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How Technology is Bridging the Gap between Sport, Health, and Medicine

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Abstract

Stretching back to the ancient Greek Olympics, athletes have sought the mentorship of coaches as a means of improving their athletic ability. This tactic of seeking guidance from a master craftsman is still present in all fields from medicine to fitness. What has changed are the channels available to distribute those lessons. Modern advances in technology have made coaching simpler, convenient, and effective for people to receive world-class coaching regardless of the physical distance between them and their coach. This chapter will examine three topics. First, we will explore the benefits of having a coach guide you towards your sport or health and wellness goals. Next, we will investigate recent advancements in technology allowing coaches to reach more people while keeping them engaged and maintaining retention. We will then examine medical technology companies currently employing these strategies and how the success they are having with clients is transferable to the sport industry. Coaching has been around for millennia, what is new is how we use technology to improve the coach and client connection.

Keywords: health, wellbeing, technology, training, sports

1. The value of a coach in improving sport performance and general health

From the moment people are born, babies begin the learning process. Learning for people starts in the same way as many other mammals, with the chameleon effect. People imitate the basic facial expressions of their parents as a chameleon copies the colors of its surroundings. Babies continue mimicking influential people in their lives through infancy, childhood, adolescence, and carry this skill through adulthood. People are constantly mimicking others

they admire from siblings, schoolyard peers, co-workers, and their spouse; we continue mimicking the people around us which we deem appropriate [1, 2]. These individuals act as social models to base our actions, they are inspirations in our life for how we are supposed to act in a given context. Whether it is intended or not, these people are our teachers, mentors, and coaches. They help us establish our identity and group mental models that we carry with us to our next social circle [1]. The chameleon effect is so strong and effective, that it was formalized into a proper learning method centuries ago. This method is commonly referred to as apprenticeships. Apprenticeships come in all formats, but staying within our scope, when athletes form apprenticeships with mentors, the mentors are more commonly known as coaches.

Looking back to ancient Greece, Egypt, Babylon, and Rome, apprenticeships were the backbone for building a skilled workforce [3]. This was the fashion for passing along skills from an experienced craftsman to a novice. Skills were passed along through observation and trial and error, and when adolescents came of age, they became valuable members of society [4]. Focusing on sports of that period, it is worth exploring ancient Greece's strong history with athletes and coaches as the founders of the Olympics. Athletes then as they do now pair up with a coach who is a master of their discipline to teach them the skills and knowledge of their sport.

The coach and athlete relationship went on in this manner for some period, focusing on different sports as the times changed, but always maintaining a basic mentorship approach. Although coaching techniques change as societies evolve, human nature adapts at a slower rate and thus coaching theory in its basic mentorship approach is relatively constant [5]. However, as we approached the modern era, the concept of coaching split. On one side, there was the British approach where sports were viewed as leisure activities. Athletes of this philosophy did not want to be seen spending too much time developing skills for the fear that they would appear to be trying too hard. On the other side, there was the American approach to sports. The Americans possessing a more competitive and entrepreneurial spirit saw the value in sport coaching. This cultural difference led to Yale University hiring legendary head coach Walter Camp who took them to countless American-football championships over their Harvard University rival. Yale lost only four times to Harvard whom took the British approach in the first three decades of their teams' late 1800s/early 1900s sport rivalry. Now, just as Yale did then, athletes seek guidance from experienced coaches to teach them mastery of their sport [6].

Upon reaching a certain stage, people forget there is value in coaching. There comes a point in many people's lives when they feel they have learned enough from others and can learn the rest on their own. However, this could not be further from the truth as people and the game are constantly evolving. This need for coaching opens an opportunity for coaches to build a client base who are willing to invest the time necessary to properly mentor an athlete. Coaches are a combination of teacher, mentor, boss, and therapist. Therapist in the sense that coaches use psychological skills training such as leadership, goal-setting, self-awareness, and visualization in their coaching style [7]. Remember, coaches are not coaches if they have no one to coach. This makes it a coach's responsibility to show the value of coaching to those who are not currently involved.

1.1. Even the best athletes have coaches

At what stage is a person considered so great at their craft that they no longer need the guidance of another? Colonel John Boyd was an Airforce pilot and military strategist commonly known for his creation of the OODA loop (observe, orient, decide, act). With that said, he was also well known for his desire to learn from a variety of disciplines and combine those disciplines together forming something new from something old. He would blend rules from a variety of areas bringing a new perspective to an idea [8]. If you follow Colonel Boyd's lead, you could say learning never ceases, since you can always apply something old from one area to a new area and make it novel.

