RESEARCH BRIEF

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September 2021

By Dan Corro, Tom Daley, and Barry Lipton

Workers Compensation and Group Health—Comparing Utilization of Physician Services

Although the workers compensation benefit delivery system is specifically geared to the needs of employers and injured workers, it operates within a much larger healthcare system. Group health (GH) makes up a far bigger portion of that system than workers compensation (WC), but the two coverages have many commonalities in medical services covered. Accordingly, it makes sense to tap into group health data to compare prices and utilization between the two.

NCCI has published a series of studies comparing medical costs between WC and employer-sponsored GH insurance.[1] They compared the cost of physician services to treat a select group of injuries for a select group of states. This study continues and extends that prior research by:

- Refining the measurement of utilization differences
- Analyzing relativities between WC and GH for the cost of physician services, separately for price and utilization
- Affirming that utilization continues to be the greatest factor pushing WC costs above GH

In February 2020, NCCI published the article "Comparing the Quantity and Prices of Physician Services Between Workers Compensation and Group Health" [5]. This article extends that work by also looking at a mix of services.

This continues our approach of examining the key components of medical costs:

- Prices of services
- Quantity of services
- Mix of services

[1] Please refer to Related NCCI Articles, [1–5] after the Conclusion.

KEY FINDINGS

For 12 common WC injuries, the cost of physician services within the WC and GH insurance systems indicates that:

- WC pays more than GH to treat comparable injuries
- The most pronounced difference between WC and GH is the greater quantity of physical medicine services in WC
- Utilization differences are much bigger than price differences for WC relative to GH, explaining most of the cost difference
- Utilization differences vary principally by type of injury: all selected injuries show a higher level of utilization for WC than for GH
- Price differences are more related to the jurisdiction than to the type of injury for WC, due in part to the different state fee schedules that apply
- Cost differences between states are more correlated with price differences than with utilization differences
- Traumas to arms and legs consistently have smaller cost and utilization differences in WC, while chronic pain-related injuries, such as bursitis and back pain, have larger differences
- A more expensive mix of procedures in complex WC cases contributes to higher costs relative to GH, especially for referral-based care, like radiology and surgery

BACKGROUND AND METHODOLOGY

The WC experience for this study is from NCCI's Medical Data Call (MDC). The MDC captures transaction-level detail on medical bills processed on or after July 1, 2010. That detail includes 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.[2]

The GH data for this study consists of medical experience from employer-sponsored health benefit plans. NCCI licensed it from Truven Health Analytics, an IBM Watson Health Company that provides healthcare data and analytics.[3]

Both the WC and the GH data are for Service Years 2013 through 2016. To be comparable with WC, GH payments reflect the full cost of any service, including any copayment, deductible, or coinsurance. Critical to the study, both WC and GH use CPT codes to identify physician procedures and ICD diagnosis codes.[4]

In many respects, this article is a follow-up and an extension of the February 2020 article. Much of the methodology for this study is the same or very similar to the prior study. To avoid redundancy, we have relegated the more detailed discussions of methodology to the Appendix.

While the WC and GH data capture similar data elements, there are some significant differences. The most significant challenge to our analysis stems from the way transactions are organized in the two systems. WC transactions include a claim number that identifies the workplace injury and lets us group the medical services together to treat the injury. While GH transactions include coding for diagnosis and procedure, they do not have an identifier that ties all the treatments for a given injury together (such as accident date). The cost comparisons we seek apply at the WC cost-per-case level. We overcome this by using a common algorithm to group both WC and GH transactions into "episodes" of care.

We grouped medical transactions into episodes based on the medical condition being treated. The study looks at physician services for 12 common WC injuries, half of which we call "acute" and the other half "chronic."

[2] 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.

[3] 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.

[4] "Current Procedural Terminology" (CPT) is a standard coding scheme in medical billing to identify specific procedures. CPT is a registered trademark of the American Medical Association. ICD refers to "International Classification of Diseases," which is also a standard coding scheme in medical billing. CPT and ICD codes are reported on both the GH and WC transaction data.

Having organized WC and GH transactions into episodes, we then construct a market basket of episodes. The market basket assigns a frequency weight to each episode. The weighting matches WC and GH episodes to control for differences in several patient and injury characteristics:

- Age of the patient when treatment began
- Year when treatment began
- Gender of the patient
- State (of domicile for GH; of jurisdiction for WC)
- Type of injury

Appendices A and B discuss assigning transactions into episodes and episodes into a market basket respectively. The more technical Appendix D provides details on constructing the market basket.

When comparing WC to GH costs, we express results as relativities (referred to as differentials). For example, if a WC amount is $1,230 and the corresponding amount for GH is $1,000, the ratio is 1.23 and the differential of WC to GH is 123%. Differentials over 100% correspond to WC amounts that are greater than for GH; differentials under 100% correspond to higher GH amounts.

We construct two cost differentials:

- A "unit price" differential
- A "utilization" differential

The "unit price" differential isolates differences in the reimbursements paid to providers for a single specific medical procedure (or "unit"). The maximum allowable reimbursement (MAR) in WC physician fee schedules (PFS) is a good example of a unit price. The PFS specifies MARs by CPT procedure code (to apply in the state for services performed after the effective date of the schedule, and before the effective date of a newer PFS).

To determine a unit price differential applicable to a collection of WC episodes from the market basket, we:

1. Identify what procedures treat that collection of episodes
2. Calculate what those procedures would have cost if reimbursed at the unit prices determined by averaging actual WC payments by CPT procedure code
3. Calculate what those same procedures would theoretically have cost if reimbursed at the unit prices determined by averaging actual GH payments by CPT procedure code
4. Divide the WC theoretical cost by the GH theoretical cost

A simplified example illustrates the calculation in Table 1; here the collection of WC episodes from the market basket includes only a very few uncomplicated elbow injuries:

Table 1: Derivation of Unit Price Differential

			Unit Price		Cost = Units x Price	
CPT	**Procedure**	**# Units**	**GH**	**WC**	**GH**	**WC**
99212	Office Visit	12	$45	$55	$ 540	$ 660
97140	Physical Therapy	15	$50	$45	$ 750	$ 675
73070	Elbow X-Ray	10	$75	$100	$ 750	$ 1,000
Total			Theoretical Cost:		$2,040	$ 2,335
			Unit Price Differential:			**1.14**

We calculate the unit price differential between WC and GH as the ratio of two hypothetical costs for the same set of medical services. Because the number and type of medical services are the same, the ratio measures differences in the unit prices paid for the various physician services. The unit price differential isolates the cost impact due to changing reimbursement amounts from a schedule of GH unit prices to a schedule of WC unit prices.

"Utilization" refers to the set of specific medical procedures used to treat an injury or a group of injuries. Utilization encompasses the procedures used, along with how many units of each procedure are delivered. Differences in utilization between WC and GH are due to differences in the mix of services (e.g., MRI vs. X-ray) or the number of services.

To estimate utilization differences, we first reprice all the treatments to a common fee schedule. As a result, all cost differences after this adjustment are due to differences in utilization, as there is no difference in prices. In doing this, we need to consider that some medical procedures are more resource-intensive than others and cost more. For example, a state PFS will specify a higher MAR for the CPT code of a complex surgery procedure than for the CPT code for an office visit. However, state PFS MARs vary over time with updates for inflation. The ideal utilization measure should only depend on what medical procedures are delivered and should not vary by jurisdiction or time.

