Remote Patient Monitoring:
Reducing Hospital Readmission Rates for Hip and Knee Replacement Surgery

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Abstract

Senior Citizens are being readmitted to hospitals with 30 days for recurring issues from their initial hospital stay and it is costing Health Systems $528 million in penalties from The Centers of Medicare and Medicaid Systems (Boccuti & Casillas, 2018). A segment of those penalties come from Hip and Knee replacements, the goal is to determine if implementing a remote patient monitoring tool will improve the post surgical care through telerehabilitation and reduce or prevent a readmission to the hospital.

Introduction

Remote Patient Monitoring (RPM) solutions have reduced hospital readmissions by 50% with over 80% of the patient satisfied with the telehealth solution (PR Newswire, 2019). RPM reduces costs for health systems and coupled with insurance reimbursements, there is the potential for a net profit on patient’s joint replacements. Seniors, defined for this project as 65 years of age and older, are having joint replacement surgery at a higher percentage than any other age group in the United States (Mayo Clinic, 2019). Total Knee and Hip Replacements, also known as Total Knee/Hip Arthroplasty (TKA/THA) or Joint replacement provides patients with improved health benefits. These benefits include improved quality of life with pain free joints and the ability to return to a typical healthy lifestyle. Despite documented benefits, many Total Joint Replacement (TJR) patients find it difficult to access rehabilitation following discharge from hospital (Nelson, Crossley, Bourke & Russell, 2017). Remote Patient Monitoring
is a solution we can deploy to serve the market of seniors in need of rehabilitation following joint replacement surgery.

The RPM solution will meet the need of patients who have found it difficult to get access to rehabilitation, but the additional benefits of RPM can supplement the patients in between rehab visits. There will be better real-time metrics and feedback to the patient on how well they are progressing, this is not possible with the traditional methods even house calls. The RPM solution discussed in this proposal will be built using cloud computing technologies that allow for speed to market, scalability, and a consumption based model that charges a client for what services they use.

**The Patient, The Hospital and The Insurer**

Jaxon is a 65-year old retiree living at home with his wife Freda and their Yorkshire Terrier, Blade. Jaxon and Freda retired to Florida and live in a gated community on a golf course where they play a full round on Saturday mornings. Jaxon walks to his favorite breakfast restaurant, The Broken Egg on Mondays and Thursdays to talk shop with his friend over coffee and eggs. Jaxon has been having pain in his knees and has been told he needs a Total Knee Arthroplasty (TKA) on his left knee and shortly after a Total Hip Arthroplasty (THA).

Jaxon will have his knee and hip replaced at his local hospital, a leader in THA/TKA. Jaxon has insurance through Medicare now that he is retired, they have approved him for surgeries and he is anxiously awaiting the replacements to get him back to playing golf with his
beloved, Freda. The Hospital’s goal is to perform the THA/TKA within the budget of the value based payments Medicare has guaranteed for this medical operation and optimal patient outcomes. The health insurer wants to pay for a surgery with incentives for value patient care and reducing postoperative issues that have a patient admitted due to complications from the initial surgery.

While Jaxon is a fictional character in this proposal, his description is what hospitals see when an elderly patient comes in to the hospital for joint replacement (THA or TKA) surgery.

**The Compelling Event**

Universal Healthcare has been a national topic since 1993, when President Bill Clinton appointed First Lady Hillary Clinton to head a committee to prepare legislation for overhauling the nation’s healthcare system (Friedman, 1993). Over the next 17 years the prospect of universal healthcare, healthcare for children (CHIP) were small steps in the quest to build a healthcare system that could support and sustain itself.

In 2010, The Affordable Care Act (ACA) was passed and signed into law. This act is known as the “health reform act”, in which the intricacies of how health care is provided to millions of Americans are covered. Once it was passed, this Act was enacted in two folds; the Patient Protection and Affordable Care Act on March 23, 2010, and the Healthcare and Education Reconciliation Act amended this on March 30th, 2010. This law’s objective was to
support health care coverage, associated costs, and preventative care. In the ACA was section 3025, that required the establishment of the Hospital Readmissions Reduction Program (“Hospital Readmission Reduction Program”, 2019).

