BRIEF

A Mapping Review of Teamwork Training and Assessment in Pharmacy Education

Kathryn A. Morbitzer, PharmD, MS, Amanda A. Olsen, PhD, MA, Jacqueline E. McLaughlin, PhD, MS

a University of North Carolina at Chapel Hill, UNC Eshelman School of Pharmacy, Chapel Hill, North Carolina
b University of Texas at Arlington, Arlington, Texas

Corresponding Author: Kathryn Morbitzer, University of North Carolina at Chapel Hill, UNC Eshelman School of Pharmacy, 321A Beard Hall, Campus Box 7574, Chapel Hill, NC 27599. Tel: 919-966-9124. Email: kmorbitzer@unc.edu

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Objective. To explore how teamwork is taught (ie, skills and format), measured, and assessed within pharmacy education. Findings. Of the 114 references retrieved, 18 studies met the inclusion criteria for review and data abstraction. The included studies encompassed 17 schools or colleges of pharmacy. Ten studies (56%) described how teamwork training was integrated into courses while other studies included workshops, clinical rotations, modules, interprofessional simulations, long-term projects, and retreats. Learning activities involving patient cases were the most common teaching methods described [n=12 (67%)]. For the teamwork principles taught, all articles included leadership training or evaluating leadership skills in their program. To assess teamwork, 17 (94%) of the programs used self-reported measures of skills/behaviors, attitudes, and/or knowledge. No standardization existed between the skills/behaviors, attitudes, and knowledge attributes assessed nor the method in which these attributes were assessed. Fourteen studies (78%) demonstrated improvements in attitude-related outcomes, 13 (72%) studies demonstrated improvements in skills-related outcomes, and six studies (33%) described improvements in knowledge related outcomes.

Summary. Teamwork is regarded as an integral component of being an effective health care professional. While teamwork is common in pharmacy curricula, there are few studies describing strategies for teaching pharmacy students effective teamwork strategies. The articles reviewed revealed a wide range of approaches to teaching, measuring, and assessing teamwork skills within pharmacy education. This review highlights an opportunity to further explore and identify the teamwork skills that are requisite for success in pharmacy practice, which could then be supported by standardized teamwork training programs and assessments.

Keywords: pharmacy student, teamwork, training, education

INTRODUCTION

A growing body of health science literature emphasizes the importance of teamwork. In health care practice, experts increasingly agree that including pharmacists on health care teams can improve patient outcomes. Similarly, employers of pharmaceutical sciences graduates recognize collaboration as a key skill for success in today’s workplace. Effectively preparing students for the realities of team-based care and other collaborative environments remains a key focus, and challenge, as pharmacy schools work to develop curricula aligned with the health care needs of society.

Teamwork in pharmacy education is prevalent and diverse, varying in its context, purpose, and structure. Students may encounter teamwork through the use of classroom-based pedagogies such as project-based learning (PjBL) or team-based learning (TBL). Experiential education, such as introductory pharmacy practice experiences (IPPEs) or advanced pharmacy practice experiences (APPEs) may also involve collaboration with technicians, pharmacists, or other members of the health care team. Further, students may experience teamwork within educational environments and groups, such as research laboratories, academic committees, and co-curricular organizations.

Research on group-based pedagogies, such as TBL and interprofessional education (IPE), generally describes positive outcomes. When compared to traditional lecture formats, TBL can result in increased student engagement and improved learning outcomes. Similarly, interprofessional immersion can improve learner views of collaborative ability, confidence, and importance. While clear consensus concerning the importance (ie, why) of teamwork exists, there is a lack of literature and related research describing strategies for teaching pharmacy students how to work in teams (ie, how teamwork is taught, measured, and assessed).

