

Incorporating Interprofessional Education Into a Graduate Nurse Practitioner Pharmacotherapeutics Course with a Pharmacist Educator

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Incorporating interprofessional education (IPE) into the training curricula of health care professionals is of increasing relevance for today's health care environment because of the need for professionals to work collaboratively in team-based medicine. National centers focused on the guidance and accreditation of training programs and health care systems are increasingly calling for novel education programs that prepare students for patient care, with the ultimate goal of making a positive impact on health outcomes; even the World Health Organization released a statement in support of IPE.¹

In 2015, the American College of Clinical Pharmacology (ACCP) released a policy statement regarding the need to improve and expand clinical pharmacology education in medical and nursing schools to ensure learners have a solid background in clinical pharmacology and therapeutics prior to applying these concepts in practice.² In the same year, the American Association of Colleges of Nursing also released a position statement entitled "Interdisciplinary Education and Practice" that provided recommendations for nursing schools to develop curricula with opportunities for students to interact with other disciplines, collaborate with other disciplines to implement IPE, and conduct research to evaluate outcomes of incorporating IPE into nursing curricula.³ One potential avenue of incorporating ACCP and AACN's recommendations into curriculum could be to include other disciplines, such as pharmacists, as educators in the didactic education of nurse practitioner students. However, currently

Abstract

Background: Limited literature exists on the value of a pharmacist co-educator in Doctor of Nursing Practice (DNP) didactic education.

Purpose: Incorporate a pharmacist co-educator into a DNP pharmacotherapeutics course to improve the education of DNP students.

Method: A pharmacist and nurse practitioner co-taught a DNP pharmacotherapeutics course. At course completion, students received an evaluation form. Mean scores on the final evaluations from the previous three years were combined and compared with the mean score for each response item post-implementation of the pharmacist co-educator. Thematic analysis was conducted on open-comment responses in the evaluation.

Discussion: A thematic analysis of course evaluations indicated a positive shift in DNP student perception of the course and their view of interprofessional collaboration with pharmacists. Mean final evaluation scores demonstrated slight improvement, though not statistically significant.

Conclusions: Implementation of interprofessional education (IPE) in a DNP pharmacotherapeutics course may enhance learning and promote collaboration among early-career DNPs and pharmacists.

there is limited literature available directly related to involving pharmacists as educators in a doctor of nurse practitioner (DNP) pharmacotherapeutics course.

Preliminary evidence suggests a benefit from incorporating pharmacist educators into other healthcare professional curricula, as demonstrated by the following studies. A study by McGuire et al. used objective structured clinical examinations (OSCEs) facilitated by clinical pharmacists to help medical students review commonly reported prescribing errors and evaluated the

ABBREVIATIONS

ACCP - American College of Clinical Pharmacology

DNP - Doctor of Nursing Practice

IPE - interprofessional education

OSCEs - objective structured clinical examinations

students' self-reported learning.⁴ Analysis of student reviews demonstrated that pharmacist involvement was beneficial and helped improve prescribing knowledge. Another study by Tittle et al. evaluated the impact of a pharmacist-taught course in practical prescribing to medical students completing their final-year clinical placements.⁵ The course consisted of a 2-hour, pharmacist-led teaching session each week for 4 weeks at 5 different hospitals. Teaching methods in these sessions included small group tutorials, practice prescribing questions, shadowing of pharmacists, etc. Focus group discussions conducted at the end of each course demonstrated that students had increased confidence in prescribing and viewed pharmacists as knowledgeable and approachable resources. Though neither of these studies incorporated a pharmacist into formal didactic learning, both demonstrated promising results from pharmacists' involvement in the education of other health care professionals.^{4,5}

In an effort to improve the learning experience of DNP students and better prepare them for their experiential education and future medication prescribing as nurse practitioners, we incorporated IPE in their pharmacotherapy didactic course. By integrating pharmacists into a pharmacotherapy course for DNPs, our aim was to improve the prescribing knowledge base of future DNPs and promote collaborative practice skills and competencies between DNPs and pharmacists.