**Problem Understanding**

Senior citizens recovering from Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) are susceptible to a hospital readmission within the four weeks after surgery. The senior’s preoperative health status plays a major role in the chances of complications from joint replacement. Using the Postoperative Respiratory Failure (PRF) Risk Calculator, it shows seniors with hypertension and diabetes have a 18% higher chance of respiratory complications from hip replacement surgery (Surgical Risk Calculator, 2019). Postoperative fatalities may be reduced by 1.1% when using enhanced recovery methods (Savaridas, 2014). This study had 4,500 participants and 1.1% of 4,500 equals 49 additional lives saved. While 1% seems small, it looms very large for the families of loved ones saved. The readmission of patients within 30 days of their initial hospital release results in financial penalties for the hospital (“Hospital Readmission Reduction Program,” 2019). Remote Patient Monitoring (RPM) is a form of telehealth that could reduce the rate of readmission or fatalities related to these two surgeries within 30 days. What if RPM could incorporate an enhanced recovery program that health professionals, family members and patients could view, monitor and validate the recovery process? The issue of postoperative complications and deaths can be greatly reduced by having resolutions for the challenges causing complications. This reduction also decreases the penalties a hospital will pay for readmission. How did this become a problem?
In 2009, Center for Medicare and Medicare Services (CMS) started using excess readmission ratios (ERR) to measure performance for each of the six conditions/procedures in the program (“Hospital Readmission Reduction Program,” 2019):

- Acute Myocardial Infarction (AMI)
- Chronic Obstructive Pulmonary Disease (COPD)
- Heart Failure (HF)
- Pneumonia
- Coronary Artery Bypass Graft (CABG) Surgery
- Elective Primary Total Hip Arthroplasty and/or Total Knee Arthroplasty (THA/TKA)

Our research provides a detailed synopsis of this law and its impact on Elective THA and TKA. Also, how RPM will assist in reducing readmissions post surgery.

Research

The Center for Medicare and Medicaid Services (CMS) provides annual reports on readmission penalties for public viewing. CMS looked at readmission data from July 2014 through June 2017. The penalties went into effect October 2018 and continue through September 2019. This year, 3,173 hospitals were evaluated and 2,599 (82%) were penalized (Allen, 2018).
Under the Patient Protection and Affordable Care Act of 2009, CMS began instituting reimbursement penalties for 30-day readmissions after hospitalizations for heart failure, acute myocardial infarction, and pneumonia. In August of 2013, the CMS announced the expansion of this policy to include patients admitted for elective THA and TKA for fiscal year 2015. Furthermore, because private insurers often emulate Medicare’s payment methods, most expect many insurers to follow suit (Clement, Kheir, Derman, Flynn, Speck, Levin & Fleisher, 2014).

These reports show how hospitals perform against the regulations set forth in the Hospital Readmission Reduction Program (HRRP). Our focus will be on the penalties for THA/TKA. Research has shown significant improvements using enhanced recovery for THA/TKA patients, however costs control still challenges optimal recovery outcomes. The median profit and contribution margins, respectively, were as follows, based on a 2014 study: TKA episode, USD $5209 and USD $11,726; 30-day readmission, USD 608 and USD 3814; TKA visit with readmission, USD $2855 and USD $13,901; TKA visit without readmission, USD $5300 and USD $11,652 (Clement, Kheir, Derman, Flynn, Speck, Levin & Fleisher, 2014).

Enhanced Recovery starts with the admission of the patient into the recovery program the same day of the surgery (Savaridas, 2014). Patients are encouraged to walk as soon as possible, urine catheters are avoided, and local anesthetic is given with the encouragement of mobility (Savaridas, 2014). Anesthetic medication requires a patient to remain in an institutionalized center under a physician's care, but is there a way to deliver similar reductions in postoperative setbacks without the need for admission into a rehabilitation clinic or skilled nursing facility (SNF)? RPM has data that states the answer is yes.
Data Analysis

A 2014 report identified that up to 50% of all the readmissions are potentially preventable and cost Medicare $17.4 billion annually (Mittal, Wang, Goben & Boyd, 2018). Defining risk factors for hospital readmission following elective total (THA) and (TKA) has received increased attention in peer reviewed orthopedic surgery literature over the past 5 years. The Patient Protection and Affordable Care Act (ACA) has legislated penalties up to 3% of annual payments from the Centers for Medicare and Medicaid Services (CMS) to hospitals whose 30-day readmission rates exceed expected levels after accounting for documented patient medical comorbidities (Cite). The 30-day all cause readmission rate for primary TKA decreased by 46% between the Group A and B time intervals; In contrast, 30-day readmission rates following primary THA did not decrease (Keeny, Nam, Johnson, Nunley & Clohisy, 2015). The THA post surgical recovery may require more mobilization content to properly flex the hip, but with technology that can also provide real-time data, we believe the resolution is a data analysis session or sessions away from delivering a decrease in admission rates.

Technical Approach

Technically, Jaxon will need a medical professional to help keep him active during the immediate weeks after surgery. Enhanced care for Jaxon allows him to rehabilitate at home and have a medical professional visit him twice per week. The five days in between those twice
weekly visits are asking Jaxon to follow a regiment of mobilizing the knee and hip. Our proposal is using technology to validate how effective are the rehabilitation sessions without the medical professional. The hope is we can provide a solution to bridge the gap between the visits with tangible data to aid Jaxon’s recovery today but data to holistically track what methods are working for patients using the remote content provided. TKA and THA are much different than the other five conditions under the HRPP, but data on the other five conditions provide an optimistic blueprint for build this new possibility. The University of Penn Health Systems Home Care Division (Penn Care at Home) showed a 73% reduction in 30-day readmissions using telehealth (O’Connor, Asdornwised, Dempsey, Huffenberger, Jost, Flynn & Norris, 2016).