When watching any professional sports team, you can look to the sidelines and see teams' and individuals' coaches lined up and down the field or court. Regardless of how good an athlete becomes, they know they need a coach if they want to continue improving. Atul Gawande, a surgeon noticed his performance in the operating room had peaked. He reached a point where he felt he could not perform any better than his current state. Dr. Gawande had a similar feeling about his tennis game. He felt his tennis skills had plateaued years ago and now he was trying to hang on to what he once had. This was until while on vacation he encountered a tennis pro who reminded him how regardless of when we believe we have peaked, there is always someone available who can show us another angle or approach that we did not see [6]. Just as Colonel Boyd blends disciplines, Dr. Gawande was blending perspectives to create something better and improve upon what he thought was his optimal ability. Dr. Gawande applied his new insight from tennis to surgery and saw an improvement in both areas. It is important for coaches to keep stories such as Colonel Boyd's and Dr. Gawande's in mind when they encounter athletes who have determined for themselves that they are too good for coaching. Part of a coach's job is teaching, and these lessons are valuable insights into why we constantly need to challenge ourselves and improve.

1.2. Coaching the coaches

It's not just the athletes that need coaching to succeed, but the coaches. In a peer-reviewed article regarding leadership published by the researcher in 2018 [1], it was determined that time must be spent properly training coaches, so they can effectively lead their athletes. Furthermore, coaches are setting the standard for tomorrow's athletes and they need to be properly trained to provide the best leadership to these athletes. Learning through experience, and the art of followership were shown to be the best way of training future leaders. These two leadership development characteristics imply athletes need an environment where they can practice their craft and must be good at following their mentors lead if they want to improve. Coaches like all leaders, need to properly learn their craft in an environment that allows them to make mistakes and discover their unique coaching style. This is best accomplished under the supervision of a more senior coach with the trainee acting as her assistant coach. By allowing the trainee to encompass the role of an assistant, it allows for the trainee to create an image of leadership identity, observe and mimic mentors and coaches, make impacting decisions, manage perceptions, and develop a leadership style through trial and error. All of these benefits were present among leaders when the opportunity to learn through

experience was present. The second part of developing effective coaches is mastering the art of followership, which implies the notion that to be a good leader, first you must be a great follower (**Table 1**). Learning through experience will not be beneficial if the person placed in the leadership position is not open to be a follower and learn from their mentors. The old style of leadership knowledge being held onto by an individual working in isolation at the top is a thing of the past and has proven ineffective. Today’s leaders must work collaboratively with a variety of people bringing different skills to the problem [5]. Thus, mastering the art of followership is a prerequisite for great leaders and will grant the coach positive mental models, collective efficacy, cohesion, challenge, an encouraging environment, positive self-conception, and self-sacrifice [1].

Real world application of training coaches can take place as a pilot program where coaches work with select athletes in a supervised environment where the coach can employ a variety of coaching strategies while receiving feedback from a mentor-coach who has been deemed qualified by previously completing the training or going through a certifying committee. Committees have been shown effective at improving inter-department communication and gaining valuable feedback [9]. This is exactly what coaches need when establishing their coaching identity. By undergoing a training program in a controlled environment, it provides quality assurance when the coach is introduced to a formal role representing a collegiate or professional sports team, trainer at a resort or health spa, or exercise physiologist working in a clinical setting. A service provider’s main resource is their reputation and pilot programs are a proven method of introducing quality services.

Committees now have access to platforms such as GoToMeeting, Skype, and Zoom to communicate across the globe. This grants coaches access to the best committee to help them achieve their desired end state. In the past, people were limited to coaches in their vicinity. Those coaches may not have been the best fit for a particular client. Additionally, when clients or coaches moved, their relationship often dwindled until it eventually ceased. Now, coaches can continue working with clients even if vast distance separates them. The past decade has unleashed the ability for people seeking guidance to have a hand selected team with members on different continents. This gives coaches the ability to form a coalition, combining their unique backgrounds for a client’s particular needs and goals.

