SOA Research Institute
SOCIETAL PURPOSE

Health Care Cost Trends

Actuarial Innovation and Technology

# Closing the Analytical Loop: Technology Assessments and Actuarial Methods

## Digital Diabetes Management Solutions, V1.1 and Virtual Musculoskeletal Solutions, V1.0

JANUARY | 2025

# Closing the Analytical Loop: Technology Assessments and Actuarial Methods

Digital Diabetes Management Solutions, V1.1 and Virtual Musculoskeletal Solutions, V1.0

**AUTHORS**

Gregory Warren, FSA, FCA, MAAA
Partner and Consulting Actuary
Axene Health Partners, LLC

Joan C. Barrett, FSA, MAAA
Principal
Axene Health Partners, LLC

Tony Pistilli, FSA, MAAA, CERA, CPC
Consulting Actuary
Wakely

Nathan Stokes ASA, MAAA
Consulting Actuary
Axene Health Partners, LLC

**SPONSORS**

Health Care Cost Trends Strategic Research Program

Peterson Health Technology Institute

# TABLE OF CONTENTS

# Closing the Analytical Loop: Technology Assessments and Actuarial Methods

# Digital Diabetes Management Solutions, V1.1 and Virtual Musculoskeletal Solutions, V1.0

## Section 1: Executive Summary

About two-thirds of all Americans agree that the top health priority is lowering out-of-pocket costs and/or getting more value for their money.[1] One way to address this problem is to use new technologies to reduce the costs associated with chronic diseases such as diabetes and heart disease. After all, Americans with one or more chronic diseases account for 90% of the total health care spend in the United States.[2] The problem is: How do decision-makers, such as payers, providers and consumers, know which technologies truly meet their needs and which do not?

### 1.1 ABOUT THIS RESEARCH

The purpose of this report is to examine, from an actuarial perspective, how well current evaluation techniques serve the needs of key decision-makers, such as payers, providers and consumers, and to provide guidance on how to apply the various techniques during the decision-making process. This evaluation will be based on two assessments prepared by the sponsor of this research, the Peterson Health Technology Institute (PHTI), a nonprofit initiative that provides independent evaluations of innovative digital health technologies to improve health and lower costs. Using evidence-based research, PHTI analyzes the clinical benefits of a new technology and its potential financial impact, as well as the impact on equity, privacy and security.[3]

The two assessments evaluated are "Digital Diabetes Management Solutions, V1.1"[4] and "Virtual Musculoskeletal Solutions, V1.0."[5] Each of the assessments involved an extensive literature review that was compiled in accordance with the ICER-PHTI Assessment Framework for Digital Health Technologies[6], where ICER is the Institute for Clinical and Economic Research. This framework is designed to set evidence standards for health technologies, such as drugs and devices. Similarly, for each of these assessments, the goals included answering four key questions:

- What is the technology?
- Does it work and, if so, for whom?
- Is it worth it?

- What recommendation does the evidence support?

The authors of this report, each of whom is an actuary, evaluated each assessment using a two-step process. The first step is a gap analysis designed to identify gaps in information and methods actuaries might find helpful in performing their duties.

The second step is a case study applying typical actuarial methods to the two technologies with an emphasis on techniques for assessing the impact of technologies over one to three years and incorporating results into actuaries' day-to-day work. For diabetes, the actuarial focus was on measuring the budget impact of adopting a new technology, a well-established process. The analysis also introduced a new concept, "Total Risk Analysis." For the musculoskeletal (MSK) analysis, the actuarial focus was on return on investment (ROI), which included a new analytical technique, the "Value Stack."

Both the gap analyses and the case studies were performed in accordance with the Actuarial Standards of Practice,[7] with an emphasis on identifying risk, mitigating risk and disclosing any remaining risks.

The overall results of both the PHTI and actuarial assessments of the budget impact of virtual diabetes management solutions are directionally similar and of the same order of magnitude. However, actuaries will want to generate more detailed analyses to answer key purchaser questions, which are detailed in the sections below.

### 1.2 DIABETES

Diabetes is a disease characterized by the body's inability to regulate and use glucose, a type of sugar the body uses to generate energy. It is a risk factor for several other diseases, including heart disease. There is seldom a one-time cure for diabetes; instead, the disease must be managed on a day-to-day basis using some combination of behavioral and lifestyle modification, blood glucose monitoring and testing, and prescription drugs, including insulin. Blood glucose monitoring can be done using finger sticks with a blood glucose monitoring device or a continuous glucose monitor (CGM).

In the diabetes assessment, PHTI measured the effectiveness of three types of technology designed to assist a patient in monitoring and managing Type II diabetes: a remote patient monitoring system, which enables a care team to monitor a patient's blood glucose levels between visits, an interactive behavioral and lifestyle modification system (BHM), and nutritional ketosis, also called a ketogenic diet, a strict diet plan. In the PHTI reports, a connected blood glucose monitoring device was used in all three approaches. Although all three technologies were discussed in the assessment, this report focuses on RPM.

The PHTI diabetes assessment addressed all four questions listed above. Specifically, the assessment noted that RPM resulted in clinical improvements for Type 2 diabetics at a cost of $21.3M per year per 1 million members or $1.77 per member per month (PMPM), where a member is defined as an individual enrolled in the specific benefit plan under consideration. Because of the net cost increase, PHTI recommended that RPM not be covered.

From an actuarial perspective, a key question is "Is there enough information available to responsibly measure the risk associated with the information in the assessment?" Enough information was at hand to answer this question affirmatively. The report also provided some examples of bright spots, such as the relatively smaller patient population that is starting insulin for the first time.

This report also summarizes information and methodologies needed for actuaries to incorporate results into their projection of any anticipated increases or decreases in health care claims costs and associated

premium rates that would result from new or revised coverage of these virtual diabetes care solutions. In considering the budget impact of a new technology, a decision-maker basically has three questions:

- What is the expected impact in the next year or so?
- What are the chances we will exceed the budget?
- If the projected budget exceeds the expected budget, what are the chances it was because of an incorrect projection versus random variation?

The first question can be answered using pricing techniques that have been around for some time. The second two questions can be answered using Total Risk Analysis, a newly introduced technique.

The technique used in the assessment is similar to a technique often used by a health actuary to estimate the budget impact of a new technology, where the budget impact reflects both the expected change in claims costs and the anticipated savings from the adoption of the technology. One note: In this report, the term "claims costs" includes the costs of administering the program. The assumption is that the impact on other expenses is immaterial, although other, more detailed techniques can be used, such as the alternate methodology described in Section 4. In this case the alternate methodology showed results similar to the assessment methodology, as shown in Table 1.1.

Table 1.1
NET BUDGET IMPACT

| Row | Purpose | Description | PHTI | Alternative | Comments |
|---|---|---|---|---|---|
| a | PMPM Values | Claims Costs PMPM | $ 1.77 | $ 2.46 | Table 4.3, row e |
| b | | Savings PMPM | $ (0.28) | $ (0.13) | Table 4.2 row s |
| c | | Budget Impact | $ 1.49 | $ 2.33 | a + b |
| d | Baseline | TCOC PMPM | $ 560 | $ 560 | Table 4.1, row a |
| | | | | | |
| e | % of TCOC | Claims Costs | 0.32% | 0.44% | a ÷ d |
| f | | Savings | -0.05% | -0.02% | b ÷ d |
| g | | Budget Impact | 0.27% | 0.42% | e + f |

Regardless of which methods and assumptions are used to determine the expected budget impact, it is always a good idea to consider the range of possible values, especially if the range of values could make a material difference in the decision-making process. Our new Total Risk Analysis technique provides a consistent framework for incorporating both the random variation risk and the projection risk into the decision-making process.

The overall results of both the PHTI and actuarial assessments of the budget impact of virtual diabetes management solutions are directionally similar and of the same order of magnitude. But actuaries also need to understand better how results vary in different populations, how the year-over-year cost changes are affected, and the risks present in the various assumptions and calculation methodologies over what the PHTI assessment provides.

## 1.3 MUSCULOSKELETAL ASSESSMENT

In the musculoskeletal (MSK) assessment, PHTI measured the effectiveness of three categories of virtually based solutions in treating MSK conditions: app-based exercise therapy solutions, physical therapist–guided solutions, and remote therapeutic monitoring (RTM)–augmented PT solutions.

The MSK PHTI assessment concluded that app-based exercise therapy solutions and physical therapist–guided solutions both delivered net savings, whereas the RTM-augmented PT solutions increased the overall cost to treat MSK conditions.

### THE GAP ANALYSIS

Gap analysis considers the sources, methodologies and assumptions in the MSK PHTI assessment from an actuarial perspective to identify anything additional or different that should be considered to fully contribute to actuarial decision-making regarding whether new or revised coverage of MSK digital health solutions is clinically and financially beneficial to payers and patients. Some discussion also surrounds calculation methods related to membership mix and some assumptions related to adoption of the therapies. The report also discusses actuarial use of ROI calculations to help decide whether new clinical programs, health care technologies or therapies are likely to deliver health care cost savings (returns) greater than their costs (investments).

### THE CASE STUDY

When an actuary is involved in deciding whether a new clinical program, health technology or medication is "worth" covering, and what, if any, coverage limits should apply, considerations include TCOC, effectiveness, risk factors and side effects. This analysis may vary by population. Actuaries often use ROI calculations to compare the projected health care cost savings to the costs of the program, technology or medication.

The MSK case study illustrates how such ROI calculations can be used, and it introduces a multidimensional stakeholder impact model (the "Value Stack") that additionally assesses how the incremental ROI differs among the various stakeholders involved.

The PHTI and actuarial assessments of whether and how to cover the various MSK virtual solutions arrived at largely the same conclusions. Actuaries typically need more understanding of the variance in results for different populations and time periods and approaches than what was provided in the PHTI assessment.

## 1.4 LESSONS LEARNED

The lessons learned from this report fall into two broad categories: those related to the assessment process and those related to the need for research outside the scope of the assessment process. The key lessons learned about the assessment process include the following:

- The PHTI assessments provide an excellent starting point for analyzing the financial impact of a new technology. That said, actuaries need to be able to rapidly develop the impact on projected claims costs (and therefore on premium rates) to determine whether and how to cover new technologies. In particular, they need to understand how those factors may vary for different populations and periods as discussed in context throughout the report.

- The PHTI assessments were designed with a specific purpose in mind, which may or may not be the same purpose as someone applying the results in a specific circumstance. Actuaries and other analysts need to apply due diligence in their work to account for those differences. In particular, the range of possible values needs to be considered as part of the analysis.

Given the increasing importance of digital technology going forward, it is important to fill in some gaps in the underlying knowledge base available today:

- *The Technology Adoption Curve:* One of the key assumptions in determining the financial impact of any new technology is understanding how many people will adopt the new technology and how long it will take for that to happen after the technology becomes available.

- *The Cost-Effectiveness Curve*: Another key set of assumptions relates to how well the technology works once a member starts using the technology, how long it takes to realize results, and how long the results last.

Of course, one of the problems with developing a technology adoption curve or a cost-effectiveness curve is that we have no real way of knowing what will happen with a new technology when it is first introduced. That said, comparisons to existing technologies similar to the ones at hand can be useful in providing a starting point for this type of analysis.

Other areas for further development are the two relatively new analytical techniques discussed in this report, Total Risk Analysis and Value Stack, which provide more in-depth knowledge about the types and sources of risk in these sorts of analyses as well as deeper understanding about how the ROI of new technologies varies for different populations, stakeholders and time periods.

# Section 2. Introduction

This section provides a level set for readers who may or may not be familiar with the terminology and analytical techniques underlying the thought process used by decision-makers such as payers, providers and consumers when it comes to adopting coverage for a new technology.

## 2.1 THE ROLE OF TECHNOLOGY IN HEALTH CARE

If you have visited a doctor lately, you have probably noticed that they are now often using a tablet to review your medical history instead of a folder full of papers or that they are using a high-resolution big screen TV to look at your X-rays instead of the blurry pictures on an image reader. These changes are just the tip of the iceberg. Technology is rapidly changing virtually every aspect of health care. Although this offers the potential to reduce the total cost of care (TCOC) and improve quality, decision-makers may want to weigh the cost of the new technology against the value of the technology.

Some examples of how technology is changing health care include the following:

- *Research:* Artificial intelligence (AI) can quickly identify patterns present in large amounts of data. In pharmaceutical research this can be useful in limiting possible ingredients for new drugs and identifying potential patients for clinical trials. Generative AI can be useful in producing initial versions of regulatory requirements.[8]

- *Surgical and Diagnostic Procedures:* Robotic surgical systems, which provide better vision and control for the surgeon, enable minimally invasive surgical procedures through tiny incisions. This often means less pain and fewer infections for the patient.[9]

- *Resource Utilization and Planning:* In Japan, hospitals are using drones to perform routine tasks such as showing guests to a patient's room. Providers are using drones to deliver medical supplies to rural areas.[10]

- *Communication:* We have seen a rise in telehealth since the COVID-19 pandemic. This has certainly made certain types of care, especially mental health, easier for patients. Similarly, the proliferation of electronic health records has reduced paperwork and reduced errors for certain functions, such as prescribing drugs.

- *Self-Care:* Today consumers can purchase a variety of devices to monitor their health without a prescription, including fitness trackers, oximeters, blood pressure monitors and even mobile EKG monitors. In addition, continuous glucose monitors are available with a prescription.

- *Remote Monitoring:* Because of the "I've fallen, and I can't get up" commercials, we are all aware of the concept of medical alert systems. But other forms of remote monitoring are used, including blood pressure, glucose and EKG systems.

## 2.2 STAKEHOLDER PERSPECTIVES

Any clinical situation has several direct stakeholders, including the drug or device manufacturer, regulators, payers, providers and consumers. The focus in this report will be on stakeholders who make day-to-day decisions about using a specific drug, protocol or device. In this report the term "decision-maker" will refer to either a payer, a provider or a consumer.

## PAYERS AND HEALTH PLANS

The term "payer" refers to an organization that bears the primary risk associated with funding a specific benefit plan. Examples of payers include The Centers for Medicare and Medicaid Services (CMS), which is the primary sponsor of both Medicaid and Medicare, state governments (who also fund Medicaid), self-insured plan sponsors such as employer groups and Taft-Hartley trust funds, and insurers such as Aetna and Cigna that insure individuals and small groups. To manage that risk, payers decide what supplies and services will be covered under the benefit plan, including any restrictions on that coverage and the patient's cost-share payment requirements. Of course, those decisions are subject to state and federal regulation.

In a payer organization, a technology evaluation may be the result of an ongoing process and/or an ad hoc request. Payers routinely monitor the technology pipeline to see what new technologies are in review by the Federal Food and Drug Administration (FDA) or have recently been approved. If a new technology is likely to hit the market in the current fiscal year or in the next, then that technology will be evaluated, even if it has not yet been approved. Not all evaluations start with the pipeline. Employers will often request an evaluation of something that they are considering for their employees, even if the technology is not part of the payer's standard benefit package. Similarly, a state may mandate coverage of a new technology not in the standard benefit package. Regardless of how the evaluation process begins, the actuary or other analyst must do the evaluation with the data available at the time. Sometimes the only information available is just some idea about the applicable population with little or no cost and utilization data. Similarly, the evaluation must be completed within the timeframe permitted. Although the timeframe may be several weeks for pipeline technologies, the timeframe for employer requests may be a matter of just a few hours. Payers update technology assessments frequently as more information becomes available, especially if the technology is expected to have a material impact on the budget. This continual review process is often referred to as the actuarial control cycle.

Needless to say, payers are concerned about the impact of new technologies on TCOC. In practical terms, TCOC includes all medical and pharmaceutical costs regardless of whether the costs are related to the disease or technology under consideration. In many cases the purchaser will be concerned with the budget impact of a new technology in the current plan year or an upcoming plan year. This makes sense because a health insurance company's profit and loss are typically measured on an annual basis, and compensation for many employees within a payer or provider organization is also determined on an annual basis. The budget impact of a new technology is the increase in claims costs, less the TCOC savings. The increase in claims costs includes the direct cost of the technology and the associated clinical costs such as additional physician visits and lab tests. The TCOC savings result from fewer services such as emergency department visits and inpatient stays. This process is discussed in more detail in Sections 3 and 4.

Payers may take a more strategic approach and look at the value of a new technology over a longer period to reflect the technology adoption curve associated with a new technology. Once a new technology is covered by a benefit plan, it takes time for patients and providers to become aware that the technology is covered and to discuss whether the technology is appropriate for the patient. During this "ramp-up" phase, utilization increases but with little or no offsetting short-term savings, so TCOC is expected to increase. Eventually utilization reaches a steady state, during which small variations in utilization may occur from year to year because of factors such as population shifts and the introduction of new technologies such as the one under consideration. A longer time horizon also allows payers to consider the cost-effectiveness curve, which is similar to a technology adoption curve, except that it measures TCOC over time starting with the date a patient first uses the new technology. If a technology is indeed cost-effective, then the TCOC will increase initially followed by a reduction in costs as savings are realized. The long-term value of a

new technology is typically measured using return on investment (ROI) analytics. Budget analytics are discussed in more detail in Sections 3 and 4.

Although budget impact and the ROI are almost always part of the conversation, a decision-maker may consider other types of value such as member satisfaction, quality of life, employee productivity and clinical outcomes. Member satisfaction is outside the scope of this report. Some forms of quality of life and productivity value that can be "monetized" with proxy measures and assumptions are incorporated into the Value Stack model that is introduced in Section 6. Clinical outcomes are considered in scope only to the extent it impacts potential cost savings. The impact on the technology on the health and well-being of the patient is outside the scope of this report. ROI is discussed in more detail in Sections 5 and 6, the two musculoskeletal sections.

If a payer's initial assessment of a new technology shows that the technology is not cost-effective, then the payer can take several steps to change that trajectory, such as the following:

- *Coverage:* In the absence of legal or philosophical issues, the payer can deny coverage altogether or restrict coverage to targeted patients, where the targeted patients are the ones most likely to have the most benefit from the technology. A process known as prior authorization is usually required to show that patients meet the coverage standards. Under this process the provider submits paperwork, which is then reviewed by the payer for a coverage determination.
- *Cost-Share:* By definition, cost-share is the portion paid by the patient for a service. Cost-share mechanisms include deductibles, copays and coinsurance.
- *Cost Negotiations.* The price of the technology can be negotiated between the manufacturer and payer.

