ViPTA

The Virtual Physical Therapy Assistant

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Executive Summary

Physical therapists (PTs) are the backbone of patient care. They take care of the disabled in hospitals and help them recover, enable injured athletes to get back to their professions, and encourage healthier lifestyles among all patients. In the United States, patients see PTs over 75 million times on an annual basis, totalling 9% of annual medical visits[1].

Once the COVID-19 pandemic started and disrupted their physical practice, some PTs were able to adapt to a virtual format but many faced challenges primarily due to the difficult onboarding process. Those that did successfully adapt found the platforms to be convenient—not only during stay-at-home orders but also in everyday practice after that period. Thus, the pandemic not only validated the need for improved telehealth within physical therapy, it also accelerated the trend for PTs to use it as a means of more convenient patient visits. We see this trend continuing even after the pandemic as PTs add more technology into their practice.

Despite this convenience, many PTs are still unable to perform the same treatments online as they can in-person, finding the virtual environment bereft of useful information. Therefore, there exists an opportunity for an improved physical therapy telehealth platform. To facilitate this, our team created ViPTA, the Virtual Physical Therapy Assistant. ViPTA is a platform that integrates patient management, patient accountability, and video analysis tools to allow PTs to continue to improve their patients' lives as effectively and seamlessly as in-person treatment.

Description

To technically savvy physical therapists who desire to forge into telehealth for outpatient and continued care, ViPTA offers a scalable platform that connects therapists virtually with their existing patients, keeps patients accountable for exercises, and integrates with a suite of data-assistive devices that provides enriching information. ViPTA consists primarily of 2 parts: (1) dashboards for PTs and patients and (2) a data analytics engine.

Technology

Dashboard

For PTs, the primary function of the dashboard is patient management. Through the dashboard, PTs can organize their appointments via a built-in calendar, gather summarized patient information, and add and filter patient assignments. PTs can quickly view information about their patients, with the easy ability to create and view upcoming appointments, meeting links, and exercise plans for each patient. They can also view all of their upcoming appointments in a built-in calendar, and then assign exercise plans to patients. Once patients receive the exercise plan, they can record their progress on ViPTA and send in recorded submissions. By adding comments about a patient's exercise recording submission, PTs and patients can also communicate with each other, pinpointing specific areas of improvement. As a patient uploads his or her progress onto the platform, the PT furthermore gains a better understanding of the patient's progress, so both parties are up to date on patient condition and progress.

For patients, the primary function of the dashboard is accountability. For each of their assignments, patients can submit a report that includes a confirmation of the duration and repetition of their exercise. In addition, they can record a video of themselves performing the exercise and add notes on how they felt; this information is then fed virtually to the PT, providing the possibility for instant

[1] Oxford Academic, Physical Therapy & Rehabilitation Journal, *Utilization and Clinical Outcomes of Outpatient Physical Therapy for Medicare Beneficiaries With Musculoskeletal Conditions*, 2011

feedback. Moreover, ViPTA provides a built-in video mirror feature, which allows a patient to use his or her home webcam as a mirror, allowing the patient to understand his or her exercise movements. Coupled with this webcam is the metronome feature, which allows the patient to time specific exercise movements. One important piece of feedback we received after conducting a dozen of interviews with PTs and patients was that in the physical environment, PTs would record their patients while playing a metronome so that their foot would hit the ground at a specific time; this metronome and webcam feature allows both parties to keep track of these movements virtually, from the comfort and convenience from their own environment.

Our dashboard stack consists of a Django-based backend (Python) coupled with a MySQL database. The backend prefills information on the front-end pages and processes information and reports submitted by the user. The front-end uses HTML, CSS, and JavaScript. PTs can manage their appointments, assignments, and patient reports. The web app is currently designed to be accessed through a web browser, and we plan to make it mobile-friendly in the future.

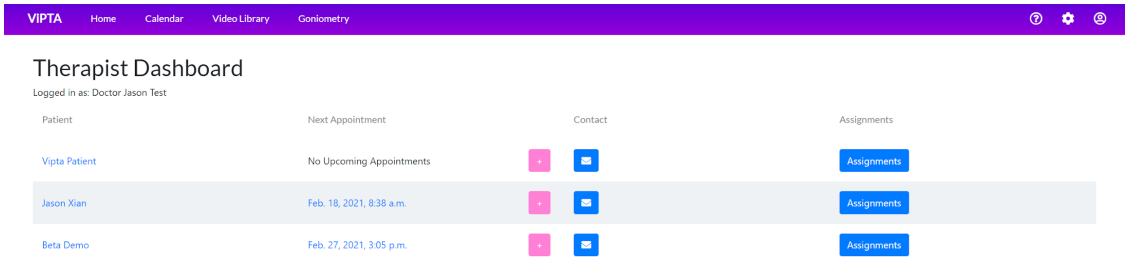

Figure 1: *The Therapist Dashboard provides a simple, clean view of the PT's patients and upcoming appointments, contact information, assignments, as well as the ability to add new appointments quickly.*