	Learning through experience	The art of followership
Leadership development framework	Create an image of leadership identity	Positive mental models
	Observe & mimic mentors and coaches	Collective efficacy
	Make impacting decisions	Cohesion
	Manage perceptions	Challenge
	Develop leadership style through trial and error	Encouraging environment
		Positive self-conception
		Self-sacrifice

Table 1. Leadership development framework: coaches can acquire the above traits when working with a mentor [1].

1.3. Individual coaching versus group coaching

Individual coaching and group coaching are two ways for a coach to engage with his clients. Individual coaching is more personalized and costly for athletes, whereas group coaching delivers a less personal approach with reduced cost to the client. Research by Losch et al. [10] discovered, although individual coaching and group coaching were effective at reducing client procrastination and facilitating goal attainment, clients who participated in individual coaching saw a higher degree of satisfaction and attainment of their goals. It was also learned that asking individuals to perform exercises without support from coaches is not sufficient.

These findings highlight two needs for coaches where advances in technology can easily fill the gaps. The first is a need for individualized programs. People who train individually have a high degree of satisfaction and saw better results attaining their goals than people training in groups [10]. Technology now allows for athletes to send individualized programs to clients around the globe entailing full exercise descriptions, pictures, and/or videos. This advancement allows clients to quickly and easily swap out the appropriate exercises for clients without spending time repeatedly writing descriptions for each exercise. This same process provides clients with the individualized programs they need to achieve the benefits mentioned in Losch et al.'s study.

The second benefit of technological advances in connected coaching is the ability for trainers to maintain the same level of income from group sessions, while providing the attention of individual sessions. Group training sessions appeal to trainers under the premise that a trainer can get more clients into a session because the rates are lowered and make as much money if not more than during individual sessions. This principle follows basic supply and demand. The more clients a coach can train in an hour, the lower the rate for each client. Using advances in technology, trainers can implement customized exercise regimens for their clients using workout building programs which allows trainers to save programming time and thus get their programs out to a larger group of people as they do during group training.

The coaching world is making a shift, and strategic adoption of advances in technology allowing coaches to reach more clients on a personal level will open revenue streams for trainers by expanding their reach, improving client retention, and personalizing exercise programs. Trainers whom adopt this approach to technology earliest, will place themselves in a strategic position for increased revenue.

2. The benefit of applying technological advantages to sport, fitness, and health

According to Jones [11], "It is based on the notion that at the heart of coaching lies the teaching and learning interface, and the myriad ways through which coaches influence athletes to develop and improve." This teaching and learning interface can come in many forms. How a coach and their athletes engage in their lessons will vary depending on the sport, coach, and individual athlete. Regardless, according to Dudley et al. [12], the most important elements of coaching are: supportive leadership, effective communication, open-mindedness,

and the ability to be empathetic. These four characteristics help coaches identify client problems and provide solutions to those problems as well as establish trust in their relationship. These attributes have remained constant in their essence throughout the centuries. With that said, the interface through which this relationship takes place has changed during that same time. From a purely verbal face-to-face communication of knowledge and experience during times when written documentation was scarce, to the introduction of the printing press which allowed coaches to share knowledge they have written for numerous athletes for study and intervention. Even in the age of the personal computer, tablet, and smartphone that we live in now, this style of coaching, providing athletes with face-to-face coaching as well as written programs they can perform on their own time is the current model of online coaching. With that said, this unidimensional model is the foundation of the technology currently available to coaches. It is a dated static approach operating in a new dynamic system.

Technology has progressed to a level where it can effectively be used as an arm of coaching, extending the reach beyond what coaches are currently providing their athletes, yet coaches are providing static documents, PDFs, and drag and drop workouts in a unidimensional system. Currently, there is very little feedback provided to the coaches. A new dynamic approach to coaching, employing the same communication channels people positively respond to on other social networks, combined with the growing use of activity trackers such as Garmin, Fitbit, and Apple Watch, allows coaches to gain access to real-time results from their clients. Coaches are now able to provide online programming to their clients and receive data allowing them to adjust programs as necessary. Activity tracker feedback offers coaches an honest feedback mechanism and open communication without hindering clients. Clients simply wear their activity tracker and coaches monitor client progress in the background. Coaches can finally take a once static exchange of information delivered as a snapshot in time (a one-hour workout program) and incorporate 24 hours per day feedback from activity trackers, making programs dynamic and alive.