### MEDICAL PROVIDERS

Financial considerations are top of mind for providers, such as doctors and hospitals, just like they are for payers. Unlike payers, however, a provider's financial considerations depend on whether the provider is prescribing a new technology or considering purchasing a new technology for their practice. Providers are often paid on a fee-for-service basis, which simply means the payer reimburses the provider for services rendered at the negotiated rate. By definition, there is no link to quality or efficiency. That said, about 25% of all Medicaid and commercial spend and over 50% of all Medicare spend[11] are reimbursed using some type of alternate payment methodology (APM) tied to quality and the management of costs. Examples of APMs include capitated payments, year-end pay-for-performance bonuses, shared savings and global budgets. Depending on the type of reimbursement methodology, a provider may also be concerned about TCOC or per episode costs.[12] Of course, the provider will also be concerned about the new technology's impact on the patient, including the patient's need for training and monitoring.

### CONSUMERS

Costs will also be important to the consumer, regardless of whether it is specifically the patient's cost-share amount or an out-of-pocket expense. Even if the consumer considers the technology affordable, other considerations such as the applicable health benefits and ease of use will come into play.

## 2.3 DATA AND STANDARDS FOR EVALUATIONS

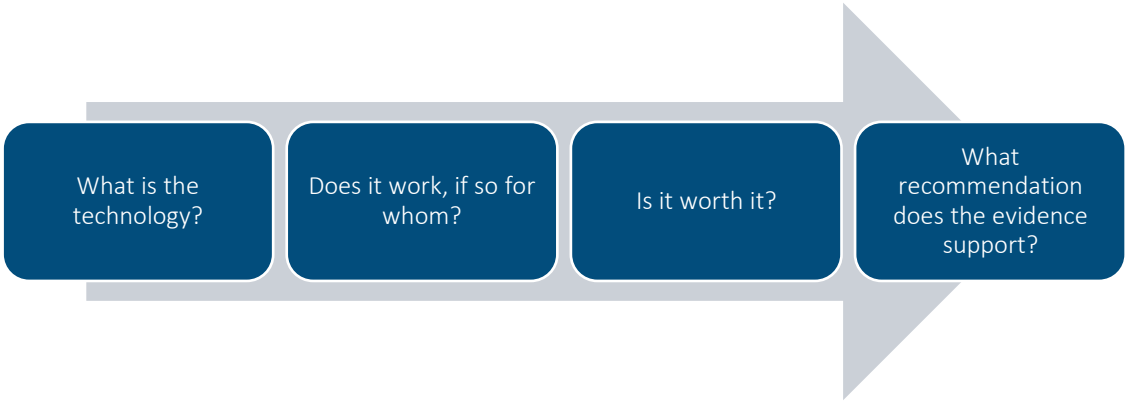
The availability of data is a key factor in determining the quality of any financial evaluation. Similarly, an evaluation must follow legal requirements and/or professional standards. This subsection discusses the available data and standards for two key types of evaluations.

## ICER-PHTI ASSESSMENT FRAMEWORK

When a device is first introduced, the primary sources of data are found in regulatory filings required by the FDA and the manufacturer's website. This information is usually clinical in nature with little or no cost and utilization information. Once a device has been on the market for a while, analysts can assess the value of the device using real-world evidence (RWE) and other data. One way to do that is to rigorously study results for a specific population, under specific circumstances, and for a specific period. The results are often published in an academic journal. In addition, information about the device may be published on other sources, among them government websites, the manufacturer's website and consumer health information sites, such as the Mayo Clinic site.

The Institute for Clinical and Economic Research (ICER), an organization that focuses on evidence-based reviews of health care interventions, has partnered with the Peterson Health Technology Institute (PHTI) to develop a consistent, evidence-based methodology and set of standards for conducting an assessment on digital health technologies (the ICER-PHTI Assessment Framework for Digital Health Technologies).[13] As a result, the goal of the ICER-PHTI assessment process is to answer the questions shown in Figure 2.1.

**Figure 2.1**
ICER-PHTI KEY QUESTIONS




The process of developing an assessment includes an evidence-based review of available data, a clinical evaluation, a financial evaluation and stakeholder input at the beginning and end of the process. The final deliverable includes the paper, detailed back-up evidence and models, and summaries for patients, providers and policymakers.

## DECISION-MAKER ANALYTICS

In most cases the analytics needed for decision-makers are actually performed by the payer and then provided to providers and patients. Several key differences lie between the approach used for the PHTI assessments and the approach used by payers:

- *Review Process:* The ICER-PHTI Assessment Framework for Digital Health Technologies actively solicits input from patients, clinicians, health economists and others. In most cases, payers rely on a policy and therapeutics committee of clinicians to evaluate the clinical criteria for approval and then just a few other key players who are knowledgeable about the impact of the technology from both a financial perspective and the perspective of the decision-makers.

- *Analytical Capability:* Similar to other stakeholders, payers often rely on published data when a device first comes to market. In addition, payers have access to detailed historical information about each claim incurred by a patient and demographic information about the patient. This

information affords the opportunity for payers to back-test assumptions used in the prior year and to refine the assumptions in the current year because the payers have access to detailed claim and eligibility information.

- *Governance:* Each payer has its own set of process controls to ensure the integrity of their analytics. In addition, actuaries, who often perform this type of work, are bound by a set of professional standards. In the U.S., these standards are referred to as the Actuarial Standards of Practice.[14] The standards require an actuary to actively determine if there are any material risks associated with their analysis, and, if there are, the actuary must resolve the problem or disclose it to anyone relying on that analysis, including those outside the organization. A material risk means that the problem may impact a decision made by someone relying on the analysis. A new technique, known as Total Risk Analysis, has been introduced to provide a consistent methodology for analyzing both the projection risk and the random variation risk associated with any projection.[15]

# Section 3. Gap Analysis for Digital Diabetes Management Solutions

The purpose of a gap analysis for digital diabetes management systems is to provide an actuarial perspective on their PHTI assessment and to address whether any revisions or additions to the sources or methods would strengthen their applicability and usability for actuarial evaluations. This gap analysis will focus on the applicability and usefulness of the PHTI assessment, in particular as actuaries prepare claims cost projections and budgets and develop health insurance premium rates.

## 3.1 DIGITAL DIABETES MANAGEMENT SOLUTIONS ASSESSMENT

This discussion relates to the assessment entitled "Digital Diabetes Management Solutions" v1.1 and is dated March 2024 (the PHTI assessment).[16] The purpose of the PHTI assessment is to compare digital treatments to "usual care," which is based on the expected mix of type and severity of claims as described in the American Diabetes Association clinical guidelines. By contrast, a payer measures budget impact as the change in health care spend within the category and then potentially also the change in TCOC from one period to another. Additionally, the payer may evaluate the ROI (including TCOC savings alongside other quantifiable forms of value in the numerator) that is projected to result from coverage of the device over various timeframes. ROI calculations have sometimes been misused by vendors who have "claimed credit" for regression to mean and other statistical variations that were sometimes a significant portion of the apparent realized "savings." Such concerns can be addressed while still benefiting from the intuitive and common-sense decision-making tool that the ROI equation represents.

## 3.2 TYPE 2 DIABETES

Type 2 diabetes is a disease characterized by the body's inability to regulate and use glucose, which is a type of sugar used by cells to produce energy. Insulin is the hormone that delivers glucose to the cells. The body may produce too much or too little insulin. Similarly, the cells may not respond to the insulin, resulting in the cells taking in less sugar. Two short-term adverse consequences may result from this process. If the blood sugar is too low, the person may become weak and/or dizzy, resulting in falls, car accidents and other similar incidents. If the blood sugar is too high, the body stores the excess sugar, resulting in weight gain. Diabetes is a risk factor for several other diseases and complications, including heart disease, circulatory diseases, strokes and amputations of the feet or limbs.[17]

There is no one-time treatment for Type 2 diabetes: no magical surgery, no short-term treatment course such as chemotherapy. Instead, patients, with their doctors' guidance, must manage the disease daily. Some of the more common techniques for managing Type 2 diabetes include the following:[18]

- *Behavior and Lifestyle Modification:* Obesity is a major risk factor for Type 2 diabetes, so behavioral and lifestyle modifications may be necessary to lose or maintain one's weight. For some people this may mean simple changes to their diet and exercise regimen. In some cases, the patient may be able to achieve diabetes remission through an aggressive diet known as either nutritional ketosis or a ketogenic diet. Several forms of patient support are available, including extensive material on the internet or through pamphlets in the doctor's office, diabetes programs that include online information, classes, consultations with a dietician or similar care team member, and the remote patient monitoring (RPM) process described below.

- *Glycemic Monitoring and Testing.* Two ways are used to monitor one's glucose levels. The first is known as an A1c or HbA1c test, which is usually done about once every three months. This test may involve a lab test or a finger prick using an A1c self-check meter. The second method is a

glucose test, which can be used at any point in the day. Several types of glucose monitoring techniques are common, including the following:[19]

- *Nonconnected Blood Glucose Monitoring:* Under this method, the patient pricks their finger with a special needle and then tests their blood using a test strip inserted into the glucometer. This process can sometimes be difficult for patients and does not provide a digital record of the results.

- *Continuous Glucose Monitoring (CGM):* A CGM is a device worn on the patient's arm or other body part. The CGM continuously transmits glucose levels to a reader assuming the reader is within distance. In addition, the patient can test their glucose level at any time. The reader stores and presents historical trends.

- *Connected Blood Glucose Monitoring with Remote Patient Monitoring (RPM):* The RPM process uses a connected glucometer to collect glucose readings, data from third party applications and manually entered data, such as food intake. An algorithm then analyzes the data and produces some automated guidance and suggestions. The algorithm also alerts the care team, which includes the doctor and perhaps a diabetes educator and health coach.

- *Prescription Drugs:* The doctor may also prescribe one or more prescription drugs to treat Type 2 diabetes. Several therapeutic classes of medications are often used to treat it. Each class has subtly different therapeutic purposes, and the various drugs within these therapy classes have different gross and net prices.

Although each benefit plan sponsor determines coverage of services and supplies under its own plan, reviewing Medicare coverage is often a source of guidance for other plans. Medicare covers most of the services mentioned above, including up to 10 hours of "diabetes training," subject to certain limitations. Medicare limitations are also found on some other services.[20]

### 3.3 ASSESSING DIGITAL DIABETES MANAGEMENT SOLUTIONS

The PHTI assessment was based on an extensive literature review with the objective of comparing three Type 2 diabetes treatment plans to "usual care" for Type 2 diabetes treatment. The assessment focused exclusively on solutions that use noncontinuous blood glucose monitors and did not include solutions relying on CGM. The assessments were designed to estimate the budget impact under the following three scenarios:[21]

- *Remote Patient Monitoring (RPM):* This treatment plan enables physicians to monitor patients between visits.
- *Behavioral and Lifestyle Modification (BLM):* The interactive process described above.
- *Nutritional Ketosis:* This process may result in diabetes remission through a strict diet. Intensive dietary guidance is an integral part of this treatment path.

The analysis underlying the PHTI assessment began by reviewing all the sources of data and eliminating sources that were not relevant to the assessment. The next step was to summarize results and compare findings. The key clinical findings included the following:

- *Changes in A1c Results:* For RPM and BHM, the reduction in A1c levels varied from 0.23% to 0.60% compared to usual care as described above. Nutritional ketosis achieved even better clinical results.

- *Impact on TCOC:* A one-point reduction in A1c level translates to roughly a 1.7% reduction in TCOC, including both medical and pharmacy costs, according to one published source.[22]

- *Durability:* Because of limits in the time frames underlying each paper, the durability of RPM and BHM is unclear. Durability refers to how long the benefits of a new technology last, an important element for decision-makers to consider.

- *Equity and Access:* Although no evidence was found of preferential treatment in the studies reviewed, the authors suggested caution in applying the findings to specific audiences.

- *Privacy and Security:* In 2022 the National Institute of Standards and Technology performed a special review of the systems. This review pointed out that, as with any system, cyber-risks, such as ransomware, are always a threat. In addition, some risks are associated with manually input data and data from other sources.

- *Safety:* The devices themselves undergo FDA approval and regulatory oversight to evaluate their safety, but the digital solutions do not.

Once the information was collected, the authors prepared a budget impact model using a combination of the results of the literature review and some key assumptions. The key conclusions from the budget impact model were that the annual costs per 1 million commercial patients using RPM would be $21.3 million, and for BHM the annual cost would be $5.1 million. Based on this information, the authors of the PHTI assessment concluded that the BHM and RPM solutions should not be adopted. The assessment noted that the nutritional ketosis was more likely to show favorable results and could be cautiously adopted.

## 3.4 THE DIGITAL DIABETES GAP ANALYSIS

This report analyzes the gaps in the PHTI assessment from three viewpoints: PHTI's viewpoint, the actuary's viewpoint and a decision-maker's viewpoint.

### THE PHTI VIEWPOINT

The authors of this report reviewed the assessment to determine if PHTI fully answered the questions posed in Figure 2.1.

*How Well Do They Work?*

The PHTI assessment recognizes these programs may provide small clinical improvement in A1c levels, though most improvements were not clinically significant. In this context, the term "clinically significant" means that the change in A1c levels is sufficient to change the trajectory of the disease. Clinical advisors for the assessment indicated that a change in A1c level of less than 0.5% would be unlikely to meet these criteria. The range of values was noted, and several graphics, such as Exhibit 12 in the assessment, provided a good overview of the impact of the programs from that standpoint. Mentions were made of secondary health impacts, such as weight loss and lower cholesterol levels, but none of the secondary impacts were found to have statistical or clinical significance in the literature. The assessment did not indicate whether additional published research in these areas could provide a more complete view of the impact across the entirety of patients, including the impact on comorbid disease states and the variability of results for different subpopulations.

*For Whom Does It Work?*

The PHTI authors noted that these digital solutions may be helpful for newly diagnosed diabetics to determine the best course of treatment for those patients.

*Is It Worth It?*

The authors provided cost estimates for RPM and BHM, but not for nutritional ketosis, which makes it more difficult to validate that nutritional ketosis "is worth it." They suggested that further testing of nutritional ketosis solutions is warranted.

*What Recommendations Does the Evidence Support?*

The authors concluded that the currently available data for RPM and behavioral modification methods do not support adoption of these plans. Virta's study implies that nutritional ketosis may be more cost-effective than RPM and behavioral modification. The authors recommended that decision-makers perform an analysis using their own data regularly. An example of this type of analysis is provided in Section 4 of this report.

## THE ACTUARIAL PERSPECTIVE

Although many reasons exist why an actuary would read the assessment and find it useful, for the purposes of this report the assumption will be that the assessment will be used as a starting point for determining budget impact if one or more of the interventions is adopted while developing projections for future claim cost budgets and premium rate development. The key items of interest in this situation are methodology, strengths of the assumption and the risk analysis. These items are critical for development of commercial self-funded claims cost budgets, commercial fully insured premium rates, Medicaid fee-for-service claims cost budgets and Managed Medicaid capitation rates, as well as Medicare fee-for-service claims cost budgets and Medicare Advantage and Prescription Drug Plan premium rates. They will be discussed in more detail in the case study in Section 4. The highlights are summarized here.

*Methodology*

The methodology shown in the PHTI assessment has many similarities to what an actuary would use for this purpose. To be clear, however, this methodology represents an "all-in" number. In other words, the assumption is that all costs and all savings are realized in the short term (one-to-three-year budget window). That number is very useful in gauging the materiality of the intervention, but for budget impact purposes it will likely take several years for the full impact to be realized. Information about the expected time to savings may or may not be part of the data available at any point in time. Two techniques for that type of projection process are shown in the case study.

*The Assumptions*

In the PHTI assessment, the authors provided enough information for an actuary to use in determining the strength of the evidence for improvements in A1c levels. It would be helpful, however, if further research could help assess how the impact on TCOC from a one-point reduction of A1c varies for different subpopulations and over time. Another key assumption is the 25% participation rate, which was based on expert judgment. Additional quantitative research on participation rates for various populations would be helpful.

Finally, the time periods used in the assessment were "year 1," "year 2" and so on. In actuarial practice, the analysis is applied to a specific period (e.g., calendar year 2024) for budget and premium rate-setting purposes. To the extent possible, it would have been extremely helpful to know what the applicable calendar period was for key assumptions, such as the cost of providing the services.

*Risk Analysis*

The materiality of the issues discussed above will be addressed in more detail in the case study. The case study will also illustrate a technique known as Total Risk Analysis, which, as the name implies, is a consistent method for estimating both the projection risk and the random variation risk for a projection.

## THE DECISION-MAKER'S PERSPECTIVE

Once a decision-maker is convinced that the underlying projection is correct, then the next step is to make sure they understand how the information will be used in their specific situation.

In reviewing an analysis, the decision-maker first wants to be sure they understand what is included in the analysis and what is not. The questions they may ask include "How is CGM factored into this?" and "What about Ozempic and other new drugs?" Depending on the available data, definitive answers may or may not be possible. In that case it is helpful to note that the answer is not available. Another key question is "How do the PHTI findings compare to other sources?" In some cases, such as the change in A1c levels, the assessment provided adequate information. In other cases, such as the participation rate, additional research on patterns of participation rates for various populations would be helpful.

Once the cost is estimated and vetted, the decision-maker must decide whether and, if so, how to cover the service under consideration. Choices include not covering the service, covering it subject to limitations, and negotiating prices with the providers, manufacturers and vendors. Although the range of options will vary somewhat between books of business (commercial, Medicare, Medicaid etc.) based on regulatory context, the process and key decision points are common across books of business. Member satisfaction and well-being are also important considerations in this process. Understanding the potential budget impact and projected ROI of each coverage option, various coverage limitations and various potential net prices would help decision-makers significantly.

Once RWE in the form of actual claim experience has emerged, then the payer will want to better understand how the results varied from expectations. For the most part, the information in the PHTI assessment was adequate for this purpose. That said, it would have been helpful to start with a baseline of current costs and utilization by type of service (inpatient, hospital, outpatient and drugs).

# Section 4. Diabetes Case Study

This section presents a case study for estimating the budget impact from an actuarial perspective due to the adoption of a new technology using the PHTI assessment of digital diabetes management solutions as a starting point. This diabetes case study will focus more on applicability for health actuaries as they project claims cost budgets and set premium rates. The musculoskeletal solution case study later in this report will focus more on health actuarial roles and modeling in assessing the decision of whether and, if so, how to cover a new technology and how to "assess if it is worth it."

