

Return-to-Play in Sport: A Decision-based Model

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Objective: Return-to-play (RTP) decisions are fundamental to the practice of sports medicine but vary greatly for the same medical condition and circumstance. Although there are published articles that identify individual components that go into these decisions, there exists neither quantitative criteria nor a model for the sequence or weighting of these components within the medical decision-making process. Our objective was to develop a decision-based model for clinical use by sports medicine practitioners.

Data Sources: English literature related to RTP decision making.

Main Results: We developed a 3-step decision-based RTP model for an injury or illness that is specific to the individual practitioner making the RTP decision: health status, participation risk, and decision modification. In Step 1, the *Health Status* of the athlete is assessed through the evaluation of *Medical Factors* related to how much healing has occurred. In Step 2, the clinician evaluates the *Participation Risk* associated with participation, which is informed by not only the current health status but also by the *Sport Risk Modifiers* (eg, ability to protect the injury with padding, athlete position). Different individuals are expected to have different thresholds for “acceptable level of risk,” and these thresholds will change based on context. In Step 3, *Decision Modifiers* are considered and the decision to RTP or not is made.

Conclusions: Our model helps clarify the processes that clinicians use consciously and subconsciously when making RTP decisions. Providing such a structure should decrease controversy, assist physicians, and identify important gaps in practice areas where research evidence is lacking.

Key Words: return to play, medical decision making, sport participation, injury, preparticipation physical examination
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INTRODUCTION

Previous injury is associated with up to a 4-fold increase in the risk of reinjury,¹ and the treatment of all injuries includes advice on when it is safe to resume sport participation. For this reason, return-to-play (RTP) decisions are critical to the practice of clinical sport medicine. In general, previous research related to RTP decision making has focused on conditions with serious long-term morbidity or potential mortality such as concussion,^{2–12} spinal cord injuries,^{13–17} and cardiovascular abnormalities.^{18–27} Even though musculoskeletal trauma represents the majority of injuries in sports medicine, there is little original RTP research for them. In the absence of clear scientific evidence, RTP decisions lack standardization^{28–30} and can be a source of confusion and disagreement for physicians, athletes, coaches, and administrators.^{31,32} More importantly, the RTP process may be open to influence by those not trained or experienced in medical decision making.^{33,34} Practices such as game-day injections to mask pain and deviations from the typical medical approaches to allow full healing have become commonplace in sports medicine practice, leading to questions among bioethicists,^{35,36} media,^{37,38} legal professionals,³⁹ and medical professionals.^{40–44}

In 2002, the American College of Sports Medicine issued a “consensus statement” on RTP to help team physicians “make an informed decision as to whether an injured or ill athlete may safely return to practice or competition.”⁴⁵ Although it includes a list of the various elements involved in RTP, the consensus statement fails to describe how or why those elements influence the medical decision-making process. Indeed, the statement reflects the difficulties and complexities in RTP medical decisions:

■ *This statement is not intended as a standard of care, and should not be interpreted as such. This statement is only a guide, and as such is of a general nature consistent with the reasonable and objective practice of the healthcare professional. Individual decisions regarding the return of an injured or ill athlete to play will depend on the specific facts and circumstances presented to the physician. Adequate insurance should be in place to help protect the athlete, the sponsoring organization, and the physician.*

The purpose of this article is to synthesize the available literature concerning RTP and to propose a model for RTP decision making in sports medicine. We believe that this model

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helps clarify the processes that clinicians use consciously and subconsciously when making RTP decisions. Providing such a structure provides a logical rationale for the RTP process with the hope that it will decrease controversy, assist physicians, and identify important gaps in practice areas where research evidence is lacking. The model is applicable for emergent, urgent and nonurgent decisions, although the weighting of individual components will differ with the context partly because of importance and partly because it may not be possible to obtain all the information when decisions need to be made rapidly—but a decision still has to be made nonetheless.

RETURN-TO-PLAY DECISION MAKING: THE DECISION-BASED RTP MODEL

In clinical practice, RTP may refer to “full return without restrictions,” “partial return,” “allowed to practice,” and so forth. The model proposed in this article is applicable to any of these definitions, but for clarity, we will use the following RTP definition for our examples: “medical clearance of an athlete for full participation in sport without restriction (strength and conditioning, practice, and competition).”