The workers compensation relative price index (WCRPI) assigns relative intensity to services by their CPT code and venue of service. Some key properties of the WCRPI that make it a preferred metric of WC utilization are that it:

- Is designed to be independent of jurisdiction and time
- Incorporates the Medicare resource-based relative value scale (RBRVS) to assign relative intensity by CPT code
- Customizes those relativities to WC claim experience

We determine the utilization differential as the ratio of two hypothetical costs, but here there are **two** sets of medical services. To determine a utilization differential, we:

1. Identify what procedures are used to treat a collection of WC episodes from the market basket
2. Identify what procedures are used to treat a corresponding collection of GH episodes from the market basket, matched to the WC collection of episodes using the five patient and injury characteristics presented earlier
3. Calculate what the GH and WC episode procedures would hypothetically have cost if both were reimbursed at the WCRPI unit prices by CPT procedure code
4. Divide the WC hypothetical cost by the GH hypothetical cost

We calculated each cost using the WCRPI unit price schedule (i.e., we held unit prices fixed). Since the prices are the same, the difference is all due to the number and type of medical services. The utilization differential includes the impact due to changes in the volume and mix of services. The market basket weight matches the two costs as to the patient and injury characteristics of the WC and GH episodes. Table 2 illustrates the calculation:

Table 2: Derivation of Utilization Differential

		# Units		Unit Price	Cost = Units x Price	
CPT	**Procedure**	**GH**	**WC**	**WCRPI**	**GH**	**WC**
99212	Office Visit	10	12	$ 50	$ 500	$ 600
97140	Physical Therapy	5	15	$ 40	$ 200	$ 600
73070	Elbow X-Ray	5	10	$ 85	$ 425	$ 850
Total				Hypothetical Cost:	$1,125	$ 2,050
				Utilization Differential:		**1.82**

In short, to determine the:

- Unit price differential: use one set of medical services and two price schedules, one WC and one GH
- Utilization differential: use one price schedule and two sets of medical services, one WC and one GH

Appendix D details the calculation and interpretation of the unit price and utilization differentials.

Analyzing the cost of physician services

For both GH and WC patients, doctors and other medical professionals use CPT coding to identify medical procedures. We itemized physician services into four broad service categories by reference to ranges of CPT codes (see Appendix C for more detail):

- Evaluation and Management (E&M)
- Physical Medicine
- Radiology
- Surgery

We use the following terms in a precise manner in this study:

- "Cost" signifies the total amount paid for the various services to treat an injury
- "Unit price" refers to the amounts paid for individual procedures identified by their CPT code and place of service
- "Quantity" refers to the volume (number of services) within a category of services (such as radiology)
- "Mix" refers to the distribution of individual procedures within a category of services (such as X-rays vs. MRIs)
- "Utilization" represents both the volume (number of services) and the mix of services (such as X-rays vs. MRIs)

We capture that terminology in two cost models:

(1) Cost = Unit Price x Utilization

(2) Utilization = Quantity x Procedure Mix

To analyze cost differences between WC and GH, we translate the first equation into differentials:

(3) Cost Differential = Unit Price Differential x Utilization Differential

We saw that the unit price and utilization differentials are calculated as ratios of hypothetical costs, each customized to best isolate a cost component. However, we calculate the cost differential as the product of two component differentials. The cost differential is not the same as the ratio of two bottom-line costs, and this formulation allows us to better isolate cost components (e.g., by using a market basket and the WCRPI) and to provide insights not available otherwise.

In the February 2020 article [5], we derive a quantity differential between WC and GH that is analogous to the utilization differential (see Appendix D for more detail). The quantity differential compares the volume of services across categories and does not capture differences in mix of procedures within a service category (e.g., specific X-rays and MRIs within radiology). The quantity differential is compatible with the utilization differential, as both use the WCRPI price schedule.

Translating the second equation into differentials:

(4) Utilization Differential = Quantity Differential x Procedure Mix Differential

The Procedure Mix Differential is derived from equation (4) as a ratio of two known differentials:

(5) Procedure Mix Differential = Utilization Differential ÷ Quantity Differential

This is consistent with our terminology since the mix of procedures within a service category does impact utilization, but not quantity.

In short, to determine the:

- Utilization differential: use one CPT level price schedule and two sets of medical services, one WC and one GH
- Quantity differential: use one price schedule averaged across service category and two sets of medical services, one WC and one GH
- Procedure mix differential: divide the utilization differential (which reflects the CPT mix within a service category) by the quantity differential (which does not)

We combine the three component differentials into a model for analyzing the cost differential:

(6) Cost Differential = Unit Price Differential x Quantity Differential x Procedure Mix Differential

Injuries selected for analysis

To analyze WC-to-GH cost relativities, we use the 12 injuries in Exhibit 1—the same injuries as in the February 2020 article [5]. We assign each episode a code that identifies the injury or medical condition contemplated when grouping services into the episode. For each injury code, we process the individual physician services and calculate unit price and utilization differentials. We chose the 12 injuries for their prevalence in WC. They encompass a variety of injury types: from pain-based conditions, such as bursitis and 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 with injuries analyzed in prior studies (see the list of related NCCI articles after the conclusion). For example, we selected “Lower back disc disorders” to match the “Herniated intervertebral disk” of prior studies. We selected “Other lower back disc disorders, including the spine” to match “Other spinal and back disorders” and so exclude herniated intervertebral disk.[5]

[5] Prior studies included carpal tunnel syndrome (CTS) among the list of injuries. However, while there is a CTS episode category, it is not recommended for research purposes. We instead include “Other bone and joint disorders.” This category excludes episodes that the grouper algorithm identifies as CTS but are 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. For the chronic injuries, there is generally a wider range of possible medical severities, and a wider range of generally accepted treatment protocols, than for the acute injuries.

FINDINGS

We analyze differences between WC and GH in the cost of physician services for the 12 injuries in Exhibit 1. We do this in five sections:

1. By states
2. By injuries
3. By physician service categories
4. By age and gender
5. Utilization of Evaluation and Management (E&M) services

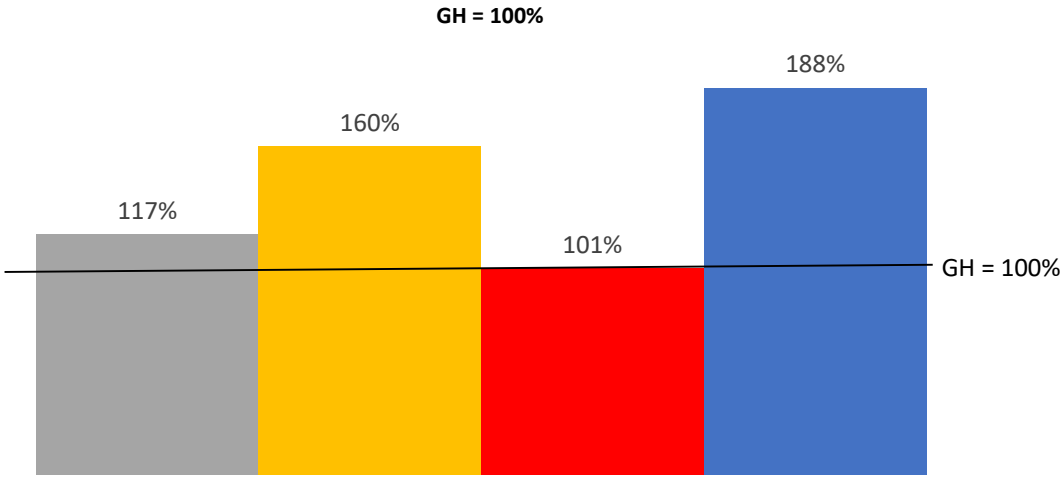
The first four sections use the three-component model of the cost differential: unit price, quantity, and procedure mix. The last section looks at how E&M services compare between WC and GH.

For the 12 injuries combined, quantity provides the largest difference between WC and GH while procedure mix has little impact (quantity is taken from Exhibit 2 of the February 2020 article [5]). The component differentials of WC over GH indicate that:

- Combining the three components of the model, WC costs are 88% higher than GH
- Differences in quantity account for nearly four-fifths (77%) of higher WC costs
- Differences in unit prices account for just over one-fifth (22%) of higher WC costs