## 4.1 THE DECISION-MAKER'S PERSPECTIVE

As noted in the Introduction, the decision to cover or not cover a new drug, protocol or device is usually made at the payer level. The payer then "sells" that decision to providers and consumers. One may see some back and forth in the process, but for the purposes of this report we are assuming that the payer is the primary decision-maker. For self-insured plans, the payer is the employer. In any budget-setting process, the decision maker has three basic questions that are common across all books of business (commercial, Medicaid, Medicare etc.):

- What is the expected budget for next year?
- What are the chances we will exceed the budget?
- If we do exceed the budget, is it because of random variation or a missed projection?
    - If the answer is because of a missed projection, then a review of the projection process may be needed.
    - If the risk is because of random variation, then the payer may need to institute some type of risk mitigation, such as dropping coverage of the device, negotiating better deals with the manufacturer or service provider, restricting coverage or enhancing stop loss or reinsurance protection.

The first question is answered using the budget-setting techniques described below. These techniques have been around for a long time, and most payers have sophisticated systems set up for this purpose. The second and third questions can be answered using Total Risk Analysis, a technique recently formalized and addressed in more depth below.

## 4.2 AN ALTERNATE APPROACH

PHTI developed their cost estimates using "usual care" as the comparator. This is similar to a payer's development of a budget impact analysis for a new technology that compares the total projected cost including the new technology to the total projected cost without the new technology. Payers usually express budget impact as a per member per month (PMPM) value or a total dollar amount. The PMPM is calculated as total costs divided by total member months. Total costs may be measured on an allowed basis (before cost-sharing) or a net basis (after cost-sharing). A member month represents how long each individual member is in the plan during the applicable period. For example, a member who is in the plan only during January and February of a calendar year contributes only two member months, but a member who is continually enrolled during a full calendar year contributes 12 member months.

In this section the authors will compare the PHTI methodology to an alternate methodology using a payer's definition of budget impact. Under the alternate approach, the analyst can use data available from a data warehouse, which includes eligibility data at the member level, such as age and gender, and details about every claim incurred by a member, including type of service and date of service. The data warehouse usually does not include the results from lab tests and other information available from electronic health records. In this case study, both methodologies are based on a commercial population.

With the exception of the data sources, actuaries often use a similar methodology to what PHTI used to determine budget impact of a new technology. That said, other methodologies can be used, such as the one described below. Regardless of the method used, the biggest challenge is more likely than not to be the data. Some pieces of the puzzle are readily available from a data warehouse or from published data. This data availability and applicability can vary by book of business. Sometimes data must be adjusted for demographic, geographic or disease prevalence and claim utilization and severity patterns. Other pieces of the puzzle can be inferred from published papers, industry websites and similar sources. The remaining pieces of the puzzle must be assumed. In some cases, the assumption can be based on the analyst's knowledge from similar situations, and in others the assumption is basically a "best guess." Regardless of the data and methods used, several factors must be considered:

- *Risk Analysis:* To comply with the actuarial standards of professionalism, actuaries must identify any risks associated with their analysis and either mitigate the risk or disclose it. The amount of effort required depends on the degree to which any assumption or methodology impacts the materiality of the results and the availability of data.
- *Explaining Results:* Users of any analysis will want to test the assumptions and results for reasonableness. One way to do this is to compare the results of the analysis at hand to the results from similar analyses. Another way to do this is to ensure that questions such as "How does this technology really work?" and "Did you consider a specified factor in the analysis?" are answered.
- *Actual Expected Analysis:* Although the emphasis in this report is entirely on the initial estimate of the budget impact of a new technology, most payers back-test their original estimate as more RWE becomes available. This is done in part to fine tune the assumptions and methodology for use in future budget estimates, but also to provide a knowledge base for making assumptions about other technologies.

## 4.3 THE BUDGET IMPACT ESTIMATE

The primary difference between the PHTI methodology and the alternate methodology is in the process for estimating claim costs. Actuaries use trend analysis and forecasting to project claim cost impacts into future time periods based on core and non-core trend factors.

### CORE TREND PROJECTION

In its simplest form, a budget projection is the PMPM for the current year trended to the next year. The trend consists of both core elements and non-core elements. Core elements are elements such as cost per service and utilization that the payer must consider every year, whether the payer is a health plan, a self-funded employer plan sponsor, a state Medicaid agency or managed Medicaid health plan, or the CMS. By definition, core trend elements can be projected using past experience, although some analysis and judgment may be required if there are anticipated changes to past experience.[23] An example of a core trend projection is shown in Table 4.1.

Table 4.1
CORE TREND PROJECTION

| Row | Purpose | Description | Value | Calcuation |
|---|---|---|---|---|
| a | Starting Value Year 0 | Current Year PMPM | $560 | Assumed |
| b | Trend Factors | Unit Costs | 4.0% | Assumed |
| c | | Utilization | 2.0% | Assumed |
| d | | Mix and Severity | 0.5% | Assumed |
| e | | Demographic Shifts | 0.5% | Assumed |
| f | | Net Trend | 7.1% | (1 + b) x (1 + c) x (1 +d ) x (1 + e) -1 |
| g | PMPM Year 1 | Projected PMPM | $600 | a x (1 + f) |

A few comments about this calculation:

- *Current Year PMPM:* The current year PMPM may be on an allowed basis (the total the provider receives from the payer and the patient) or the net amount (the amount that is just the payer's responsibility). In most cases the current year PMPM is a projection because the amount is determined before the current year is complete. Techniques for that projection and the associated risk are outside the scope of this report.
- *Unit Costs:* In this report unit costs are assumed to be the allowed cost for services, such as an office visit or a day in the hospital. The impact on trend is calculated using a market basket of services and supplies. This is similar to the calculation of a consumer price index except that the value of the services is based on the payer's experience. Core unit costs are often the primary driver of the trend.
- *Utilization:* Core utilization, such as office visits and admits, is generally driven by economic changes, such as the change in disposable income or the change in the unemployment rate, and the number of workdays in the period. Core utilization is often the primary driver of variance in trend.
- *Mix and Severity:* In this report, mix and severity refer to the gradual change in clinical practices over time. Examples include shifts from inpatient to outpatient, changes in clinical guidelines and some new technologies. This number is usually fairly constant but material.
- *Demographic Shifts:* Even in a stable population, some shift occurs in the age distribution of a population. Some new members join the plan, some members leave the plan, and everyone gets a year older. This number is also relatively stable but material.

## NON-CORE TRENDS

By definition, a non-core trend element is one that cannot be projected by experience and requires an ad hoc analysis. Examples include enactment of major legislation, disruptive network negotiations and new technologies. The technique for analyzing the impact depends on the perceived materiality of the change. If the change is small enough, it can simply be rolled into one of the core trend elements described above. In this case the costs were considered material enough to warrant an ad hoc analysis. Two approaches are used here, the alternate approach and the PHTI approach, and are broadly applicable across books of business. The numbers used in this subsection correspond to the starting value from Table 4.1, row a. In other words, the goal is to determine what the experience in year 0 would have been if the RPM technology were available at that time. In the following examples, year 0 corresponds to 2023, and year 1 corresponds to 2024.

*The Alternate Methodology*

The purpose of the alternate methodology is to provide more detail about what is expected to happen once the technology is introduced to provide more information about expectations up front. The alternate methodology is done in two steps. The first step is to estimate how people with Type 2 diabetes will adapt to the new technology, as shown in Table 4.2.

Table 4.2

EXPECTED RPM UTILIZATION

| Row | Category | Supply Type | Before Coverage | Moving to RPM | After Coverage | Comments |
|---|---|---|---|---|---|---|
| a | Insulin Users | Test Strips | 4,175 | 50% | 2,088 | Calculated/Assumed |
| b | | CGM | 5,993 | 10% | 5,394 | Calculated/Assumed |
| c | | No Monitoring | - | N/A | - | Calculated/Assumed |
| d | | RPM | - | N/A | 2,687 | Calculated/Assumed |
| e | | Total | 10,168 | | 10,168 | a + b + c + d |
| f | Non-Insulin Users | Test Strips | 18,852 | 20% | 15,082 | Calculated/Assumed |
| g | | CGM | 8,445 | 10% | 7,601 | Calculated/Assumed |
| h | | No Monitoring | 18,852 | 10% | 16,967 | Calculated/Assumed |
| i | | RPM | - | N/A | 6,499 | Calculated/Assumed |
| j | | Total | 46,148 | | 46,148 | f + g + h + i |
| k | Total | Test Strips | 23,027 | 25% | 17,169 | a + f |
| l | | CGM | 14,438 | 10% | 12,995 | b + g |
| m | | No Monitoring | 18,852 | 10% | 16,967 | c + h |
| n | | RPM | - | N/A | 9,186 | d + i |
| o | | Total | 56,317 | N/A | 56,317 | |
| p | Participation Rate | Insulin Users | N/A | | 26.4% | d ÷ e |
| q | | Non-Insulin Users | N/A | | 14.1% | i ÷ j |
| r | | Combined | N/A | | 16.3% | q ÷ p |

The data used to determine the values in the "Before Coverage" column were based on the Merative MarketScan commercial data set for 2021, which is aggregated from the data warehouses of several major carriers. This column represents the year 0 values assuming that the new technology is not covered. Technically, this column should have been trended from 2021 to 2023, but the authors considered that immaterial for this purpose. That may or may not be the case under other circumstances. Similar approaches can be used with other data sets including Medicare and Medicaid claim data. The next column, % moving to RPM, is assumptions. For example, one assumption is that everyone on insulin is currently being monitored, either by test strips or using a CGM, and that patients using test strips are more likely to move to a connected blood glucose monitor–based RPM solution than a patient using a CGM. Similar logic is used for non-insulin users, but the assumption is that not every non-insulin user monitors his or her glucose daily. The "After Coverage" column represents the year 0 values assuming that the technology is covered.

The second step in this calculation is to estimate the change in monitoring costs due to the introduction of the non-RPM methodology, as shown in Table 4.3. In this table the average annual costs for test strips and CGM are based on proprietary sources. The assumed average annual costs for an RPM solution include the cost of the equipment and monitoring as well as the additional clinical costs associated with monitoring the results.

Table 4.3
EXPECTED CHANGE IN MONITORING COSTS

| Row | Time Period | Supply Type | Members | Costs Per User | Comments |
|---|---|---|---|---|---|
| a | Before Coverage | Test Strips | 23,027 | $500 | Table 4.2. row k |
| b | | CGM | 14,438 | $3,000 | Table 4.2. row l |
| c | | No Monitoring | 18,852 | $0 | Table 4.2. row m |
| d | | RPM | - | $4,000 | Table 4.2. row n |
| e | | Total | 56,317 | $54,828,810 | Total Costs |
| f | | Cost Per Diabetic | | $974 | From row e |
| g | | PMPM | | $4.57 | e ÷ 12,000,000 |
| h | After Coverage | Test Strips | 17,169 | $500 | Table 4.2. row k |
| i | | CGM | 12,995 | $3,000 | Table 4.2. row l |
| j | | No Monitoring | 16,967 | $0 | Table 4.2. row m |
| k | | RPM | 9,186 | $4,000 | Table 4.2. row n |
| l | | Total | 56,317 | $84,312,783 | Total Costs |
| m | | Cost Per Diabetic | | $1,497 | From row l |
| n | | PMPM | | $7.03 | k. ÷ 12,000,000 |
| o | Change | Total Costs | | $29,483,973 | l - e |
| p | | Cost Per Diabetic | | $524 | o ÷ l |
| q | | PMPM | | $2.46 | o ÷ 12,000,000 |

*The PHTI Methodology*

The PHTI methodology also used a two-step process. The first step is to determine the eligible population as shown in Table 4.4. PHTI referred to this process as the "population funnel." PHTI used a literature search to determine the key values in this table. As it turns out, these values are close to the comparable numbers from the alternate methodology, which were derived from RWE. That does not always happen.

Table 4.4
PHTI METHODOLOGY: ELIGIBLE POPULATION

| Row | Purpose | Description | PHTI | Alternative | Comments |
|---|---|---|---|---|---|
| a | Type 2 Diabetics | Total Population | 1,000,000 | 1,000,000 | Baseline |
| b | | % Adults | 78.9% | 78.14% | Calculated |
| c | | % Diabetic | 8.0% | 9.25% | Calculated |
| d | | % Diabetic Type 2 | 95.0% | 77.9% | Assumed |
| e | | Sub-Total: Number Type 2 | 59,964 | 56,316 | a x b x c x d |
| f | Insulin Users Who Self-Monitor | % Insulin Users | 20.0% | 18.1% | Calculated |
| g | | % Non-Continuous Glucometer | 55.0% | N/A | Calculated |
| h | | Sub-Total: Insulin Users Who Self-Monitor | 6,593 | N/A | e x f x g |
| i | Non-Insulin Users Who Self-Monitor | % Non Insulin Users | 80.0% | 81.9% | Calculated |
| j | | % Non-Continuous Glucometer | 75.0% | N/A | Assumed |
| k | | Sub-Total: Non-Insulin Users Who Self-Monitor | 35,978 | N/A | e x i x j |
| l | Total Eligible Population for Self-Monitoring | Total Number | 42,571 | N/A | h + k |
| m | | % of Total Population | 4.3% | N/A | l ÷ a |

The second step in the process is to estimate the unit costs and total costs, as shown in Table 4.5. Two new assumptions are seen in this table. The first is the participation rate shown in row b. In this context the term "participation rate" refers to the percentage of the population using the technology. Like the migration numbers in the alternative method, little information is available to base the assumption on other than an understanding of the process and, perhaps, a comparison to similar technologies. The other

key assumption is the average annual cost per RPM patient. To estimate that number, PHTI used Medicare fee schedules. The fee schedule included both the cost of the equipment and the additional payments to physicians for monitoring the patient. PHTI used the maximum billable amount for physician services. Under the alternate approach, this amount was determined using proprietary information regarding the average annual costs for a CGM, which was $3,000, then adding $1,000 to cover the additional costs payable to physicians for monitoring the patients.

Table 4.5
PHTI METHODOLOGY: UNIT COSTS AND TOTAL COSTS

| Row | Purpose | Description | PHTI | Alternative | Comment |
|---|---|---|---|---|---|
| a | Total Costs | Eligible Population | 42,571 | N/A | Table 4.2, row l. |
| b | | Participation Rate | 25% | N/A | Assumed |
| c | | New Users | 10,643 | 9,186 | a x b x c |
| d | | Cost Per New User | $2,002 | N/A | Assumed |
| e | | Total Costs | $21,306,986 | $29,483,973 | c x d |
| f | Comparisons | Number of Diabetics | 59,964 | 56,316 | Table 4.4, row e |
| g | | Cost per Diabetic | $355.33 | $523.54 | e ÷ f |
| h | | PMPM | $1.77 | $2.46 | e ÷ 12,000,000 |

Because of the differences in methodology, a direct assumption-by-assumption comparison is not feasible. That said, the total cost under the alternate method is higher than the cost under the PHTI method despite that the alternate method projected fewer diabetics than the PHTI method. The primary reason for the difference is that the alternate method projected a higher annual cost for RPM users than did the PHTI assessment. The costs in the assessment are based on Medicare costs, and the costs under the alternative method are based on commercial costs, which are likely to be higher.

## 4.4 SAVINGS ESTIMATES

Before covering a new technology, a payer wants to know not only about the value to the patient, but also what cost savings are projected. The most direct way to measure that is in terms of reduced TCOC due to a reduction in the A1C level. After all, a lower A1c level is associated with lower costs because of fewer inpatient admits, fewer emergency department visits etc. On the other hand, TCOC is also impacted by factors unrelated to diabetes, such as cancer and automobile accidents. The other factors should even out over a large enough population. With this in mind, both the PHTI and alternate methods projected savings based on the reduction in A1c, as shown in Table 4.6. The alternate method produced lower savings than the PHTI method. A few comments about that follow:

- *Reduction in A1c Level:* The only way to measure changes in A1c level is by using lab results, which are not typically available in claims or eligibility data. Both the PHTI and alternate methods relied on the literature review included in the PHTI assessment. Additional research on how those results vary for different populations would be helpful.
- *TCOC Impact from A1c Reductions:* Similarly, both the PHTI and alternate methods relied on a study[24] that showed that for patients with an A1c level $\geq$ 7% for every 1.0% reduction in A1c level, there was a 1.7% reduction in TCOC. This study was based on numerous sources, including the Merative MarketScan data, which included the A1c levels. In the PHTI calculation, the eligible population was limited to patients with an A1c level of 7% or higher. The alternate methodology did not include that adjustment, so the savings assumptions were adjusted to account for it.

- *Average Cost Per Diabetic:* The PHTI methodology based the average cost per person with Type 2 diabetes on a literature review. Under the alternate methodology the average cost per person with Type 2 diabetes is based on the 2021 data from the MarketScan data set trended to 2023 using a 4% annual trend rate for unit price increases. In both cases the average cost per diabetic includes total medical and pharmacy costs including costs not related to diabetes. One reason for the difference in the two values may be that the cost for the alternative method includes provider discounts. It is important for payers to incorporate the impact of provider discounts to project claims cost budgets for the amount for which the payers will be accountable to pay.