The most common type of decision-making model is the rational decision model,^{46–48} in which individuals weigh the advantages and disadvantages of decision “A” (eg, allowing an athlete to compete) against the advantages and disadvantages of decision “B” (eg, restricting an athlete from participation). In the medical context of RTP, the issue is more complex because the physician is actually making a decision that affects someone else. There are additional factors and influences (medical and otherwise) that must be considered.

Figure 1 shows the decision-making model for RTP using an influence diagram.⁴⁹ In an influence diagram, the *states of nature* elements (the circumstances under which a decision is made) are illustrated with circles. *Decision* elements are usually illustrated with squares (we have used a rectangle in our diagram), and arrows are used to illustrate when information from one element contributes information to another element. The model integrates and sequences the many factors mentioned in the published literature and shows how they interact and at what point they should be considered in the RTP decision-making process. We first describe the model globally and then explain each component in subsequent sections of the article.

OVERVIEW

The first step in the decision-making process is the *Evaluation of Health Status* of the athlete. Evaluating health status requires an assessment of the athlete’s recovery from a biological, psychological, and functional standpoint and is done by considering several *Medical Factors*. In essence, it is an evaluation of how much healing has occurred and how close to “normal” the previously injured tissue is. This is essential because tissue that has not healed is generally weaker or less functional than it was before the injury and therefore more likely to be reinjured.

Evaluation of Health Status (Step 1) is the most important piece of information that clinicians have for the *Evaluation of*

Participation Risk. However, there are several other factors associated with the sport or activity (*Sport Risk Modifiers*) that, although not directly related to the evaluation of health status, have the capacity to substantially increase or decrease the participation risk for a given health status. For example, a swimmer with a medial collateral ligament injury to the knee may have a different risk than a football player (different sports), a first baseman with rotator cuff disease may have a different risk than a pitcher (different positions), and a recreational field hockey player may have a different risk related to a stress fracture than an Olympian (different competitive levels).

Evaluation of *Participation Risk* (Step 2) is essential in the rational decision-making model because a high reinjury risk represents the main disadvantage of allowing RTP (Decision A). However, there are additional factors that also represent disadvantages or advantages for Decision A (or similarly for Decision B of not allowing participation). We have called these factors *Decision Modifiers* (Step 3) because they may change the decision that would have been made if *Participation Risk* had been considered alone. Although it might be argued that the health of the athlete should be the only concern, all activity is associated with risk. Therefore, the clinician’s role is to help determine what is an acceptable level of risk, and this evaluation must occur within the context of the *Decision Modifiers* present in a given situation. There are 3 important points related to decision modifiers. First, unlike *Participation Risk*, these factors are not restricted to the athlete. For example, family, coaches, and even the doctor may benefit or be harmed if the athlete is allowed to RTP or is prevented from RTP. Second, some clinicians may not consider all the factors listed as appropriate (eg, a physician in a conflict of interest may risk losing employment), but the factors are included because we believe that they are currently being considered in clinical practice today. Third, *Decision Modification* is set aside from the other steps because *Participation Risk* does not contribute information about *Decision Modification*, and *Decision Modification* cannot be used to determine RTP except in the context of knowing participation risk.

The next section discusses each of the components in greater detail. The main purpose of this article is to make note of what the literature defines as the individual components that make up the RTP medical decision. The actual value of each of these components with respect to contribution and weight in the decision-making process may or may not be quantifiable, but the value of RTP guidelines lies in the consideration of all such components before making an important decision.

SPECIFIC CONSIDERATIONS FOR RTP DECISION MAKING

Evaluation of Health Status: Step 1

Although estimates of biological healing time can be considered in the *Evaluation of Health Status*,^{14,30,50–53} a complete evaluation of the health status for any particular injury or illness based on history, symptoms, signs, laboratory tests, and functional testing is preferable. We recognize that this is a developing clinical science. For example, plain

