



Comparing the Quantity and Prices of Physician Services Between Workers Compensation and Group Health

The open-ended nature of workers compensation medical liability underscores the need for effective cost controls while still delivering the best outcome for the injured worker. At the same time, medical care to injured workers must also be delivered within a much larger and multifaceted healthcare system. The facet most closely aligned with workers compensation is group health insurance.

Commercial group health insurers collect far more medical experience than is generated from workers compensation claims and may have greater influence over the healthcare market. Accordingly, it makes sense to tap into group health data because it may hold information to help maintain a workers compensation benefit delivery system that is specifically geared to the needs of employers and workers, but is designed to function within a much larger healthcare environment.

About a decade ago, NCCI published a series of studies comparing medical costs between workers compensation (WC) and employer-sponsored group health (GH) insurance. Those studies compared physician services to treat a select group of injuries for a select group of states. This study continues and extends that work, including:

- Using newer experience and including more jurisdictions
- Analyzing relativities between WC and GH for the cost of physician services by price and quantity
- Refining the measurement of differences in quantity
- Affirming that quantity of services continues to be the greatest factor pushing WC costs above GH
- Relating differences between WC and GH costs to technology and cost sharing

A follow-up to this article on quantity and price will compare the utilization (quantity and mix of services) of physician services between WC and GH.

Executive Summary

Our findings on the costs of physician services within the WC and GH insurance systems indicate that, for a selected group of injuries:

- WC pays more than GH to treat comparable injuries
- Quantity differences dominate price differences, explaining 80% of the cost difference for a select group of 12 common WC medical conditions
- Quantity differences vary principally by type of injury; all the injuries considered show a higher quantity of services for WC than for GH

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- Price differences are more related to the jurisdiction than to the type of injury, due, in part, to the different WC physician fee schedules that apply by state
- Traumas to arms and legs consistently have the smaller cost and quantity differences, while chronic or pain-related injuries, such as bursitis and back pain, have larger differences
- Differences between WC and GH depend on the medical service category:
 - Evaluation, management, radiology, and physical medicine costs are higher in WC due to the greater quantity of those services, even for states where WC prices are lower than GH
 - Higher WC costs for surgery are driven more by higher prices than by quantity
 - Quantity and prices for radiology services are higher in WC than in GH; however, technological advances have moved them closer in recent years
 - The most pronounced difference between WC and GH is the higher quantity of physical medicine services in WC, which may be partly due to cost sharing in GH

We conclude with several observations on medical cost containment prompted by these findings.

Background and Methodology

The WC experience for this study is from NCCI's Medical Data Call (MDC). The MDC captures transaction-level details on medical bills processed on or after July 1, 2010. The details include dates of service, charges, payments, procedure codes, and diagnosis codes. NCCI collects the data and administers the Call for 35 jurisdictions where NCCI provides ratemaking services and for several additional states.¹

The GH data for this study consists of medical experience from employer-sponsored health benefit plans. The data was licensed from Truven Health Analytics, an IBM Watson Health Company that provides healthcare data and analytics.²

Both the WC and GH data are for Service Years 2013 through 2016. To be comparable to WC, GH payments reflect the full cost of any service, including any copayment, deductible, or coinsurance.

Comparing WC with GH costs to treat an injury

WC claims arise from work-related injuries. Accordingly, MDC transactions are linked to a specific injury via the WC insurance carrier's claim number. GH data, however, is not reported by injury. A GH claim typically corresponds to a medical encounter, perhaps as simple as a short visit to a doctor's office or as complex as an extended stay at a hospital. This presents a technical hurdle, because many of the important cost comparisons of WC with GH would be at the WC claim or injury level.

To make such comparisons, we use Truven software (given the acronym MEG) that groups transactions of a patient into "episodes" of care, where an episode refers to the collection of medical encounters to treat a specific medical condition. The medical condition, e.g., bursitis, is identified with an episode group code (EGC). An EGC is comparable to a diagnosis code, but typically is at a higher aggregation level than the thousands of ICD³ codes reported on medical transactions.

The MEG software:

- Processes the medical transactions for a patient
- Identifies a medical condition, where possible, and assigns an EGC
- Groups into an "episode" the transactions to treat the condition

¹ Jurisdictions included in this study are AK, AL, AR, AZ, CO, CT, DC, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MD, ME, MO, MS, MT, NC, NE, NH, NM, NV, OK, OR, RI, SC, SD, TN, UT, VA, VT, and WV. When making price comparisons with state physician fee schedules, we do not include IA, IN, MO, NH, and VA. We note that while VA currently has a physician fee schedule, it became effective on January 1, 2018, after the data used in the study.

² By contractual agreement, statistics for CT, ID, LA, ME, MT, NH, NM, and SC are not shown in the state-specific exhibits. The experience from those states is, however, included in multistate figures. Also, RI is excluded because WC state-specific procedure coding is not suited to match with GH data. Figures for the state of HI are not shown in state-specific exhibits due to a comparatively small volume of GH episodes.

³ ICD refers to "International Classification of Diseases," which is a standard coding scheme used in medical billing. ICD codes are reported on both the GH and WC transaction data. There are several editions, the current one is referred to as the ICD10.

MEG was used to group GH medical transactions into GH episodes and to group MDC transactions into WC episodes. One workplace accident can result in multiple medical conditions. Accordingly, more complex WC claims may be broken into more than one episode. Different WC claims are processed as coming from different patients, so no episode can include transactions from two different WC claims.

Studying episodes enables us to compare medical cost data grouped using the same logic for both WC and GH transactions and classified using the same EGCs. We will use the terms “injury,” “medical condition,” and “episode” interchangeably to refer to the result of applying the MEG routine to both the WC and GH transaction data.

When comparing WC to GH, we express results as relativities, also called differentials. For example, if a WC cost is \$1,230 and the corresponding cost for GH is \$1,000, the ratio is 1.23 and the cost differential of WC to GH is 123%. Relativities over 100% correspond to WC costs that are greater than for GH; relativities under 100% to higher GH costs.

Differentials can isolate the impact on cost of a change in prices. By holding quantity fixed, the differential isolates a price impact. The WC and GH prices used in this study are averages for a type of service, such as radiology. Accordingly, a difference in the mix of services within a service category (e.g. MRI vs. X-ray) between WC and GH is reflected in the price differential. Conversely, holding price fixed isolates the quantity impact on cost. The Appendix details the calculation and interpretation of the price and quantity differentials.

Analyzing physician services

For both GH and WC patients, doctors and other medical professionals use the same Current Physician Terminology (CPT)⁴ coding scheme. When analyzing cost differences between WC and GH, physician services are itemized into four broad service types by reference to ranges of CPT codes (c.f. Exhibit 7):

- Evaluation and Management
- Physical Medicine
- Radiology
- Surgery

The terms “cost,” “price,” and “quantity” are used in a precise manner in this study.

- “Cost” signifies the total amount paid for the various services to treat an injury
- “Price” refers to the amounts paid for individual services
- “Quantity” measures the number of services grouped by the type of service (say, by surgery or physical medicine)

Albeit simplified, we regard cost as a function of price and quantity (the symbol “ \approx ” denotes “is approximately”):

$$\text{Cost} \approx \text{Price} \times \text{Quantity}$$

Because cost has two factors, a relativity, or “differential,” between two costs can be analyzed and estimated as the product of two component differentials:

$$\text{Cost Differential} = \text{WC Cost} \div \text{GH Cost} \approx \text{Quantity Differential} \times \text{Price Differential}$$

The quantity differential compares the number of services of a given service type. Because medical services vary greatly in intensity and expense, not all services are given the same weight. For example, in the GH-based denominator of the quantity differential, the weight given the number of radiology services is different from the weight given the number of physical medicine services. The difference in weight is based on how expensive the two sets of GH services are. In calculating the numerator, the number for a given service type is the WC count, while its weight is the same as the weight used in calculating the denominator and varies with the intensity of the set of GH services for that service type. In this way, assuming one schedule of prices reflecting one set of intensities, price is being held fixed when determining the quantity differential.

⁴ CPT is a registered trademark of the American Medical Association.

Consistent with counting services by service type to measure quantity differences, payments are averaged over service types to measure price differences. Differences in the mix of services within a service type affect those averages and are therefore captured in the corresponding price differential. The Appendix details the derivation of the price and quantity component differentials used in this paper.

The comparison of quantity levels between WC and GH uses an analytical tool—newly developed at NCCI—to measure differences in utilization and quantity. The workers compensation relative price index (WCRPI) assigns relative values to services by their CPT code and locations of service. The WCRPI measures the intensity of a specific procedure or of a set of procedures.

Some key properties of the WCRPI:

- Designed to be independent of jurisdiction and time
- Incorporates the Medicare resource-based relative value scale (RBRVS) to assign relative intensities by CPT
- Customizes those relativities to WC experience

The WCRPI is used to assign price-based weights when determining the quantity differential.

Injuries selected for analysis

To analyze WC-to-GH Cost relativities, we use the 12 injuries in Exhibit 1. Each injury is identified by an EGC. For each, we process the individual physician services and analyze cost differentials via differentials in price and quantity. The 12 injuries were chosen for their prevalence in workers compensation. They encompass a variety of injury types, from pain-based conditions—like bursitis or backaches—to acute conditions—such as fractures or lacerations.

