MILLIMAN WHITE PAPER

Hospital payments for COVID-19 inpatient treatment

An analysis of inpatient claims data

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Milliman

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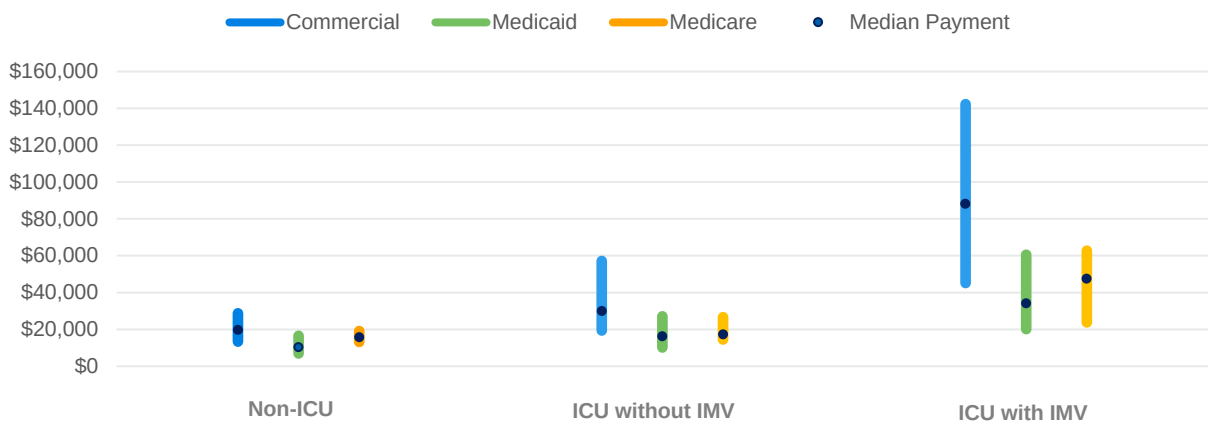
1. Executive summary

In this white paper, we provide an analysis of actual claims experience for hospital admissions for treatment of coronavirus disease 2019 (COVID-19) by commercial, Medicaid, and Medicare sources of insurance coverage (i.e., market). We further stratify hospital admissions from each market into three distinct severity levels. Figure 1 shows the observed median and interquartile range (i.e., range between 25th percentile and 75th percentile) of hospital payments for COVID-19 inpatient treatment for hospital admission dates ranging from April 1, 2020 through July 31, 2020, stratified by market and severity level.

FIGURE 1: 2020 INTERQUARTILE RANGE OF HOSPITAL PAYMENTS PER COVID-19 ADMISSION



ICU: Intensive care unit
IMV: Invasive mechanical ventilation

This white paper presents statistics by market that result from market-specific dynamics and population characteristics (e.g., different per admission payments and lengths of stay). We caution readers against drawing conclusions about inpatient hospitalization care in any one of these markets, or the relationship between or among markets, based solely on the information in this white paper without first considering the complex dynamics and specific population characteristics of members in each market that influence the statistics reported.

Key findings of our analysis include:

- **Hospital payments vary significantly by market and severity level.** Payments to hospitals for COVID-19 inpatient admissions involving invasive mechanical ventilation (IMV) are substantially higher than admissions not involving IMV. Payments are also considerably higher for the commercial market compared to the Medicaid and Medicare markets.
- **Length of stay varies significantly by severity level, with less variation by market.** The observed average length of stay in each market is five to eight days for COVID-19 inpatient admissions not requiring one or more days in an intensive care unit (ICU) compared to 17 to 20 days for ICU admissions involving IMV.
- **Hospital payments per admission do not follow the normal distribution.** The presence of admissions with very large hospital payments, which are generally associated with longer lengths of stay, results in mean hospital payments per admission and mean lengths of stay being higher than corresponding medians for the same cohort.

The distribution of the claims data we analyzed by market and geographic region is unknown and may not represent a nationwide average. Hospital payments in this whitepaper do not include payments to other providers for services to inpatients, such as professional payments to physicians for inpatient visits, procedures, and the interpretation of diagnostic tests. Those other payments can be substantial and should be included in any assessment of the total cost of care for COVID-19 inpatient treatment.

As new therapies are introduced and treatment patterns for hospitalized COVID-19 patients evolve over time, length of stay, hospital payments, and mortality rates may also change. Therefore, observations in this whitepaper may not be representative of future period experience. Comparisons to other sources of information should take into consideration the presence of relevant differences, such as population demographics and reimbursement differences underlying the populations of interest (e.g., commercial vs. Medicare).

2. Background

The first cases of COVID-19 were identified in the United States in January 2020[1] and the World Health Organization (WHO) characterized COVID-19 as a global pandemic in March 2020.[2] Over the following months, the new infection spread rapidly in the United States and communities throughout the world. As of March 10, 2021, more than 29 million people in the United States have been infected with COVID-19, leading to more than 527,000 deaths.[3]

As the United States experienced waves of infection spikes in localities across the country during the past year, hospital bed and ICU bed occupancy reached very high levels in several regions for periods of time in 2020, with surges in infection rates leading to increases in the percentage of beds occupied by COVID-19 patients.[4,5,6] At the same time, particularly during March through May 2020, hospitals and other healthcare providers provided significantly fewer services than usual not related to COVID-19 treatment, as providers and patients cancelled or postponed non-urgent care to reduce the spread of the virus and preserve hospital capacity to care for infected patients.[7]

Treatment patterns and care pathways for hospitalized COVID-19 patients have evolved rapidly over time, especially in areas, such as disease-specific therapies, respiratory support, management of organ failure, and anticoagulation. The U.S. Food and Drug Administration (FDA) has issued emergency use authorization for various biological products with proven effectiveness in treating COVID-19, which has contributed to improvements in care and reduced reliance on IMV for inpatient treatment.[8] As of March 10, 2021, there are also three COVID-19 vaccines in distribution in the U.S. after receiving recent FDA emergency use authorization, which play an important role in the global strategy to reduce the spread of infection spread and disease severity.[9] Despite the evolution of treatment patterns for inpatient COVID-19 care and deferral of non-essential and elective services, ensuring efficient resource allocation remains a top priority. Providers everywhere seek to optimize processes and patient outcomes, while preserving hospital capacity for patients who need inpatient treatment for COVID-19 and other serious health conditions.