Decision-Based RTP Model

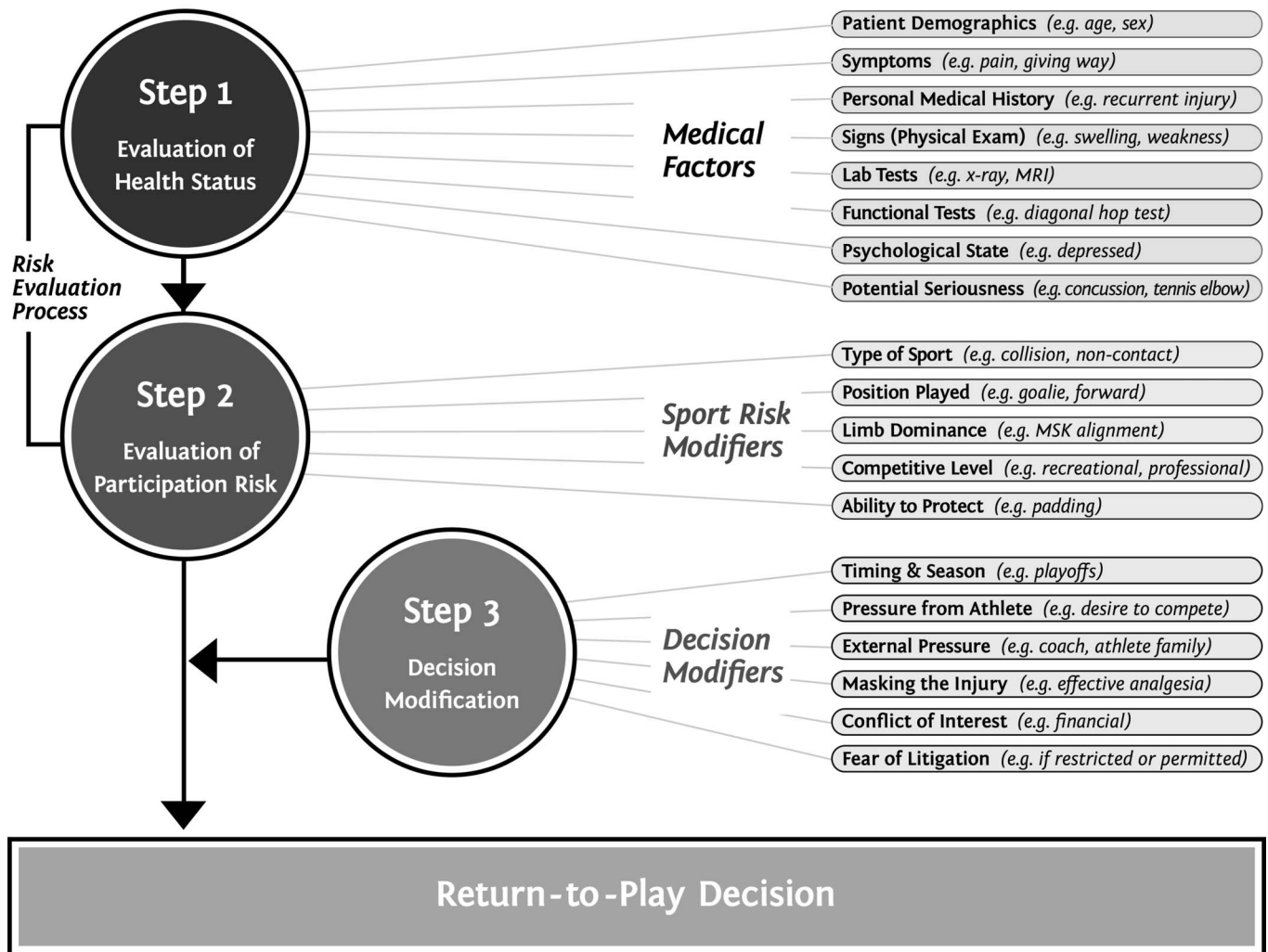


FIGURE 1. Decision-based RTP model. The decision-based RTP model for an injury or illness is specific to the individual practitioner making the RTP decision. The large black circles represent the states of nature elements (the circumstances under which a decision is made). The RTP square represents the final decision that actually results in an action being taken. The texts on the far right are individual factors or components identified from the literature that contribute information to the states of nature. These factors are grouped into *Medical Factors*, *Sport Risk Modifiers*, and *Decision Modifiers* and are on the left because they represent the general concepts the clinician should focus on when making a decision (the details are provided on the right). In Step 1, the health status of the athlete is assessed through the evaluation of *Medical Factors*. For example, symptoms, signs, and testing provide information on how much healing of the injury or illness has occurred. In Step 2, the clinician evaluates the risk associated with participation. For example, the health status is usually heavily weighted when the known reinjury and long-term sequelae risks are high (eg, if an athlete participates with only partial healing). However, there are *Sport Risk Modifiers* that also affect the risk associated with participation. For example, it may be possible to protect the injury with padding or to minimize risk by changing the position of the player. Although the RTP decision is fundamentally based on the risk associated with participation, decision making in all fields is based on a risk–benefit balance. There may be benefits to an athlete that affect what is considered an acceptable risk. For example, play-off competitions may result in significant financial and nonfinancial gains. Accounting for these *Decision Modifiers* (Step 3) is the final step in the process that leads to the actual RTP decision. *Decision Modification* is set aside from the other steps because Participation risk does not contribute information about *Decision Modification*, and *Decision Modification* cannot be used to determine RTP except in the context of participation risk. Finally, the process is recursive; decisions to not clear an athlete for participation are revisited as the healing process continues, and decisions that allowed an athlete to play are revisited if symptoms or signs recur or if the status of any of the *Sport Risk Modifiers* or *Decision Modifiers* are changed.

radiographic or magnetic resonance findings lag behind the physiological healing of bone after a stress injury.^{54,55}

