Measuring Medical and Pharmaceutical Costs Along the Disability Continuum

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Acronyms and Abbreviations

ACS	American Community Survey
AHRQ	U.S. Agency for Healthcare Research and Quality
CCAE	MarketScan Commercial Claims and Encounters research database from Truven Health Analytics
CCS	Clinical Classification Software
CPT©	Current Procedural Terminology from the American Medical Association
First Absence Date	first date of worker absence according to the short-term disability claim
Full Duty Date	return-to-work date according to the short-term disability claim
HIPAA	Health Insurance Portability and Accountability Act
HPM	Health and Productivity Management research database from Truven Health Analytics
IPW	inverse probability weighting
Lasso	least absolute shrinkage and selection operator method
MSA	metropolitan statistical area
PAC	potentially avoidable costs
Physiological durations	evidence-based return-to-activity duration recommendations
RTW	return-to-work
STD	short-term disability
Observed duration	the actual disability duration for the claim

EXECUTIVE SUMMARY

Reduced disability durations are beneficial for employers but are also associated with health benefits to the patient (Talmage, Melhorn, & Hyman, n.d.). Typically, employers estimate the costs of disability-related absences by multiplying the number of lost workdays by fixed estimates for lost wages, benefits, lost productivity, and replacement labor. Missing from this equation is an estimate of the health care costs incurred during these absences. In order to get a full and accurate picture of disability absence costs, we quantified: (1) the medical costs for each day during a disability episode, and (2) the potentially avoidable medical costs if disability cases returned to work at an optimal recovery duration.

To estimate the cost of medical care during disability, ReedGroup analyzed a longitudinal dataset of ~886k short-term disability (STD) claims representing 41 million medical events. By evaluating the medical costs incurred during the disability episode and the length of disability as compared to MDGuidelines® physiological duration tables, we calculated the potential medical cost savings associated with reduced disability durations. The level of detail available in this dataset allowed us to adjust for potential case-level covariates that affected both disability duration and medical costs, such as disease severity, treatment type, history of prior STD absence, employment status, and more.

We found that for non-surgical and surgical treatment of meniscus disorder, 35% and 50% of medical costs, respectively, occurred by the first absence date and 18-20% occurred after half of the employees returned to work (RTW). We observed significant variability in total medical costs for the disability episode by both diagnosis and treatment. For example, the average total medical costs during the disability episode for anxiety claims was only ~$2k, while it was more than $26k for morbid obesity. With respect to treatment for meniscus disorder, the average cost per case for non-surgical treatment was ~$3k, whereas arthroscopic meniscectomy was ~$7k, and total knee replacement was ~$25k.

Although most medical costs are incurred at the start of an individual's disability, we found that significant expenses could have been saved throughout the disability episode. For example, among the 13,000 cases that experienced treatment for meniscus disorders, approximately $10.4 million in medical and pharmaceutical costs were incurred after the point when the individual could reasonably have been expected to return to work. Similarly, among the 1,256 carpal tunnel cases that had a carpal tunnel release surgery, approximately $957 in excess costs per case could have been saved had the employees returned to work within the expected durations. When applied to a population of all U.S. workers with short-term disability benefits, we believe that approximately $6.5 billion, or 23% of total STD-related medical costs are avoidable. These results demonstrate that evidence-based medical care and case management, aimed at reducing disability durations, may help employers reduce medical expenditures.

INTRODUCTION

Disability-related absences impose a staggering $443 billion on private employers in the U.S. due to absence and lost productivity costs each year (IBI, 2017). This estimate, however, does not include the health care cost burden that is incurred during the disability episode. Since private employers provide health insurance for more than half of the U.S. population and half of all medical and pharmacy payments are attributable to approximately one-quarter of employees who had a disability-related absence, medical costs must be included in the estimates of disability-related absence costs (Gifford, 2017; Kaiser Family Foundation, 2016).

Despite the burden of medical costs on employers, estimating the medical costs associated with disability has proven difficult. Health Insurance Portability and Accountability Act of 1996 (HIPAA) regulations restrict employers' access to employees' private health information to prevent this information from being used against employees in connection with their employment. The currently available medical cost estimates are typically a single fixed estimate for all diagnoses and do not account for how medical costs decrease throughout the disability episode.

The goals of this project were to use a large, integrated set of health care and absence data to: (1) calculate the daily average medical costs throughout the disability episode for multiple conditions; and (2) quantify the medical costs that could be avoided by reduced disability durations, after adjusting for case characteristics.