Applying technology in sport in this manner allows coaches to bring their exercise programs to life. One company, iGetBetter Wellness takes the concept a step further by allowing coaches to establish thresholds for their clients so coaches are only alerted to check on a client when a threshold is violated. Otherwise, the coach and client can step-back and allow the program to progress without interruption. This concept allows coaches to monitor and train a much greater number of clients at a higher standard of care. In essence, athletes constantly have coaches monitoring their progress, but coaches are not constantly bombarded with alerts because thresholds set by the coach act as gatekeepers for when coaches receive information from clients. If coaches want to automate their feedback, they can send automatic responses for specific threshold violations [13].

In my book *How to Improve at Fitness and Beat the Competition: Sport and Exercise Science for athletes in Search of Excellence* [14], I make the following statement,

“Society has redefined American culture focusing on time efficiency as well as maximizing value within that given time. With that said, medicine, science, and technology are collaborating to bring attention to America’s growing health concerns. With medicine and science discovering what needs to be done to improve American health and technology implementing new techniques of engaging people to improve

their health. This hybrid between fields is the perfect opportunity to convince busy people to begin implementing relatively non-time-consuming exercise programs such as the ones justified in the above research into their lives, prolonging life as well as increasing its quality – athletes should use new technologies to monitor their health."

The sport industry is participating in a world where people have ever-growing circles of concern needing their attention. These concerns should be prioritized and streamlined to effectively incorporate time for effective sport intervention. Technological advances allow for such priorities to take place. An example of this are activity trackers reminding individuals to stand throughout the day without putting thought into it. People simply set a reminder to stand up and walk around their office or home every set period then wait for the alert to remind them to move [15]. Technology such as this allows people to focus on their career, education, or family while still getting in the activity they need to live healthy lives.

2.1. Social networks and positive behavior

In 2014, Maher et al. [16] conducted research regarding social networks and health behavior change. The team of researchers compared 10 studies to determine if social networks are beneficial health behavior interventions. Their results concluded that there are significant benefits associated with positive behavior change from social network intervention. Coaches who are aware of such interventions and are willing to engage with athletes on social networks can be successful in two ways. First is through the positive behavior changes mentioned in Meher and colleagues study. The second is through the social presence and social media exposure that will naturally occur from working with clients on a social network. People on social networks like and share high arousal post that spark positive emotions [17]. When many people share high-arousal positive-emotion post, it makes post go viral which is great for business exposure. When a coach's athletes do this, it acts as free marketing for the coach. This free marketing exposure extends the coaches brand to new prospects and provides the coach an opportunity to grow their coaching business.

2.2. Client retention

The coach and athlete relationship exist in numerous circumstances. The two most basic types are the traditional coach of a team and the coach of an individual. Coaches of teams attain clients from an array of methods depending on the context. For professional teams it is through sports agents and player contract negotiations and for high school teams it is generally based upon the athlete's location for public school and the school's reputation for private schools.

When it comes to coaches working with individual athletes in a private business setting such as a gym, the relationship may change. This is especially true if the coach is acting as a business owner or independent contractor for a private coaching company. In this role, the coach is now acting as a service provider for hire and is in constant worry the athlete may leave them. It is 5–25% easier for a service provider to maintain a client than to find a new client [18]. It is also suggested that increasing customer retention rates by 5% increases profits by 25–95% [19]. These statements make it clear that special attention must be placed on client retention. One method for increasing client retention is gamification. Gamification

has been proven to be especially effective at attracting, engaging, and retaining athletes [20]. Gamification is the process of applying game-based mechanics or attributes of a card, board, or videogame to another field in order to increase usage. Game-based mechanics take many shapes, often unrecognizable as a game. Many social networks utilize gamification without you knowing [21].

2.3. Just how accurate are activity trackers?

Perhaps the greatest technological advancement in activity tracking is wrist-worn activity monitors used to measure a variety of features including but not limited to steps, sleep, stress, and heart rate. The data these activity trackers gather can then be sent to a phone app, website, or other device. It seems every day an additional co-worker enters the building swapping their traditional watch or replacing formally bare wrist with a smart-watch. With that said, watches are only the beginning of wearable activity trackers. Some companies are in the process of developing wearable technology that can be worn on a necklace, bra, in a shoe, or other locations [22]. What we are seeing now is only the beginning of activity tracking and sport motion monitoring. There is no reason activity trackers cannot be placed on lacrosse sticks or soccer balls to measure velocity, running shoes to measure impact and pace, or a basketball to track the number of shots taken in an hour. Information such as this adds valuable data points to a coach's exercise programming abilities. One way of looking at these additional data points is thinking of them as additional time athletes are spending under the supervision of their coach. If a tennis player's racquet is capable of tracking a pre-set swing for a given athlete that data can be sent back from dozens of athletes at once, which would otherwise prove impossible for a single coach to effectively get eyes on every player in the same period [23]. This would allow coaches to focus their time on an athlete's other areas of concern (**Figures 1–4**).

