PRAC Assessment Grant - Final Report

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Project Title
Assessment of an Integrative Longitudinal Case-Based Learning Model as a Curriculum Strategy to Enhance Teaching and Learning

Project Dates
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Summary of Overall Project Accomplishments as Related to Intended Outcomes

The primary purpose of this ongoing research project is to assess outcomes of an innovative case-based learning (CBL) approach, the Integrative Longitudinal Case-Based Learning (ILCBL) model, using the Indiana University Department of Physical Therapy (IU DPT) Family Tree. This model was developed and implemented by the IU DPT faculty as a means to foster student problem-solving and clinical decision-making skills and to facilitate cultural and ethical competency in preparation for entry-level clinical physical therapy practice. The initial phase (Phase 1) of three in this study was supported by PRAC funding and was completed during the stated project dates (Phases summarized in Table 1).

Table 1. Summary of ILCBL Research Project Phases	
Phase 1	Focused on investigating the effectiveness of the model in enhancing students' critical thinking and problem-solving within individual courses across a single semester (supported by PRAC grant)
Phase 2	Will focus on developing structured case matrices that facilitate coordinated integration of selected cases longitudinally within the curriculum. Impact of the longitudinal model as well as learning outcomes will be measured (PRAC grant in submission)
Phase 3	Will focus on determining the effectiveness of this teaching and learning strategy in translating course content into clinical physical therapy practice

Preliminary outcomes from Phase 1 reflect the effectiveness of the model in enhancing students' critical thinking and problem-solving within individual courses across a single semester. These findings supported the initial goal of creating more effective learning through complex case-based application. The research team has begun to implement Phase 2 of the investigation with the primary objective of developing structured case matrices that integrate longitudinally within the curriculum. We plan to measure the impact of the longitudinal model indirectly by surveying students as they matriculate through the program as well as directly by evaluating specific learning outcomes within courses. A third phase will aim to determine the effectiveness of this teaching and learning model by evaluating clinical decision-making and problem solving within physical therapy practice.

In addition to the educational implementation and outcome findings, the PRAC grant allowed researchers an opportunity to update the The IU DPT Family Tree (second edition), evolving from 37 to 44 inter-related cases to represent greater case diversity across four generations. Dissemination of the educational findings from Phase 1 were accomplished through a local presentation (EC Moore) as well as a peer reviewed publication entitled "An Integrative, Longitudinal Case-Based Learning Model as a Curriculum Strategy to Enhance Teaching and Learning," published in the Journal of Physical Therapy Education (see attached article). Furthermore, a peer-reviewed session proposal, "It's All in the Family: Making the Case for Instructional Collaboration Using the Integrated Longitudinal Case-Based Learning Model," was accepted for presentation at an upcoming professional meeting, the American Physical Therapy Association Combined Sections Meeting, in Chicago, February 2012. Finally, a textbook publisher has invited the research team to develop an e-book case family based on our initial work. PRAC funding ($2500) was utilized for video editing supplies, student worker assistance, copying, model volunteers, and dissemination of findings.

Data Collection Methods and Analysis of Findings

This research project involved both quantitative and qualitative methodology. Data was gathered through student surveys, including Likert scale questions as well as open ended qualitative responses, on the implementation and effectiveness of the model in supporting the development of critical thinking and problem solving skills in individual courses (findings summarized in Tables 2 and 3). The attached article provides a detailed account of project development and findings. Students were also randomly assigned different case formats (traditional and ILCBL) in a course. Quantitative data was gathered by analyzing student documentation of specific clinical indicators relating to examination and intervention techniques as deemed relevant to the specific case. Documentation analysis generated a score based upon grading rubrics and mean scores were compared across both types of case formats.

Qualitative assessment of student discussions and written answers for each assignment was analyzed for themes and missing information (results to be published).

Table 2. Student Affirmative response rates for questions concerning the use of the IUDPT Family Tree.

SURVEY QUESTION	P511*	P643[!]	P532^	AVERAGE ACROSS COURSES
1. The integrated case series facilitated consideration of multiple aspects of patient care.	96.8%	93.9%	88.0%	**92.9%**
2. The integrated case series facilitated consideration of psychosocial issues related to patient care.	80.6%	90.9%	92.0%	**87.8%**
3. The integrated case series facilitated consideration of diversity issues, including race, culture and lifestyle, involved in patient care.	67.7%	90.9%	92.0%	**83.5%**
4. Recommend use in this course in the future.	90.3%	69.7%	84.0%	**81.3%**
5. The integrated case series facilitated consideration of patient care across the lifespan.	64.5%	90.9%	73.3%	**76.2%**
6. Overall, the Integrated case series facilitated learning.	*83.9%*	72.7%	72.0%	**76.2%**
7. Recommend using the cases in other courses in the curriculum.	*80.6%*	66.7%	73.0%	**73.4%**
8. The integrated case series facilitated consideration of the legal, ethical and economic aspects of patient care.	58.1%	69.7%	92.0%	**73.3%**
9. The integrated case series facilitated development of clinical decision making abilities.	87.1%	57.6%	72.0%	**72.3%**
10. The integrated case series facilitated development of critical thinking and problem solving skills.	80.6%	51.5%	80.0%	**70.7%**
11. Cases from the case series were used frequently during this course.	71.0%	53.8%	84%	**69.6%**
AVERAGE FOR INDIVIDUAL COURSES	**78.2%**	**73.5%**	**82.0%**	

*P511: Framework for Clinical Decision Making and Professionalism

[!]P643: Psychosocial Dimensions of Physical Therapy

^P532: Legal and Ethical Issues in Physical Therapy

Table 3: Representative Student Course Comments
"The integrated case series helped to see how everyone is related and how each person's problems could be related to another person's problems."
"I like having a picture to go along with the case, it makes it more real"
"I do like the integrated case series – just because I like how everyone is related and all the lovely issues that go along with being a family."
"Integrate earlier and also in other courses."
"We just need to be more consistent using them."
"Use the same case in various classes so a well-rounded study of the case can be done."
"Too many cases, kind of overwhelming."
"They are used so infrequently they don't feel like integrated cases."