STUDY DATA AND METHODS

The Truven MarketScan Health and Productivity Management (HPM) and Commercial Claims and Encounters (CCAE) databases were used for this study. These databases contain de-identified, patient-level disability (HPM) and medical (CCAE) claims for commercially-insured U.S. employees. Our analysis dataset included employees that had commercial health insurance and an STD absence that started between January 1, 2007 and December 31, 2013. These short-term disability claims were connected to medical records that occurred between January 1, 2007 and December 31, 2014. Medical data from 2014 was included to capture the costs for disability claims that began at the end of 2013. Since most STD programs do not provide benefits longer than one year, we included cases with a disability duration between 0 and 365 (Bureau of Labor Statistics, 2011; IBI, 2016). The final analysis dataset represented 886,110 STD claims for 7,614 diagnoses and included more than 41 million medical events (Figure 1).

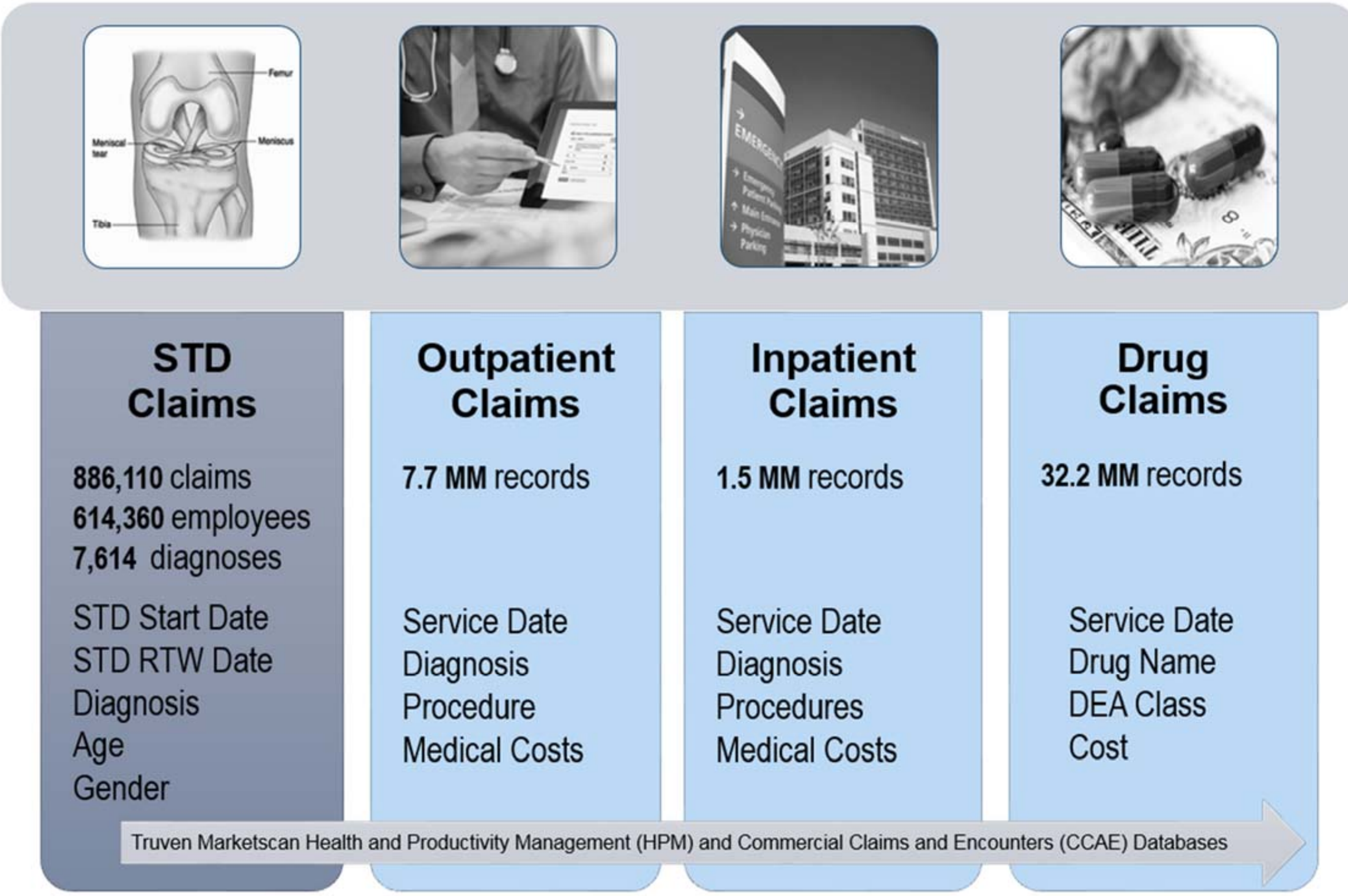

Figure 1. Linkage of key data elements from the Truven MarketScan Databases.

