students in preparing

pharmacotherapeutic posters. Twenty topics were provided to the entire class (91 students) in the beginning of their final year of study. Students who chose to participate in this optional curricular activity created their own team of 3 to 5 members and selected a pharmacotherapeutic topic from the disease state topic list (Table 1). They were also required to write examination questions related to their posters. Instructions on how to prepare a poster (Appendix 1) and an examination question writing guide were provided to students.<sup>20</sup> Eleven teams were formed to work on the integrated longitudinal curricular activity, which represented 38 of 91 (42%) graduating students. Accordingly, the participants generated 11 posters. The remaining graduating students (58%) did not participate in the study. Teams were formed in September and students had 7 months to create their posters. Two weeks prior to the submission deadline, teams could request that faculty members review their posters.

All P3 students were given a comprehensive NAPLEX review book in the beginning of the fall semester and were expected to study the review book during their APPEs. Additionally, a CD-ROM, which included 2 comprehensive practice NAPLEX commercial examinations as a supplement to the review book, was retained by the institution to administer at a later date.<sup>21</sup> The commercial examination was administered to the students the week prior to graduation when they returned to campus for a required NAPLEX review session. Students were not aware they would be taking the commercial examination until just before it was administered. While completing the commercial examination was a required component of the NAPLEX review session, the examination results did not have any impact on students' advancement to graduation.

Because the majority of graduating students (88%) signed and submitted an Authorization to Release Information to NABP form to the NABP, the authors were able to compare identifiable NAPLEX results (reported by the NABP) with the identifiable commercial examination results (reported by the institution). Participants and non-participants' mean percentage scores from the commercial examination and the NAPLEX were compared (Table 2).

The integrated longitudinal curricular activity design incorporated at least 2 components of the revised Bloom's taxonomy of learning: apply and create.<sup>22-23</sup> In other words, it required students to use previously learned knowledge from the P1 through P3 curricula (ie, apply), and to integrate and combine the different elements to generate and present a poster (ie, create). To effectively assess and award the best poster, they were evaluated on clarity, accuracy, and format of the content, which included

Table 1. Pharmacotherapeutic Topics Available for Posters for Graduating Doctor of Pharmacy Degree Students

Topic <sup>a</sup>
Hypertension
Coronary artery diseases
Thromboembolism
Heart failure and arrhythmias
Hyperlipidemia
Diabetes
Renal failure
Endocrine disorders
Gastrointestinal diseases
Nutrition, fluids, and electrolytes disorders
Oncology and solid organ transplant
Parkinson and Alzheimer diseases
Rheumatoid arthritis, osteoarthritis, gout, and lupus
Pain managements and migraines
Seizure disorders
Mood disorders
Psychiatric diseases
Asthma and chronic obstructive pulmonary disease
Infectious diseases, human immunodeficiency virus, and acquired immune deficiency syndrome
Men's and women's health

<sup>a</sup> Students were allowed to choose any disease state within their topics, eg, for psychiatric diseases, the group could focus on depression or bipolar.

an abstract, introduction, pathophysiology and pharmacology, symptoms and treatments, pharmaceuticals and pharmacokinetics, contraindication and toxicology, and patient education “pearls.”

The student teams submitted their posters electronically. Faculty members reviewed the content and appearance of each poster to verify the inclusion of the required criteria. Eleven posters were printed (full-color print, 36” x 48”) and displayed on campus. The posters were presented to the entire graduating class during a required poster session. Twenty-four assigned groups of P1 and P2 students (consisting of 4 P1 and 4 P2 students) reviewed, evaluated, and discussed the content of the posters. They also answered the corresponding assessment questions in a 4-hour poster session. All 24 groups

were required to turn in completed evaluation forms, which assisted in tracking participation. Student evaluations were combined with those from faculty members to score each poster. The team members of the highest-ranked poster presentation were recognized at the school recognition program during commencement week. The P3 student evaluations, which included their perceptions of the effectiveness of the integrated longitudinal curricular activity (Tables 4 and 5), were completed the day after the poster presentations were completed.