Exhibit 2: WC-to-GH Relativity in the Cost of Physician Services

Unit Price, Quantity, Procedure Mix, and Cost Differentials for 12 Injuries

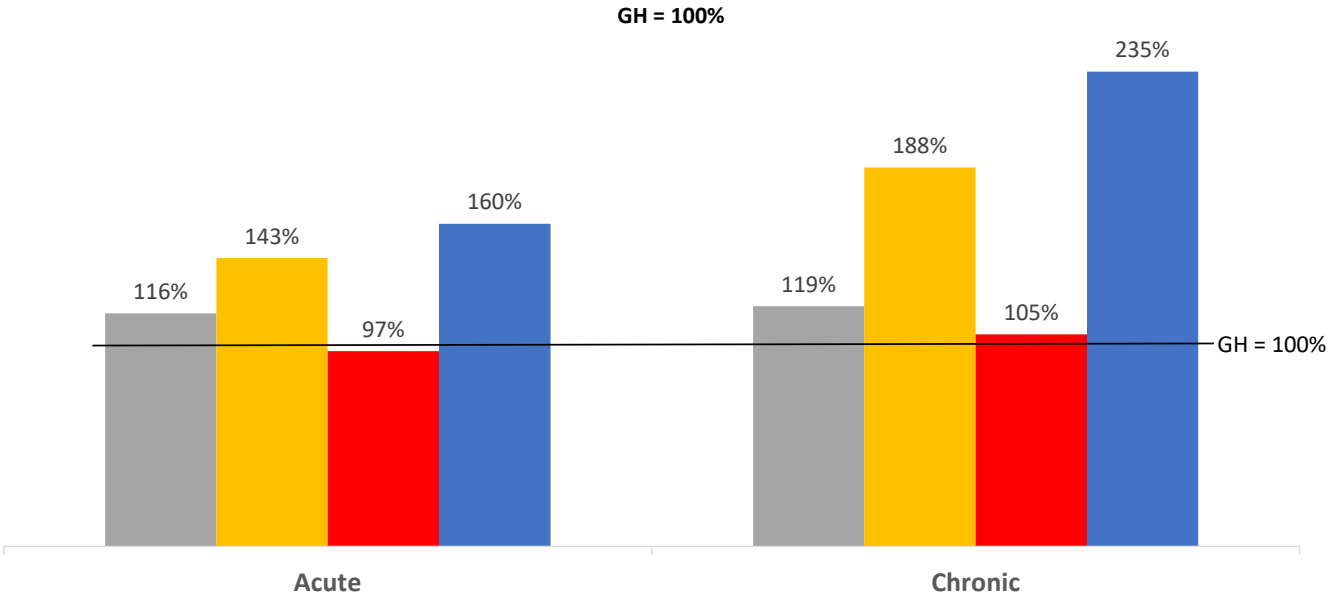


The pattern of differentials remained generally similar when we viewed the six acute and six chronic injury groupings separately, as in Exhibit 3 (Exhibit 3 quantity is taken from Exhibit 6 of the February 2020 article [5]). Quantity plays the dominant role for both groups of injuries. For all three components, Exhibit 3 shows that differences are greater for chronic injuries:

- While costs are higher in WC for both groups, cost differences are much greater for chronic, as compared to acute, injuries (235% vs. 160%)
- For the acute injuries, quantity accounts for nearly 90% of the entire cost differential (143% of 160%)
- For chronic injuries, differences in quantity account for four-fifths of higher WC costs
- Differences in unit prices push WC costs higher than GH for both groups, but somewhat more for chronic injuries than for acute (119% vs. 116%)
- Differences in mix of services push WC costs a little lower than GH for acute injuries and a little higher for chronic injuries (97% vs. 105%)

Exhibit 3: WC-to-GH Relativity in the Cost of Physician Services

Unit Price, Quantity, Procedure Mix, and Cost Differentials for Acute and Chronic Injuries

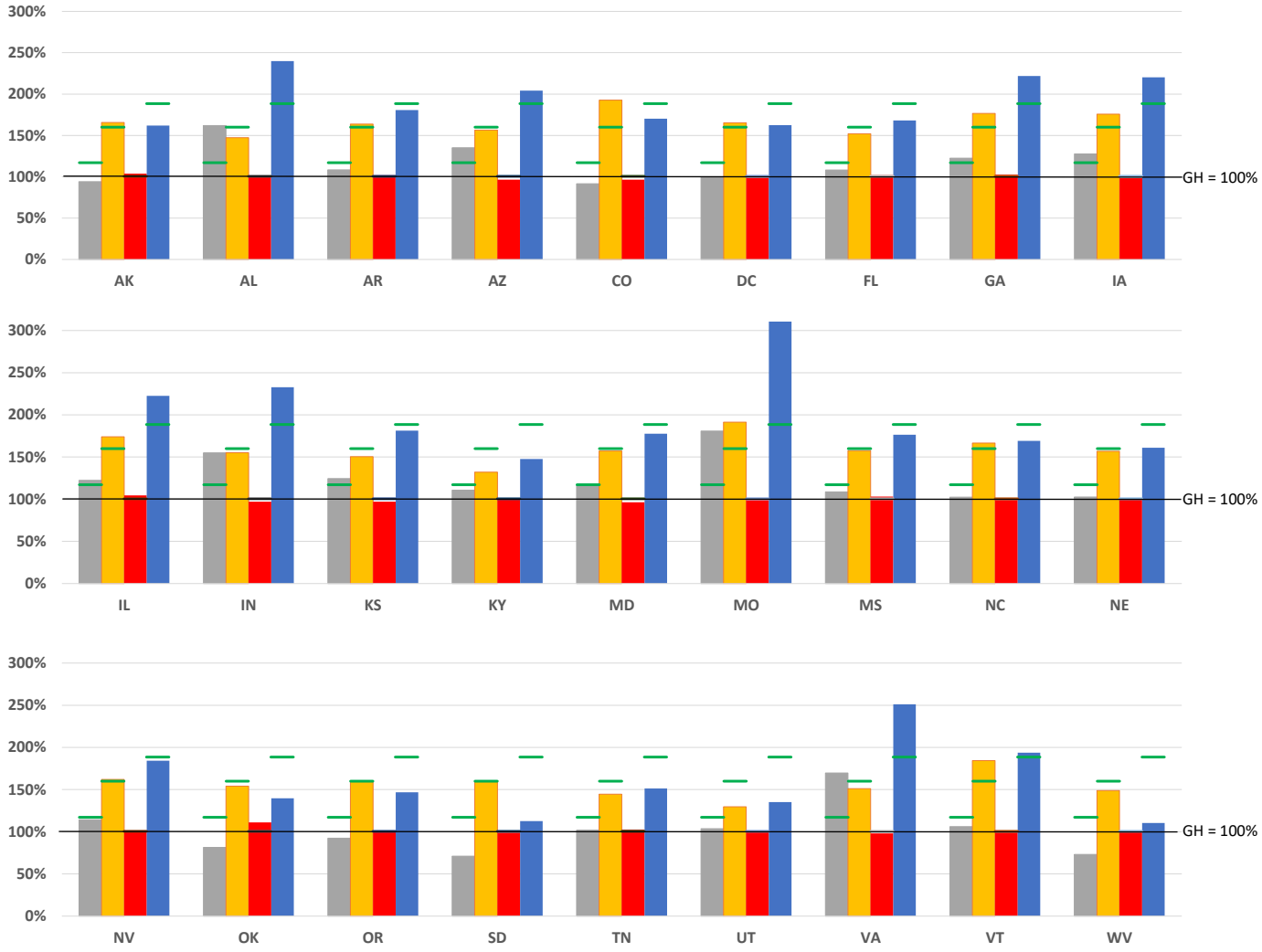


Differences in WC and GH across states

The decomposition picture in Exhibit 2 varies considerably when calculated by state in Exhibit 4A, even though the mix component hovers near 100% (Exhibit 4A quantity taken from Exhibit 3A of the February 2020 article [5]). The short green lines facilitate comparison of state values with the "all states combined" values shown in Exhibit 2 (because the short green lines for Procedure Mix are at 101%, they are often obscured by the GH = 100% line).