[1] Holshue, M.L., DeBolt, C., Lindquist, S., et al. First case of 2019 novel coronavirus in the United States. N Engl J Med. 2020;382(10):929-936. doi:10.1056/NEJMoa2001191. https://www.nejm.org/doi/full/10.1056/NEJMoa2001191. Published March 5, 2020. Accessed February 24,2021.

[2] World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020. Posted March 11, 2020. Accessed February 24, 2021.

[3] The New York Times. Coronavirus in the U.S: Latest Map and Case Count. https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html. Updated March 10, 2021. Accessed March 10, 2021.

[4] Centers for Disease Control and Prevention. COVID-19 Stats: COVID-19 Incidence, by Age Group – United States, March 1–November 14, 2020. https://www.cdc.gov/mmwr/volumes/69/wr/mm695152a8.htm?s_cid=mm695152a8_w. Updated January 1, 2021. Accessed February 24, 2021.

[5] Centers for Disease Control and Prevention. COVIDView – A Weekly Surveillance of U.S. COVID-19 Activity. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/. Updated January 4, 2021. Accessed February 24, 2021.

[6] U.S. Department of Health and Human Services. COVID-19 Reported Patient Impact and Hospital Capacity by State. https://healthdata.gov/dataset/covid-19-reported-patient-impact-and-hospital-capacity-state. https://healthdata.gov/dataset/covid-19-reported-patient-impact-and-hospital-capacity-state. Updated February 19, 2021. Accessed February 24, 2021.

[7] American Hospital Association. Hospitals and health systems face unprecedented financial pressures due to COVID-19. https://www.aha.org/guidesreports/2020-05-05-hospitals-and-health-systems-face-unprecedented-financial-pressures-due. Published May 2020. Accessed February 24, 2021.

[8] U.S. Food and Drug Administration. Emergency Use Authorization (EUA) information, and list of all current EUAs; coronavirus disease 2019 (COVID-19) EUA information; drug products. https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization. Updated February 23, 2021. Accessed February 24, 2021.

[9] U.S. Food and Drug Administration. FDA Issues Emergency Use Authorization for Third COVID-19 Vaccine. https://www.fda.gov/news-events/press-announcements/fda-issues-emergency-use-authorization-third-covid-19-vaccine. Updated February 27, 2021. Accessed March 10, 2021.

Milliman previously published nationwide estimates for average length of stay and per-admission payments made to hospitals based on assumptions drawn from early worldwide experience with hospitalized COVID-19 patients, which we applied to payers in the commercial (i.e., fully insured and self-funded group insurance), Medicare fee-for-service (FFS), and Medicaid markets.[10] Those estimates were not based on actual payer claims experience for COVID-19 hospitalizations, due to the timeline of COVID-19 admission experience required for claims analysis of cases.

In this follow-on analysis, we refine those estimates using real claims experience for COVID-19 inpatient treatment in 2020 for hospital admission dates from April 1 through July 31. We also provide mortality rates by inpatient severity level, stratified by market.

Our study focuses on hospital payments and length of stay for COVID-19 inpatient admissions. Consistent with our previous analysis, we report payment by the payer and any applicable patient cost sharing to the hospital for their resources required to care for inpatients, such as room and board, nursing services, drugs, diagnostic tests, and medical equipment and supplies. Hospital payments do not include payment to other providers for services to inpatients, such as professional payments to physicians for inpatient visits, procedures, and the interpretation of diagnostic tests.

We note that payments made to hospitals and other providers for COVID-19 inpatient hospitalizations are not a measure of the total cost of COVID-19 to society. The costs of the pandemic are significant and include, but are not limited to, the health care costs associated with prolonged COVID-19 symptom duration, sequelae of COVID-19 infection, and elevated rates of symptomatic mental health conditions during the pandemic, as well as direct economic losses.[11,12,13] The total cost of the pandemic in the U.S. due to mortality, morbidity, mental health conditions, and direct economic losses has been estimated to exceed $16 trillion, assuming the pandemic is contained by the fall of 2021.[14] Evaluation of the full economic impact of COVID-19 is outside the scope of this white paper.

3. Analysis

SUMMARY OF RESULTS

We separate our analysis into three markets, commercial, Medicaid, and Medicare. The Medicare results include both FFS and Medicare Advantage (MA) claims. We stratify admissions into the following three severity levels:

- Non-ICU: All days during the admission occur in a regular hospital bed.
- ICU without IMV: At least one day during the admission occurs in an ICU bed.
- ICU with IMV: At least one day with IMV during the admission (with all IMV days occurring in an ICU bed).

This white paper presents a number of statistics by market that result from market-specific dynamics and population characteristics (e.g., different per admission payments and lengths of stay). We caution readers against drawing conclusions about inpatient hospitalization care in any one of these markets, or the relationship between markets, based solely on the information in this white paper without first considering the complex dynamics and specific population characteristics of members in each market that influence the statistics reported.

[10] Bazell, C., Kramer, M., Mraz, M., et al. How much are hospitals paid for inpatient COVID-19 treatment? Milliman.com. https://www.milliman.com/en/insight/how-much-are-hospitals-paid-for-inpatient-covid19-treatment. Updated June 2020. Accessed February 24, 2021.

[11] Tenforde, M.W., Kim, S.S., Lindsell, C.J., et al. Symptom Duration and Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network – United States, March–June 2020. MMWR Morb Mortal Wkly Rep 2020;69:993-998. http://dx.doi.org/10.15585/mmwr.mm6930e1. Updated July 31, 2020. Accessed February 24, 2021.

[12] Centers for Disease Control and Prevention. Late Sequelae of COVID-19. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/late-sequelae.html. Updated November 13 2020. Accessed February 24, 2021.