Materials and Methods

Background

This project was conducted through an established DNP program in Wisconsin. In the fall of 2018, the director of the DNP graduate program requested pharmacist involvement in their Spring 2019 Pharmacotherapeutics for Advanced Clinical Practice course with the goal of promoting IPE among early-career nurse practitioners and pharmacists. The aims of the project were two-fold: enhance the course for students in the second semester of their DNP program curriculum, and enhance student learning of the materials. The primary coordinator of the project was a licensed pharmacist in a first-year pharmacy residency program at a rural, tertiary care

TABLE 1. Course Topics

Topic	Pharmacist or Nurse Practitioner Led	Online or In-Person
Introduction to Pharmacotherapeutics	Pharmacist	In-person
Infectious Disease (antibacterial, antifungals)	Nurse Practitioner	Online
Infectious Disease (antivirals, vaccines, HIV/AIDS); Lab/Diagnostics	Nurse Practitioner	In-person
Head, Eyes, Ears, Nose, Throat	Pharmacist	Online
Cardiovascular (dyslipidemia, hypertension)	Nurse Practitioner	In-person
Cardiovascular (arrhythmia, heart failure, ischemic heart disease, acute coronary syndromes)	Nurse Practitioner	Online
Respiratory	Nurse Practitioner	In-person
Gastrointestinal/Liver	Pharmacist	In-person
Renal/Genital/Urologic	Pharmacist	Online
Musculoskeletal	Pharmacist	In-person
Pain/Neuromuscular Disorders	Nurse Practitioner	Online
Neurologic/Mental Health	Pharmacist	In-person
Endocrine/Immunity/Skin	Pharmacist	In-person
Endocrine	Pharmacist	Online

health system.

Project Design/Activity Description

Prior to the Spring 2019 semester, the department chair, graduate programs director, course coordinator, and other key stakeholders met to determine course needs and how to best structure pharmacist educator involvement. The group decided a pharmacist would co-teach the course with the existing nurse practitioner instructor from the past several years. The lectures were then divided between the nurse practitioner and pharmacist based on designated instructor credit load, expertise in the material, and scheduling coordination. This course was designed to be a combination of in-person and online lectures, with topics coordinated with the other DNP course topics. The nurse practitioner taught six lectures (three online, three in-person) and the pharmacist taught eight (three online, five in-person; Table 1). The entire course consisted of 14 lectures (six online and eight in-person), five online reading quizzes, five online discussion posts, and four in-class exams. The pharmacist had access to all previous presentation materials and revised the materials for the pharmacist-

led online and in-person lectures (n=8) based on preferred teaching style, content, and required updates to course lectures.

To ensure consistency in content between educators, course updates focused on the following elements: learning objectives; brief background on disease state; relevant treatment guidelines; non-pharmacologic treatment; and dosing, mechanism of action (MOA), adverse effects, contraindications, and precautions for each medication.

"Knowledge Check" questions, designed to reinforce key concepts covered in the lectures, were added throughout the lectures as participation aides. Students would anonymously answer these questions using an online polling function. The pharmacist co-educator also developed discussion questions, reading quizzes, and exam questions to match the updates to the materials. Materials were peer-reviewed by other pharmacists at Marshfield Clinic Health System to ensure content accuracy.

Objectives

The primary objectives of this project were to identify changes in student satisfaction scores and thematic content of student-provided feedback as a proxy

measure of enhanced student learning. Evaluation of student feedback was chosen as the primary objective rather than knowledge/exam performance due to differences in exam structure and questions in each year limiting the capability for direct comparison.

Evaluation

Student course evaluations from the Spring 2019 semester were compared to student course evaluations of the same course from the previous 3 years (Spring 2016, Spring 2017, and Spring 2018). All evaluations from students enrolled in those 4 years were included in the analysis. Prior to Spring 2016, differences in course design limited the applicability of course evaluation assessment for the impact of pharmacist-led IPE on student learning; therefore, these evaluations were not included in the analysis. Information on past course evaluations was acquired retrospectively from the course records of previous years. All evaluations were obtained anonymously by a third party and were not linked to the students who completed them. This project was classified as exempt by the health system's Institutional Review Board (IRB) and the DNP program's IRB.