**Solution Development**

Technology adoption in healthcare has traditionally been slower than the corporate sector. Emerging technologies like 3rd party hosted cloud computing (cloud) or On-premise managed solutions like private cloud provide the promise of scalability, elasticity and acceleration. Cloud Computing or computing in which information, services, and resources are provided as needed over a network (the "cloud") are an attractive network infrastructure alternative due to lower costs and speed to market (Kabachinski, 2011). Building network infrastructure to support this solution would be costly and timely, additionally trying to predict the peaks and valleys of usage could risk network performance or outages. The proposed solution should be born and managed with cloud computing technologies. The ability to spin up
and run quickly will prove to be a vital requirement, alternatively if the solution does not meet standards it can be shut down with consumption being the only lost costs incurred. Reduced infrastructure and capital equipment costs, institutions may find additional budgets in the cost savings to afford electronic health record (EHR) systems or apply more of the budget to staff or other operational expenditure needs (Kabachinski, 2011).

Remote Technology through cloud solutions has seen growth in the last 10 years in the wake of ACA provisions incentivizing health systems to reduce costs but improve patient outcomes. The four most important goals of a health system is to increase positive patient outcomes, reduce costs and minimize risk. Technology that can monitor a patient outside of the four walls of a hospital reduce risks of infection, reduce the cost of care as the patient will not require a bed in the hospital and technology provides a real-time reading of patient vitals with the ability to interact via visual chat. Cloud Computing also allows multiple pieces of this solution to be “threaded” together or integrated with minimal impact to the health system’s existing infrastructure. The proposed solution for supporting THA/TKA is new, but telehealth/remote patient monitoring is an existing solution that has proven to deliver significant reductions in hospital readmissions.

Solution is existing, but its use is for other ailments such as COPD, Heart Failure and Pneumonia. The proof that patients can be monitored remotely has been proven with telehealth. Health Recovery Solutions used tablets to reduce cardiac readmissions by 71% (Kutzleb & Shea,
2014). The challenge will be to duplicate those reductions in patients recovering from surgeries on joints that require more movement to increase outcomes. Our solution is developed with the idea that technology will be an unbiased judge of how well the rehabilitation is going, collect data to help improve future patient outcomes and assist an already overwhelmed home healthcare worker shortage. According to a report by PHI, the Bureau of Labor Statistics found that there will be 7.8 million direct care job openings between 2016 and 2026 (Campbell, 2019). The RPM disease-specific engagement kits are customized with educational video, care plans, medication reminders while integrated with mobile peripherals to engage patients (H.R. Solutions, n.d.). The content will provide the necessary physical therapy content and measure the performance of the patients. RPM's software allows for the management of high-risk patients and provides seamless communication with health professionals through video chat, wound imaging and text messaging. For family members and caregivers, the software is accessible to give them the ability to be fully involved in their family member's care and well-being (H.R. Solutions, n.d.). This technology could be an unbiased advocate for the THA/TKA patient.

The RPM Bundle Consolidates Vendors, Platforms and Points of Contact for:

- Equipment, including Tablets, Phones and Wearables
- Cross-Platform Wireless Data Plans
• Mobile Device Management
• Procurement & Financing
• Project Management
• Level 1 & Level 2 Support
• Kitting & Deployment based on Health System/Patient needs
• Rehabilitation Content and Resistance Bands