[13] Czeisler, M.É., Lane, R.I., Petrosky, E., et al. Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic – United States, June 24–30, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1049–1057. http://dx.doi.org/10.15585/mmwr.mm6932a1 Updated August 14, 2020. Accessed February 24, 2021.

[14] Cutler, D.M., Summers, L.H. The COVID-19 Pandemic and the $16 Trillion Virus. *JAMA.* 2020;324(15):1495–1496. https://jamanetwork.com/journals/jama/fullarticle/2771764. Revised October 12, 2020. Accessed February 24, 2021.

Table 1 provides a summary of key metrics for each market and severity level (non-ICU, ICU without IMV, and ICU with IMV), including total admission counts, mean hospital payment per admission, and mean length of stay per admission:

TABLE 1: SUMMARY OF COVID-19 ADMISSIONS

NUMBER OF ADMISSIONS BY INPATIENT SEVERITY LEVEL

MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	ALL ADMISSIONS
Commercial	3,459	540	441	4,440
Medicaid	3,061	507	473	4,041
Medicare	7,628	1,360	1,341	10,329
All Markets	**14,148**	**2,407**	**2,255**	**18,810**

MEAN HOSPITAL PAYMENT PER ADMISSION BY INPATIENT SEVERITY LEVEL

MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	ALL ADMISSIONS
Commercial	$23,894	$57,333	$119,902	$37,497
Medicaid	$13,381	$30,190	$50,466	$19,831
Medicare	$18,895	$28,837	$58,366	$25,328
All Markets	**$18,924**	**$35,515**	**$68,743**	**$27,020**

MEAN LENGTH OF STAY (DAYS)

MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	ALL ADMISSIONS
Commercial	5.4	11.8	19.5	7.6
Medicaid	6.3	11.5	17.6	8.3
Medicare	7.6	12.2	16.6	9.4
All Markets	**6.8**	**12.0**	**17.4**	**8.7**

*The information shown in Table 1 includes all inpatient admissions with the COVID-19 diagnosis code (U07.1) on the hospital claim as the principal or a secondary diagnosis, based on summarized MedInsight contributor data. The admissions include both patients who were discharged alive and those who expired in the hospital.

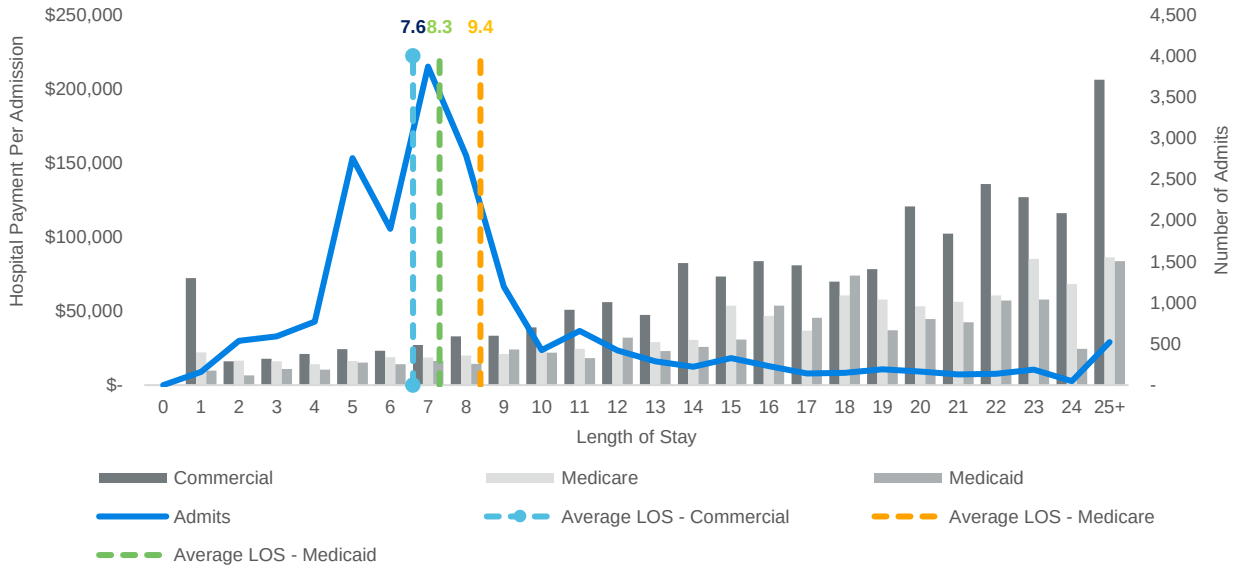
Table 2 shows the distribution of admissions by market and severity level. The Medicare market shows a higher prevalence of ICU admissions (with or without IMV) compared to the commercial and Medicaid markets, which is likely driven by age and health status differences in the underlying populations.

TABLE 2: COVID-19 INPATIENT ADMISSIONS | DISTRIBUTION OF SEVERITY BY MARKET

MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV
Commercial	77.9%	12.2%	9.9%
Medicaid	75.7%	12.5%	11.7%
Medicare	73.9%	13.2%	13.0%
All Markets	**75.2%**	**12.8%**	**12.0%**

Figure 2 provides a visualization of hospital payment per admission by length of stay. The histogram provides average hospital payment per admission of a specific length of stay across all severities, identified separately for each market. The blue line shows the number of admissions associated with each length of stay. The three vertical lines mark the median lengths of stay for each market.