The purpose of this study was to review published research in pharmacy education that described how students were taught to work in teams and/or assessed as collaborators. The following research questions were explored:

(RQ1) How is teamwork taught (ie, skills and format) within pharmacy education?
(RQ2) How is teamwork measured and assessed within pharmacy education?
METHODS

The protocol for this mapping review was developed to provide the most comprehensive selection of articles and to specifically capture how teamwork is taught, measured, and assessed within pharmacy education. To be included in this paper, studies must have met the following criteria: 1) included students in a PharmD curriculum from accredited pharmacy schools, 2) were peer reviewed, 3) were published between 2000-2019, and 4) described teaching teamwork and/or how teamwork is measured and assessed within pharmacy education. Specific outcomes related to teamwork skills/behaviors, attitudes, and/or knowledge as defined by Baker and colleagues needed to be reported in the study to be eligible for inclusion. Studies were excluded if they: 1) solely reviewed the literature (e.g., meta-analysis, systematic review, literature review, etc.), 2) were not peer reviewed (e.g., commentaries, dissertations, book chapters, etc.), 3) were solely on survey development (i.e., studies to develop surveys used to assess teamwork), 4) were only on assessing readiness but not how teamwork was taught, or 5) were solely published in an abstract format.

The databases that were selected for this review included PubMed/Medline, SCOPUS, PsychINFO, EMBASE, and ERIC. PubMed/Medline, SCOPUS, and EMBASE are databases commonly used to identify studies that are related to health care and interventions, ERIC was selected to find additional education articles, since it is the largest education database in the world, and PsychINFO was selected to capture interdisciplinary research in education and the social sciences. The search terms selected for this review were “pharmacy education” AND teamwork. These search terms were selected to provide the most comprehensive, inclusive, and broad selection of articles related to teamwork in pharmacy.

Journal articles were cataloged in Mendeley (London, United Kingdom), a reference management software, and were uploaded into Covidence (Melbourne, Australia), a software used for abstract and article screening, data extraction, and quality assessment. Each abstract was screened by two individuals for inclusion in the full article screening, and conflicts were resolved by a third reviewer. Subsequently, each full article was screened by two individuals for inclusion in the review, and conflicts were resolved by a third reviewer. For the full review, data extraction was completed by two individuals, who each extracted data from half of the included articles for 13 different variables of interest. Ten percent of the articles were reviewed and audited by a third individual with more than 95% agreement across variables.

Variables of interest for this study included the teamwork training program design or intervention, duration of the program, learner characteristics or demographics, teaching methods used, teamwork knowledge, skills, and behaviors emphasized as defined by Baker and colleagues, teamwork model/instrument utilized, outcomes expected/measured, individual(s) performing the assessment, and intervention results, among others (Table 1). Baker and colleagues’ teamwork framework was utilized since these knowledge, skills, and behaviors were established to meet the Institute of Medicine’s recommendation that organizations develop effective, evidence-based interdisciplinary team training programs. A review with similar methodology utilized the Baker and colleagues framework to assess teamwork training in medical student and resident education. All variable information and related data were cataloged in an Excel document.

RESULTS

Of the 114 references identified, 21 duplicate articles were removed, 50 articles were deemed irrelevant during the initial screening phase, and 25 articles were excluded based on the eligibility criteria. This resulted in 18 studies fulfilling all criteria for inclusion and data extraction. The included studies encompassed 17 schools or colleges of pharmacy. Pharmacy student involvement in the programs ranged from first-year to fourth-year students. Nine studies (50%) described programs that also included students from other health professions, with the most common being nursing [n= 7 (39%)] and medicine [n = 6 (33%)].

RQ1: How is teamwork taught (ie, skills and format) within pharmacy education?

Table 2 describes the characteristics of teamwork training programs published within pharmacy education. Ten studies (56%) described how teamwork training was integrated into courses while other programs included workshops [n = 2 (11%)], clinical rotations [n = 2 (11%)], modules [n = 1 (6%)], interprofessional simulations [n = 1 (6%)], long-term projects [n = 1 (6%)], and retreats [n = 1 (6%)]. Learning activities involving patient cases were the most common teaching methods described with patient simulations, role-play exercises, and patient encounters included in 12 articles (67%). Duration of programs ranged from a one-day workshop to a semester long course.