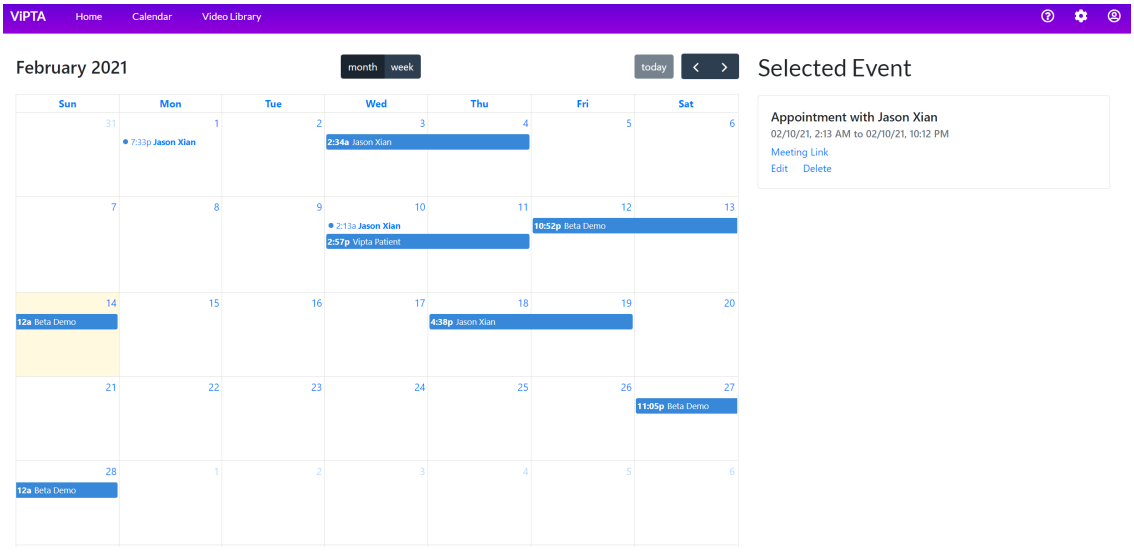

Figure 2: *The calendar feature allows PTs to view past and future appointments and quickly join a meeting and read notes about an appointment.*

Data Analytics Engine

ViPTA provides PTs and patients with extra data analytics tools to gain more insights about exercises, such as skeletal detection, which overlays a skeleton on patients' exercise videos, and joint angle detection (called "goniometry" in the industry), which measures the angles between joints to give specific feedback about an exercise. Patients and PTs are able to view videos of patients doing their exercises, which are submitted by patients. The video library curates each patient's videos for the PT or patient to review and provides links to pre-existing videos online from YouTube or vetted PT video libraries like HEP to demonstrate exercises to patients. The video library also provides data analytics about each patient-submitted video and allows PTs to add comments to videos. The data analytics includes the skeletal detection feature for which we built a pipeline to analyze user-submitted MP4 videos using the OpenPose neural network. We use video encoders and decoders to convert the video into a stream of images, analyze and annotate each frame, and recombine frames into a video. Currently, the video library has been completed, and videos can be linked to assignments. Example videos are played side-by-side with the patient's submitted video, which has skeletal detection overlaid on top of it. We also have a static page for PTs to perform goniometry (angle measurements) on pictures, with skeletal detection overlaid on the picture. So far, we have implemented bicep angle measurements on images, which appear in just a few seconds. Coupled with the goniometry feature, ViPTA also provides PTs with the ability to draw on any image that they upload onto the platform. They can then save the image and share it with the patient through report comments, thus doubling the amount of information PTs can relay to their patients about how their exercise looked.

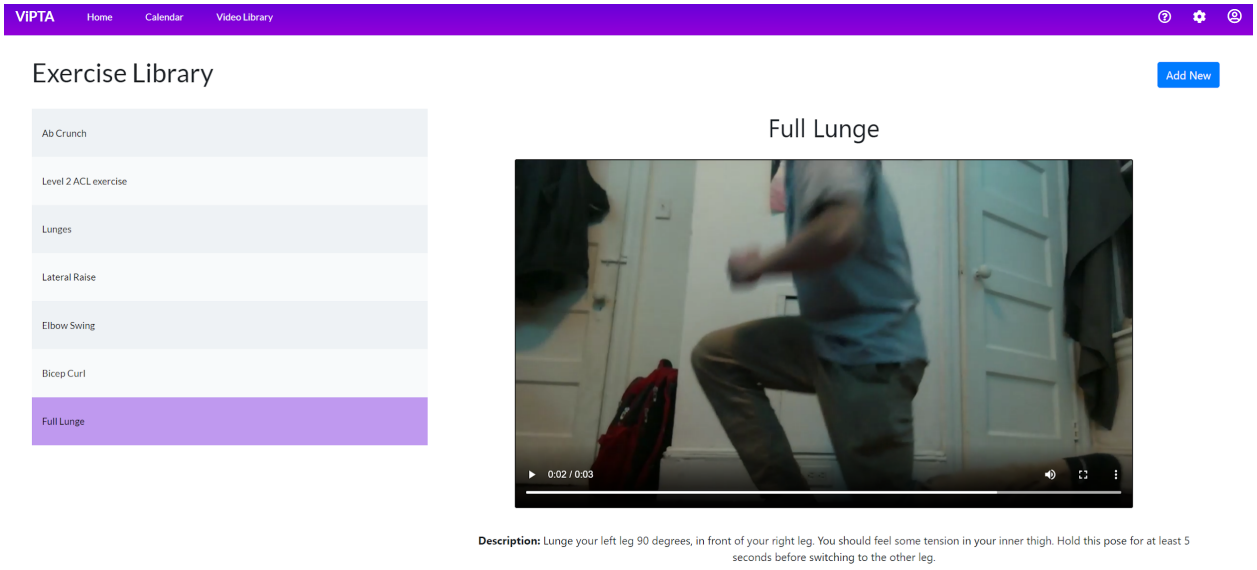

Figure 3: *The video library curates each patient's videos for review and provides data analytics about each patient-submitted video and links to pre-existing videos to demonstrate exercises to patients.*