- Patient demographics: Sex and age^{50,56-59} influence the health status because of hormonal and age-related factors that can affect tissue regenerative abilities.
- Symptoms: History of the present illness provides very important information in the evaluation of an athlete's health status. Pain is considered an essential factor in the evaluation by most authors,^{14,16,30,51,52,56-69} presumably because it is indicative of incomplete healing. Other symptoms that are often used by clinicians, such as stiffness or sensation of joint stability, are not explicitly discussed in the literature.
- Personal medical history: The literature emphasizes some aspects of the history that are related to the current injury.^{58,62,70} For example, authors have distinguished between first-time injuries versus recurrent injuries.^{13,15,50,71,72} Family history and medical history can predispose an athlete to other medical conditions or injuries, and the medical history provides the physician with a context in which to evaluate the health status.
- Signs: Like symptoms, the presence or absence of signs on physical examination have been used by some authors to propose RTP recommendations based solely on these criteria. These recommendations are summarized in Table 1. Of these signs, muscular strength and joint range of motion (ROM) are most frequently mentioned. Most authors suggest that muscular strength should be at or near preinjury levels (often measured compared with the uninvolved limb) before returning an athlete to sports.^{14,30,51-53,56-61,65,67,68,71,73-79} However, the acceptable range for near normal is 70%⁵³ to 100%,⁵⁸ and these recommendations seem to be based on opinion and clinical experience, most likely because of the paucity of good scientific evidence. Similar criteria have been proposed for ROM,^{13,14,17,30,51-53,56-61,64,65,67,68,72,73,75-80} and others have added criteria that ROM should be pain free.^{30,52,57,72} In addition, some authors suggest that the injury site should be functionally stable^{13,15,28,52,53,61,62,71,72,81} and nontender,^{51,66,69,82} and joints should be without swelling^{30,61,62,80} or effusion.^{30,60} Although girth has been mentioned,³⁰ no specific criteria have been provided.
- Laboratory tests: Imaging techniques such as plain radiographs,^{13,15,30,63,65,66,72,82} magnetic resonance imaging,^{13,15,29,58-60,63,66,72} computed tomography,^{13,52,63,66,82} bone scan,⁶³ and ultrasound⁵⁸ can provide objective evidence of tissue healing and detect some of the structural and

physiologic abnormalities that suggest incomplete healing.^{13,17,65,72,79} Laboratory tests are also of value in recovery from illness and some injuries.