Business Case and Analysis of Alternatives

Alternatives are different from the traditional or the standard operating procedures. Historically knee and hip replacements required hospitalization, typically one to three days. A hospital stay allows the patient access to medical professionals, and in return the medical staff will be able to closely monitor the progress of patient health. A hospital stay also carries risks of infections. One of the most common hospital infections is Clostridium difficile (CDF). CDF is an infection that exists in both a bacterial and spore form (Appolid, 2011). This infection is the most common hospital acquired infection across the United States; the spectrum of the infection runs the gamut from asymptomatic colonization to death in three days (Appolid, 2011). Hospitals have been trending to shorten patient hospital stays to reduce exposure to infections like CDF. Knee surgeries have been treated as outpatient surgeries in recent years. The positive outcomes from enhanced care that promotes joint mobility as soon as possible has allowed hospitals to avoid an overnight stay for knee replacements. Surgery, followed by a recovery room stay for a few hours is concluded with discharge and rehabilitation instructions.
Postoperative rehabilitation options for many years had been focused on hospital stays and follow-up care in ambulatory care facilities such as clinics and physician’s practice follow-up visits. The move from fee-based care to value care has challenged the traditional rehabilitation methods, and has forced patients, hospitals and health insurers to evaluate alternative ways to deliver the positive postoperative outcomes. 65-year old male, Mark Mayberry had TKA surgery on both knees in 2018. He mentioned there was a health professional (physical therapist) that visited him twice per week and a nurse who came to check his vital twice over three weeks. The nurse also removed his stitches in week 3; the physical therapist left him with instructions on exercises to do daily in between visits. Mark mentioned, he was not sure if he was doing the exercises correctly but he did his best. In some cases our “best” delays the healing process if exercises are done incorrectly and cause injuries. RPM solutions will provide results of how well therapy is going and inform the patient if they are correctly following the instructions. Providers are using off-the-shelf solutions like Microsoft Kinect to blend rehabilitation content into their RPM content. Patients can follow the avatar such as Reflexion Health’s photo below (Reflexion Health, 2019):
Brick and mortar rehabilitation clinics stand to be the biggest risk and threat. The current practice of clinic-based TKA rehabilitation appointments is demanding on both the resources of the health provider and on outpatients’ time and their short-term quality of life. This is exasperated by the temporary handicap on patients’ mobility following TKA, including their inability to drive for at least the first six weeks post operation (Msayib, Gaydecki, Callaghan, Dale, & Ismail, 2017). There is the risk of a senior adapting to a new technology. A Reflexion Health study found that the technology for telerehabilitation was simple. In the research Ellen Highkin is quoted as stating “If you can turn on a TV, you can use VERA (Virtual Exercise Rehabilitation Assistant), it’s that simple (Reflexion Health, 2019). Another common risk is the battery life of the device. The mobile devices are built with only the necessary applications for RPM to try and
insure there are no other applications that will drain the battery, additionally it is encouraged to keep the device plugged in, only unplug if use in areas not near an electrical outlet. Bandwidth connectivity is another risk, as the RPM solution being proposed is a bundled solution to make it turnkey for the patient and will rely on Long Term Evolution (LTE) connectivity. Different mobility providers will have stronger signals in certain areas. How many of us know the “dead zones” in our commute to work, in our offices and at home? Combating the bandwidth and connectivity challenge is a growing technology called Internet of Things Single SIM (IoT Single SIM). IoT Single SIM, which automatically finds and connects the mobile device to the strongest signal is a solution we will explore to eliminate or greatly reduce this risk. One SIM connects over 100 mobile providers globally through their mobile network and pools all the providers’ minutes to deliver one consolidated pool to the health system (Mettel, 2019). This solution reduces complexity, carriers and billing.

**Ethical Considerations**

Visual technology integrated into patient care opens up questions surrounding ethical considerations. First, access to a patient’s personal health information needs be considered and protected. Secondarily, who will have authorized access to patient protected data? Protected Health Information or is individually identifiable information relating to the health status of an individual that is created, collected, or transmitted, or maintained by a HIPAA-covered entity (HIPAA, 2019). Third, what safeguards are in place to protect patient data? Telehealth solutions
are increasing in popularity to serve rural populations, aging populations and remote monitoring of patients. Highly regulated sectors such as finance and healthcare have some of the costliest data breaches; they generally incur large fines and much higher financial losses due to loss of customers and business opportunities (Zeadally, Isaac & Baig, 2016). In 2018, AccuDoc, UnityPoint Health and CNO Financial Group had data breaches that exposed over 4 million records (Davis, 2019). Protecting data in this new cyber world requires multiple levels of security. Cloud Access Security Broker (CASB) is a security software that sits between a customer premise and infrastructure and a cloud provider’s infrastructure. CASB becomes the gatekeeper to ensure the security protocols set within a customer’s four walls will extend out to the cloud provider, such as the RPM solution we are proposing. CASB protects the “inside-out” data, such as monitoring user behavioral patterns. CASB also protects “outside-in” data or protecting against threats coming from outside the organization in like viruses, hackers and direct denial of service (DDoS). CASB can extend into multi-level authentication security tools to ensure a user is who they state they are. CASB could also be included in the RPM bundle by leveraging partnerships with Managed Security Providers. Masergy, a leading security as a service provider states that cybersecurity is about more than prevention, detection and response is mandatory (Denton, 2018). Masergy and other partners offer a managed solution that covers all levels of cybersecurity including a managed CASB.

It is widely recognized that the future of healthcare services will depend heavily on e-health systems and technologies. In fact, many health professionals have argued that for healthcare to be affordable and sustainable, we need to deploy e-health systems to make patient workflows more efficient and reduce the high administrative/management costs often associated
with paper-based care (Zeadally, Isaac & Baig, 2016). As healthcare organizations move away from paper to digital services using like RPM security will be an even bigger priority than it was before.

