Pharmacy Education, 2016; 16 (1) 18 - 25

An interprofessional nursing and pharmacy student simulation in acute pain management

ERICA OTTIS[1*] & GRETCHEN GREGORY[2]

[1]*University of Missouri-Kansas City School of Pharmacy, University of Missouri, Columbia, Missouri 65211, USA*

[2]*Sinclair School of Nursing, University of Missouri, Columbia, Missouri 65211, USA*

Abstract

Background: A team simulation was designed to expose nursing and pharmacy students to interprofessional teamwork.

Aim: The goals were to emphasise patient safety in acute pain management, gauge change in attitudes about interprofessional learning, and have students understand more about the roles of different professions.

Methods: Teams of four students collaborated during the simulation. Learners completed pre- and post-surveys to measure attitudes toward interprofessional learning and change in clinical confidence. Students provided reflection regarding their perceptions about the interprofessional simulation.

Results: There was a positive shift among all students in attitudes from pre- to post-simulation. Differences between nursing and a cohort of pharmacy students were found for confidence in clinical skills, with nursing students gaining more confidence from participating in the simulation. Student reflection demonstrated that 42% had a better understanding of others' roles in patient care post-simulation.

Conclusion: This simulated activity emphasised how interprofessional teamwork can improve patient safety, encouraged students to develop new working relationships, and enhanced role identification around acute pain management.

Keywords: *Pain, Simulation, Safety, Pharmacy, Nursing*

Introduction

Interprofessional Education (IPE) has become an increasing focus in health professions education in order to prepare graduates for collaborative practice. IPE occurs "when students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes" (World Health Organisation [WHO], 2010: p.13 and Interprofessional Education Collaborative [IPEC], 2011: p.8). Accreditation guidelines for health professions schools have also begun to stress the importance of IPE. The current guidelines for the Accreditation Council for Pharmacy Education (ACPE) have a standard on interprofessional education that discusses preparing pharmacy graduates to serve as a contributing member of an interprofessional team in a variety of settings (ACPE 2016). The American Association of Colleges of Nursing (AACN) Baccalaureate Essentials requires a program to prepare the graduate to demonstrate appropriate team-building and collaborative strategies when working with interprofessional teams (AACN 2008). The Tri-Regular (Federation of State Medical Boards, National Association of Boards of Pharmacy, and National Council of State Boards of Nursing) collaborative position statement on interprofessional team-based patient care discusses achieving a patient-centered approach to care by supporting teams that foster shared responsibility and display mutual respect (Chaudhry *et al*., 2014).

Pain management is a complex and important topic in healthcare and there is evidence to support that the amount of time dedicated to pain in health professions curricula is not adequate and rarely provided in an interprofessional manner (Briggs *et al*., 2011; Tauben & Loeser, 2013). Different health professionals can provide input into the management of pain and approaching education interprofessionally may provide improvements in patient safety. However, many studies that address interprofessional team training for safe and effective pain management focus on post-graduate learners instead of pre-licensure students, and there is conflicting evidence for the effect of interprofessional pain management training on patient outcomes (Carr *et al*., 2003; Irajpour, 2006). The link between learning outcomes of health professions students and patient outcomes is a major incentive for incorporating additional IPE experiences into both pre- and post-licensure training (Institute of Medicine [IOM], 2015). One study that focused on pain education of pre-licensure students, described a curriculum for six different health science programs that focused on cancer related pain and included a combination of didactic sessions and small group sessions that utilised standardised patients. They demonstrated an improvement in students' beliefs and knowledge about pain, as well as a better understanding of interprofessional roles. The students in this curriculum also highly rated the standardised patient small group sessions (Watt-Watson *et*

[*]Correspondence: Erica Ottis, *Clinical Assistant Professor, 809 Lewis Hall Columbia, MO 65211, USA. Tel: +1 573 884 4960; Fax: +1 573 884 2166. Email: ottisej@umkc.edu*

ISSN 1447-2701 online

al., 2004). Others have also used standardised patients to assess acute pain management in both pre- and post-licensure physician and nursing trainees, and found that learners were more confident in their ability to manage acute pain and also had improved attitudes toward interprofessional collaboration (Salam *et al*., 2014).