Other Tools & Features

Video Analysis

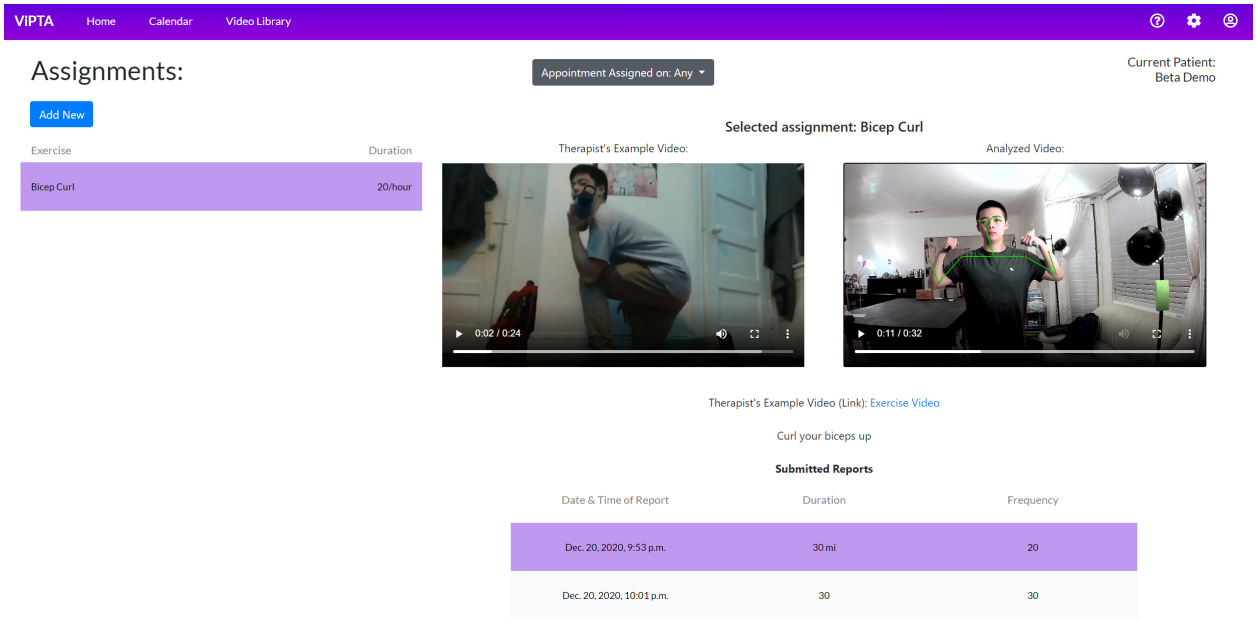

Figure 4: *The video analysis page allows patients to submit a report of their exercise and compare their own video side-by-side with the PT's example video , as well as view the overlaid skeletal detection.*

Goniometry & Drawing

Our goniometry feature allows PTs to annotate exercise images submitted by patients to demonstrate proper posture and form when performing the assigned exercises. This feature leverages JavaScript and the OpenCV library in Python.

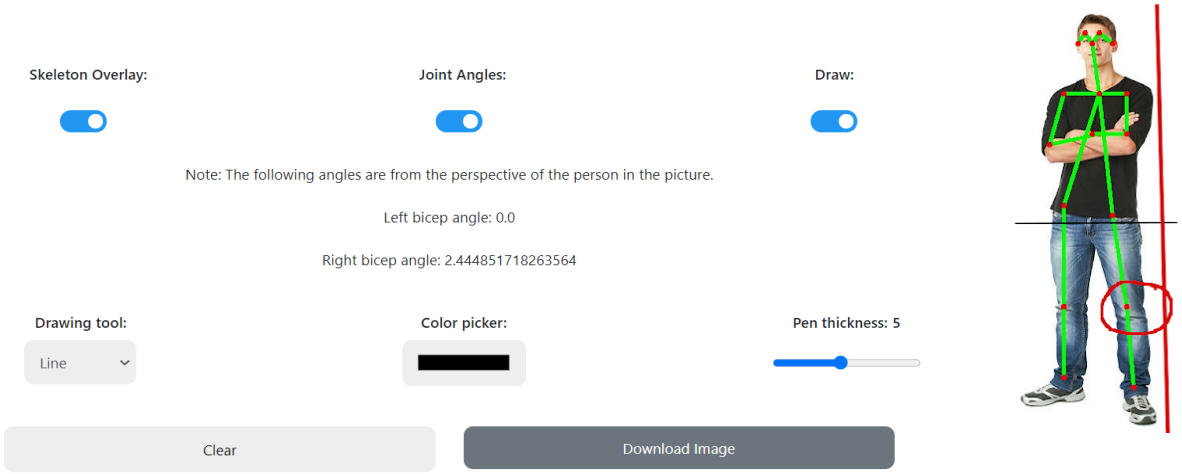

Figure 5: *The Goniometry page performs joint angle detection and enables patients and PTs to draw on images*

Metronome

We provide a metronome feature for patients to time their exercises to a rhythm, with ability to increment the tempo. This feature leverages JavaScript.