For the teamwork principles taught, all articles described included leadership training or evaluating leadership skills in their program. Specifically, 16 (89%) articles described their program addressing the solicitation of team member ideas in defining goals and objectives, and 13 (72%) articles described their program addressing fostering trust between
team members. Nine studies (50%) did not describe a specific teamwork model used to teach teamwork within the program designs (Table 2).

RQ2: How is teamwork measured and assessed within pharmacy education?

The reported outcomes of the teamwork training programs are described in Table 3. Seventeen (94%) of the programs used self-reported measures of skills/behaviors, attitudes, and/or knowledge. No standardization existed between the skills/behaviors, attitudes, and knowledge attributes assessed nor the method in which these attributes were assessed. Examples of skills/behaviors measured included communication, ability to integrate information into a therapeutic plan, and ability to work cohesively as a team. Attitude measures identified included assessing the importance placed on collaboratively working with peers or on a team and believing that teamwork skills can be learned. Of the five studies that reported on knowledge-related outcomes, four (80%) studies assessed student understanding of roles within a team and other health care professions.

Six (33%) programs used instruments that had undergone reliability testing and had been previously validated, including the Interdisciplinary Education Perception Scale (IEPS), the Readiness for Interprofessional Learning Scale (RIPLS), the Performance Assessment of Communication and Teamwork (PACT), and the Student Perceptions of Physician-Pharmacist Interprofessional Clinical Education (SPICE) instrument. Fourteen studies (78%) demonstrated improvements in attitude-related outcomes, 13 (72%) studies demonstrated improvements in skills-related outcomes, and six studies (33%) described improvements in knowledge-related outcomes.

DISCUSSION

Within the pharmacy profession, increased emphasis has been placed on the importance of teamwork across the health professions for improving patient care and patient safety. Previous literature has demonstrated that teamwork and successful team performance can be developed through training, specifically when team members learn key tenants of teamwork, as well as practice and continuously develop their teamwork skills. In order to aid the incorporation of teamwork training within the pharmacy curricula, this review examined programs designed to teach, measure, and assess teamwork within pharmacy education.

As stated previously, literature within the health professions emphasizes the importance of effective teamwork and the articles identified through this review demonstrate the various collaborative learning approaches used within pharmacy curricula. While group-based pedagogies such as TBL or PjBL are commonly used within health professions curricula and have been shown to enhance student knowledge, retention, and problem-solving skills, our review suggests that there is not currently a consistent way in which students are taught how to work in teams (ie, inconsistent format of teamwork, skills taught, and assessment strategies within pharmacy education).

While specific teamwork training programs for explicit purposes exist, such as TeamSTEPPS® for interprofessional teamwork training, there is not a standardized format or program used to teach teamwork skills within pharmacy education. Additionally, most teamwork formats were incorporated within an isolated course in the curriculum, which only accounted for approximately half of the programs described in the literature. This mapping review can be used by others in the academy to determine formats used to teach teamwork and outcomes used to measure and assess teamwork. However, given the importance of being able to effectively work within a team in the pharmacy profession, educators should consider whether it is prudent and feasible to create or adapt a standardized teamwork training program for pharmacy education. The work from Baker outlines principles to include within the teamwork format. Baker states that teamwork should be distinct from taskwork and that formats which allow those to function with only the knowledge and skill of the task at hand is not enough. Teamwork depends on each group member being able to anticipate the needs of others, adjust to each other’s actions and to the changing environment, and to have a shared understanding of how a procedure should happen. Based on the teamwork formats described in the articles included in the mapping review, it seems reasonable to question whether a format including all of Baker’s principles currently exists within pharmacy education.