### EVALUATION AND ASSESSMENT

To evaluate the effectiveness of the integrated longitudinal curricular activity on the examination scores, participant and nonparticipant results from the commercial examination and NAPLEX (first-time test takers) were compared (Table 2). Because the results from the commercial examination and NAPLEX were normally distributed, parametric statistics were used to calculate *p* values. A 2-tailed unpaired *t* test analysis was applied using Microsoft Excel 2013, and indicated that the difference in the examinations’ mean values between participants and nonparticipants was significant for both the commercial examination and NAPLEX (*p*=0.023 and *p*=0.033, respectively). In addition, the Cohen *d* effect size was calculated to examine strength of effect for the 2 independent groups of participants and nonparticipants.

Additional analyses were conducted to determine the combined yet unique contribution of commercial examination performance and integrated longitudinal curricular activity participation in explaining variance in NAPLEX scores. A hierarchical multiple regression analysis was performed using SPSS, version 20 (IBM Corp, Armonk, NY), where commercial examination scores were entered into the model first and integrated longitudinal curricular activity participation was added in the second step (Table 3). Commercial examination scores predicted a significant amount of variance (ie, 34%) in NAPLEX scores. When integrated longitudinal curricular activity participation was added to the model, there was a slight increase (ie, 2% or a small effect) in the predictive ability of the overall model; however, this increase was not significant and

Table 2. Commercial Examination and North American Pharmacist Licensure Examination Scores of Integrated Longitudinal Curricular Activity Participants and Nonparticipants

Examination	ILCA Participant Scores,		Nonparticipant Scores,			
	Mean (SD)	N <sup>a</sup>	Mean (SD)	N <sup>a</sup>	<i>p</i>	<i>d</i>
Commercial	55.0 (6.4)	38	51.8 (6.6)	52	0.023	0.4922
NAPLEX	105.1 (13.4)	36	98.3 (14.6)	44	0.033	0.4852

Abbreviations: ILCA = integrated longitudinal curricular activity.

<sup>a</sup> N differs because of students who did not authorize National Association of Boards of Pharmacy to release their North American Pharmacist Licensure Examination scores. Scores from commercial examination are in percentages.

Table 3. Multiple Regression Analyses of Commercial Examination Score and Integrated Longitudinal Curricular Activity Participation Variables on North American Pharmacist Licensure Examination Scores

Model	Independent Variables	R Square	R Square Change	P
1	Commercial examination	0.340		<0.001
2	Commercial examination and integrated longitudinal curricular activity	0.354	0.015	0.19
1	Integrated longitudinal curricular activity	0.057		0.033

multicollinearity of the 2 predictors was not excessive ( $r = .222$ ). There was a medium positive correlation between the commercial examination scores and NAPLEX scores (Figure 1). In addition, the correlation between both the commercial examination and NAPLEX scores was 0.562 for participants as compared to 0.557 for nonparticipants.

Because the curriculum was assessed using a pass/no pass grading system, correlation of examination performance with current grade point average (GPA) was not possible. A simple regression analysis, however, was performed using prepharmacy GPA. The P3 students' prepharmacy cumulative GPAs did not provide a prediction model on how well students would perform on the commercial examination and NAPLEX (data not shown).

To evaluate the effectiveness of the integrated longitudinal curricular activity on students' NAPLEX preparation and all pharmacy students' curricular discussion, survey instruments were generated and administered using the learning management system, Blackboard (Blackboard Inc, Washington, DC). Participants completed a survey instrument to assess their experiences with the preparation of posters (Table 4). A survey instrument was also distributed to all P1, P2, and P3 students to assess the effectiveness of the posters in facilitating student discussions in curricular matters (Table 5). These survey instruments were distributed before P3 students graduated and, therefore, prior to students taking the NAPLEX. The P3 students reported their perceptions on how well the posters addressed clinical topics that would potentially be covered on the NAPLEX (Table 5). Faculty members who reviewed and evaluated the posters were also surveyed (Table 6). Survey questions reported in Tables 4 and 6 were evaluated and reviewed by the school's leadership. Questions reported in Table 5 were reviewed and evaluated by the school's assessment committee. A 5-point Likert scale (strongly agree, agree, neutral, disagree, strongly disagree) was used for data presented in Tables 5 and 6.