Exhibit 1: Injuries Included in the Cost Analyses

Chronic and Complex	Inguinal hernia
	Bursitis
	Lower back disc disorders
	Other bone and joint disorders
	Other lower back disorders, including the spine
	Upper back spine/spinal cord injury
Acute and Trauma-Related	Ankle fracture or sprain
	Humerus/shoulder fracture, dislocation, or sprain
	Wrist/hand fracture, dislocation, or sprain
	Knee ligament injury
	Lower extremity open wound or blunt trauma
	Upper extremity open wound or blunt trauma

The 12 selections also attempt to match EGCs with injuries examined in prior studies. For example, “Lower back disc disorders” were selected to match the “Herniated intervertebral disk” of prior studies. “Other lower back disorders, including the spine” was selected to match “Other spinal and back disorders” and so excludes herniated intervertebral disk.⁵

⁵ Prior studies included carpal tunnel syndrome (CTS) among the list of injuries. However, while there is a carpal tunnel EGC, it is not recommended for research purposes. We instead include “Other bone and joint disorders.” This EGC excludes episodes that MEG identifies as CTS but is common among WC episodes.

We call six of the injuries “Acute and Trauma-Related” or simply “Acute.” The WC costs for these injuries are generally closer to GH costs than for the other six “Chronic and Complex,” or simply “Chronic,” injuries. The terms are not meant to precisely coincide with their clinical meanings. They provide a useful grouping consistent with prior studies. There is generally a wider range of possible medical severities among the Chronic injuries and a wider range of generally accepted treatment protocols, compared to Acute injuries.

Comparing WC and GH episodes

The following patient and injury characteristics were used to match GH with WC experience:

- Age of the patient when treatment began
- Year when treatment began
- Gender of the patient
- State (of domicile for GH, of jurisdiction for WC)
- EGC

For each combination, the experience of the GH episodes is scaled to match the number of WC episodes with that combination. The result is a market basket of episodes where GH episodes are customized to the number and mix of WC episodes.

The MEG logic supports 585 medical conditions identified by an EGC code. The matching excludes many EGCs, such as those for pediatrics and conditions related to pregnancy. After matching GH and WC episodes, 69 EGCs are included in the basket. The market basket includes the 12 injuries in Exhibit 1.

The market basket is used to make comparisons between WC and GH costs in which the number of episodes is the same for all five characteristics. For the 12 injuries, costs of physician services are found by summing over transactions. A transaction is assigned a frequency based on the weight that its episode has in the market basket. In this way, summing transaction costs produces amounts for WC and GH that reflect the same number of episodes by state, injury, year, age, and gender. For example:

- The quantity differential is the ratio of what two costs would be when one WCRPI average price schedule applies (holding average prices by service type fixed) and,
 - The numerator is the cost of the volume of services observed to treat a set of WC injuries
 - The denominator is the cost for the volume of services observed to treat a set of GH injuries
 - The two sets of injuries have not only the same number of injuries, but they also have the same mix by age, year, gender, state, and type of injury
- The price differential is the ratio of what two costs would be when two average price schedules apply (holding the number of services by service type fixed) and,
 - The numerator is the cost for the number of services, by service type, to treat a set of WC injuries all paid at the corresponding WC average prices
 - The denominator is the cost of the same WC number of services, by service type, but at the corresponding GH average prices

The Appendix discusses the construction of the episode market basket and provides more detailed interpretations for the price and quantity component differentials used in this paper.

FINDINGS

We analyze the cost of physician services for the 12 injuries in Exhibit 1. The discussion looks at how WC-to-GH differentials compare among:

- 27 states
- 12 injuries
- 4 physician service types

We also discuss three topics that emerged from the research:

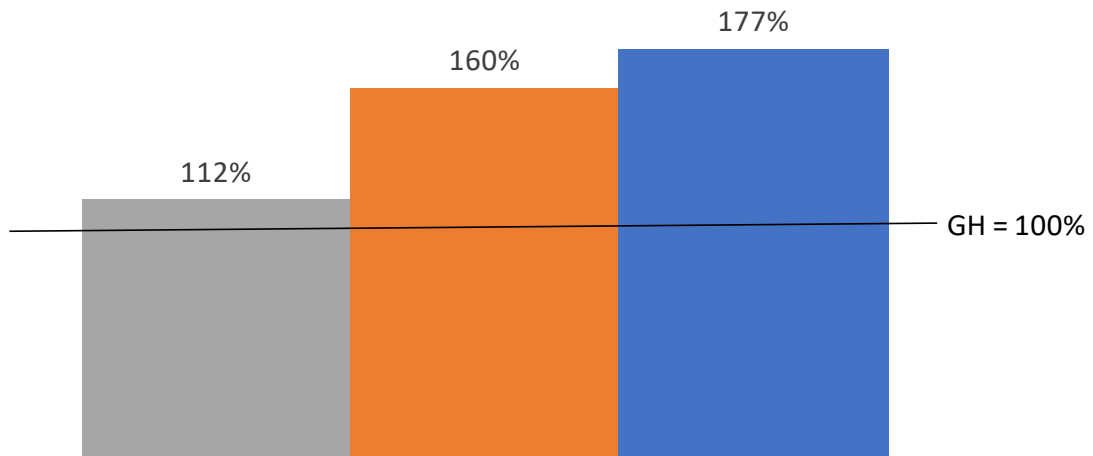
- The price differential for radiology
- The quantity differential for physical medicine
- Differences between WC and GH costs by the patient’s age and gender

Physician services for 12 injuries

Exhibit 2 illustrates price and quantity differentials as components of the cost relativity of WC to GH with experience combined over all states. For each of the three bars, the GH amount is represented as 100%. As in all the exhibits in this section, these relativities are for physician services for the 12 injuries in Exhibit 1.

Exhibit 2: WC-to-GH Cost Relativity for Physician Services

Price and **Quantity** Components of **Cost** for 12 Injuries, GH=100%



The percentages greater than 100% in Exhibit 2 indicate that both WC prices and WC quantity and, consequently, WC costs, are greater than observed for GH, after controlling for episode mix.

Differentials among states

The decompositions shown in Exhibit 2 vary considerably by state, as shown in Exhibit 3A. The short horizontal green lines are the national values shown in Exhibit 2.

Exhibit 3A: WC-to-GH Cost Relativity in the Cost of Physician Services by State
 Price and Quantity Components of Cost for 12 Injuries Relative to National Values, GH=100%



The price, quantity, and cost relativities of WC to GH for the states are provided in Exhibit 3B, with GH set to 100% for each state and component. The states are sorted by the cost column in order of increasing cost relativity to GH. Each column is individually scaled by color:

- All states have WC quantity at least 30% above GH
- All states with WC cost more than 65% above GH also have WC prices higher than GH
- All states with WC cost less than 65% above GH also have WC prices lower than the multistate 12% figure in Exhibit 2
- Among the five lowest cost relativity states, three (WV, SD, OK) are driven by lower WC prices and the other two (UT, KY) by lower quantity
- The three highest cost relativity states (MO, AL, VA) are also the three highest price relativity states
- The four states with no WC physician fee schedule (MO, VA, IA, IN) all have price relativities over 130% and cost relativities over 200%.⁶

Exhibit 3B: WC-to-GH Cost Relativities by State
Expressed as a Percentage of GH=100%

State	Price	Quantity	Cost
WV	75%	149%	111%
SD	75%	160%	111%
UT	102%	130%	130%
OK	86%	154%	133%
KY	108%	132%	141%
TN	99%	145%	145%
OR	92%	160%	146%
FL	96%	152%	146%
CO	79%	193%	147%
NV	90%	162%	147%
NC	96%	167%	153%
DC	98%	165%	161%
MD	109%	157%	165%
AK	107%	166%	167%
NE	108%	157%	170%
KS	114%	150%	170%
AZ	115%	156%	174%
AR	107%	164%	178%
MS	117%	158%	185%
VT	111%	184%	193%
IN	136%	155%	202%
GA	117%	177%	209%
IL	128%	174%	219%
IA	131%	176%	225%
VA	161%	151%	238%
AL	170%	147%	256%
MO	162%	191%	304%

⁶ Virginia did not have a WC physician fee schedule for WC during the period of this study; Virginia implemented a physician fee schedule on January 1, 2018.

When comparing the relativities by state, cost is more correlated with price than with quantity, as shown in Exhibit 3B. Exhibit 3B also shows that some states with WC physician fee schedules (PFS) have WC prices that are competitive with, or even below, GH prices. Alabama has a PFS and a very high cost differential (256%); however, its PFS is based on usual and customary fees. Most state WC PFSs are resource-based and benchmarked to Medicare.

Colorado emerges as an exceptional state in Exhibit 3B, pairing high quantity with low prices relative to GH. The lower prices can be explained by the WC PFS. For the higher quantity, some point to providers arguing that any treatment(s) allowed in the WC Treatment Guidelines must be approved.

The range in price differentials among the states is greater than the range for quantity. This is reasonable because prices would be expected to respond to jurisdictional differences, such as fee schedules, as well as to regional variation in the cost of living or accessibility of care.

In sum, while there are differences in both price and quantity among the states, cost and price relativities to GH correlate when the experience is organized by state. In the next section, we shift perspective from geography to diagnosis, organizing the experience by injury.