MEDICAL COSTS AND DIAGNOSTIC GROUPINGS

Medical costs from the CCAE database represent the total gross, eligible payment after applying pricing guidelines, such as fee schedules or discounts negotiated by health plans, but before the total payment was allocated to the health plan or employee in the form of deductibles, copayments, and coordination of benefits. All medical events that occurred during the disability episode were used in our identification of treatments and comorbid conditions, but we only counted the costs for medical events associated with the primary diagnosis.

The diagnosis reported on the STD claim was used as the **primary diagnosis** for each record. Treatments and comorbid conditions were identified from the medical claims. To identify and categorize each medical event by relatedness to the primary STD diagnoses, we used a combination of the 2015 version of the Agency for Healthcare Research and Quality's (AHRQ) Clinical Classification Software (CCS) and Major Diagnostic Subcategories as defined by the World Health Organization (Elixhauser, A; Steiner, C; Palmer, L, 2015). AHRQ developed the CCS to collapse diagnoses and procedures into a manageable number of clinically meaningful groups. The CCS single-level system groups diagnoses into 285 mutually exclusive categories. We found that the CCS system alone excluded some medical events that were relevant to the primary diagnosis, so we also included the costs for medical events for diagnoses in the same Major Diagnostic Subcategory as the primary diagnosis.

DEFINING THE DISABILITY EPISODE

The **disability episode** for each STD claim was defined using the employees' first absence date and the date they returned to full duty. Medical events and costs that occurred up to one week (seven days) prior to the employees' first absence date were included to capture medical events, such as pre-op office visits, imaging studies, or procedures, that were directly related to the primary diagnosis. For some records, the benefit start date was reported as the first absence date and these medical events occurred during a waiting period before the initiation of STD benefits. Medical events and costs that occurred up to one month (30 days) after the date that the employee returned to full duty were included since medical costs do not end abruptly when someone returns to work. This 30-day buffer served as an adjustment for the fact that cases with shorter durations typically incurred higher medical costs in the month following the return to work date than did cases with longer durations.

DISABILITY TIMELINE FOR A MENISCUS DISORDER

The service date for each medical event was used to assign that event and its associated costs to the day relative to the first absence date, which was defined as day zero. Figure 2 illustrates a single disability episode for a 50-year-old male with a meniscus tear who was absent for 64-days and incurred approximately $9,000 in medical costs during that time.