Obstacles/Challenges Encountered

No significant obstacles or challenges were encountered; however, feedback from student surveys was utilized by the research team to alter implementation of the ILCBL model. For example, some students were confused on the purpose of this approach. Other students indicated the cases were not being integrated within or between classes in a longitudinal and coordinated manner. Another difficulty was tracking the use of the cases by different instructors.

Changes Made to Address Obstacles/Challenges Encountered

A formal introduction of the case family and ILCBL model was provided using a PowerPoint presentation during a class in their first semester as a means to address the students' confusion on the purpose of this approach. Case matrices are under development for selected cases to better integrate case use in a longitudinal manner. Finally, a second PRAC grant has been submitted to acquire funding to help sustain a student worker to serve as a "case coordinator" charged with tracking the matrices and case files and communicating with faculty about when targeted cases should be implemented.

An Integrative, Longitudinal Case-Based Learning Model as a Curriculum Strategy to Enhance Teaching and Learning

M. Terry Loghmani, PT, PhD, MTC, Amy J. Bayliss, PT, DPT,
Valerie Strunk, PT, MS, and Peter Altenburger, PT, PhD

Background and Purpose. Indiana University faculty and students developed a multi-generational case family series as a tool for implementing the Integrated Longitudinal Case-Based Learning (ILCBL) model supporting the achievement of program objectives. The purposes of this paper are to present the development of the Indiana University Doctor of Physical Therapy Family Tree as a tool for the application of the ILCBL model and to discuss preliminary findings evaluating the model's effectiveness.

Method/Model Description and Evaluation. The Indiana University Doctor of Physical Therapy Family Tree: An Integrated Case Series, comprised of 37 interrelated cases spanning 4 generations, was co-created by faculty and students to serve as a tool to enhance teaching and learning. ILCBL is a novel perspective on case-based learning. Its aim is to facilitate the development of student problem-solving and clinical decision-making skills, as well as cultural and ethical competence in preparation for clinical practice.

Outcomes. Outcome measures included student course surveys (n = 89/102; 87.25% response rate) and clinical discussion forum comments (n = 69/69; 100% response rate). Student survey results were supportive of the ILCBL model, citing benefits in problem solving, critical thinking, and clinical preparation; however, a desire for more consistent use was indicated. Clinical discussion forum comments reflected the longitudinal value of ILCBL in translating classroom knowledge into clinical application. Faculty comments also highlighted the efficiency and effectiveness of the ILCBL model.

Discussion and Conclusions. The ILCBL model successfully supports course and program objectives. The case family series is an effective and efficient means for implementation of the ILCBL model. The most promising aspect of ILCBL is students' perspective of its longitudinal value in fostering critical thinking skills and cultural and ethical sensitivity. Future developments will focus on more consistent and integrated applications of the case family series towards expansion of the ILCBL concept.

Key Words: Teaching methods, Critical thinking, Case-based learning, Curricular strategy.

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Human subjects' research approval was gained from an IU Institutional Review Board and all subjects provided written informed consent prior to participating in the study.

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BACKGROUND AND PURPOSE

In 2003, in its first year of a newly designed Doctor of Physical Therapy curriculum, Indiana University (IU) was presented an opportune moment to foster faculty collaboration toward a comprehensive education model. The goal was to implement the Integrated Longitudinal Case-Based Learning (ILCBL) model with the goals of decreasing course isolation, facilitating effective learning, and increasing efficiency. A pedagogical instrument, The Indiana University Doctor of Physical Therapy Family Tree: An Integrated Case Series, was constructed connecting the mission, vision, and curricular threads with the hope of facilitating learning across the curriculum.

The IU physical therapy curriculum is derived from an analysis of current practice standards articulated in the American Physical Therapy Association's (APTA) *Guide to Physical Therapist Practice*[1] and the *Normative Model of Physical Therapist Professional Education*,[2] as well as from disablement[3] and clinical decision-making models.[4-6] Integration of these various resources has led to a progressive curricular design where basic science forms a knowledge base from which applied sciences build. The goal is to prepare new clinicians to think critically and to problem solve for all types of patient conditions. While the structure of the curriculum lends itself to the development of these skills, creating educational experiences that draw these components together can be challenging. Consequently, implementing pedagogical approaches within the classroom that foster applied learning becomes essential. The literature describes several different strategies to promote effective clinical reasoning, including problem-based learning (PBL),[7,8] case-based learning (CBL),[9-11] and standardized patient simulations (SPS).[12,13] Each of these techniques employs different strategies to promote effective clinical reasoning.