Comments

Our comments feature allows therapists and patients to comment on their submitted exercise reports, giving PTs the ability to annotate a point in the video where the patient might need improvement.

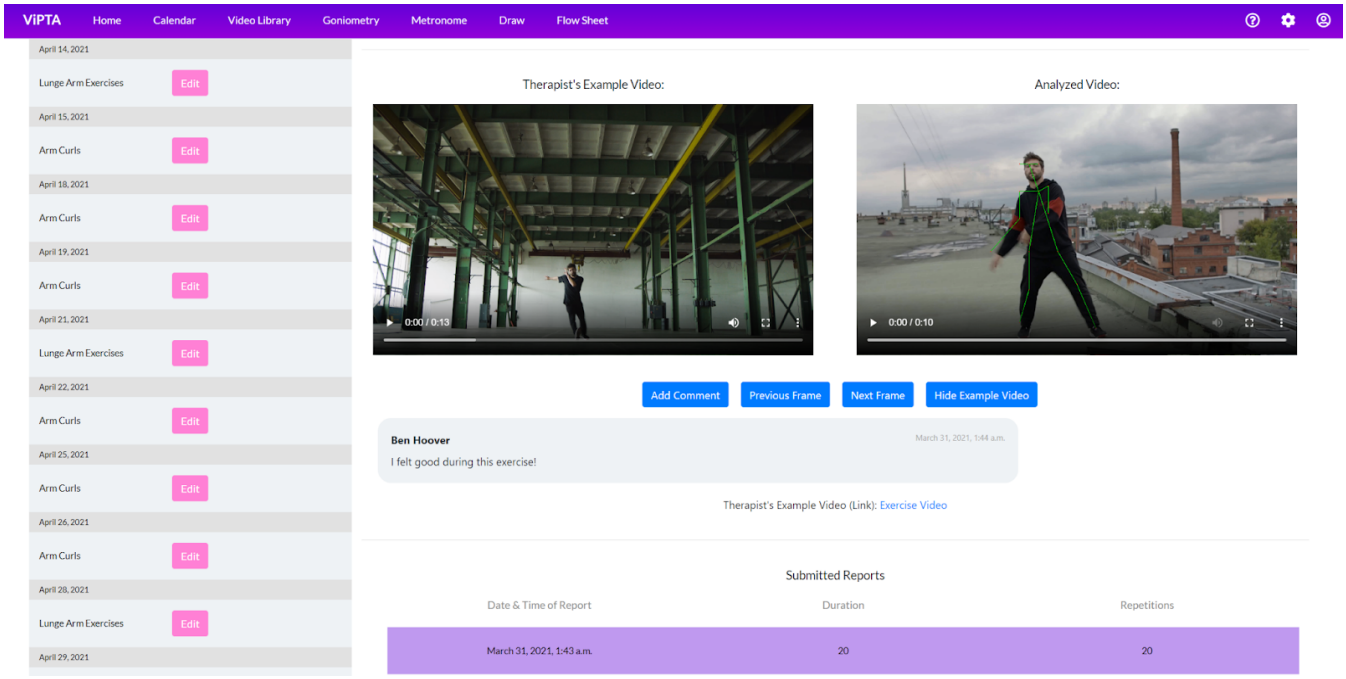

Figure 6: *The comments feature enables PTs and patients to share feedback and ask questions about tasks.*

Flow Sheets

Flow sheets allow therapists to create and assign exercise plans using templates based on previously assigned exercise plans. We have created this tool to have an easy-to-use drag and drop interface. One of the biggest pain points PTs face is adding exercise assignments and sharing them with patients. In the physical environment, they would often hand patients a sheets of paper called “flow sheets,” which detail which exercise to perform on which day. In half of our interviews with PTs, they mentioned that Electronic Medical Record (EMR) systems like EPIC were built for general-hospital use, not PT-specific use. As such, we created a flow sheet feature (Figure 7), which allows PTs to assign exercises by creating templates. With these templates, PTs can make exercise plans that are specific to certain patients and regiments, all the while duplicating existing ones so that they don’t waste time writing down each and every exercise. We see this feature as a major differentiating feature, as PTs will likely use this feature even when they return to the office and see patients in-person.