Exhibit 4A: WC-to-GH Relativity in the Cost of Physician Services
Unit Price, Quantity, Procedure Mix, and Cost Differentials
for 12 Injuries and Relative to National Values

GH = 100%



The following table shows how the three component differentials relate with the cost differential model by state. Exhibit 4B gives the unit price, quantity, procedure mix, and cost differential of WC-to-GH by state. GH is set to 100% for each state and component. We sorted the states by the cost column in order of increasing relativity to GH. We scaled each column individually by color. Our observations include:

- All states have WC quantity at least 30% above GH
- Every state with WC cost more than 70% above GH also has WC unit prices higher than GH
- Every state with WC cost less than 78% above GH, has a WC unit price less than or equal to the multi-state 117% differential in Exhibit 2
- Among the five lowest cost differentials, lower WC unit price differentials drive four (WV, SD, OK, and OR) and lower volume drives the fifth (UT)
- The four highest cost differential states (MO, VA, AL, and IN) are also the four highest unit price differential states
- The procedure mix differential is much closer to 100% than the quantity differential for all 27 states3
- The procedure mix differential is usually closer to 100% than the unit price differential
- The unit price differential strongly correlates with cost differential by state (coefficient = 0.92)
- The quantity differential has some correlation with cost by state (coefficient = 0.46)
- The procedure mix differential does not correlate with the cost differential by state (coefficient = –0.24)

Exhibit 4B: WC-to-GH Cost Differentials by State

Expressed as a Percentage of GH = 100%

State	Unit Price	Quantity	Procedure Mix	Cost
WV	73%	149%	101%	110%
SD	71%	160%	99%	113%
UT	104%	130%	100%	135%
OK	82%	154%	111%	140%
OR	92%	160%	100%	147%
KY	111%	132%	101%	148%
TN	102%	145%	103%	151%
NE	103%	157%	100%	161%
AK	94%	166%	104%	162%
DC	99%	165%	99%	162%
FL	108%	152%	102%	168%
NC	103%	167%	99%	169%
CO	92%	193%	97%	170%
MS	109%	158%	103%	176%
MD	117%	157%	96%	178%
AR	108%	164%	102%	181%
KS	124%	150%	97%	181%
NV	114%	162%	100%	184%
VT	106%	184%	99%	194%
AZ	135%	156%	97%	204%
IA	128%	176%	98%	220%
GA	122%	177%	103%	222%
IL	122%	174%	105%	222%
IN	155%	155%	97%	233%
AL	162%	147%	101%	240%
VA	170%	151%	98%	251%
MO	181%	191%	99%	343%

Key findings from Exhibit 4B include the following:

- State cost differentials between WC and GH are more correlated with price than with utilization differences
- Every state with unit price differential near or below 100% (in a shade of green) has a WC Physician Fee Schedule
- Conversely, states having a WC PFS have unit price relativities at or below 135% and all but one less than 125%.6

This demonstrates that a WC PFS can make prices competitive with or even below GH prices. Alabama has a very high-cost differential (240%), and its PFS is based on usual and customary fees, whereas most other state WC PFSs are resource-based and benchmarked to Medicare.

Missouri has the largest cost differential in Exhibit 4B, pairing the largest unit price differential with high quantity relative to GH. Missouri has no WC PFS and no treatment guidelines.

Colorado emerges as a somewhat exceptional state in Exhibit 4B, pairing the highest quantity differential with low unit prices relative to GH. The Colorado WC PFS explains the lower prices. The higher utilization in Colorado suggests the potential for more effective application of the Colorado Treatment Guidelines.

The range in unit price differentials among the states is greater than the ranges for quantity and mix. This is reasonable, as we would expect prices to respond to jurisdictional differences, such as fee schedules, as well as to regional variation in the cost of living or accessibility of care. While there are differences in unit price and utilization among the states, WC cost differentials and unit price differentials to GH correlate strongly at a state level.

Differentials (Exhibit 3) are greater for the six chronic, as compared with the six acute, injuries. Exhibits 5A and 5B plot eight differentials by state (Exhibit 5 quantity is taken from Exhibit 5 of the February 2020 article [5]). For every state, the WC cost and quantity differentials for the chronic group of injuries are greater than for the acute group.

We sorted states by the cost differential for chronic injuries, which is the greatest of the eight differentials for most states. Exhibit 4B shows that the unit price differential strongly correlates with the cost differential by state, and Exhibit 5A plots those differentials. Exhibit 5B plots the two utilization component differentials, procedure mix, and quantity.

Exhibit 5A plots the cost and unit price differentials by state and reveals the following:

- For all 27 states, cost differentials are higher for chronic than for acute injuries, and the two are positively correlated by state (coefficient = 0.882)
- Unit price differentials are higher for chronic than for acute injuries in many, but not all states, and the two are positively correlated by state (coefficient = 0.809)
- For both chronic and acute injuries, cost and unit price differentials are strongly and positively correlated by state (coefficients = 0.905 and 0.939, respectively)
- For chronic injuries, all states with a cost differential over 260% have a unit price relativity over 140%
- For the more straightforward-to-treat acute injuries, the cost and unit price differentials are closer together and smaller than the two differentials for chronic injuries

[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.

Exhibit 5A: WC-to-GH Relativity in the Cost of Physician Services
Unit Price and Cost Differentials by State for Six Chronic (○) and Six Acute (◊) Injuries

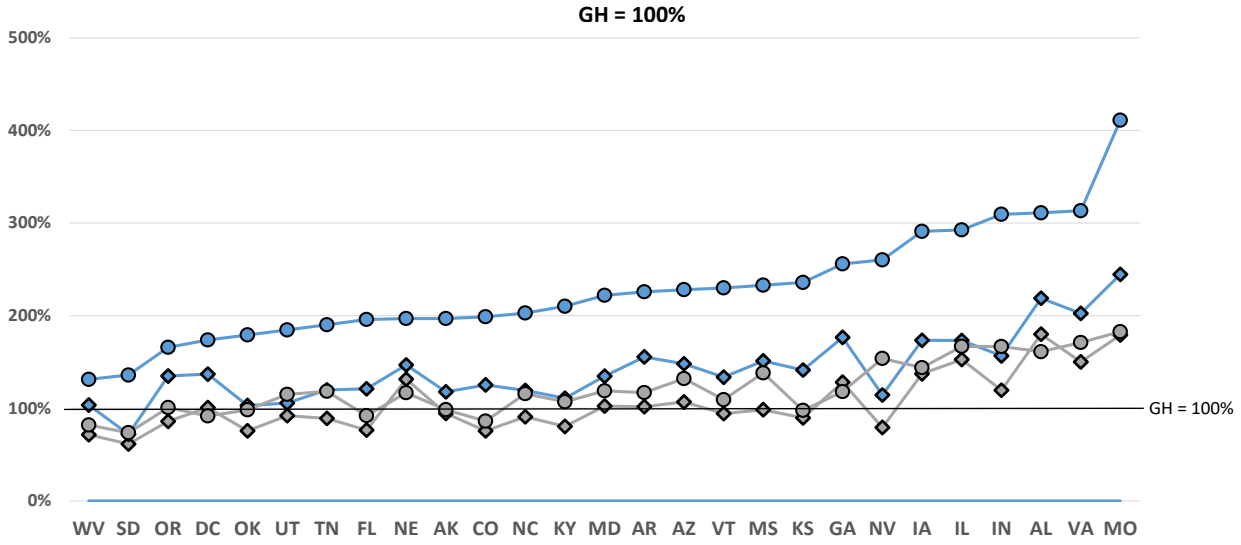
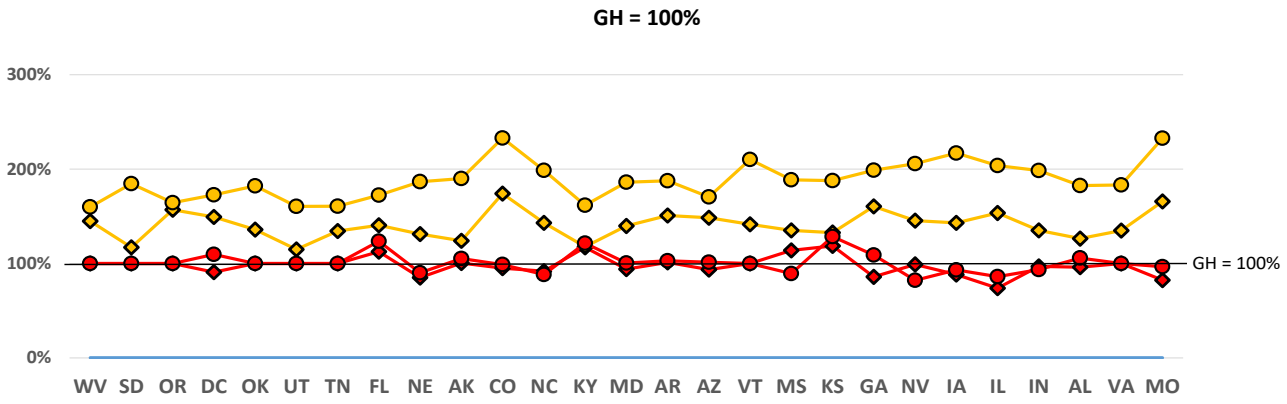


Exhibit 5B plots the quantity and procedure mix differentials by state and shows us that:

- For all 27 states and for both chronic and acute injuries, quantity dominates procedure mix to account for higher WC utilization than for GH
- For all 27 states, quantity differentials are higher for chronic injuries than for acute injuries, and the two are only somewhat positively correlated by state (coefficient = 0.537)
- For all 27 states, both procedure mix differentials are lower than the respective quantity differential
- For all 27 states, procedure mix differentials for both chronic injuries and acute injuries fluctuate around 100% and the two are only somewhat positively correlated by state (coefficient = 0.584)
- The state quantity differential for chronic injuries is the only one of the four differentials to show any tendency to increase from left to right along with the cost differential (coefficient = 0.587)
- For both chronic and acute injuries, the quantity and mix differentials are only weakly and negatively correlated by state (coefficients = –0.381 and –0.475, respectively)

Exhibit 5B: WC-to-GH Relativity in the Cost of Physician Services
Quantity and Mix Differentials by State for Six Chronic (○) and Six Acute (◊) Injuries



When viewed by state, quantity consistently contributes to greater WC utilization than for GH. Procedure mix does not.