All of this tracking sounds great; however, the technology is still relatively new. While research has shown consumer-level activity trackers to be valid for the measurement of many daily activities, there is still room for improvements [22]. Most activity tracker improvements are taking place first in the medical field. The medical field's highly regulated environment operates at a high standard due to the risk involved with using lower-grade technology [24]. As better technology is invented for medicine, these inventions and innovations will benefit sports, health, and wellness. This concept provides reason for sport coaches to have insight in medical coaching practices.

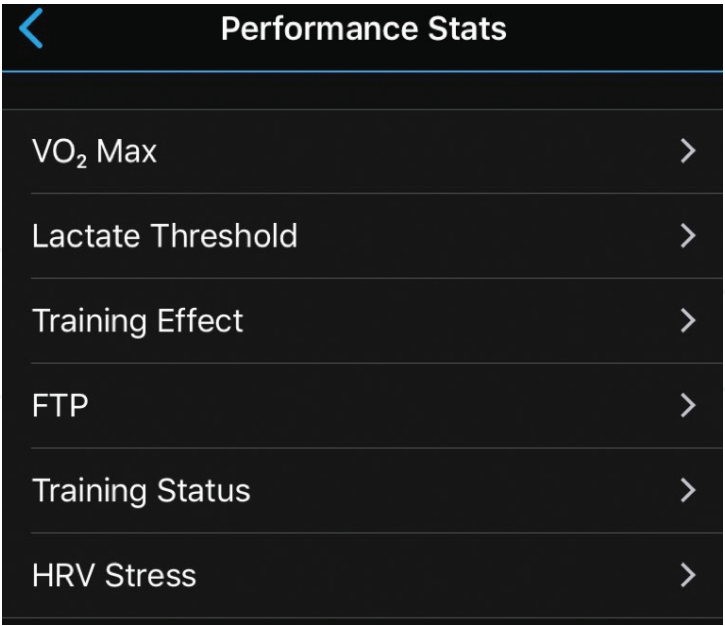
2.4. A smooth transition from medicine to sport

Medicine and sport exist on the same health spectrum. Traditionally, medicine has been used as a reactive treatment for individuals seeking aid after experiencing troubles affecting daily life. Whereas, sport is catered more towards increasing activity levels and/or human performance, with hopes that an active lifestyle will improve quality of life resulting in less future medical intervention. A 2014 article published by Harvard Health Publishing, a part of Harvard Medical School explains how the more exercise an individual gets, the healthier they will be, as long as they do not become injured from the process. As little as 15 min of moderate activity such as brisk walking was shown to make a difference in health [25]. This slight increase in activity can make people healthier and reduce the incurrence of medical intervention.



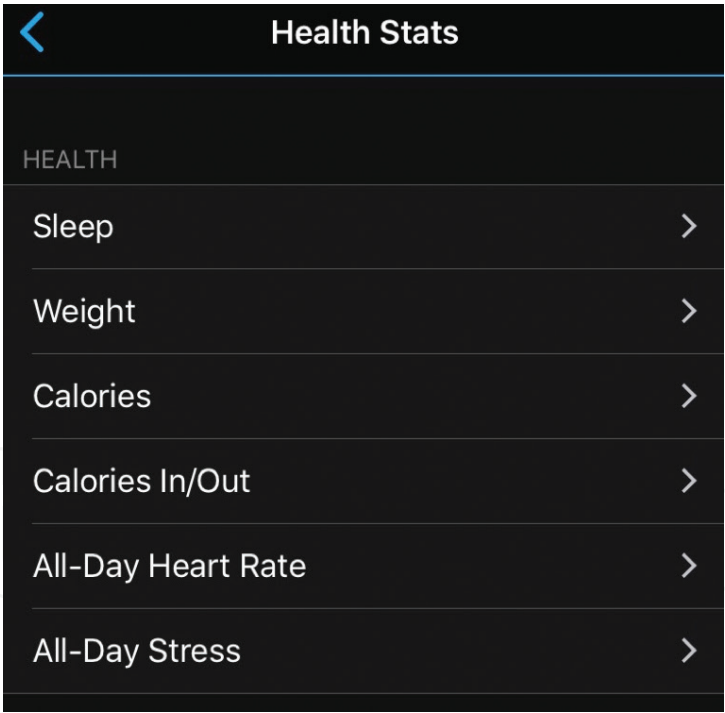
Figure 1. Garmin app user profile screenshot.