Problem-based learning represents an instructional strategy involving student-centered learning through open-ended problems. Students are encouraged to research their own answers, collaborate with colleagues, and use faculty as facilitators. In contrast,

CBL involves the use of individual patient scenarios for the application of learned material. Case implementation can occur prior to or following lecture presentation to provide educational relevance by focusing students on key learning outcomes.[14] These lecture-based case studies often do not formally challenge student clinical reasoning. Consequently, instructors often use a modified CBL presentation where small student groups are provided with a case and specific relevant questions relevant to that case in an attempt to stimulate clinical decision making. The modified CBL process fosters student collaboration, open discussion, and critical thinking within a structured problem-solving format and is frequently used in medicine,[15,16] nursing[17,18] and pharmacy[19] curricula. Standardized patient simulations involve role-playing different patient scenarios using trained actors, which enables students the opportunity to practice learned techniques.[12] While PBL and SPS offer effective outcomes, both have limitations, such as specific training requirements for PBL and cost effectiveness issues for SPS. These limitations led the IU faculty toward a deeper investigation into the hidden potential of case-based learning.

Research on the effectiveness of CBL is somewhat limited. While there are many articles detailing its approach and discussing the implications of the strategy, few studies provide data supporting the significance.[20] Schwartz et al[21] studied the implementation of CBL in medical programs and found improved problem-solving skills, enthusiasm for learning, and greater independence when compared to students educated with traditional teaching methods. Other researchers discovered that moral reasoning skills improved significantly using case studies as a tool for small-group discussion.[22] Rein and colleagues[23] reported improvements in standardized test scores and student course satisfaction after transitioning a traditional introductory clinical medicine course from lecture to case discussion. Chiropractic clinical decision-making was compared using a class of traditional education delivery to a case-based format.[10] Findings indicated significantly better results for case-based instruction when evaluating scores on test questions dealing with application of learned material. While this data is limited, the evidence supports the implementation of case-based learning as an effective form of education for applied learning.

Several researchers have looked at the application of CBL to create more realistic patient case scenarios.[24-27] Richards et al[28] found students involved in detailed case analysis to be more patient-centered. These researchers implemented a longitudinal case study design within a single class environment, exposing students to the progressive nature of a medical history. The goal was to develop students' awareness of the aging process and its implications on medical management. Overall, students reported high satisfaction, with approval of the interactive nature of case-based learning as well as the realistic continuity provided by the longitudinal case study format.[11] Findings suggest longitudinal case study design may provide a more realistic, complex patient—requiring students to integrate multiple sources of data within their clinical decision making.

Baldwin and Schaffer[9] presented a paper on the creation and implementation of a continuing case study dealing with an extended family in a nursing curriculum. In this format, the considerations of ethics, psychosocial concerns, and social responsibility played a large factor as students were made aware of an entire "family tree" rather than a single case in isolation. The study found high participant satisfaction and regular correlations between family history and disease when making clinical decisions.[9] The authors felt this approach required students to integrate curricular content better than traditional CBL.

The evidence suggests longitudinal case study design as well as the use of complex patient familial connections offer more realistic and meaningful learning experiences. Based upon these findings, the IU faculty decided to construct the Integrated Longitudinal Case-Based Learning (ILCBL) model incorporating the benefits of progressive case study formats and integrative family dynamics. The ILCBL model represents a conceptual framework of CBL that involves the integration of multicultural, psychosocial, and interpersonal information with a longitudinal design within and across courses emphasizing disease progression and aging (Table 1). To implement this framework, a case family pedagogical instrument, the IU DPT Family Tree, was created comprised of a series of cases built across 4 generations.

The purpose of this paper is twofold. First, the development of the IU DPT Family Tree as an effective tool for the application of an ILCBL approach is presented. Second, preliminary findings evaluating the effectiveness of the implementation of the ILCBL model and IU DPT Family tree on student problem solving, critical thinking, and cultural and ethical awareness are discussed.

Table 1. Conceptual Framework of the Integrative, Longitudinal Case-Based Learning (ILCBL) Model and Case Family Pedagogical Instrument (IU DPT Family Tree)

<table>
<tr><th colspan="3">Integrative, Longitudinal Case-Based Learning Model</th></tr>
<tr><th>Learning Application</th><th></th><th>Implementation</th></tr>
<tr><td>Multicultural</td><td rowspan="3">Integrative</td><td>Within/Between Courses</td></tr>
<tr><td>Psychosocial</td><td>Within/Across Semesters</td></tr>
<tr><td>Interpersonal</td><td>Classroom to Clinic</td></tr>
<tr><td>Disease progression</td><td rowspan="3">Longitudinal</td><td>Within Courses</td></tr>
<tr><td>Aging</td><td>Across Courses</td></tr>
<tr><td>Familial Relationships</td><td>Throughout the Curriculum</td></tr>
<tr><td colspan="3">Pedagogical Instrument
IU DPT Family Tree: A Case Series</td></tr>
<tr><th>Design</th><th>Content</th><th>Applicability</th></tr>
<tr><td>2 Families</td><td>Pictures</td><td>Geriatrics to Pediatrics</td></tr>
<tr><td>4 Generations</td><td>Social History</td><td>Multicultural</td></tr>
<tr><td>37 Biographies</td><td>Suggested Medical History</td><td>Across Practice Patterns</td></tr>
</table>

Abbreviations: IU, Indiana University; DPT, doctor of physical therapy.