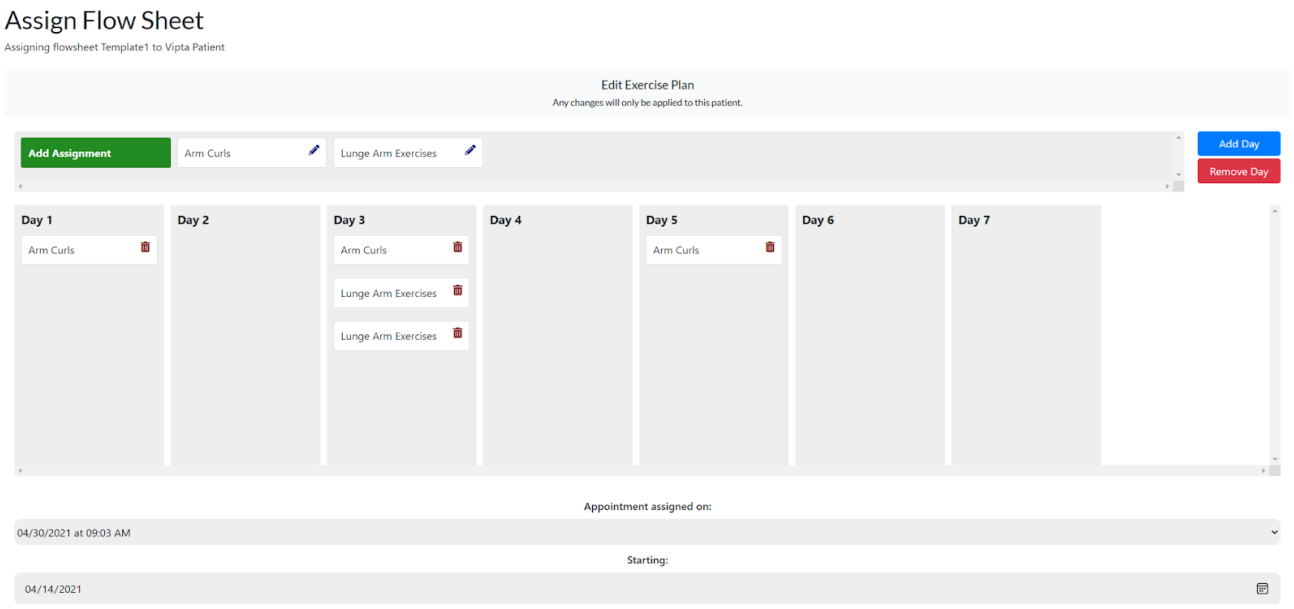

Figure 7: *The flow sheet feature enables PTs to create and re-use exercise plans to suit the needs of patients.*

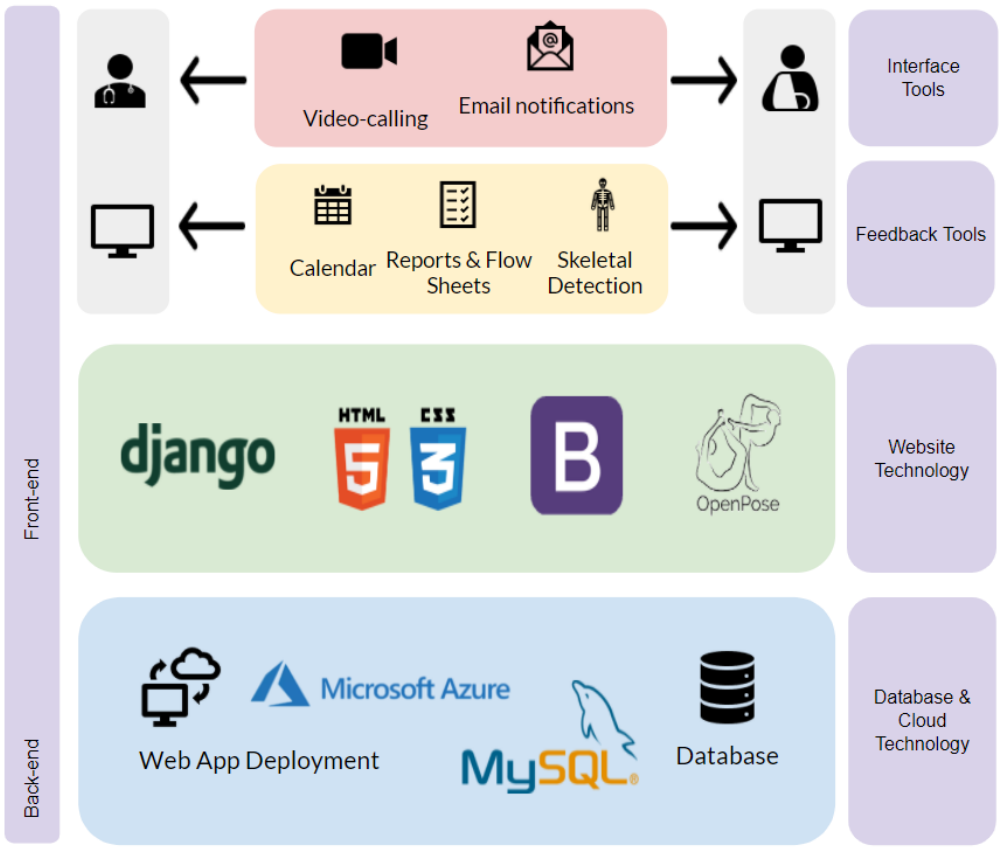

Figure 8: *Overview of our technical infrastructure, with tools and frameworks used to build our features.*

