Influence of residency training on the clinical reasoning development of Kenyan physiotherapists

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ABSTRACT

Objective: The purpose of this study was to explore the clinical reasoning development of physical therapists participating in an 18-month orthopaedic residency program in Nairobi, Kenya.

Methods: A mixed methods research design was utilized. The participants' clinical reasoning was assessed through a live patient examination prior to entering the residency program and upon graduation. One-on-one interviews were performed with the residents to explore their clinical reasoning during the final examination.

Results: Residents ($n = 14$) demonstrated a statistically significant improvement in their ability to perform an examination of a patient and determine a hypothetical diagnosis. The clinical reasoning process described by the participants included the hypothetical deductive and narrative reasoning models. The residents did not appear to incorporate pattern recognition during the patient assessment.

Discussion: Similar to studies on novice and expert practice in physical therapy, residents demonstrated an improvement in cue acquisition, the ability to verify and refute a hypothetical diagnosis, and the ability to match interventions to patients impairments. In addition, the residents utilized a combination of clinical reasoning models during the examination and evaluation of the patient including hypothetical deductive reasoning and narrative reasoning.

Level of Evidence: 4

KEYWORDS

Clinical reasoning; residency education; Kenya; physical therapy

Introduction

The Kenya Medical Training College Higher Diploma Program offered the first post-graduate orthopaedic residency program administered by the Jackson Clinics Foundation in 2012 [1]. The Jackson Clinics Foundation is a non-governmental organization in the United States formed for the purpose of funding humanitarian efforts in Africa [2]. The mission of the program is to help improve the standard of clinical practice within Kenya for better delivery of consistent, high quality physical therapy care to the community [2].

Few studies have investigated the influence of residency education on clinical reasoning development and patient outcomes. These studies have been limited to survey tools utilized with residency graduates and retrospective assessment of database outcomes [3–5]. Despite the subjective reports of improvement in clinical reasoning and career advancement noted by survey-based studies, residency education in the United States has not been shown to improve patient outcomes [3–5].

Clinical reasoning development has been shown to be a key component of post-graduate education and has been associated with expert practice [6]. Although

it is theoretically accepted that residency education will contribute to the advancement of clinical reasoning, limited studies have investigated the influence of residency training on the clinical reasoning development of physical therapists [3,4]. An objective measurement of clinical reasoning development through residency education in physical therapy has not been reported.

Three key clinical reasoning strategies have been recognized in physical therapy including hypothetical-deductive reasoning, pattern recognition, and narrative reasoning; with all three appearing to relate to clinical experience [7–9]. Novice clinicians tend to use hypothetical-deductive reasoning, whereas expert clinicians rely more on pattern recognition and narrative reasoning during the clinical decision-making process [7–9]. The hypothetical-deductive reasoning process requires assessment of the ability to gather cues from the examination to develop and reassess a working hypothesis. The pattern recognition model concentrates on the unseen intellectual development of a diagnosis based on experience [9]. Finally, the narrative reasoning process results in a shared understanding of the patient's perspective to reach an inclusive view of the patient's impairments [9].

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📎 Supplemental data for this article can be accessed [here](#).

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Methods

Objective

The purpose of this study was to explore the clinical reasoning development of physical therapists participating in an 18-month orthopaedic residency program in Nairobi, Kenya.

Study approval

Approval for this study was received from the three respective institutions. Informed consent and confidentiality practices were followed.

Subjects

This study utilized a convenience sample of residents in the third cohort of an orthopaedic manual therapy residency program in Nairobi, Kenya. All residents were over 18 years old and could speak and read English. The residency program was chosen based on the unique characteristics of the participants, which limited the introduction of covariates into the study. None of the participants had completed continuing education courses prior to entering the residency, and all residents entered and completed the program at a three-year technical level of physical therapy education.

A total of 14 residents in the third cohort of the residency program agreed to participate in the study. These residents completed live patient examinations at the initiation and completion of the residency program. Three residents initiated the program with the third cohort but had not completed all modules in order to sit for the final live patient exam. The age of the residents in the third cohort ranged from 26 to 38 years, with a mean age of 32.3 years. Clinical experience ranged from 4 to 16 years, with a mean of 9.0 years. The residents worked in a variety of practices including generalists (inpatient and outpatient care), outpatient orthopaedics, sports rehabilitation, and pediatrics.