METHOD/MODEL DESCRIPTION AND EVALUATION

The concept for the IU DPT Family Tree was initially conceived during a faculty retreat as an instrument for the implementation of the ILCBL model. The aims of the model were to foster student problem solving, clinical decision-making skills, and cultural and ethical competence in preparation for clinical practice. The IU DPT Family Tree, a series of patient cases, represents the tool that facilitates the aims and goals of the model (Table 2). A faculty member and 2 students worked together over the course of academic year 2006–2007 to create objectives, implementation strategies, and case templates. Student participation was thought to be critical in the development of the cases, as the students were actively progressing through the curriculum and would be intimately familiar with the content and objectives in all courses. The students were asked to draw upon their life experience, patient exposures, and course content. In addition, the students were asked to evaluate the program's mission, vision, and objective statements. Additional premises are summarized in Table 2.

Initially, a key "marriage" was developed that would draw 2 family genealogies together. From that, 37 interrelated cases were created across 4 generations (Figure 1). Even though all the interrelated cases were derived from 2 multigenerational families, there was a conscious effort by the development team to build in diversity along the dimensions of race, ethnicity, gender, sexual orientation, socioeconomic status, age, physical ability, and religious beliefs. An example of an individual case biography is portrayed in Figure 2. A faculty member who had not been involved in the development process reviewed and edited the document for cohesiveness and continuity of the case biographies across the lineages. Input was then received from the entire faculty, and the final version was printed and made available on a shared drive. Faculty were free to copy and paste whole cases or portions of cases from the electronic file. No requirements to use the IU DPT Family Tree were established during the inaugural implementation of the model; however, all faculty who did implement cases from the family tree were asked to track how they used each case, including specified diagnoses, on an Excel spreadsheet. In addition, faculty were free to implement cases using their own educational strategy. Examples of case implementation strategy included lecture summary, small-group discussion, laboratory application, course projects, and practical exams.

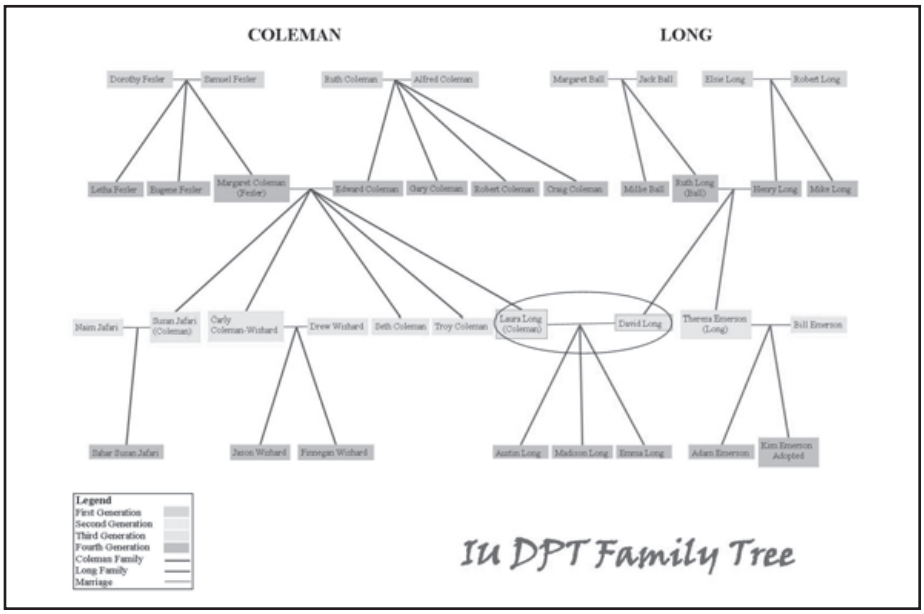
Human subjects' research approval was gained from an IU Institutional Review Board and all subjects provided written informed consent prior to participating in the study. The initial implementation strategy, which occurred in the fall of 2007, is outlined in Table 3. Specifically, family tree cases were used in a first-year, first-semester course facilitating the introduction of basic concepts of documentation and goal writing, different clinical decision-making and disablement models, and generating an hypothesis and a plan of care. Cases also were used with the same first-year students in foundational physical therapy examination and intervention courses for problem-solving in the context of a patient's family support system, for role-playing to practice examination and treatment skills, and during lab practical testing.

Second-year students used the IU DPT Family Tree cases to explore psychosocial di-

Table 2. Goals and Premises for the Implementation of the Integrated, Longitudinal Case-Based Learning (ILCBL) Model

GOALS FOR ILCBL MODEL
1. Reflect across the lifespan and within specialty areas
2. Facilitate critical thinking and problem solving throughout examination and intervention process
3. Explore psychosocial, emotional, and interpersonal aspects of patient care
4. Address legal, ethical, and economic aspects
5. Apply clinical decision-making models
6. Consider multicultural aspects of patient care—including race, religion, economic status, educational level, and ethnic background
PREMISES FOR CASE DEVELOPMENT
1. Cases should be realistic, interesting, and potentially clinically relevant
2. Cases could be used to explore the impact of family relationships on members' function and quality of life
3. Cases would allow situations, relationships, conditions or co-morbidities to unfold, even if they did not present initially with a medical condition
4. Cases would provide flexibility for faculty to embellish, tailor, or add to in order to focus on specific learning objectives in a given lecture or lab

Figure 1. The IU DPT Family Tree



Circle Denotes "Key Marriage"

Figure 2. An Example of a Specific Case Within the IU DPT Family Tree

Troy Coleman

Age: 25

Gender: Male

Race: Caucasian

Work History: Troy is a factory worker and has been working with the same company since graduating from high school.

Living Environment: He lived with his wife in a modest home in the country until the divorce. After his wife left, he moved into a friend's third story 2- bedroom apartment.