Health and wellness is also employed after medical treatment ceases and patients are seeking additional guidance. There is a need for multidisciplinary teams to improve clients' wellness and improve health upon completion of medical intervention. With that said, there are companies aiming at connecting the two points on the spectrum. iGetBetter, is a pre- and post-medical treatment company providing a platform for clinicians to prepare and monitor orthopedic and cardiovascular patients before and after surgery in order to increase their success and recovery rate. iGetBetter is taking a preventative and post-rehabilitation approach more commonly seen in health and wellness and applying it to medicine [26]. Moreover, they are now blending what has been shown to be a successful intervention in medicine into health and wellness resort spas through the application of sport. They have come full circle, employing the same strategic mindset of Colonel John Boyd mentioned earlier by taking a health and wellness mindset and sharing it in a medical setting then using their medical-grade platform in a health and wellness setting, but with medical-grade patient security and

A screenshot of a mobile application interface titled "Performance Stats". It features a dark background with a list of performance metrics, each followed by a right-pointing chevron icon. The metrics listed are VO₂ Max, Lactate Threshold, Training Effect, FTP, Training Status, and HRV Stress. A blue back arrow is visible in the top left corner.

Performance Stats	
VO ₂ Max	>
Lactate Threshold	>
Training Effect	>
FTP	>
Training Status	>
HRV Stress	>

Figure 2. Garmin performance statistics.

A screenshot of a mobile application interface titled "Health Stats". It features a dark background with a list of health-related metrics, each followed by a right-pointing chevron icon. The metrics listed are Sleep, Weight, Calories, Calories In/Out, All-Day Heart Rate, and All-Day Stress. A blue back arrow is visible in the top left corner. The word "HEALTH" is displayed in all caps above the list.

Health Stats	
HEALTH	
Sleep	>
Weight	>
Calories	>
Calories In/Out	>
All-Day Heart Rate	>
All-Day Stress	>

Figure 3. Garmin health statistics.

activity monitoring. What is being created using health, wellness, and sport ideologies for medical intervention is being adapted back to health, wellness, and sport while maintaining its high medical quality standard.



Figure 4. Garmin insights page.

2.5. Leadership in medicine involves coaching

The high standards and prestige associated with being a medical professional is the result of years of high quality medical training. This training is available in a variety of formats, however, a study by McNamara et al. [27] concluded clinical leadership development programs include mentoring, coaching, and action-oriented learning interventions. This is of significance because it shows a need for medical professionals to receive coaching which can be provided through social platforms. Medical professionals currently share opinions and advice through annotations or behind the scene notes that the patient generally does not see. This ability opens up a communication channel for medical professionals to advice and coach each other on a particular patient. Medical doctors can share insights into a patient's progress and coach each other to the best solution using a holistic approach of everyone involved with the patient's medical well-being.

Now imagine if an athlete’s fitness trainer, skills coach, and dietician could all communicate and share insight in the same manner as medical professionals (Figures 5–7). This approach is part of the medical technology iGetBetter Wellness is bringing to sports professionals [13].

2.6. As a means of culture change

Thorn and Raj in their article *A Culture of Coaching: Achieving Peak Performance of Individuals and Teams in Academic Health Centers* [28], suggest that currently in medical academia there is a lack of focus on the “being” aspect of practicing medicine. Medical students should spend more time learning how to be a coach, listening to client stories and painting positive relational perceptions of their patients. The authors recommend integrating professional coaches and teaching faculty how to develop coach like behaviors that will aid in this culture shift. Their findings suggest faculty who are already employing such techniques are seeing a significant enhancement in board pass rates, an increase in both faculty and resident perceptions