This paper will describe an interprofessional team simulation, developed in the acute post-operative setting, for nursing and pharmacy students. These two professions were chosen to work together because of the significant role nursing and pharmacy have in assessing pain and guiding drug therapy to manage pain. In addition, the interaction of nursing and pharmacy students at the patient bedside was important to understanding the opposite profession's role in the management of pain. The specific goals of the simulation were to (1) emphasise patient safety issues surrounding acute pain management; (2) gauge student readiness for and change in attitudes about interprofessional learning; and (3) to provide a foundation of learning in the IPEC competency areas of interprofessional communication, roles and responsibilities, and teams and teamwork.

Methods

Interprofessional education at the University of Missouri-Columbia has been an ongoing effort since 2003 with a primary focus on quality improvement and patient safety (Vyas *et al*., 2012). The University of Missouri-Kansas City School of Pharmacy has a distance location in Columbia and those pharmacy students have participated in various IPE activities offered since 2008.

In the autumn of 2012, Objective Structured Clinical Exams (OSCEs) were integrated into the pharmacy curriculum and students from the main pharmacy campus in Kansas City (location A) travelled to the distance pharmacy campus in Columbia (location B) so all pharmacy students could utilise one simulation centre for these performance-based assessments. For spring 2013, there was an opportunity to work with the University of Missouri-Columbia Sinclair School of Nursing and incorporate an interprofessional team simulation into one of the stations that pharmacy students would rotate through as part of the OSCE. The pharmacy students were in their fourth year of a five-year curriculum and nursing students were in the first semester of their third year. It was the first formal IPE experience for the pharmacy students from location A. The pharmacy students from location B and the nursing students had previously participated in one or more IPE exercises. This simulation was repeated in the spring of 2014 and the results will include data from both iterations.

Simulation Scenario

In order to meet the learning objectives outlined in Table I, a simulation surrounding the care of a post-operative patient recovering from a hip replacement was developed. This IPE exercise was integrated into existing courses for both the nursing and pharmacy school. Slightly different learning objectives were defined based on the approaches used in preparing the two student groups, as described below, but the experience still emphasised the same IPEC competencies for all students.

Table I: Learning objectives for interprofessional team simulation

Pharmacy Simulation Objectives:
Knowledge • Determine the drug-related problem(s) leading to current symptoms Attitude • Increase positive attitudes related to the importance of interprofessional teamwork in maintaining patient safety Skills • Demonstrate effective interprofessional communication • Recommend appropriate pain management based on patient specific factors • Recommend therapies to manage the side effects of opiate pain medications • Educate patient on current pain management issues and how the team has resolved the issue • Communicate team management plan with physician member of the healthcare team

Nursing Simulation Objectives:
Knowledge • Same as above Attitude • Same as above Skills • Identify signs and symptoms of an adverse reaction to medication • React to medication adverse effects • Recognise opiate naïve patients and communicate information in a timely manner • Utilise Situation Background Assessment Recommendation (SBAR) for communication to pharmacy student • Communicate effectively between pharmacy students and nursing students/staff to provide safe and effective post-op pain management • Program PCA with double safety checks • Initiate frequent pain assessment after change in medication • Educate patient on current pain management issues and how the team has resolved the issue • Communicate team management plan with physician member of the healthcare team

Table II: Analytical checklist for interprofessional pain simulation

Gathering Information	Yes	No
1. Asks about home medications (Tylenol)		
2. Confirms patient drug allergies (hives/itching to codeine)		
3. Assess current level of pain on a 0-10 scale		
4. Determines patient has been experiencing significant nausea since beginning the morphine post-operatively		
5. Determines patient has been experiencing significant sedation since beginning the morphine post-operatively		
6. Determines that current PCA dose is too high for an elderly patient who is opiate naïve.		