FIGURE 2: AVERAGE HOSPITAL PAYMENT PER ADMISSION BY LENGTH OF STAY FOR EACH MARKET



In reviewing the claims data, we observe:

- **Length of stay and hospital payment are correlated, but the relationship is weak.** This can be observed in Figure 2. While larger hospital payments are associated with longer lengths of stay, adding or subtracting one additional day does not necessarily change the hospital payment in a linear fashion. This relationship varies by market. In Medicare FFS, the hospital payments follow a publicly available formula based on Medicare severity diagnosis-related groups (MS-DRGs), but not all Medicare claims analyzed are from Medicare FFS.[15] The MS-DRG methodology does not scale payments linearly by length of stay, although changes in length of stay can have some effect on payments. The impact of changes in length of stay in the MA, Medicaid, and commercial markets is not always known, since the arrangements between the hospital and the payer are often not public. In those markets, there is a wide range of hospital payment methodologies, such as a discount off billed charges, per diem payments, methodologies that leverage MS-DRGs, and other case-rate payments. Only a strict per diem methodology would yield a direct change in hospital payment as a result of a change in length of stay.
- **Hospital payments vary significantly by market and severity level.** Mean hospital payments range from approximately $13,000 for non-ICU admissions in the Medicaid market to approximately $120,000 for ICU with IMV admissions in the commercial market. Market-specific hospital payment differences are a key driver of the variation in hospital payment per admission across markets within a given severity level, resulting in the mean commercial market payment being more than double the mean Medicaid market payment in the ICU with IMV severity level.
- **Lengths of stay vary significantly by severity level.** Mean lengths of stay range from five to eight days for non-ICU admissions and 17 to 20 days for ICU admissions involving IMV**.** There is less variation in the length of stay by market within a given severity level. However, when all severity levels are aggregated, the mean length of stay for admissions in the Medicare market exceeds the commercial and Medicaid markets by approximately one to two days, which suggests a correlation between length of stay and age or overall health status.

[15] MedPAC. Hospital Acute Inpatient Services Payment System. http://www.medpac.gov/docs/default-source/payment-basics/medpac_payment_basics_16_hospital_final.pdf. Revised October 2016. Accessed February 24, 2021.

- **Hospital payments per admission are not normally distributed.** The presence of admissions with very large hospital payments, which are generally associated with longer lengths of stay, results in mean hospital payment per admission and mean length of stay being higher than corresponding medians for the same cohort. Table 3 shows mean and median hospital payments per admission and length of stay measures by market across all severity levels.

TABLE 3: COVID-19 INPATIENT ADMISSIONS

HOSPITAL PAYMENT PER ADMISSION AND LENGTH OF STAY (ALL SEVERITY LEVELS)

MARKET	MEAN HOSPITAL PAYMENT PER ADMISSION	MEDIAN HOSPITAL PAYMENT PER ADMISSION	MEAN LENGTH OF STAY	MEDIAN LENGTH OF STAY
Commercial	$37,497	$21,697	7.6	5.0
Medicaid	$19,831	$12,214	8.3	5.0
Medicare	$25,328	$16,714	9.4	7.0

The appendix shows additional detailed percentile statistics for length of stay and hospital payment per admission, including 95% confidence intervals and standard error, stratified by market and inpatient severity level.

Table 4 shows survival status statistics, specifically, the mean length of stay and hospital payment per admission by survival status. We rely on claim discharge status to determine survival status, therefore, actual mortality rates may exceed those shown in the claims data we analyzed because some patients may have expired after leaving the hospital. This table provides additional granularity by discharge status for the averages presented in Appendix A. We note, that those patients in the ICU with IMV severity level who expire during the admission have a lower length of stay than those who are discharged alive. Therefore, changes in mortality rates over time may significantly affect the mean length of stay for the ICU with IMV inpatient severity level.

TABLE 4: COVID-19 INPATIENT ADMISSIONS

NUMBER OF ADMISSIONS BY SURVIVAL STATUS AND SEVERITY LEVEL

	PATIENT SURVIVED			
MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	TOTAL
Commercial	3,421	510	269	4,200
Medicaid	2,944	450	235	3,629
Medicare	6,877	1,060	531	8,468
All Markets	**13,242**	**2,020**	**1,035**	**16,297**

	PATIENT EXPIRED			
MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	TOTAL
Commercial	38	30	172	240
Medicaid	117	57	238	412
Medicare	751	300	810	1,861
All Markets	**906**	**387**	**1,220**	**2,513**

HOSPITAL PAYMENT PER ADMISSION BY SURVIVAL STATUS AND SEVERITY LEVEL

	PATIENT SURVIVED			
MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	TOTAL
Commercial	$23,821	$55,945	$129,175	$34,470
Medicaid	$13,082	$29,691	$52,402	$17,688
Medicare	$18,802	$28,108	$59,552	$22,522
All Markets	**$18,827**	**$35,489**	**$76,024**	**$24,525**

TABLE 4: COVID-19 INPATIENT ADMISSIONS (CONTINUED)

	PATIENT EXPIRED			
MARKET	**NON-ICU**	**ICU WITHOUT IMV**	**ICU WITH IMV**	**TOTAL**
Commercial	$30,468	$80,936	$105,398	$90,477
Medicaid	$20,902	$34,123	$48,555	$38,705
Medicare	$19,743	$31,412	$57,589	$38,097
All Markets	**$20,343**	**$35,651**	**$62,567**	**$43,199**

MEAN LENGTH OF STAY BY SURVIVAL STATUS AND SEVERITY LEVEL

	PATIENT SURVIVED			
MARKET	**NON-ICU**	**ICU WITHOUT IMV**	**ICU WITH IMV**	**TOTAL**
Commercial	5.4	11.5	20.5	7.1
Medicaid	6.3	11.7	21.2	7.9
Medicare	7.7	12.8	20.8	9.1
All Markets	**6.8**	**12.2**	**20.8**	**8.4**

	PATIENT EXPIRED			
MARKET	**NON-ICU**	**ICU WITHOUT IMV**	**ICU WITH IMV**	**TOTAL**
Commercial	7.4	15.8	18.0	16.0
Medicaid	6.7	10.6	14.1	11.5
Medicare	6.8	10.2	13.9	10.4
All Markets	**6.8**	**10.7**	**14.5**	**11.1**

Table 5 provides mortality rates for COVID-19 admissions by market for each severity level. Best estimates of projected mortality are likely to reflect current treatment patterns; as such, estimating mortality based on admissions from April 1, 2020 through July 31, 2020 is likely to overstate the mortality rate going forward for COVID-19 strains of similar virulence, unless mortality increases driven by hospital system overcapacity begin to occur.[16] Future rates of mortality by inpatient severity level will be influenced by many variables. Several potential future mortality rate scenarios related to changes in the patterns of health care services or the characteristics of the COVID-19 virus include:

- Continued decline in mortality, potentially at a slower rate than the early months of the pandemic, if treatment patterns and therapeutics continue to evolve, especially in light of vaccine distribution targeted early to vulnerable populations. They may also decline if the threshold for admission is reduced due to lower overall rates of infection.
- Plateau in mortality, if hospital systems have achieved all that is possible in the current infrastructure without the introduction of new therapies.
- Increase in mortality, if ICU and overall hospital capacity remains a concern for an extended period of time and / or mutations in the virus lead to greater virulence.