Differentials among injuries

This section looks at WC versus GH cost component differentials for the 12 injuries in Exhibit 1. When organized by injury, Exhibit 4 shows that all 12 have both WC cost and quantity more than 10% above GH:

- The five highest cost differentials over GH are for chronic injuries
- The five lowest cost differentials over GH are for trauma injuries
- For all the injuries considered, the quantity is greater than the price differential
- Knee ligaments have the lowest cost and quantity relativity
- Bursitis has the highest price, quantity, and cost relativities

Exhibit 4: WC-to-GH Cost Relativities by State Expressed as a Percentage of GH=100%

Injury	Price	Quantity	Cost
Knee ligament injury	103%	110%	114%
Lower extremity open wound or blunt trauma	83%	164%	137%
Upper extremity open wound or blunt trauma	92%	150%	138%
Wrist/hand fracture, dislocation, or sprain	108%	147%	154%
Ankle fracture or sprain	98%	163%	155%
Inguinal hernia	124%	127%	156%
Humerus/shoulder fracture, dislocation, or sprain	116%	138%	156%
Upper back spine/spinal cord injury	103%	182%	187%
Other lower back disorders, including the spine	135%	161%	222%
Other bone and joint disorders	118%	195%	229%
Lower back disc disorders	127%	184%	235%
Bursitis	138%	217%	289%

When organized by injury, the WC cost relativity over GH correlates with both price and quantity. The correlation is somewhat stronger for quantity, with quantity accounting for most of the cost relativity.

While grouping injuries together can be helpful, it is not black and white. Because inguinal hernia is often treated surgically, that injury is not grouped with the simpler acute and traumatic claims. Technology has largely standardized the treatment of those claims—and because of economies of operation, there are facilities that specialize in their treatment. That may help to explain why, within the chronic injuries, the pattern for inguinal hernia most resembles the pattern for the acute claims (with a cost relativity of 156%).

Conversely, sprains and strains are pain-based injuries that can mirror a more complex or chronic condition. Shoulder injuries (also with a cost relativity of 156%) can be particularly difficult to diagnose. This might help explain why sprains and strains show the biggest cost relativities among the acute injuries (from 154% to 156%).

For every state the WC cost and quantity differentials for the acute group of injuries are smaller than for the chronic group. The four differentials are plotted by state in Exhibit 5. States are sorted by the chronic cost differential, which is the greatest of the four differentials for most states:

- The same three states have the highest cost relativities for both the chronic and acute injury groups
- The two states with the lowest chronic cost relativities are among those with the lowest acute cost relativities
- All states with cost relativity over 275% for chronic injuries have a relativity over 150% for acute injuries
- All states with cost relativity under 225% for chronic injuries have a relativity under 150% for acute injuries
- WC has relatively more services than GH or all states and for both the acute and the chronic injuries (i.e., a quantity differential over 100%)
- For many states, the cost and quantity relativities for the more straightforward-to-treat acute injuries are closer together and smaller than the relativities for chronic injuries

Exhibit 5: WC-to-GH Relativity in the **Cost** and **Quantity** of Physician Services by State for Six Chronic (◊) and Six Acute (○) Injuries, GH=100%

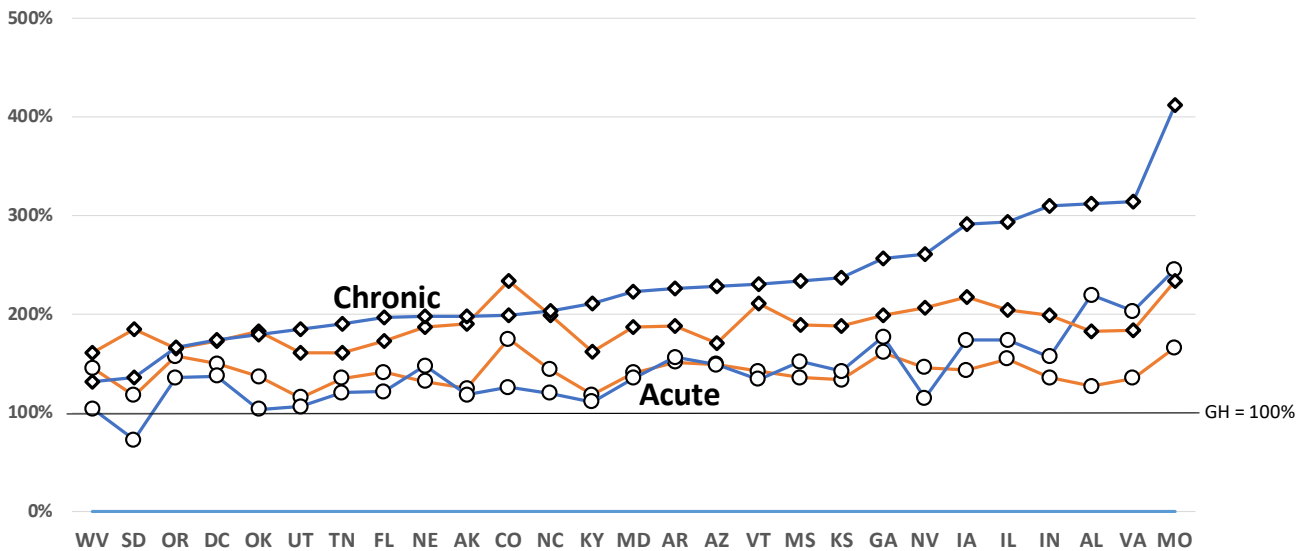
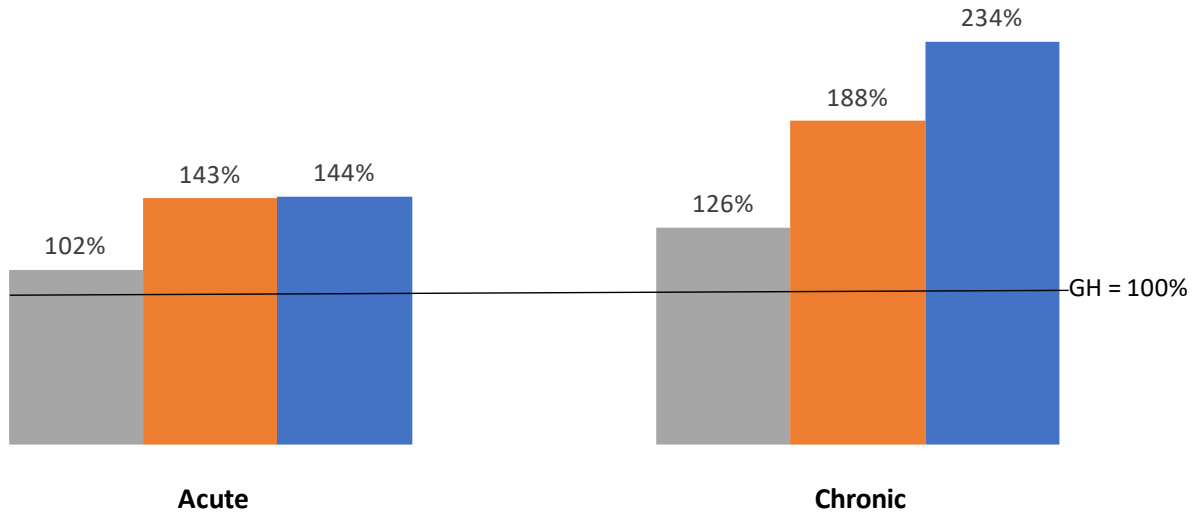


Exhibit 6 summarizes the comparison by injury type. The more straightforward claims, represented by the acute and traumatic group, have quantity and price levels closer to GH than do the more complex and chronic claims. We will explore this further in the next section when we drill down according to the types of medical services provided.

Exhibit 6: WC-to-GH Relativity in the Cost of Physician Services by Injury Group
 Price and Quantity Components of Cost for 12 Injuries, GH=100%



Differentials by service type

We itemize the cost relativity components into the four physician service types listed in Exhibit 7:

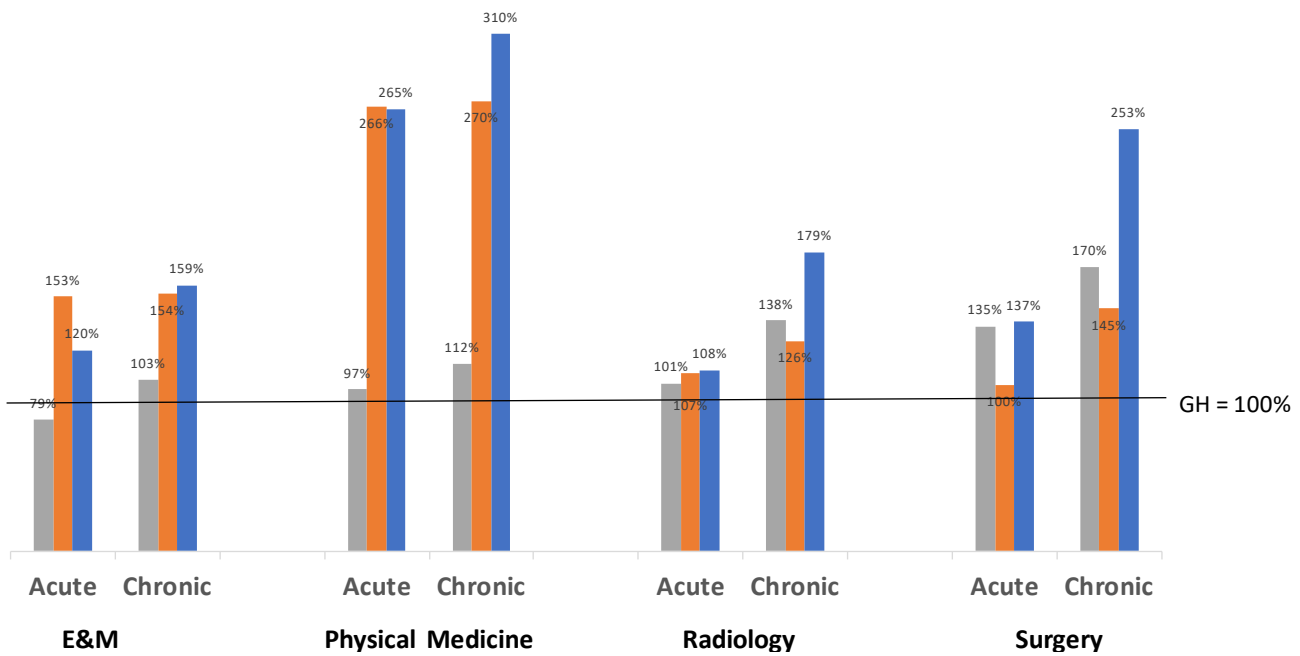
Exhibit 7: Types of Physician Services

Evaluation and Management (E&M)	Includes consultations in and out of hospital; CPT codes between 99200 and 99499
Physical Medicine	Includes physical medicine procedures and supplies, whether performed by MD, chiropractor, or physical therapist; CPT codes between 90000 and 99199
Radiology	Includes professional and technical component; CPT codes between 70000 and 79999
Surgery	Includes CPT codes between 10000 and 69999

Cost components for the four service type categories and by injury group are itemized in Exhibit 8:

- Each of the four service categories has chronic injuries showing a higher price relativity to GH than acute injuries
- For E&M and physical medicine, higher quantity accounts for the higher WC cost relativity over GH
- Physical medicine has the highest quantity relativity
- Each of the four service categories has higher WC cost relativities for chronic injuries coming from a combination of higher WC price and WC quantity relativities
- Surgery for acute injuries has a higher WC cost relativity due to higher WC prices and quantity on par with GH
- WC radiology cost on acute injuries is near par with GH, with both price and quantity close to GH

Exhibit 8: WC-to-GH Relativity in the Cost of Physician Services by Type and Injury Group
 Price and Quantity Components of Cost for 12 Injuries, GH=100%



Apart from surgery and radiology on acute injuries, all injury groupings and service types show markedly higher quantity for WC than for GH. This is consistent with the need for surgery or radiology for an acute injury being more straightforward and dictated by the injury. More WC surgery services on chronic injuries is evidence of a tendency toward more invasive treatment in WC for those injuries.

The price relativity depends, in part, on the WC mix of specific procedures within a service type (as noted above and detailed in the Appendix). For each service type, the higher price relativities for chronic claims are due in part to WC claims receiving a more costly mix of procedures. Some of the most expensive radiology procedures (e.g., an MRI performed both with and without contrast) are nearly exclusive to the WC chronic claims.

Mix differences contribute to the higher price relativities for specialty care on chronic claims. Exhibit 8 indicates that higher costs for radiology and surgery are due more to price than quantity. Differences between WC and GH in the mix of services will be investigated in a follow-up article that examines differences in the utilization (mix and quantity) of physician services between WC and GH.

Radiology and technology

While we find greater costs for WC radiology than for GH, earlier studies found even greater differences. In this section, we examine the notable change in radiology differentials.

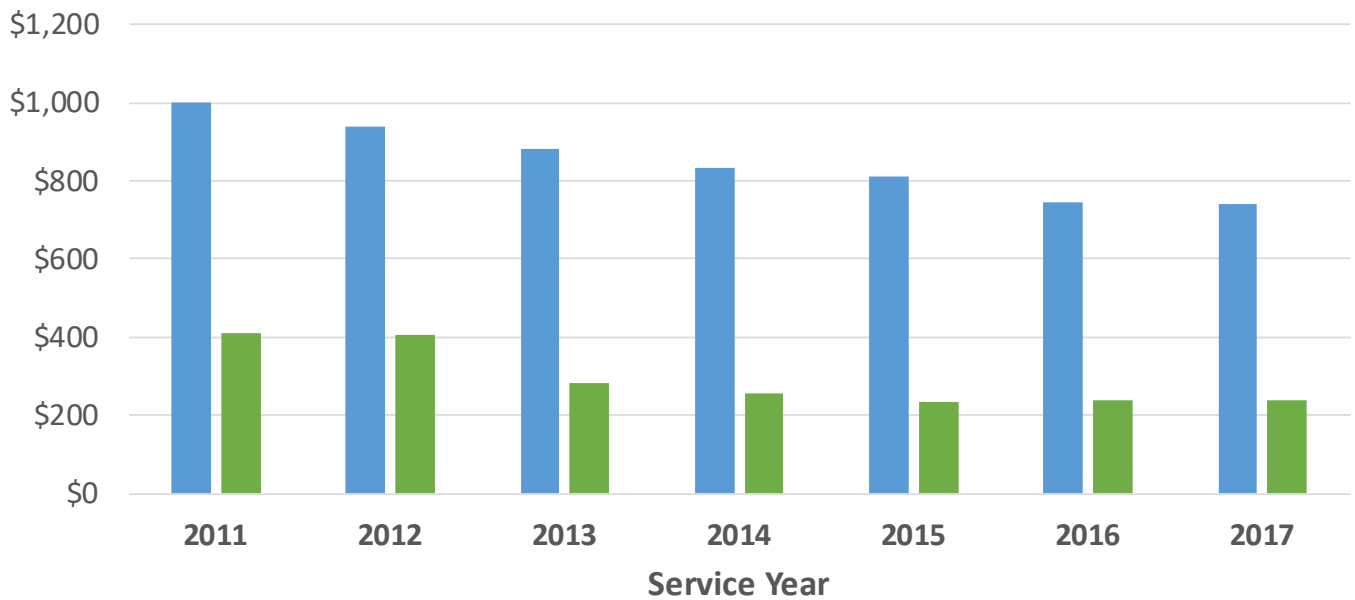
Technological advances in communication and digital imaging have transformed medical imaging, effectively increasing the reading capacity of radiologists. This has, in effect, increased supply and lowered prices. Lower Medicare prices provide a particularly important example for WC, because many states base their PFS on Medicare.

Medicare prices influence the maximum allowable reimbursement (MAR) specified in many states’ PFS. Exhibit 9 illustrates this for an imaging procedure common in WC claims. The amounts are countrywide average fees for an MRI of a lower extremity (CPT code 73721). From 2011 to 2017, the countrywide average Medicare reimbursement dropped over 40%, from just over \$400 to about \$240. This includes a 30% drop from 2012 to 2013. While WC average MARs for this procedure also dropped over the period 2011 to 2017, they declined by a smaller percentage, about 25%. Although many states have a PFS that is based on Medicare fees, the timing and reduction in the countrywide MAR need not exactly match Medicare:

- Not all state physician fee schedules are Medicare-based, and some use an outdated Medicare schedule
- For Medicare-based PFSs, the relativities of the MAR to what Medicare pays varies between states, between service types, and over time
- The time frames and rules for updating the PFS vary by state

Exhibit 9: WC Fee Schedule Maximum Allowable Reimbursement and Medicare Fee for an MRI by Service Year

CPT 73721: MRI of Lower Joint Without Contrast

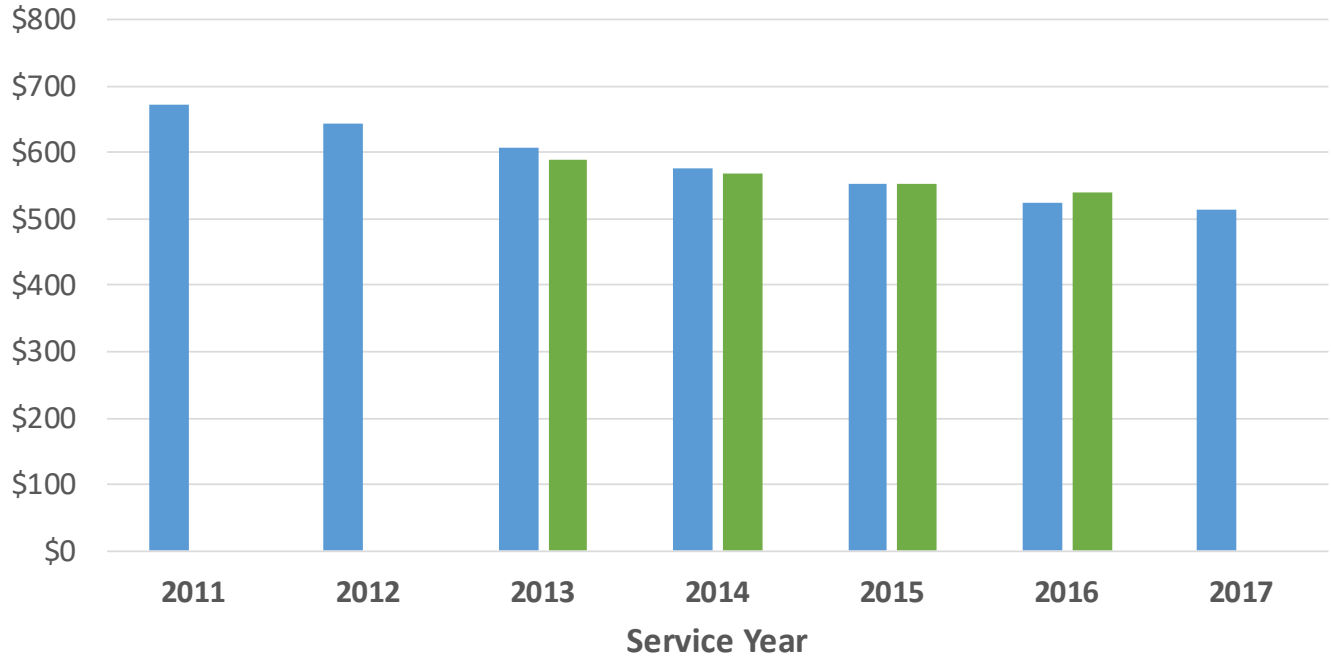


The drop from 2012 to 2013 for Medicare does lower MARs as the Medicare changes and lower radiology prices work their way into many state physician fee schedules. Because a lot of WC payments are at the MAR, or at a fixed percentage discount, lowering MARs is effective at lowering WC prices.