Relatedly, it has been suggested that, under the theory of social regulation of learning, optimal collaborative learning includes students monitoring and controlling for their own, peers’, and group’s cognition, motivation, and emotions during a group task. While our review indicates that some currently used teamwork formats incorporate some of these principles, there still appears to be a lack of format which utilize techniques and tools that teach students how to regulate within groups. A recent study by Lyons and colleagues introduces a new web-based tool for fostering social regulation of learning within collaborative learning. Tools such as this may be beneficial to use within a variety of teamwork formats in order to help create metacognitive awareness and allow students to identify and develop strategies to overcome challenges within teams.
One reason for the lack of standardization among teamwork training may be the limited consensus regarding teamwork core competencies for pharmacists. The Center for the Advancement of Pharmacy Education (CAPE) 2013 Educational Outcomes state that pharmacists should actively participate and engage as a health care team member by demonstrating mutual respect, understanding, and values to meet patient care needs.\textsuperscript{38} However, the CAPE educational outcomes do not provide guidance on specific teamwork skills pharmacy curricula should emphasize to meet the associated outcome, instead deferring to each school’s own interpretation. Our review shows that all published programs incorporate some combination of the eight teamwork principles outlined by Baker, but the emphasis and priority placed on each principle remains unknown.\textsuperscript{19} This suggests there is an opportunity to define core competencies related to teamwork to guide how pharmacy schools achieve the CAPE educational outcome.

In addition to defining teamwork core competencies for the pharmacy profession, our review also indicates that variability exists in how teamwork skills are assessed. Currently, published literature demonstrates that teamwork skills are widely self-assessed by students using surveys or questionnaires.\textsuperscript{9,21,23-26,28,29,31-33,35,36} While the self-assessment of teamwork skills may instigate crucial self-reflection for improvement within students, it may also be beneficial to have pharmacy educators complete evaluations to help students foster growth in these areas. This mapping review also suggests that assessments measuring the degree to which participants applied what they learned while in a training environment to their behavior post-training are lacking. We postulate that the development of pharmacy core competencies related to teamwork may serve as the impetus for the creation of best practices in teaching teamwork skills with standardized and holistic assessments.

Several of these points were recently addressed by pharmacy educators at the University of Florida College of Pharmacy.\textsuperscript{43} Farland and colleagues reasoned that teamwork should be developed and evaluated longitudinally across the pharmacy curriculum rather than within a single course or program. Additionally, teamwork assessment plans should incorporate a process to assess individual contributions and team dynamics. To address these points, a model of Continuous Development of Teamwork Skills using longitudinal self, peer, and team feedback processes across multiple courses was implemented and evaluated. The researchers found that the use of this model identified individual students and teams that met the teamwork standards identified by the school in addition to identifying those that needed further coaching to achieve the designated learning outcomes. This model may serve as a starting point to address the teamwork training needs identified through our review.

While this review generated insight into a critical area within pharmacy education, it is not without limitations. First, there may be publication bias as our review included only published articles in peer-reviewed journals. Therefore, other effective designs related to teamwork training may exist in unpublished literature or articles that did not align with the designated inclusion or exclusion criteria. Second, the inclusion of Baker’s teamwork principles within the training program was only counted as present or absent, meaning the quality or extent of the content was not included, as this information was frequently not described in each article. In addition, it is also reasonable to postulate that teamwork skills are taught in other educational environments, such as research laboratories, academic committees, and co-curricular organizations. Particularly, co-curriculum participants have reported that communication, collaboration, and influence are skills emphasized through involvement in the co-curriculum.\textsuperscript{14} Our literature search identified articles describing activities embedded within the PharmD curriculum, suggesting future research is needed focusing on how teamwork is taught, measured, and assessed in other educational environments.

CONCLUSION

Although teamwork is regarded as an integral component of effective health care, there was a paucity of literature describing strategies for teaching pharmacy students how to work effectively in teams. This mapping review describes the approaches taken to teach, measure, and assess teamwork within pharmacy education. This review highlights an opportunity to further explore and identify core competencies for teamwork in pharmacy, with corresponding standardized teamwork training programs and assessments.

REFERENCES


8. Vogler JS, Davis DW, Mayfield BE, Finley PM, Yasseri D. The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork. *Instructional Science.* 2018;46:457-488.