Following the final exam, students in the Spring 2019 course were given the same course evaluation that was used in previous years (Table 2). These evaluations included eight response items, each on a 4-point Likert rating scale in which students were instructed to rate each item as strongly disagree (1), disagree (2), agree (3), or strongly agree (4), as well as two open-comment response items. The students also completed a separate evaluation with both Likert rating scale questions and open-response questions specifically assessing the value of pharmacist involvement in the course (Table 2).

Data analysis

Evaluation response items were summarized with descriptive statistics, and the Kruskal-Wallis test was used to compare results for each response item by time period using SAS software (SAS Institute, Cary, NC, USA). The scale from 2018 had a neutral category for students to choose, while the other 3 years did not, so 2018 was excluded from the comparison. Results were deemed statistically significant at the

TABLE 2. Course Evaluation Response Items

	<i>Rate strongly agree to strongly disagree (Likert rating scale)</i>	<i>Open comment response items</i>
<i>Standard response items</i>	<ol style="list-style-type: none"> 1. The objectives of the course were clear and understandable. 2. I was able to achieve the course objectives. 3. The organization of the course helped me to learn. 4. Course content supported achievement of the course objectives. 5. Readings were helpful in achieving course objectives. 6. Other supporting course materials were helpful in achieving course objectives. 7. I was encouraged to be an active participant in my learning. 8. Evaluation in the course was fair and measured my learning. 	<ol style="list-style-type: none"> 1. Identify specific components of the course you found most helpful and why. 2. Identify suggestions for improvement.
<i>Response items specific for pharmacist involvement</i>	<ol style="list-style-type: none"> 1. Having a pharmacist co-teach this course helped me to learn. 2. I will be more likely to consult a pharmacist when prescribing medications in my future practice after this course. 	<ol style="list-style-type: none"> 1. Identify the benefits of having a pharmacist involved in teaching this course. 2. Identify concerns or suggestions for improving pharmacist involvement in this course.

5% level ($p < 0.05$) without adjustment for multiple comparisons. To conduct the thematic analysis of the open-comment response items, the primary investigator (pharmacist instructor) identified similar comments across student course evaluations to identify codes. Codes were further organized into larger overarching themes. Evaluations from Spring 2016–2018 were then compared to the Spring 2019 course evaluations. At each point, the codes and potential themes were reviewed by a pharmacy mentor and a researcher professionally trained in qualitative data analysis. A similar thematic analysis was also conducted on evaluation response items specific to pharmacist involvement (Table 2) to determine how students responded to having a pharmacist co-teach the pharmacotherapeutics course.

Results

Quantitative Analysis

Overall, 42 course evaluations were used in the statistical analysis (19 from Spring 2019, and 23 from Spring 2016 ($n=11$) and 2017 ($n=12$) combined), with scores from Spring 2018 only reported in Figure 1 (not included in pooled statistical analysis). Figure 1 shows the trends in mean scores

by year over the eight evaluation response items. The only scores that were slightly higher in 2016–2018 than in 2019 were the two response items related to course objectives in 2016 and the response item related to readings in 2017. The 2019 scores were somewhat higher than those in 2018 for all eight response items.

In 2019 when a pharmacist co-taught the course, the mean scores were slightly higher than the means for the previous years combined (Table 3), though none of the response items had a statistically significant positive change ($p < 0.05$) in the semester with IPE compared to the combined results from 2016 through 2017. This may in part be due to a reduced sample size since 2018 was not included in the pooled analysis.

For each of the eight evaluation response items, the 2019 semester had a smaller percentage of students choosing the "Strongly Disagree" category than previous years (data not shown). The response items assessing students' perceptions of pharmacist involvement in the course scored 3.5 and 3.6 on a 4-point scale with a score of 4 indicating that the student strongly agreed with the statements (Table 4).

Qualitative analysis

A number of codes were identified from the open comment response items from Spring 2016 to Spring 2019. Responses from Spring 2016, Spring 2017, and Spring 2018 were analyzed together (Table 5). Spring 2019 course evaluations were analyzed (Table 6) and then compared to codes and themes identified from previous years. Finally, responses to the pharmacist-specific evaluation response items from Spring 2019 were analyzed (Table 7).