For the same MRI procedure, Exhibit 10 shows how lowering WC prices have brought them closer to GH prices.

Exhibit 10: Average MRI Prices for WC and GH by Service Year

CPT 73721: MRI of Lower Joint Without Contrast



A 2006 NCCI study⁷ put the cost for radiology at 276% of GH. The cost differential has since dropped to 132% in the current study, due largely to reductions in maximum allowable fees for radiology services in state fee schedules. This brought WC prices down and closer to GH prices. Closer prices lessen the incentive to do more services on WC claims.

Technology brought prices closer, which led to closer quantity and costs for radiology—all while improving imaging quality and accessibility.

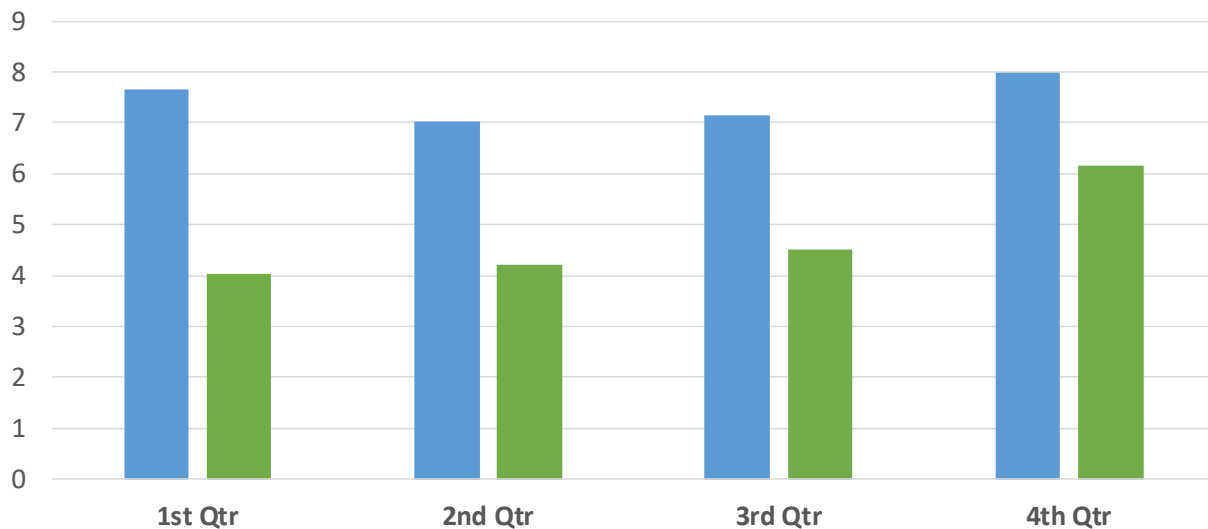
⁷ Exhibit 9 in the 2006 NCCI Research Brief “Workers Compensation vs. Group Health: A Comparison of Utilization.” When making this comparison, we truncate episodes at 90 days, as was done in the 2006 study. The price and quantity component figures are not comparable due to changes in methodology.

Physical medicine and cost sharing

An important difference between GH and WC is that WC medical coverage is not subject to cost sharing in the form of copayments, deductibles, or co-insurance. For GH, about 30% of the cost for physical medicine for the 12 injuries is out-of-pocket for the patient. In commercial carrier GH, deductibles typically kick in at the beginning of the year. Because there are no deductibles in WC, comparing the number of GH to WC visits per episode by calendar quarter, as in Exhibit 11, may help reveal how deductibles influence the use of physical medicine in GH:

- WC claims have more visits per episode for all four quarters
- The number of GH visits increases over the year
- The number of WC visits does not increase and appears to be seasonal, declining in the warmer months
- For GH, the number of visits is greatest in the fourth quarter, perhaps due to more GH annual aggregate deductibles having been met

Exhibit 11: WC vs. GH Visits per Episode by Calendar Quarter of Service Averages Over Episodes With Some Physical Medicine Service



Cost sharing (deductibles in particular) very likely lowers the quantity of GH physical medicine services relative to WC throughout the year, and more so in the beginning of the year before annual aggregate deductibles are met.

At over 260% of GH, the quantity differentials for physical medicine (Exhibit 8) are the biggest cost component relativity between WC and GH. Its main ingredients are:

- Among the 12 injuries, WC patients are 45% more likely to receive physical medicine services
- Among patients receiving some physical medicine service, WC patients receive:
 - 50% more visits
 - 20% more modalities per visit

Moreover, the average cost of a WC visit is 37% more than for GH.

It is reasonable to infer that cost sharing is a major driver of the lower quantity of physician services for GH when compared with WC, as shown in Exhibit 8. All else being equal, GH deductibles would be expected to lower the volume of GH services. That, in turn, makes WC more costly by comparison, increasing the relative quantities and costs.

WC and GH coverages differ in their incentives for patients to seek professional medical care. For example:

- Cost sharing is a disincentive for GH patients
- Some WC claimants and claimant attorneys may find an incentive to seek additional medical care to support wage replacement benefits over a longer healing period or to negotiate a better settlement

Both tend to push WC quantity higher relative to GH.

Age and gender

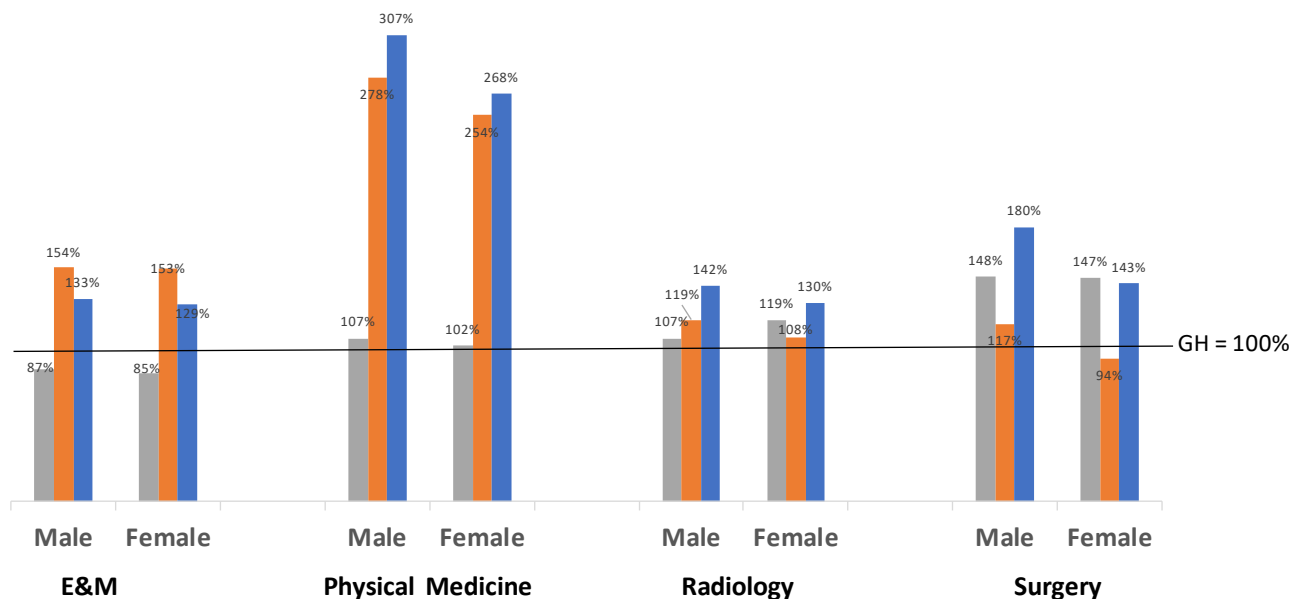
The cost comparisons in the above sections control for both gender and age because GH episode frequencies are matched to the number of WC injuries in the market basket of episodes. In this section, we consider whether there are systematic differences in the relationship between WC and GH treatment costs by age or by gender.

Many studies have shown that women make greater use of healthcare services than men do.⁸ Contributing factors most often identified include the utilization of obstetrics and gynecology services. Comparing WC and GH episodes provides a natural experiment, mitigating some of these more obvious differences to GH services.