Option/Management Strategies (including patient education)

7. Recommend change to fentanyl due to pruritus/ hives with morphine and codeine		
8. Discontinue basal opioid infusion		
9. Recommend appropriate fentanyl PCA regimen [Self-bolus: 25-50mcg **AND** lockout interval: 5-10 min **AND** max hourly limit: 100-300mcg]		
10. Recommend addition of Tylenol 500mg [1 **or** 2 tablets q 6h PRN pain]		
11. Recommend an anti-histamine for relief of itching from hives [Benadryl 12.5-25mg po/IV x1 **OR** hydroxyzine 25mg po/IV x1]		
12. Recommend an anti-nausea medication for acute management of nausea [Zofran 4-8mg IV x1 **OR** Phenergan 12.5-25mg IV x1 **OR** Compazine 5-10mg IV x1]		
13. Recommend a bowel regimen to prevent opioid induced constipation [**MUST** include senna or bisacodyl]		
14. Educate patient re: cause of current symptoms [nausea and fatigue]		
15. Educate patient re: changes to pain regimen		

Immediately before the simulation, students were divided into teams of two nursing students and two pharmacy students. Nursing students had been trained on the content of the case before entering the simulated environment. The training provided to the nursing students included how to utilise standardised communication techniques, how to perform a targeted assessment for a patient with acute pain, and clinical recommendations to consider based on patient findings. The pharmacy students were receiving a course grade for their performance, evaluated by an analytical checklist (Table II), therefore pharmacy students had no knowledge of the patient case scenario prior to the simulation. Upon entering the simulated environment, all of the students were given a brief introduction to the patient by a standardised physician, who was role played by a pharmacy faculty member (Table III). The standardised physician introduced the students to the case and provided medication orders based on the nursing/ pharmacy team recommendations, but did not provide additional assistance.

Table III: Stem statement provided to students by standardised physician

Introduction: It is now 3 pm and you are seeing Clara Goldy, a 73-year-old female with a PMH of osteoarthritis who was admitted for a right total hip replacement. The surgery was performed 8 hours ago and was successful with minimal blood loss. In the post-op recovery area the patient received 4 doses of Fentanyl 25mcg with minimal relief of pain, therefore patient controlled analgesia (PCA) was started 6 hours ago, and the current PCA settings are in her chart.

Her current vitals are: BP 105/63, RR 12, HR 61, O_2 sat 97% on room air

Pertinent Physical Exam:
On my initial physical exam her pupils are reactive to light, her lungs are clear to auscultation and her cardiovascular exam is normal. She has normal bowel sounds and no bleeding or oozing from the surgical site.

Final Stem Statement: Please work as a team to assess the current status of the patient. Nursing students, please begin with patient assessment and pharmacy students we have provided you with a bedside chart to review the patient's current labs and medication orders to assess their appropriateness. Once your assessments are complete, please communicate with me as a team to provide your recommendations for the patient.

Nursing students started with a targeted assessment of the patient. Safety issues were embedded to be discovered as part of the assessment. The standardised patient appeared sedated and voiced concern regarding nausea. The patient was also wearing an allergy arm band with a known codeine allergy, and the patient was beginning to experience itching and hives at the intravenous administration site from the morphine that had been ordered.

Pharmacy students were provided with a bedside chart to review medications that had already been ordered and administered post-operatively. Pharmacy students were not provided with a home medication list for the patient, however if they talked to the patient regarding what she took at home for pain, they were able to elicit that the patient had only been using acetaminophen prior to admission. Due to inappropriate dosing of morphine in an opiate naïve patient, the standardised patient was experiencing a slightly depressed respiratory rate and excessive sedation. The codeine allergy was also noted in the patient chart. After their initial assessments, pharmacy and nursing students continued to discuss patient concerns and the identified potential threats to patient safety as an interprofessional team at the bedside. Nursing students were instructed to utilise communication tools such as Situation, Background, Assessment and Recommendation (SBAR) for interprofessional communication. The students worked as a team to address adverse reactions and design a safe and effective pain

regimen for the patient within a 20 minute time period. This included identifying an alternative regimen to control the patient's acute pain, providing recommendations on how to treat the patient's nausea and itching, and communicating the team plan with the standardised physician. Once the standardised physician had signed off on the orders, the nursing students demonstrated to the pharmacy students the appropriate way to change out the patient controlled analgesia (PCA) syringe at the bedside, and the pharmacy students briefly explained the medication changes that were being made to the standardised patient.