Among 12 injuries

We now shift perspective from geography to diagnosis, organizing the experience for each of the 12 injuries. Exhibit 6 shows the unit price, quantity, procedure mix, and cost differentials of WC-to-GH. We scaled each column individually by color (Exhibit 6 quantity is taken from Exhibit 4 of the February 2020 article [5]).

Exhibit 6 shows that:

- All 12 injuries have their WC cost 21% or more above GH with their WC unit price 6% or more above GH
- The five injuries with the highest WC cost differential over GH are all chronic injuries
- Five of the six injuries with the lowest WC cost differential over GH are acute injuries
- Except for the knee ligament injury, the quantity is greater than the unit price differential
- For all 12 injuries, the quantity differentials are greater than 100%
- Knee ligament injury has both the lowest WC cost differential over GH and the lowest quantity differential, while bursitis has both the highest cost differential and the highest quantity differential
- Bursitis has the second highest unit price and the highest WC quantity relativity over GH
- For each injury, the procedure mix is the component differential closest to 100% and it is
- Over 100% for five of the six chronic injuries (with the exception being upper back spine/spinal cord disorder)
- Under 100% for five of the six acute injuries (with the exception being upper extremity open wound, or blunt trauma)
- There is strong positive correlation by injury between the cost differential and each of the quantity and procedure mix component differentials (coefficients of 0.933 and 0.723, respectively)

Exhibit 6: WC-to-GH Cost Relativities by Injury
Expressed as a Percentage of GH = 100%

Injury	Unit Price	Quantity	Procedure Mix	Cost
Knee ligament injury	120%	110%	91%	121%
Inguinal hernia*	124%	127%	102%	161%
Upper extremity open wound, or blunt trauma	106%	150%	102%	162%
Lower extremity open wound, or blunt trauma	106%	164%	95%	165%
Wrist/hand fracture, dislocation, or sprain	116%	147%	97%	166%
Humerus/shoulder fracture, dislocation, or sprain	128%	138%	95%	167%
Ankle fracture or sprain	111%	163%	96%	173%
Other lower back disorders, including spine*	114%	161%	107%	198%
Upper back spine/spinal cord injury*	114%	182%	99%	205%
Other bone and joint disorders*	117%	195%	101%	232%
Lower back disc disorders*	116%	184%	114%	244%
Bursitis*	126%	217%	107%	291%

* Chronic and Complex

Younger GH patients with knee and shoulder injuries are more likely to be treated with arthroscopic surgery (Exhibits 16 and 17 of the February 2020 article [5]), which partly explains those injuries having the lowest procedure mix differentials, at 91% and 95%, respectively.

We would expect type of injury to largely dictate the medical services required for treatment. So, it is not surprising that for each injury the procedure mix component is closer to 100% than either unit price or quantity. However, the procedure mix component in Exhibit 6 takes on a wider range over the 12 injuries than it does over the 27 states in Exhibit 4B. WC episodes tend to get more expensive care than GH episodes for some injuries and less expensive care for others, as indicated by procedure mix components above and below 100% in Exhibit 6. When we combined injuries by state, offsetting relativities between WC and GH produce the procedure mix differentials closer to 100% in Exhibit 4B.

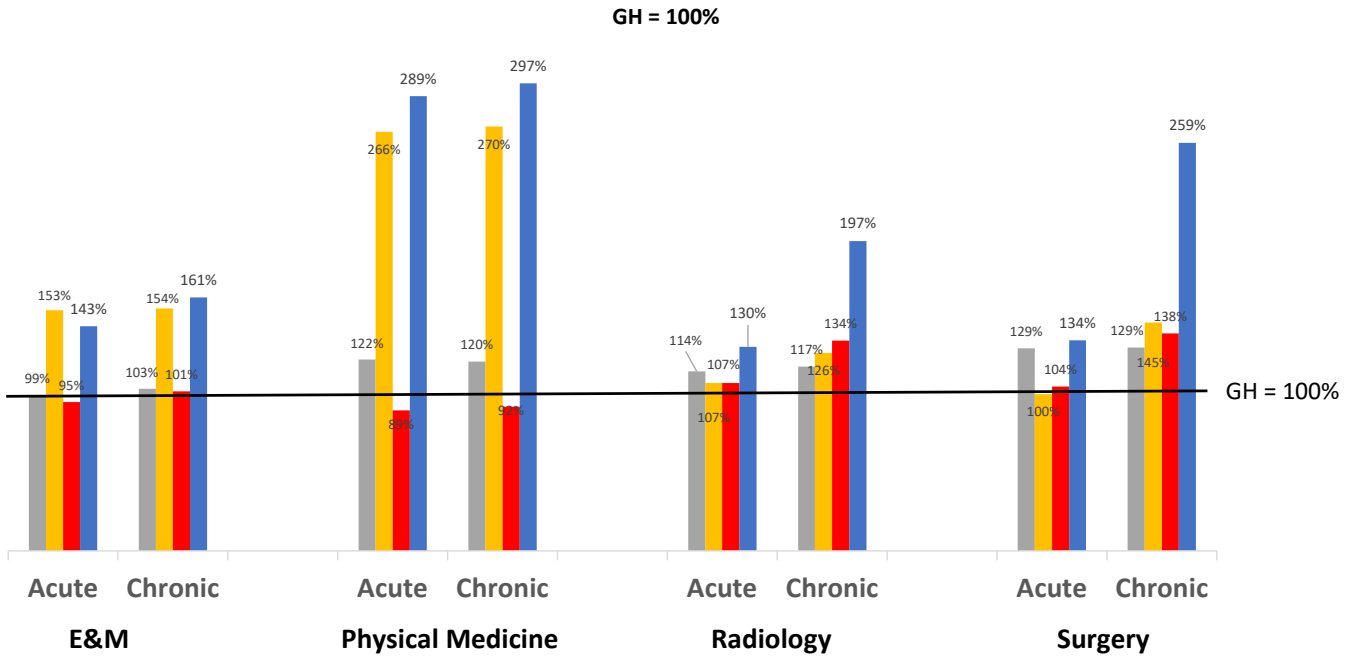
Among four physician service categories

Now we look at acute vs. chronic injuries within service categories. Exhibit 7 plots their components for the four service categories (we took Exhibit 7 quantity from Exhibit 9 of the February 2020 article [5]):

- For both acute and chronic injuries:
  - Higher quantity accounts for the higher WC cost relativity for E&M and for physical medicine
  - The quantity of physical medicine is the greatest component cost differential of WC over GH
  - All three component differentials are more than 100% for radiology
- The highest procedure mix differentials are for chronic injuries within radiology and surgery
- For surgery on acute injuries, both quantity and mix components indicate that WC is about on par with GH
- For physical medicine, GH uses a more expensive mix of physical therapy procedures than WC

Exhibit 7: WC-to-GH Relativity in the Cost of Physician Services by Type and Injury Group

Unit Price, Quantity, Procedure Mix, and Cost Differentials for 12 Injuries



Spinal manipulation is more frequent for GH episodes than for WC episodes and is typically more expensive than the physical therapy modalities most common on WC episodes. This helps explain procedure mix differentials for WC below 100% for physical medicine.