Access to a patient’s personal health records can have a big impact on the patient beyond healthcare. Medical information can be worth ten times more than credit card numbers on the deep web. Hackers will sell stolen data and fraudsters can use this data to create fake IDs to buy medical equipment or drugs, or combine a patient number with a false provider number and file fictional claims with insurers (Sulleyman, 2017). Limiting authorized access to patient records will also keep the circle of users small, which can make the audit trail smaller and attainable if a breach occurs. HITRUST was founded in 2007 to be a safeguard for sensitive information and provide best practices for building secure information highways (HITRUST, 2019). Building a HITRUST infrastructure will provide Common Security Frameworks that are used to protect personal health and financial data. HITRUST established a security framework to guide organizations that create, access, store, or exchange personal health and financial information on the best way to ensure security (HITRUST, 2019). This process should always be implemented in any telehealth or remote patient monitoring solution along with a CASB solution to protect all levels of security in a healthcare organization.
Financial Analysis

There are upfront investments required to deliver this solution. Cost reductions and reimbursements will provide incentives to launch as soon as possible. CMS has provided Current Procedural Terminology (CPT) codes that they will reimburse to healthcare providers for patient care. Leveraging existing CPT codes allows for the opportunity to build a financial model that would include the bundled technology needed to deliver a seamless experience for all parties. The patient, health insurer, health system and patient’s loved ones will have access to their view of the overarching platform.

How will billing the billing and reimbursement work financially? Below are estimated numbers proposed by one of the leading Remote Patient Monitoring firms focused in Long Term Care. Historically, CMS has funded 100% of the CPT Codes in this example:

<table>
<thead>
<tr>
<th>RPM Reducing Readmissions</th>
<th>Equipment</th>
<th>Quantity</th>
<th>Mthly Cost</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpEx</td>
<td>Pulse Oximeter</td>
<td>100</td>
<td>$300.00</td>
<td>$3,600.00</td>
<td>$3,600.00</td>
<td>$3,000.00</td>
</tr>
<tr>
<td></td>
<td>Ktting</td>
<td>100</td>
<td>$300.00</td>
<td>$3,600.00</td>
<td>$3,600.00</td>
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<tr>
<td></td>
<td>BP Monitor</td>
<td>100</td>
<td>$500.00</td>
<td>$6,000.00</td>
<td>$6,000.00</td>
<td>$4,500.00</td>
</tr>
<tr>
<td></td>
<td>VERA Tablet</td>
<td>100</td>
<td>$1,700.00</td>
<td>$20,400.00</td>
<td>$20,400.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>Total Recurring Costs</td>
<td></td>
<td></td>
<td></td>
<td>$2,800.00</td>
<td>$33,600.00</td>
<td>$33,600.00</td>
</tr>
<tr>
<td>CMS Reimbursement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Reimbursement Cost</td>
<td>100</td>
<td></td>
<td>$12,475.00</td>
<td>$149,700.00</td>
<td>$149,700.00</td>
<td>$149,700.00</td>
</tr>
<tr>
<td>Annual Net Revenue</td>
<td></td>
<td></td>
<td></td>
<td>$116,100.00</td>
<td>$116,100.00</td>
<td>$142,200.00</td>
</tr>
</tbody>
</table>
This chart is based on a three year forward looking financial analysis using 100 Units to support up to 100 patients on a monthly basis. The initial amortization schedule follows the typical mobility supplemental service plan of 24 months. After the initial term the hardware is now an asset of the organization, thus eliminating that monthly cost. There is an option to warranty the devices, but after two years it is recommended the healthcare provider run with the devices until they are no longer serviceable. A team member in our organization still has his iPhone 2 from 2009; he wants to be the last iPhone 2 user! If the hardware is cared for, RPM content is streamed over the internet which allows the content to remain current, fresh and compliant. We anticipate the reduction in purchases of Pulse Oximeter and BP Monitors after the first two years. The need for these devices will not meet the same level as in years’ past because these device can be sanitized and reused.

The billing platform will be connected back to the RPM provider to validate and correlate the CPT codes and their subsequent reimbursement funds from CMS.

**CPT Codes and Reimbursement Billing:**

Initial Setup and Training = $21.00

20 minutes per month = $54.00

Monthly medical device equipment = $49.75

Total Reimbursement = $124.75; Net Revenue Per Patient = $99.75
Business Case and Financial Impact of RPM

According to Mayo Clinic there are about 1,000,000 hip and knee replacements performed annually across the United States (Mayo Clinic, 2019). Net revenue per patient is $817 according to Vital Tech when adding in Value Care credits (VitalTech, 2019). $817 multiplied by the number of hip and knee replacements offer $817,000,000 in potential revenue for health systems using RPM. That is revenue in this telehealth solution directly, but RPM can also supplement the home health caretaker shortage in the United States. The outlook for leveraging telemedicine to reduce the costs of patient care is evident in the CMS announcements within the last twelve months of new CPT codes enabling Remote Patient Care (CMS, 2019):
**CPT code 99453:** Remote monitoring of physiologic parameter(s) (e.g., weight, blood pressure, pulse oximetry, respiratory flow rate), initial; set-up and patient education on use of equipment. The proposed Medicare payment for these services is $21.