<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Variable Description</th>
<th>Variable Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamwork Training Program Design/Intervention</td>
<td>How different programs or interventions were designed to better understand how pharmacy students interact with others.</td>
<td>Interprofessional education programs and programs that were solely comprised of pharmacy students.</td>
</tr>
<tr>
<td>Duration of the Program</td>
<td>Documented how long the teamwork intervention lasted.</td>
<td>Semester, Month, Year, Two-Weeks, etc.</td>
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<tr>
<td>Learner Characteristics or Demographics</td>
<td>Defined the sample and group features, such as specific health professions disciplines, student year, and learner environment.</td>
<td>Health professions disciplines (ie, medical, pharmacy, nursing, etc.); student year (ie, first-year, second-year, third-year, etc.); learner environment (ie, online, face-to-face, etc.).</td>
</tr>
<tr>
<td>Teaching Methods Used</td>
<td>Description of how information was proliferated to the students.</td>
<td>Simulations, lectures, case scenarios, etc.</td>
</tr>
<tr>
<td>Teamwork Principles</td>
<td>Characterized using Baker and colleagues (2005) defined mechanism of teamwork.19</td>
<td>Team leadership, mutual performance monitoring, backup behavior, adaptability, team/collective orientation, shared mental models, mutual trust, and closed-loop communication.</td>
</tr>
<tr>
<td>Teamwork Model/Instrument</td>
<td>Identifying the different model/instrument used to measure different aspects of teamwork.</td>
<td>Readiness for Interprofessional Learning Scale (RIPLS), Team-Based Learning (TBL), etc.</td>
</tr>
<tr>
<td>Outcomes Expected/Measured</td>
<td>How the expected outcomes were measured</td>
<td>Data collection, analysis, study design, and the specific tenants of teamwork that were included as outcome variables.</td>
</tr>
<tr>
<td>Individual Performing the Assessment</td>
<td>Person who conducted the assessment</td>
<td>Students, faculty members, preceptors, etc.</td>
</tr>
<tr>
<td>Intervention Results</td>
<td>Identified whether the intervention or study was deemed “favorable.”</td>
<td>Statistically significant results indicating that an intervention may measure or increase teamwork within pharmacy education</td>
</tr>
<tr>
<td>Author</td>
<td>Format of Teamwork</td>
<td>Duration of Program</td>
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<tr>
<td>Camiel LD et al. (2017)</td>
<td>TBL; in-class group-based activities following Readiness Assurance Tests</td>
<td>14-week course</td>
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<tr>
<td>Collier IA and Baker DM (2017)</td>
<td>Group presentations</td>
<td>Semester course</td>
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<tr>
<td>Elmore L et al. (2014)</td>
<td>Adapted TBL activities</td>
<td>Two-semester course</td>
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<tr>
<td>Hameen-Anttila K et al. (2010)</td>
<td>Students worked in groups to create materials that schoolteachers could use to teach children about rational use of medicines</td>
<td>Semester course</td>
</tr>
<tr>