Table 4.6
SAVINGS ESTIMATES

| Row | Purpose | Description | PHTI | Alternative | Comments |
|---|---|---|---|---|---|
| a | Average Cost Per Diabetic | Average Annual Costs for Type 2 Diabetes Patients | $17,335 | $11,000 | Assumed/Calculated |
| b | Savings: Current Insulin Users | Incremental Improvement in A1C | 0.37% | 0.37% | Assumed |
| c | | TCOC Savings Per 1% Reduction in A1C > 7.0% | 1.70% | 1.35% | Assumed |
| d | | Net Annual Savings Per New RPM User | $109 | $55 | a x b x c x 100 |
| e | | Eligible Population | 6,593 | N/A | Assumed |
| f | | % New Users | 25% | N/A | Assumed |
| g | | Total New RPM User | 1,648 | 2,687 | e x f |
| h | | Total Savings | $179,720 | $147,629 | d x g |
| i | Savings: Non-Insulin Users | Incremental Improvement in A1C | 1.20% | 1.20% | Assumed |
| j | | TCOC Savings Per 1% Reduction in A1C | 1.70% | 1.15% | Assumed |
| k | | Net Annual Savings Per Existing Diabetic | $354 | $152 | a x i x j x 100 |
| l | | Eligible Population | 35,978 | N/A | Table 4.2, row l |
| m | | % New Users | 25% | N/A | Assumed |
| n | | Total New RPM | 8,995 | 9,186 | l x m |
| o | | Total Savings | $3,180,796 | $1,394,452 | k x n |
| p | Total Savings | Insulin Users | $179,720 | $147,629 | h |
| q | | Non-Insulin Users | $3,180,796 | $1,394,452 | o |
| r | | Total Savings | $3,360,517 | $1,542,081 | p + q |
| s | | PMPM Savings | $ 0.28 | $ 0.13 | r ÷ 12,000,000 |

## 4.5 NET IMPACT

The net budget impact of a technology is the net claims cost minus the net savings as shown in Table 4.7. Although the PMPM numbers are important, a payer, regardless of book of business, will often pay more attention to the net costs as a percentage of total costs shown in row g. Before acting on these results, the payer may recalculate the results using their own population and negotiated amounts. They may even use a third methodology. Once they are satisfied with the number, they have several options, including covering the technology regardless of the price, negotiating lower costs and/or performance guarantees, restricting coverage to a specific population, or not covering the service at all.

Two items of note here. First, the results in Table 4.7 reflect just direct costs and savings. Other factors that a payer may consider, such as productivity and quality of life, are not considered in claims cost budgets and premium calculations. They can sometimes be considered in various types of ROI calculations, which will be discussed in Sections 5 and 6. Second, the biggest driver of the difference in claims costs is the assumption regarding the expected annual costs for a member using RPM. The PHTI number was based on Medicare numbers, and the alternate methodology used the number for a commercial population, which is generally

higher than the Medicare number. In a real-life situation, the actual reimbursement amount should be known or could be reasonably estimated.

Table 4.7
NET IMPACT

| Row | Purpose | Description | PHTI | Alternative | Comments |
|---|---|---|---|---|---|
| a | PMPM Values | Claims Costs PMPM | $1.77 | $2.46 | Table 4.3, row e |
| b | | Savings PMPM | ($0.28) | ($0.13) | Table 4.2 row s |
| c | | Budget Impact | $1.49 | $2.33 | a + b |
| d | Baseline | TCOC PMPM | $560 | $560 | Table 4.1, row a |
| e | % of TCOC | Claims Costs | 0.32% | 0.44% | a ÷ d |
| f | | Savings | -0.05% | -0.02% | b ÷ d |
| g | | Budget Impact | 0.27% | 0.42% | e + f |

## 4.6 BUDGET PROJECTIONS

Because the calculations above are based on year 0, the year before the timeframe for the projected budget, the next step is to incorporate the results into the budget projection process. One way to do this is to assume that the entire net savings will be incorporated into the first-year results, as shown in Table 4.8.

Table 4.8
BUDGET PROJECTION METHOD 1

| Row | Purpose | Description | Year 1 | Year 2 | Year 3 | Comments |
|---|---|---|---|---|---|---|
| a | Core Values | Starting Value | $560 | $600 | $648 | Table 4.1, row a |
| b | | Trend | 7.1% | 8.0% | 6.5% | Assumed |
| c | | Final Value | $600 | $648 | $690 | a x b |
| d | Non-Core Values | Claims Costs | $0.89 | $1.77 | $1.77 | 50% Table 4.6, row d |
| e | | Savings | $0.00 | ($0.14) | ($0.28) | 50% Table 4.6, row e |
| f | | Net Costs | $0.89 | $1.63 | $2.05 | d - e |
| g | | Trend | 7.1% | 8.0% | 6.5% | Table 4.1, row f |
| h | | Final Value | $0.95 | $1.76 | $2.18 | f x (1 + g) |
| i | Combined | Core Values | $600 | $648 | $690 | c |
| j | | Non-Core Values | $0.95 | $1.76 | $2.18 | f |
| k | | Final Value | $601 | $650 | $692 | i + j |

Although this is the simplest method, it may not be the most realistic projection. Ideally, the projection would reflect both the technology adoption curve, and the cost-effectiveness curve discussed earlier and as shown in Table 4.9. For simplicity, this method assumes that the technology reaches 50% of its potential in year 1 and the remaining 50% in year 2. The savings lag behind the adoption by one year.

Since both the PHTI method and the alternative method produce results that are of the same order of magnitude, actuaries could use either method when determining overall plan trend rates and claims costs budgets for an entire plan. For program evaluations that have a larger percent impact on overall PMPM claims costs, more detailed and precise impact projections will be more important. Program adherence would be one of the details that will be important to study and incorporate.

Table 4.9
BUDGET PROJECTION METHOD 2

| Row | Purpose | Description | Year 1 | Year 2 | Year 3 | Comments |
|---|---|---|---|---|---|---|
| a | Core Values | Starting Value | $560 | $600 | $648 | Table 4.1, row a |
| b | | Trend | 7.1% | 8.0% | 6.5% | Assumed |
| c | | Final Value | $600 | $648 | $690 | a x b |
| d | Non-Core Values | Claims Costs | $1.77 | N/A | N/A | Table 4.5, row h |
| e | | Savings | -$0.28 | N/A | N/A | Table 4.6, row s |
| f | | Net Costs | $1.49 | N/A | N/A | d - e |
| g | | Trend | 7.1% | 8.0% | 6.5% | Table 4.1, row f |
| h | | Final Value | $1.60 | $1.72 | $1.84 | f x (1 + g) |
| i | Combined | Core Values | $600 | $648 | $690 | Row c |
| j | | Non-Core Values | $1.60 | $1.72 | $1.84 | Row h |
| k | | Final Value | $602 | $650 | $692 | i + j |

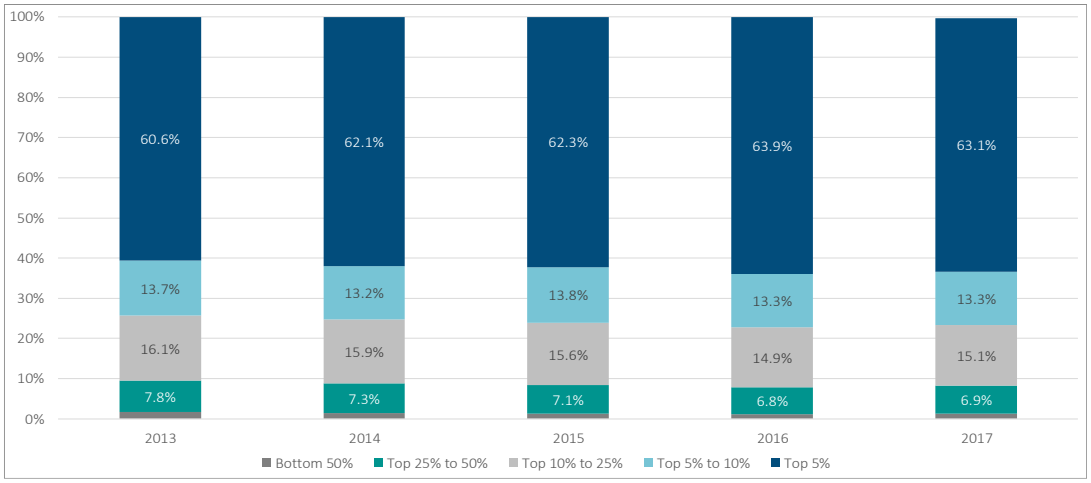
Each year the payer will compare the initial projection to determine the quality of the data and methods used in the initial projection. Based on that comparison, the payer may or may not update the methods and assumptions used for the next year's projection.

## 4.7 TOTAL RISK ANALYSIS

As the discussion above highlights, there is a wide range of value for an expected budget projection, each potentially leading to a different course of action for a payer. Even if the range of possible values is relatively small, it is still possible to miss the budget because of a large claim or some other random occurrence. Total Risk Analysis[25] is a relatively new technique for consistently answering questions such as "What are the chances we will miss the budget projection?" in a manner that reflects both the projection risk and the random variation risk at the time a projection is made. TRA is broadly applicable across all books of business.

The underlying theory behind Total Risk Analysis is that if the mean of a projection is known exactly, then the probability of a claim amount for an individual can be estimated using a probability distribution table known as a cost distribution like the ones shown in Figure 4.1.

Figure 4.1
COMMERCIAL COST DISTRIBUTIONS




Source: Joan Barrett, Achilles Natsis, and Tony Pistilli, Calculated Risk: Driving Decisions Using the 5/50 Research, *Society of Actuaries*, 2024, https://www.soa.org/resources/research-reports/2023/calculatedrisk-using-550research/.

As it turns out, risk is seldom measured at the individual level. Instead, it is measured at a group level, where the group can be an employer group or a book of business from a major carrier. Either way, mathematically, the group is considered a random sample. Because it is a random sample, the Central Limit Theorem applies.[26] This means that the PMPMs should follow the normal distribution. Based on the authors' experience, PMPMs do follow the normal distribution, although the curve may be somewhat skewed at times.

To determine the probability that a projection will exceed the budget is a three-step process. The first step is to determine the range of possible values for the budget estimate and assign a probability to each such value, as shown in rows a through e in Table 4.10. The second step is to estimate the probability of exceeding the budget for each scenario (row f). The third and final step is to take the weighted average of the probability of exceeding the budget for all the scenarios (the combined column in row f) In this example the probability of exceeding the budget is 22.8%. This table can be used after experience has emerged to determine whether a miss is due to random variation or an imperfect projection. For example, if the actual PMPM turns out to be $650, then based on row b, in Scenario 5 the chance that this was due to random variation is less than 2.3%, which implies that the projection method was probably inadequate.

Table 4.10
TOTAL RISK ANALYSIS TABLE

| Row | Purpose | Description | Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4 | Scenario 5 | Combined |
|---|---|---|---|---|---|---|---|---|
| a | Scenario Structure | Scenario Description | -2+ Std Dev Below Mean | -1 to -2 Std Dev Below Mean | +/- 1 Std Dev From Mean | 1 to 2 Std Dev Above Mean | 2+ Std Dev Above Mean | |
| b | | Scenario Probability | 2.3% | 13.6% | 68.3% | 13.6% | 2.3% | 100.0% |
| c | Projection Range | Core Elements | $552.00 | $574.80 | $600.00 | $625.20 | $644.40 | $600.02 |
| d | | Non-Core Elements | $0.50 | $1.00 | $1.49 | $2.25 | $3.50 | $1.55 |
| e | | Total | $552.50 | $575.80 | $601.49 | $627.45 | $647.90 | $601.57 |
| f | Risk Analysis | Probability of Exeeding the Budget | 0.1% | 0.3% | 15.3% | 73.9% | 96.4% | 22.8% |

# Section 5. Gap Analysis for Virtually Enabled Musculoskeletal Care

The purpose of this section is to analyze the PHTI assessment of virtually enabled musculoskeletal (MSK) solutions from an actuarial perspective and determine if information is available that could be useful in the decision-making process that is not identified and incorporated into the assessments. This gap analysis will focus more on health actuaries' roles and models in making decisions about whether and, if so, how to cover new technologies and how to assess if "they are worth it." The first gap analysis for Digital Diabetes Management Solutions focused more on actuaries' roles in setting claims cost budgets and premium rates.

## 5.1 VIRTUALLY ENABLED MUSCULOSKELETAL CARE ASSESSMENT

The PHTI assessment is entitled "Virtual Musculoskeletal Solutions" v1.0 and is dated June 2024.[27] The purpose of the PHTI assessment is to compare virtual treatments to in-person physical therapy (PT) and to "usual care," which is the typical mix of type and severity of claims evident within historical payer claims for MSK treatment.

## 5.2 MUSCULOSKELETAL CONDITIONS

Musculoskeletal disorders (MSKDs) are conditions that affect the body's muscles, bones and joints, causing pain and impairing movement and function. These disorders can result from various factors, including injury, repetitive strain, aging and underlying diseases such as arthritis. MSKDs include osteoarthritis, rheumatoid arthritis, tendinitis, carpal tunnel syndrome, fibromyalgia and bone fractures. These conditions often lead to discomfort, pain and decreased mobility, impacting daily activities and overall quality of life. In the short term, MSK pain can cause difficulty in performing routine tasks, leading to missed work or school, reduced physical activity and a potential decline in mental health. Long-term consequences may include chronic pain, disability, an increased risk of falls and fractures and even depression. Any of the major areas of the MSK system can be affected, which include the neck, shoulders, wrists, back, hips, legs, knees and feet. Proper diagnosis and management are essential to mitigate the effects of MSKDs and maintain physical function and independence.

Although each benefit plan sponsor determines coverage of services and supplies, reviewing Medicare coverage is often a source of guidance for health plans, self-funded employers, state agencies and other plan sponsors. Medicare covers many forms of care, including services such as telehealth visits for physical therapy, over-the-counter and prescription drugs, lifestyle modification, assistive devices and surgical interventions.

## 5.3 ASSESSING VIRTUALLY ENABLED MUSCULOSKELETAL CARE

The PHTI assessment was based on an extensive literature review with the objective of comparing three categories of virtually based solutions in treating MSK conditions. The three virtually based solutions are the following:

- *App-based exercise therapy solutions:* Provide self-directed exercise therapy using care plans that are primarily designed and updated with algorithms, based on data from computer vision analysis or on-body motion sensors. Physical therapist involvement is limited once an exercise program is established.
- *Physical therapist–guided solutions:* Offer virtual PT with a higher level of clinical involvement when onboarding participants, designing exercise therapy regimens and managing their care. This generally includes items noted in the app-based exercise therapy solutions while offering more frequent human interaction with coaches and physical therapists through both video visits and asynchronous communication.

- *Remote therapeutic monitoring (RTM)–augmented PT solutions:* Supplement in-person PT with virtual care. These solutions support patients with self-directed exercises between in-person sessions and enable physical therapists to monitor their patients' progress remotely. The primary in-person physical therapist continues to direct care and may bill for the use of these solutions via RTM billing codes.

The app-based exercise therapy solutions were assumed to provide a modest clinical benefit and were analogized to benefits such as discounted gym memberships or other preventative health interventions.

Medical cost savings from the physical therapist–guided solutions were calculated from two sources: delivering PT at a lower cost and improving speed of initiation and adherence to therapy. The savings from delivering PT at a lower cost were calculated by comparing the episode-level costs of eight PT visits billed through traditional insurance. The publicly available Medicare fee schedule was used to develop the unit cost amount for Medicare. Estimates of the relativity of commercial and Medicaid fee schedules to the Medicare fee schedule were used to develop the unit cost amount for those two lines of business. The cost of delivering PT through a virtually enabled MSK solution was assumed to be a one-time fee between $575 and $1,144, with a middle scenario of $995 per episode reflecting a published price for Hinge in 2022, which was a price estimate published in a Hinge Health study.[28] Savings from improving speed of initiation and adherence to PT were calculated using cost estimates for early/delayed and adherent/nonadherent PT treatment, and a shift toward earlier and more adherent treatment. Additionally, savings from improving speed of initiation were calculated to also include seeking a physical therapist as a first point of care instead of more expensive physical medicine and rehabilitation or orthopedist providers.

Savings for remote therapeutic monitoring-augmented PT solutions were calculated in the same manner as the physical therapist–guided solutions. But because these solutions bill for each visit in a manner similar to traditional PT, rather than the single case rate, an added cost of delivering PT in this scenario actually offsets the savings created through earlier and more adherent treatment.

## 5.4 THE VIRTUALLY ENABLED MUSCULOSKELETAL CARE GAP ANALYSIS

### METHODOLOGY

The methodology used in the PHTI assessment allows for the inclusion of the two main sources of value, namely, more effective treatment of MSK conditions through providing earlier and more adherent PT, as well as providing PT more cost-effectively. The calculation of treatment savings by shifting patients from delayed and/or nonadherent categories to early and/or adherent categories is similar to the total opportunity methodology, which will be outlined below. The formulas used do not allow for a full movement of all patients to the "early adherent" category (the maximum possible savings) without creating negative membership in other categories, though the assumptions used in the published model are not exposed to this problem. We find an opportunity for the formulas used in the PHTI assessment models to be revised to avoid any scenarios that might artificially create negative membership numbers.

The calculation of cost-effective treatment cost by comparing unit costs for in-person and virtual PT is appropriate and helpful. The calculation of costs for remote therapeutic monitoring-augmented PT solutions includes the full cost for in-person PT and an additional cost: it is not clear why a full course of in-person PT would take place for members using the RTM technology. Thus, the added treatment costs under the RTM approach may be overstated.

The methodology does not include any sources of indirect value, such as productivity value for employee and employer, which can be important components of MSK-related treatment value because of the

debilitating effect that MSK can have on an employee's activity level. Other forms of societal value (e.g., caregiver savings or reduced burden on charities and other organizations supporting patients) could also be evaluated to provide a comprehensive view of the full ROI offered by these solutions. The various forms of value and cost (e.g., total cost of care savings, productivity value or societal value) could be quantified separately so that various stakeholders can include the types of value most important to them in their ROI calculations and treatment decisions.

### ASSUMPTIONS

Some assumption choices may not be ideal from an actuarial perspective, but they do not result in materially different results. The use of the annual Consumer Price Index (CPI) for medical care understates medical trends compared to other widely published actuarial trend surveys[29] that show a 5% to 8% annual trend when both utilization increases and unit price increases are included, instead of 1% to 4%. The CPI for medical care comprises three costs: patient payments made directly to retail establishments for medical goods and services, health insurance premiums paid by the consumer, including Medicare Part B premiums, and health insurance premiums deducted from employee paychecks. In contrast, actuarial trend surveys look at the cost for medical goods and services to patients and payers. The latter methodology is likely more appropriate for the model given the model is trending forward total costs (not including the premium costs that the CPI includes).