The standardised physician also served as an evaluator for the simulation. Pharmacy students were assessed on the ability to identify drug-related problems and make medication therapy decisions during the simulation. The analytical checklist (Table II) served as the evaluation tool for the pharmacy students. The checklist was validated and a cut score was calculated by faculty not involved in the original writing of the simulation scenario. If pharmacy students exceeded the predetermined cut score then a "pass" score was received for the station. Pharmacy students were given credit for a checklist item even if the nursing students made or assisted with the recommendation due to the interprofessional nature of the simulation. Nursing students were evaluated on targeted assessment, interprofessional communication skills, and safe medication administration. The standardised patient also evaluated the entire interprofessional team on the effectiveness of their communication with patients. Each nursing student participated in the simulation two to three times due to a mismatch between the numbers of nursing and pharmacy students. Using standardised communication strategies with the student pharmacist and standardised patient was stressed during the repeated participation of nursing students.

Following the simulation, students participated in a 20 minute debrief session, facilitated by a pharmacy and nursing faculty member, which focused on interprofessional teamwork and communication. This included discussion on how to set appropriate treatment goals as a team, the importance of documentation in acute pain management, and ensuring the use of communication models (*i.e.* SBAR) that were both interprofessional and patient-centered. Roles and responsibilities of the different professions in the care of the patient were also discussed.

One week prior to the event, all students completed a 19 item electronic survey. Survey items were adapted from both the Readiness for Interprofessional Learning Survey (RIPLS) (Parsell & Bligh, 1999) and the Evaluation of Teamwork Knowledge, Attitudes and Skills for Health Sciences Students (Brock *et al*., 2011). The survey was adapted from these two validated tools to include questions that were pertinent to our simulation scenario and to shorten the length of the survey from greater than 50 items down to nineteen. Survey items are presented in Table IV.

Table IV: Student responses pre- and post-interprofessional acute pain simulation (n=303)

Survey Item[a]	Pre-Survey Mean Score	Post-survey Mean Score
I have experience WORKING as part of an interprofessional team	3.5	3.5
I have experience LEARNING as part of an interprofessional team	3.7	3.7
I am looking forward to (pre)/enjoyed (post) the interprofessional team activity	3.8	4.1**
I believe interprofessional education is beneficial	4.3	4.5**
Learning with other disciplines will help me to become a more effective member of a healthcare team	4.3	4.5**
Patients ultimately benefit if interprofessional healthcare students learn together to solve patient problems	4.4	4.6**
Interprofessional healthcare team training exercises help me appreciate other professionals	4.2	4.5**
Shared learning with other health care students will help me to communicate better with patients and other professionals	4.2	4.4**
Teamwork skills are essential for all healthcare students to learn	4.4	4.6**
Shared learning during my professional program will help me become a better healthcare team provider	4.3	4.5**
I don't want to waste my time learning with other health care students	2.0	1.6**
I feel unsure about my professional role as part of an interprofessional healthcare team	3.3	3.1**
Participating in simulated team exercises with other healthcare students is a good use of learning time	3.8	4.2**
Working in an interprofessional healthcare team improves patient safety	4.3	4.6**
I can work with an interprofessional healthcare team to develop a treatment plan	4.1	4.2**
I can easily communicate therapeutic recommendations with other members of the healthcare team	3.9	4.0*
I can effectively gather information from a patient encounter to identify therapeutic problems	4.0	4.1
I feel I am very good at integrating information into a plan	3.8	4.0*
I can communicate a therapeutic plan to a patient effectively and concisely	4.0	4.0

[a] Mean score based on a 5 point Likert scale from 1=Strongly Disagree to 5=Strongly Agree

* $p<0.05$

** $p<0.001$

Students closed the experience with a post-survey containing identical questions to the pre-survey and four additional questions addressing interprofessional teamwork during the simulation (Table V). Both the pre- and post-survey also contained open-ended questions. On the pre-survey students were asked, "What is the most important thing you expect to learn from this interprofessional activity?" and "What other comments do you have about interprofessional learning?" The post-

survey asked, "What is one thing you learned about the role of nurses or pharmacists in acute pain management that you did not know before today?" and "What is the most important learning experience you took away from the interprofessional training?"