Business Analysis

Value Proposition

For physical therapists, ViPTA expands the capabilities of what PTs can do online. First, ViPTA provides an enhanced user management experience with the ability to see all patients on one page (Figure 1). PTs can simply click on the next appointment link to launch their favorite video platform like BlueJeans or Zoom. The same meeting links and appointments are also populated in a compact calendar view for PTs to get a glimpse of their schedule (Figure 2). Second, it allows PTs to quickly add new assignments. The electronic medical records (EMRs) that most PTs use today were not built for PTs but for general physicians. In physical practice, PTs often assign multiple exercises between visits through written flow sheets. ViPTA integrates these flow sheets online, allowing PTs to share them with patients from any place, and allows PTs to stylize them to fit their preferences. Third, ViPTA adds video analysis tools for PTs to gain more information out of the virtual environment. PTs can share example exercise videos that they make themselves or through a third party with their patients (Figure 3). In turn, the patient can record a video of themselves, which is then overlaid with skeletal detection (Figure 4). During live calls, PTs can also take a screenshot of the patient doing an exercise and run the image through ViPTA's goniometry feature (Figure 5) to obtain the skeletal detection and find joint angle measurements, giving both parties specific feedback, which is especially liked by insurance providers.

For patients, ViPTA simplifies the telehealth experience. In our user interviews, we found that patients frequently lose meeting links and thus have to frequently call their PTs for the link. Through the patient dashboard, patients can view all their appointments in one centralized location. ViPTA also helps with patient accountability. By having patients fill out a report of their exercise, patients can track and report their progress on a frequent basis. Recording videos of their exercise also creates a positive feedback loop in which patients are aware of how they are doing an exercise. Through side-by-side videos of the example video and their analyzed video (Figure 4), patients can also make objective comparisons of their exercise. If there are any inconsistencies, the PT can also give feedback to correct the exercise.

Stakeholders

Our key stakeholders include physical therapists, doctors and health systems, sports coaches, and insurance companies. We envision PTs to be the primary users of our platform, with doctors being secondary stakeholders who provide consultations, or check-in on their patients after surgery or rehabilitation. We also consider physical trainers and sports coaches to be secondary stakeholders, since they check-in on patients recovering from an injury or undergoing physical therapy to avoid accidents. Insurance companies can also be important stakeholders who inform our pricing structure, and work with us to ensure we adhere to regulations.

Market Opportunity

The market opportunity for tele-PT solutions is two-fold. First, most clinics lack adequate technology solutions to digitally communicate with their patients. Second, patients who undergo virtual PT sometimes find the virtual environment less effective compared to in-person sessions.

Expanding on the first point, even the largest health systems such as Penn Medicine have adopted video-conferencing solutions like Verizon's BlueJeans, but have not done much else in the way of quantifying the patient's progress over video or tracking patient progress between visits digitally. Our

platform-agnostic offering integrates well with PTs workflows since they can continue to use their video-conferencing client of choice and use our dashboard to monitor their clients between visits.

Regarding the second point, we have started developing a suite of data analytics, video analysis, and computer vision tools which measure patients' range of motions as they exercise in front of a camera, in lieu of goniometry and other PT equipment. This aspect of our offering is a continual work in progress as we get input from PTs regarding what tools they would find helpful. Moreover, this suite of tools enables us to serve sports coaches and physical trainers in the future, as they have a high need for capturing athletic movement and correcting it.

The timing to enter this market is ripe due to the heavy demand due to COVID-19, which we believe will be extended far beyond the pandemic. A survey of about 6500 PTs from the American Physical Therapy Association (APTA's) found that, four months into the pandemic, 76% of private outpatient practices still saw their patient caseload decline due to hesitancy towards in-person treatment and lack of an effective telehealth solution. This lack of ability to maintain business through telehealth also financially impacted PTs, with about 74% of PTs seeing more than 25% decrease in revenue in July of 2020. Currently, the most popular solution for PTs is to video call patients and email them exercise instructions, but many wish for an integrated platform that would better allow him to see and diagnose his patients online, demonstrate exercises, and keep track of his patients' progress to make his virtual care for patients as effective as in person.

Market Size and Trajectory

The current landscape of physical therapy is very fragmented. In the United States, there are approximately 38,000 PT clinics. 94% of PT clinics are single-unit operations (small specialized clinics with few physical therapists). Along with their dominant market share, single-unit operations also account for 54% of industry receipts, indicating that large clinics and health systems like Penn Medicine control about half of the market revenue with more concentrated, consolidated power. Currently, EPIC and Cerner, the leading EMRs, dominate the large, 500+ bed hospital market, with a market share of 58% and 27% respectively, totalling 85%.

Narrowing the market further, we define the market for our product as the total number of occupational therapy and physical therapy visits that have used telehealth. To gain an estimate of the market size, we computed both a top-down and bottom-down estimate, with the top-down estimate yielding a market-size of $1.08B and the bottom-up estimate being $1.19B.

To compute the a top-down estimate, we started with the total US market size for telehealth, which stands at $26.14 billion[2]. Telerehabilitation represents about 5.5% of that segment, which includes occupational therapy, physical therapy, chronic diseases, and other areas. Our platform targets the therapy sectors in particular, which constitutes about 75% of the rehabilitation market[3]. Combining the above information, we arrive at a market size of $1.08B, with a corresponding CAGR of 13.4% as of 2020, indicating rapid growth in this area.

