

# Athletic Training Residency Program Development and Assessment of Advanced Clinical Reasoning

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**Context:** Clinical reasoning is an inferential process of collecting and evaluating data in patient cases, necessary in all care. Athletic training residency programs are emerging rapidly as the industry standard for developing clinical specialists who possess advanced clinical reasoning needed for complex cases.

**Objective:** The purpose of this study was to explore current practices of advanced clinical reasoning development and assessment in athletic training residency programs.

**Design:** Inductive qualitative research.

**Setting:** Web-based teleconferencing platform (Zoom Video Communications).

**Patients or Other Participants:** Seven of 10 Commission on Accreditation of Athletic Training Education–accredited residency program directors (RPDs) (age = 46 ± 9 years, years as RPD = 5 ± 6).

**Data Collection and Analysis:** We used qualitative, semistructured interviews. Audio files were transcribed verbatim, checked for accuracy, deidentified, and member checked before analysis. We used a 2-person data analysis team and an inductive coding approach. The researchers reviewed the transcripts independently, met to develop a codebook, applied the codes, and conducted internal auditing. Trustworthiness was established through member checking, multiple-analyst coding, and auditing.

**Results:** Three themes emerged from the RPDs about developing advanced clinical reasoning: (1) defining clinical reasoning, (2) instructional tactics, and (3) assessment tactics. RPDs defined clinical reasoning as the process of the resident justifying their decision-making and the accuracy of their decisions. RPDs described both clinical and didactic instructional tactics, including mentoring, lectures and discussions, case presentations, and journal club. RPDs described assessing advanced clinical reasoning through patient and preceptor feedback in structured and unstructured formats, self-reflection, and knowledge testing to measure clinical reasoning. RPDs highly relied on preceptors and clinical mentoring, but also described a singular reliance on residents to appraise the clinical reasoning capacity of their own preceptors.

**Conclusions:** RPDs define clinical reasoning as rationalization and accuracy of decisions. Although the programs are engaged in effective clinical and didactic approaches to teach advanced clinical reasoning, they rely heavily on the subjectivity of preceptors and residents to assess these outcomes.

**Key Words:** Clinical decision-making, postprofessional education, clinical specialist

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## KEY POINTS

- Residency program directors define clinical reasoning as the rationalization and accuracy of decisions, specifically related to definitively diagnosing and creating treatment plans for patients.
- Residency programs are implementing a variety of clinical and didactic instructional strategies to advance clinical reasoning in their residents as well as several assessment tactics to measure proficiency.
- As residencies continue to evolve, more robust assessment measures of advanced clinical reasoning should be integrated to complement the clinical mentoring and didactic education offered through these programs.

## INTRODUCTION

As the profession has evolved, athletic training education has moved to mirror the structure and competencies of other allied health care professions.<sup>1,2</sup> One way the profession has shifted is in the development of accredited residency programs. The purpose of athletic training residency programs is to develop clinical specialists in focused areas of practice such as orthopaedics or pediatrics.<sup>3</sup> To assess resident progression throughout their time in residency, the Athletic Training Milestones Project (AT Milestones Project) was created as an educational tool to measure both maintenance of core competence and proficiency development within a specialty area of practice that is based on previous work within the medical education community.<sup>4</sup> Even though neither the AT Milestones Project nor the Commission on Accreditation of Athletic Training Education (CAATE) has identified clinical reasoning specifically as a measurable component of clinical education, the skill of clinical reasoning is a foundational competency for the implementation of evidence-based care and is highlighted as such in a multitude of postprofessional health care residency programs and fellowships.<sup>5-7</sup> Unfortunately, the current literature regarding the development and assessment of clinical reasoning in athletic training education is scarce, particularly pertaining to advanced clinical reasoning developed through residency programs.

The 2 most discussed models of clinical reasoning in research are hypothetico-deductive reasoning and case-pattern recognition.<sup>8</sup> Hypothetico-deductive (analytical) reasoning can be described as the formation of a hypothesis and the subsequent testing to prove or disprove the hypothesis.<sup>8</sup> This model of reasoning is most used by novice clinicians. Case-pattern recognition (nonanalytical) involves the recognition of key features that trigger connections to past knowledge and experience, and is used more commonly by experienced clinicians.<sup>8</sup> Although literature does not identify a particular model to be superior, Eva et al<sup>9</sup> suggested that a combination of analytical and nonanalytical clinical reasoning is most helpful in clinical diagnosis. In an effort to improve clinical

reasoning development in athletic training education, some learning strategies have been identified in literature. Some methods include the learner-centered technique of summarizing findings, narrowing differentials, analyzing differentials, probing instructors, planning management, and self-directed learning for case presentations or case-based analogical reasoning with cuing from an instructor.<sup>10,11</sup> Further, medical education as a whole has identified and implemented a number of objective measures of clinical reasoning that can demonstrate detectable change, such as the Diagnostic Thinking Inventory or Script Concordance Test.<sup>12-14</sup> However, to our knowledge, there is no literature suggesting how or if these techniques or others are being applied to the development of advanced clinical reasoning among clinical specialists in athletic training. Exploring how residency program directors (RPDs) or preceptors develop and assess clinical reasoning could help educators understand the purpose of a residency and aid educators at all levels of education.