Physical therapists in the residency program complete six onsite modules over 18 months. Each module consists of ten days of onsite education provided by physical therapy instructors from the United States. The online didactic portion of the program utilizes the Clinical Practice Guidelines and Current Concepts in Orthopedics, 3rd edition (American Physical Therapy Association) as background reading and preparation for participation in onsite modules [2]. The emphasis of the onsite modules is development of clinical reasoning and advancement of skills in participants, with a focus on manual therapy clinical practice and evidence-based practice. In addition to onsite modules and online resources, residents receive clinical mentoring by instructors from the United States.

Research design

A mixed-methods research design was utilized to explore the influence of an orthopaedic residency program on the clinical reasoning of participating physical therapists to determine a hypothetical diagnosis and associated treatment plan. Participant clinical reasoning was assessed prior to entering and at completion of the residency program through a live patient examination. In addition, one-on-one interviews were performed with residents to explore their clinical reasoning to generate a hypothetical diagnosis during the final examination.

Procedure

To assess the observable components of clinical reasoning used in the live patient examination, a clinical performance evaluation tool based on the Description of Specialty Practice (DSP) in Orthopaedic Physical Therapy was utilized [10]. The tool assesses the physical therapist's ability to collect key information, integrate the information into a previous knowledge framework to develop a diagnosis and prognosis, and select appropriate interventions based on this assessment [11]. The assessment is divided into five categories: examination, evaluation, diagnosis, prognosis, and intervention. Each category is further divided into multiple skills to allow for a measurable assessment of each component [11]. The assessment form contains a total of 64 items or skills. The tool was chosen for this study because it incorporates context or environment as well as interaction with the patient through a live patient examination. The incorporation of the environment allows for the assessment of narrative reasoning in addition to utilization of hypothetical-deductive and pattern recognition models. Furthermore, initial studies with the tool suggest that it is valid and reliable for the assessment of clinical reasoning in orthopaedic practice [11]. To determine internal consistency, Cronbach's alpha for the five categories measured by the tool was assessed; examination .86, evaluation .83, diagnosis .84, prognosis .51 and intervention .80 [11]. Cohen's kappa coefficient was determined for interrater reliability of each of the 64 items. Sixty items demonstrated a Kappa greater than .61 and percent agreement greater than 75% [11]. Construct validity was determined comparing physical therapists whom had completed residency training and therapists without residency training or continuing education coursework using Fisher's exact test with a p value less than .001 [11].

The assessment of the baseline and final live practical examinations was performed by two examiners. The examiners were current instructors in a United States residency program. Each examiner had over 20 years of clinical experience and was a Board-Certified Clinical Specialist in Orthopaedic Physical

Therapy. Both examiners provided significant input during the development of the tool and had extensive experience with the assessment tool in United States Residency programs. Neither of the examiners instructed nor provided mentoring to the cohort of residents in the Kenya program. Each skill was analyzed for significant differences between the baseline and program completion scores.

Immediately following the final practical examination, residents participated in individual, one-on-one interviews onsite with the primary investigator. Contact between the residents and primary investigator was limited to the initial process of informed consent, and there was no further interaction prior to the interviews. The primary investigator used open-ended questions to probe the perspectives of participants and guide the interviews. The participants were asked to share their hypothetical physical therapy diagnosis for the patient and describe the process they utilized to determine the diagnosis. In addition, participants were questioned about their proposed treatment plan based on the diagnosis.

Data analysis

For the live patient assessment, baseline and completion scores were compared with a McNemar's test, after removing 'not applicable' scores to create a dichotomous outcome variable. 'Not applicable' scores implied that the item would provide no additional information based on patient presentation, or would be contraindicated. The significance level with Bonferroni correction for multiple comparisons was set at 0.001.

Resident scores for each of the five overall categories of examination, evaluation, diagnosis, prognosis, and intervention were also determined. The category scores for each resident at baseline and completion were then compared. The change in score for each category was assessed using the McNemar's test, with removal of 'not applicable' scores. The significance level with Bonferroni correction was set at .01. Finally, overall resident performance at baseline and completion was compared using a Wilcoxon Matched Pairs test, with significance level set at .05.

A phenomenological approach was utilized to understand the clinical reasoning process from participant's perspectives. Interviews were audio recorded and transcribed by an independent transcriptionist to ensure accuracy. Information from the semi-structured interviews was coded using NVivo for Mac to arrange codes. Thick, rich narratives of the participants have been provided to inform the clinical reasoning models identified. To ensure credibility, a member of the research study team, with extensive qualitative research expertise, confirmed the themes through peer review. Furthermore, peer review of the

data was used to identify potential bias on the part of the primary investigator. Member checks (respondent validation) were performed with 10 of the residents. The clinical reasoning models identified from the interviews were triangulated with the results of the live patient examination.