Table V: Additional post -survey results on teamwork (n=303)

Survey Item[a]	Mean Score (±SD)
Patients were utilised as critical components of the care team	4.0 (±0.72)
Healthcare team members were consulted for their expertise	4.2 (±0.65)
Healthcare team members exchanged information with the patient	4.1 (±0.71)
Healthcare team members asked questions about information provided by other team members	4.1 (±0.76)

[a] Mean score based on a 5 point Likert scale where 1=Strongly Disagree to 5=Strongly Agree

Survey results were de-identified for analysis to protect participant confidentiality. Data were analysed in aggregate using descriptive and non-parametric statistics calculated by SAS version 9.3 (Cary, NC). Descriptive statistics were used for demographic data and for post-survey questions that were not included on the pre-survey. Survey results were matched for each student and the sign test was used to assess the difference between pre- and post-survey responses for all students. The Wilcoxon Rank-Sum test was used to assess the change in scores from pre- to post-simulation between the location A and B pharmacy students, and the change in scores from pre- to post-simulation between the location B pharmacy students and nursing students. Nursing students were only compared to location B pharmacy students to control for confounders that may have been present due to different baseline experience with IPE and the lack of a nursing cohort from location A. For the qualitative data gathered from open-ended survey questions, one investigator coded each result by major themes in order to apply descriptive statistics to student responses. This educational exercise was reviewed and approved by the IRB at both campus locations.

Results

Over two years 343 students participated in the interprofessional simulation. Of these, 25% were nursing students and 75% were pharmacy students. A total of 303 students completed both a pre- and post-survey (88% response rate). Overall, when comparing pre-survey responses to post-survey responses for all students there were several items where a significant difference was seen (Table IV). There was a statistically significant difference from pre- to post-simulation in questions related to attitudes toward IPE and the benefits of shared learning on both teamwork and patient care. Students also had a significant change on some survey items related to confidence in clinical skills from pre- to post-simulation. Specifically, students felt that they could work with an interprofessional team to develop a treatment plan ($p<0.001$), communicate therapeutic recommendations with other members of the healthcare team ($p=0.0017$), and integrate information into a plan ($p=0.016$). Two items regarding clinical confidence did not show a significant difference from pre- to post-simulation and centred around working with the patient. The simulation had a neutral effect on students' ability to gather information from a patient to identify therapeutic problems ($p=0.18$) and communicate a therapeutic plan to a patient ($p=0.11$). The simulation also had a neutral effect on familiarity of learning or working with an interprofessional team for the entire student cohort.

Post-simulation, 85% of nursing and pharmacy students either agreed or strongly agreed that the patient was included as part of the team, 87% agreed or strongly agreed that team members exchanged information about the patient, and 85% either agreed or strongly agreed that team members asked questions of each other based on information provided. Mean responses for these survey items related to teamwork can be found in Table V. Pharmacy students received a passing score 94% of the time as evaluated by the analytical checklist (Table II).

When examining responses among various subgroups of students based on campus location and profession, significant differences were not seen from pre- to post-simulation between the location A (n=177) and location B (n=58) pharmacy students. However, when comparing the mean change from pre- to post-survey responses between the location B pharmacy students (n=58) and nursing students (n=68), significant differences were seen for five survey items (Table VI). Specifically, a significant difference was observed for three survey items related to confidence in clinical skills such as developing a treatment plan ($p=0.016$), communicating recommendations to other team members ($p=0.005$), and integrating information into a plan ($p=0.007$). While both professions experienced change in the positive direction, nursing students had a higher magnitude of change from pre- to post-simulation.