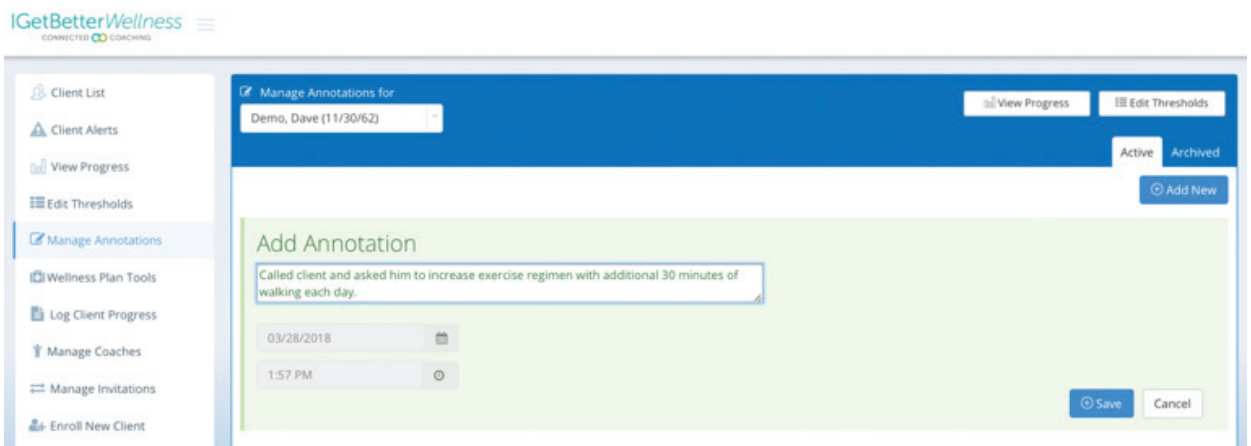


Figure 5. Medical doctor saving an annotation to a client’s profile.

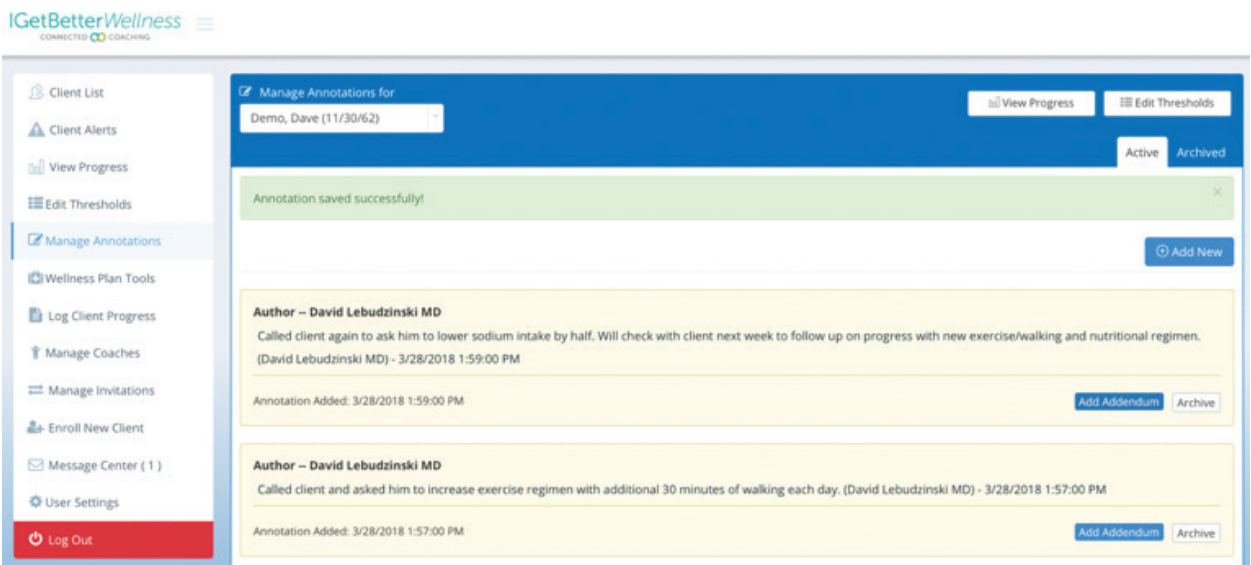


Figure 6. Annotation after the doctor successfully saves the note.