Responses from previous years identified several areas for improvement including the need to update material for new and emerging information, to create greater concordance across course materials, and to streamline presentation and organization of the material to maximize retention. In contrast, responses from Spring 2019 instruction did not include references to these deficiencies. Students referred to the expanded knowledge base provided by pharmacist instruction, though paired this strength with a request to highlight medications more commonly used in general practice. The breadth of material covered in each exam continued to be a critique from previous years. Several changes suggested by students, such as reorganizing material to increase user-friendliness, could easily be incorporated in future iterations of the course.

TABLE 3. Mean and Median Scores for Course Evaluation Response Items before (Combined 2016–2017) and after Including a Pharmacist Co-Educator

	2016 - 2017		2019		<i>P-value</i>
	<i>Mean</i>	<i>Median</i>	<i>Mean</i>	<i>Median</i>	
The course objectives were clear and understandable.	2.9	3	2.9	3	0.927
I was able to achieve the course objectives.	2.7	3	2.8	3	0.822
The organization of the course helped me to learn.	2	1	2.4	2	0.175
Course content supported achievement of the course objectives.	2.3	2	2.8	3	0.117
Readings were manageable and helpful in achieving objectives.	2.5	3	2.6	3	0.746
Other supporting course materials were helpful in achieving course objectives.	2.5	3	2.8	3	0.308
I was encouraged to be an active participant in my learning.	2.8	3	3	3	0.563
Evaluation in the course was fair and measured my learning.	2.3	2	2.9	3	0.071

For each response item, the student was asked to circle strongly agree, agree, disagree, or strongly disagree. For the purposes of analyzing the data, strongly agree was interpreted as a 4, agree as a 3, disagree as a 2, and strongly disagree as a 1.

TABLE 4. Average Scores for Pharmacist Involvement Course Evaluation Response Items

	<i>Score</i>
Having a pharmacist co-teach this course helped me to learn.	3.5
I will be more likely to consult a pharmacist when prescribing medication in my future practice after this course.	3.6

For each response item, the student was asked to circle strongly agree, agree, disagree, or strongly disagree. For the purposes of analyzing the data, strongly agree was interpreted as a 4, agree as a 3, disagree as a 2, and strongly disagree as a 1.

TABLE 5. Themes and Codes in Standard Open Comment Response Items - 2016 through 2018

<i>Response Item</i>	<i>Theme</i>	<i>Codes and Example Comments</i>
<i>Identify specific components of the course you found most helpful and why</i>	Good Organization	Instructor was well organized and approachable <ul style="list-style-type: none"> “Content was appropriate for class.” “Instructors were approachable.”
	Course Materials Beneficial	Assignments helpful <ul style="list-style-type: none"> “The discussions were helpful to utilize our knowledge from our book.” “In class quizzes were helpful when the questions were straightforward.” “The discussions helped me remember things in more detail.” Powerpoints helped explain content <ul style="list-style-type: none"> “Powerpoints were super helpful in review for exams verses going through 19 chapters for one exam.” “Voice over one notes were extremely helpful for learning the material.” “Voice over PowerPoints were helpful.” Readings/textbook helpful <ul style="list-style-type: none"> “The readings helped me learn the most.” “The textbook was organized well and easy to read, very informative.” “Readings were also helpful.”

TABLE 5 CONT. Themes and Codes in Standard Open Comment Response Items - 2016 through 2018