<td>Hasnain M et al. (2012)</td>
<td>Interprofessional experience with pharmacy and medical students designed to demonstrate the value of functioning effectively in interprofessional teams</td>
<td>3-week course</td>
</tr>
<tr>
<td>Janke K et al. (2009)</td>
<td>Off-campus retreat that combined organized learning activities and social/networking opportunities</td>
<td>28-hour</td>
</tr>
<tr>
<td>MacDonnell C et al. (2012)</td>
<td>Interdisciplinary workshop; teams alternated between working together on patient cases and on the evaluation of standardized patients</td>
<td>1-day workshop</td>
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<tr>
<td>Maldonado A et al. (2013)</td>
<td>APPE rotation where students participate on an interdisciplinary solid organ transplant team</td>
<td>1-month rotation experience</td>
</tr>
<tr>
<td>Ottis E and Gregory G (2016)</td>
<td>Interprofessional team simulation comprised of nursing and pharmacy students</td>
<td>OSCE simulation comprising ~20 minutes</td>
</tr>
<tr>
<td>Peeters M et al. (2017)</td>
<td>Interprofessional teams engaged in simulations, standardized-patient interviews, case-based communications exercises, vital signs training, and patient safety rotations</td>
<td>16-week course</td>
</tr>
<tr>
<td>Author and Year</td>
<td>Description</td>
<td>Duration</td>
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<tr>
<td>Pittenger et al. (2013)</td>
<td>IPE groups created a communication plan for coordinating and collaborating on the care of diabetes patients in an ambulatory setting</td>
<td>15-week course</td>
</tr>
<tr>
<td>Rotz M et al. (2016)</td>
<td>Interprofessional experiential course series</td>
<td>6 semesters</td>
</tr>
<tr>
<td>Saini B et al. (2011)</td>
<td>Interprofessional learning module that included completing a 1-day interprofessional workshop and teaching students in interprofessional teams</td>
<td>3-day module</td>
</tr>
<tr>
<td>Sevin A et al. (2016)</td>
<td>Elective course where students provided patient care in an interprofessional clinic and participated in bi-weekly workshops in which students reflected on their experiences and discussed roles, team dynamics, communication skills, and challenges</td>
<td>Semester course</td>
</tr>
<tr>
<td>Snyder Franklin A et al. (2016)</td>
<td>Phenytoin pharmacokinetics workshop that utilized a TBL format</td>
<td>Groups met face-to-face over a 3-day weekend or online over a 2-week period</td>
</tr>
<tr>
<td>Vyas D et al. (2012)</td>
<td>Interprofessional course utilizing patient simulation designed to teach patient safety and teamwork skills</td>
<td>Four-week course</td>
</tr>
<tr>
<td>Zakaria SF and Awaisu A (2011)</td>
<td>Shared learning experience with third-year students working in smaller groups mentored by fourth-year students.</td>
<td>Semester</td>
</tr>
<tr>
<td>Zaudke J et al. (2016)</td>
<td>Interprofessional practice experience during family medicine clerkship</td>
<td>1-month rotation experience</td>
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TBL=team-based learning; IPEC=interprofessional education collaborative; OSCE=objective structured clinical examination; APPE=advanced pharmacy practice experience; IPE=interprofessional education

