Athlete Health and Human Performance Will Not Improve Without Transdisciplinary Collaboration and Data Sharing in Elite Sport

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Abstract

There are two largely competing models for an athletics organization at both the collegiate and professional levels: the High Performance Model and the Medical Model. The High Performance Model arises from international Football perspective that places a "Performance Director" at the center of teams supporting the athletes. The Medical Model, supported by both the National Athletic Trainers Association and the NCAA, separates off medical staff (athletic trainers, physical therapists, and physicians, predominantly) and emphasizes the autonomy of medical decisions. The Medical Model has left clinicians in a "medical silo", limiting our ability to care for the individual athletes as holistic people and limits our wider impact in the field of athlete health and injury mitigation. We argue that Medical Model is consistent with the High Performance Model only if we reject the notion that the "Performance Director" is an administrative person and instead conceptualize this as a "Health and Performance Information Hub" which facilitates transdisciplinary collaboration. This Commentary details how a data broker system can be used to accelerate transdisciplinary collaboration within an athletic organization, leading to better healthcare for athletes and improved team and individual performance. Furthermore, a transdisciplinary organization with data sharing is able to turn real-world data into real-world evidence, enhancing the care and performance of athletes locally as well as facilitating the creation of generalizable knowledge in the area of sports medicine and human performance.

Framing the Problematic Current State of Athletics

There are two largely competing models for an athletics organization at both the collegiate and professional levels: the High Performance Model and the Medical Model. The High Performance Model (Figure 1) largely arises from international football perspective that places a "Performance Director" at the center of teams consisting of Athletic Training staff (AT), Physical Therapists, Medical Director, Strength and Conditioning, Sports Nutrition, Sport Psychology, and in direct communication with the sport coaches and operations staff.[1] In contrast, the Medical Model separates off medical staff (ATs and physicians, predominantly) and emphasizes the autonomy of medical decisions and is designed to minimize potential conflicts of interest that could adversely affect athlete health.[2] While the High Performance Model is the predominate framework used internationally and in some professional organizations in the United States, the Medical Model has been strongly advocated by both the National Athletic Trainers Association[3] and the NCAA.[2] While there are legal benefits of the Medical Model[4] and potential benefits on AT case-load,[5] it also creates a clear "medical silo" which has pitfalls both for the performance and health of individual athletes within the organization but also negative ramifications for the Athletic Training profession as a whole.

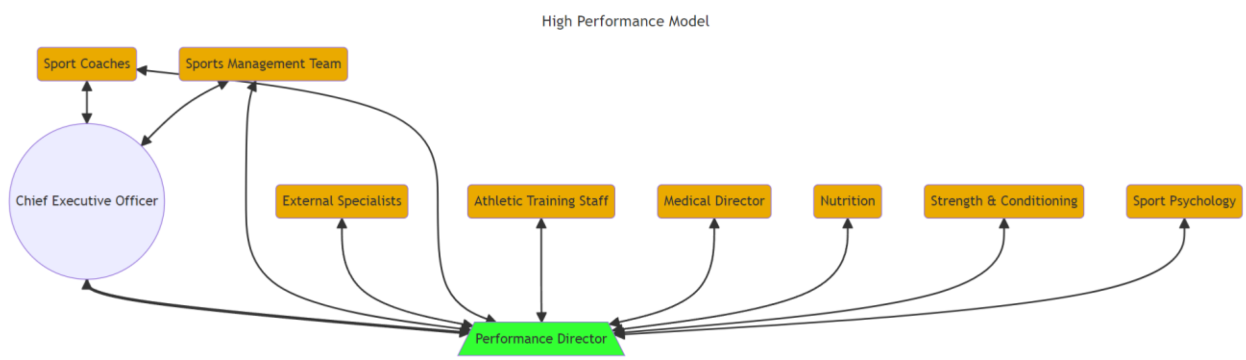

Figure 1. Diagram of High Performance Model as described by Smith and Smolianov.