<i>Response Item</i>	<i>Theme</i>	<i>Codes and Example Comments</i>
<i>Identify suggestions for improvement</i>	Course Materials Not Beneficial	<p>PowerPoints and readings not useful</p> <ul style="list-style-type: none"> • "The powerpoints and handouts were not helpful and made it difficult to focus during studying for exams." • "Please teach content on exams in PowerPoints, I feel as if the content is important to test, should be taught in PowerPoint/in class lecture." • "Powerpoint were not helpful and most were a waste of time to go through." <p>Outdated powerpoints/materials</p> <ul style="list-style-type: none"> • "Content was often incorrect or did not agree with the book/literature. PowerPoints were hard to follow and often did not contain pertinent information." • "Assure that materials are up to date instead of just reusing from previous years." • "UPDATE YOUR POWERPOINTS – a lot of information is outdated." • "The PowerPoints had conflicting points, mis-spelled words, unknown abbreviations, and the organization was difficult to follow." <p>Assignments not beneficial</p> <ul style="list-style-type: none"> • "Sometimes in class quizzes covered obscure content or had multiple correct answers – this did not really enhance my learning." • "Some D2L scenarios did not incite very animated student discussion." <p>Exams poorly written/not reflective of materials.</p> <ul style="list-style-type: none"> • "The exams had many questions that went against what the textbook said." • "Ensure that exams are reflective of the information presented and the information in the readings." • "Exams were not reflective of any book or lectures." <p>Lectures not beneficial</p> <ul style="list-style-type: none"> • "Need better prepared lectures. Information sometimes wasn't clear, contradictory, or incorrect." • "I personally did not find class lectures very helpful... did not help me prioritize class content and did not help me understand concepts any better." • "In class meetings did not assist me in learning the content."
	Content too Broad/Extensive	<p>Too much content per exam</p> <ul style="list-style-type: none"> • "There are not enough exams – there is far too much content to effectively learn the material. We were cramming rather than learning." • "18 chapters for one exam is to much content, one does not learn when info is crammed, it was a struggle just to read all the chapters and notes." • "Having 15+ chapters to cover on one test was difficult." <p>Content not focused enough</p> <ul style="list-style-type: none"> • "Focus lectures on important pieces of the powerpoint we need to know." • "PowerPoints must address need to know pharmacology – it was too focused on the pathophysiology and had very little need to know info on pharmacotherapy that instructors expect students to know." • "This class needs to be teaching medications not patho." <p>Need learning objectives</p> <ul style="list-style-type: none"> • "Goals need to match the teaching, and goals for learning were not made clear." • "Objectives need to be identified for each test." • "Have clearer objectives for each lecture to guide studying."
	Need Better Course Organization	<p>Better/more timely feedback and instructor engagement</p> <ul style="list-style-type: none"> • "Also feedback from the instructors would be helpful. Course questions were never answered timely on [the distance learning platform] and sometimes not at all." • "Instructors did not always give timely feedback on these discussions which made them even less helpful." <p>Timely posting of materials</p> <ul style="list-style-type: none"> • "Have course material ready at beginning of course." • "Please inform students in a timely manner when audio is up or if no audio will be up." • Consistency in course • "Information needs to be in one place and one place only." • "If multiple instructors are teaching, please coordinate to ensure that the scope of exam questions reflects the general approach to the course." <p>Need better overall organization</p> <ul style="list-style-type: none"> • "The organization of information made this course confusing." • "Overall the design of this course I feel did not facilitate learning." • "Content is disorganized."