[16] Asch, D.A., Sheils, N.E., Islam, M.N., et al. Variation in U.S. Hospital Mortality Rates for Patients Admitted With COVID-19 During the First 6 Months of the Pandemic. JAMA Intern Med. https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2774572. Updated December 22, 2020. Accessed February 24, 2021.

TABLE 5: COVID-19 INPATIENT ADMISSIONS

MORTALITY RATES BY SEVERITY LEVEL

MARKET	NON-ICU	ICU WITHOUT IMV	ICU WITH IMV	TOTAL
Commercial	1.1%	5.6%	39.0%	5.4%
Medicaid	3.8%	11.2%	50.3%	10.2%
Medicare	9.8%	22.1%	60.4%	18.0%
All Markets	**6.4%**	**16.1%**	**54.1%**	**13.4%**

DISTRIBUTION OF ADMISSIONS BY MS-DRG

We assign MS-DRGs to each admission in the claims data based on diagnosis and procedure codes on the inpatient facility claim according to version 37 of the MS-DRG grouping methodology developed by the Centers for Medicare and Medicaid Services (CMS).[17] MS-DRG was not used by payers to determine hospital payments for all claims analyzed.

Table 6 shows the distribution of the most common MS-DRGs observed in the claims data we analyzed. We show this distribution by severity level and market.

TABLE 6: COVID-19 INPATIENT ADMISSIONS

DRG DISTRIBUTION BY MARKET AND SEVERITY LEVEL DRG DISTRIBUTION - NON-ICU

MS-DRG	DESCRIPTION	COMMERCIAL	MEDICAID	MEDICARE	ALL MARKETS
207	Respiratory system diagnosis with ventilator support >96 hours	0.0%	0.0%	0.0%	0.0%
208	Respiratory system diagnosis with ventilator support <=96 hours	0.0%	0.0%	0.0%	0.0%
870	Septicemia or severe sepsis with mechanical ventilation >96 hours	0.0%	0.0%	0.0%	0.0%
871	Septicemia or severe sepsis without mechanical ventilation 96+ hours, with major complication or comorbidity (MCC)	16.1%	14.0%	16.4%	15.8%
177	Respiratory infections and inflammations with MCC	59.6%	47.4%	58.9%	56.5%
178	Respiratory infections and inflammations with complication or comorbidity (CC)	4.2%	5.7%	5.7%	5.3%
All others		20.2%	32.8%	19.1%	22.3%
Total		**100.0%**	**100.0%**	**100.0%**	**100.0%**

DRG DISTRIBUTION - ICU WITHOUT IMV

MS-DRG	DESCRIPTION	COMMERCIAL	MEDICAID	MEDICARE	ALL MARKETS
207	Respiratory system diagnosis with ventilator support >96 hours	0.0%	0.0%	0.1%	0.0%
208	Respiratory system diagnosis with ventilator support <=96 hours	0.0%	0.0%	0.0%	0.0%
870	Septicemia or severe sepsis with mechanical ventilation >96 hours	0.0%	0.0%	0.0%	0.0%
871	Septicemia or severe sepsis without mechanical ventilation 96+ hours, with MCC	25.7%	27.8%	31.5%	29.5%
177	Respiratory infections and inflammations with MCC	52.4%	47.3%	46.2%	47.8%
178	Respiratory infections and inflammations with CC	0.4%	1.0%	0.8%	0.7%
All others		21.5%	23.9%	21.4%	21.9%
Total		**100.0%**	**100.0%**	**100.0%**	**100.0%**

[17] CMS. "MS-DRG Classifications and Software." https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/MS-DRG-Classifications-and-Software, https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/MS-DRG-Classifications-and-Software, December 23 2020. Accessed February 24, 2020.

TABLE 6: COVID-19 INPATIENT ADMISSIONS (CONTINUED)

DRG DISTRIBUTION - ICU WITH IMV

MS-DRG	DESCRIPTION	COMMERCIAL	MEDICAID	MEDICARE	ALL MARKETS
207	Respiratory system diagnosis with ventilator support >96 hours	32.2%	25.4%	25.6%	26.8%
208	Respiratory system diagnosis with ventilator support <=96 hours	13.8%	14.6%	14.5%	14.4%
870	Septicemia or severe sepsis with mechanical ventilation >96 hours	27.0%	27.9%	31.3%	29.8%
871	Septicemia or severe sepsis without mechanical ventilation 96+ hours, with MCC	10.7%	17.5%	16.9%	15.8%
177	Respiratory infections and inflammations with MCC	1.6%	1.5%	1.3%	1.4%
178	Respiratory infections and inflammations with CC	0.0%	0.0%	0.0%	0.0%
All others		14.7%	13.1%	10.4%	11.8%
Total		**100.0%**	**100.0%**	**100.0%**	**100.0%**

COMPARISON TO OTHER PUBLISHED RESEARCH

U.S. hospital lengths of stay associated with COVID-19 inpatient treatment have been analyzed in published literature as COVID-19 experience has become available, while other investigators have modeled expected lengths of stay based on international comparisons from the earliest months of the pandemic and / or coding and clinical considerations.[10,18] Estimates vary with respect to the use of actual COVID-19 patient experience, underlying population of interest (i.e., demographics), the time period of experience, and the types of admissions underlying the measurements (e.g., all admissions combined vs. ICU admissions). It is essential to consider these characteristics when comparing estimates from different publications given the correlations that exist between these variables and length of stay estimates. For instance, length of stay for COVID-19 inpatient treatment will differ for Medicare vs. commercial populations, for early 2020 vs. late 2020 experience, and for ICU vs. non-ICU admissions.