Results

Baseline scores on the assessment were obtained in 2014, and scores at program completion were obtained in 2016. Residents' scores for six of the 64 items at baseline or completion were consistently 'not applicable' for the skill based on the patient presentation. Each of the 58 remaining items were analyzed for significant differences between the baseline and completion scores. Detailed results are presented in the supplemental material. Participants demonstrated a significant improvement on the live patient examination from baseline to completion on 17 of the items, in the categories of evaluation, diagnosis, and prognosis. One item in the category of intervention regarding joint mobilization demonstrated a statistically significant change. Two additional items, exercises for mobility and soft tissue mobilization, approached significance at .002.

Forty items on the assessment tool did not demonstrate a statistically significant change in scores. Three of these clinical skills, related to patient interview, demonstrated satisfactory performance at time of entry to the program. These three items included communication with the patient, building rapport, and localizing the area of symptoms. Three items on the tool remained not applicable at entry and at completion for the majority of residents based on the patient presentation. The additional 36 items on the tool demonstrated a positive change in the mode, however, the median change in scores were not statistically significant.

Resident scores for each of the five overall categories of examination, evaluation, diagnosis, prognosis, and intervention were compared at baseline and completion. [Table 1](#) demonstrates the statistical significance of the change in scores by category. The categories of examination and diagnosis demonstrated a statistically significant change. The category of prognosis approached significance at .015. The category of evaluation did not demonstrate a statistically significant change.

In addition, the exam pass rate (minimum score 75%) improved overall from 0% to 100%. Percentage scores on the baseline examination ranged from 11.7% to 61.5%, whereas final percentage scores ranged from 75% to 98.1%. [Figure 1](#) provides a visual representation of the change in percentage scores on the practical examination from baseline to completion for each subject, demonstrating that all subjects

Table 1. Entry and graduation change in scores by category.

Live Patient Examination	Freq. Satisfactory scores prior to residency education	Score prior to residency education Mode, median and IQR	Freq. Satisfactory scores following residency education	Score following residency education Mode, median and IQR	p-value (McNemar)
Examination	32.3%	31.0/34.0/8.5	60.6%	33.0/36.5/8.7	.001
Evaluation	12.5%	24.0/21.0/5.5	69.6%	21.0/24.0/5.5	.207
Prognosis	4.8%	10.0/10.0/1.5	92.9%	12.0/12.0/1.0	.015
Diagnosis	17.9%	2.0/2.0/1.3	100%	4.0/4.0/*	.002
Intervention	6.4%	14.0/14.5/6.0	64.3%	14.0/17.0/4.0	.219

* limited variation in scores resulted in inability to compute IQR

improved their individual performance. The statistical analysis of full group scores at baseline versus completion demonstrated a significant change in performance ($p < .001$).

Following the practical examination, the residents were interviewed and asked to describe the hypothetical physical therapy diagnosis and the process they used to arrive at that conclusion. Residents discussed using the hypothetical-deductive reasoning process and narrative reasoning process throughout the examination of the patient, and in some instances, they integrated both processes to develop a physical therapy diagnosis. Residents also discussed the need to perform a thorough individualized examination and the utilization of key findings to form a hypothetical diagnosis. The acquisition of cues from the patient's narrative and examination to develop and reexamine the hypothetical diagnosis followed the four steps

outlined in the hypothetical- deductive reasoning process: cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation [7]. In addition, the residents discussed the need to listen to the patient's story and the importance of understanding the patient's perceptions of the pathology.

The residents discussed several of the steps of hypothetical-deductive reasoning. J.O. described the process as: 'So I do the objective examination, come up with an idea what I am treating, then I'm able to rule out issues and rule in others. After that I can make the treatment plan and execute the treatment and retest.' The focus on utilization of findings from the examination to guide the treatment plan was further expanded upon by H.M.:

Clinical reasoning, for me, it means how one can process information that you get from a patient. Take that information, narrow it down and really get to what is

Entry and Completion Percentage Scores

Figure 1. Entry and completion scores (%). The median change in score for the group was 45.5%, with an interquartile range of 20.7%. The 95% confidence interval for the median change in score was (40.0%, 66.0%), indicating considerable gains in skills as a group.

happening to this patient. Rather than just having an overview.