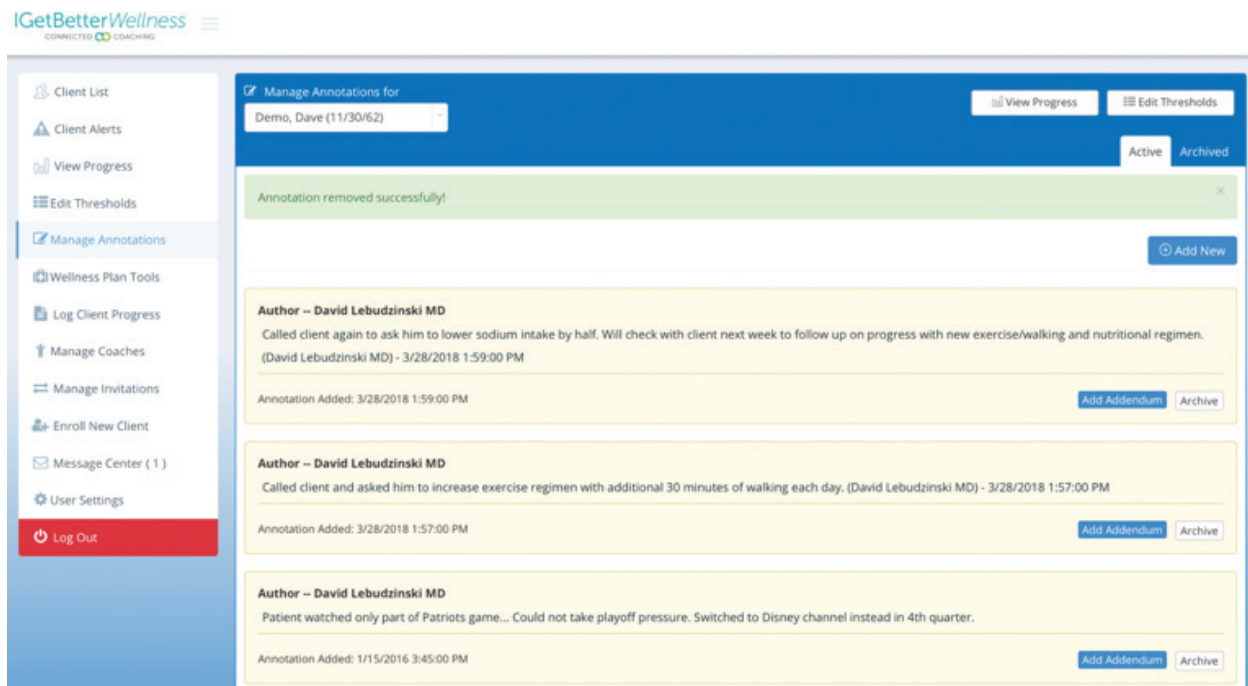


Figure 7. Stream of saved notes by the doctor.

of residents' lifelong learning ability, and a discernable confidence in resident mindsets. The anecdotal evidence also reported enhanced trust in collegial relationships and a surprise in the positive change in their attitudes.

The need for coaches as intermediaries in medical school is an opportunity for open source teaching platforms such as Moodle and Canvas to allow coaches to extend the reach of their services. Every year, online teaching and training is becoming more prevalent and accepted in academia as evident by the increase in schools providing online education [29]. This creates a perfect opportunity for coaches to benefit from this trend. Just as sports professionals can learn from medical professionals, this is an ideal opportunity for coaches to share their interpersonal skills and healthy and active demographic experience with medical doctors.

3. Conclusions

In closing, there is ample evidence that technological coaching advances are leading to improved client sport performance, health, and retention. Just as technology has always been an underlying theme in humanities progress, from the agricultural revolution 12,000 years ago when people began using tools to domesticate plants and animals, to the global food operations we conduct today. Coaching has been present and evolving throughout history, shifting form as technology advances yet always maintaining its underlying theme of helping others improve. The application of new technology in the coaching process is nothing new, just the next chapter in our story. What is new, is how coaches involve modern technology while providing multidisciplinary teams to improve clients' wellness and improve health. Never before have coaches had such an expansive

influence over their athletes. This reach provides a challenge for coaches to find the method for them that best takes advantages of the dynamic and integrated coaching experience occurring today.

Conflict of interest

The author of this work is a contractor for iGetBetter Wellness Inc., which is one of the examples used in the research.

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