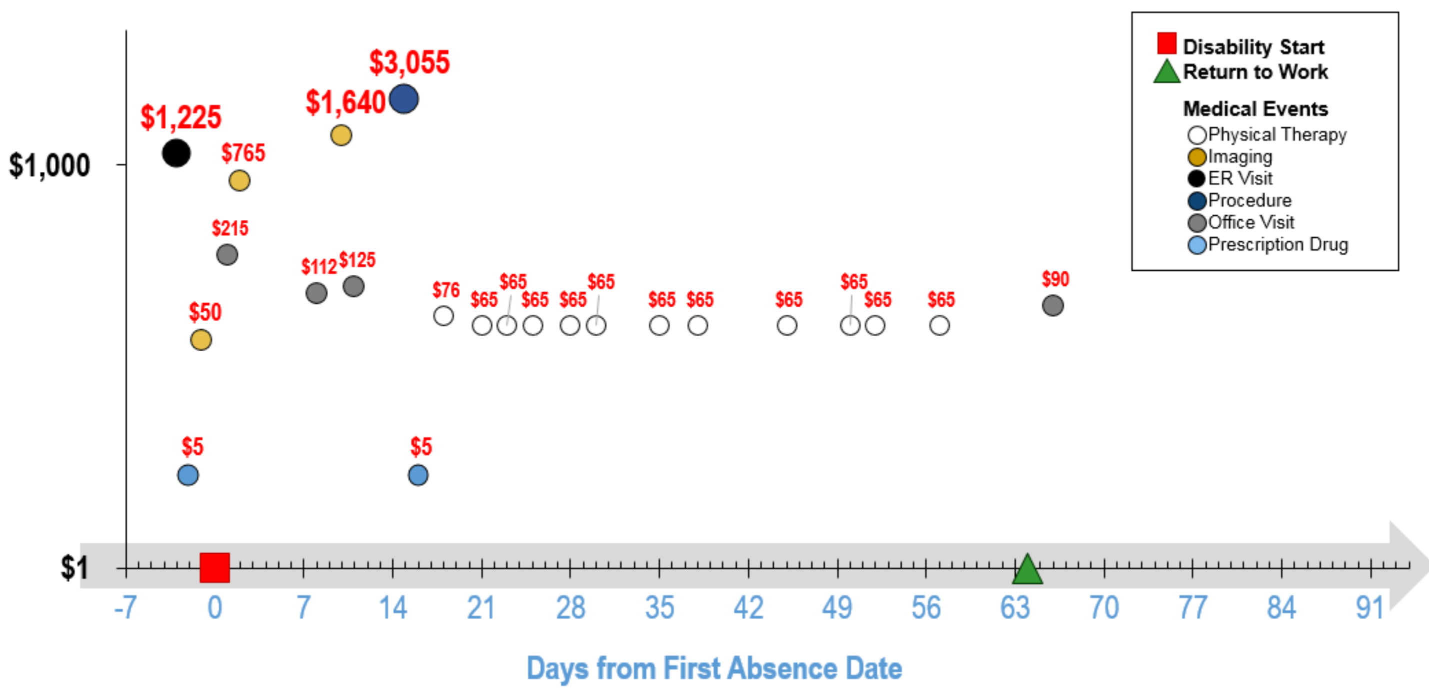

Figure 2. Example of a timeline of events and costs occurring during a single disability episode.

Starting at the beginning of the timeline, we see that this man went to the emergency room three days before his first absence date, which cost $1,225. He then received an imaging study that cost $50 (Doppler scan) and an opiate prescription for $5. On the first day after his first absence date, he visited an outpatient physician ($215) and was prescribed an MRI ($765). Again, he visited an outpatient physician ($112) on day 8 and was prescribed an MRI with contrast ($1,640). He returned for an outpatient pre-operation visit ($125) on day 11. On day 15, he had an arthroscopic meniscectomy surgery ($3,055) and received a post-operative opiate prescription ($5). He started physical therapy on day 18 and continued with this therapy every few days ($65-

$76 per visit) until he returned to work on day 64. Since we included all events that occurred up to 30 days after the return to work date, we can see that the only other medical event for this man was an outpatient office visit ($90) on day 66, shortly after returning to work.

For more information on meniscus disorders please review MDGuidelines for "Meniscus Disorders, Knee" and "Meniscectomy and Meniscus Repair" at www.mdguidelines.com

MEDICAL COSTS ALONG THE DISABILITY CONTINUUM

TREATMENT DETERMINES MEDICAL COST

To gain even greater granularity on the medical costs of a disability episode, we used the Current Procedural Terminology (CPT) codes of a case to assign treatment groupings. For example, we grouped meniscus disorder cases (ICD-9-CM codes: 836.0, 836.1, 836.2) based on whether or not the patient had any treatment for this condition and then whether or not the treated patients had surgery. We found a large variability in total medical costs by treatment for a meniscus disorder (Table 1). Average treatment costs ranged from $1,259 for the group that did not receive treatment to more than $25k for the cases that had a total knee replacement. Arthroscopic meniscectomy was by far the most common treatment with 10,973 (71%) of meniscus disorder cases in our analysis dataset receiving this option. No reported treatment related to the meniscus disorder was common but the 2,149 cases still incurred an average of $1,259 per case from office visits and diagnostic testing.

Table 1. Summary of the distribution of costs for 15,488 meniscus disorder cases by treatment type.

Treatment	Count	Total Medical Cost		
		25th%ile	Mean	75th%ile
Surgical Treatment				
Arthroscopic meniscectomy	10,973	$4,085	$7,409	$8,588
Meniscus repair	180	$5,938	$11,695	$14,939
Meniscus repair AND arthroscopic meniscectomy	145	$5,738	$11,721	$14,039
Total Knee Replacement	142	$8,565	$25,538	$36,482
Open AND arthroscopic meniscectomy	6	$5,729	$6,841	$7,943
Open meniscectomy	2	$8,982	$14,373	$19,764
Non-Surgical Treatment				
Non-surgical treatment	1,891	$649	$3,831	$4,739
No treatment	2,149	$47	$1,259	$993

We repeated this evaluation for carpal tunnel syndrome to see if this variability exists for another common condition. Again, we found a large variability in total medical costs by treatment for carpal tunnel syndrome (Table 2). Average total medical costs for the surgical group was approximately twice the cost incurred by the non-surgical treatment group. Our findings demonstrate that treatment is important for accurately estimating the total medical costs of the case.

Table 2. Summary of the distribution of costs for 10,984 carpal tunnel syndrome cases by treatment type.