Qualitative comments to the open-ended survey questions were also collected. Pre-simulation, when students were asked "What is the most important thing you expect to learn from the interprofessional activity?", team communication (34%), the roles and responsibilities of their own profession and other health care professionals within the team (28%), and how to work better as a team (26%) were the most common themes. Post-simulation, students were asked, "What is one thing you learned about the role of nurses or pharmacists in acute pain management that you didn't know before today?" Prominent themes that emerged included specific observations regarding roles in patient care (42%), learning more about the other professions' clinical knowledge base (22%), and how to utilise other team members for efficient and safe patient care (17%). Selected student comments are presented in Table VII.

Table VI: Comparison of mean change from pre- to post-simulation for location B pharmacy students vs. nursing students (n=126)

Survey Item[a]	Nursing (n=68)	Location B Pharmacy (n=58)
	Mean change pre to post	Mean change pre to post
I have experience WORKING as part of an interprofessional team	0.35	-0.10*
Participating in simulated team exercises with other healthcare students is a good use of learning time	0.40	0.14*
I can work with an interprofessional healthcare team to develop a treatment plan	0.41	0.16*
I can easily communicate therapeutic recommendations with other members of the healthcare team	0.38	0.07*
I feel I am very good at integrating information into a plan	0.37	0.10*

[a] All responses based on a 5 point Likert scale from 1=Strongly Disagree to 5=Strongly Agree

* $p<0.05$

Table VII: Representative Student Comments from Qualitative Data

Theme	Student Comment
Teamwork	"Trust in your teammates because you can't do it all by yourself and working as a team improves patient care."
	"I learned that working as a team is the best way to provide safe and effective medical treatment to patients."
	"Every member of the health care team has different strengths and we should utilise each other in order to provide the best care to our patients."
Communication	"Interprofessional communication is important in improving patient care and it can be done successfully when we get together, respect each other, listen to each other, and care for our patient."
	"I learned that communication is essential in patient safety and that each healthcare professional can gain important information from other healthcare professionals."
	"Personally, I failed to express myself more effectively. I didn't mention that I had a concern about the patient allergy and the medication she was on..."
Role clarity	"I learned that nurses are able to assess and make recommendations on treatment for patients."
	"Nurses can do many of the same thing pharmacists' can- which if we had known about this before could have decreased the amount of time having to revisit things, redoing things, and could have increased overall patient care."
	"I learned that the pharmacists played a more integral role at the bedside then what I previously assumed."
	"I assumed it was my job to relay the information between pharmacy and my patient but it is nice that they [pharmacist] come and are involved in close proximity so they can answer any questions the patient might have that are outside of my scope of practice."

Discussion

This pilot project allowed nursing and pharmacy students the opportunity to work as an interprofessional team in identifying potential safety issues for a patient with acute pain. Overall, students demonstrated improved attitudes toward interprofessional learning and recognised the importance of shared learning, communication, and teamwork to address patient safety issues. While students did not perceive much improvement in some of their clinical abilities post-simulation, such as integrating information into a plan or communicating that plan with the patient, this is to be expected. The majority of students participating had not been exposed to an interprofessional team simulation and repeated IPE exercises would most likely be necessary to show increased confidence in clinical knowledge or abilities. For example, Watt-Watson *et al*. (2004) found that after pre-licensure health science students completed a 20 hour curriculum on pain management, significant differences in pain knowledge and beliefs were observed. For the location B pharmacy students and the nursing students who had all participated in one or more IPE activities there were some significant differences found when comparing confidence in clinical abilities between the two professions from pre- to post-simulation. The nursing students had a greater magnitude of positive movement for all items where there was a significant difference between the professions. This could demonstrate a relationship between the nursing students repeating the simulation multiple times and gaining confidence with integrating information into a plan and communicating that plan as part of an interprofessional team. Another possible explanation for this finding includes the training the nursing students received prior to the simulation. Having an enhanced awareness of anticipated clinical findings and information on how to utilise standardised communication techniques, such as SBAR, may have contributed to the significant difference found between the nursing and location B pharmacy students. For one item in particular regarding experience working as an interprofessional team, the location B pharmacy students had negative movement from pre- to post-simulation. This result may be explained by the pharmacy students drawing on previous knowledge of working in interprofessional teams and having an increased sense of confidence pre-simulation regarding their teamwork skills. In addition, the pharmacy students were receiving a grade based on their clinical performance during the simulation. Individual student perception of performance may have affected the response to the question as some may have felt post-simulation that they were an ineffective member of the team.