Residents also discussed the development of non-patient identified problems (NPIPs) as described in the HOAC II algorithm developed by Rothstein, Echternach, and Riddle [12]. Rather than focusing on the local area of symptoms in isolation, residents considered the underlying cause or contributing factors for the development of the symptoms. D.M., explained:

Now you need [sic] start think what structures are there that could cause pain. You don't just go to the back and assess it. You connect. It could be from the ankle joint, from the hip problem, could be from the muscular stuff.

In addition to using objective measurements to support the patient's physical therapy diagnosis, residents expressed the importance of listening to the patient's story to develop a shared meaning for the patient's symptoms. These descriptions support the integration of the narrative reasoning process in the evaluation of patients. S.K.S. expanded on how the clinical hypothesis was developed to include narrative reasoning.

My reasoning has changed in terms of how I listen to the patient tell me her story. Because I listen, I'm trying to come up with either a hypothesis or the nature what [sic] this is, or time and pattern of the patient's pain. So it helped me be able to listen better and include a number of things the patient tells me, so that I'm able to involve the patient also.

M.D. concurred about the importance of listening to the patient's story: 'Clinical reasoning simply means how you integrate what the patient is telling you. Because you have to listen to the patient. Whatever he or she is saying, what he's saying will lead you to what to do.'

Residents described gaining a wider perspective by synthesizing objective data with the patient's story. Some residents described a combination of sources to determine a hypothetical diagnosis for the patient, integrating two clinical reasoning processes: hypothetical-deductive reasoning and narrative reasoning. It was through the integration of objective data and the patient's subjective comments that many of the residents discovered the underlying condition. As J.N. explained: 'One it was from the patient's mouth, the description of the problem that she had. It gave me a clue of this should be this, but still I have to assess and find out if it is really the structure that is troubling here.'

In addition to the development of a hypothetical physical therapy diagnosis, screening for non-musculoskeletal pathology and making timely referrals were highlighted as key components of the examination. Residents discussed the need to examine the patient from a systemic perspective versus looking at

the area of somatic symptoms in isolation. They noted the need to recognize both medical and psychological issues present and considered this as a component of the clinical reasoning process. The determination of appropriateness of the patient for physical therapy was performed throughout the assessment. As explained by D.M., whether to refer or not is grounded in the reasoning process during the re-assessment.

It's something you need to refer because sometimes you get red flags. So you need to refer to the surgeon. Because sometimes you get a red flag, you go ahead with something, maybe you can get a problem and make it worse. Yea, so every day the patient comes to reassess [sic], we get her testing.

In addition to red flags, J.N. discussed yellow flags indicating psychosocial influences on the patient's symptoms.

Through clinical reasoning you are able to determine whether a patient is appropriate for physical therapy. We are able now to tell the red flags or the yellow flags. These kind of things, the psychosocial need.

Discussion

Residents in the third cohort of the orthopaedic residency program in Kenya demonstrated an improvement in knowledge and clinical reasoning, as measured by performance on the assessment tool administered upon residency entry and at time of residency completion. The process utilized by the residents aligns with the hypothetical-deductive reasoning process in which hypothesis revision occurs throughout the patient encounter [13]. Residents demonstrated a significant improvement on five of the six items in the category of prognosis. These items closely align with the HOAC II algorithm, including choosing reassessment measures and selecting and prioritizing interventions based on the patient's impairments [13].

Although there was no significant change in individual skills within the category of examination, cue acquisition improved between baseline and at completion. On entering the program, residents collected an average of 36.1% of available cues in the history and examination. At completion, the residents assessed 81.3% of cues. Similar to research performed by May et al, cue acquisition considered key for the diagnosis of the patient was incomplete for residents entering the program [12]. The lack of appropriate cue acquisition has been associated with novice practice, which suggests that minimal connections were being made between the history and the physical examination [12]. Prior to participation in the residency program, the therapists' performance during the subjective examination was consistent with novice practice.

The category of evaluation focuses on the identification of relevant data, prioritization of limitations, development of a hypothetical diagnosis, screening for medical referral, and selecting the intervention approach [12]. These skills are directly related to cue interpretation and hypothesis generation within the hypothetical-deductive reasoning model [13]. Residents demonstrated a significant improvement in ten of the seventeen items assessed in this subcategory. These improvements suggest that the residents were utilizing the hypothetical-deductive reasoning model to link objective data and impairments with the purpose of designing patient specific interventions. Two of the items that did not demonstrate a significant change included: (1) responding to the emerging data from the examination and (2) performing adjustments to interventions when necessary. These skills may be better tested when using the tool during mentoring sessions with residents versus during a single session. Reassessments of patients for ongoing care may provide a better opportunity to observe these skills in context.