Based on Exhibit 7, we attribute the higher differentials for chronic injuries in WC (Exhibit 3) to specialized referral-based care such as radiology and surgery.

By age and gender

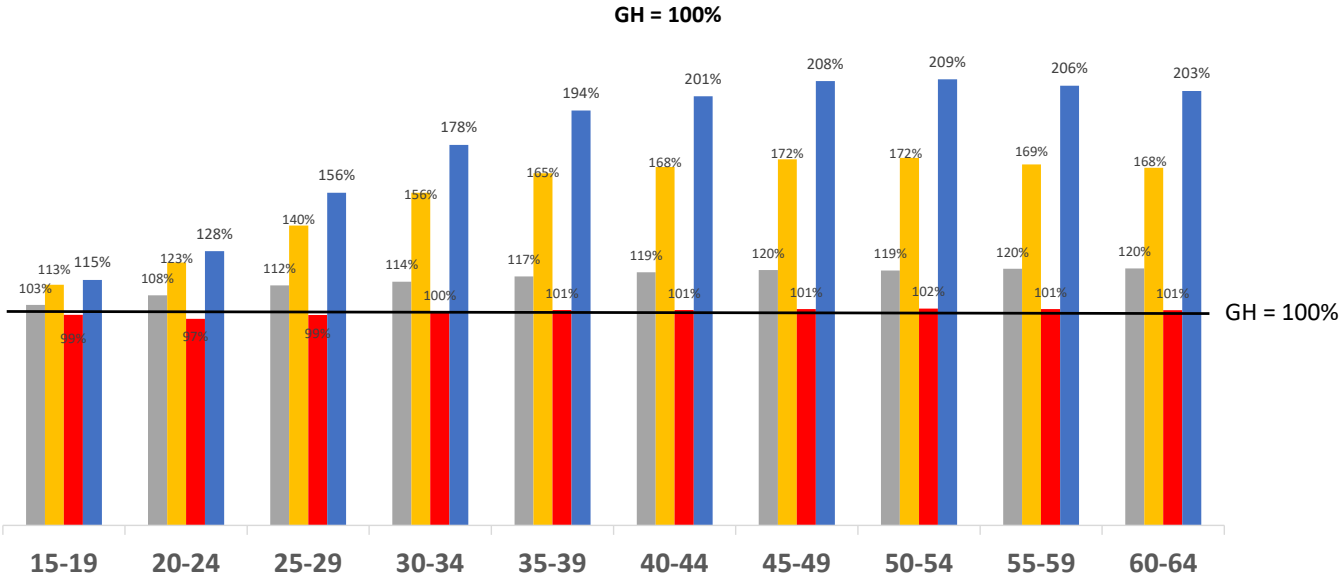
We control for age and gender differences in our analysis (cf., Appendix B). We do not control for occupation or physical activities. We designed the plots in Exhibits 8 and 9 to show whether there are systematic differences by age or by gender between WC and GH in any of the three cost component differentials.

Exhibit 8 shows that each of the three components conforms to a consistent pattern by age group:

- Both unit price and quantity differentials of WC over GH increase with age until age 40, after which they flatten at or near 120% and 170% respectively
- All age groups show relatively similar procedure mix components near the overall 101%
- Younger GH patients with knee and shoulder injuries are more likely to be treated with arthroscopic surgery (Exhibits 16 and 17 of the February 2020 article [5]), which partly explains patients under 30 having procedure mix components under 100%

Exhibit 8: WC-to-GH Relativity in the Cost of Physician Services by Age Group

Price, Quantity, Procedure Mix, and Cost Differentials for 12 Injuries



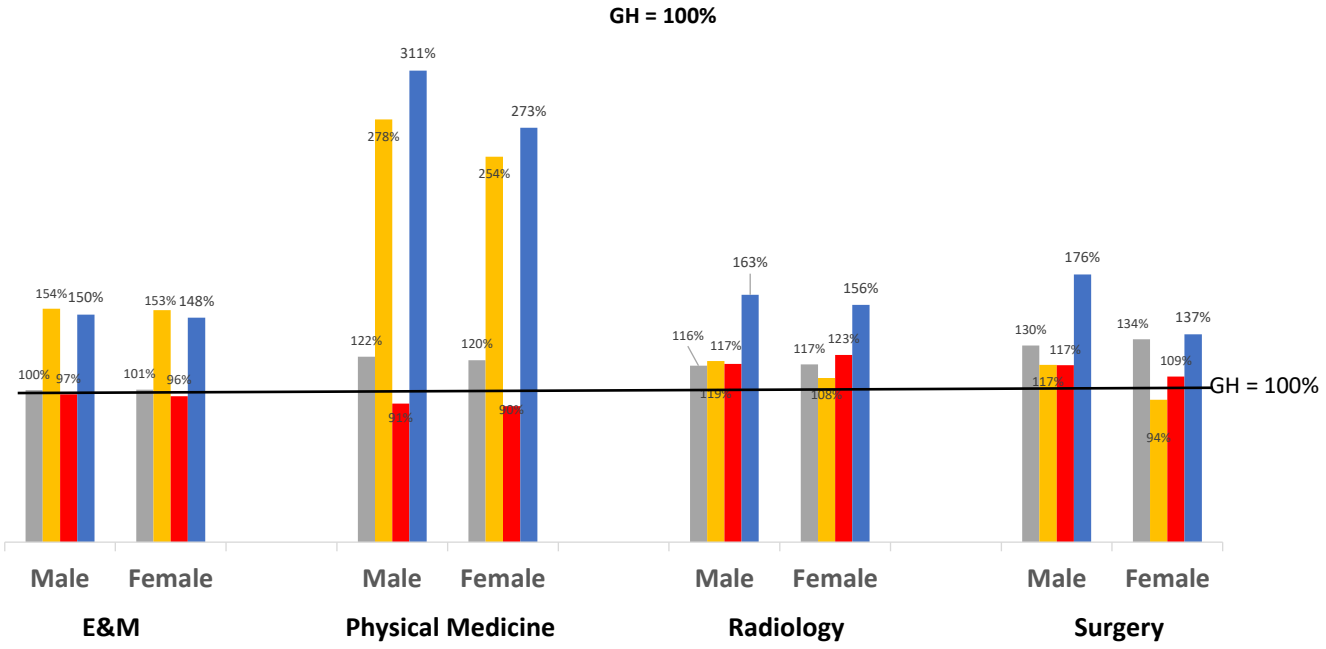
Turning to gender, Exhibit 9 shows both male and female patients with cost differentials well over 100% for all four service categories:

- For all four categories:
  - Differences between WC and GH in both cost and quantity are greater for males
  - The unit price component differential is about the same for males and females
- For E&M:
  - All three components are very close by gender
  - Differentials are near 100% for procedure mix and unit price
  - Higher E&M costs for WC than for GH are attributed to a greater volume of E&M services
- For physical medicine:
  - Unit price and procedure mix do not differ by gender
  - Quantity is higher in WC for both genders, especially for males
  - For both genders, the use of more expensive procedures pushes GH costs higher relative to WC

For referral-based care, the three components reveal some gender differences in the relationship between WC and GH:

- For radiology:
  - The difference in quantity is greater for males
  - The difference in mix of procedures is greater for females
- For surgery:
  - The difference in quantity lowers WC below GH for females and raises WC above GH for males
  - Gender differences are small for unit prices
  - The difference in mix of procedures is greater for males

Exhibit 9: WC-to-GH Relativity in the Cost of Physician Services by Type and Gender
Unit Price, Quantity, Procedure Mix, and Cost Differentials for 12 Injuries