With little to no current evidence to describe how athletic training residency programs develop and assess clinical reasoning skills, it is difficult to understand how programs are guiding residents in their progression towards becoming clinical specialists. Therefore, the purpose of this study was to explore current practices and perceptions of clinical reasoning development and assessment in residency programs. This study was guided by the following questions: (1) How do athletic training residency programs develop clinical reasoning among their residents? (2) In what ways, if any, do athletic training residency programs measure clinical reasoning development?

## METHODS

### Design

We used a qualitative research design with inductive coding to investigate clinical reasoning development and assessment in athletic training residency programs. An inductive approach to qualitative research has been described as a simple and effective system for the identification of themes from raw, qualitative data.<sup>15,16</sup> A general inductive approach is very similar to the grounded theory approach; however, unlike grounded theory, a general inductive approach typically stops at the description of themes without construction of a theory.<sup>15,16</sup> This study was approved by the university institutional review board before participant recruitment and data collection.

### Participants

RPDs from CAATE-accredited athletic training residency programs were recruited for participation in this study and all participants consented before each interview. RPDs are responsible for compliance with CAATE standards; planning,

**Table 1. Participant Demographic Characteristics**

Pseudonym	Age, y	Gender <sup>a</sup>	Years of AT Certification	Years as Residency Program Director
Benjamin	48	Male	23	10
Jacob	52	Male	22	16
Judith	35	Female	16	3
Naomi	33	Female	11	2
Patrick	42	Male	20	5
Isaiah	48	Male	23	1
Peter	61	Male	38	1
Mean ± SD	46 ± 9		22 ± 8	5 ± 6

Abbreviation: AT, athletic trainer.

<sup>a</sup> Five men (71.4%), 2 women (28.6%).

development, implementation, delivery, documentation, and assessment of the residency program; clinical practice experiences, and programmatic budgeting.<sup>3</sup> At the time of this study (June 2020) there were 10 CAATE-accredited residency programs, and emails were sent to all 10 RPDs. Seven RPDs consented to participate in the study. Participant demographics can be seen in Table 1.

### Instrumentation

To collect data, a semistructured interview protocol was developed and reviewed by members of the research team. In addition, the script was also reviewed by 2 other athletic trainers with experience in qualitative research and residency education. The final interview script consisted of 6 demographic items and 10 exploratory questions. All questions were open-ended and most included follow-up questions, which allowed the principal investigator to ask probing questions and have flexibility in the data collection. Questions in the script addressed how residency programs develop and assess clinical reasoning (Table 2).

### Procedure

All interviews were performed by the principal investigator via Zoom Video Conferencing (Zoom) software. All interviews were audio only to ensure consistency among all participants regardless of the participant's access to a video camera. The interview began by asking participants for verbal informed consent to participate in the study and have their responses recorded. All participants were informed before the interview that they maintained the right to stop the interview and withdraw their responses from the study at any time during the data collection. Interviews lasted roughly 30 minutes, and participants were given 15 days to withdraw data after collection.

Audio from all interviews was recorded and transcribed using Zoom transcription software. Transcripts were then reviewed for accuracy by the principal investigator. The principal investigator also removed any personal identifying information and assigned pseudonyms to ensure participant confidentiality. After participant transcripts were deidentified, each transcript was sent to the respective participant to check for accuracy (ie, member checking). Interviews and recruitment