Treatment	Count	Total Medical Cost		
		25th%ile	Mean	75th%ile
Surgical Treatment				
Carpal Tunnel Release	1,261	$3,921	$8,923	$9,091
Non-Surgical Treatment				
Non-Surgical Treatment	8,828	$1,436	$4,505	$5,710
No Treatment	895	$17	$626	$420

AVERAGE DAILY MEDICAL COSTS

One primary goal for this research was to calculate the average daily medical costs during a disability episode. We found that the highest average daily medical cost was incurred on the first day of absence, followed by a decline in costs through the remainder of the disability, for both meniscus disorder and carpal tunnel syndrome and for all associated treatments. For meniscus disorder (Figure 3a), the average daily medical cost for the non-surgical treatment option was higher than for arthroscopic meniscectomy from approximately 100 days onward, indicating the ongoing need for medical treatment among the non-surgical group. The variability in the average daily medical costs was the greatest for the meniscus repair group because only 180 cases (1%) received this treatment. Both the variability and the small number of cases receiving this treatment indicate that meniscus repair is likely not a cost-effective treatment for meniscus disorder. Among carpal tunnel cases (Figure 3b), the cost declined faster through time for the surgical group than for the non-surgical group.

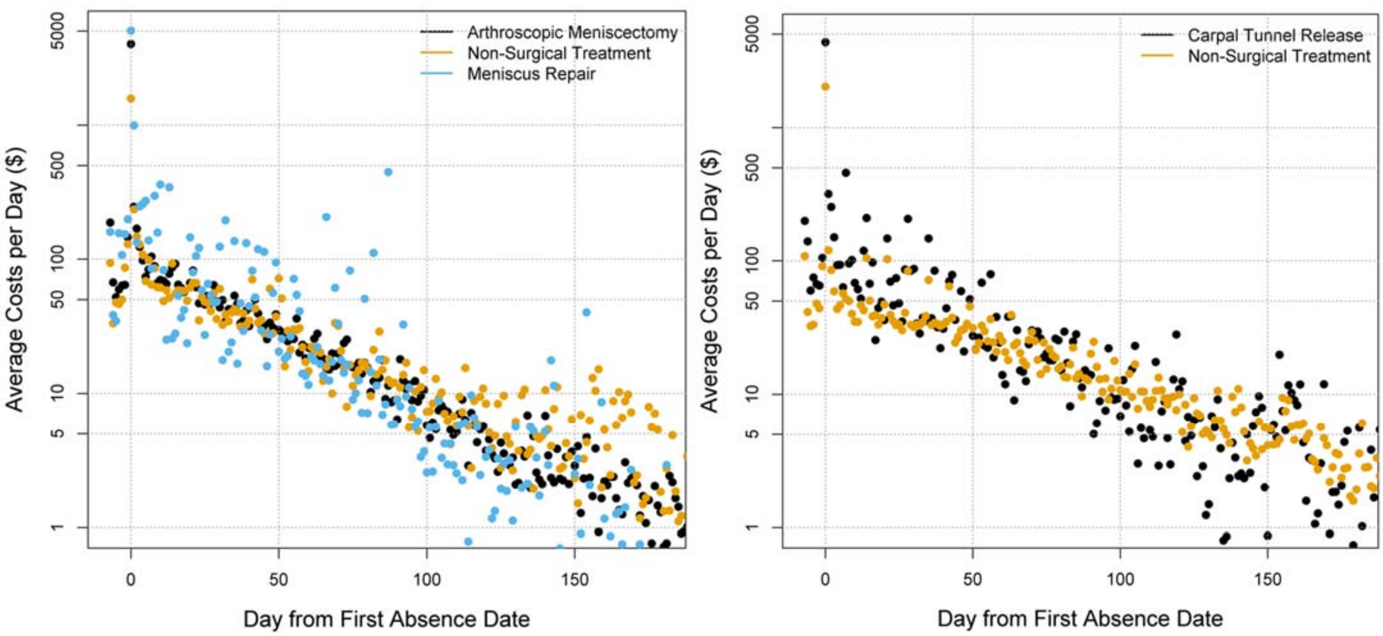

Figure 3. Average daily medical cost for three meniscus disorder treatments(a) and two carpal tunnel treatments (b).