- Functional tests: At times, an injured tissue may be healed biologically, but deficits remain that are secondary to the injury. Functional testing allows the clinician to assess the status of the athlete with respect to function by testing exercise maneuvers that simulate sport-specific actions. An appropriately designed battery of functional tests helps assess the integration of muscular strength, ROM, proprioception, endurance, and confidence,^{28,60,77,83} and each individual test within the battery should mimic the forces and stresses that will be experienced by that athlete in a competitive situation.^{14,28,30,45,52,56,57,62,68,84,85} In general, authors recommend that RTP should occur when there is no pain,³⁰ no instability,³⁰ normal kinematics,^{14,30} and near symmetrical performance compared with the contralateral limb.^{30,53,74}
- Psychological state: Authors have recently emphasized the importance of psychological "readiness" or "confidence" before RTP.^{45,50,57,86,87} Apprehension, fear, and anxiety are associated with a higher risk of reinjury⁸⁶ in addition to negative effects on performance.
- Potential seriousness: Finally, the health status is related to the particular tissue injured, its extent, and the propensity for healing.^{15,29,34,50,58,59,62} For example, the evaluation of health status is very different for a concussion versus an ankle sprain. This is an important field for further research because short-term and long-term effects of participation after injury can substantially affect health after retirement from sport.

Like symptoms, the presence or absence of signs on physical examination has been used by some authors to propose RTP recommendations based solely on these criteria, without accounting for other factors affecting risk or the decision-modifying factors.^{69,79} Although some authors have suggested that RTP should only be allowed after complete resolution of symptoms,^{17,30,69,78,79} the proposed model clearly demonstrates why these individual components cannot be considered in isolation. Although they are considered before the *Evaluation of Participation Risk and Decision Modification*, they remain only the first step in the RTP process. Further, the model helps us to understand why providing general recommendations without describing any of the specific symptoms is of limited value.

TABLE 1. General Recommendations for Each of the Physical Signs Used by Clinicians to Evaluate Whether an Athlete Should Be Allowed to Return to Play

Sign	General Recommendation	References
Strength	At or near pre-injury levels or symmetrical with unaffected side	14,30,51-53,56-61,65,67,68,71,73-79
Range of motion	At or near pre-injury levels or symmetrical with unaffected side	13,14,17,30,51-53,56-61,64,65,67,68,72,73,75-80
Joint stability	No instability	13,15,28,52,53,61,62,71,72,81
Tenderness	Injury site should be nontender	51,66,69,82
Inflammation or swelling	No swelling or inflammation	30,61,80
Effusion	No effusion	30,60
Girth	No specific recommendation provided	30

Evaluation of Participation Risk: Step 2

- **Type of sport:** Participation in collision sports (eg, football and rugby) generally poses a higher risk of acute injury compared with participation in contact sports (eg, basketball), which poses a higher risk compared with participation in noncontact sports (eg, swimming).^{15,30,50–52,56–60,62,64,78,82,88,89} However, high velocity sports (eg, alpine skiing) without collision or contact are also associated with high risks.^{15,89} Noncontact sports may not present a high risk for acute injury, but RTP decisions may need to be conservative because disabling overuse injuries do occur in some activities⁶⁰ (eg, femoral stress fracture in a long-distance runner and patellar tendinopathy in a football lineman).
- **Position played:** Different positions within a sport are exposed to different forces and stresses and therefore different risks.^{30,50,56–58,90} For example, an acromioclavicular sprain in a quarterback is repeatedly stressed during the throwing motion but receives much less stress in a field goal kicker.
- **Limb dominance:** An athlete's hand (or foot) dominance affects whether an injury is likely to be repeatedly stressed during activity (eg, a baseball pitcher with an injury to the dominant vs nondominant shoulder).^{30,59}
- **Competitive level:** In general, greater size, speed, and strength in the more competitive athlete mean that these athletes will experience greater forces and greater stresses on the body. Furthermore, competitive athletes may be more likely to push themselves beyond the levels of non-competitive athletes in an attempt to win. Therefore, for the same health status, higher levels of competition are associated with higher health risk.^{50,57,58,64,66,91}
- **Ability to protect:** For some injuries, taping, bracing, splinting, or padding may reduce the risk for the same level of tissue healing.^{30,45,52,61,62,81,82} A related consideration should be whether the piece of equipment poses a higher risk of reinjury to other athletes,^{45,88} but this is usually governed by the rules of the sport.