**CPT code 99454:** Remote monitoring of physiologic parameter(s) (e.g., weight, blood pressure, pulse oximetry, respiratory flow rate), initial; device(s) supply with daily recording(s) or programmed alert(s) transmission, each 30 days. The proposed Medicare payment for these services is $49.75.

**CPT code 99457:** Remote physiologic monitoring treatment management services, 20 minutes or more of clinical staff/physician/other qualified healthcare professional time in a calendar month requiring interactive communication with the patient/caregiver during the month. The proposed Medicare payment for these services is $54.

CMS stated in this new ruling that it plans to issue further guidance to help practitioners and stakeholders determine the scope of service and better interpret the code and descriptions listed above. Specifically, we can expect guidance on the types of technology that can be used to provide these new RPM services, whether the descriptor for CPT Code 99454 includes transmissions that occur other than daily, and whether CPT Code 99453 can be furnished via telecommunication technology (O’Connor, 2018). Succinctly, stated RPM is a disruptive technology that needs further guidance on how deep it will be integrated into these new codes. If history is any indicator, RPM will be more prevalent in future patient care. The Centers for Medicare & Medicaid Services (CMS) announced in July 2018, a proposed rule to allow home
health agencies to be reimbursed for RPM. This was the first time in the 50+ year history of Medicare would recognize RPM for reimbursement. "We are proposing to modernize Medicare to promote innovation and improve home health by increasing access to remote patient monitoring," said CMS Administrator Seema Verma during a call announcing the rule. "This will allow patients to share more live-time data with their providers and caregivers, which will lead to more tailored care and increased positive health outcomes (Slabodkin, 2018)." This has also had analysts bullish on home healthcare.

“We expect the home healthcare market to grow rapidly and compose a greater share of overall healthcare utilization in the coming years, and we really think home health is an area that providers should invest in now,” research analyst Nicky Lineaweaver told Home Health Care News (Bryant, 2019). The impact home health has on the healthcare industry goes beyond cost reduction and reducing readmissions; it is redefining the go to market strategy for health systems. IBISWorld labels Home Care a growth industry over the next five years with a reported 99.4 billion in revenue annually. Two key drivers for this growth are Federal funding for Medicare/Medicaid and the number of adults in the United States age 65 or older. Home health spending is projected to reach $173 billion by 2026 (Bryant, 2019). As such, a growing number of healthcare providers want to monetize on this trend. To make this happen healthcare providers are aligning partnerships with home care providers to enter the marketplace (Bryant, 2019). The convergence of the CMS funding RPM with updated CPT codes, aging population electing to have joint replacement surgery, the growth of cloud computing technology in healthcare to
support decreasing patient care margins and the dense growth of mobile data technology allow Remote Patient Monitoring to be the technology for postsurgical joint replacement patients.

**Recommendation and Project Timeline**

The recommendation to use RPM for telerehabilitation is based on sound research, market validation and the opportunity for cost savings. RPM content is customizable to the six diseases CMS has incentivized the healthcare industry to improve patient outcomes. The RPM disease-specific engagement kits are customized with educational video, care plans, medication reminders while integrated with mobile peripherals to engage patients. RPM's software allows for the management of high-risk patients and provides seamless communication with them through video chat, wound imaging and text messaging. For family members and caregivers, the software is accessible to give them the ability to be fully involved in their family member's care and well-being (H.R. Solutions, n.d.).

Roadmap to the January 2020 Product Launch. The Proof of Concept should take about 90 days and will be matched to the health system’s purpose built success criteria. Sample milestone schedule below and will be ready to launch on 07/01/2019.
Milestones and Target Dates:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/1/2019</td>
<td>Proof of Concept Launched</td>
</tr>
<tr>
<td>10/1/2019</td>
<td>Proof of Concept Complete</td>
</tr>
<tr>
<td>10/31/2019</td>
<td>Budget Approved for RPM</td>
</tr>
<tr>
<td>11/1/2019</td>
<td>RFP Launched</td>
</tr>
<tr>
<td>11/22/2019</td>
<td>Down Selection/Notification of Presentation Dates</td>
</tr>
<tr>
<td>12/3/2019</td>
<td>RFP Finalists Presentations</td>
</tr>
<tr>
<td>12/10/2019</td>
<td>RPM Vendor Selected</td>
</tr>
<tr>
<td>12/10/2019</td>
<td>Contracts Requested</td>
</tr>
<tr>
<td>1/10/2020</td>
<td>Contracts Signed</td>
</tr>
<tr>
<td>1/24/2020</td>
<td>RPM Production Launch</td>
</tr>
</tbody>
</table>