**Table 2. Interview Protocol**

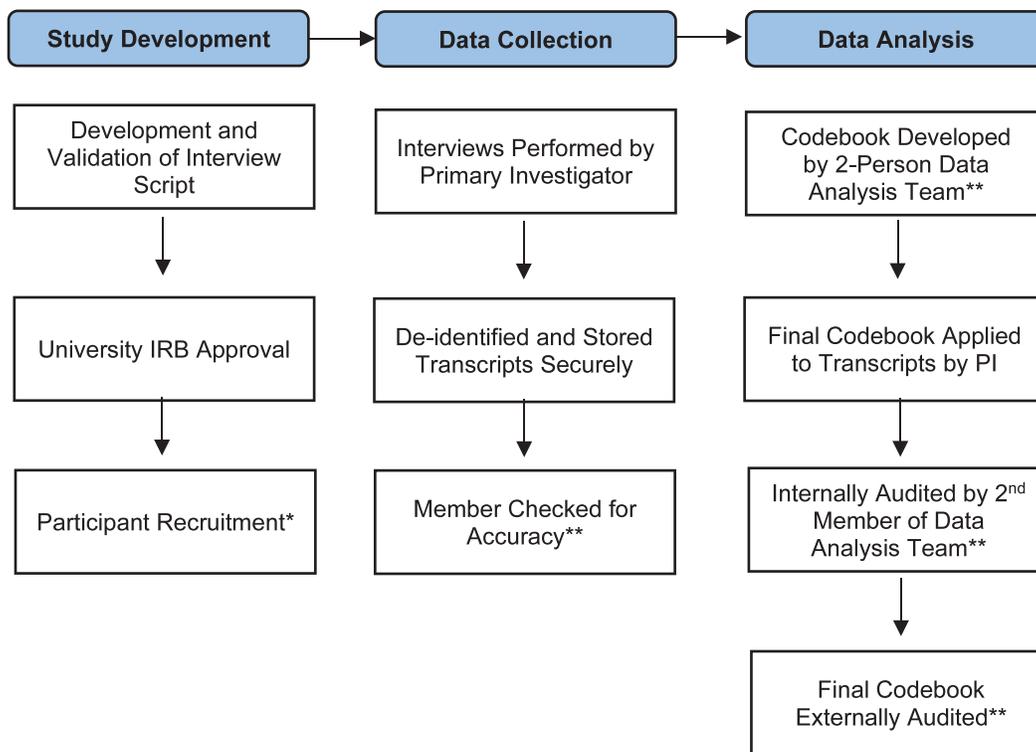
1. Please describe your athletic training residency program (ask specific questions below if any are not answered)
  - a. What is the program's specialty area in athletic training?
  - b. How many faculty members does the residency have?
  - c. What are those faculty members' roles?
  - d. How many preceptors do the residents have?
  - e. How many hours a week do the residents spend in didactic learning?
  - f. What clinical experiences are residents exposed to?
2. On average, how many hours do residents spend in clinical practice per week?
3. On average, how many hours do the resident spend in one-on-one mentored time with preceptors?
4. What skills do you hope your residents possess upon program completion?
5. In what ways, if any, do you develop these skills?
  - a. If diagnostic skills are stated—In what ways do you develop advanced diagnostic skills?
  - b. If rehabilitation skills are stated—In what ways do you develop advanced exercise prescription skills?
  - c. If advanced intervention skills are stated (eg, manual therapy)—How do you develop advanced intervention selection skills?
6. What learning outcomes do you use to guide resident development?
7. How would you define clinical reasoning?
8. In your opinion, what is the importance of clinical reasoning in the development of a clinical specialist?
9. In what ways, if any, does your program ensure preceptors demonstrate clinical reasoning in their practice?
10. In what ways, if any, does your program develop clinical reasoning skills among the residents?
11. How do you assess and reassess clinical reasoning skills throughout the program?
  - a. What tools, if any, do you use to measure clinical reasoning development?
12. If a tool is mentioned—Can you describe the tool? What has been your experience with those tools?
13. If no tool is mentioned—Would you be willing to use an assessment tool if available? Why or why not?
14. What learning strategies, if any, have you implemented that have aided in clinical reasoning development among residents?
  - a. Can you explain these strategies?

continued until we reached saturation, whereby the interviews were yielding no new information. Saturation was achieved in that redundancy had occurred through much of the interview process.

### Data Analysis and Management

Inductive coding was performed on the participant transcripts following a rigorous inductive process that has been previously described in the literature.<sup>15,17,18</sup> First, the 2 members of the research team (D.W.H., L.E.E.) completed close readings of the text so that they had good familiarity with the data. Then, categories and themes were applied to the textual data independently by the investigators. The 2

**Figure 1. Study flowchart. \*Only residency program directors of Commission on Accreditation of Athletic Training Education (CAATE) residencies were considered for inclusion into the study. \*\*Used to establish trustworthiness.**



members (D.W.H., L.E.E.) then met to discuss and develop a codebook that would be applied to the data. These categories were then organized so that groups of overlapping or lower-order themes could be grouped into overarching, higher-order themes. Following methods used in other inductive content analysis research, this process was continued until first-, second-, and third-order themes were developed.<sup>18</sup>

To assess trustworthiness, member checking, peer debriefings, and an internal audit were performed in accordance with recommendations for effective general inductive approaches to qualitative research.<sup>15</sup> Member checks were performed by research participants to safeguard accuracy and clarity. Peer debriefings with 2 researchers (C.E.W.B., M.J.R.) experienced in qualitative research also helped ensure credibility of the coding process. Finally, an audit was performed by a final member of the research team to assess methodologic rigor and accuracy of coding. A flowchart of the entire study process can be found in Figure 1.

## RESULTS

After analysis of the data, 3 main themes emerged: defining clinical reasoning, instructional tactics, and assessment tactics (Figure 2). Clinical reasoning was primarily defined by participants as the process of justifying or explaining decision-making. Some RPDs also defined clinical reasoning as accuracy in diagnosis or management of orthopaedic conditions. Instructional tactics described by RPDs included a heavy emphasis on mentorship along with didactic methods such as lecture, journal club, and clinical scholarship. When discussing assessment tactics, participants described both structured and unstructured assessment of resident development by both athletic training residents and preceptors.