Decision Modification: Step 3

- **Timing and season:** During the off-season, there may be less benefit to the athlete to return sooner. Allowing an athlete to participate in the play-offs may carry significant benefits in the form of bonus payments, scholarships, and so forth. Furthermore, the risk of reinjury in this situation may include only short-term disability but no long-term consequences. Therefore, for the same level of risk, the balance of advantages and disadvantages changes with respect to the timing and season involved.^{14,17,32,50,57,58,63,66,81}
- **Pressure from athlete:** In most jurisdictions, the clinician must make the legal decision for RTP, although disagreement does exist about the extent to which the athlete should be involved in the decision.^{17,29,32,41,59,73,74,92,93} In brief, the primary decision is left to the clinician because it is often difficult to determine if the athlete is in a position to provide informed consent because of the nature of the injury (eg, concussion) or if she/he is being coerced by "handlers" or "superiors" (eg, coach) or family members. Within this context, the clinician's assessment of what constitutes an acceptable risk may contradict the athlete's assessment.^{41,74}

Although the clinician has more experience evaluating the absolute level of injury risk, the athlete may (or may not) be in a better position to evaluate other risks, such as job security, potential scholarships, contract offers, and endorsements, and any of the athlete's other goals within sport.^{14,16,32,41,50,81,90}

- **External pressure:** In the context of both competitive amateur and professional sport, many different groups of people stand to benefit (in a variety of ways) from a timely return of the athlete to competition, including coaches, teammates, relatives, team administrators, agents, sponsors, league officials, fans, and media.^{14–16,32,34,41,50,88} Some of these groups may provide valuable additional information for the evaluation of risks and benefits, and some may provide misinformation and undue pressure related to their focused concern. Within an overall complex matrix of decision making, all the groups have the potential to influence the RTP decision. Although the immediate reaction of some clinicians may be to suggest these all be discounted, an athlete may consider the hopes and dreams of family members (or team members) as valid and important factors that need to be considered when balancing risks and benefits.
- **Masking the injury:** The use of cortisone injections, local anesthetics, and analgesics is very common in sport medicine³⁴ because it can increase function and allow injured players to participate. This factor could be considered under either *Evaluation of Participation Risk* or *Decision Modification* or both. For example, if someone has an acromioclavicular sprain and is able to return to play because it was injected with lidocaine, they may be at increased risk of worsening the pathology and prolonging the disability. To keep the decision-based RTP model as simple as possible, we have chosen to include it as only a *Decision Modifier* because there are other contexts where masking the injury has little effect on injury risk.
- **Conflict of interest:** Although it is the ethical obligation of the clinician to be an advocate for the athlete,^{34,41} clinicians also have obligations to the team if they are paid employees. Potential conflicts of interest arise when the team's best interests and the athlete's best interests are not aligned.^{33,41,88,93} In this context, advocating too strongly for the athlete means that the clinician may enter into a conflict with coaches or risk losing his or her job, including all of the perks, status, and money associated with it.⁴¹ In essence, the clinician should be transparent with the athlete about dual roles and responsibilities so that the athlete is properly informed (analogous to informed consent). How often this occurs is difficult to determine because clinicians are subject to the same frailties as the general public, and it must be considered as a potential modifying factor for RTP decisions.
- **Fear of litigation:** This is actually a special form of conflict of interest. Physicians are typically sued for damages that may result when an athlete is injured after an RTP decision that is deemed as too early or if an athlete is deemed inappropriately restricted from returning to play with consequent financial or nonfinancial loss.⁹³ Although this

fear concerns only the clinician's welfare, the fear is based on the potential benefits and harm that the athlete may be exposed to. Furthermore, in other areas of medicine, this fear is tempered by providing informed consent. However, the concept of informed consent is weak in sport medicine. For example, although adult athletes are considered capable of making every other decision in their life including medical ones, RTP decisions have been considered the responsibility of the team physician and "informed consent" is not considered a general defense. That said, regardless of the RTP decision, clinicians need to fully inform athletes about the risk of RTP and properly document all instructions and restrictions given to the athlete should it need to be drawn on as evidence in the future.^{29,34,41,61,88,92,93}

CONCLUSION AND RECOMMENDATIONS

We have outlined a 3-step decision-based model for RTP that provides the clinician with structure and transparency within a complex process. The model includes the major factors within the *Evaluation of Health Status* and *Evaluation of Participation Risk*, as well as factors involved in the *Decision Modification*.

Our hope is that each of these individual components will become topics for future research. Progress needs to be made quantifying the importance of each of the individual components of each step, and ethical constructs need to focus on the unique sports medicine environment.

The decision-based RTP model provides a foundation for research into the individual factors and components that, when integrated, provide clinicians with an evidence-based rationale for RTP decision making.

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