Of the 38 participants who responded to the quantitative questions, more than 83% felt that the integrated longitudinal curricular activity assisted them in NAPLEX preparation and enhanced their knowledge of the presented topic (Table 4). In addition, participants reported that the

integrated longitudinal curricular activity provided them with a unique opportunity to create a professional poster, improve poster presentation skills, and promote collaboration with peers toward a common goal.

The majority of all P1 through P3 students agreed that the poster review provided an effective summary of different disease states. Most students also indicated that reviewing posters provided an environment where curricular topics were discussed and provided an effective summary of different treatment goals associated with the clinical presentations (Table 5).

Ten of the 13 faculty members who participated as poster judges completed the feedback survey. The majority of faculty members felt the posters integrated curricular topics from P1 through P3 curricula, provided a forum for student discussions about different medications, and provided a productive end-of-year curricular activity for graduating students (Table 6).

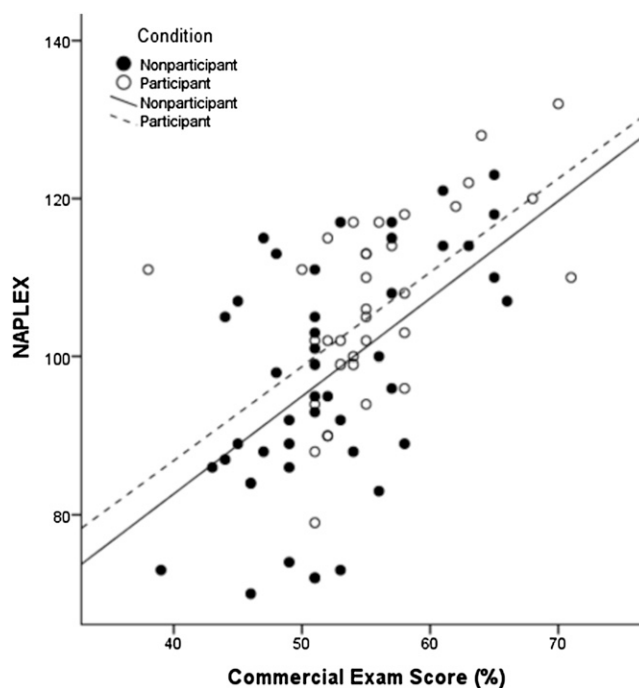


Figure 1. Correlation between commercial examination scores and North American Pharmacist Licensure Examination scores for participants and nonparticipants.

Table 4. Participants' Perceptions of the Effectiveness of the Integrated Longitudinal Curricular Activity<sup>a</sup>

Survey Question	Student Response, % Agree
The ILCA enhanced your knowledge of the presented topic.	86
The ILCA enhanced your skills in making a professional poster.	86
The ILCA assisted you in enhancing your poster presentation skills.	85
The ILCA assisted you in your preparation for NAPLEX.	83
The ILCA provided a forum for collegial discussion about P1-P3 curricular topics.	74
The ILCA assisted you in integrating the knowledge you developed from P1-P3 curriculum.	60

Abbreviations: ILCA= integrated longitudinal curricular activity; NAPLEX=North American Pharmacist Licensure Examination.

<sup>a</sup> Response rate: n=38 (95%)

## DISCUSSION

Preparing pharmacy students to maximize their performance on the NAPLEX while facilitating curricular discussions between all students is desirable for many pharmacy programs. Our study found that administration of an integrated longitudinal curricular activity was effective in achieving these collective outcomes. The *t* test analysis inferred that participants performed statistically better compared to nonparticipants on both the comprehensive examination and NAPLEX. The regression analysis revealed an interdependence of the integrated longitudinal curricular activity on the commercial examination. The activity alone accounted for little of the variability in NAPLEX scores, yet the activity was complementary to the commercial examination influence. The predictors, when examined in tandem, aligned with successful outcomes yet alone may not have yielded similar results. Academically stronger students may have been predisposed to participate in the integrated longitudinal curricular activity, resulting in similar performance on

both examinations. The participants' scores had a slightly stronger correlation between the commercial examination and NAPLEX. The performance of the nonparticipants' on the commercial examination aligned so closely to NAPLEX that the result overshadowed the influence of the integrated longitudinal curricular activity. This cohort did not complete the activity, yet the commercial examination was predictive of NAPLEX results.