TABLE 6. Themes and Codes in Standard Open Comment Response Items - Spring 2019

<i>Response Item</i>	<i>Theme</i>	<i>Codes and Example Comments</i>
<i>Identify specific components of the course you found most helpful and why</i>	Course Materials Beneficial	<p>Readings/textbook helpful</p> <ul style="list-style-type: none"> • “Content and readings were appropriate.” • “I actually liked the textbook.” • “The supplemental guidelines were helpful tools/aids from ADA/AHA, etc. to summarize major concepts.” <p>Objectives were helpful</p> <ul style="list-style-type: none"> • “It was helpful that the Pharm D told us what was just for our information and what was important for us to remember.” • “When objectives were put on the powerpoints that was helpful.” • “Learning objectives helpful when studying for exams.” <p>Assignments were beneficial</p> <ul style="list-style-type: none"> • “Discussion very time consuming but beneficial.” • “The quizzes before class helped me prepare for the subject matter we would be learning about.” • “Quizzes were helpful in identifying what might be considered key points of the concept.” <p>PowerPoints were helpful</p> <ul style="list-style-type: none"> • “Good thorough lectures.” • “PowerPoints helpful.” • “Meds for disease conditions were emphasized.”
		<p>Instructors were Helpful</p> <ul style="list-style-type: none"> • “Having a Phar[m]D instructor was most helpful for lectures and an excellent resource to have in class answering questions.” • “I really enjoyed having a pharmacist co-teach the course.” • “I appreciate the way she explained background and mechanisms of each action so clearly.”
<i>Identify suggestions for improvement</i>	Content too Broad/Extensive	<p>Too much content per exam</p> <ul style="list-style-type: none"> • “A lot of content in short time periods made it difficult to absorb/memorize material in a meaningful way.” • “There are so many chapters/ppts to prepare and read before each exam...it's too much.” • “Possibly more frequent exams/quizzes to reduce the amount of info on each.” <p>Content not focused enough</p> <ul style="list-style-type: none"> • “Focus more on meds that we as family practice providers will actually be prescribing.” • “Readings were hard to say if they were beneficial because the book was overwhelming how in depth it went.” • “Reduce reading to relevant info, not just ‘good to know’.” <p>Need learning objectives</p> <ul style="list-style-type: none"> • “Objectives to be put on every powerpoint would be helpful.” • “Post clear learning objectives for each section.” • “Learning objectives need to be highlighted and provided prior to presentation of topics.”
		<p>Course Materials Not Beneficial</p> <ul style="list-style-type: none"> • “I didn't find the discussions helpful because I was restating a lot of what was in the book.” • “Don't think quizzes on material not taught yet should be graded.” • “Discussions and posts online should not be included.” <p>Need timely posting of materials</p> <ul style="list-style-type: none"> • “PowerPoints should be posted a week ahead of time or at least 24 hrs prior to start of class.” • “Having powerpoints out early would be helpful in focusing areas of study.” • “Make sure all material is given to use in a timely manner.” <p>Better/more timely feedback</p> <ul style="list-style-type: none"> • “Grading of discussions was inconsistent and feedback was unclear on what could be improved upon, what was missing, and why points were deducted.” • “Discussion feedback on lacking areas would be helpful instead of just highlighting the category.” <p>Need better overall organization</p> <ul style="list-style-type: none"> • “Voiceovers were long, preferred in person content to ask questions/clarify.” • “Need clearer instructions for what is expected of us in the discussions.” • “Organization needs much improvement.”

TABLE 7. Themes and Codes in Pharmacist-Specific Open Comment Response Items

Response Item	Theme	Codes and Example Comments
<i>Identify the benefits of having a pharmacist involved in teaching this course</i>	Positive Interdisciplinary Cooperation	<p>Helpful to have pharmacist because they are the experts on medications</p> <ul style="list-style-type: none"> • “Has depth of knowledge of medications and felt as though having an expert in that area was beneficial.” • “Extensive knowledge beyond what a Nurse Practitioner would know.” • “More knowledge of adverse effects of meds and insurance info.” <p>Good to have a different perspective</p> <ul style="list-style-type: none"> • “Fresh interdisciplinary perspective. Supplemented nursing and medical approaches.” • “Interesting broad insight.” • “Able to give a pharmacist’s perspective.”
	Pharmacist was a Helpful Resource	<p>Pharmacist had good interaction with students</p> <ul style="list-style-type: none"> • “Strongly encourage keeping the instructor because of positive interaction with students.” • “Having a pharmacist was amazing.” • “Good to have a Pharm.” <p>Pharmacist was knowledgeable</p> <ul style="list-style-type: none"> • “Answered questions on the spot.” • “Very knowledgeable.” • “Having a pharmacist teach was most beneficial for up to date information.” <p>Gave tips/supplemental information</p> <ul style="list-style-type: none"> • “Explains mechanics of action in an easy manner, gives real life examples.” • “Helpful hints of what to write on Rx, etc.” • “Able to point out prescriptive concerns.” <p>Provided helpful resources for future practice</p> <ul style="list-style-type: none"> • “Having a pharmacist teach was most beneficial for...bringing attention to what resources are available.” • “She guided us to use pharmacists as resources.” • “Aware of resources for future practice.”
<i>Identify concerns or suggestions for improving pharmacist involvement in this course</i>	Need Better Course Coordination	<p>Need more timely posting of materials</p> <ul style="list-style-type: none"> • “Have voiceover powerpoints [powerpoints] and powerpoints for notes for lecture ready the Friday before.” • “Post powerpoints/study materials in a timely manner.” • “Having readings and lectures post more timely.” <p>Slide voice-over needs to be improved</p> <ul style="list-style-type: none"> • “Voice overs could be put together so we don’t have to play each slide separately.” <p>Need better accessibility to pharmacist while off campus</p> <ul style="list-style-type: none"> • “Accessibility with not being on campus was difficult.”
	More Pharmacist Experience	<p>May be helpful to include Acute Care pharmacist/pharmacist with more experience</p> <ul style="list-style-type: none"> • “Alternating an Acute Care vs Primary Care Pharm D would be ideal.” • “Perhaps someone with a little more practical experience in the field.” <p>Worried may lose nursing/prescriber view of medications</p> <ul style="list-style-type: none"> • “Don’t lose the nursing/provider side to managing medications.”