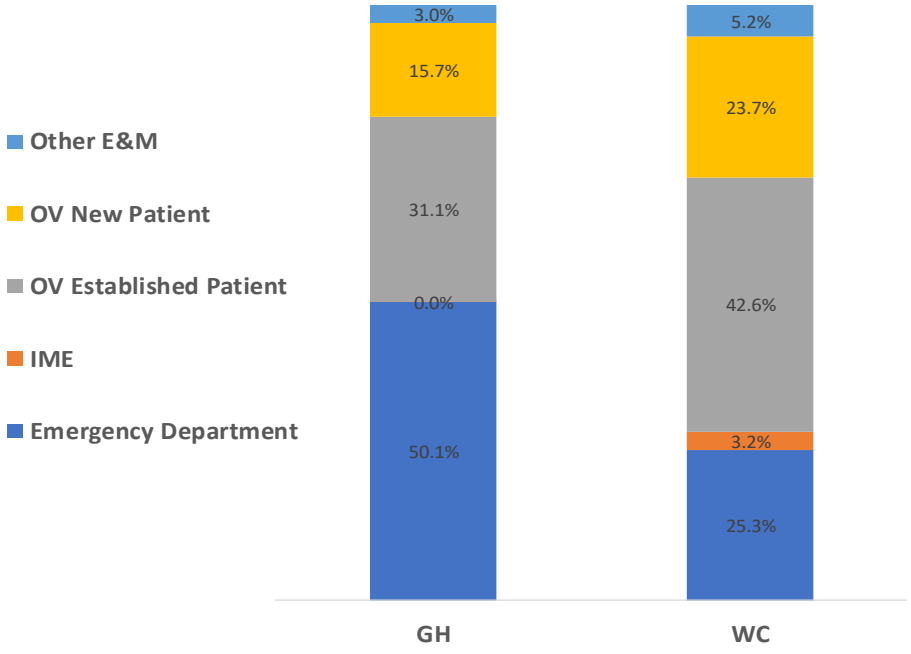
The cost differential for surgery is greater for males than for females. This is because in WC, as compared with GH, more referral services go to treat male patients, as a higher quantity differential indicates. Because the mix of injuries is the same, we feel that occupation mix is not a driver of the differences.

Utilization of E&M services

For evaluation and management services, Exhibits 7 and 9 show few differences between WC and GH by gender or by acute vs. chronic injuries. However, Exhibit 10 shows noteworthy differences between WC and GH episodes in how payments for E&M services for the 12 injuries break down into subcategories:

- The share of emergency room visits in GH is about one-half, while the WC share is about one-fourth
- Office visits (OV) are about two-thirds of WC E&M payments but less than half for GH
- The share of E&M payments for independent medical exams (IMEs) are about 3% for WC and essentially zero for GH

Exhibit 10: Comparison of E&M Payment Distributions for 12 Injuries



Timing helps explain the markedly higher GH share of E&M payments going to emergency care facilities. Unlike WC, GH covers injuries that occur outside the typical workday or workweek, such as at nighttime or on weekends. Those are also times when the emergency room may be the only place to obtain timely and professional medical care.

E&M services for WC injuries are more directed at established patients compared to GH, as can be seen by the ER and office visit shares. That suggests more WC follow-up care per episode, consistent with E&M quantity differentials over 150% in Exhibits 7 and 9. The return-to-work incentive for injured workers may also help explain high WC utilization relativities (quantity times mix) for radiology and surgery on chronic cases (Exhibit 7).

A procedure mix differential of 100% indicates that the WC and GH mix distributions have similar impacts in the cost differential, but may have different WC and GH procedure mix distributions. For example, although Exhibits 7 and 9 show procedure mix components near 100% for E&M, the distributions in Exhibit 10 show GH with a greater share of E&M payments going for ER procedures and a smaller share for office visits.

CONCLUSION

A model of component cost differentials of physician services between WC and GH for 12 common WC injuries (Exhibits 2, 3, and 6) showed that:

- WC costs more than GH to treat comparable injuries, after controlling for claim characteristics such as age and gender
- Utilization differences account for about 78% of the overall cost differential for WC
- Chronic pain-related injuries, such as bursitis and back disorders, have larger differentials amongst the 12 injuries studied

We also found (Exhibits 4 and 6) that:

- Unit price differentials vary principally by state, with most states having higher unit prices for WC than for GH
- Utilization differentials vary principally by type of injury, with all 12 injuries showing higher WC utilization
- A WC physician fee schedule in a state is often associated with prices that are competitive with, or even below, GH prices

There are distinct patterns of medical services by service category. Comparing WC to GH (Exhibit 7):

- Evaluation, management, and physical medicine costs are higher for WC due to greater utilization
- For WC, the greatest proportional component difference is in the utilization of physical medicine
- For chronic cases, radiology and surgery cost more for WC due to both higher unit prices and greater utilization

A greater volume of services is the primary driver of higher treatment costs for WC over GH for primary care (office visits and physical therapy). For specialty care (radiology and surgery), greater volume combines with a more expensive mix of procedures to drive WC treatment costs higher, especially on more complex injuries (Exhibit 7).

For all age groups, quantity dominates mix in driving WC costs higher than GH and are greatest after age 40 (Exhibit 8).

For males and females and for all four physician service categories, the cost differential model has WC costs higher than GH; however, differences are greater for males than for females. More referral-based services, on average, to treat an injury (Exhibit 9) drive greater differences for males.

RELATED NCCI ARTICLES—AVAILABLE AT NCCI.COM

1. “What Can Workers Compensation Learn From Group Medical Insurance,” NCCI, July 2005
2. “Workers Compensation vs. Group Health: A Comparison of Utilization” NCCI, November 2006
3. “Making Workers Compensation Medical Fee Schedules More Effective,” NCCI, December 2007
4. “Technical Paper: Effectiveness of WC Fee Schedules—A Closer Look,” NCCI, February 2009
5. “Comparing the Quantity and Prices of Physician Services Between Workers Compensation and Group Health,” NCCI, February 2020

APPENDIX

Appendix A: Comparing WC costs with GH costs to treat an injury

WC claims arise from work-related injuries. Accordingly, MDC transactions are linked to a specific injury while GH transactions are 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 the cost comparisons we seek between WC and GH would be at the WC claim or injury level.

To make such comparisons, we use Truven software 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. We identify the medical condition (e.g., bursitis) 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 ICD codes reported on medical transactions.

The medical episode grouper (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

We used MEG software 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 that is grouped using the same logic for both WC and GH transactions and classified using the same EGCs.

Appendix B: 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)
- Episode group code (EGC)

For each combination, we scaled the experience of the GH episodes to match the number of WC episodes with that combination. The result is a market basket of episodes where we customized GH episodes 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, we included 69 EGCs in the basket. The market basket includes the 12 injuries in Exhibit 1.

We use the market basket to make comparisons between WC costs 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. The market basket weight of an episode is the proportion of episodes that that episode represents in the basket. At the individual medical service or transaction level, that same weight plays the role of the number of times that service for that episode is performed. Accordingly, we assign each transaction 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.

Appendix C: Service Categories

We itemize the cost relativity components into the four physician-service categories, determined by the ranges of CPT codes listed in Exhibit C.1:

Exhibit C.1: Categories 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 an 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

Appendix D: Determination of the Cost Differential

Because cost has two factors, unit price and utilization, a difference between costs naturally breaks down into two components. There are, however, various ways to calculate such a decomposition and corresponding ways to interpret the components. This appendix details the decomposition of the WC-to-GH cost differential into unit price and utilization differentials used in this paper. It also recalls the average price and quantity differentials used in the February 2020 article [5] to facilitate understanding the similarities and the differences. The most noteworthy aspect of both of these decompositions is the use of the WCRPI to measure differences in quantity and utilization. The discussion is more technical than in the article.

Episode Level Data

Let E denote a set of episodes. We can identify elements of E with subsets of medical payment transactions grouped by MEG into WC and GH episodes of care for a specified medical condition. We assigned each episode a unique identifier and an indicator variable WC01:

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

We use the MEG output to assign a unique identifier and several “demographic” variables to the episodes, including (but not restricted to):

- EPIID: unique episode ID
- 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
- AY: Accident Year—year of earliest service on the episode

As part of the analysis, we assigned each episode 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

This is 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 "mix-adjusted" comparisons between GH and WC, but geared to what matters most for WC. Most importantly, it assures that the number and mix of episodes reflected in the comparisons is the same for GH as for WC, at least in regard to 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 EGCs (6 acute and 6 chronic). Index T elements with the subscript $i \in I = \{1, 2, \dots, |T|\}$. We have grouped all elements of T by MEG into episodes, assigned a unique episode ID, and assigned an EGC from the list of 12 injuries.

Think of the elements of T as observations for individual medical procedures for which we have the following data elements, where we take episode-level characteristics 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/non-facility, based on place of service
- PAY: paid amount (includes copay and deductible for GH)

We assigned the first eight data elements 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. Those sums are cost amounts whose ratio, or differential, is the ratio of two average costs per episode.