The source for the assumption of a 90% shift from nonadherent to adherent is not documented. Because this assumption is a key driver of savings value, it would be helpful to document this assumption so the user can assess its validity. This may be an area warranting additional research, and plan sponsors may want to study analogous shifts within their own data related to other technologies. The assumption that year 2 savings are equal to year 1 was because of the use of a two-year savings assumption that was divided evenly between the two years for ease of use. It would be helpful to develop additional research on the allocation of savings between the first and second year to increase the precision of savings allocations for digital MSK programs as actuaries project annual results and incorporate those projections into annual claims cost budgets and premium rates

## 5.5 THE ACTUARIAL PERSPECTIVE

To present a complete picture of the risk associated with an analysis, actuaries tend to review and analyze all possible sources of data, even those that are deemed biased. As part of that process, an actuary will carefully review the data, methods and analyses associated with that information. When actuaries are unable to eliminate bias well enough to establish causation, they adjust for the identified bias and correlations while using appropriate disclaimers in keeping with the actuarial standards of practice.[30] This is often necessary because actuaries must complete their work in the context of product development and regulatory rate filings with often imminent deadlines that must be met for their organization's products to be offered for sale in that market. So rating factors must be calculated and implemented even if bias and/or confounding factors exist in their research. But this risk is managed through regular retrospective studies of the pricing factors that enable factor revisions to be made to continually improve their accuracy. Here are some examples:

- Hinge Health's digital MSK solution was shown to reduce annual medical spend by $2,244 per MSK member and deliver a hard ROI of 2.26. The medical savings is driven by 68.7% fewer patients undergoing invasive procedures when compared to a control group.[31]

- Vori Health has a solution within the physical therapist-guided solution category that was shown to generate $1,660 of annual net savings per member as validated by Milliman. In addition,

Milliman has also reviewed and validated Vori Health's methodology for quantifying the financial impact of MSK solution programs.[32]

- Sword Health has been shown to generate gross savings in medical spend by approximately $3,000. Two independent studies conducted by Risk Strategies Consulting[33] and The Validation Institute using propensity score matching and matched cohorts, respectively. Assuming a program price of $1,000 implies net savings in the neighborhood of $2,000.

Confidence increases in the savings generated by MSK digital solutions when multiple independent sources are suggesting similar results. Each solution is unique, and its merit must be confirmed accordingly, but the evidence here is telling: digital MSK therapy solutions typically add value through convenience, personalization and overall reduced spend of medical care.

Of course, it is worth noting that underlying selection bias is potentially skewing and inflating results. Even considering the estimated savings from Hinge Health, Vori Health and Sword Health as high-end/maximum point estimates, discounting these values still suggests directionally net positive movement. These companies, and others, are recognizing opportunities to combine, or replace, traditional methods with virtually enabled approaches that meet patients where they are and empower them to address their MSK therapy needs.

## 5.6 THE DECISION-MAKER'S PERSPECTIVE

In addition to the commentary provided in the section "The Decision-Maker's Perspective" in Section 4, there is impetus in understanding how, where and to whom the types of value accrue, and which stakeholders incur which portions of the costs. Many stakeholders are found within health care—individual patients, providers, payers, governmental bodies, caretakers and even society at large—and multiple areas contribute to the overall value and cost of health care spend, such as medical costs, pharmacy costs, productivity value (presenteeism, absenteeism etc.) and societal value (caregiver savings, charitable organization burden etc.). Furthermore, segmenting the population for different books of business and/or considering different durations are helpful lenses in determining the worthiness of a program.

By considering all these dimensions, one can develop an ROI for each cell that allows stakeholders to discuss facets of the program and consider different types of potential guarantees. Discussions can then focus on coming to agreement on assumptions and methodology of savings and cost development.

# Section 6. Case Study for Virtually Enabled Musculoskeletal Care

The purpose of this section is to present case studies for virtually enabled MSK care from a payer actuarial perspective. The virtually enabled case study will include an ROI example and a Value Stack example as additional approaches that payers can take beyond the budget and TRA work presented in the digital diabetes management solutions case study. Although ROI models have drawn some hesitancy from various payers because of methodological weaknesses in various vendors' claiming of savings and value delivery over the past few decades, the ROI equation still represents an intuitive decision-making tool so long as data and calculation methodologies are openly disclosed and discussed. Actuaries are regularly engaged in each of these roles within payers and have latitude to select methodologies and assumptions from within a "reasonableness" range according to Actuarial Standards of Practice, which apply across health actuarial work in all books of business (commercial, Medicaid, Medicare etc.).

## 6.1 VIRTUALLY ENABLED MUSCULOSKELETAL CARE ACTUARIAL CASE STUDY

Payers of all types (health plans, self-funded employers, at-risk providers and Accountable Care Organizations, state and federal agencies) are under significant pressure to improve efficiency and quality of care. Care management interventions are a key tool for achieving this goal by removing inefficiencies and improving the quality of care for the most severe populations. Yet the cost of these interventions can sometimes make it impossible for payers to allocate their limited budgets to them.

The ROI calculation is a common tool used in a wide variety of business settings, including health care payer decision-making, to quantify the costs and benefits of a proposed action and facilitate the financial evaluation of the full range of possible proposed actions. Like any analytic tool, it is important to have transparent understanding of the selected methodologies and assumptions within ROI calculations for there to be confidence in their results.

Because of the number of stakeholders involved in a health care decision (patient, payer, provider, patient caregivers, society etc.) as well as the many sources of financial value that can be achieved from positive health care events (medical cost reductions, patient productivity increases, caregiver relief etc.), a more complex tool to evaluate ROI is needed beyond a single overall ROI measure. The Value Stack presented below is a recently developed, multidimensional ROI model that addresses this.

This case study will focus on commercial membership, though this case study format could be replicated for other Medicare and Medicaid populations.

## 6.2 RETURN ON INVESTMENT

ROI is the ratio between an initiative's incremental return (value) and its incremental investment (cost). Incremental value can include reductions in medical and pharmacy costs, increased productivity value for employees and employers, and other societal value such as a reduction in caregiver burden (time away from work, other caregiver costs, charitable organization burden etc.). Similarly, incremental costs are inclusive of all new costs due to the intervention, including the administrative or vendor costs of an initiative, as well as any offsetting medical or pharmacy costs (e.g., if savings are gained through an optimized pharmacology strategy, any increase in pharmacy spend would be a new net cost required to achieve the associated medical cost savings).

Payers are interested in the ROI for an initiative over both the nearest 12-month period and the full duration of an initiative. The nearest 12-month period is of interest because the payer's revenue is subject to a regulatory cycle that is generally performed annually and results in an updated price that is submitted to and approved by regulatory authorities several months earlier. Additionally, health care policies are

generally 12 months in duration, meaning that members will join and leave the plan at these 12-month policy start and end dates. This means that initiatives with a multiyear savings opportunity may not fully benefit a payer if a member leaves the plan during that multiyear period. At the same time, payers can be interested in longer-term initiatives if they believe that the long-term gains will likely materialize even as membership turns over.

In addition to being attentive to how ROI varies across different timeframes, payers are often interested in understanding how ROI varies for different population segments, lines of business (e.g., commercial, Medicare or Medicaid), treatment strategies, levels of disease severity or other relevant dynamics. Payers segment their ROI analyses by these factors to better understand a clinical strategy and make decisions about targeted deployment of an initiative.

## INCREMENTAL VALUE CALCULATION

The type of value that contributes the most to the incremental value calculation is often total cost of care (medical and pharmacy cost) savings. Actuaries commonly calculate savings for clinical interventions using a two-step formula: first calculating the TCOC of the disease burden for the intervention population (the "total opportunity") and then determining what percentage of the total opportunity can be reduced through the clinical intervention (incremental savings value). With respect to the MSK case study, the total opportunity is the TCOC of MSDs. This methodology has the benefit of outlining the range of potential net savings in step 1 because the percent savings used in step 2 cannot exceed 100%: savings will never be greater than the total opportunity. The determination of the appropriate percent savings assumption can include significant discretion, so outlining the minimum and maximum can be a helpful guide to judging the reasonableness of a percentage savings assumption as well as the materiality of using a different assumption.

Ideally, other forms of potential value such as productivity value and societal value can also be quantified and added to TCOC savings to quantify the full potential incremental value of the clinical intervention. The simplicity of this model facilitates easier communication of results for decision-makers without being overly simplistic to the point of misrepresenting the sources of value.

In the MSK case study, total opportunity is calculated as the incremental event count of inpatient admits for MSK conditions, emergency room visits, surgical procedures, joint injections, imaging, PT and occupational therapy, specialist office visits, nonspecialist/primary care office visits, costs for related comorbid conditions and employee productivity. The first two sources of savings (incremental event count and costs for related comorbid conditions) were developed from the Merative MarketScan commercial data, and employee productivity was estimated using academic literature.

The MarketScan data analysis segmented the adult (age 18 and over) population in the data set by four criteria: age band (18–24, 25–34, 35–44, 45–54 and 55–64), gender (male and female), clinical acuity (low, medium and high) and impacted joint category (back, shoulder, arm, wrist/hand, hip/lower limb, knee and ankle).

The clinical acuity definitions are described in Table 6.1. The "Very High" acuity group includes patients who had an MSK surgery: this represents a patient group with an immediately actionable acute issue. The "High" acuity group represents people on an acute care pathway that is imminently approaching surgery. The "Medium" acuity group was seen in a primary care or PT setting for an MSK-primary issue; their condition has not yet escalated to higher levels of MSK care, though it is a distinct and actionable issue for the patient. The "Low" acuity group consists of patients who had MSK issues that were not the primary reason they sought medical care but were a contributing factor to that care.

Table 6.1
ACUITY GROUP DEFINITIONS

| Acuity Grouping | Claims Data Definition |
|---|---|
| Very High | Patient had MSK-related surgery (inpatient or outpatient, excludes joint injections) |
| High | Patient had MSK-related emergency room visit, joint injection or specialist visit |
| Medium | Patient had MSK-related primary care, imaging or PT visit |
| Low | Patient had MSK diagnosis code in any position for any level of care |
| No MSK | Patient had no MSK diagnosis codes in any position for any level of care |

"MSK-related" in this table means that the primary diagnosis code was for a MSK condition. Diagnosis codes in this list excluded MSK conditions related to trauma (fractures, sprains etc.) as well as MSK conditions with an underlying immunological (rheumatoid arthritis, psoriatic arthritis, multiple sclerosis etc.) or congenital cause (craniosynostosis, developmental dysplasia, deformities, other defects etc.). The service categories used in the definitions were developed from MarketScan's "Procedure Group" field, which is a proprietary aggregation of CPT, ICD-10-CM and HCPCS codes maintained by Merative. The final model aggregated the "Very High" and "High" groups to enhance the credibility due to the "Very High" group having very few members assigned to it.

The joint category in question was determined by segmenting the diagnosis code list by the joint to which each code is related. To combine very small categories into more credible buckets, lower back, upper back and neck diagnosis codes were all aggregated into "back," and upper limb and elbow diagnosis codes were aggregated into "arm." Members were mapped to a single joint category to avoid duplication. In the limited number of cases where patients had diagnosis codes that mapped to multiple joint categories, the joint category with the largest amount of allowed spend attributable to it was the member's assigned joint category.

Utilization was calculated as each unique occurrence of any CPT/HCPCS/ICD-10-CM code in a procedure group for a member on a single date of service, where that code line reflected insurer payment (i.e., positive allowed costs that were paid and not denied).

To convert the incremental utilization to incremental cost, unit cost numbers were developed from the MarketScan analysis. The unit cost numbers were segmented by joint category only; the other segmentations (age, sex and severity) should not impact the unit cost to such a degree that any differences they drive are more powerful than the statistical noise introduced from a segmented unit cost into smaller buckets.

In addition to the incremental utilization of MSK-related services, the MarketScan data analysis provided the incremental PMPM for cost attributable to non-MSK services that was calculated for members in each severity group and joint category by comparing them to the "No MSK" group.

The percentage of total opportunity that can be converted to savings for incremental MSK utilization was calculated by review of academic literature about the impacts of early versus delayed PT and adherence to a PT regimen,[34] avoidance of high-intensity procedures and surgeries with effective PT,[35] and replacement of in-person PT (assumed to be 95%). The two academic studies used here were also a key feature of PHTI's model and represent the best available research to date. A 25% reduction was applied to the two sources of savings in *Fritz* to account for potential overlap between the two sources (i.e., receiving PT early and adhering to it may not be as cost-effective as the sum of each impact calculated separately). The percentage of total opportunity that can be converted to savings for incremental non-MSK spend was calculated by review of academic literature.[36]

Finally, the total opportunity value from improving productivity was estimated using the results of three studies.[37] Two studies provided a total number of absent days from work specific to lower back and hip pain, and a third study provided an estimate of the total cost of absenteeism/productivity loss. These studies were limited in that they focused on only two of the seven joint categories that were modeled. They also were specific to a high-acuity group. These numbers were adjusted to reflect all joint category and severity groupings used in the model by estimating the number of productivity days lost for each type of service used in estimating the incremental medical service utilization from the MarketScan data. For example, an assumed three days were lost due to an ER visit, one day was assumed lost due to imaging, two days were assumed lost due to a joint injection etc. This created a total number of productivity days lost by joint category and severity grouping, which was then aggregated to produce a ratio of productivity by joint category (e.g., the estimated productivity impact due to back-related MSK was 23% greater than the average opportunity calculated from the three studies, whereas the estimated productivity impact due to ankle-related MSK was 37% less than the average). This allowed us to use the academically sourced numbers specific to high-severity lower back and hip pain for all severity and joint category groupings.

These analyses produced incremental productivity value estimates for a 12-month period. To estimate incremental productivity value in year 2, a monthly reduction rate was calculated using a study of clinical outcomes following a digital MSK program[38] that tracked pain scores at three-, six- and 12-month intervals. Exponential regression was applied to these three estimates to project the monthly reduction in effectiveness through month 24. Exponential regression was selected because it is appropriate for compounded trends and because of the property of diminishing more slowly when approaching zero. This resulted in incremental productivity value for year 2 being estimated as 23.4% less than in year 1. No incremental productivity value was estimated for year 3 and onward. Although it is possible that effectiveness extends past year 2, no relevant literature was found to support estimating into these periods, and because incremental productivity value will only nominally increase overall incremental value for the full program, it is appropriate to omit them in year 3 and beyond.

### INCREMENTAL COST CALCULATION

This case study model distinguishes between low, medium and high acuity groups for purposes of calculating estimated TCOC savings and other incremental value. Similarly, estimated incremental costs are also calculated for those three acuity groups. Some digital MSK programs are targeted for only one acuity group, and in this situation the model represents a scenario where separate digital MSK programs are contracted separately to cover each acuity group. It would be expected that a program designed for a lower-acuity population would be less expensive than a high-acuity program. Some digital MSK programs do not distinguish between acuity and enroll members in all acuity groups in high-intensity programs. This case study does not consider such an approach because a more optimal approach is available through aligning various solutions with their appropriate acuity level.

Limited publicly available data about pricing for digital MSK programs are available, especially for an acuity-directed program. A study of the Hinge Health program performed by Optum[39] quoted a program price of $995. A presentation at the 2024 SOA Heath Meeting that included Solera Health as a participant (slides available to conference attendees, but not published publicly) quoted price points of $10, $190 and $460 for their low (smartphone app subscription), medium (advanced smartphone app guided care utilizing sensors and other digital tools) and high-acuity (personalized guided care via a provided tablet, accessories and dedicated physical therapist) programs, while referencing the $995 number in the Hinge Study. Solera is likely able to access volume discounts from vendor programs because of its aggregation of clients, so for the purposes of the cost estimates in this analysis we assumed that Solera's numbers represent the most aggressive price point. Sworkit, a provider of a low-acuity smartphone app platform, advertises an annual price of $60;[40] a two-year cost of $120 was used as the cost estimate for app-based solutions. The $995

published number from Hinge was used as the cost estimate for the virtual PT solutions. Finally, a cost estimate of $2,237 for the RTM solutions that was used in PHTI's work was adopted because of a lack of other publicly available information.

The model assumes that a one-time fee will be paid during program enrollment, as this seems to be the most common fee structure among current digital MSK providers. At the same time, it would be plausible to charge a per-member-per-month fee, fees at the achievement of clinical milestones (e.g., completion of a PT regimen), a population-level per-month fee, or a combination of these various fee structures. It is expected that the total fees under any price structure would be similar.

### PROGRAM ELIGIBILITY AND PARTICIPATION

Program participation was estimated by first calculating the prevalence of MSK diagnoses using the same joint category and acuity definitions used for the incremental value calculation. An adjustment was made to inflate the prevalence of the low-severity group due to under-reporting of MSK diagnosis codes in claims data (due to members who never seek care for an MSK condition and secondary MSK conditions, which are not coded due to incomplete coding). The results of this analysis are included in Appendix A.

The model accepts a census for covered members by age band and gender, and the total number of MSK disease-prevalent members is calculated by multiplying this census by the prevalence per 1,000 numbers discussed above. The model assumes different enrollment mixes at a severity level for each solution and incorporates different assumptions for a "loose" and "controlled" targeting approach. The loose targeting approach is indicative of an "all-comers" model, where the program is made available to those who seek it out. This tends to incorporate a lower-acuity mix of individuals. In contrast, the controlled targeting approach is indicative of a model where predictive analytics and other techniques provide insight into who may most benefit from the program, and program eligibility is limited to these members. These individuals who would most benefit from the program may also be pursued through proactive targeting to encourage their enrollment in the program.

Specifically, the app-based solution model assumes a 42%-58% split between low-acuity and medium-acuity enrollment in the "loose" targeting approach, and 33%-67% in the "controlled" targeting approach. Virtual PT and RTM each assume a 36%-64% split between medium-acuity and high-acuity enrollment in the "loose" targeting approach, and 100% high-acuity enrollment in the "controlled" targeting approach.

## 6.3 RETURN-ON-INVESTMENT RESULTS

The complete ROI analysis for each of the three solutions for each targeting method is shown in Tables 6.2 through 6.7.

Table 6.2 shows the ROI for the app-based program with the loose targeting approach. It shows how many members are eligible for the MSK program and how many are low-acuity, medium-acuity and high-acuity members. It also projects how many members at each acuity level are expected to enroll and how many are expected to be highly engaged. It then projects both medical cost savings and indirect savings for each of two years and in aggregate for various areas of the MSK system and calculates the per member per year (PMPY) savings as well as the per-highly-engaged member savings before showing the overall ROI and the ROI using only the medical cost savings.