Creating a "medical silo" means the AT staff may not have a holistic view of the physical and cognitive demands being imposed on their athletes or how these demands are being counter-balanced by nutritional or other modalities within their own organization. The high-profile acceptance of the High Performance Model at the professional level means ATs have ceded considerable input in the areas of injury mitigation to sport scientists and sport-specific rehabilitation to strength and conditioning personnel who may have a lower level of formal medical training than ATs but a greater focus on sport-specific performance. A prime example of how ceding medical expertise to non-medical staff comes in the form of "workload management" to mitigate injury and enhance performance,[6] but more specifically, the use of the acute-chronic workload ratio (ACWR) to decrease injury in sport.[7,8] ACWR posited that there was a fundamental ratio between acute workload and chronic workload and that a spike in acute work resulted in "injury", but the measurement of workload was highly non-uniform (accelerometers, surveys, GPS, etc.) and "injury" seemed to either mean any type of injury at all, depending on the study. The balance between training and over-use injuries has always been a responsibility shared across many practitioners in an organization, something the High Performance Model overtly recognizes but the Medical Model does not, even if some organizations implementing the Medical Model have ancillary policies and procedures recognizing this shared responsibility. However, the High Performance Model originated ACWR which has now been widely discredited as atheoretical and lacking any causal evidence;[9] it is reasonable to expect that an AT trained in the different processes of both bony remodeling and muscular physiology would not subscribe to the idea that some blanket metric from a survey or an accelerometer should be used as a guide for both stress fractures and muscle strains. The High Performance Model seems to be more theoretically "correct" as a way to holistically understand athlete health, injury, and performance; however, its implementation seems critically flawed in such a way that it over-emphasizes performance at the expense of medicine, which often requires a higher level of scientific evidence to make conclusive statements about patient care. In contrast, the Medical Model has left ATs in a "medical silo" (see Figure 2), which limits our ability to holistically care for the individual athletes and limits our wider impact in the field of athlete health and injury mitigation. We argue that Medical Model is theoretically consistent with the High Performance Model *only* if we reject the notion that the "Performance Director" is an administrative person and instead conceptualize this as a "Health and Performance Information Hub" which facilitates transdisciplinary collaboration.

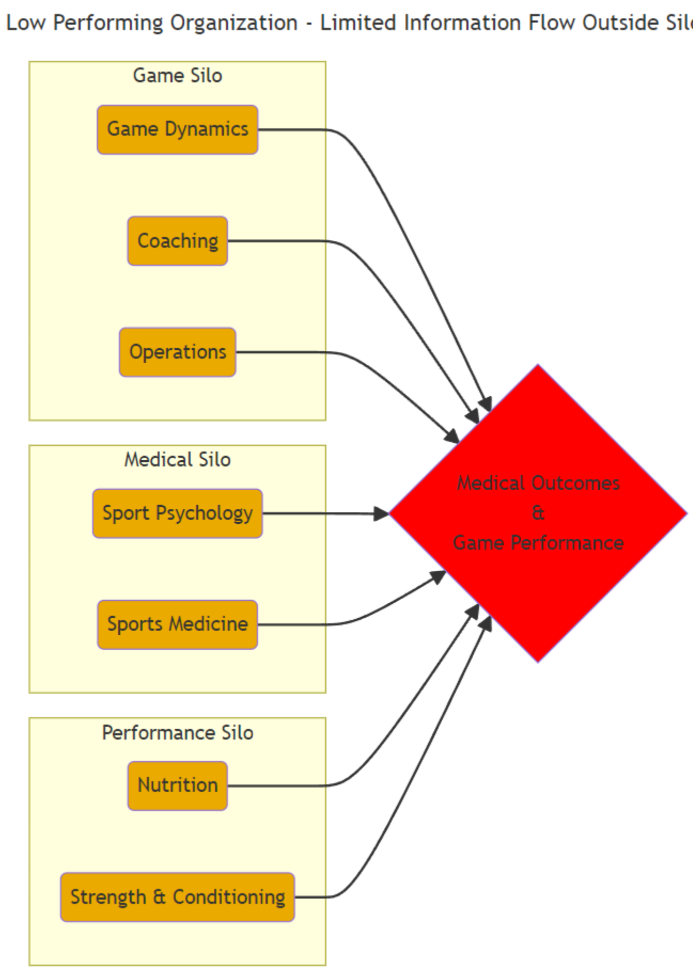

Figure 2. Diagram of typical athletic organization under the Medical Model.