Students also felt post-simulation that they were able to work effectively together in exchanging information and asking questions of each other. They also felt patients were included as part of the team. Based on these results and the additional qualitative comments where students often mentioned the goal of improving care and patient safety as part of teamwork, it appears that the goal of exposing students to and helping them understand the

contributions of interprofessional teamwork and communication to building a safer care environment was met.

This experience focused on the collaborations necessary between nursing and pharmacy students in the management of acute pain. Both of these professions have a major role in assessing and treating pain and this team simulation contributes a unique perspective on the nursing-pharmacy dyad relationship and how they value working together. Students had to share information that each profession had gathered in order to address the most immediate patient safety concerns. The qualitative data was valuable in exploring this relationship as the students commented many times on learning about the other professions role in the care of a patient and how to utilise each other to improve care. By working together as a team the students were able to see how the roles of both nursing and pharmacy are vital to safe pain management.

This interprofessional team simulation was certainly not without limitations. While validated tools were utilised to measure the change in student attitudes, these tools were adapted to meet the needs of this specific simulation. Also, while there is literature to support that a single intervention can improve attitudes toward IPE (Miller *et al*., 2013), and our results certainly demonstrate improvement in attitudes, repeated exposure to IPE could sustain these attitudes and help to increase student confidence in working on a team. The learners in this simulation were also at different points in their curriculum, with the nursing students having limited clinical experience compared to the pharmacy students. Attitudes of the pharmacy students may have been harder to change at that point in their curriculum. A goal in the future would be to better integrate interprofessional activities throughout both the pharmacy and nursing curriculum and measure attitudes early on and at the end of their student career. Additionally, because the post-survey was completed immediately after the simulation, retention of what was felt or learned from the interprofessional simulation would be difficult to measure. Unlike Carr *et al*. (2003) who observed a decrease in average patient pain scores after interprofessional seminars on pain management, our results do not allow us to link this particular IPE exercise with improvements in patient safety surrounding pain management in the clinical setting. More robust evaluation measures and a real-time bedside IPE exercise would need to be developed to assess the impact of this student cohort on patient care.

In addition to these limitations, the verbal feedback from students during the debriefing session allowed us to understand the importance of designing future iterations of the simulation to include time for team formation. Similar to the icebreaker activity mentioned by Miller *et al*. (2013), allowing students to come together as a team for five-ten minutes prior to the beginning of the simulation should help them become more comfortable with each other. Having some time to discuss each profession's role within the context of the case may also help them perform better as a team. The lack of team formation prior to the simulation may also explain why students felt there was no impact on their experience learning or working with an interprofessional team from pre- to post-simulation. Because the pre-simulation preparation was different for nursing and pharmacy, this affected the current design of the simulation. Changing the design in the future where similar goals and preparatory work for both professions are utilised may allow the interprofessional team to develop increased cohesion regarding interprofessional teamwork and communication. Like Salam *et al*. (2014) who found that a low stakes learning environment allowed for increased learner engagement, designing the simulation in a low stakes way for all learners may produce more broad change in clinical confidence regarding acute pain management and engagement with the patient at the bedside.

Conclusion

Interprofessional team simulations are a successful way to increase interactions between nursing and pharmacy students and improve the understanding of clinical roles and responsibilities in the management of pain. The simulation also helped to emphasise how interprofessional teamwork and communication can maintain a safe patient environment and demonstrated improved attitudes toward interprofessional education.