The Process and The Path to Production

Implementing Remote Patient Monitoring requires time and patience, while the speed to market is fast there are requirements that need to be met to ensure a successful launch. Telerehabilitation is a bleeding edge technology, but we can use the experience of similar RPM deployments to provide some background and success criteria. The most important initial step is ensuring the solution has an executive sponsor and a mission statement, this project needs someone within the organization that understands and supports the mission of this project. Every project implemented should have its own mission statement; the statement clearly identifies the goals so that all team members understand the greater priority. Everyone must do their job to have collective project success.
Bill Belichick, Head Coach of the New England Patriots has won more Super Bowls (The National Football League Championship) than any other coach in the modern era. His leadership style is based on challenging each individual team member to be prepared with a game plan each week. Belichick's famous saying “Do Your Job” is used to refocus his team on their task (Rodic, 2017). It means complete your assignments, execute to the best of your ability and trust that your teammates will do the same (Rodic, 2017). In a complex project like RPM, that is the only way a team can be successful, that is the only way a complex project can be successful.

The team should have representatives from all business units or departments, especially those who may oppose this technology implementation. Building a team of opposing ideas allows for collaboration, understanding and compromise. Each of these will be vital to success. In this research it has been discussed why a technology like RPM is successful at reducing patient readmissions, but it must be stated that the success of technologies like RPM are rooted in learning from failures. Telehealth today benefits from mobile bandwidth like 4G/5G wireless which makes it easy to ship equipment to a patient’s home and have optimal performance. 15 years ago, the mobile industry was using RIM Blackberry phones using 3rd generation bandwidth that seem archaic today. There is a trough of failures through the years that have prepared RPM to support the reduction of hospital readmissions. RPM technology is a disruptive technology to an industry that is very slow to move to the bleeding edge.

Health Systems can rely on bundled solution providers who will inventory the necessary hardware and keep the software up to date. Integration with a health system’s Electronic Health
Records (EHR) is a critical step in connecting business flow. This integration also reduces if not eliminates the need for additional training. A health professional will continue to work as they always have, while the RPM tool will pick up the indicators needed to do its job. A THA/TKA patient is released from the hospital, the package and kitting should arrive via overnight mail with simple instructions for the patient to activate service. Once the device is powered on and the patient is authenticated, the mobile signal will push the necessary information down to the device. In under five minutes, the content and avatar are ready to partner with the patient on their road to recovery. When the patient is done with the RPM hardware and software, there is a return shipment form that sends the equipment back to be sanitized, wiped and reset for the next patient.

**Conclusion**

This proposal discusses market trends, risks, threats and financial business cases that build a compelling reason to implement RPM. Another transaction of value worth noting is the evergreen philosophy RPM brings to a healthcare client. The adoption and adaption of technology in healthcare will only grow, similar to growth patterns of cloud in corporate industries. A bundled solution with guardrails to secure critical and sensitive data; additionally there is low risk on the launch of this solution with consumption based modeling to only pay for what is consumed. If this solution is not what was promised, the only financial risk to the healthcare organization are the resources consumed. This makes the best financial case for cloud
computing versus buying on premise equipment. The foundation for a solution like this has been laid for RPM, with the other five chronic diseases defined by CMS receiving reimbursement.

THA/TKA can follow suit and regulations, along with new CPT codes state he Centers for Medicare & Medicaid Services believe this to be case as well. RPM does not solve every problem, but it is an automated advocate for the most vulnerable population in our country; senior citizens who elect to have their joints replaced so they can walk to their favorite restaurant or down their favorite golf course.
References


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doi:10.1016/j.apmr.2015.12.021


Shared PowerPoint with Numbers

Follow up Interview with VitalTech [Telephone interview]. (2019, April 2).


doi:10.1371/journal.pone.0204272


What is Considered Protected Health Information Under HIPAA? (2019, March 07). Retrieved April 20, 2019, from
https://www.hipaajournal.com/what-is-considered-protected-health-information-under-hipaa/


doi:10.1007/s10916-016-0597-z
Appendix A

How is CPT Code 99457 different from CPT Code 99091 (O’Connor, 2018):

<table>
<thead>
<tr>
<th>CPT Code 99457</th>
<th>CPT Code 99091</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requires 20 minutes of time spent</td>
<td>Requires 30 minutes</td>
</tr>
<tr>
<td>Based on a calendar month</td>
<td>Based on a 30-day period</td>
</tr>
<tr>
<td>Allows for time spent by clinical staff</td>
<td>Limited to Physicians and QHCPS</td>
</tr>
</tbody>
</table>
Appendix B

Telerehabilitation Portal and Supporting Documentation (Reflexion, 2019):
The results are in. Virtual physical therapy with VERA™ for total knee replacements saves time, steps, and money – while improving patient outcomes.

Conducted by Duke Clinical Research Institute, VERITAS is the first large-scale prospective randomized controlled trial comparing virtual versus traditional physical therapy.