Social History: He had married his high school sweet heart right after graduation. After six years of marriage, his wife abruptly left him without an explanation.

Lifestyle: He does not exercise because his job is physically demanding and he is worn out by the time he's finished with work. The last thing he wants to do when he gets home is work out. After his wife left, he started drinking up to 10 beers per day on the weekends, sometime alone and sometimes with friends.

mensions of patient care, allowing the family tree format to be compared with isolated CBL. This was achieved by supplementing the first 6 lectures with traditional isolated cases presented during each lecture in order to reinforce important concepts. In contrast, the last 6 lectures used case studies from the IU DPT Family Tree case series. The implementation of the Family Tree cases was then longitudinally connected to the students' ethics course. Implementation of several of the same cases between psychosocial dimensions and ethics provided students with an opportunity to explore different aspects of the same case, provoking strong emotional reactions and in-depth ethical discussions.

A 5-point Likert Scale survey was developed to evaluate the students' perceptions on the use of the ILCBL model in the classroom (Table 4). Survey questions primarily focused on students' perceptions on whether the

Table 3. Overview of the Initial Implementation of the IU DPT Case Family and Subsequent Points of Assessment

Longitudinal Implementation Plan of ILCBL Model					
Student Groups	Course Implementation and Assessment				
First-year students	Fall First year	Spring First year	Summer First year	Assessment	
	Clinical decision making	Foundational sciences	Summer internship	Initial assessment	Follow-up assessment
	Initial exposure to case family and theoretical approach to use of the model	Implementation of IU DPT Family Tree cases (examination and treatment problem solving)	Application of learned material	Following foundational sciences curricula	End of summer affiliation
Second-year students	Fall Second year	Summer Second year		Assessment	
	Psychosocial Dimensions	Ethics	Clinical Internship	Initial assessment	Follow-up assessment
	Contrasting with isolated CB learning	Connections between cases used in fall to summer		Following Psychosocial Dimensions	Following Ethics and Clinical Affiliations

Abbreviations: IU, Indiana University; DPT, doctor of physical therapy; ILCBL, Integrated Longitudinal Case-Based Learning.

Table 4. Survey Tool for the Evaluation of the IU DPT Family Tree Implementation

INSTRUCTIONS: Respond to each statement below in terms of your agreement or disagreement. If you strongly agree, mark SA; agree, mark A; undecided, mark U; disagree, mark D; strongly disagree, mark SD.

1. Overall, the integrated case series facilitated my learning.
2. I recommend using cases from the integrated case series in this course in the future.
3. I recommend using cases from the integrated case series in other courses in the curriculum.
4. Cases from the integrated case series were used frequently during this course.
5. The integrated case series facilitated development of my clinical decision-making abilities.
6. The integrated case series facilitated development of my critical thinking and problem-solving skills.
7. The integrated case series facilitated consideration of multiple aspects of patient care.
8. The integrated case series facilitated consideration of patient care across the lifespan.
9. The integrated case series facilitated consideration of diversity issues (including race, culture, and lifestyle) involved in patient care.
10. The integrated case series facilitated consideration of psychosocial issues related to patient care.
11. The integrated case series facilitated consideration of the legal, ethical, and economic aspects of patient care.

Please answer the following questions in the space provided on the form.

12. How were cases from the integrated case series used in this course?
13. Which do you prefer, using cases from the integrated case series or cases presented in isolation to help accomplish learning objectives in this course? Why?
14. What future recommendations do you have on how cases from the integrated case series could be used in this course or other courses in the curriculum?
15. What aspects of the integrated case series were most valuable?
16. What aspects of the integrated case series were least valuable?

ILCBL model enhanced learning, how frequently cases were incorporated into learning activities, and whether use of the family cases facilitated development of critical thinking and problem solving. It should be noted that neither of the student authors nor their class peers were surveyed. Results were analyzed via frequency distribution of responses. In order to assess student perceptions on whether the ILCBL model had prepared them for clinical education, students participating in first and second clinical affiliations were asked an open-ended survey question in an online forum: "In what ways did use of the family cases help to prepare you for your first/second clinical rotation? How can they be better

Table 5. Student Survey Response Rate

Data Set	Data Set Description	Respondent #	TOTALS
One	Clinical Decision Making First-year students	31/36	**89/102 (87.25%)**
	Psychosocial Dimensions in Physical Therapy Second-year students	33/33	
	Ethical and Legal Issues Second-year students	25/33	
Two	Clinical Education I First-year students	36/36	**69/69 (100%)**
	Clinical Education II Second-year students	33/33	

Table 6. Student Perceptions on Whether the IU DPT Family Tree Facilitated Learning

SURVEY QUESTION	P511 First-year course	P643 Second-year course	P532 Second-year course	AVERAGE ACROSS COURSES
1. The integrated case series facilitated consideration of multiple aspects of patient care.	96.8%	93.9%	88.0%	**92.9%**
2. The integrated case series facilitated consideration of psychosocial issues related to patient care.	80.6%	90.9%	92.0%	**87.8%**
3. The integrated case series facilitated consideration of diversity issues (including race, culture, and lifestyle) involved in patient care.	67.7%	90.9%	92.0%	**83.5%**
4. Recommend use in this course in the future.	90.3%	69.7%	84.0%	**81.3%**
5. The integrated case series facilitated consideration of patient care across the lifespan.	64.5%	90.9%	73.3%	**76.2%**
6. Overall, the integrated case series facilitated learning.	83.9%	72.7%	72.0%	**76.2%**
7. Recommend using the cases in other courses in the curriculum.	80.6%	66.7%	73.0%	**73.4%**
8. The integrated case series facilitated consideration of the legal, ethical, and economic aspects of patient care.	58.1%	69.7%	92.0%	**73.3%**
9. The integrated case series facilitated development of clinical decision-making abilities.	87.1%	57.6%	72.0%	**72.3%**
10. The integrated case series facilitated development of critical thinking and problem-solving skills.	80.6%	51.5%	80.0%	**70.7%**
11. Cases from the case series were used frequently during this course.	71.0%	53.8%	84%	**69.6%**
AVERAGE FOR INDIVIDUAL COURSES	**78.2%**	**73.5%**	**82.0%**	