Within the four main service type categories, we compare the WC over GH cost components by gender (Exhibit 12):

- There is no meaningful gender difference in the price differentials
- Except for surgery, both male and female patients have similar differentials for both price and quantity
- Men use a somewhat greater quantity of surgery services in WC than in GH, while women use somewhat less
- There is no evidence that greater utilization of GH services by women carries over to WC

Exhibit 12: WC-to-GH Relativity in the Cost of Physician Services by Gender Within Category, Price and Quantity Components of Cost for 12 Injuries, GH=100%

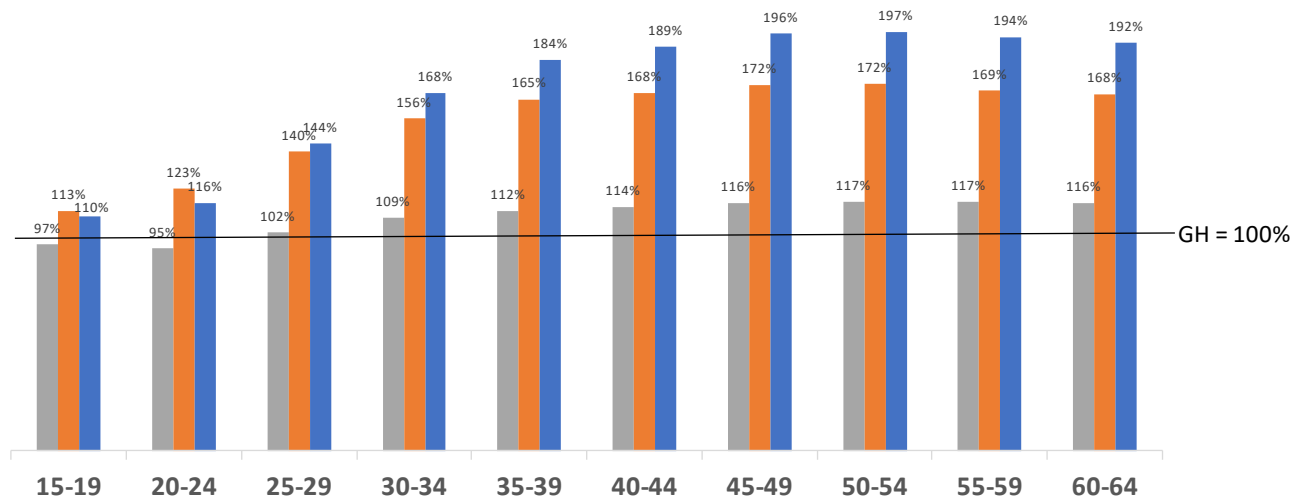


⁸ See, for example, “Gender Differences in the Utilization of Health Care Services” by Klea D. Bertakis, MD, MPH in the *Journal of Family Practice*, 2000, February; 49(2):147-152, available at <https://www.mdedge.com/familymedicine/article/60747/womens-health/gender-differences-utilization-health-care-services>.

The age of the patient clearly plays a role in the healing process, as does worker experience in job safety. For 10 age groups, ranging from age 15 to 65 at the start of care, the WC-over-GH cost differential components indicate that (see Exhibit 13):

- As workers age, the quantity relativity of WC to GH increases more than the relativity in price
- For workers over 25, both price and quantity drive WC costs higher than GH
- Before age 40, both price and quantity relativities of WC over GH increase with age
- After age 40, both price and quantity relativities remain stable, at near 117% and 170%, respectively

Exhibit 13: WC-to-GH Relativity in the Cost of Physician Services by Age Group
 Price and **Quantity** Components of **Cost** for 12 Injuries, GH=100%



With slower healing, the quantity of services would be expected to increase with age. That expectation would apply to both WC and GH episodes, but not necessarily to their differentials. We find that (Exhibit 13):

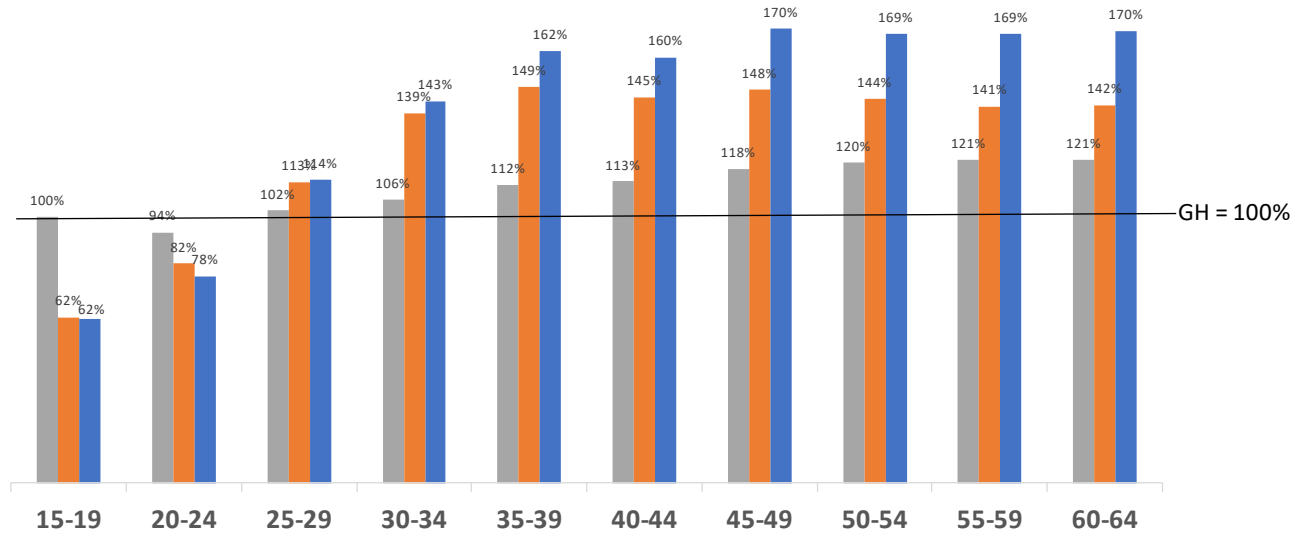
- Until age 40, the WC quantity differential increases faster with age than the GH quantity differential
- The price differential indicates that up to age 40, WC patients receive an increasingly more expensive mix of services

We have seen (Exhibit 13) WC quantity differentials beginning above 100% and increasing with age until stabilizing at maximum differentials after age 40. That pattern generally holds by gender and for each of the 12 injuries, but we note two exceptions: shoulder and knee injuries both have quantity differentials under 100% for the youngest age groups.

For shoulder injuries (Exhibit 14):

- In the youngest age group, the WC quantity differential begins at 38% below GH
- Up to age 25, quantity is greater for GH episodes
- The WC quantity differential steadily increases with age to be over 40% above GH by age 35
- The price differential is like that for other injuries, increasing from 100% to about 120%
- Both price and quantity differentials stabilize at maximum amounts after age 45

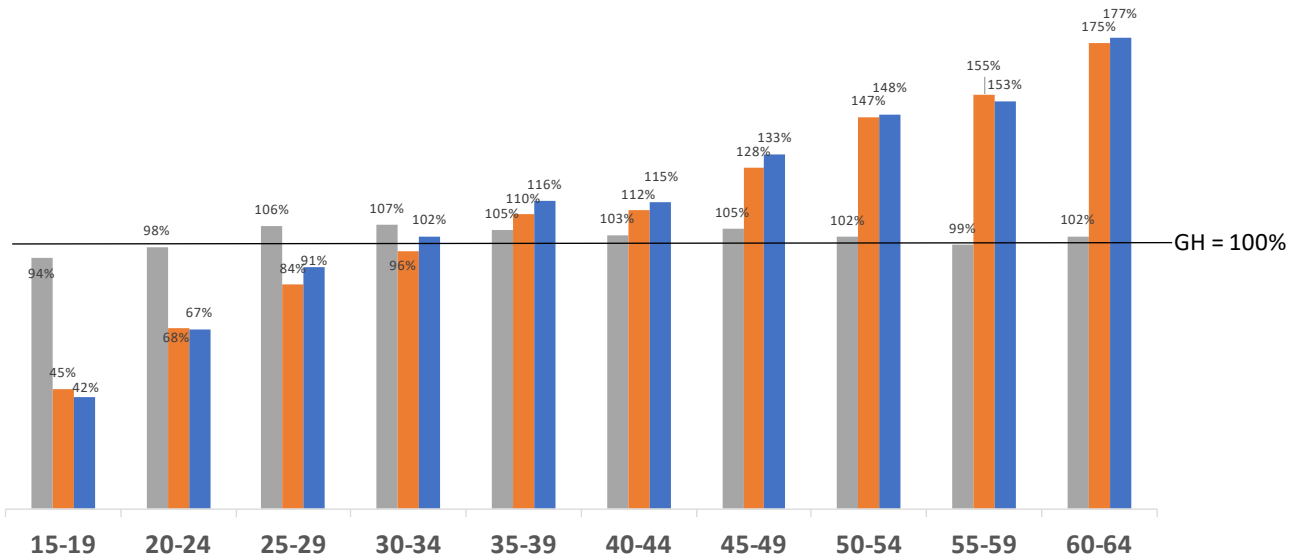
Exhibit 14: WC-to-GH Relativity in the Cost of Physician Services by Age Group
 Price and Quantity Components of Cost for Shoulder Injuries, GH=100%



For knee injuries (Exhibit 15):