### Compared to traditional PT, VERA reduces:

- **Total readmissions by 60%**
- **Total outpatient PT visits by 86%**
- **Total home health visits by 95%**
- **Total urgent care or ER visits by 30%**
- **Total skilled nursing facility stays by 60%**

### Outcomes

**Traditional PT**
- 10.1 outpatient PT visits
- 4.8 home health visits

**VERA**
- 1.4 outpatient PT visits
- 0.3 home health visits

### Patient Demographics

- **306** patients
- **41-86** years old
- **65** average age
- **63%** female

- **19-61** range of BMI
- **31.8** average BMI
- **40%** private insurance
- **50%** Medicare

Bettger, Janet Prvu et al. VERITAS: Effect of Virtual Exercise Rehabilitation In-home Physical Therapy versus Traditional Care for Total Knee Arthroplasty. Poster presented at ACRM Annual Conference; 2018 Sept 30-Oct 3; Dallas TX.
Using motion-capture technology, VERA precisely measures 26 joints and limb motion – 30 times per second.

**Preferred.**

“If you can turn on a TV, you can use VERA. It’s that simple.”

Ellen Highkin
Knee Replacement Patient

“Patients appreciate not having to come in as often. They get the benefit of doing the exercises at home along with the oversight of a licensed physical therapist.”

Joe Martucci, Physical Therapist
Yale New Haven Health Center for Musculoskeletal Care

“Patient satisfaction is off the charts. People recover just as well – or even better – with VERA than with standard physical therapy.”

Frank Aluisio, MD
Greensboro Orthopaedics

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**Proven.**

<table>
<thead>
<tr>
<th></th>
<th>TRADITIONAL PT Mean (SD)</th>
<th>VERA Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6 weeks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee Flexion ROM</td>
<td>111.4° (16.0°)</td>
<td>114.5° (15.3°)</td>
</tr>
<tr>
<td>Knee Extension ROM 6 weeks</td>
<td>2.9° (3.4°)</td>
<td>2.5° (3.6°)</td>
</tr>
<tr>
<td><strong>12 weeks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>3.0 (2.6)</td>
<td>2.7 (2.0)</td>
</tr>
<tr>
<td>KOOS Overall</td>
<td>67.2 (14.3)</td>
<td>69.6 (12.1)</td>
</tr>
<tr>
<td>KOOS Pain</td>
<td>76.7 (17.5)</td>
<td>78.4 (14.0)</td>
</tr>
<tr>
<td>KOOS Symptom</td>
<td>53.9 (11.1)</td>
<td>54.9 (12.2)</td>
</tr>
<tr>
<td>KOOS Function/Daily Living</td>
<td>80.9 (17.7)</td>
<td>82.7 (13.6)</td>
</tr>
<tr>
<td>KOOS Sports/Recreation</td>
<td>61.5 (28.3)</td>
<td>75.6 (19.2)</td>
</tr>
<tr>
<td>KOOS QoL</td>
<td>58.3 (20.0)</td>
<td>61.8 (18.8)</td>
</tr>
<tr>
<td>KOOS JR</td>
<td>72.9 (13.0)</td>
<td>74.3 (12.2)</td>
</tr>
<tr>
<td>PROMIS Survey – Physical</td>
<td>14.8 (2.8)</td>
<td>15.3 (2.4)</td>
</tr>
<tr>
<td>PROMIS Survey – Mental</td>
<td>16.1 (3.2)</td>
<td>16.6 (2.5)</td>
</tr>
<tr>
<td>Survey – Satis w/Physical Fxn</td>
<td>4.9 (1.2)</td>
<td>4.9 (1.3)</td>
</tr>
<tr>
<td>Average Outpatient Visits</td>
<td>10.1 (8.1)</td>
<td>1.4 (4.4)</td>
</tr>
<tr>
<td>Average Home Health Visits</td>
<td>4.8 (6.3)</td>
<td>0.3 (1.6)</td>
</tr>
<tr>
<td>Total Outpatient Visits</td>
<td>1450</td>
<td>199</td>
</tr>
<tr>
<td>Total Home Health Visits</td>
<td>686</td>
<td>36</td>
</tr>
<tr>
<td>Total MD Office Visits</td>
<td>398</td>
<td>379</td>
</tr>
<tr>
<td>Total Urgent Care/ER Visits</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>Avg. Days Patients Reported Doing PT per Week</td>
<td>3.3 (2.0)</td>
<td>5.9 (1.7)</td>
</tr>
</tbody>
</table>

VERA saves $2,745 per patient

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* Bettger, Janet Prvu et al. VERITAS: Effect of Virtual Exercise Rehabilitation In-home Physical Therapy versus Traditional Care for Total Knee Arthroplasty. Poster presented at ACRM Annual Conference; 2018 Sept 30-Oct 3; Dallas TX.

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VERA saves $2,745 per patient

The proof is in the data

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* MM30027