## Defining Clinical Reasoning

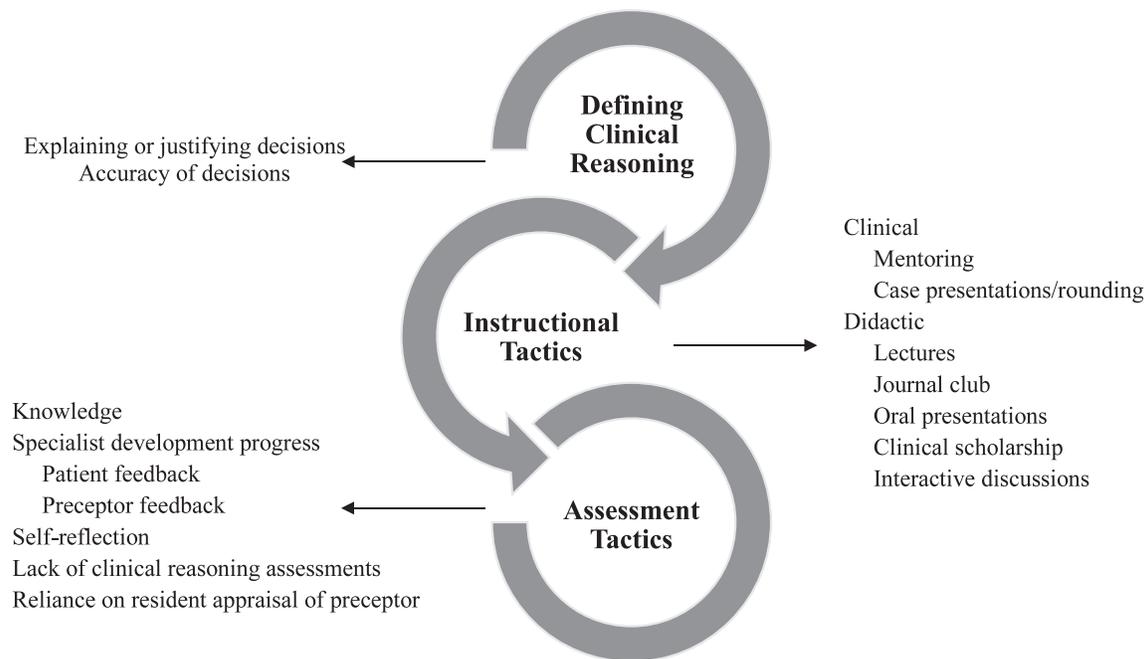
The most common definition of clinical reasoning given by participants was the process of justifying or explaining decision making by the resident. Several participants described clinical reasoning as the skill of taking relevant information from patient history, evaluation, and medical knowledge and conceptualizing this data to make clinical decisions. The residents then verbally describe that process to the mentor. Peter explained it as the following:

*It is the ability to take information presented following a physical examination and medical history [and] to be able to formulate a plan of treatment utilizing current evidence and best practices in a patient-centered approach.*

Other participants described clinical reasoning in a similar manner, with some adding that it is the resident's ability not only to make clinical decisions, but to verbally describe or demonstrate the reasoning process to the mentor. In this sense, Judith stated, "Overall, it's hopefully our ability to be able to see their thought process specifically explained out [and] then how it's backed by the research." Judith's definition of clinical reasoning highlights the need for residency faculty to see residents demonstrate their clinical reasoning process and highlights a common theme of making evidence-based decisions. Another definition given by some of the participants was that clinical reasoning includes the accuracy of diagnosis and treatment planning. Jacob described clinical reasoning as the following:

*It's being able to... take a competent history and understand past medical history. Identify what you know the patient presents with, whether that's even to the point of observation, palpation, patient physical exam, and then process that information. Taking in all aspects of the patient, current*

**Figure 2. Emergent themes and categories.**



history, past medical history, past surgeries. Based on the pathology, looking at observation of the patient doing special tests and then taking all the information that they gather to come up with a differential diagnosis and then being able to utilize that to identify the treatment plan.

Judith also mentioned clinical reasoning through the lens of decision-making accuracy but expanded the definition to include the act of assessing decision accuracy by comparing clinical decisions to literature. Judith continued:

*They start to develop their treatment progression of what they're initially going to focus on, or what are some manual techniques, or... some exercises that are proven to help this impairment and then... depending on the type of athlete, then we've also asked them to review the literature and see if there's any return-to-sport progressions that are available for that type of athlete or that type of injury. And if there isn't, then we asked them [to] find the most evidence-based applicable version. And then, how would you modify that based on your specific athlete or your athlete's position that isn't necessarily been catered to in the literature?*

### Instructional Tactics

RPDs described a wide range of instructional tactics that could be broadly grouped into clinical and didactic experiences. Clinically, participants emphasized a heavy reliance on mentorship as a primary instructional tactic (accredited residencies are required to ensure that 20% of the focused clinical practice time is one-on-one with a preceptor).<sup>3</sup> One common method used in residency education is mentor observation of practice. When asked about clinical experiences of the residents, Benjamin stated, "It's mentorship based. They're not on their own. There's someone there that they're learning from who is in that current role that they aspire to."

Benjamin's description of observed practice hinted that a substantial portion of resident clinical experience is under the supervision of a preceptor. Some participants described more

independent experiences for residents, and one described a lack of autonomous practice. On the topic of autonomy and practice observation by mentors, Isaiah said, "They [residents] won't do anything autonomous. They'll always have someone with them when they're in their clinical hours." This was the experience described by only one of the RPDs.

Along with pure observation of practice, participants also described a heavy use of interactive questioning during clinical instruction. Participants explained this as an important step in clinical specialist mentorship, and most residency programs appear to place emphasis on regular, informal dialogue among preceptors and residents. Peter described his residency's use of interactive questioning as "a lot of open-ended questions which will cause them to think without giving them the answer."