- For patients under 35, quantity is greater for GH episodes
- For patients over 35, quantity is greater for WC episodes
- The quantity differential of WC over GH increases steadily with age (about 2.6% per year)
- The price differential oscillates about GH (between 94% and 105%)

Exhibit 15: WC-to-GH Relativity in the Cost of Physician Services by Age Group
 Price and Quantity Components of Cost for Knee Injuries, GH=100%



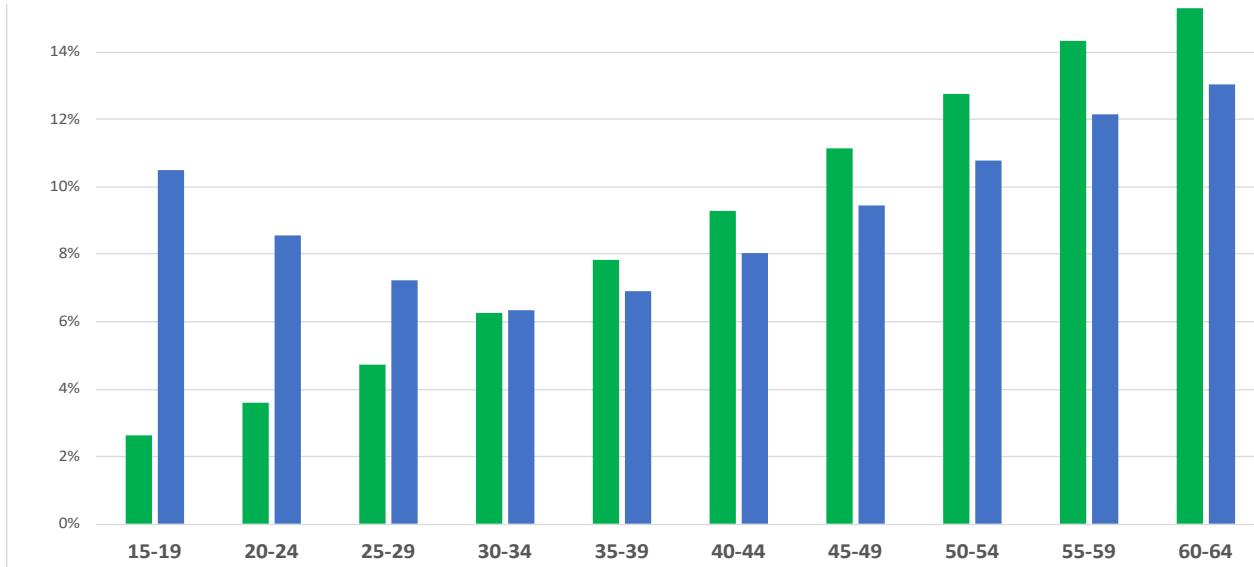
Not only do the relativities between WC and GH differ for shoulder and knee injuries, but those differences also vary with the age of the patient. The greater GH exposure to sports-related injuries, especially for younger patients, may help explain this. Knees and shoulders are especially prone to such injuries.

Further, we expect that the use of arthroscopic surgery correlates with the application of a sports medicine treatment paradigm. For patients under 30, Exhibits 16 and 17 show markedly larger shares of knee and shoulder injuries being treated with arthroscopy in GH than in WC.

For shoulder injuries (Exhibit 16):

- The share of episodes with arthroscopy in WC increases with age (about 0.25% per year)
- The share of episodes with arthroscopy in GH declines up to about age 30 and then increases with age, but more slowly than in WC
- Under age 30, GH episodes are as much as 8% more likely than WC episodes to be treated with arthroscopy
- After age 40, GH episodes are about 2% less likely to be treated with arthroscopy

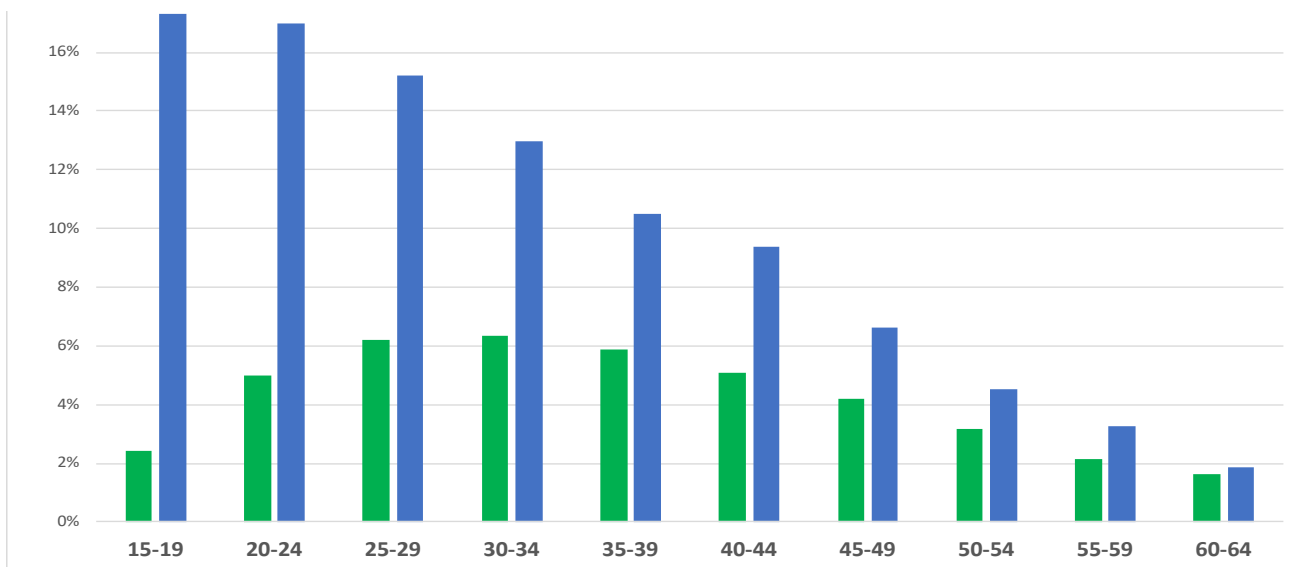
Exhibit 16: WC vs. GH Share of Shoulder Injuries Treated With Arthroscopy by Age Group



For knee injuries (Exhibit 17):

- Arthroscopy use declines with age in GH, from over 17% of episodes for the youngest age group to under 2% for the oldest
- Arthroscopy use in WC increases with age before age 30 and then declines
- For all age groups, but especially under 25, GH knee injuries are more likely to be treated with arthroscopy

Exhibit 17: WC vs. GH Share of Knee Injuries Treated With Arthroscopy by Age Group



Conclusion With Observations on Cost Containment

Analyzing cost differentials of physician services between WC and GH for 12 common WC injuries (Exhibits 2 and 6):

- After controlling for claim characteristics like age and gender, WC costs more than GH to treat comparable injuries
- Quantity dominates price, accounting for about 80% of the overall cost difference
- Traumas to arms or legs consistently have the smaller cost and quantity differentials, while chronic pain-related injuries such as bursitis and back pain have larger differentials

We also saw (Exhibits 3 and 4) that:

- Price differentials vary principally by state, with most states having higher prices for WC than for GH
- Quantity differentials vary principally by type of injury
- All 27 states and all 12 injuries show WC quantity and cost above GH

Medical services exhibit distinct patterns by service type, comparing WC to GH (Exhibit 8):

- Evaluation, management, and physical medicine costs are higher due to greater quantity
- The greatest proportional difference is in the quantity of physical medicine
- For chronic claims, WC costs are higher due to both higher prices and greater quantity
- For referral-based services on acute claims:
 - WC radiology price, quantity, and cost are close to GH
 - WC surgery is priced higher than GH, but WC is on par with GH for quantity

Earlier NCCI studies comparing WC with GH showed a higher cost of radiology for WC over GH. They suggested investigating the application of WC fee schedules to radiology.⁹ That noted, we attribute the improvement to declines in prices driven by technology and lower Medicare reimbursements for radiology (Exhibits 9 and 10).

Better control over the quantity of physical medicine services may potentially lower WC medical costs. Because physical therapy visits are relatively inexpensive, utilization review based on counting the number of visits may not be cost effective.

Yet physical therapy can be critical to recovery and return to work: two primary objectives for WC. There are considerations regarding the use of physical therapy that may prove less favorable to WC than to GH:

- Cost sharing in GH may lower the utilization of those services (Exhibit 11)
- GH plans may limit or exclude certain modalities, like manipulations or cold packs
- Continued physical therapy on a WC claim may be used to justify more lost-time benefits
- Physical therapy visits on a WC claim may not entail taking time off from work

Many states promulgate WC treatment guidelines that include the utilization of physical medicine. They are meant to promote quality of care and not as justification for performing the maximum allowable number of services.

Among the 12 injuries, males receive somewhat more surgery services in WC than in GH, while females receive somewhat less. For other physician service type categories, there is no difference by gender in the quantity differential, with both genders showing consistently higher quantity in WC. Also, there are no meaningful differences by gender in the price differentials (Exhibit 12).

Ages 35 to 40 are transitional in the WC-to-GH relationship. Both WC price and quantity relativities typically begin above GH and then increase with age to remain near their maximums after age 40 (Exhibit 13). Shoulder and knee injuries are exceptional, with GH providing greater quantity of services to treat younger patients (Exhibits 14 and 15). We attribute those exceptions to a greater GH exposure to sports-related injuries (Exhibits 16 and 17).