We compare the measurements of lengths of stay and hospital payments in this analysis of claims data to the following published research:

- In June 2020, Milliman published a white paper with estimates of the national average hospital payments for inpatient treatment of COVID-19.[10] The results in this white paper differ from those estimates, largely because the June 2020 report provided nationwide estimates based on expected patterns of COVID-19 admissions, and the results in this whitepaper are based on actual COVID-19 admission claims and these may not be reflective of national averages. The June 2020 estimates for Medicare were also strictly for Medicare FFS, and the claims analyzed in this white paper include MA claims.
- CMS published a summary of COVID-19 Medicare claims and encounter data from January 1, 2020 through November 20, 2020.[19] That data snapshot shows the mean hospital payment was $23,558, approximately 7% lower than the mean Medicare hospital payment in the claims data we analyzed of $25,328. The CMS data snapshot also implies a median length of stay of approximately seven days, which is consistent with the Medicare claims data we analyzed. The CMS data snapshot contains both Medicare FFS and MA claims data.

[18] Rees, E., Nightingale, E., Jafari, Y., et al. COVID-19 length of hospital stay: a systematic review and data synthesis. BMC Med 18, 270 (2020). https://doi.org/10.1186/s12916-020-01726-3. Published September 3, 2020. Accessed February 24, 2021.

[19] Centers for Medicare and Medicaid Services. Preliminary Medicare COVID-19 Data Snapshot - *Medicare Claims and Encounter Data: Services January 1 to November 21, 2020, Received by December 18, 2020.* https://www.cms.gov/files/document/medicare-covid-19-data-snapshot-fact-sheet.pdf. Updated December 18, 2020. Accessed February 24, 2021.

- The Epic Health Research Network (EHRN) published an analysis of lengths of stay for COVID-19 admissions through July 2020.[20] Data used in the EHRN study are stratified by mortality status and an overall length of stay is not reported, but the weighted average of the reported median lengths of stay across all four statuses reported is approximately 6.6 days, which is similar to the median length of stay we observed in the claims data we analyzed. EHRN did not stratify their data by market, so it is difficult to compare the EHRN results with observations from the claims data we analyzed. Hospital payments are not reported in the EHRN study.
- The U.S. Department of Health and Human Services (HHS) and the Centers for Disease Control and Prevention (CDC) published a report on COVID-19 admissions among healthcare personnel.[21] The HHS / CDC data show a median length of stay of four days, with an interquartile range of three to nine days. Those results are similar to the commercial data we analyzed, which shows a median length of stay of five days and an interquartile range of three to nine days. Hospital payments are not reported in the HHS / CDC study.
- FAIR Health issued a report in July 2020 reporting key characteristics of COVID-19 patients, using claims from January 2020 through May 2020.[22] FAIR Health reported hospital payments stratified by age group, but they did not report the number of admissions by age group. Therefore, an overall median or mean hospital payment cannot be derived from that report. By age group, FAIR Health reported median hospital payments of $17,219 (for ages 23 to 30) to $24,012 (for ages 51 to 60). These are in generally in the same range as the commercial median payments in the claims data we analyzed.

Mortality rates for hospitalized COVID-19 patients have also been reviewed in published literature.[23,24] A consistent theme is the observed reduction in mortality rates over time during the pandemic.[25,26,27] Reduced mortality rates in hospitalized COVID-19 patients are linked to growing clinical experience that has improved treatment patterns and the availability of new therapeutics. Similar to length of stay, estimates for absolute rates of mortality vary widely and can be difficult to normalize when comparing across sources with different demographics, time periods of care, and patient severity levels. Therefore, published mortality rates are not directly comparable to the mortality rates we observed in claims data.

[20] Epic Health Research Network. Inpatient Lengths of Stay, Number of ICU Days Among COVID-19 Patients Differ from Common Model Assumptions. https://ehrn.org/articles/inpatient-lengths-of-stay-and-number-of-icu-days-among-covid-19-patients-differ-from-common-model-assumptions. Posted August 14, 2020. Accessed February 24, 2021.

[21] Kambhampati, A., O'Halloran, A., Whitaker, M., et al. "COVID-19–Associated Hospitalizations Among Health Care Personnel – COVID-NET, 13 States, March 1–May 31, 2020." Centers for Disease Control and Prevention. https://www.cdc.gov/mmwr/volumes/69/wr/mm6943e3.htm. Updated October 30, 2020. Accessed February 24, 2021.

[22] FAIR Health. "Key Characteristics of COVID-19 Patients." https://s3.amazonaws.com/media2.fairhealth.org/brief/asset/Key%20Characteristics%20of%20COVID-19%20Patients%20-%20Profiles%20Based%20on%20Analysis%20of%20Private%20Healthcare%20Claims%20-%20A%20FAIR%20Health%20Brief.pdf. Published July 14, 2020. Accessed February 24, 2021.

[23] AHA Journal. Racial and Ethnic Differences in Presentation and Outcomes for Patients Hospitalized with COVID-19: Findings from the American Heart Association's COVID-19 Cardiovascular Disease Registry. https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.120.052278. Published November 17, 2020. Accessed February 24, 2021.

[24] Oxford University Press. Risk Factors for Intensive Care Unit Admission and In-hospital Mortality Among Hospitalized Adults Identified through the US Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciaa1012/5872581. Published July 16, 2020. Accessed February 24, 2021.

[25] STAT. Data show hospitalized Covid-19 patients are surviving at higher rates, but surge in cases could roll back gains. https://www.statnews.com/2020/11/23/hospitalized-covid-19-patients-surviving-at-higher-rates-but-surge-could-roll-back-gains/. Posted November 23, 2020. Accessed February 24, 2021.