Using a bottom-up approach, the market stands at $1.19 billion. Every year, 883.7 million medical visits are made[4], with one-fifth of those being telehealth appointments[5]. About 9% of those visits are for virtual physical and occupational therapy at an average of $75 per visit[6].

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[2] Fortune Business Insights, *Telehealth Market Size*, 2020

[3] Fortune Business Insights, *Telerehabilitation Market Size*, 2020

[4] Centers for Disease Control and Prevention, *National Ambulatory Medical Care Survey*, 2016

[5] Healthcare Finance, *Telehealth is expected to drive $29 billion in healthcare services in 2020*, 2020

[6] Thervo, *How Much Does Physical Therapy Cost?*, 2021

Customer Segment

Currently, 85% of larger hospital networks use one of two electronic health record systems, EPIC or Cerner, establishing high barriers to entry. In addition, the physical therapists who work in hospitals mostly tend to inpatient care, which has a smaller need for a virtual platform, due to the fact that their clients are already in the hospital. In the future, we may consider implementing features to integrate with EPIC, but this will require further analysis when the platform gains traction and we gain more feedback. Hence our key customer segments are technically savvy physical therapists in smaller, independent clinics with standalone electronic health record systems that can more easily be replaced.

While this customer segment is much more fragmented, as mentioned in our market sizing analysis, it poses fewer barriers to entry in terms of systems we need to integrate with, and greater upside potential due to the large volume of independent clinics. This segment also has a higher and growing need for a standalone tele-PT platform, as they feel the most burden with complicated, uninformative telehealth platforms and thus has a strong upside potential. In the U.S., this market makes up 54% of industry receipts, and a whopping 94% of PT clinics are single-unit operations. So to have the biggest impact, this is our market to win. Further, focusing on smaller clinics reduces competition as other digital natives such as WizeCare and Theranow are currently targeting large hospitals.

Our strategy is to first focus on a smaller number of these clinics and create positive feedback loops which help improve our platform, and then scale up to capture the business of larger physical therapy networks by partnering with physical therapy associations and insurance companies. A partnership with insurance companies will be critical for the larger customer segment because some insurance plans require patients to schedule in-person visits before pursuing telehealth.

Go To Market Strategy

Our target customer segment are small clinics with less than 10 PTs. Our target end-users are patients who are younger and have sports-related or musculoskeletal injuries. These patients have the highest level of need, high willingness-to-pay for new digital solutions in return for convenience, and longer treatment cycles, in which they may start with in-person rehabilitation and eventually transition to virtual appointments to track their progress. Our plan is to start locally in Pennsylvania and scale by state, since insurance requires PTs to have state licenses. Focusing small first helps create positive feedback loops to improve our platform. After, we can target sports coaches and physical trainers who require advanced tools, and later larger hospital networks once we scale.

Small clinics are our beachhead market for three reasons. First, PTs who work in hospitals mostly tend to inpatient care, so they have a smaller need. Second, it reduces competition because other Digital Natives are currently targeting large hospitals. This route also has fewer barriers to entry since we don't have to *immediately* compete with big EMRs like EPIC. This means we minimize adoption friction while reducing Customer Acquisition Cost, since we don't have to spend money on EMR integration. Third, this market has a strong upside potential. In the U.S., this market makes up 54% of industry receipts, and a whopping 94% of PT clinics are single-unit operations. So to have the biggest impact, to help PTs the most, this is our market to win.

Competition

While this market opportunity is huge, the market is not very saturated. Still, we see four possible domains of competition. First, least competitive with us are telehealth conferencing platforms. These offer general video chatting solutions but nothing tailored to PTs, like skeletal detection, meaning there's not much value-add to them. Second, Electronic Medical Records, or EMRs, are common in large hospitals, but PTs dislike how they can't create exercise plans on them. Third, physical incumbents, who started off as clinics and built their own platform, have vertical integration, but they also incur heavy costs by hiring PTs. The last group, digital natives, are online-only platforms that started around 2018. We face the most competition from them, as PTs want a PT-specific platform but can't build their own.

Although we may eventually face some competition from existing EMRs such as EPIC, focusing on single-unit clinics (our target customers) helps us avoid the fierce competition in managing patient records. As such, our main source of competition comes from telehealth platforms.

Most telehealth platforms are general-purpose, web-based video communication platforms with some physical therapy offerings:

- *BlueStream* features queue management capabilities, integrates with existing EMRs, and is positioned as a B2B player for large medical centers and health networks.
- *Doxy.me* is a general telehealth platform, free for patients with a monthly fee for clinics.
- *RingCentral* is a business communications platform that offers services in various sectors beyond healthcare (e.g., retail, education, financial services).

Few platforms focus solely on physical therapy, with most being relatively new:

- *Virtual Physical Therapists* is a mobile-first PT platform that started in 2017. It partners with musculoskeletal specialists to provide consultations.

- *ATI Physical Therapy* is a vertically integrated PT network that started in 1996. It owns over 900 physical clinics, directly hires physical therapists, and partners with sports clubs. In April 2020, it started its online PT platform, ATI Connect.
- *Wizecare* is a mobile-first platform that focuses on providing patients with skeletal exercise feedback by following activities on pre-recorded videos.