Furthermore, participants emphasized interactive questioning as an important mentorship method in clinical reasoning development in residents. They described a form of cooperative learning in which residents can work through thought processes with preceptors. When discussing the interactive questioning and dialogue that occurs in his residency program, Jacob said,

*It's that interdisciplinary learning or the cooperative learning, the ability for the athletic trainer resident to work with others who are already at the specialty area and be able to bounce ideas off of them.*

Both observation of practice and interactive questioning were mentioned by several participants to describe a form of instructional tactics defined as guided practice. Through this, residents are given more autonomy in their practice. Residents can make clinical decisions in a safe environment and then lean on the experience, knowledge, and clinical reasoning abilities of preceptors to adjust and refine their own practice. In this model, preceptors can assess the abilities of the resident and amend instruction to fit the clinical development needs of

the resident. Judith described her residents' clinical experiences:

*Our focus is on rehabilitation. We have the program director, and then we have another key coordinator, and then we have 3 [people] that fill in as preceptors, or mentors. Our athletic training resident spends 3 afternoons in the clinic getting mentored, working with a coach treating patients. And then we also have a relationship with the local university and we have a physical therapist that functions in their athletic training room and does the long-term rehabs. There, our athletic trainers will spend typically 2 mornings in the athletic training room, mainly focusing on long-term rehab. And then depending on what sport they have an interest in, they also build a relationship with the staff athletic trainers at that university and help with some of the traditional like acute athletic training... covering practices and games. They also usually take the lead on any long-term care rehab or lingering injuries.*

She continued to describe the mentorship process:

*Working with our other mentors and just gauging and seeing how our residents are developing and performing throughout the residency year and then sitting down with them and trying to provide constructive criticism in areas for them to improve. Just making sure that development is occurring throughout the year.*

Some other tactics discussed by participants included case presentation and rounding. In this, residents are described as completing several clinical case studies and presenting those case studies to preceptors or faculty of the residency, either in formal presentations or informal case rounding. A number of participants, especially those associated with residency programs based in the physician clinic setting, described presentation of patient information and care plan suggestions to the physician or preceptor as a common practice in their program. Describing this process, Isaiah said,

*Along with any of the special tests that are needed, they should be able to look at some diagnostic imaging and suggest any further diagnostic imaging that might assist in a diagnosis and they should be able to present that case to their provider.*

During the interviews, numerous instructional didactic tactics were mentioned. Tactics mentioned included lectures, journal club, oral presentations, clinical scholarship, and interactive discussion. Journal club was regularly mentioned by participants and described as occurring in relation to grand rounds completed with other providers within the organization. Not all participants described oral presentations as an instructional tactic, but a few did mention weekly or periodic presentation requirements from their residents. Along with presentations, evidence-based practice was mentioned a number of times. Participants described forms of clinical scholarship including literature examination, research, and dissemination of current rehabilitation trends at local and national conferences. Judith stated the following:

*We have a pretty heavy research component to our program, and we want to make sure that they're well-versed, engaging in, and discussing and disseminating current trends in sports rehabilitation and then being able to have the chance to disseminate that at local and national conferences.*

Although some participants were less descriptive of their didactic techniques, most described interactive formats as a

more effective technique in the education of their residents compared to more traditional lecture styles. Peter explained it as follows:

*We've gotten away from it [PowerPoint presentation] and we have made it more of a guided question-and-answer presentation to where it's more interactive with the group. To where questions are asked during the presentation where information is presented. And then there's question and answer during the actual presentation to where it creates professional dialogue rather than just sitting and watching information presented.*

Like the interactive discussions for clinical instruction, didactic instruction that incorporated an open forum between preceptors and residents was described positively. Some RPDs describe participating in didactic education directly, whereas the majority recruited preceptors as the primary instructor in most didactic experiences. When asked about her residency's didactic education, Naomi explained, "Our preceptors really take the lead on the didactic teaching. [They] do a really great job of making sure that it's an open forum for discussion and talking [residents] through that."

### Assessment Tactics

Residency programs also used multiple clinical reasoning assessment tactics. One method mentioned by participants was assessment of knowledge. Although no uniform method of knowledge assessment was described, a common practice seen in a few programs was the implementation of pretesting and posttesting of declarative medical knowledge, which is inconsistent with typical assessments of clinical reasoning. Some described this as occurring during each cycle of the residency to determine resident progression towards becoming a clinical specialist, and others used knowledge assessment primarily as a baseline measure to identify areas for growth within the resident. Jacob described his use of knowledge assessment:

*I think first of all we have to find out where they are... truly identifying where they are on the continuum of their orthopaedic knowledge. We start with a test that's been developed within our program and our physicians and providers to identify areas that they do have understanding and in areas that they don't.*

Naomi also described their use of medical knowledge testing in her residency program:

*We also do a preassessment, posttest regarding their medical knowledge and their musculoskeletal knowledge and radiology and imaging review.*

Another assessment tactic mentioned by all participants was the use of preceptors in resident assessment. This was the most mentioned form of assessment described by participants in this study. Residency programs rely heavily on structured and unstructured feedback from preceptors to describe how residents are progressing as clinical specialists. Examples of structured feedback included clinical competency evaluations and use of the AT Milestones.<sup>4</sup> Patrick mentioned,

*We use things like the AT Milestones which are really based in the ACGME [Accreditation Council for Graduate Medical Education] core competencies. That's what graduate medical education uses. That's what physician residency and fellow-*

ship programs use. So, it makes sense for us to utilize those as well.