Table 6.2

## ROI FOR APP-BASED PROGRAM AND LOOSE TARGETING APPROACH

**ROI Summary**

| Health Plan Membership | 100,000 | |
|---|---|---|
| **Eligible For MSK Program** | **48,062** | **48.1%** |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| **Enroll In MSK Program** | **1,292** | **1.3%** |
| Low-Acuity | *543* | *0.5%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | - | *0.0%* |
| **Highly-Engaged in MSK Program** | **1,292** | **1.3%** |
| Low-Acuity | *543* | *0.5%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | - | *0.0%* |

| Program |
|---|
| App-Based |

| Targeting Approach |
|---|
| Loose |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$395,461** | **$325,212** | **$720,674** | **$3.95** | **$3.25** | **$3.60** | **$306** | **$252** | **$279** | **1,292** |
| **Medical Cost Savings** | **$284,092** | **$235,671** | **$519,763** | **$2.84** | **$2.36** | **$2.60** | **$220** | **$182** | **$201** | **1,292** |
| Back | 119,799 | 99,381 | 219,180 | 1.20 | 0.99 | 1.10 | 239 | 198 | 219 | 501 |
| Shoulder | 27,697 | 22,976 | 50,672 | 0.28 | 0.23 | 0.25 | 236 | 196 | 216 | 117 |
| Arm | 8,418 | 6,983 | 15,400 | 0.08 | 0.07 | 0.08 | 219 | 182 | 201 | 38 |
| Wrist/Hand | 21,841 | 18,118 | 39,959 | 0.22 | 0.18 | 0.20 | 194 | 161 | 178 | 112 |
| Hip/Lower Limb | 19,113 | 15,855 | 34,969 | 0.19 | 0.16 | 0.17 | 282 | 234 | 258 | 68 |
| Knee | 50,299 | 41,726 | 92,025 | 0.50 | 0.42 | 0.46 | 187 | 155 | 171 | 269 |
| Ankle | 36,925 | 30,632 | 67,557 | 0.37 | 0.31 | 0.34 | 198 | 164 | 181 | 186 |
| **Indirect Cost Savings** | **$111,370** | **$89,541** | **$200,911** | **$1.11** | **$0.90** | **$1.00** | **$86** | **$69** | **$78** | **1,292** |
| Back | 52,118 | 41,903 | 94,021 | 0.52 | 0.42 | 0.47 | 104 | 84 | 94 | 501 |
| Shoulder | 14,023 | 11,274 | 25,297 | 0.14 | 0.11 | 0.13 | 120 | 96 | 108 | 117 |
| Arm | 2,819 | 2,266 | 5,085 | 0.03 | 0.02 | 0.03 | 73 | 59 | 66 | 38 |
| Wrist/Hand | 6,184 | 4,972 | 11,155 | 0.06 | 0.05 | 0.06 | 55 | 44 | 50 | 112 |
| Hip/Lower Limb | 7,805 | 6,275 | 14,079 | 0.08 | 0.06 | 0.07 | 115 | 93 | 104 | 68 |
| Knee | 17,215 | 13,841 | 31,056 | 0.17 | 0.14 | 0.16 | 64 | 52 | 58 | 269 |
| Ankle | 11,207 | 9,010 | 20,217 | 0.11 | 0.09 | 0.10 | 60 | 48 | 54 | 186 |
| **Total Costs** | **$155,044** | | **$155,044** | **$1.55** | **$0.00** | **$0.78** | **$120** | **$0** | **$60** | **1,292** |
| **ROI** | **2.6:1.0** | **-** | **4.6:1.0** | | | | | | | |
| *Medical Costs Only* | *1.8:1.0* | - | *3.4:1.0* | | | | | | | |

Overall, the back and then the knee are the areas of the MSK system where the greatest savings are projected. Both the overall ROI (2.6:1.0) and the ROI for Medical Costs Only (1.8:1.0) are promising in the first year alone, with the two-year cumulative ROI being larger as more savings opportunities are projected to be realized. Medical Cost Savings are larger than the Indirect Cost Savings across all areas of the MSK system.

Table 6.3 shows the ROI for the app-based program with the controlled targeting approach. Using the controlled targeting approach, fewer members are projected to enroll (833 versus 1,292) than in the loose targeting approach in Table 6.2.

Table 6.3

## ROI FOR APP-BASED PROGRAM AND CONTROLLED TARGETING APPROACH

**ROI Summary**

| Health Plan Membership | 100,000 | |
|---|---|---|
| **Eligible For MSK Program** | **48,062** | **48.1%** |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| **Enroll In MSK Program** | **833** | **0.8%** |
| Low-Acuity | *271* | *0.3%* |
| Medium-Acuity | *562* | *0.6%* |
| High-Acuity | - | *0.0%* |
| **Highly-Engaged in MSK Program** | **833** | **0.8%** |
| Low-Acuity | *271* | *0.3%* |
| Medium-Acuity | *562* | *0.6%* |
| High-Acuity | - | *0.0%* |

| Program |
|---|
| App-Based |

| Targeting Approach |
|---|
| Controlled |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$294,361** | **$242,065** | **$536,426** | **$2.94** | **$2.42** | **$2.68** | **$353** | **$290** | **$322** | **833** |
| **Medical Cost Savings** | **$211,207** | **$175,209** | **$386,415** | **$2.11** | **$1.75** | **$1.93** | **$253** | **$210** | **$232** | **833** |
| Back | 89,153 | 73,958 | 163,110 | 0.89 | 0.74 | 0.82 | 280 | 232 | 256 | 319 |
| Shoulder | 20,600 | 17,089 | 37,688 | 0.21 | 0.17 | 0.19 | 267 | 222 | 245 | 77 |
| Arm | 6,236 | 5,174 | 11,410 | 0.06 | 0.05 | 0.06 | 241 | 200 | 220 | 26 |
| Wrist/Hand | 16,259 | 13,488 | 29,748 | 0.16 | 0.13 | 0.15 | 220 | 183 | 201 | 74 |
| Hip/Lower Limb | 14,221 | 11,797 | 26,018 | 0.14 | 0.12 | 0.13 | 316 | 262 | 289 | 45 |
| Knee | 37,399 | 31,025 | 68,424 | 0.37 | 0.31 | 0.34 | 219 | 182 | 200 | 171 |
| Ankle | 27,338 | 22,679 | 50,017 | 0.27 | 0.23 | 0.25 | 224 | 186 | 205 | 122 |
| **Indirect Cost Savings** | **$83,155** | **$66,856** | **$150,011** | **$0.83** | **$0.67** | **$0.75** | **$100** | **$80** | **$90** | **833** |
| Back | 38,892 | 31,269 | 70,161 | 0.39 | 0.31 | 0.35 | 122 | 98 | 110 | 319 |
| Shoulder | 10,479 | 8,425 | 18,905 | 0.10 | 0.08 | 0.09 | 136 | 109 | 123 | 77 |
| Arm | 2,108 | 1,695 | 3,804 | 0.02 | 0.02 | 0.02 | 81 | 66 | 74 | 26 |
| Wrist/Hand | 4,621 | 3,715 | 8,337 | 0.05 | 0.04 | 0.04 | 63 | 50 | 56 | 74 |
| Hip/Lower Limb | 5,835 | 4,691 | 10,526 | 0.06 | 0.05 | 0.05 | 130 | 104 | 117 | 45 |
| Knee | 12,845 | 10,328 | 23,173 | 0.13 | 0.10 | 0.12 | 75 | 61 | 68 | 171 |
| Ankle | 8,374 | 6,733 | 15,106 | 0.08 | 0.07 | 0.08 | 69 | 55 | 62 | 122 |
| **Total Costs** | **$100,004** | | **$100,004** | **$1.00** | **$0.00** | **$0.50** | **$120** | **$0** | **$60** | **833** |
| **ROI** | **2.9:1.0** | **-** | **5.4:1.0** | | | | | | | |
| *Medical Costs Only* | *2.1:1.0* | - | *3.9:1.0* | | | | | | | |

The controlled approach to the app-based program in Table 6.3 is expected to deliver lower savings PMPY than the loose targeting approach in Table 6.2 but a higher ROI and a lower program "investment" by the payer.

Table 6.4 shows the ROI and various savings projections for the virtual PT program with the loose targeting approach. The virtual PT program is expected to enroll more members (2,093) than the loose targeting approach for the app-based program (1,292) shown in Table 6.2. The virtual PT program shown in Table 6.4 has just two acuity levels: medium-acuity and high-acuity.

Table 6.4

## ROI FOR VIRTUAL PT PROGRAM AND LOOSE TARGETING APPROACH

| Health Plan Membership | 100,000 | |
|---|---|---|
| **Eligible For MSK Program** | **48,062** | **48.1%** |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| **Enroll In MSK Program** | **2,093** | **2.1%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | *1,344* | *1.3%* |
| **Highly-Engaged in MSK Program** | **2,093** | **2.1%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | *1,344* | *1.3%* |

| Program |
|---|
| Virtual PT |

| Targeting Approach |
|---|
| Loose |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$5,011,213** | **$4,111,957** | **$9,123,170** | **$50.11** | **$41.12** | **$45.62** | **$2,394** | **$1,965** | **$2,179** | **2,093** |
| **Medical Cost Savings** | **$3,244,981** | **$2,691,909** | **$5,936,890** | **$32.45** | **$26.92** | **$29.68** | **$1,550** | **$1,286** | **$1,418** | **2,093** |
| Back | 1,616,930 | 1,341,342 | 2,958,272 | 16.17 | 13.41 | 14.79 | 1,612 | 1,338 | 1,475 | 1,003 |
| Shoulder | 348,594 | 289,180 | 637,773 | 3.49 | 2.89 | 3.19 | 1,686 | 1,399 | 1,542 | 207 |
| Arm | 49,043 | 40,684 | 89,727 | 0.49 | 0.41 | 0.45 | 924 | 767 | 846 | 53 |
| Wrist/Hand | 122,071 | 101,265 | 223,336 | 1.22 | 1.01 | 1.12 | 902 | 749 | 825 | 135 |
| Hip/Lower Limb | 280,980 | 233,090 | 514,070 | 2.81 | 2.33 | 2.57 | 2,408 | 1,998 | 2,203 | 117 |
| Knee | 629,046 | 521,832 | 1,150,879 | 6.29 | 5.22 | 5.75 | 1,765 | 1,464 | 1,615 | 356 |
| Ankle | 198,317 | 164,516 | 362,834 | 1.98 | 1.65 | 1.81 | 893 | 741 | 817 | 222 |
| **Indirect Cost Savings** | **$1,766,231** | **$1,420,048** | **$3,186,280** | **$17.66** | **$14.20** | **$15.93** | **$844** | **$678** | **$761** | **2,093** |
| Back | 1,093,281 | 878,997 | 1,972,278 | 10.93 | 8.79 | 9.86 | 1,090 | $ 876 | 983 | 1,003 |
| Shoulder | 204,414 | 164,348 | 368,762 | 2.04 | 1.64 | 1.84 | 989 | $ 795 | 892 | 207 |
| Arm | 23,707 | 19,061 | 42,768 | 0.24 | 0.19 | 0.21 | 447 | $ 359 | 403 | 53 |
| Wrist/Hand | 48,647 | 39,112 | 87,759 | 0.49 | 0.39 | 0.44 | 360 | $ 289 | 324 | 135 |
| Hip/Lower Limb | 103,280 | 83,037 | 186,318 | 1.03 | 0.83 | 0.93 | 885 | $ 712 | 798 | 117 |
| Knee | 203,899 | 163,935 | 367,834 | 2.04 | 1.64 | 1.84 | 572 | $ 460 | 516 | 356 |
| Ankle | 89,003 | 71,558 | 160,562 | 0.89 | 0.72 | 0.80 | 401 | $ 322 | 362 | 222 |
| **Total Costs** | **$2,082,553** | | **$2,082,553** | **$20.83** | **$0.00** | **$10.41** | **$995** | **$0** | **$498** | **2,093** |
| **ROI** | **2.4:1.0** | **-** | **4.4:1.0** | | | | | | | |
| *Medical Costs Only* | *1.6:1.0* | - | *2.9:1.0* | | | | | | | |

Table 6.4 indicates that the virtual PT program delivers much greater PMPY savings across the plan membership than does the app-based program in Tables 6.2 and 6.3. This is partially because of higher enrollment. But each of the projected ROIs for the virtual PT program with the loose targeting approach as shown in Table 6.4 is slightly lower than the comparable ROIs for the app-based program in Table 6.2, indicating that although the virtual PT program delivers greater PMPY savings it comes with a greater PMPY cost (investment) to the payer.

Table 6.5 shows the ROI and various savings projections for the virtual PT program with the controlled targeting approach. The controlled targeting approach for the virtual PT program projects enrolling only high-acuity members, whereas the loose targeting approach for the virtual PT program in Table 6.4 enrolled both high-acuity and medium-acuity members.

Table 6.5

## ROI FOR VIRTUAL PT PROGRAM AND CONTROLLED TARGETING APPROACH

**ROI Summary**

| Health Plan Membership | 100,000 | |
|---|---|---|
| **Eligible For MSK Program** | **48,062** | **48.1%** |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| **Enroll In MSK Program** | **1,344** | **1.3%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | - | *0.0%* |
| High-Acuity | *1,344* | *1.3%* |
| **Highly-Engaged in MSK Program** | **1,344** | **1.3%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | - | *0.0%* |
| High-Acuity | *1,344* | *1.3%* |

| Program |
|---|
| Virtual PT |

| Targeting Approach |
|---|
| Controlled |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$4,624,691** | **$3,794,122** | **$8,418,813** | **$46.25** | **$37.94** | **$42.09** | **$3,442** | **$2,824** | **$3,133** | **1,344** |
| **Medical Cost Savings** | **$2,968,338** | **$2,462,416** | **$5,430,755** | **$29.68** | **$24.62** | **$27.15** | **$2,209** | **$1,833** | **$2,021** | **1,344** |
| Back | 1,499,918 | 1,244,273 | 2,744,191 | 15.00 | 12.44 | 13.72 | 2,056 | 1,705 | 1,880 | 730 |
| Shoulder | 321,588 | 266,777 | 588,365 | 3.22 | 2.67 | 2.94 | 2,416 | 2,004 | 2,210 | 133 |
| Arm | 40,932 | 33,956 | 74,888 | 0.41 | 0.34 | 0.37 | 1,556 | 1,290 | 1,423 | 26 |
| Wrist/Hand | 100,714 | 83,549 | 184,263 | 1.01 | 0.84 | 0.92 | 1,558 | 1,293 | 1,425 | 65 |
| Hip/Lower Limb | 262,323 | 217,613 | 479,937 | 2.62 | 2.18 | 2.40 | 3,630 | 3,012 | 3,321 | 72 |
| Knee | 580,047 | 481,184 | 1,061,232 | 5.80 | 4.81 | 5.31 | 2,750 | 2,281 | 2,515 | 211 |
| Ankle | 162,815 | 135,065 | 297,880 | 1.63 | 1.35 | 1.49 | 1,526 | 1,266 | 1,396 | 107 |
| **Indirect Cost Savings** | **$1,656,353** | **$1,331,706** | **$2,988,058** | **$16.56** | **$13.32** | **$14.94** | **$1,233** | **$991** | **$1,112** | **1,344** |
| Back | 1,041,950 | 837,727 | 1,879,677 | 10.42 | 8.38 | 9.40 | 1,428 | 1,148 | 1,288 | 730 |
| Shoulder | 190,542 | 153,195 | 343,737 | 1.91 | 1.53 | 1.72 | 1,432 | 1,151 | 1,291 | 133 |
| Arm | 20,911 | 16,812 | 37,723 | 0.21 | 0.17 | 0.19 | 795 | 639 | 717 | 26 |
| Wrist/Hand | 42,530 | 34,194 | 76,724 | 0.43 | 0.34 | 0.38 | 658 | 529 | 594 | 65 |
| Hip/Lower Limb | 95,550 | 76,822 | 172,373 | 0.96 | 0.77 | 0.86 | 1,322 | 1,063 | 1,193 | 72 |
| Knee | 186,948 | 150,306 | 337,254 | 1.87 | 1.50 | 1.69 | 886 | 712 | 799 | 211 |
| Ankle | 77,922 | 62,649 | 140,571 | 0.78 | 0.63 | 0.70 | 730 | 587 | 659 | 107 |
| **Total Costs** | **$1,336,906** | | **$1,336,906** | **$13.37** | **$0.00** | **$6.68** | **$995** | **$0** | **$498** | **1,344** |
| **ROI** | **3.5:1.0** | **-** | **6.3:1.0** | | | | | | | |
| *Medical Costs Only* | *2.2:1.0* | - | *4.1:1.0* | | | | | | | |

When comparing the results projected for the controlled targeting approach for the virtual PT program in Table 6.5 to the loose targeting approach for the virtual PT program in Table 6.4, we see similar patterns to what we saw when comparing Table 6.3 (controlled targeting approach for app-based program) to Table 6.2 (loose targeting approach for the app-based program). For both programs the controlled targeting approach drives less overall and PMPY savings than the loose targeting approach but with higher ROI and less overall program "investment" by the payer.

Table 6.6 shows the ROI and various savings projections for the RTM program with a loose targeting approach enrolling both high-acuity and medium-acuity members. The enrolled members are the same targeted members as those enrolled for the virtual PT program in Table 6.4.