While the results did not identify specific factors that directly contributed to predicting improved performance on the commercial examination and NAPLEX, longitudinal discussions (ie, during the 7-month timeframe) among participants on how to effectively create and present a poster may have positively affected participants' preparation for both examinations. Indeed, participants stated the integrated longitudinal curricular activity provided a forum for collegial discussion about P1 through P3 curricular topics and assisted them in integrating the knowledge they developed from the curriculum. The majority of students agreed that reviewing posters provided

Table 5. A Comparison Between First-Year Through Third-Year Students' Perceptions and Impressions of the Effectiveness of the Poster Activity<sup>a</sup>

Assessment Question	First-Year Student Responses, % Strongly Agree + Agree	Second-Year Student Responses, % Strongly Agree + Agree	Third-Year Student Responses, % Strongly Agree + Agree
The poster review integrated and advanced the knowledge you developed from the first-year or second-year curriculum.	62	82	-
The poster review provided an environment where curricular topics were discussed.	71	83	60
The poster review provided an effective summary of different disease states.	75	79	80
The poster review provided an effective summary of different treatment goals that were associated with the clinical presentations.	65	76	53
The poster review provided an effective summary of different contraindications and major drug interactions associated with the presented drugs.	54	56	52

<sup>a</sup> Response rates: first-year students, n=95 (97%); second-year students, n=94 (100%); third year students, n=91 (98%).

Table 6. Faculty Perceptions of the Effectiveness of the Poster Presentations<sup>a,b</sup>

Survey Question	Faculty Response, % Strongly Agree + Agree
Posters integrated curricular topics from first-year through third-year curricula.	90
Poster presentations provided a forum for student discussions about different disease states.	100
Poster presentations provided a forum for student discussions about different medications.	90
Poster presentations were a productive end-of-year curricular activity for graduating students.	90
On average, you feel that student teams provided a professional poster presentation.	90
On average, you believed that student teams effectively conveyed their messages to their audiences.	100

<sup>a</sup> Faculty members were full-time and were from pharmacy practice and pharmaceutical sciences.

<sup>b</sup> Response rate: n=13 (77%).

an effective summary of different disease states and provided an environment where curricular topics could be discussed. There was less agreement related to whether the posters provided an effective summary of different treatment goals, contraindications, and major drug interactions associated with the presented disease state (Table 5). Reasons for these lower ratings could be that not all posters effectively conveyed these messages or teams may have faced challenges, including concise content because of space limitations on the poster. Faculty member perceptions paralleled student perceptions with high ratings on the format and effectiveness of the presented posters. Student perceptions of learning may not accurately represent the intended student learning outcomes<sup>24</sup>; however, faculty perception combined with the examination results may support student perceptions in our study.

Implementing the integrated longitudinal curricular activity was a win-win venture for our PharmD degree program as well as for students and faculty members. It connected graduating students to their peers through the longitudinal discussions and preparation of posters, and helped them develop poster preparation and presentation skills. The preparation, presentation, and discussion of the posters may have better prepared graduating students for the NAPLEX. All classes of pharmacy students at the institution interacted and discussed the content of posters, which may have introduced students to new information or reinforced materials they had already learned. The latter is supported by ACPE Guideline 10.2 where a process for application and reinforcement of curricular content is encouraged.<sup>19</sup> Faculty members also benefited by having the opportunity to engage in students' application of curricular knowledge through review and evaluation of their posters.