We also use two derived data elements:

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

We assigned the additional variable WCRPI to the T observations by looking up values by CPT and FACILITY. This WCRPI lookup table assigns relative intensity amounts to specific physician services and is specifically designed to measure differences in WC utilization. The WCRPI is independent of jurisdiction and time, incorporates the Medicare resource-based relative value scale (RBRVS) to assign relative intensities by CPT, and is customized to WC experience.

Let $I_0 = \{i \mid t_i \in T \text{ and } WC01(t_i) = WC01_i = 0\}$ and $I_1 = \{i \mid t_i \in T \text{ and } WC01(t_i) = WC01_i = 1\}$. 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 = $\sum_{i \in I_0} PAY_i \times WGTratio_i$

The cost = unit price × utilization model

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

- $STATE_a = STATE_b$
- $EGC_a = EGC_b$
- $AY_a = AY_b$
- $CPT_a = CPT_b$
- $FACILITY_a = FACILITY_b$
- $AGE\_GRP_a = AGE\_GRP_b$
- $SEX_a = SEX_b$
- $PROCgrp_a = PROCgrp_b$
- $EGCgrp_a = EGCgrp_b$

Where the last two equalities are redundant, being implied by the others. Observe that for any *j,* the pair $a,b \in K_j$ implies that $\mathrm{WCRPI}(a) = \mathrm{WCRPI}(b) = \mathrm{WCRPI}_j$, where we again use transparent (perhaps now even abusive) notation. 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:

- $Q_{0j} = \sum_{i \in I_{0j}} WGTratio_i$
- $Q_{1j} = \sum_{i \in I_{1j}} WGTratio_i = \sum_{i \in I_{1j}} 1 = |I_{1j}|$
- $P_{0j} = \frac{\sum_{i \in I_{0j}} PAY_i \times WGTratio_i}{\sum_{i \in I_{0j}} WGTratio_i} = \frac{\sum_{i \in I_{0j}} PAY_i \times WGTratio_i}{Q_{0j}}$ *where* $Q_{0j} > 0$
- $P_{1j} = \frac{\sum_{i \in I_{1j}} PAY_i \times WGTratio_i}{\sum_{i \in I_{1j}} WGTratio_i} = \frac{\sum_{i \in I_{1j}} PAY_i \times WGTratio_i}{Q_{1j}} = \frac{\sum_{i \in I_{1j}} PAY_i}{|I_{1j}|}$ *where* $Q_{1j} > 0$
- $R_{0j} = \frac{\sum_{i \in I_{0j}} WCRPI_j \times WGTratio_i}{\sum_{i \in I_{0j}} WGTratio_i} = \frac{WCRPI_j \times \sum_{i \in I_{0j}} WGTratio_i}{Q_{0j}} = WCRPI_j$ *where* $Q_{0j} > 0$

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

- $WC\_Cost = \sum_{i \in I_1} PAY_i \times WGTratio_i = \sum_j P_{1j} \times Q_{1j}$
- $GH\_Cost = \sum_{i \in I_0} PAY_i \times WGTratio_i = \sum_j P_{0j} \times Q_{0j}$

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 unit price and utilization differentials:

- *Unit Price_Differential* $= \frac{\sum_j P_{1j} \times Q_{1j}}{\sum_j P_{0j} \times Q_{1j}}$
- *Utilization_Differential* $= \frac{\sum_j R_{0j} \times Q_{1j}}{\sum_j R_{0j} \times Q_{0j}} = \frac{\sum_j WCRPI_j \times Q_{1j}}{\sum_j WCRPI_j \times Q_{0j}}$

Where we replaced empirical GH average unit prices (P_{0j}) by the WCRPI in determining the utilization differential, note that multiplying the WCRPI schedule by a constant factor will not change the differentials.

This motivates the definition of the cost differential:

- *Cost Differential = Unit Price_Differential × Utilization_Differential*

Note that the unit 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} for the same CPT procedure are used for the numerator cost and "GH weighted mean" prices P_{0j} are used for the denominator cost. Note that because we matched CPT between WC and GH in the $I = \bigcup_j K_j$ partition, a different WC and GH mix by CPT procedure does not directly impact the unit price differential in this model.

We can also interpret the utilization differential as a ratio of a WC cost over a GH cost. Here the numerator and denominator costs are both hypothetical, being determined using a common fee schedule based on WCRPI relativities. Since CPT is matched between WC and GH, we reflect differences in CPT procedure mix (e.g., X-ray vs. MRI), as well as differences in volume, in the Q_{0j} and the Q_{1j}. Here we measure the CPT mix impact by the WCRPI utilization relativities as opposed to empirical prices (such as the P_{0j}), which can vary by state and date of service. The utilization differential responds to differences in both volume and mix of services.

Since we use the WCRPI schedule, and not GH unit prices, to measure utilization, the cost differential model does not have a natural representation as a ratio of costs. A little arithmetic makes this explicit:

- *Cost Differential* $\div \left(\frac{WC\_Cost}{GH\_Cost}\right) = \frac{\sum_j P_{1j} \times Q_{1j}}{\sum_j P_{0j} \times Q_{1j}} \times \frac{\sum_j WCRPI_j \times Q_{1j}}{\sum_j WCRPI_j \times Q_{0j}} \times \frac{\sum_j P_{0j} \times Q_{0j}}{\sum_j P_{1j} \times Q_{1j}} = \frac{\sum_j WCRPI_j \times Q_{1j}}{\sum_j P_{0j} \times Q_{1j}} \times \frac{\sum_j P_{0j} \times Q_{0j}}{\sum_j WCRPI_j Q_{0j}}$

We can interpret the first factor on the right as the hypothetical cost impact of changing from GH unit prices to the WCRPI schedule using a WC frequency distribution. We can interpret the second factor as the hypothetical cost impact of changing from the WCRPI schedule to GH unit prices using a GH frequency distribution. Often, but not always, these factors will largely cancel one another. However, neither factor is of primary interest for comparing WC and GH costs. This observation helps motivate the definition of the cost differential model as simply the product of the unit price and utilization differentials.

The Appendix to the February 2020 article [5] details how we determined the quantity differential. That study used a different, but closely related, cost decomposition model. That approach regards cost as having the two factors: average price and quantity. For convenient comparison, we briefly recall how we determined the quantity in the February 2020 article [5]. That decomposition also uses the WCRPI to measure differences in quantity.

The cost = average price × quantity model

Instead of the above partition that includes CPT, this model uses a less granular partition. The set $I = \bigcup_k K_k$ is partitioned into a disjoint union such that for any k, the pair $a,b \in K_k$ if and only if:

- $STATE_a = STATE_b$
- $EGC_a = EGC_b$
- $AGE\_GRP_a = AGE\_GRPb$
- $SEX_a = SEX_b$
- $AY_a = AY_b$
- $PROCgrp_a = PROCgrp_b$
- $EGCgrp_a = EGCgrp_b$

The essential difference between the two models is that CPT is **not** matched between WC and GH in this $I = \bigcup_k K_k$ partition.

Set:

- $I_{0k} = I_0 \cap K_k$
- $I_{1k} = I_1 \cap K_k$
- $Q_{0k} = \sum_{i \in I_{0k}} WGTratio_i$
- $Q_{1k} = \sum_{i \in I_{1k}} WGTratio_i = \sum_{i \in I_{1k}} 1 = |I_{1k}|$
- $R_{0k} = \frac{\sum_{i \in I_{0k}} WCRPI_i \times WGTratio_i}{\sum_{i \in I_{0k}} WGTratio_i} = \frac{\sum_{i \in I_{0k}} WCRPI_i \times WGTratio_i}{Q_{0k}} = MeanWCRPI_k \; where \; Q_{0k} > 0$

And we determined the quantity differential (which is sensitive to volume differences and incorporates WCRPI relativities of intensity, but is not sensitive to differences in the mix by CPT of procedures within a service category) is:

- $Quantity\_Differential = \frac{\sum_k R_{0k} \times Q_{1k}}{\sum_k R_{0k} \times Q_{0k}} = \frac{\sum_k MeanWCRPI_k \times Q_{1k}}{\sum_k MeanWCRPI_k \times Q_{0k}}$