Discussion

Summary of Findings

Overall, DNP students responded positively to pharmacist instruction on pharmacotherapeutics. Many deficiencies identified from previous years’ evaluations seemed to have been resolved with the addition of a new instructor, and thematic analysis of the pharmacist-specific evaluation questions indicated that students appreciated pharmacist involvement in the course. New deficiencies could be easily remedied in future iterations of the course, such as organization of material on the distance learning platform, greater inclusion

of common medications prescribed in general practice, and increasing concordance between instructors’ feedback before returning comments to students. Incorporating feedback, such as reducing the amount of material covered in an exam, may take a more concerted effort, but this remained a common critique across years. Interestingly, students sometimes gave conflicting opinions, possibly because of varying preferences and learning styles, which may contribute to the results of the study. For example, some students enjoyed the assignments and textbook, while other students (even in the same year) did not

find the same readings and assignments beneficial. Future studies could further refine data quality by asking students to rate their opinion on different aspects of the course and how much each aspect impacted their learning.

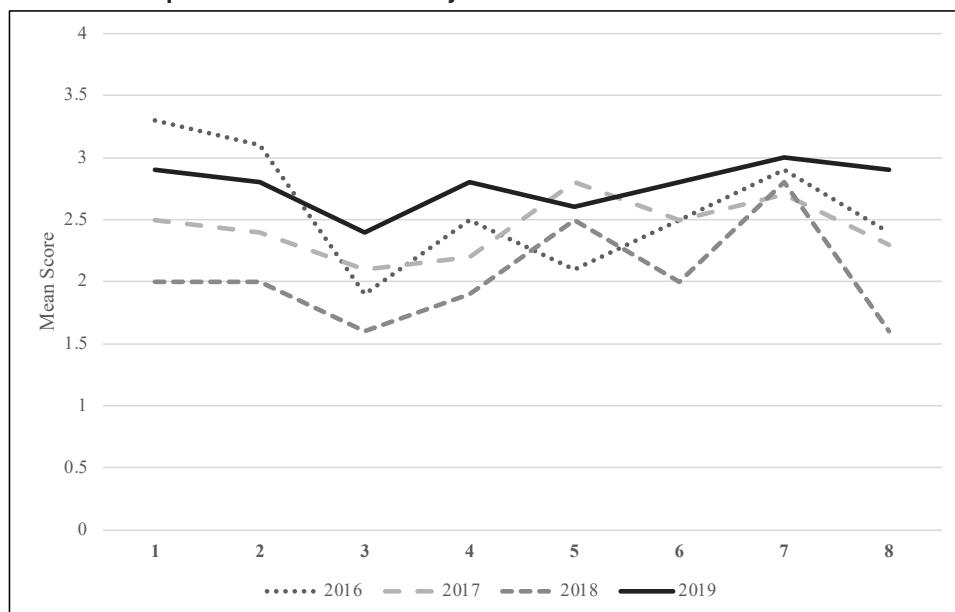
One major thematic change noticed between previous years and the 2019 semester was in the helpfulness of course materials. In the Spring 2016, 2017, and 2018 semesters, the most common theme mentioned was that the course materials were not beneficial; however, in the Spring 2019 evaluations, one of the most mentioned themes was that the course

materials were beneficial. This may be in part due to the pharmacist updating the materials and directing students to the most important information, indicating interdisciplinary cooperation with a pharmacist taking the lead in medication teaching may be beneficial for student learning. Teaching methods that the pharmacist incorporated into the course (e.g. knowledge check questions, updated discussion and reading quiz questions) may also have impacted the improved perception of benefit of course materials.