[26] Horwitz, L., Jones, S., Cerfolio, R., et al. "Trends in COVID-19 Risk-Adjusted Mortality Rates." Journal of Hospital Medicine. https://www.journalofhospitalmedicine.com/jhospmed/article/230561/hospital-medicine/trends-covid-19-risk-adjusted-mortality-rates. Published October 23, 2020. Accessed February 24, 2021.

[27] Dennis, J., McGovern, A., Vollmer, S., et al. "Improving Survival of Critical Care Patients with Coronavirus Disease 2019 in England: A National Cohort Study, March to June 2020." Critical Care Medicine. https://journals.lww.com/ccmjournal/Abstract/9000/Improving_Survival_of_Critical_Care_Patients_With.95449.aspx, 2020. Updated February 21, 2021. Accessed February 24, 2021.

4. Data sources and methodology

DATA SOURCES

We report hospital payments and length of stay for COVID-19 admissions from the Milliman MedInsight Emerging Experience dataset. The claims data encompasses 18,810 total hospital admissions for COVID-19 treatment for admission dates from April 1 through July 31, 2020, with claims paid through October 31, 2020. Contributor data represents a sample of claims experience from Milliman clients and includes experience for payers in commercial (i.e., fully insured, and self-funded group insurance), Medicaid, and Medicare markets. Medicare contributor data includes a mix of Medicare FFS (approximately 39.5% of admissions) and MA (approximately 60.5% of admissions).

Geographic characteristics of the contributor data are not included in the sample dataset due to agreements with contributing carriers. The exact payment methodology associated with each hospital admission is also unknown. These variables have a material impact on hospital payments per admission.

We identify COVID-19 inpatient admissions in the claims data based on the COVID-19 diagnosis code U07.1 appearing on the hospital claim in the principal or a secondary diagnosis code position.[28] Table 7 provides a summary of the total number of admissions included in the analysis by month, severity level, and market.

TABLE 7: COVID-19 INPATIENT ADMISSIONS | TOTAL ADMISSIONS BY MONTH

TOTAL ADMISSIONS - ALL SEVERITY LEVELS

MARKET	APRIL	MAY	JUNE	JULY	TOTAL
Commercial	1,955	740	682	1,063	4,440
Medicaid	1,282	864	781	1,114	4,041
Medicare	4,657	1,976	1,305	2,391	10,329
All Markets	**7,894**	**3,580**	**2,768**	**4,568**	**18,810**

TOTAL ADMISSIONS - NON-ICU

MARKET	APRIL	MAY	JUNE	JULY	TOTAL
Commercial	1,492	566	515	886	3,459
Medicaid	976	658	564	863	3,061
Medicare	3,451	1,456	928	1,793	7,628
All Markets	**5,919**	**2,680**	**2,007**	**3,542**	**14,148**

TOTAL ADMISSIONS - ICU WITHOUT IMV

MARKET	APRIL	MAY	JUNE	JULY	TOTAL
Commercial	198	105	106	131	540
Medicaid	118	112	124	153	507
Medicare	485	293	226	356	1,360
All Markets	**801**	**510**	**456**	**640**	**2,407**

TOTAL ADMISSIONS - ICU WITH IMV

MARKET	APRIL	MAY	JUNE	JULY	TOTAL
Commercial	265	69	61	46	441
Medicaid	188	94	93	98	473
Medicare	721	227	151	242	1,341
All Markets	**1,174**	**390**	**305**	**386**	**2,255**

[28] Centers for Medicare and Medicaid Services. ICD-10 MS-DRGs version 37.1 R1 effective April 1, 2020. https://edit.cms.gov/files/document/icd-10-ms-drgs-version-371-r1-effective-april-1-2020-updated-march-23-2020.pdf. Published March 23, 2020. Accessed February 24, 2021.

The analysis relies on a de-identified dataset containing COVID-19 admissions summarized on the following variables:

1. Market *(commercial, Medicare, or Medicaid)*
2. Admission Date *(April 1, 2020 through July 31, 2020)*
3. MS-DRG
4. Revenue Code
5. Death Flag *(Mapped based on discharge code = 20 or 41)*
6. ICU Flag *(Mapped based on revenue code: '0200', '0201', '0202', '0203', '0209', '0210', '0211', '0212', or '0219')*
7. Invasive Mechanical Ventilation Flag *(Mapped based on ICD procedure code: 0BH13EZ, 0BH17EZ, 0BH18EZ, 5A1935Z, 5A1945Z, or 5A1955Z)*

The dataset provides the following summarized information:

1. Admission Count
2. Day Count
3. ICU Day Count
4. Total Allowed (i.e., hospital payment)
5. Total Billed
6. Total Paid
7. Total Copay
8. Total Coinsurance
9. Total Deductible
10. Total Coordination of Benefits

Claims include paid run-out through October 31, 2020.

INPATIENT SEVERITY LEVEL

We utilize the variables identifying ICU and IMV to stratify patients into the three severity levels used in our analysis: non-ICU (ICU = "N" and IMV = "N"), ICU without IMV (ICU = "Y" and IMV = "N"), and ICU with IMV (ICU = "Y" and IMV = "Y").

PERCENTILE STATISTICS

To derive the 95% confidence intervals for hospital payments per admission and length of stay shown in the Appendix, we use a bootstrap methodology involving 5,000 iterations of random sampling with replacement, each based on a sample of 500 inpatient admissions extracted from the contributor data.

5. Caveats and limitations

This white paper was commissioned by Amgen, Inc. (Amgen). We developed this information to illustrate the range of hospital payments and lengths of stay for COVID-19 admissions. This information may not be appropriate, and should not be used, for other purposes.