There were limitations to this study. Students who were motivated to learn more about a disease state and opted to participate in the activity may have been academically stronger students. As such, a higher motivation among participants may have positively influenced the examination results. Additionally, the commercial examination

was administered during P3 students' commencement week, while the NAPLEX was taken within 3 months after commencement. As a result, other individual student NAPLEX preparations, unknown to the authors, may have influenced the results of NAPLEX. During their P3 year, students completed APPEs at different sites, thus the impact of APPE learning on student performance on the examinations was unknown. After the administration of the commercial examination, faculty members provided a 6-hour basic and clinical sciences review session to P3 students during commencement week. Similarly, the effect of this review session on NAPLEX results was not known. However, P3 students largely liked the session as a NAPLEX review tool (data not shown).

While we were unclear if the commercial examination questions were psychometrically validated, the NAPLEX included 185 questions, of which 150 were psychometrically validated. The NAPLEX questions were used by the NABP to calculate a candidate's score and 35 questions were used to collect psychometric statistical information for possible scored items in a future NAPLEX.<sup>25</sup> The NABP used a 3-parameter Item Response Theory model to calculate test takers' scaled score (ranges from 0 to 150, with 75 as a cutoff for a passing scaled score).<sup>26</sup>

A few teams faced challenges in their electronic communications, as would be expected with a distance project. Many teams reported that 100% of their work was done electronically because of their varied geographic locations. Students did gain experience in the challenges of electronic communications, which may assist them in their future professional collaborations.

The integrated longitudinal curricular activity was continued in the 2011-2012 and 2012-2013 academic years. It was administered for the fourth time in the 2013-2014 academic year. Improvements have been incorporated since the beginning of the integrated longitudinal curricular activity (first cycle, ie, presented data). The format now includes the addition of new assignments for the teams: creation of key clinical points, and monitoring parameters

and patient education documents. In addition, the Oregon State Board of Pharmacy has approved continuing education credit for faculty members and external pharmacists, including preceptors and alumni, who attend the poster session.

Many students benefited from the integrated longitudinal curricular activity, such that poster preparation and presentation is now a required component of the P3 curriculum at our institution. In addition, P1 and P2 classes are required to review and discuss displayed posters by the conclusion of their corresponding academic years.

## SUMMARY

This integrated longitudinal curricular activity may have better prepared graduating PharmD degree students for the NAPLEX and may have been a training tool for professional poster creation and presentation. Most P1 through P3 students and faculty members reported that the poster activity enhanced student engagement in curricular learning and discussions. The integrated longitudinal curricular activity is now a core component of the P3 class curriculum.

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Appendix 1. Poster instructions to facilitate poster preparations.

**1. Title**

- include topic
- names of all team members
- your school's name

**2. Abstract**

- short description of the poster (150 words maximum)

**3. Introduction**

- overview and background of topic (150 words maximum)

**4. Pathophysiology and Pharmacology Interface**

- explain cause(s) of the disease/disorder
- the class(es) of drugs that are used to treat the disease/disorder
- MOA for the above class(es)

**5. Symptoms and Treatments Interface**

- signs and symptoms
- treatment goals
- common inpatient/outpatient drug therapies used to treat the disease/disorder
- appropriate dosing
- OTC or/and herbal medicines that are used in the treatment (if any)
- pediatric/geriatric considerations
- what did you learn from your APPE's that applies to symptoms and treatments

**6. Pharmaceutics and Pharmacokinetics Interface**

- explain the available dosage forms and drug delivery systems used in the drug therapy
- what are the *unique* physicochemical and medicinal chemistry properties of drugs used to treat
- name and explain if there are any biotechnology drug products available to treat the disease/disorder
- explain how PK can be utilized to provide the best therapeutic outcome

**7. Contraindication and Toxicology Interface**

- contraindications and major drug interactions that a pharmacist should know
- major drug induced problems
- recommendations (solutions) to avoid drug interactions
- provide essential counseling pearls

**8. Conclusion**

- generate 5-10 multiple choice questions based on the presented materials
- provide the key with a short explanation of the correct answer

**9. References**

- list of references used in your presentation