The Difference between Transdisciplinary and Interdisciplinary

At best, collaboration in most athletic organizations is interdisciplinary, meaning a group of individuals with different expertise work together to address a common problem, each from their own disciplinary perspectives.[10] In other words: "stay in your lane, I'll stay in mine, and together we'll have a team that isn't injured and wins games/matches." In reality, ATs know a lot about sports medicine, but also aspects of human performance and technology. The Sport Scientist may know a lot about technology, but also have an idea about injuries specific to that sport and increasing performance particular to that sport. The strength coach obviously has an expertise in strength and conditioning, but their regular exercise regimens with athletes make them uniquely capable to identify potential issues before they're seen in the athletic training facility. In 1992, Rosenfield coined the term "transdisciplinary" as an organizational method emphasizing that different disciplines are working from a shared conceptual framework to solve a problem and not just working together from their own disciplinary frameworks (i.e. interdisciplinary).[10] In the sports context, this means all practitioners should not just be working together in their singular areas of expertise, they should be working jointly, using a shared conceptual framework informed by all of their disciplines to enhance performance and decrease injuries. This does not mean ATs should be expected to "do more sport science and conditioning", which would be a multidisciplinary approach (one person/group using many disciplines). We also do not suggest that individual disciplines should have "more meetings" but rather that information and data flows should be standardized and structured around a shared vision to increase athlete health and performance. At the professional and collegiate levels, there is often access to higher level data infrastructure and analytical talent that can facilitate this type of transdisciplinary work within an athletics organization (Figure 3). In this way, we increase the quality of athlete care while potentially decreasing the administrative burden on the practitioner via the *effective* implementation of technology.

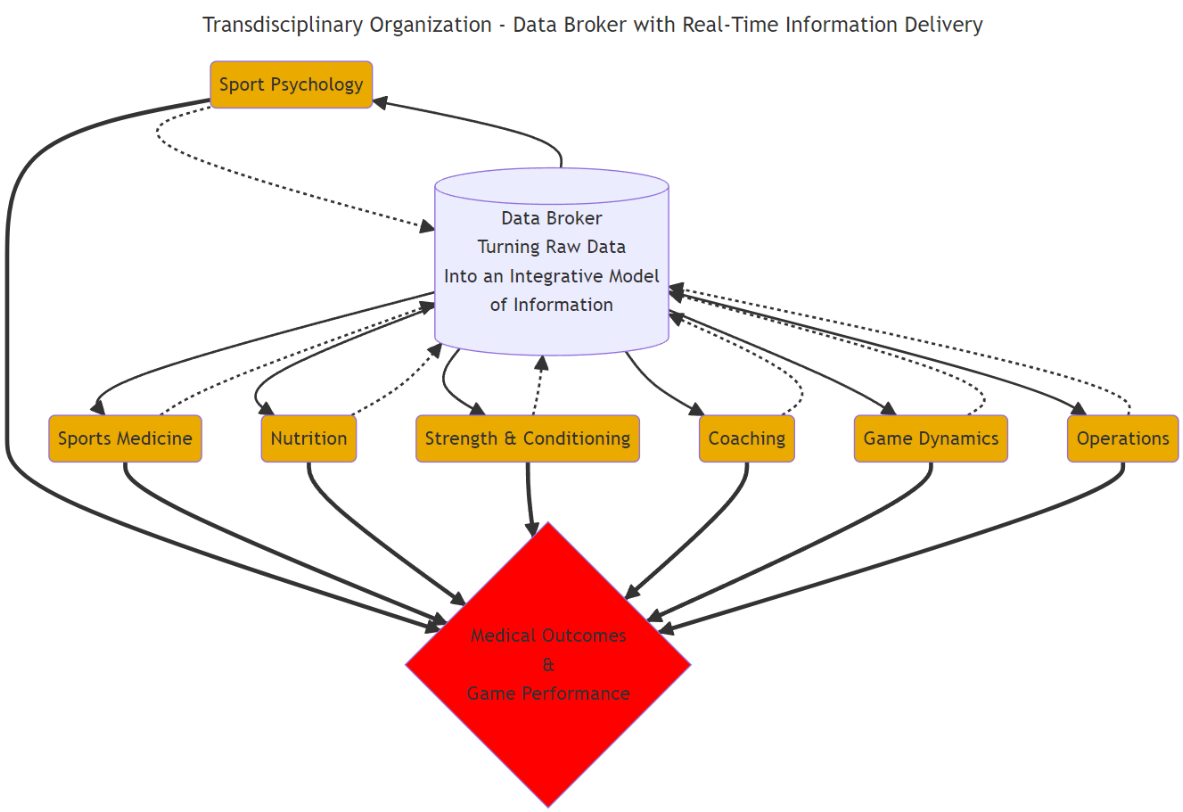

Figure 3. Diagram of the data and information flow that occurs in a transdisciplinary organization using an automated data broker with real-time information delivery.