The distribution of the claims data we analyzed by market and geographic region is unknown and may not represent a nationwide average. Hospital payments vary significantly by region, meaning payments to hospitals in some locations may differ significantly from the nationwide estimates presented in this white paper. Differences between the claims data summarized in this white paper and current or future nationwide payment amounts may result from evolution in disease treatment patterns, payer-specific payment structures, geographic variation in the incidence of COVID-19 admissions, new legislation, federal rulemaking, and other unforeseen events that affect the per-admission hospital payment for COVID-19 admissions in one or more markets.

We note, the following limitations with respect to our summarized dataset and the conclusions of our analysis:

- **Hospital payment estimates do not include payments for other services provided to hospitalized COVID-19 patients, such as professional payments for inpatient physician visits.** Costs other than the hospital payment for an inpatient admission can be substantial and are outside the scope of this analysis.
- **The hospital payment methodologies for all payers underlying the experience are not known.** Commercial hospital payment methodologies vary significantly by carrier due to the wide range of structures available in the commercial market, which are often not public, as do MA payment methodologies. Medicaid hospital payment methodologies also vary by state.
- **Estimates for Medicare include both FFS and Medicare Advantage.** Hospital payment methodologies and length of stay estimates for inpatient admissions are likely to differ between FFS and MA.

In preparing our estimates, we relied upon claims data processed by Milliman MedInsight. The data were not audited but were reviewed for reasonableness.

Guidelines issued by the American Academy of Actuaries require actuaries to include their professional qualifications in all actuarial communications. Matt Kramer and Matt Mraz are consulting actuaries for Milliman, Inc. They are members of the American Academy of Actuaries and meet the qualification standards to render the actuarial opinion contained herein.

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Appendix

INPATIENT ADMISSIONS STATISTICS | LENGTH OF STAY AND HOSPITAL PAYMENT PER ADMISSION STATISTICS COVID-19-RELATED HOSPITALIZATIONS (ALL SEVERITY LEVELS)

ALL HOSPITALIZATIONS (NON-ICU AND ICU COMBINED)

Length of Stay Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	4,440	LOS	7.60	0.13	7.34	7.87	1	1	3	5	9	16	146
MEDICAID	4,041	LOS	8.30	0.15	8.02	8.59	1	2	3	5	10	19	104
MEDICARE	10,329	LOS	9.38	0.09	9.20	9.56	1	2	4	7	12	20	145

Hospital Payment per Admission Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	4,440	Hospital Payment	$37,497	$1,095	$35,488	$39,788	$0	$8,629	$14,661	$21,697	$36,680	$70,281	$2,429,856
MEDICAID	4,041	Hospital Payment	$19,831	$555	$18,803	$20,973	$36	$4,966	$7,395	$12,214	$21,086	$36,007	$873,083
MEDICARE	10,329	Hospital Payment	$25,328	$331	$24,697	$26,015	$50	$10,515	$13,746	$16,714	$22,485	$49,329	$1,607,990

NON-ICU HOSPITALIZATIONS

Length of Stay Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	3,459	LOS	5.43	0.09	5.26	5.61	1	1	2	4	7	11	86
MEDICAID	3,061	LOS	6.33	0.12	6.09	6.57	1	1	2	4	8	13	104
MEDICARE	7,628	LOS	7.61	0.08	7.45	7.77	1	2	3	6	10	15	143

Hospital Payment per Admission Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	3,459	Hospital Payment	$23,894	$360	$23,232	$24,635	$0	$7,807	$13,364	$19,604	$28,724	$41,621	$529,465
MEDICAID	3,061	Hospital Payment	$13,381	$222	$12,961	$13,822	$36	$4,146	$6,914	$10,255	$16,521	$24,982	$257,950
MEDICARE	7,628	Hospital Payment	$18,895	$177	$18,544	$19,248	$50	$9,732	$13,162	$15,622	$19,104	$28,963	$380,916

INPATIENT ADMISSIONS STATISTICS | LENGTH OF STAY AND HOSPITAL PAYMENT PER ADMISSION STATISTICS
COVID-19-RELATED HOSPITALIZATIONS (ALL SEVERITY LEVELS) - CONTINUED

ICU WITHOUT IMV HOSPITALIZATIONS

Length of Stay Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	540	LOS	11.76	0.50	10.79	12.79	1	3	5	9	14	24	101
MEDICAID	507	LOS	11.55	0.53	10.54	12.63	1	3	5	8	13	23	102
MEDICARE	1,360	LOS	12.20	0.31	11.58	12.82	1	3	5	9	16	24	145

Hospital Payment per Admission Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	540	Hospital Payment	$57,333	$5,414	$48,151	$69,398	$23	$13,914	$19,377	$29,900	$57,147	$107,052	$2,429,856
MEDICAID	507	Hospital Payment	$30,190	$2,976	$25,127	$36,741	$79	$7,092	$10,143	$16,046	$27,087	$53,718	$873,083
MEDICARE	1,360	Hospital Payment	$28,837	$1,076	$26,795	$31,015	$1,408	$12,612	$14,491	$17,196	$26,642	$51,165	$521,170

ICU WITH IMV HOSPITALIZATIONS

Length of Stay Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	441	LOS	19.54	0.72	18.16	20.92	1	5	10	16	25	38	146
MEDICAID	473	LOS	17.61	0.61	16.42	18.80	1	3	8	15	24	36	79
MEDICARE	1,341	LOS	16.61	0.33	15.96	17.29	1	3	8	14	23	32	93

Hospital Payment per Admission Statistics

LOB	Admissions	Attribute	Mean	Standard Error	CI_95_lower	CI_95_upper	Min	Per10	Per25	Per50	Per75	Per90	Max
COMMERCIAL	441	Hospital Payment	$119,902	$6,956	$107,034	$134,559	$21	$20,388	$45,150	$87,985	$142,292	$228,830	$1,645,026
MEDICAID	473	Hospital Payment	$50,466	$2,641	$45,598	$55,947	$1,350	$13,808	$20,139	$34,006	$60,530	$96,789	$856,852
MEDICARE	1,341	Hospital Payment	$58,366	$1,857	$54,975	$62,184	$1,408	$16,444	$23,801	$47,485	$62,750	$99,999	$1,607,990