ACCRUAL OF COSTS OVER TIME

We evaluated the accrual pattern of medical costs throughout the disability episode and confirmed that a significant proportion of medical costs were incurred on or before the first day of disability for both conditions and all treatments (Figure 4). For meniscus disorder, ~35% of costs for non-surgical cases and 50% of costs for surgical treatment cases occurred in the early days of the disability (Figure 4a). For carpal tunnel syndrome, ~40% of total costs were accrued by the first day of disability for both treatments. Despite these large upfront costs, we found that substantial costs continue to accrue throughout the remainder of a six-month disability period. Notably, these costs are incurred by fewer cases as time passes and cases return to work. When we identified the point at which half of the cases have returned to work (~50 days for both conditions), medical services that contributed approximately 18-26% of the costs, depending on the condition and treatment, had not yet occurred.

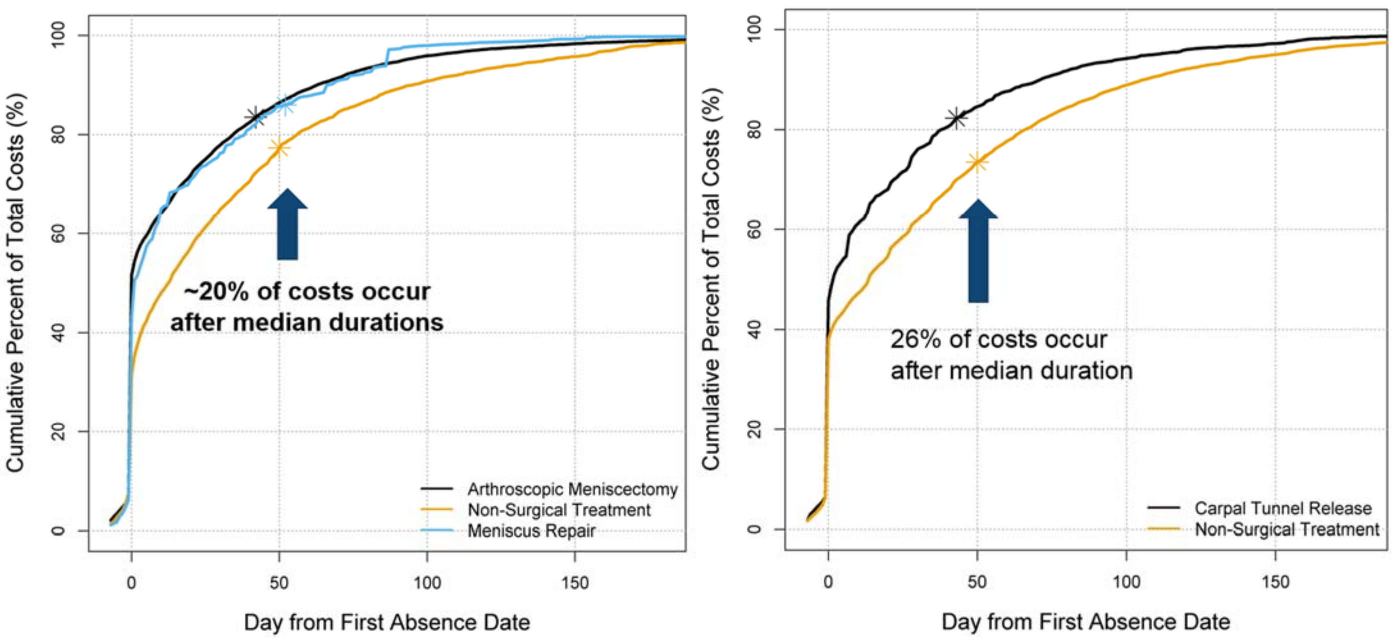

Figure 4. Cumulative percent of total costs throughout a six-month disability period for meniscus disorders (a) and carpal tunnel syndrome (b).

POTENTIALLY AVOIDABLE COSTS

Due to the relationship between disability duration and medical costs, we quantified the medical costs that could be avoided if cases returned to work at the optimum recovery time. We used the MDGuidelines physiological durations as the optimum recovery time. Therefore, the potentially avoidable costs (PAC) are the difference in costs if all employees returned at the optimum RTW date, as opposed to the observed RTW date.

MDGUIDELINES PHYSIOLOGICAL DURATIONS

The **physiological durations** are recommended disability durations that represent the physiological healing time for uncomplicated cases. Developed by the MDGuidelines Medical Advisory Board, the physiological durations are based on clinical expertise and informed by real world claims. MDGuidelines physiological durations provide minimum, optimum, and maximum recovery time by job classifications (Table 3). These job classifications were developed by the United States Department of Labor's *Dictionary of Occupational Titles* and are based on the amount of physical effort required to perform the work.

For the purposes of this analysis, we used the optimum duration for the medium job class. For example, the optimum duration for the medium job class in Table 3 is 21 (calendar) days.