Our vision for where ViPTA fits into this competitive landscape is to create a feature-rich platform which combines all the features PTs care most about, while also integrating with their existing workflow wherever possible.

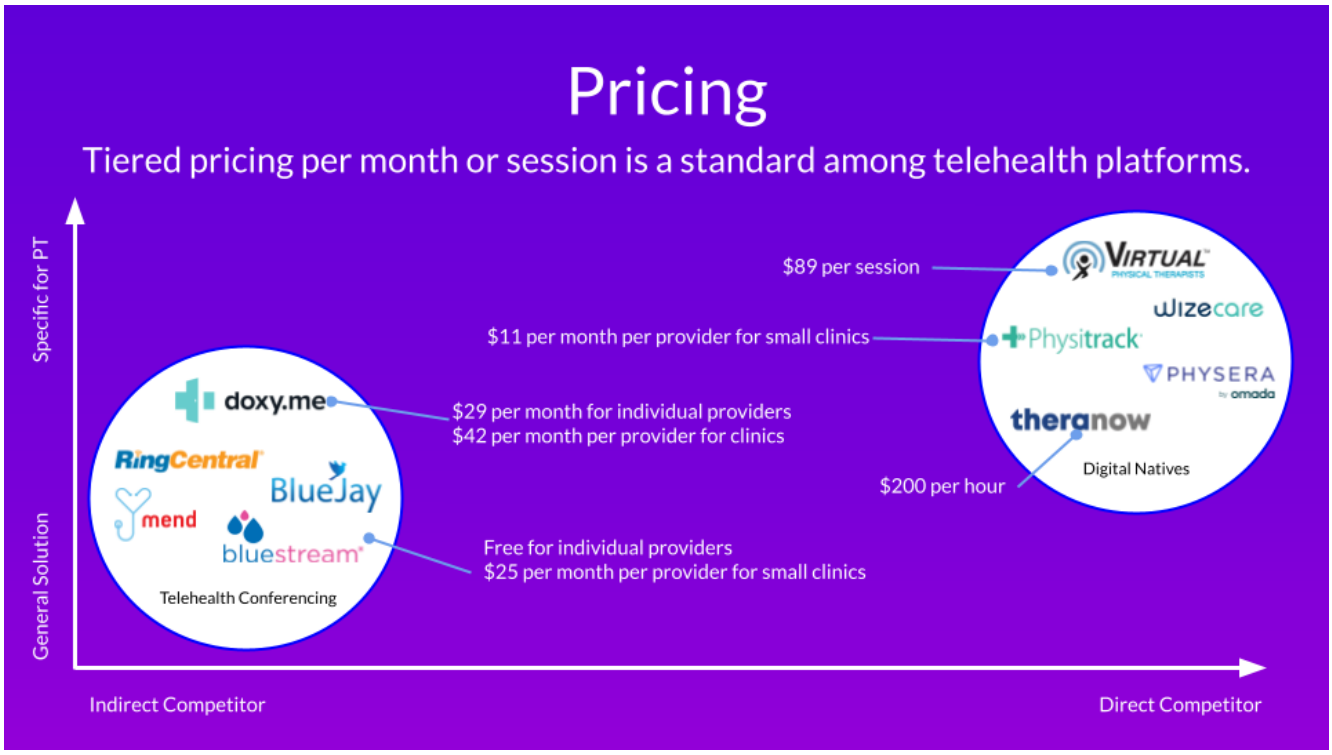
Cost Structure

As a platform, ViPTA's goal is not to hire PTs but to provide technology. Thus, we do not incur the same therapy costs as competitors like ATI Physical Therapy do. ViPTA's fixed costs include domain registration, server costs, marketing and sales, and wages for developers to maintain and upgrade the platform and for IT staff to provide customer service. The variable costs include hardware materials for IoT enabled technology, which will be partially offset by selling or renting out the equipment to clinics.

Revenue Model

Across these players, pricing is fairly standard. Telehealth platforms like Doxy charge per month per provider and scale their price depending on clinic size. Digital natives, though, charge per session, hour, or month. As a platform, we want to reduce friction for patient adoption and solve the demand problem. Thus, ViPTA will have a SaaS B2B revenue model. This model aims to encourage smaller PT networks to adopt our platform so we can enter the market. The platform will offer tier-leveled pricing based on the size of practices. While Virtual Physical Therapists charges $89/session, Bluestream has

tiers ranging from $25/month to $50/month depending on provider size, and Doxy charges $35/month for individual providers and $50/month for clinics. Thus, our revenue model is most similar to Doxy's.



Financial Projections

Based on a conjoint analysis with PTs, patients, and students, we determined our current monthly price should be $35.99 per PT per clinic. Using these numbers, our 5 year Income Statement projections forecast a net income of $41M in year 5 of operations. We are using conservative estimates for ViPTA market share and percent of PT visits which occur virtually.

With regards to the post-pandemic outlook for tele-PT, we believe that our solution will continue to gain traction even after 2021 because the lower cost of Virtual PT appointments compared to in-person makes them a more attractive choice for clients paying out of pocket. According to a study from the Duke Clinical Research Institute to evaluate the costs and benefits of virtual PT, their virtual PT platform was able to save patients over $2700 annually when compared to usual care with traditional physical therapy.