Table 6.6

## ROI FOR RTM PROGRAM AND LOOSE TARGETING APPROACH

**ROI Summary**

| Health Plan Membership | 100,000 | |
|---|---|---|
| **Eligible For MSK Program** | **48,062** | **48.1%** |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| **Enroll In MSK Program** | **2,093** | **2.1%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | *1,344* | *1.3%* |
| **Highly-Engaged in MSK Program** | **2,093** | **2.1%** |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | *749* | *0.7%* |
| High-Acuity | *1,344* | *1.3%* |

| Program |
|---|
| RTM |

| Targeting Approach |
|---|
| Loose |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$5,011,213** | **$4,111,957** | **$9,123,170** | **$50.11** | **$41.12** | **$45.62** | **$2,394** | **$1,965** | **$2,179** | **2,093** |
| **Medical Cost Savings** | **$3,244,981** | **$2,691,909** | **$5,936,890** | **$32.45** | **$26.92** | **$29.68** | **$1,550** | **$1,286** | **$1,418** | **2,093** |
| Back | 1,616,930 | 1,341,342 | 2,958,272 | 16.17 | 13.41 | 14.79 | 1,612 | 1,338 | 1,475 | 1,003 |
| Shoulder | 348,594 | 289,180 | 637,773 | 3.49 | 2.89 | 3.19 | 1,686 | 1,399 | 1,542 | 207 |
| Arm | 49,043 | 40,684 | 89,727 | 0.49 | 0.41 | 0.45 | 924 | 767 | 846 | 53 |
| Wrist/Hand | 122,071 | 101,265 | 223,336 | 1.22 | 1.01 | 1.12 | 902 | 749 | 825 | 135 |
| Hip/Lower Limb | 280,980 | 233,090 | 514,070 | 2.81 | 2.33 | 2.57 | 2,408 | 1,998 | 2,203 | 117 |
| Knee | 629,046 | 521,832 | 1,150,879 | 6.29 | 5.22 | 5.75 | 1,765 | 1,464 | 1,615 | 356 |
| Ankle | 198,317 | 164,516 | 362,834 | 1.98 | 1.65 | 1.81 | 893 | 741 | 817 | 222 |
| **Indirect Cost Savings** | **$1,766,231** | **$1,420,048** | **$3,186,280** | **$17.66** | **$14.20** | **$15.93** | **$844** | **$678** | **$761** | **2,093** |
| Back | 1,093,281 | 878,997 | 1,972,278 | 10.93 | 8.79 | 9.86 | 1,090 | 876 | 983 | 1,003 |
| Shoulder | 204,414 | 164,348 | 368,762 | 2.04 | 1.64 | 1.84 | 989 | 795 | 892 | 207 |
| Arm | 23,707 | 19,061 | 42,768 | 0.24 | 0.19 | 0.21 | 447 | 359 | 403 | 53 |
| Wrist/Hand | 48,647 | 39,112 | 87,759 | 0.49 | 0.39 | 0.44 | 360 | 289 | 324 | 135 |
| Hip/Lower Limb | 103,280 | 83,037 | 186,318 | 1.03 | 0.83 | 0.93 | 885 | 712 | 798 | 117 |
| Knee | 203,899 | 163,935 | 367,834 | 2.04 | 1.64 | 1.84 | 572 | 460 | 516 | 356 |
| Ankle | 89,003 | 71,558 | 160,562 | 0.89 | 0.72 | 0.80 | 401 | 322 | 362 | 222 |
| **Total Costs** | **$4,682,082** | | **$4,682,082** | **$46.82** | **$0.00** | **$23.41** | **$2,237** | **$0** | **$1,119** | **2,093** |
| **ROI** | **1.1:1.0** | **-** | **1.9:1.0** | | | | | | | |
| *Medical Costs Only* | *0.7:1.0* | - | *1.3:1.0* | | | | | | | |

Table 6.6 shows that the RTM program with a loose targeting approach seems to deliver the same savings PMPY and in total dollars as the virtual PT program with a loose targeting approach in Table 6.4 but with a much higher cost (investment by the payer). Thus, the ROI for the RTM program with a loose targeting approach is much lower than the ROI for the virtual PT program with a loose targeting approach.

Table 6.7 shows the ROI and various savings projections for the RTM program with a controlled targeting approach enrolling only high-acuity members. The enrolled members are the same targeted members as those enrolled for the virtual PT program with the controlled targeting approach in Table 6.5.

Table 6.7

ROI FOR RTM PROGRAM AND CONTROLLED TARGETING APPROACH

ROI Summary

| Health Plan Membership | 100,000 | |
|---|---|---|
| Eligible For MSK Program | 48,062 | 48.1% |
| Low-Acuity | *27,132* | *27.1%* |
| Medium-Acuity | *7,494* | *7.5%* |
| High-Acuity | *13,436* | *13.4%* |
| Enroll In MSK Program | 1,344 | 1.3% |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | - | *0.0%* |
| High-Acuity | *1,344* | *1.3%* |
| Highly-Engaged in MSK Program | 1,344 | 1.3% |
| Low-Acuity | - | *0.0%* |
| Medium-Acuity | - | *0.0%* |
| High-Acuity | *1,344* | *1.3%* |

| Program |
|---|
| RTM |

| Targeting Approach |
|---|
| Controlled |

| | *Total Dollars* | | | *PMPY - Plan Membership* | | | *PMPY - Highly Engaged* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Year 1* | *Year 2* | *Years 1 & 2* | *Members* |
| **Total Savings** | **$4,624,691** | **$3,794,122** | **$8,418,813** | **$46.25** | **$37.94** | **$42.09** | **$3,442** | **$2,824** | **$3,133** | **1,344** |
| **Medical Cost Savings** | **$2,968,338** | **$2,462,416** | **$5,430,755** | **$29.68** | **$24.62** | **$27.15** | **$2,209** | **$1,833** | **$2,021** | **1,344** |
| Back | 1,499,918 | 1,244,273 | 2,744,191 | 15.00 | 12.44 | 13.72 | 2,056 | 1,705 | 1,880 | 730 |
| Shoulder | 321,588 | 266,777 | 588,365 | 3.22 | 2.67 | 2.94 | 2,416 | 2,004 | 2,210 | 133 |
| Arm | 40,932 | 33,956 | 74,888 | 0.41 | 0.34 | 0.37 | 1,556 | 1,290 | 1,423 | 26 |
| Wrist/Hand | 100,714 | 83,549 | 184,263 | 1.01 | 0.84 | 0.92 | 1,558 | 1,293 | 1,425 | 65 |
| Hip/Lower Limb | 262,323 | 217,613 | 479,937 | 2.62 | 2.18 | 2.40 | 3,630 | 3,012 | 3,321 | 72 |
| Knee | 580,047 | 481,184 | 1,061,232 | 5.80 | 4.81 | 5.31 | 2,750 | 2,281 | 2,515 | 211 |
| Ankle | 162,815 | 135,065 | 297,880 | 1.63 | 1.35 | 1.49 | 1,526 | 1,266 | 1,396 | 107 |
| **Indirect Cost Savings** | **$1,656,353** | **$1,331,706** | **$2,988,058** | **$16.56** | **$13.32** | **$14.94** | **$1,233** | **$991** | **$1,112** | **1,344** |
| Back | 1,041,950 | 837,727 | 1,879,677 | 10.42 | 8.38 | 9.40 | 1,428 | 1,148 | 1,288 | 730 |
| Shoulder | 190,542 | 153,195 | 343,737 | 1.91 | 1.53 | 1.72 | 1,432 | 1,151 | 1,291 | 133 |
| Arm | 20,911 | 16,812 | 37,723 | 0.21 | 0.17 | 0.19 | 795 | 639 | 717 | 26 |
| Wrist/Hand | 42,530 | 34,194 | 76,724 | 0.43 | 0.34 | 0.38 | 658 | 529 | 594 | 65 |
| Hip/Lower Limb | 95,550 | 76,822 | 172,373 | 0.96 | 0.77 | 0.86 | 1,322 | 1,063 | 1,193 | 72 |
| Knee | 186,948 | 150,306 | 337,254 | 1.87 | 1.50 | 1.69 | 886 | 712 | 799 | 211 |
| Ankle | 77,922 | 62,649 | 140,571 | 0.78 | 0.63 | 0.70 | 730 | 587 | 659 | 107 |
| **Total Costs** | **$3,005,688** | | **$3,005,688** | **$30.06** | **$0.00** | **$15.03** | **$2,237** | **$0** | **$1,119** | **1,344** |
| **ROI** | **1.5:1.0** | - | **2.8:1.0** | | | | | | | |
| *Medical Costs Only* | *1.0:1.0* | - | *1.8:1.0* | | | | | | | |

Similar to the comparison of the RTM program with a loose targeting approach to the virtual PT program with a loose targeting approach, the RTM program with a controlled targeting approach drives the same savings as the virtual PT program with the controlled targeting approach but with higher program costs for the payer and therefore a lower ROI. Also similarly, the controlled targeting approach for the RTM program drives less overall and PMPY savings than the loose targeting approach for the RTM program but a higher ROI. We note a few points:

- A few common patterns that emerged from evaluating these ROI scenarios include that loose targeting approaches for all three programs drive more overall and PMPY savings than controlled targeting approaches but with lower ROI.
- The virtual PT program delivers more overall and PMPY savings at a higher ROI than the app-based program for both the loose and controlled targeting approaches.
- The RTM program delivers the same overall and PMPY savings as the virtual PT program for both the loose and controlled targeting approaches but with a lower ROI because of higher program costs.

## 6.4 THE VALUE STACK

The Value Stack, also called a Stakeholder Impact model, is a newly emerging format for displaying the multidimensional ROI by source of value/cost, stakeholder, line of business (book of business) and

timeframe to facilitate decision-making. Frequently, key decision-makers will be most interested in a subset of the sources of value or cost. For example, payers may be interested only in medical and pharmacy cost savings (TCOC savings), whereas employers and employees may also be interested in productivity value, and other stakeholders may also consider societal value. Table 6.8 shows the value stack for the RTM solution under the controlled targeting approach.

Table 6.8

VALUE STACK

| Timeframe | Line of Business |
|---|---|
| Years 1 & 2 | Fully-Insured |

| Net New Value ($M) | | | | Stakeholder | Net New Cost ($M) | | | |
|---|---|---|---|---|---|---|---|---|
| Rx | Medical | Productivity | Societal | | Rx | Medical | Productivity | Societal |
| $ - | $ - | $ - | $ 0.26 | Society *ROI Favorable* | $ - | $ - | $ - | $ - |
| $ - | $ - | $ - | $ - | Government *n/a* | $ - | $ - | $ - | $ - |
| $ - | $ - | $ - | $ - | Providers *n/a* | $ - | $ - | $ - | $ - |
| $ - | $ - | $ 2.36 | $ - | Employers *ROI Favorable* | $ - | $ - | $ - | $ - |
| $ - | $ 4.48 | $ - | $ - | Health Plans *1.5:1.0* | $ - | $ 3.01 | $ - | $ - |
| $ - | $ - | $ - | $ - | PBMs *n/a* | $ - | $ - | $ - | $ - |
| $ - | $ 0.95 | $ 0.36 | $ - | Patients *ROI Favorable* | $ - | $ - | $ - | $ - |
| **$ -** | **$ 5.43** | **$ 2.73** | **$ 0.26** | **Total** *2.8:1.0* | **$ -** | **$ 3.01** | **$ -** | **$ -** |

| Net New Value ($M) | | | | Stakeholder | Net New Cost | | | |
|---|---|---|---|---|---|---|---|---|
| Rx | Medical | Productivity | Societal | | Rx | Medical | Productivity | Societal |
| | | | | Society ROI Favorable | | | | |
| | | | | Government n/a | | | | |
| | | | | Providers n/a | | | | |
| | | | | Employers ROI Favorable | | | | |
| | | | | Health Plans 1.5:1.0 | | | | |
| | | | | PBMs n/a | | | | |
| | | | | Patients ROI Favorable | | | | |
| | | | | Total ROI 2.8:1.0 | | | | |

Overall, the comprehensive ROI for the digital MSK health program in this scenario is 4.4:1 over two years. The incremental costs are additional medical costs paid by the health plans that are associated with the optimization of care. Incremental value largely comprises medical cost savings accruing to health plans and patients (in the form of reduced deductibles, copays and coinsurance payments). Pharmacy and medical cost savings together comprise TCOC savings. Different calculation methods can be applied to project TCOC savings. A research project published earlier this year by the SOA Research Institute (entitled "Reimagining Pharmacy Financing")[36] examined the pros and cons of different TCOC savings calculation methodologies for higher cost versus lower cost diabetes and hypertension medications.

Health plans are projected to realize a 1.5:1 ROI as the incremental medical cost savings is expected to be 1.5 times the incremental medical costs necessary to achieve care optimization. Significant productivity value is also projected to accrue to employers and some to patients/employees without employers or patients accruing any incremental costs. Value Stacks can also be used to compare ROIs for various time

periods as well (one year, two years, three years, five years, 10 years etc.) to set expectations on “break-even periods” and for long-term strategic planning purposes.

Having the different ROIs calculated transparently for the various stakeholders can bring greater insight to all parties involved in access and reimbursement negotiations, clinical programs, and medical policy design and coverage decisions. The greater clarity that a Value Stack provides can help stakeholders understand and better influence decisions being made by other stakeholders. Intermediary stakeholders can better appreciate the ROI their clients may realize from certain coverage decisions. Value-based agreements can be based on components of the Value Stack that are important to the stakeholders involved, and open, transparent assumptions and calculation methodologies can be refined through negotiations and ongoing research.

# Section 7. Lessons Learned and Next Steps

Although the PHTI assessments raised health care analytics to a new level, more is left to be done for such assessments to be useful and relevant for the various day-to-day responsibilities actuaries fulfill. Some of the areas for further work are related to the preparation and interpretation of the assessment. In addition, areas for further research and education exist within the health economics community that would help bridge their work to the actuarial approaches upon which payer decision-making often relies.

## 7.1 ASSESSMENTS

The PHTI assessments provide a solid foundation for payers and others to measure the budget impact and calculate the ROI for a new technology. That said, an actuary or analyst must consider multiple factors in using this information. These differences include the following:

- *Population:* By design the PHTI assessments are population based and not specific to any one payer, such as a self-insured employer. In the diabetes case study, a comparison was made between the eligible member in the assessment and the eligible members in the overall commercial population as determined by the MarketScan data. For the most part, the numbers were similar but not exactly the same. Actuaries are responsible for modeling impact for the populations for which they calculate ROI, TCOC budget impact and premium rates. Having the ability to efficiently adjust the results of studies for population differences is important for actuaries to be able to apply the results of studies such as the PHTI assessment.

- *Comparators:* Similarly, by design the comparator for the assessments was "usual care" and care with the new technology. For an individual payer, the "usual care" may differ from the "usual care" of a broader national population or the population selected for a particular published study. Again, the numbers in the assessments were close to the MarketScan data, and those differences may or may not have been material. But having the ability to adjust expected results for those differences when they are expected to be material is important for actuaries.

- *Data Collection and Curation:* Since the goal of the PHTI assessments is to provide evidence-based conclusions, the assessments reflected only papers and sources that met those established criteria. To fully understand the risk associated with a new technology, an actuary must consider all sources relevant to that analysis even if some are biased. Of course, the actuary must identify any sources of risk (including bias) associated with that process and opine on whether its impact is likely to be material and the range of potential magnitude of the impact.

- *Methodology and Assumptions:* Although actuaries often use the techniques described in the assessments to measure the impact of a new technology, sometimes a more nuanced approach best meets the needs of the payer or clients. Similarly, a wide range of possible values exists for the assumptions that may or may not be relevant to the decision-maker. Using dynamic scenario-driven models or stochastic models to assess the range of possible outcomes and the unlikely but extreme magnitude of impact of potential "black swan events" is often useful to actuaries.

Although the PHTI assessment was well documented overall, several areas stand out where more information would have been extremely useful. For example, it would have been very useful to have more information about how results vary for different populations, time periods and key input assumptions. Also, if an assumption is based on certain procedure codes, such as the ones used to estimate the cost of an RPM, then the assessment would provide even greater usability if it specified the effective period of the data. Other areas were noted above.

## 7.2 FURTHER RESEARCH AND EDUCATION

Some of the key assumptions in the assessments had to do with estimating how people will behave once a new technology is introduced. How many people are willing and able to pay for the new technology? How long will it take for people to start using the technology? Important questions also surround what happens clinically once a patient starts using the technology. How long will it take before clinical benefits are realized? Do the benefits increase or level off over time? Of course, we have no way of knowing this when a new technology is introduced, but lessons are to be learned from studying the answers to those questions using similar technologies that have been around for a while.

Ultimately, actuaries need to evaluate the answers to those questions and their quantified impact to build appropriate budget forecasts and premium rates and to evaluate the ROI of new or changing programs.

Finally, the two new techniques discussed in this report, Total Risk Analysis and the Value Stack, need to be studied further in various applications to be incorporated into day-to-day analytics.

## Section 8. Acknowledgments

The researchers' deepest gratitude goes to those without whose efforts this project could not have come to fruition: the Project Oversight Group and others for their diligent work reviewing and editing this report for accuracy and relevance.

Project Oversight Group members

Kenneth S. Avner, FSA, MAAA

Craig Cartossa, ASA, MAAA

Wenjun Dong, FSA

Ian G. Duncan, FSA, FIA, FCIA, MAAA, FCA

Kevin B. Francis, FSA, MAAA

Blake Hill, FSA, FCIA,

Thomas Lemire, FSA

Amanda LoBello, FSA, MAAA

Daniel Mulhern, FSA, MAAA

Pei Pei, ASA

Marjorie A. Rosenberg, FSA, Ph.D.

Sudha Shenoy, FSA, MAAA, CERA

At the Peterson Health Technology Institute

Caroline Pearson

Prabhjot Singh, M.D., Ph.D.