Table 3. Example physiological duration table.

JOB CLASS	MINIMUM	OPTIMUM	MAXIMUM
Sedentary	1	7	42
Light	3	14	42
Medium	14	21	56
Heavy	21	32	84
Very Heavy	28	48	91

CALCULATING POTENTIALLY AVOIDABLE COSTS

To calculate potentially avoidable costs (PAC), we considered two important aspects of a leave:

1. Due to the complexity of their disease, some cases may not have been able to return to work sooner than their observed returned to work. Conversely, due to the lack of disease complexity, some cases should have returned to work sooner than their observed return to work.
2. Individuals returning to work more quickly than average may have more medical costs after they return to work than individuals who return to work more slowly.

To account for both of these aspects, we built marginal structure models where the outcome was all medical costs up to 30 days after RTW and used inverse probability weighting (IPW) to account for the probability that interventions could get a case back to work at the optimum duration.(Cole & Hernán, 2008)

IPW's were constructed by fitting a log-linear multiple variable regression model with disability durations as the outcome. The following variables were potential predictors in the regression model: age, gender, history of previous disability leave, history of previous recurrence for same condition, insurance plan type, whether an opioid was prescribed, whether the employee is salaried or in a union, whether individual was hospitalized during leave, and whether a surgical procedure was performed. We used the sum of the number of unique ICD-9-CM codes and the sum of the number of unique procedures codes as additional metrics of disease severity. In addition, we generated geographical variables by linking each record's metropolitan statistical area (MSA) or, if unavailable, county to data from the 2007-2011 American Community Survey (ACS) to get the five-year average values for median household income, population density (# of people per square mile), and percent of residents with a college degree or more. This data was abstracted from the Census API with the function *acs.fetch* in the R statistical programming language.(Glenn, 2016) Coexisting conditions that fit within comorbidity groupings as defined by Quan et al. (2005) were grouped (binomial, 0/1).(Quan, Sundararajan, Halfon, & Fong, 2005)

To develop log-linear models to predict disability duration, we used the least absolute shrinkage and selection operator method (Lasso) with generalized linear model kernel.(Tibshirani, 1997) Using 10-fold cross validation, our Lasso method penalizes the mean squared error across a range of values for a regularization parameter (lambda). The final model and selected predictors were chosen using the largest value of lambda where the error was one standard deviation below the minimum error across all lambdas. This procedure was implemented using the *cv.glmnet* function from the glmnet package.(Friedman, Hastie, & Tibshirani, 2010; Simon, Friedman, Hastie, & Tibshirani, 2011)

The IPW weights are a ratio of the mean of the log disability durations (numerator) to the conditional densities of each case (denominator). The conditional densities are based on where the observed duration falls in a normal distribution with the mean equal to the mean log duration and the standard deviation equal to the residuals of the standard deviation of the multiple variable regression mentioned above. Figure 5 demonstrates the relationship between IPW and the difference between observed and predicted disability durations. For example, cases with an observed disability duration that was substantially higher than the predicted duration are given high weights. Similarly, cases with an observed disability duration substantially lower than the predicted duration are also given high weights. Therefore, we are statistically enriching the analysis to target the cases where outside factors like case management, attitudes towards work, and other potentially intervenable characteristics may have impacted when someone returns to work.