NCCI will continue to examine areas of market interest such as workers compensation versus group health insurance and to report our findings to the industry. For a complete review of ongoing NCCI research projects, please visit ncci.com.

⁹ Quote from the 2006 study: "Investigating the application of WC fee schedules to radiology may be worthwhile, especially if it's combined with expertise drawn from GH, where the study found more effective price containment."

Appendix: Decomposition of the Cost Differential

Because cost has two factors, price and quantity, a difference between costs naturally breaks down into two components. There are, however, various ways to calculate such a decomposition with corresponding interpretations for the components. This appendix details the decomposition of the WC to GH cost differential into price and quantity differentials that are used in this paper. The most novel aspect of this decomposition is the use of the WC Relative Price Index (WCRPI) to measure differences in quantity. This discussion is more technical than in the paper itself.

Episode-level data

Let E denote a set of episodes. Elements of E can be identified with subsets of medical payment transactions that have been grouped by MEG into WC and GH episodes of care for a specified medical condition. Each episode is assigned a unique identifier and an indicator variable WC01:

- WC01 = 1 for a WC episode
- WC01 = 0 for a GH episode

The MEG output is used to assign several “demographic” variables to the episodes, including, but not restricted to:

- STATE: state of jurisdiction for WC01 = 1; state of patient residence for WC01 = 0
- EGC: episode group code identifying the medical condition for the episode
- AGE_GRP: 10 groups (15–20, 20–25, ..., 60–65)
- SEX: male/female
- EPIID: unique episode ID
- AY: year of earliest service on the episode

As part of the analysis, each episode is assigned a “weight variable,” WGTratio, which is defined as:

- WGTratio = 1 for WC episodes
- WGTratio = the number of WC episodes in the episodes’ “bucket” divided by the number of GH episodes in that bucket

where a “bucket” identifies a subset of episodes sharing a common set of five demographic variables (STATE, EGC, AGE_GRP, SEX, and AY). Note that weighted statistics will reflect the same number of WC and GH episodes within each bucket. The weighted episode frequency distribution reflects the distribution of WC episodes into buckets. This is a straightforward approach for making “fair” or “episode mix adjusted” comparisons between GH and WC that is geared to what matters most for WC. This methodology assures that the number and mix of episodes reflected in the comparisons is the same for GH as for WC, at least as regards the five demographics. We refer to E , coupled with this WGTratio weight, as the “episode market basket.”

Transaction-level data

Let T denote the set of transactions for physician services for episodes from 12-episode group codes (EGCs—6 acute and 6 chronic). Index T elements with the subscript $i \in I = \{1, 2, \dots, |T|\}$. All elements of T have been grouped by MEG into episodes, assigned a unique episode ID, and assigned an EGC from the list of 12 injuries.

Think of elements of T as observations for individual medical procedures for which we have the following data elements, where episode level characteristics are taken from the episode market basket (“inherited from E ”):

- WC01: inherited from E
- STATE: inherited from E
- EGC: inherited from E
- AGE_GRP: inherited from E
- SEX: inherited from E
- EPIID: inherited from E
- AY: inherited from E
- WGTratio: inherited from E
- CPT: AMA procedure coding
- FACILITY: facility/nonfacility, venue based on place of service

- PAY: paid amount (includes copay and deductible for GH)

The first eight data elements are assigned the same value as the episode to which the transaction belongs. When summing transaction paid amounts, using the WGTratio as a weight in effect makes the sums reflect the number of episodes in the market basket, and therefore matches the WC and GH number of episodes reflected in the numerator and denominator amounts for differentials.

We also use two derived data elements:

- PROCgrp: defined from CPT procedure code (E&M, PT, radiology, surgery), see Exhibit 7
- EGCgrp: defined from EGC (acute, chronic), see Exhibit 1

We assign the additional variable WCRPI to the T observations by looking it up in a table according to the pair of values of CPT and FACILITY. This WCRPI table assigns relative intensity amounts to specific physician services and, as noted in the paper, is specifically designed to measure differences in utilization, i.e., differences in quantity and procedure mix.

Let $I_0 = \{i/ t_i \in T \text{ and } WCOI(t_i) = WCOI_i = 0\}$ and $I_1 = \{i/ t_i \in T \text{ and } WCOI(t_i) = WCOI_i = 1\}$. Clearly $I = I_0 \cup I_1$.

We want to compare WC with GH costs, so we begin with (using transparent notation):

- $WC_Cost = \sum_{i \in I_1} PAY_i = \sum_{i \in I_1} PAY_i \times WGTratio_i$
- $GH_Cost = \sum_{i \in I_0} PAY_i \times WGTratio_i$

Cost = Price × Quantity Model

Partition $I = \cup_j K_j$ into a disjoint union such that for any j , $a, b \in K_j$ if and only if:

- STATE_a = STATE_b
- EGC_a = EGC_b
- AGE_GRP_a = AGE_GRP_b
- SEX_a = SEX_b
- AY_a = AY_b
- PROCgrp_a = PROCgrp_b
- EGCgrp_a = EGCgrp_b

where the last equality is redundant, being implied by the second.

Set:

- $I_{0j} = I_0 \cap K_j$
- $I_{1j} = I_1 \cap K_j$

then clearly

- $I_0 = \cup_j I_{0j}$
- $I_1 = \cup_j I_{1j}$

Now set:

- $Q_{0j} = \sum_{i \in I_{0j}} WGRatio_i$
- $Q_{1j} = \sum_{i \in I_{1j}} WGRatio_i = \sum_{i \in I_{1j}} 1 = |I_{1j}|$
- $P_{0j} = \frac{\sum_{i \in I_{0j}} PAY_i \times WGRatio_i}{\sum_{i \in I_{0j}} WGRatio_i} = \frac{\sum_{i \in I_{0j}} PAY_i \times WGRatio_i}{Q_{0j}}$ where $Q_{0j} > 0$
- $P_{1j} = \frac{\sum_{i \in I_{1j}} PAY_i \times WGRatio_i}{\sum_{i \in I_{1j}} WGRatio_i} = \frac{\sum_{i \in I_{1j}} PAY_i \times WGRatio_i}{Q_{1j}} = \frac{\sum_{i \in I_{1j}} PAY_i}{|I_{1j}|}$ where $Q_{1j} > 0$
- $R_{0j} = \frac{\sum_{i \in I_{0j}} WCRPI_i \times WGRatio_i}{\sum_{i \in I_{0j}} WGRatio_i} = \frac{\sum_{i \in I_{0j}} WCRPI_i \times WGRatio_i}{Q_{0j}} = MeanWCRPI_j$ where $Q_{0j} > 0$

Note that for each ratio, the numerator and denominator reflect the same number of episodes. Then:

- $WC_Cost = \sum_{i \in I_1} PAY_i \times WGRatio_i = \sum_j P_{1j} \times Q_{1j}$
- $GH_Cost = \sum_{i \in I_0} PAY_i \times WGRatio_i = \sum_j P_{0j} \times Q_{0j}$

Setting $Cross_Cost = \sum_j P_{0j} \times Q_{1j}$ then:

- $\frac{WC_Cost}{GH_Cost} = \frac{WC_Cost}{Cross_Cost} \times \frac{Cross_Cost}{GH_Cost} = \frac{\sum_j P_{1j} \times Q_{1j}}{\sum_j P_{0j} \times Q_{1j}} \times \frac{\sum_j P_{0j} \times Q_{1j}}{\sum_j P_{0j} \times Q_{0j}}$

This motivates the way we define price and quantity differentials, where we replace the empirical mean prices P_{0j} with the $MeanWCRPI_j$ in the formula for the *Quantity_Differential*:

- $Price_Differential = \frac{\sum_j P_{1j} \times Q_{1j}}{\sum_j P_{0j} \times Q_{1j}}$
- $Quantity_Differential = \frac{\sum_j R_{0j} \times Q_{1j}}{\sum_j R_{0j} \times Q_{0j}} = \frac{\sum_j MeanWCRPI_j \times Q_{1j}}{\sum_j MeanWCRPI_j \times Q_{0j}}$

These differentials and their interpretation depend on the partition $I = \cup_j K_j$. We have the **formal** approximation:

- $\frac{WC_Cost}{GH_Cost} \approx Price_Differential \times Quantity_Differential$

Note that the price differential can be interpreted as a ratio of the cost for the same Q_{1j} WC quantities of services, where WC weighted-mean prices P_{1j} are used for the numerator cost and GH weighted mean prices P_{0j} for the denominator cost. Note that because CPT is not matched between WC and GH in the $I = \cup_j K_j$ partition, a different WC and GH mix by CPT procedure may impact the average prices P_{0j} and P_{1j} and, therefore, may impact the price differential in this model.

The quantity differential can also be interpreted as a ratio of a WC cost over a GH cost. Here the numerator and denominator costs equal what costs would be when prices are determined by averaging over a common fee schedule based on WCRPI relativities. Because CPT is not matched between WC and GH, differences in CPT procedure mix within a service type category (e.g., X-ray vs. MRI among radiology services) are not reflected in the Q_{0j} and Q_{1j} tallies of the number of services within a service category. However, differences in the quantity of services by category are reflected in the Q_{0j} and Q_{1j} and, therefore, reflected in the quantity differential in this model.

When determining differentials by state, procedure group, injury group, or any combination thereof, the set of transactions T is restricted to transactions satisfying the corresponding condition(s).