*Eight teamwork principles related to knowledge, skills, and behaviors: (a) the curriculum included leadership training or evaluated leadership skills; (b) team members monitor one another’s performance and provide feedback; (c) the curriculum addressed redistributing tasks upon demand by anticipating team member’s needs through accurate knowledge of their responsibilities; (d) the curriculum addressed the ability to adapt to changing situations; (e) the curriculum addressed soliciting team member ideas in defining goals and objectives; (f) the curriculum addressed fostering trust between team members; (g) the curriculum included communication training or evaluated communication skills; (h) the curriculum addressed ensuring team members are “on the same page”
<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Outcomes Expected/Measured</th>
<th>Person(s) Performing Assessment</th>
<th>Outcome Results</th>
</tr>
</thead>
</table>
| Camiel LD et al. (2017)²⁰ | During a course survey to assess team members on teamwork and satisfaction with the team; course completion survey to assess the CATME software and elements of teamwork | Student | S: On peer evaluation grades ranging from 1 to 5, contribution to team, interaction with team, keeping team on track, expecting quality significantly higher in higher GPA team than in either lower GPA or mixed GPA teams (p < 0.05)  
A: S: Satisfaction with team members was highest in lower GPA teams (p < 0.05) |
| Collier IA and Baker DM (2017)²¹ | Faculty assessments of the students' performance in group presentations and one-on-one counseling sessions | Faculty | S: Communication in both the professional group presentations and one-on-one counseling sessions significantly improved with the incorporation of active learning simulation exercises (p < 0.001)  
A: S: Students responded that adapted TBL methods significantly improved their verbal communication and teamwork skills (p < 0.001) and ability to convey ideas diplomatically (p = 0.016)  
A: Students felt more respected by team members following implementation of TBL (p = 0.026); students were less likely to attend class (p = 0.03) and did not feel that they learned more from TBL than from studying alone (p = 0.048) |
| Elmore L et al. (2014)²² | Professionalism, teamwork skills, and perception evaluated using the Chisholm survey instrument before and after implementation of program | Student | S: The competencies that the respondents reported having acquired the most during the activities were teamwork, project work, social interaction, and long-term working. During focus group discussions, the most important skills learned during the activities were identified as teamwork skills and working together with other people.  
A: A: On a 10-point visual analogue scale, the mean score related to statement "this program will influence my practice behavior with colleagues from other professions" was 7.8 ± 2.77; students noted as among the "most effective" and "important impacts" of the course the opportunity to work collaboratively with peers from another discipline  
A: Students felt more respected by team members following implementation of TBL (p = 0.026); students were less likely to attend class (p = 0.03) and did not feel that they learned more from TBL than from studying alone (p = 0.048) |
| Hameen-Anttila K et al. (2010)²³ | Questionnaire and focus group regarding the importance of competencies associated with program activities | Student | S: The competencies that the respondents reported having acquired the most during the activities were teamwork, project work, social interaction, and long-term working. During focus group discussions, the most important skills learned during the activities were identified as teamwork skills and working together with other people.  
A: A: On a 10-point visual analogue scale, the mean score related to statement "this program will influence my practice behavior with colleagues from other professions" was 7.8 ± 2.77; students noted as among the "most effective" and "important impacts" of the course the opportunity to work collaboratively with peers from another discipline  
A: Students felt more respected by team members following implementation of TBL (p = 0.026); students were less likely to attend class (p = 0.03) and did not feel that they learned more from TBL than from studying alone (p = 0.048) |
| Hasnain M et al. (2012)²⁴ | Written program evaluation with 7 Likert-type questions and 2 open-ended questions; 2 questions included asking about working with colleagues from other professions | Student | S: On peer evaluation grades ranging from 1 to 5, contribution to team, interaction with team, keeping team on track, expecting quality significantly higher in higher GPA team than in either lower GPA or mixed GPA teams (p < 0.05)  
A: S: Satisfaction with team members was highest in lower GPA teams (p < 0.05) |
| Janke K et al. (2009)²⁵ | Pre- and post-retreat survey regarding perceptions on leadership, commitment to service, the power of relationship building and teamwork, and the importance of self-reflection | Student | A: Students felt more respected by team members following implementation of TBL (p = 0.026); students were less likely to attend class (p = 0.03) and did not feel that they learned more from TBL than from studying alone (p = 0.048) |
| MacDonnell C et al. (2012)²⁶ | Faculty members and standardized patients evaluated the students using the teamwork global rating scale; students surveyed pre- and post-workshop to assess attitudes towards interdisciplinary education and | Faculty | S: 85% of students reported working cohesively as a team; 79% of student teams earned a rating of good or better in the standardized patient encounter, denoting students working cohesively as a team and sharing equally in decision-making |
surveyed after patient encounter regarding their experience as participants in a teamwork exercise