Acknowledgements

The authors wish to acknowledge the staff of the Russell D. and Mary B. Shelden Clinical Simulation Centre, Dr. Wade Davis and Dr. Bin Ge of the University of Missouri Biostatistics and Research Design Unit, and Dr. Deepti Vyas and Dr. Kathy Bowman for their thoughtful review of the paper.

Conflicts of Interest

The authors can confirm no conflict of interest.

References

Accreditation Council for Pharmacy Education: [ACPE], (2015). Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree (online). Available at: https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf. Accessed 17th January, 2016.

American Association of Colleges of Nursing [AACN], (2008). The Essentials of Baccalaureate Education for Professional Nursing Practice (online). Available at: http://www.aacn.nche.edu/education-resources/BaccEssentials08.pdf. Accessed 17th January, 2016.

Briggs, E., Carr, E. & Whittaker, M. (2011). Survey of undergraduate pain curricula for healthcare professionals in the United Kingdom. *European Journal of Pain*, **15**(8), 789-795.

Brock, D., Abu-Rish, E., Vorick, L., Wilson, S., Liner, D., Schaad, D. & Blondon, K. (2011). Online evaluation of teamwork knowledge, attitudes and skills for health science students (online). Available at: http://collaborate.uw.edu/tools-and-curricula/tools-for-evaluation.html. Accessed 17th January, 2016.

Carr, E., Brockbank, K. & Barrett, R. (2003). Improving pain management through interprofessional education: evaluation of a pilot project. *Learning in Health and Social Care*, **2**(1), 6-17.

Chaudhry, H.J., Catizone, C. & Apple, K. (2014). The Tri-Regular Collaborative position statement on interprofessional, team-based patient care (online). Available at: https://www.ncsbn.org/Team-Based_Care.pdf. Accessed 17th January, 2016.

Interprofessional Education Collaborative [IPCE], (2011). Core competencies for Interprofessional Collaborative Practice (online). Available at: https://ipecollaborative.org/uploads/IPEC-Core-Competencies.pdf. Accessed 17th January, 2016.

Institute of Medicine [IOM], (2015). Measuring the Impact of Interprofessional Education on Collaborative Practice and Patient Outcomes (online). Available at: http://iom.nationalacademies.org/Reports/2015/Impact-of-IPE.aspx. Accessed 17th January, 2016.

Irajpour, A. (2006).Interprofessional education: a facilitator to enhance pain management? *Journal of Interprofessional Care*, **20**(6), 675-678.

Miller, A., Morton, S., Sloan, P. & Hashim, Z. (2013). Can a single brief intervention improve participants' readiness for interprofessional learning? *Journal of Interprofessional Care*, **27**(6), 532-533.

Parsell, G. & Bligh, J. (1999). The development of a questionnaire to assess the readiness of health care students for interprofessional learning (RIPLS). *Medical Education*, **33**, 95-100.

Salam, T., Saylor, J.L. & Cowperthwait, A.L. (2014). Attitudes of nurse and physician trainees towards an interprofessional simulated education experience on pain assessment and management. *Journal of Interprofessional Care*; Early Online **1-3**.

Tauben, D. & Loeser, J. (2013). Pain Education at the University of Washington School of Medicine. *The Journal of Pain*, **14**(5), 431-437.

Vyas, D., McCulloh, R., Dyer, C., Gregory, G. & Higbee, D. (2012). An interprofessional course using human patient simulation to teach patient safety and teamwork skills. *American Journal of Pharmaceutical Education*, **76**(4) Article 71.

Watt-Watson, J., Hunter, J., Pennefather, P., Librach, L., Raman-Wilms, L., Schreiber, M, Lax, L., Stinson, J., Dao, T., Gordon, A., Mock, D. & Salter, M. (2004). An integrated undergraduate pain curriculum, based on IASP curricula for six health science faculties. *Pain*, **110** (1-2), 140-148.

World Health Organisation [WHO], (2010). Framework for action on interprofessional education and collaborative practice. Available at: http://whqlibdoc.who.int/hq/2010/WHO_HRH_HPN_10.3_eng.pdf. Accessed 17th January, 2016.