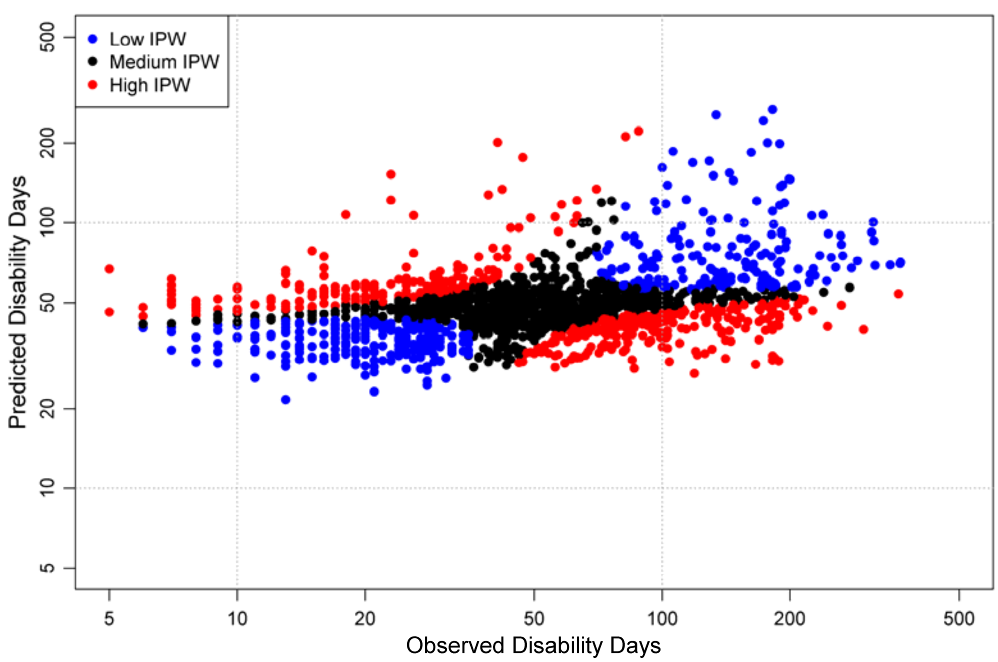

Figure 5. Example of the relationship between inverse probability weights (IPW) and the difference between observed and predicted disability durations.

We incorporated the IPW in another lasso model selection procedure, using the same methods above (the outcome, the log total medical costs, and the predictors) and added disability duration. For each case above optimum, we predicted the total medical costs using the optimum and observed disability duration. The difference between these two predicted medical costs is the PAC for that case. All PAC per condition were summed for the total PAC and divided by the number of individuals with that condition to get the average PAC. We calculated the PAC for meniscus disorder and carpal tunnel syndrome by procedure (Table 4). We calculated the average PAC for the top conditions in the Truven HPM database (Table 5). Conditions with high frequency and PACs (e.g., lumbar disc displacement) may be conditions where organizations should focus their attention to reduce medical costs associated with disability claims.

Table 4. PAC for meniscus disorder and carpal tunnel syndrome, by procedure.

Treatment	N	Total Cost (all cases)	Avg. Cost per Case
Meniscus Disorder			
Non-surgical Treatment	1,734	$900K	$529
Arthroscopic Meniscectomy	10,257	~$9.5 MM	$928
Meniscus Repair	160	$0	$0
Total PAC Savings	12,151	$10.4 MM	$868
Carpal Tunnel			
Non-surgical Treatment	8,719	$2.4 MM	$277
Carpal Tunnel Release	1,256	$1.2 MM	$957
Total PAC Savings	9,975	$3.6 MM	$361

Table 5. PAC for the top diagnoses in the HPM Truven dataset.

Diagnosis	N	Median (Optimum)	25th %ile	Mean	75th %ile	PAC/ Case
Depressive Disorder (311)	15,609	43 (28)	$338	$3,405	$2,775	$830
Lumbago; low back pain (724.2)	15,143	39 (14)	$491	$6,023	$4,406	$1,573
Anxiety (300.00)	12,659	40 (7)	$279	$2,336	$1,762	$851
Lumbar Disc Displacement (722.10)	11,437	63 (32)	$2,259	$16,174	$17,682	$3,250
Major Depressive Disorder, single (296.20)	11,059	57 (28)	$513	$4,173	$4,256	$1,168
Uterine Leiomyoma, unspecified (218.9)	10,334	44 (28)	$6,742	$12,912	$16,217	$1,927
Obesity, morbid (278.01)	8,992	31 (35)	$15,740	$26,403	$30,409	$770
Inguinal Hernia, unilateral (550.90)	7,896	35 (25)	$3,450	$6,884	$8,504	$135
Major Depressive Disorder, recurrent (296.33)	7,483	68 (28)	$785	$6,204	$7,003	$1,874
Acute Bronchitis (466.0)	7,293	18 (5)	$434	$2,721	$2,308	$409

To calculate the PAC per year for all diagnoses across the 55 million U.S. workers with STD benefits, we multiplied the STD claim rate for each diagnosis by the PAC per diagnosis and 55 million. When we summed the PAC for all diagnoses, we found that STD programs could potentially save up to $6.5 billion per year by returning cases to work within recommended time frames.

CONCLUSION

We found that medical costs change by day throughout a disability episode with the highest costs incurred at the beginning of the absence and trending downward from there. We found that knowledge of both the diagnosis of the leave and the treatment of that diagnosis were important predictors of medical costs. Despite most of the medical cost occurring at the beginning of a leave, substantial costs continue to accrue at later stages of the disability absence, which presents an opportunity for case management to reduce both the duration of absence as well as medical costs. Our research highlights that medical costs are an important part of disability absence costs and employers need to include medical costs estimates in the evaluation of disability absences to better design medical and disability benefits that work together.

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