To achieve transdisciplinary collaboration, it is necessary for all groups to "speak the same language", share data, and have an agreed-upon framework from which to review that data which is particular to their specialty. While this may sound like an insurmountable challenge, it is actually relatively easy to achieve with a data broker system. With this arrangement, each group agrees to record their data (e.g. injury record, nutrition data, body composition data, psychological testing, strength training, travel information, etc.) in a system which flows in a centralized data ecosystem. This does NOT require that ATs and Nutritionists (for example) use the same vendor (e.g. Kitman, Smartabase, Athletic Trainer System, etc.), simply that each of their individual systems can transmit the data into a central location. Once this data is in a central location, the groups simply need to agree upon "rules for who sees what" from a data perspective and, if higher-level analytics are performed, what sort of predictive or inferential models they want built into their system. The data governance rules can be regulatory in nature (e.g. HIPAA, FERPA, etc.), a 'need to know' basis instituted locally, or any other rule-based system deemed appropriate by the organization. The data can then be displayed via a real-time dashboard to the appropriate practitioners with the right context (i.e. with full data from other disciplines, a simplified data from other disciplines [e.g. rank within position group or team-level measure], or a prediction taking into account information from other disciplines without providing the underlying data).

At this point, it is valuable to return to our earlier example of workload management. I (Initials Redacted) was at a recent conference discussing load management practices with a number of NBA sport science personnel and asked what work had been done to validate that their load management practices were valid in reducing injury, and was surprised to find that the sport scientists were physically unable to pair their "load" data with the injury tracking system. While the sport scientists described it as "we can't get the data out of the system," my later discussions with NBA personnel made it clear that the issue was not technical but political and some sort of internal 'turf battle.' Indeed, after years of NBA personnel stating that the science supports "load management", they have now publicly stated that the data "…just doesn't show that resting, sitting guys out correlates with lack of injuries, or fatigue, or anything like that."[11] While organizational politics and turf battles are often inherent in any athletic organization, these roadblocks are often not apparent to upper-management (e.g. athletics directors, general managers, ownership, etc.) who have decisional authority to end unnecessary and unhelpful disputes. The process of setting up a data governance structure, approved and championed by upper-management, makes this discord apparent and able to be adjudicated appropriately.

Clearly, the artificial data and information partition between practitioners in the same organization is *not* leading to the best healthcare for the athlete, nor is it likely leading to the best team performance. Within a Transdisciplinary Organization (Figure 3), it may be agreed-upon that all clinicians want to mitigate overtraining syndrome (a medical condition) and so pre-emptively identifying athletes in the non-functional overreaching stage is of vital importance (i.e. identify a common framework). Each practitioner then notes the below information in their respective systems:

- Sport Nutrition indicates athlete has had a decreased calorie consumption coinciding with increased body fat and decreased muscle mass.
- Sport Psychology indicates steadily increasing scores on weekly Beck Depression Inventory and State Anxiety
- Strength & Conditioning records decreasing sprint speeds, deceasing jump height, and inability to maintain existing standards on the bench press

- Sports Medicine records athlete has received ice bags regularly after practice.
- The group handling game dynamics, Research & Development, notes this athlete's in-game velocity of travel has decreased and his apparent reaction time to ball movement on the court is longer.

All of these above data points individually are not necessarily flags from the onset that any one group would identify; however, when all of the data are placed together in a central repository, it paints a very clear picture of an athlete in the early stages of overtraining syndrome and someone with high likelihood of sustaining a stress fracture due to relative energy deficiency in sport (REDs).[12,13] Injury prevention is a team effort, requiring structured and trusted data sharing. It is not necessary for all clinicians to see the individual athlete's psychological testing data, which would likely be inappropriate. Nor is it helpful or necessary for the nutritionist or strength coach to see every nuance of the athlete's injury history; however, a central aggregation of data and analytical processing of those joint data sources can provide key information to the appropriate practitioner for intervention either on the mitigation side of the equation or the treatment side. Not only does this transdisciplinary approach allow for the best healthcare of our individual athletes, it also has the ability to put ATs, and sports medicine as a whole, on much firmer footing to generate evidence that our clinical practice is effective for athlete care.

It's (Still) Time for Evidence

More than 15 years ago, the Journal of Athletic Training published an editorial entitled "It's Time for Evidence".[14] The editorial emphasized that ATs were being marketed and using devices and products which were being held to no standard of efficacy or accountability. This stands in stark contrast to other fields of Medicine, such as pharmaceuticals, which undergo numerous levels of pre-clinical, clinical, and post-authorization trials to confirm that the benefit-to-harm ratio is appropriate.[15] Many aspects of our industry have not changed since 2006. The devices and products marketed to and used by practitioners across the spectrum of sports medicine (orthopaedic surgery, physical therapy, athletic training, sports nutrition, etc.) are still largely unregulated and lack high-quality evidence.