One of the most mentioned suggestions for improvement in the 2019 course evaluations was the timeliness of posting material, in that students would have appreciated the materials being available to view earlier. However, the overall feedback from students regarding pharmacist involvement in the course appeared to be positive. An example comment from one of the students highlights the positive reaction students had to a pharmacist educator: "Strongly encourage keeping the instructor because of positive interaction with students."

When asked to identify the benefits of having a pharmacist involved in teaching this course, students identified that having a pharmacist involved was helpful for interprofessional collaboration. Students also identified that the pharmacist developed positive interactions with the students and was a good resource for providing additional information outside of what was typically taught. The students suggested improving course organization similar to what was mentioned in the standard course evaluation response items. There were two comments on ensuring the pharmacist had practical experience in the field to provide the best resource for students in their learning environment. These types of comments highlight the importance of IPE in teaching healthcare professionals, as both the pharmacist and nurse practitioner educator have different perspectives to share with students. The identified themes in students' evaluations indicating students enjoyed the positive interdisciplinary cooperation and acknowledging pharmacists as a helpful resource for future practice highlights the benefit of IPE on student perception of benefit of interprofessional practice. This finding is supported by Vinluan and colleagues who evaluated both pharmacy

FIGURE 1. Response Item Mean Scores by Year



1. The objectives of the course were clear and understandable. 2. I was able to achieve the course objectives. 3. The organization of the course helped me to learn. 4. Course content supported achievement of the course objectives. 5. Readings were helpful in achieving course objectives. 6. Other supporting course materials were helpful in achieving course objectives. 7. I was encouraged to be an active participant in my learning. 8. Evaluation in the course was fair and measured my learning.

and nurse practitioner students' perceptions of IPE, and found that students' perceptions and attitudes towards IPE were positive after involvement in an interprofessional activity.⁶

Limitations

It was determined that course evaluations, prospectively collected for the 2019 year and retrospectively available from the 3 previous years, would be the primary method used to analyze the impact of including a pharmacist in a DNP course. Course evaluation review, rather than analysis of exam scores, was selected because of potential confounding factors. Different exam questions from each year would make it difficult to compare content knowledge instead of varying question difficulty. Additionally, some sections of the course content are inherently more difficult than others, so comparing different exam scores may not provide a clear picture of whether pharmacist involvement made a difference.

Students expressed wide variability in perceptions of what was beneficial and what was not. We attempted to minimize this limitation by including 3 years of previous data, but a larger sample size may be required to fully evaluate the potential variability across student cohorts. Additionally, analysis was limited to feedback students chose to self-report. Student fatigue may have limited the

breadth of feedback a student was willing to provide. Another potential factor that may have impacted our analysis was that the improvement in course evaluations could be solely because there was a new instructor, regardless of whether the individual was a pharmacist or not. Improvement in evaluations may also have been seen based on the methods the pharmacist used to teach the content, rather than general pharmacist expertise. We attempted to explore this possibility by assessing student evaluation of pharmacist involvement, but future studies of larger data with more than one classroom may help further explore this question. Lastly, course evaluations did not differentiate between the sections taught by the pharmacist and the ones taught by the nurse practitioner.

Future Directions

These results merit replication in an additional course with different instructors. One potential way to continue improving interprofessional practice and education of nurse practitioner students is by including pharmacists from specific specialties to lecture. As mentioned previously, the impact of IPE on DNP student outcomes could further support co-instruction by a pharmacist on a regular basis. Since nurse practitioners seemed to appreciate IPE with a pharmacist, future projects could

look at the impact of incorporating a pharmacist into other prescribers' education and visa-versa, including bringing a nurse practitioner educator into pharmacy school courses. Another potential area of research would be studying the long-term impact of IPE education on board pass rates for nurse practitioners and other health care professionals.

Conclusion

Collaboration with pharmacists and the field of pharmacy in general may enhance graduate nurse practitioner education and clinical practice in pharmacotherapeutics. By using IPE as a framework to incorporate a pharmacist into a DNP curriculum through a co-teaching model, students appear to both learn from and observe cross-disciplinary collaboration in action. Future projects are needed to evaluate the impact of such interprofessional/co-teaching models on student outcomes.

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