A: 67% of students strongly agreed that it was important to work with students from other health professions (p < 0.001); increase from 49% to 64% who strongly believed that workshops promoting idea and experience of teamwork with other healthcare professionals could prove invaluable in the professional development of students (p < 0.001); increase from 39% to 57% who strongly believed these workshops should be required (p < 0.001); increase from 39% to 64% who strongly believed that health professional schools should offer workshops in which healthcare professionals work together (p < 0.001); 52% strongly believed that patient would benefit from interprofessional team approach; 74% had positive perception regarding collaborating with other healthcare professionals in future

K: 84% of students reported better knowledge of what medical students learn in school, 74% reported better knowledge of what nurses learn in school, 82% reported better knowledge of what pharmacists learn in school (p < 0.001); 77% of students strongly agreed that they had an understanding of their role on team; 67% and 72% of students demonstrated understanding of advantages and disadvantages of working in a team with other healthcare professionals

Maldonado A et al. (2013)²⁷ Online pre- and post-APPE survey instrument examining perceptions of interprofessional roles, communication, and teamwork

Ottis E and Gregory G (2016)²⁸ Pre- and post-simulation survey that contained questions addressing interprofessional teamwork during the simulation

Peeters M et al. (2017)²⁹ Self-assessment questionnaire of students' achievement of course learning objectives (objectives mapped to IPEC competencies); word-cloud analysis used to provide insight into breadth and frequency of students' perceptions of other professions; end of

S: Improvement in scores was seen on 2/2 skills-related survey items
A: Improvement in scores was seen on 11/16 attitude-related survey items
K: Improvement in scores was seen on 4/4 knowledge-related survey items

S: Increased ability to 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)
A: Improvement in 13/15 items in attitude scale regarding interprofessional teamwork
K: 42% of students reported increased knowledge regarding roles in patient care, 22% reported learning more about other professions' clinical knowledge base, 17% reported increased knowledge in utilization of other team members for efficient and safe patient care

S: Self-assessment of competency for learning objectives mean (SD) total scores were pre: 2.8 (0.9) and post: 3.5 (0.8)
A: Word cloud analysis suggests overall net positive shift in perceptions of professions involved in interprofessional learning (ie, broader appreciation for the skills and roles of
course evaluations to describe student satisfaction with course

Pittenger A et al. (2013)\textsuperscript{30}  
IEPS and RIPLS were administered at baseline and the end of the course  
Student

Rotz M et al. (2016)\textsuperscript{9}  
Students evaluated using the PACT and SPICE Instrument  
Faculty performed the PACT evaluation  
Students completed the SPICE Instrument  
A: Majority of students expressed positive perceptions of interprofessional collaboration with respect to teamwork, roles and responsibilities, and patient outcomes

Saini B et al. (2011)\textsuperscript{31}  
Completion of the Asthma Knowledge for Health Professionals Scale, Attitudes Toward Health Care Teams Scale and RIPLS  
Student

Sevin A et al. (2016)\textsuperscript{32}  
Validated 42-question survey in a retrospective post-then-pre design; survey instrument assessed IPEC competencies in four domains: Values and Ethics, Roles and Responsibilities, Interprofessional Communication, and Teams and Teamwork  
Students’ self-assessment of IPEC competencies significantly improved in all four domains after completion of the course (p < 0.0001)

Snyder Franklin A et al. (2016)\textsuperscript{33}  
Survey to assess the learners’ perceptions of their teamwork competencies, team interdependence, and perceived understanding of phenytoin PK  
Student

Vyas D et al. (2012)\textsuperscript{34}  
30-item survey of knowledge, skills, and attitudes administered pre- and post-intervention  
Student

Zakaria SF and Awaisu A (2011)\textsuperscript{35}  
23-item questionnaire to assess the value of shared learning during clinical assignments involving third- and fourth-year pharmacy students and to compare the perceptions held by the 2 student groups  
Student
shared learning enhanced their ability to understand clinical problems; 31% of pharmacy students felt that they could have learned clinical problem-solving skills equally well working only with peers from their own student group. A: Statistically significant pre-post differences for all respondents for Teamwork and Patient-Centeredness ($p < 0.05$); medicine responses less favorable for Teamwork and Professional Identity than nursing and pharmacy.

<table>
<thead>
<tr>
<th>Zaudke J et al. (2016)</th>
<th>RIPLS completed pre- and post-rotation</th>
<th>Student</th>
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</table>

CATME=comprehensive assessment of team member effectiveness; APPE=advanced pharmacy practice experience; IPEC=interprofessional education collaborative; IEPS=Interdisciplinary Education Perception Scale; RIPLS=Readiness for Interprofessional Learning Scale; PACT=Performance Assessment of Communication and Teamwork; SPICE=Student Perceptions of Physician-Pharmacist Interprofessional Clinical Education.