Participants spoke favorably about the AT Milestones because they can be completed regularly to assess resident progress and give examples of action steps for residents to take to progress into the next box. However, the implementation of the AT Milestones varied among programs.

In combination with the structured formats of resident evaluation, participants also talked on regular use of unstructured feedback from preceptors. Most commonly, preceptors would subjectively describe resident progress with the RPDs based on their clinical experiences with the resident. Benjamin spoke on his use of unstructured feedback to assess resident development as a clinical specialist, stating,

In our planned and unplanned director-to-resident meetings, communications with those preceptors that are in clinics with them [residents] give me an idea of how our residents are doing and therefore I can verbally help them in improving.

In addition to reliance on preceptor feedback, some participants also involve the patient in the evaluation of residents. Patient feedback was described as important for resident development in assessing treatment effectiveness and getting an overall feel for how well the resident is providing patient-centered care. Judith expounded on this, stating that she would “try to get feedback from the patients as far as how they feel like their treatment is going just to give them [residents] that patient’s perception of things.”

The incorporation of patients was not mentioned by all RPDs. However, another assessment technique that was mentioned regularly in interviews was the use of resident self-reflection. Patrick mentioned, “There’s always informal feedback going back in reflection from the resident.”

Some residency programs used more structured styles of self-reflection, either through resident completion of the AT Milestones or regular goal setting. Others incorporated reflection and metacognition into the interactive discussions that occur in the program. And although patient, preceptor, and self-reflection of resident development were common, participants described a lack of clinical reasoning assessment when assessing clinical reasoning skill in preceptors. When asked about assessment strategies to ensure clinical reasoning in preceptors, Naomi stated the following:

*As far as actively going back and checking whether or not our preceptors are doing that [clinical reasoning] actively as part of their practice, there’s not a specific process that we go through. We just discuss a lot and try to close the loop with what we discussed with the residents and making sure that they’re incorporating that when they’re spending time with them.*

This lack of formal clinical reasoning assessment was noted in participant responses. Those who did mention assessment of clinical reasoning almost entirely relied on resident appraisal of the preceptors’ clinical reasoning capacity. As Naomi mentioned above, discussion with residents regarding the quality of the preceptor is the primary tactic used by residency programs. Isaiah echoed this in his response:

*The athletic training resident also evaluates that [preceptor] during the rotation. So a lot of the things we developed over the years through discussion, both with the evaluating of the resident, and then also the resident evaluation of the [preceptor] and the training and education that was involved with that rotation. And that’s how our educational offering right now has been shaped over the years.*

Speaking directly to clinical reasoning assessment in preceptors, Jacob also said the following:

*Well, that’s actually one of the questions in our clinical competencies evaluations. It’s one of the questions that our residents do evaluate the preceptor; it’s part of that evaluation tool. So, we are ensured by the resident’s evaluation of the preceptors.*

## DISCUSSION

Clinical reasoning, the ability to weigh evidence with the specifics of a patient case and clinical experiences, is a critical skill at all levels of professional and postprofessional education.<sup>5-7</sup> However, as an athletic trainer progresses from being a competent clinician, the goal of professional education, to a clinical specialist, clinical reasoning skills should advance and residency graduates should demonstrate higher levels of clinical reasoning associated with a provider ready for advanced practice.<sup>4</sup>

Literature describes a combination of 2 primary models, analytical and nonanalytical reasoning, as the most effective means of reasoning during clinical evaluation.<sup>9</sup> Further, medical education research has identified instructional and assessment tactics effective at developing and measuring clinical reasoning.<sup>8,10,11,13,19,20</sup> Physical therapy is one comparable profession in which residencies are designed with the goal of creating specialists in a specific content area. Physical therapy residencies often use a number of methods geared at developing and assessing advanced clinical reasoning, with mentorship, regular reflective exercises, and objective assessment tools constituting these tactics.<sup>6,7,12</sup> As residency programs increase in popularity throughout the athletic training profession, a better understanding of how programs currently perceive, instruct, and assess advanced clinical reasoning is a pivotal first step to ensuring effective outcomes in residency education. This study sought to capture these answers through semistructured interviews with residency RPDs, and as a result, the 3 emergent themes were identified.