Percentage scores from students in data set one reflect strongly agree/agree responses to 11 survey questions assessing their perceptions of whether the IU DPT Family Tree facilitated learning of material presented in class. The most significant response across the 3 didactic classes was related to the depth and breadth of the case family series to enhance student understanding of the multiple aspects of patient care.

used?" Frequency of positive versus negative responses was calculated by 2 independent investigators.

Faculty's initial impressions were collected via an e-mail survey. Primary investigators were not included in the survey. They were requested to respond, on a voluntary basis via e-mail, to the following two questions: (1) What are the identified or potential benefits of using the IU DPT Family Tree in courses you teach or in other courses within the curriculum; (2) What are the identified or potential barriers of using the IU DPT Family Tree in courses you teach or in other courses within the curriculum?

RESULTS

Two sets of data were used to evaluate the implementation of the ILCBL model (Table 5). Data set 1 represents student survey participants from first- and second-year didactic classes. The students in data set 1 were surveyed during 3 different courses. Of the surveys, 99 were returned, representing 87.25% of total students enrolled. Data set 2 represents the same cohort of students surveyed at the end of their clinical affiliations, allowing for a longitudinal implementation assessment. Data set 2 consisted of 69 respondents, representing 100% of total students enrolled. Each student answered a question pertaining to the clinical impact of the IU DPT Family Tree via an electronic discussion forum.

Students from data set 1 answered 11 questions on their perceptions of whether the IU DPT Family Tree facilitated their ability to learn the material presented in class (Table 6). Combining responses of agree and strongly agree when averaged across all 3 courses revealed the following: 76.2% of students believed the case series facilitated learning, 72.3% of students believed the Family Tree facilitated clinical decision-making skills, and 70.7% of students believed the Family Tree facilitated critical thinking and problem-solving skills.

In addition to its impact on learning, survey questions focused on the influence of the IU DPT Family Tree on the students' interpretation and application of diversity, psychosocial, legal, ethical, and economic issues. Results indicated that 83.5% of students felt the Family Tree fostered a deeper understanding of diversity issues, 87.8% of students felt it facilitated an improved consideration of psychosocial issues, and 73.2% of students agreed the it facilitated consideration of ethical, legal, and economic issues. The IU DPT Family Tree also was designed to enhance student understanding of patient care across the lifespan, and results showed that 76.2% of the respondents indicated that the IU DPT Family Tree positively contributed to their understanding of patient care considerations across the lifespan.

Table 7. Sample Student and Faculty Comments

STUDENT COURSE COMMENTS
"The integrated case series helped to see how everyone is related and how each person's problems could be related to another person's problems."
"I like having a picture to go along with the case, it makes it more real."
"I do like the integrated case series—just because I like how everyone is related and all the lovely issues that go along with being a family."
"Integrate earlier and also in other courses."
"We just need to be more consistent using them."
"Use the same case in various classes so a well-rounded study of the case can be done."
"Too many cases, kind of overwhelming."
"Not everyone always had the cases series with them during class."
"They are used so infrequently they don't feel like integrated cases."
STUDENT CLINICAL COMMENTS
"Using the case family book allows us to more specifically consider all aspects of a person's life and health before trying to make decisions about the best plan of care for that patient . . . which greatly impacts how long they need to stay in the unit and what level of independence they need to achieve."
"The most instrumental way that the case studies impacted my clinical rotation is learning how families, friends, and medical providers interact and how the patient's history with each of these could impact the course of therapy."
"I feel the cases in the family tree helped me to practice pulling together a patient's full picture. My initial instinct throughout the first year of school may have been to stay 'within the box' and only worry about what was physically wrong with a patient. Introduction to the person as opposed to the diagnosis is closer to real-life situations. In my clinical now, I have noticed that it really takes an understanding of a patient's psychosocial dimension to even effectively be able to initiate treatment."
"In a way, using the case series prevented tunnel vision when looking at a patient's condition."
FACULTY COMMENTS
"I think that use of these cases has the potential of better modeling realistic clinical practice. The detail in these cases allows a greater depth of understanding of the 'patient'; the case study person is more realistic. The 'patient' comes complete with family ties, giving insight not only into clinical and medical presentation, but also psychosocial dimensions often lacking in case studies."
"The cases allow students to better extract relevant versus irrelevant information from all of the information available."
"The availability of the information in the case biographies certainly is a time saver for faculty."
"With time, need to find a better way to integrate cases."

The most significant positive response across the 3 didactic classes, 92.9%, was related to the depth and breadth of the Family Tree to enhance student understanding of the multiple aspects of patient care. Additionally, there was positive support for the implementation of the learning tool—of surveyed students, 81.3% recommended continued use of the IU DPT Family Tree in the future, and 73.4% recommended use in other courses of the curriculum. The lowest group response was related to whether the students felt the cases were used frequently. Of the students surveyed, 30.4% indicated that the cases were not used enough.