The primary solution proposed in the commentary was to use randomized control trials (RCTs) to provide evidence that a product mitigated injury or enhanced return-to-play. While RCTs remain the "gold standard" for determining causal effects of an intervention, RCTs can be expensive to implement and challenging in the field of sport where you've got numerous stakeholders (e.g. ATs, Sport Coaches, Team Physicians, and Athletic Directors). Everyone wants "results now" and it is hard to find a stakeholder that is willing to wait for an RCT to show an intervention works, even if it is equally likely that said intervention adversely impacts injury likelihood or return-to-play. In recognition of these challenges to implementing RCTs in sports medicine, we would like to introduce our colleagues to another option which allows us to provide a high level of evidence that our clinical interventions *cause* the changes they purport: Real-World Evidence (RWE) Causal Inference methods.[16]

Real-World Evidence in Athletics

The FDA defines real-world data as "data relating to patient health status and/or the delivery of health care routinely collected from a variety of sources", and in 2018 they defined a framework for using RWE for various types of regulatory review.[17] The growing acceptance, and development of analytical methodologies to extract Causal Inferences from RWE can be a valuable tool to validate interventions used by Athletic Trainers if we embrace and facilitate this work. Turning real-world data into RWE requires collaborating with experts in the field of biostatistics and epidemiology that have a particular skill set in RWE Causal Inference. Many large Universities have one or two (or even none) of these experts and a professional clinical research organization will have many. These experts will often need direct access to the centralized data hub in Figure 3, so it is important to consult with and act on the advice of your General Counsel (attorney) to ensure that the appropriate guidelines for transmission of identifiable data are being followed (e.g. FERPA or HIPAA) and that any appropriate Memorandums of Understanding are in place. There is often an internal process of setting aside biases or assumptions (e.g. “What if my outcomes aren’t as good as I think they are?”, “What if that treatment we’ve been doing for 3 years isn’t increasing return-to-play like I’ve been telling my AD it has?”) that needs to occur because having someone critically evaluate records can create a feeling of a loss of control. Clearly, there needs to be a culture at your local organization that learning “what doesn’t work” is just as important as learning “what works”. We also need to be understanding that those RWE experts aren’t doing this complicated analytical work for ‘free’ but are often expecting to publish the results (in academia) or want renumeration (in a clinical research organization context). All expectations should be included in any agreements to mitigate potential issues.

Finally, RWE Causal Inference is a defined skill. It is not as easy as saying “we had 22 athletes get injured wearing this protective device and 78 athletes injured not wearing the device, therefore, the device works.” Many statisticians will follow the Potential Outcomes framework to derive Causal information from real-world data. Much of this framework has the goal of “making the observational data as much like an RCT as possible” so there are often complex weighting or matching processes involved to say nothing of the resulting analyses. ATs should expect to work *with* RWE experts because those experts are often not knowledgeable about sport and even less knowledgeable about how the data were recorded. It is a collaborative task to extract evidence from the data we already collect, but well worth it. Ultimately, we have three options: 1) continue to practice Athletic Training with a suboptimal evidence base; 2) work with clinical research experts to develop potentially expensive and time-consuming RCTs, which remain the gold standard of evidence; 3) leverage the data we already collect and collaborate with RWE analytical experts, potentially already at our institutions, to generate evidence supporting or refuting AT practices.

Conclusion

The Medical Model is not broken, but it does require reconceptualization. The Medical Model administrative structure is necessary to limit conflicts of interest that may harm the athlete, but in administratively partitioning off the sports medicine staff from other groups in an organization, we have inadvertently decreased the quality of care that can be provided to the athletes and also decreased the impact that ATs can have in their organization and on the medical community as a whole. There is an opportunity to adopt the philosophical ideas of the High Performance Model, while avoiding that model’s pitfall of over-emphasizing performance ideas at the expense of high-quality evidence supporting either performance or medical outcomes. Any organizational structure can fail due to poor execution, but the technical and legal solutions exist for us to judiciously share data and information across our organization that enhance athlete care and demonstrate our value to leadership, we just need to champion these efforts and support the formation of a transdisciplinary organizational structure.

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