### Defining Clinical Reasoning

Participants’ definitions of clinical reasoning as a process of either decision justification or decision accuracy align with the definition given by Jensen and Givens<sup>21</sup> that clinical reasoning is multidimensional, including a variety of cognitive activities regarding clinical judgment, decision-making, and actions. Most participants’ definitions of clinical reasoning would fall under either analytical or nonanalytical reasoning; however, there seemed to be a heavier emphasis towards the hypothetico-deductive method of reasoning.<sup>8</sup> This was most apparent when RPDs described clinical reasoning as the process of taking information from a patient and using that, in conjunction with best evidence, to create a diagnosis or treatment plan. This characterization of clinical reasoning is hypothesis driven, with patient-collected data, evidence, and

experience helping to guide the plan. Interestingly, literature often refers to this model as a “novice” approach to reasoning, which may raise questions to its presence in clinical specialist development.<sup>8</sup> An argument could be made that the heavy emphasis programs place on both medical knowledge and verbal or written metacognition may be helping shift “novice” clinicians to more “expert”-level reasoning in which residents are able to quickly and subconsciously pick from their previous knowledge and contextualized experiences to reach decisions.<sup>8</sup>

The second definition given by some participants was that clinical reasoning involves the accuracy of diagnosis and treatment planning. When considering diagnostic accuracy as a construct of clinical reasoning, it must be understood that bias can play a large role. Both hypothetico-deductive reasoning and case pattern recognition are suspect to bias.<sup>9</sup> However, literature suggests that a diagnostic approach in which clinicians are encouraged to use multidimensional reasoning can result in eliminating bias and fostering expert-level reasoning that expands the spectrum of analytical and nonanalytical models.<sup>8,9</sup> A noteworthy finding during this study was that when participants described clinical reasoning as both the process of taking relevant data to make a decision and then backing that data with evidence and metacognition, they seemed to be nurturing the same multidimensional reasoning described as necessary to reduce bias.

### Instructional Tactics

Instructional tactics discussed by participants included didactic and clinical methods. Although some participants mentioned case presentations and rounding, clinical mentorship was the most emphasized strategy among responses regarding clinical reasoning instruction. Previous research has shown clinical mentorship to be effective in improving patient outcomes and clinician performance along with the development of practitioners’ clinical reasoning capabilities.<sup>12,22</sup> It is no surprise that mentorship is a foundation of resident development. However, the application of clinical mentoring did differ between programs. Because mentorship was described by participants as occurring primarily between preceptors and residents, it is important to compare the mentoring styles described by participants (observation of practice, interactive questioning, and guided practice) to current best practices for effective preceptorship. Some qualities of effective preceptorship include talking through processes and allowing students to have a hands-on learning approach,<sup>23,24</sup> which aligns well with interactive questioning and guided practice techniques described by participants. Some participants described few to no autonomous practice opportunities for residents. This is contrary to best practices found in literature, which suggest a balanced clinical experience of guided practice and autonomy provides post-professional students with opportunities to advance clinical decision-making abilities.<sup>25</sup>

Didactically, traditional lecture was described by some of the participants, whereas others reported a more open-forum, interactive, and collaborative learning environment. It seems most residency programs have adopted collaborative learning and social interdependence theory, an evidence-based method of instruction through regular interaction between peers,<sup>26</sup> as the go-to style of teaching within their programs. Cooperative

learning not only encourages communication and teamwork to solve problems; it has also been described as an effective tool for social and emotional development in learners.<sup>27</sup> It is important to note, however, that true cooperative learning strategies involve more than just communication between students; they also involves structured opportunities for students to engage with others and develop critical reasoning skills along with improved knowledge retention.<sup>27</sup> In a cooperative learning model, instructors are not considered “expert transmitters of knowledge” but instead create an environment where students can flourish intellectually.<sup>26–28</sup> When considering the goal of residency programs is to develop clinical specialists, instructional tactics that are geared towards advanced emotional, social, and critical reasoning development are more beneficial than programs that focus on delivery of academic content. If residency programs want to develop advanced clinical reasoning, they should consider an integrated approach of clinical mentorship questioning and didactic discussion of the decision-making process.

Journal club was another didactic tactic used by most of the residency programs that engaged in this study. Journal club is understood as regular meetings between individuals to critically discuss current articles and their applicability to clinical practice.<sup>29</sup> The use of journal club has been shown to improve knowledge, reading habits, and critical appraisal skills.<sup>30</sup> This can help to set the resident up for success in the other didactic tactics mentioned by the participants, clinical scholarship, and oral presentations. As residents engage in scholarly activities such as case studies or dissemination at conferences, their ability to translate relevant knowledge into practice will also improve.<sup>31</sup>

### Assessment Tactics

In order to know if residency programs are producing clinical specialists with advanced clinical reasoning skills, programs should be assessing these skills in their outcomes.<sup>8,10,14</sup> When discussing assessment tactics in residency education, some participants described the use of medical knowledge assessments as a means of capturing both baseline and progression data from the residents. Although not directly a measure of clinical reasoning, expansive medical knowledge is a prerequisite for clinical reasoning, as a greater wealth of knowledge helps clinicians make more informed decisions.<sup>8,32</sup> In addition to knowledge assessments, all participants described some level of assessment of the resident’s specialist development progress. This occurred through structured and unstructured feedback from patients and preceptors. Traditionally, patient feedback has been used as a tool for quality improvement.<sup>33</sup> Although this is likely part of the reason for its implementation in residency education, it could be deduced from participant responses that the goal of patient feedback was to assess intervention selection effectiveness. This type of assessment could work for clinical reasoning when considering the definition of decision accuracy given by some of the participants. Other RPDs described use of patient feedback as a method to emphasize patient centeredness in resident clinical practice. Residency programs and those looking to develop advanced clinical reasoning should consider innovative ways to use patient data to assess development.