There were themes noted in subjective comments from data set 1 comparing the use of the IU DPT Family Tree to isolated case studies within the Psychosocial Dimensions course. The most significant theme that emerged was that the case series gave a greater depth to the patient featured in a given case analysis, thereby making the patient seem more real. Visual representation of the patient through use of a picture, as well as the outline of the familial relationships, enhanced this patient realism. The students surveyed from data set 1 also were asked for constructive feedback in regards to the IU DPT Family Tree. The most common recommendation for future use was more consistent implementation across the curriculum. Limitations in value varied with some students encouraging less use while others felt faculty should consider increasing the implementation. Representative student comments from course surveys and clinical forums are captured in Table 7.

Table 8. Qualitative Analysis of Student Comments During Clinical Affiliations

Qualitative Analysis			
Categories	**Themes**	**Examples**	
Positive	Applied learning	First-Year Students Basic applied skills	"Valuable in determining impairments, functional limitations, and a diagnosis" "Apply new information into actual examples" "Gave us practice with using patient history, social history, etc." "It helped me to identify impairments and functional limitations."
		Second-Year Students Focus on critical thinking & problem solving	"The use of the cases required me to problem solve and think critically." "It helped to get our brains thinking between the lines and not just look at the data."
	Realism	"Introduction to the person as opposed to the diagnosis is closer to real-life situations" "Gives us a 'whole' picture of the patient" "Closer to real-life situations" "Using the same patients allowed us to build off of a growing knowledge base."	
	Preparation/confidence	"I was already prepared before this clinical for the possibility that some patients would have great support systems and others would have poor support." "Case series prevented tunnel vision when looking at a patient's condition" "Exposure to different diagnosis"	
	Patient Depth	"I have noticed that it really takes an understanding of a patient's psychosocial dimension to even effectively be able to initiate treatment." "I am treating a person who has other issues in life that can and will affect their participation in therapy."	
Constructive	Lack of consistent use	"Were not used enough" "I think they should be used more consistently with the same diagnosis." "To be more useful, the cases must stay consistent."	
	Overuse	"Redundant at times"	

Qualitative analysis of data set 2 (student responses during clinical affiliations) revealed positive and constructive themes regarding the ILCBL model. Positive themes centered on applied learning, realism, preparation/confidence, and patient depth. Lack of consistent use and overuse were constructive themes.

The student responses (1 response/student; n = 69 students) from data set 2 were quantitatively analyzed in regards to the frequency of positive and negative comments and qualitatively analyzed for common themes (Table 8). In Clinical Education I, there were 93 positive comments and 18 negative comments regarding the use of the IBCBL model. In Clinical Education II, there were 64 positive comments and 23 negative comments. A qualitative analysis of the subjective data across both cohorts revealed the following positive themes: improved preparedness and confidence, patient depth and realism, and better awareness of applied learning concepts. Constructive themes that emerged were a lack of consistent use between and within courses and a fear of overuse.

Of the faculty, 4 out of 6 provided their impressions on the initial implementation of the IU DPT Family Tree. A common theme cited by faculty was decreased class preparation time and effort needed, as the faculty version of the Family Tree had much of the work already completed. Faculty also felt strongly about the potential that existed for collaboration between courses as IU DPT Family Tree cases were used progressively across the curriculum. Faculty members' representative comments on the integrative component of the IU DPT Family Tree are presented in Table 7.

DISCUSSION

The purpose of this paper was to present the ILCBL model and to evaluate the initial implementation of the IU DPT Family Tree case series. The goal of the model was to foster problem solving, clinical decision making, and cultural and ethical competence through the development of a cost effective and efficient teaching instrument. To determine the effectiveness of the IU DPT Family Tree, it was important to assess its impact within and between classes as well as its translation of student learning into the clinic.

Student survey results following the initial implementation of the IU DPT Family Tree revealed 70% or higher agreement that the tool fostered learning, critical thinking, and problem solving. These outcomes represent critical elements for the successful development of a skilled physical therapy clinician.[29] First- and second-year students suggested that the case scenarios provided them with more realistic patient examples when compared to traditional case application. The authentic nature was equated to the use of images, well-developed social histories, and familial connections. Often students working with single patient cases are asked to focus

strictly on patient medical issues, ignoring social and familial aspects that can impact the patient's health resources, caregiver support, and subsequent clinician decisions. The realistic depth of the cases in our instrument required more complex problem solving, which is representative of true clinical practice. Similar conclusions were seen with medical students who felt that studying longitudinal cases enhanced their ability to treat in geriatric patient environments.[11]

Post-instructional findings with second-year students also indicated that the tool was effective at helping students to learn. Specifically, the IU DPT Family Tree was used to integrate psychosocial, cultural, and ethical issues into their clinical reasoning. The complexity of the IU DPT Family Tree includes demographic information illustrating cultural, social, and ethnic diversity. Research evaluating case-based learning has demonstrated the ability to enhance cultural sensitivity in dental students. Richards[28] demonstrated that case study design that emphasized cultural variability resulted in enhanced student awareness of cultural issues on patient care. It appears that the depth of the IU DPT Family Tree fostered similar student learning outcomes. Students felt strongly that the interconnections between case members helped to create an appreciation for multicultural, psychosocial, and interpersonal differences.