Only one skill in the category of intervention, joint mobilization, demonstrated a statistically significant change between the baseline and final assessments. Two additional skills approached significance at .002, therapeutic exercise to improve mobility and soft tissue mobilization. Manual therapy and exercise were the emphasis of the program, and this emphasis appears to have influenced gains in the observed skill level. Many of the other intervention skills commonly used in outpatient orthopaedic practice were not integrated into the curriculum due to limited resources available for physical therapy treatment within the Kenyan clinical context. Residency programs with additional areas of concentration within curriculum may see a greater improvement in multiple categories of intervention skills.

Based on the above quantitative findings, residents completing the program appeared to follow the hypothetical-deductive clinical reasoning theory. The graduating residents collected key information, including a thorough history and baseline objective measures, and used it to determine special tests to be utilized to confirm or refute the hypothetical diagnosis. These findings are similar to Rivett and Higgs and May et al, who also found that both novice and expert physical therapists use a form of hypothetical deductive reasoning in their assessment of patients [12,14].

The interviews explored the residents' decision-making process during the practical exam. In the interviews, residents discussed the importance of listening to the patient and understanding their story. The desire to understand the patient's perception of illness closely follows Kleinman's Explanatory Model of Illness (EM) [15], which describes the importance of understanding the patient's perspective of the illness. The healthcare provider must understand the social

and personal meaning that the patient attaches to illness [15]. Furthermore, Kleinman argues the clinician must understand the patient's goals for treatment to develop an effective plan of care. This understanding assists in creating a shared meaning of the illness and provides a basis for patient education regarding the treatment plan [15]. The incorporation of the patient's perspective allows for the validation of the patient's EM and marks the beginning of the formation of the treatment plan [15]. The patient's perspective is an integral component of the narrative reasoning process [9].

Residents also described the integration of the clinical reasoning processes of hypothetical-deductive reasoning with narrative reasoning during the practical examination. These findings are similar to research performed by Edwards et al, which explored the clinical reasoning process utilized by expert physical therapists [7]. Two clinical reasoning processes were described by Edwards et al during the diagnosis of patients; diagnostic reasoning and narrative reasoning [7]. In this study, the residents described their clinical reasoning process as relying on the hypothetical-deductive process as well as narrative reasoning to formulate the patient's plan of care. Narrative reasoning informed the plan of care by integrating the patient's belief regarding their illness into that plan [7]. Edward's study was similar to what was found in this study.

At residency completion, none of the residents utilized an assessment style that would represent pattern recognition. In the pattern recognition model, the clinician assigns a case or patient presentation to a category based on experience with patients [7,9]. Although the lack of pattern recognition could be attributed to the nature of the examination and the residents' desire to demonstrate all skills taught within the residency, 13 of the 14 residents reported during the one on one interviews that the examination was an adequate representation of clinical practice. Pattern recognition requires significant clinical experience to develop an organized knowledge base [7,9]. From this perspective, inexperienced clinicians would not have had adequate exposure to multiple patient diagnoses and presentations to effectively utilize pattern recognition. The residents entered the program with a technical diploma in physical therapy and the use of clinical reasoning for determination of a hypothetical physical therapy diagnosis was a new competency for them. Their limited experience with developing hypothetical diagnoses may have limited the ability to incorporate the pattern recognition model.

Limitations

Delimitations included using a small sample of convenience from a single residency program in Nairobi, Kenya.

This pilot study explored a specific group of therapists from a resource-limited country, within the context of that country. As such, it may not be generalizable to other countries without modifications. However, the study informs potential approaches to the development of other residencies in similar countries, which could then consider context-specific issues and needs.

The advancement of knowledge, skills, and clinical reasoning in this study was measured by a live patient examination to incorporate context specificity. The live patient examination may not have accurately represented the clinical practice of the residents. Limitations in the qualitative assessment included potential bias in interpretation of the data. To attempt to minimize bias, an investigator with no involvement in the data collection performed an external audit of the data. In addition, member checks (respondent validation) were performed with ten of the residents.

Conclusion

Residents in the third cohort of the orthopaedic residency program in Kenya demonstrated a significant improvement in knowledge and clinical reasoning, as measured by performance on a live patient examination at entry into the program and upon completion of the residency. The graduates described using a combination of hypothetical deductive reasoning and narrative reasoning to determine a diagnosis and implement a treatment plan. The findings from this study suggest residency education can positively influence clinical reasoning development.

Disclosure statement

No potential conflict of interest was reported by the authors.

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