Preceptor feedback was the most discussed method of advanced clinical reasoning assessment and could be separat-

ed into structured and unstructured categories. Many participants described the use of some sort of competency evaluation assessing the resident's progression over time. Many programs use preceptors to complete these evaluations of the residents. Although some responses were vague about the structure of their clinical competency assessments, others mentioned their use of the AT Milestones specifically.<sup>4</sup> The AT Milestones were developed for use in resident education to assess residents across core and specialist competencies.<sup>4</sup> Participants who used the AT Milestones appreciated the structure of the tool and its specific examples of actions that should be seen in each column of progression from early learner to advanced practice, the goal of a residency graduate.<sup>4</sup> This should support the use of AT Milestones in other programs, as well as across the levels of learning, that have yet to implement the tool. However, the more consistent use of clinical competency committees could make the AT Milestones a more effective measure of clinical specialist development.<sup>34</sup> Clinical competency committees should be composed of the RPD, preceptors, and other faculty representatives who meet regularly to ensure the program is effectively progressing residents to be advanced-practice clinicians upon graduation.<sup>35</sup> Self-reflection was also incorporated by the residency programs, through regular journaling, reflective discussions, or self-evaluation using the AT Milestones. These reflective reasoning and metacognitive exercises are supported as effective means of clinical reasoning instruction; however, we could find little evidence that self-reflection is an accurate measure of advanced clinical reasoning assessment.<sup>10,36</sup>

Unstructured preceptor feedback was explained as formal and informal discussions between residents, the preceptor, and the RPD. This form of assessment seemed to often pair simultaneously with the clinical interactive questioning and didactic discussions. Although the immediate reaction to unstructured assessment of clinical reasoning by preceptors is that it may seem too subjective to include in residency education, there is evidence that expert judgment, especially when taken in through a collective "shared subjectivity," can lead to effective measures of clinical reasoning.<sup>37</sup> This method requires the evaluator to be skillful enough in advanced clinical reasoning to be considered an expert among like peers. When asked about the assessment of clinical reasoning skills in preceptors, participants noted either a lack of clinical reasoning assessment altogether or a reliance on appraisal by the resident. Resident assessment of preceptors, formative and summative, can be beneficial to determine the quality of teaching and training the preceptor demonstrates,<sup>23</sup> but it is unlikely that residents, who are not yet clinical specialists, could accurately appraise the clinical reasoning abilities of the preceptors.

When asked specifically about clinical reasoning assessment tools, most participants described no objective measures of clinical reasoning beyond preceptor and resident feedback. Although most RPDs did not indicate knowledge of current assessment tools available, a few did demonstrate openness to implementing tools into their program if a tool was shown to be effective. Several tools, such as the Diagnostic Thinking Inventory<sup>14</sup> and the Script Concordance Test<sup>13,19,38</sup>, have been developed and used in medical education to measure clinical reasoning among entry-level and postprofessional students.<sup>13,14,19,38</sup> The Diagnostic Thinking Inventory has

been shown to have face validity for assessment of analytical reasoning in athletic training students.<sup>14</sup> The Script Concordance Test has been demonstrated as a reliable tool in assessing nonanalytical clinical reasoning in postprofessional medical education.<sup>13,14,19,38</sup> Implementation of these tools along with the use of consensus building could better address the lack of assessment tactics that objectively measure change and resident-appraisal reliance issues currently found in residency programs.<sup>11-14,19,34</sup>

## LIMITATIONS

Because this is the first qualitative study to our knowledge to interview athletic training residency RPDs about their instruction and assessment of clinical reasoning among residents, some limitations do exist that are common in qualitative studies. Interviewer bias is always possible. However, we attempted to reduce bias through multiple-analyst coding and external review. Additionally, a limited number of participants, although representative, resulted in a smaller amount of data to code from. Future studies could investigate perspectives of others involved in residency education, such as preceptors, faculty, or residents themselves. As residency programs expand, future research may have larger pools of accredited programs to collect data from. With the reliance on preceptors to appraise advanced clinical reasoning, a promising future study could evaluate how preceptors are trained in residency programs, specifically to train their abilities to foster and appraise advanced clinical reasoning.

## CONCLUSIONS

Advanced clinical reasoning is a vital skill for a clinical specialist. RPDs describe clinical reasoning as both the justification and accuracy of decisions. Residency programs engage in several effective instructional tactics, placing a large emphasis on cooperative learning techniques and clinical mentorship. An interesting finding is that when describing assessment of residents, RPDs often pointed back to the subjective assessments gathered by preceptors through observation and discussion. Subjective assessment by preceptors skilled in clinical reasoning can be an effective measure, but most programs do not describe incorporating preceptor clinical reasoning evaluation beyond appraisal by the resident. This study highlights the importance of robust measures of clinical reasoning in the development of clinical specialists. Residency programs should consider including more formal assessments to measure clinical reasoning in both residents and preceptors. Additionally, we suggest programs engage in more clinical consensus building through clinical competency committees. Application of effective instruction and assessment tactics in residency education will result in improved clinical specialists and is vital to the progression of the athletic training profession.

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