Beyond individual course learning objectives, the goal of the model was to foster the development of an instrument that would encourage the progressive application of learned material longitudinally through the curriculum. Preliminary findings evaluated the delivery of the progressive nature of the cases by examining its implementation across 2 semesters. Specifically, this involved connected cases that were initially discussed in psychosocial dimensions of health care coursework that were then reintroduced in ethics coursework. Students reported that the consistency between courses established the perception of a "real patient" as opposed to one on paper. Even more significant were the connections students made with related family members within the genealogy that were not specified in the initial classroom case presentation, further substantiating the integrative nature of the instrument. The links made within the instrument demonstrate an ability to integrate student decision-making across courses.

The ultimate goal of the IBCBL model was to translate student preparation from classroom to clinical practice. Results evaluating the impact of the IU DPT Family Tree on clinical internship preparation indicated that the majority of students felt strongly that the tool was a critical element to their preparation. The most consistent emerging theme for students was applied learning that was specific to their level of educational preparation. First-year students, who had used the longitudinal cases to foster development of basic examination skills, indicated significant benefit from classroom practice with the Family Tree cases. The realistic nature of the cases within the model provided students with more clinically relevant patient preparation. Consequently, students were prepared to evaluate patient limitations within the context of a traditional disablement model gathering the appropriate examination data. Longitudinally, the tool enables faculty to build complex cases—preparing students for more advanced clinical decision making.

Second-year students expressed an appreciation for the instrument's potential to refine skills for critical analysis of patient information. Developing and refining critical-thinking skills for differential diagnosis and intervention planning represent key elements required for effective health care practice. The interconnection and depth of the cases within the Family Tree provide students with complex patient scenarios that require the application of learned material from other courses. Requiring students to draw upon and merge previously learned curricular concepts creates opportunities to develop critical-thinking and problem-solving skills. The IU DPT Family Tree, implemented at different points within the curriculum with repetitive case design, appears to have created opportunities for students to integrate various learned skills drawn from multiple curricular levels. The goal of CBL is to provide students with an opportunity to apply learned skills; in this case, the IU DPT Family Tree illustrates a successful tool for implementation of effective patient case scenarios for applied learning.

An overview assessment of the ILCBL model suggests that the integration of the Family Tree cases was successful at producing translational educational concepts. Reflecting on the initial goals and aims of the ILCBL model, 5 of 6 significant elements were found to be successfully implemented. Individual course use as well as integrated approaches demonstrated its value in increasing effective student critical thinking and clinical decision making, as well as enhancing sensitivity to ethical practice and multicultural and psychosocial awareness. Of particular significance was the model's ability to translate skills from the academic setting to the clinic in an effective and efficient manner. Outside of the explicit benefits noted, implicit benefits also have been observed in enhanced faculty collaboration and detailed curricular analysis and integration.

These findings reflect preliminary assessment of data gathered during the initial implementation phase of this project. Other outcomes measures (eg, iscores on the National Physical Therapist Examination, scores on the Physical Therapist Clinical Performance Instrument, clinical educator comments) will be considered during subsequent development and assessment phases to better determine whether this model results in improvements in learning outcomes.

While positive outcomes were noted for a majority of students within the program, some limitations in the implementation of the model were also noted. One consistent theme was the students' lack of awareness surrounding the importance of longitudinal implementation. Specifically, students reported that an earlier, more formal explanation of the model as a means to enhance learning would be beneficial. Students were made aware of the IU DPT Family Tree and the implementation of the cases within a particular class; however, formal explanation of the ILCBL model was not complete and thus may have limited some students from understanding the longitudinal connections. Student feedback indicated that early exposure to both the instrument and the integrative longitudinal learning objectives of the ILCBL model is valuable for student buy-in and understanding. Another perceived limitation of the model was that it could limit diversity of learning opportunities. However, faculty did not exclude other modes of case presentation such as videos, live patients, or isolated cases designed to support course objectives.

Students additionally noted issues with the consistency of use among different faculty. The longitudinal model is predicated on connecting cases across classes and using all of the information to enhance learning through authentic case design. Students noted that some courses and faculty were not consistent with the implementation method. This perception likely stemmed from the fact that during the inaugural implementation phase of the model, cases from the Family Tree only were introduced in some courses on a voluntary faculty basis. This approach allowed for gradual application of the model and gathering of preliminary data; however, gradual implementation may have impeded faculty's consistent use of individual cases between courses. Another possible factor could have been incomplete faculty buy-in, given that some faculty appeared to assume a more "wait and see" stance. This perspective may shift as more faculty experience using the model and outcome data are obtained. Addi-

tionally, the IU DPT Family Tree represents only 1 method to achieve course and curricular objectives, and thus should not be overused. Finally, ILCBL applications may not be appropriate in all courses.

Future directions include expanding the implementation of the IUDPT Family Tree, keeping in mind that both integrated and isolated cases will be used as needed to accomplish specific learning objectives. Systematic development and ongoing student and faculty outcomes assessment is planned for progressive, longitudinal, and integrated applications of additional cases within and across additional courses in the curriculum.

CONCLUSION

In conclusion, an integrated case family series (the IU DPT Family Tree) was created by faculty and students to serve as a teaching and learning instrument for a longitudinal, integrative learning model (ILCBL), emphasizing applied case-based learning for the development of autonomous practice. Positive preliminary outcomes indicate use of the IU DPT Family Tree enhances students' cognitive, cultural, and ethical competence in preparation for autonomous clinical practice. Although further development and outcomes assessment are needed, implementation across courses facilitated learning with enhanced curricular retention and translation between courses.

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