At the Society of Actuaries Research Institute

Achilles Natsis, FSA, MAAA

Barbara Scott

# Appendix A. Musculoskeletal MarketScan Data Analysis

**MSK Resource Use**

AHP Analysis of 2021 MarketScan Data

| Adverse Event | Incremental Utilization / K | | | Cost Per Event |
|---|---|---|---|---|
| | Low-Acuity | Medium-Acuity | High-Acuity | |
| **Back** | | | | |
| *Inpatient - MSK* | - | - | 51 | $ 18,159 |
| *Emergency Room* | 0 | 1 | 161 | $ 720 |
| *Surgical Procedures* | 1 | 8 | 361 | $ 770 |
| *Joint Injection* | 0 | 0 | 79 | $ 145 |
| *Imaging* | 8 | 525 | 466 | $ 589 |
| *Physical/Occupational Therapy* | - | 2 | 4 | $ 193 |
| *Specialist Visits* | 2 | 10 | 13,026 | $ 92 |
| *Non-Specialist Visits* | 17 | 1,887 | 1,781 | $ 156 |
| *Presenteeism Days Est* | 33 | 2,466 | 18,226 | |
| **Shoulder** | | | | |
| *Inpatient - MSK* | - | - | 27 | $ 7,775 |
| *Emergency Room* | 0 | 1 | 183 | $ 711 |
| *Surgical Procedures* | 1 | 2 | 840 | $ 1,221 |
| *Joint Injection* | 0 | 2 | 555 | $ 151 |
| *Imaging* | 17 | 588 | 846 | $ 513 |
| *Physical/Occupational Therapy* | - | 3 | 8 | $ 221 |
| *Specialist Visits* | 2 | 8 | 10,229 | $ 175 |
| *Non-Specialist Visits* | 22 | 1,406 | 2,242 | $ 164 |
| *Presenteeism Days Est* | 47 | 2,023 | 19,453 | |
| **Arm** | | | | |
| *Inpatient - MSK* | - | - | 28 | $ 3,645 |
| *Emergency Room* | 1 | 0 | 204 | $ 703 |
| *Surgical Procedures* | 1 | 5 | 507 | $ 822 |
| *Joint Injection* | - | 1 | 340 | $ 121 |
| *Imaging* | 20 | 398 | 582 | $ 472 |
| *Physical/Occupational Therapy* | - | - | 4 | $ 207 |
| *Specialist Visits* | 2 | 13 | 6,702 | $ 165 |
| *Non-Specialist Visits* | 30 | 1,391 | 1,967 | $ 157 |
| *Presenteeism Days Est* | 62 | 1,828 | 13,363 | |
| **Wrist/Hand** | | | | |
| *Inpatient - MSK* | - | - | 21 | $ 2,155 |
| *Emergency Room* | 0 | 0 | 229 | $ 663 |
| *Surgical Procedures* | 1 | 10 | 787 | $ 851 |
| *Joint Injection* | 0 | 1 | 222 | $ 141 |
| *Imaging* | 19 | 486 | 595 | $ 443 |
| *Physical/Occupational Therapy* | - | 0 | 3 | $ 189 |
| *Specialist Visits* | 3 | 12 | 4,439 | $ 202 |
| *Non-Specialist Visits* | 22 | 1,318 | 1,832 | $ 157 |
| *Presenteeism Days Est* | 51 | 1,867 | 12,147 | |
| **Hip/Lower Limb** | | | | |
| *Inpatient - MSK* | - | - | 83 | $ 11,371 |
| *Emergency Room* | 1 | 0 | 162 | $ 720 |
| *Surgical Procedures* | 1 | 5 | 843 | $ 1,666 |
| *Joint Injection* | 1 | 5 | 374 | $ 257 |
| *Imaging* | 20 | 565 | 887 | $ 531 |
| *Physical/Occupational Therapy* | - | 6 | 231 | $ 182 |
| *Specialist Visits* | 2 | 11 | 9,096 | $ 222 |
| *Non-Specialist Visits* | 23 | 1,481 | 2,257 | $ 163 |
| *Presenteeism Days Est* | 53 | 2,099 | 18,750 | |
| **Knee** | | | | |
| *Inpatient - MSK* | - | - | 55 | $ 8,535 |
| *Emergency Room* | 0 | 0 | 204 | $ 705 |
| *Surgical Procedures* | 0 | 2 | 844 | $ 1,267 |
| *Joint Injection* | 0 | 1 | 846 | $ 150 |
| *Imaging* | 11 | 518 | 791 | $ 529 |
| *Physical/Occupational Therapy* | - | 3 | 160 | $ 199 |
| *Specialist Visits* | 2 | 14 | 7,109 | $ 233 |
| *Non-Specialist Visits* | 16 | 1,501 | 2,351 | $ 165 |
| *Presenteeism Days Est* | 31 | 2,052 | 17,480 | |
| **Ankle** | | | | |
| *Inpatient - MSK* | - | - | 27 | $ 2,539 |
| *Emergency Room* | 0 | 0 | 311 | $ 652 |
| *Surgical Procedures* | 1 | 2 | 393 | $ 1,043 |
| *Joint Injection* | - | 0 | 202 | $ 130 |
| *Imaging* | 22 | 465 | 672 | $ 444 |
| *Physical/Occupational Therapy* | - | 0 | 3 | $ 190 |
| *Specialist Visits* | 3 | 14 | 5,563 | $ 228 |
| *Non-Specialist Visits* | 20 | 1,302 | 1,868 | $ 153 |
| *Presenteeism Days Est* | 47 | 1,795 | 11,678 | |

**Total Cost Of Care Offset**

AHP Analysis of 2021 MarketScan Data

| Joint Category | Acuity Group | % of Joint | Non-MSK PMPM | |
|---|---|---|---|---|
| | | | Total | Incremental |
| No MSK | NA | 67.9% | $ 260.92 | $ - |
| Back | Low | 3.2% | 596.80 | 335.88 |
| | Medium | 3.2% | 587.42 | 326.50 |
| | High | 7.0% | 504.93 | 492.35 |
| | Very High | 1.1% | 2,343.56 | |
| Shoulder | Low | 0.6% | 647.82 | 386.90 |
| | Medium | 0.9% | 526.73 | 265.81 |
| | High | 1.3% | 568.39 | 446.27 |
| | Very High | 0.4% | 1,169.59 | |
| Arm | Low | 0.2% | 1,039.44 | 778.51 |
| | Medium | 0.3% | 509.99 | 249.07 |
| | High | 0.2% | 626.91 | 632.69 |
| | Very High | 0.1% | 1,947.41 | |
| Wrist/Hand | Low | 0.6% | 483.02 | 222.10 |
| | Medium | 0.8% | 487.06 | 226.13 |
| | High | 0.5% | 641.21 | 509.65 |
| | Very High | 0.2% | 1,045.45 | |
| Hip/Lower Limb | Low | 0.4% | 728.90 | 467.98 |
| | Medium | 0.6% | 601.90 | 340.98 |
| | High | 0.7% | 586.98 | 537.23 |
| | Very High | 0.3% | 1,349.21 | |
| Knee | Low | 1.0% | 521.16 | 260.24 |
| | Medium | 1.3% | 485.88 | 224.96 |
| | High | 1.0% | 577.41 | 489.85 |
| | Very High | 0.2% | 1,664.90 | |
| Ankle | Low | 1.8% | 821.11 | 560.19 |
| | Medium | 1.7% | 516.17 | 255.25 |
| | High | 2.0% | 624.63 | 572.03 |
| | Very High | 0.7% | 1,416.84 | |

**Pain Prevalence**

*AHP Analysis of 2021 MarketScan Data*

| | | | Back | Shoulder | Arm | Wrist/Hand | Hip/Lower Limt | Knee | Ankle |
|---|---|---|---|---|---|---|---|---|---|
| Male | 18-24 | Low | 11.69 | 3.05 | 0.77 | 3.96 | 1.23 | 5.64 | 5.44 |
| | | Medium | 13.16 | 6.26 | 1.71 | 6.13 | 2.34 | 9.74 | 8.88 |
| | | High | 38.10 | 8.65 | 1.74 | 5.12 | 3.74 | 11.64 | 9.22 |
| | 25-34 | Low | 16.15 | 3.72 | 0.88 | 3.37 | 1.31 | 6.93 | 5.74 |
| | | Medium | 19.29 | 5.85 | 1.64 | 5.20 | 2.42 | 9.16 | 8.54 |
| | | High | 54.53 | 8.09 | 1.37 | 4.02 | 3.67 | 10.26 | 7.89 |
| | 35-44 | Low | 24.62 | 5.55 | 1.91 | 4.13 | 2.10 | 11.38 | 8.11 |
| | | Medium | 27.96 | 7.81 | 3.87 | 5.88 | 3.73 | 12.81 | 10.74 |
| | | High | 74.49 | 13.09 | 3.51 | 5.03 | 5.49 | 15.46 | 8.85 |
| | 45-54 | Low | 29.92 | 7.51 | 2.90 | 4.96 | 3.20 | 17.41 | 9.87 |
| | | Medium | 34.20 | 10.21 | 4.90 | 6.65 | 5.30 | 17.18 | 12.00 |
| | | High | 80.06 | 20.98 | 4.73 | 6.07 | 8.31 | 27.01 | 9.54 |
| | 55-64 | Low | 34.76 | 8.64 | 2.33 | 6.58 | 4.82 | 25.25 | 10.60 |
| | | Medium | 37.89 | 11.54 | 4.07 | 7.53 | 8.24 | 21.67 | 12.48 |
| | | High | 78.11 | 26.05 | 4.16 | 7.62 | 12.61 | 40.41 | 9.37 |
| Female | 18-24 | Low | 22.75 | 2.82 | 0.58 | 3.26 | 1.57 | 8.62 | 6.48 |
| | | Medium | 18.17 | 3.99 | 1.25 | 5.65 | 2.73 | 10.72 | 10.63 |
| | | High | 56.85 | 5.56 | 1.19 | 5.14 | 4.73 | 12.83 | 11.49 |
| | 25-34 | Low | 27.67 | 3.29 | 0.58 | 4.17 | 2.08 | 11.68 | 6.76 |
| | | Medium | 21.61 | 4.16 | 1.11 | 6.47 | 2.64 | 10.46 | 9.37 |
| | | High | 77.47 | 5.86 | 1.04 | 5.57 | 5.01 | 12.51 | 9.54 |
| | 35-44 | Low | 34.74 | 5.09 | 1.27 | 5.57 | 3.06 | 17.06 | 9.76 |
| | | Medium | 31.80 | 6.88 | 2.51 | 8.08 | 4.42 | 15.21 | 12.66 |
| | | High | 93.17 | 10.98 | 2.62 | 7.33 | 7.58 | 19.25 | 11.92 |
| | 45-54 | Low | 40.92 | 7.71 | 2.02 | 7.37 | 4.79 | 25.19 | 12.65 |
| | | Medium | 39.30 | 10.17 | 3.96 | 9.76 | 7.02 | 21.43 | 16.11 |
| | | High | 96.50 | 21.37 | 4.25 | 9.93 | 11.65 | 34.91 | 15.55 |
| | 55-64 | Low | 41.60 | 8.61 | 1.50 | 9.67 | 6.62 | 32.59 | 13.92 |
| | | Medium | 41.48 | 10.65 | 2.81 | 11.35 | 9.90 | 25.80 | 17.00 |
| | | High | 88.23 | 24.93 | 2.92 | 11.64 | 16.04 | 49.40 | 14.70 |

# Endnotes

[1] Drew Altman, Why Affordability Is the Big Tent, *KFF*, 2024, https://www.kff.org/from-drew-altman/why-affordability-is-the-big-tent/.
[2] Centers for Disease Control and Prevention (CDC), Fast Facts: Health and Economic Costs of Chronic Conditions, *CDC*, 2024, https://www.cdc.gov/chronic-disease/data-research/facts-stats/index.html.
[3] Peterson Health Technology Institute, About Us, *Peterson Health Technology Institute*, 2024, https://phti.org/about-us/.
[4] Peterson Health Technology Institute, Digital Diabetes Management Solutions Health Technology Assessment V1.1, *Peterson Health Technology,* 2024, https://phti.org/wp-content/uploads/sites/3/2024/04/PHTI-Digital-Diabetes-Mgmt-Assessment-Report-v1.1.pdf.
[5] Peterson Health Technology Institute, Virtual Musculoskeletal Solutions Health Technology Assessment, V1.2, *Peterson Health Technology Institute,* 2024, https://phti.org/wp-content/uploads/sites/3/2024/07/PHTI-Virtual-MSK-Solutions-Assessment-Report-v1.2.pdf.
[6] Peterson Health Technology Institute, ICER-PHTI Assessment Framework for Digital Health Technologies, *Peterson Health Technology Institute,* 2023, Microsoft Word - ICER-PHTI Assessment Framework for Digital Health Technologies
[7] Actuarial Standards Board, 2024 Standards of Practice, *Actuarial Standards Board,* 2024, https://www.actuarialstandardsboard.org/standards-of-practice/.
[8] Mathew Hutson, Cutting to the Chase, *Nature* 627 (2024):S2–S5 .
[9] Health Research Funding, 12 Pros and Cons of the Da Vinci Robotic Surgery, *hrf*, n.d., https://healthresearchfunding.org/12-pros-and-cons-of-the-da-vinci-robotic-surgery/.
[10] Rachel Marley, Top 10 Healthcare Trends Expected to Take 2023 by Storm, 2022, Healthcare Transformers. 2022, Top 10 healthcare trends for 2023 | Healthcare Transformers
[11] Health Care Payment Learning & Action Network, APM Framework Home Page, *HCPLAN,* 2017, https://hcp-lan.org/apm-framework/.
[12] Mitre Corporation, An Alternative Payment Model: APM Framework, *HCPLAN,* 2017, https://hcp-lan.org/workproducts/apm-refresh-whitepaper-final.pdf.
[13] Peterson Health Technology Institute, Assessment Framework, *Peterson Health Technology Institute*, 2020, https://phti.org/our-approach/assessment-framework/.
[14] Actuarial Standards Board, Standards of Practice, *Actuarial Standards Board*, 2024, https://www.actuarialstandardsboard.org/standards-of-practice/.
[15] Joan Barrett, Achilles Natsis, and Tony Pistilli, Calculated Risk: Driving Decisions Using the 5/50 Research, *Society of Actuaries,* 2024, https://www.soa.org/resources/research-reports/2023/calculatedrisk-using-550research/
[16] See note 4 above.
[17] Joan Barrett et al., Reimagining Pharmacy Financing, *Society of Actuaries,* 2024, https://www.soa.org/resources/research-reports/2024/reimagining-pharmacy-financing/
[18] Ibid.
[19] Ibid.
[20] Thomas B. Ferrante, Rachel B. Goodman, and Nathaniel M. Lacktman, 2021 Medicare Remote Patient Monitoring FAQs: CMS Issues Final Rule, *National Law Review,* 2024, https://natlawreview.com/article/2021-medicare-remote-patient-monitoring-faqs-cms-issues-final-rule
[21] See note 12 above.

[22] M. J. Lage and K. S. Boye, The Relationship between HbA1c Reduction and Healthcare Costs among Patients with Type 2 Diabetes: Evidence from a U.S. Claims Database, Current Medical Research Opinion 36 (2020):1441–1447.
[23] Joan C. Barrett, *Medical Claims Cost Trends*. Group Insurance. 8th ed. Skwire, 2020.
[24] See note 21 above.
[25] Joan Barrett, Achilles Natsis, and Tony Pistilli, Calculated Risk: Driving Decisions Using the 5/50 Research, *Society of Actuaries,* 2024, https://www.soa.org/resources/research-reports/2023/calculatedrisk-using-550research/
[26] Ibid.
[27] See note 5 above.
[28] Patrick Curran and Heidi Laughlin, Hinge Health Medicare Cost and Utilization Study, *Optum,* 2022, https://assets.ctfassets.net/cad7d5zna5rn/6BN7T0unYTlqPcEFDmNw54/8a16f0f497294d25f9838871b7b053c2/Hinge_Health_Medicare_Cost_and_Utilization_Study.pdf.
[29] PwC, Medical Cost Trend Report: Behind the Numbers 2025, *PwC,* 2024, https://www.pwc.com/us/en/industries/health-industries/library/behind-the-numbers.html.
[30] Actuarial Standards Board, Actuarial Standard of Practice No. 23, *Actuarial Standards Board,* 2016, https://www.actuarialstandardsboard.org/asops/data-quality/.
[31] Hinge Health, Validation Institute Independently Validates Hinge Health Outcomes, *Hinge Health,* 2021, https://www.hingehealth.com/resources/press-releases/validation-institute-proven-to-reduce-medical-claims/.
[32] Austin Barrington, Deana Bell, and Austin Levenson, Independent Review of Methodology for Quantifying Financial Impact of the Vori Health Musculoskeletal Care Pathways Program, *Milliman,* Jan. 2023, https://www.milliman.com/-/media/milliman/pdfs/2023-articles/1-12-23_independent-review-of-vori-methodology.ashx.
[33] Sword Health, Assessment of Medical Cost Savings from Sword's MSK Interventions, *Sword Health,* June 2024, https://go.swordhealth.com/rs/675-GJP-011/images/Sword%20Health%20Medical%20Cost%20Savings%20Study%20June%202024?version=0.
[34] Julie M. Fritz et al., Primary Care Referral of Patients with Low Back Pain to Physical Therapy, *Spine* 37 (2014):2114–2121.
[35] Thomas R. Denninger et al., The Influence of Patient Choice of First Provider on Costs and Outcomes: Analysis from a Physical Therapy Patient Registry, *Journal of Orthopaedic & Sports Physical Therapy* 48 (2017):1–26.
[36] D. J. Gaskin and P. Richard, The Economic Costs of Pain in the United States. In Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education, *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research,* Appendix C (Washington, DC: National Academies Press, 2011).
[37] A. B. Sadosky et al., The Association between Lower Back Pain and Health Status, Work Productivity, and Health Care Resource Use in Japan, *Journal of Pain Research* 8 (2015):119–130. *Relieving Pain in America*, note 35 above. D. Allen et al., Four-Year Review of Presenteeism Data among Employees of a Large United States Health Care System: A Retrospective Prevalence Study, *Human Resources for Health* 16 (2018):59.
[38] G. Wang et al., Clinical Outcomes One Year after a Digital Musculoskeletal (MSK) Program: An Observational, Longitudinal Study with Nonparticipant Comparison Group, *BMC Musculoskeletal Disorders* 23 (2022):237.
[39] See note 28 above.
[40] Sworkit, How Much Does Sworkit Cost?, *Sworkit,* n.d., https://help.sworkit.com/en/articles/2561454-how-much-does-sworkit-cost#:~:text=Sworkit%20currently%20offers%20two%20subscription,%2Dfree%207%2DDay%20trial.

## About The Society of Actuaries Research Institute

Serving as the research arm of the Society of Actuaries (SOA), the SOA Research Institute provides objective, data-driven research bringing together tried and true practices and future-focused approaches to address societal challenges and your business needs. The Institute provides trusted knowledge, extensive experience and new technologies to help effectively identify, predict, and manage risks.

Representing the thousands of actuaries who help conduct critical research, the SOA Research Institute provides clarity and solutions on risks and societal challenges. The Institute connects actuaries, academics, employers, the insurance industry, regulators, research partners, foundations, and research institutions, sponsors, and non-governmental organizations, building an effective network which provides support, knowledge, and expertise regarding the management of risk to benefit the industry and the public.

Managed by experienced actuaries and research experts from a broad range of industries, the SOA Research Institute creates, funds, develops and distributes research to elevate actuaries as leaders in measuring and managing risk. These efforts include studies, essay collections, webcasts, research papers, survey reports, and original research on topics impacting society.

Harnessing its peer-reviewed research, leading-edge technologies, new data tools and innovative practices, the Institute seeks to understand the underlying causes of risk and the possible outcomes. The Institute develops objective research spanning a variety of topics with its strategic research programs: aging and retirement; actuarial innovation and technology; mortality and longevity; diversity, equity and inclusion; health care cost trends; and catastrophe and climate risk. The Institute has a large volume of topical research available, including an expanding collection of international and market-specific research, experience studies, models and timely research.

Society of Actuaries Research Institute
8770 W Bryn Mawr Ave, Suite 1000
Chicago, IL 60631
www.SOA.org