Supplemental Online Content

eMethods.

FAIR Health data
FAIR Health, a national non-profit organization established in 2009 to create an independent and transparent source of private insurance claims data, collects claims at least monthly from approximately 60 commercial and MA insurers covering over 150 million enrollees in total. The data cover approximately 75% of the commercially insured and 50% of the MA population. FAIR Health analysts generate reports regularly on spending and clinical trends in private insurance markets, and the data have been used by researchers and government officials as well.

We analyzed claims for care provided from January 1, 2020 to April 7, 2020 (14 weeks) that were submitted to FAIR Health by June 25, 2020. We excluded claims submitted under capitated payment arrangements, which were identified as claims without positive charge amounts. We excluded these claims because capitated spending is not affected by use of care. For hospital stays, spending was attributed to the week of the admission date.

For each week, we calculated total medical spending by summing payments across claims. FAIR Health computes service-specific standardized prices by averaging negotiated amounts across payers to create regional ratios of charges to payments, which are then applied to charges; these methods calibrate standardized prices so that aggregate spending totals closely approximate totals based on actual negotiated rates. These standardized prices are calculated to preserve the confidentiality of rates negotiated by any one insurer. We applied standardized prices calculated from 2019 claims to the 2020 claims included in the analysis.

Enrollees age 65 or older accounted for approximately 16% of spending, as expected from the smaller share of the total Medicare population covered by FAIR Health data relative to the share of the commercially insured.

Correction for unreported claims
To account for claims not yet reported in the data submitted by June 25, 2020 due to customary lags in claims processing (claims incurred but not reported [IBNR] in insurance parlance), we used 2019 data for the corresponding period and population to calculate a correction factor for each week. For a given week, the correction factor equaled the inverse of the proportion of the eventual (complete) 2019 spending total that was included in claims submitted to FAIR Health by June 25, 2019. We calculated correction factors separately for each category of claims. As expected, these corrections for the lag in claims processing and reporting affected later weeks in our study period more than earlier weeks. For example, week 13 spending was expected to be 89.2% complete relative to week 1 spending (based on 2019 experience), resulting in a 12.1% upward adjustment (1/0.892) for week 13 relative to week 1.

We tested the validity of our approach to adjusting for unreported claims by applying correction factors based on 2019 claim lags to 2020 weekly spending totals derived from less vs. more complete claims (specifically, all claims submitted by May 25, 2020 vs. claims submitted by June 25, 2020). The results suggest that our approach may slightly *underestimate* spending reductions due to COVID-19 (Table below). This may be because some insurers accelerated claims processing to mitigate the pandemic's short-term impact on provider cash flow (thereby reducing the proportion of unreported claims in March and April of 2020 relative to 2019). The

results of this validation analysis are not consistent with initial delays in claims processing due to the pandemic, as described below.

Table. Validation of correction factor for incurred but not reported (IBNR) claims

Week in 2020	Corrected weekly spending total in 2020 (billions) (using correction factors derived from 2019 data as described in the Methods)	
	Based on claims submitted by 5/25/2020 larger correction factor = 1/(proportion of total claims submitted by 5/25/2019)	**Based on claims submitted by 6/25/2020** smaller correction factor = 1/(proportion of total claims submitted by 6/25/2019) (study estimates)
Week 9	$6.29	$5.80
Week 10	$6.05	$5.61
Week 11	$5.33	$4.89
Week 12	$3.98	$3.54
Week 13	$3.58	$3.15
Week 14	$3.52	$3.13
Change from week 9 to 14	-44.1%	-46.0%

The corrected spending totals for weeks 9-14 based on less complete claims submitted to FAIR Health by 5/25/2020 are generally similar to those based on more complete claims submitted by 6/25/2020, but are consistently 8.4-13.6% higher. This suggests that our method of using the timing of 2019 claims reporting to correct for lagged claims reporting in 2020 tends to overestimate spending in the later weeks of our study period. This may be due to accelerated claims processing and payments by insurers during the pandemic (e.g., making the proportion of spending included in claims submitted by 5/25/2020 higher than it was by 5/25/2019). Thus, our reported estimates (based on more complete claims submitted by 6/25/2020) also may modestly overestimate spending to the extent that the proportion of 2020 claims reported by 6/25/2020 is greater than the proportion of 2019 claims reported by 6/25/2019. However, this analysis also indicates that any over-correction by our method is largely consistent over weeks 9-14, causing minimal impact on estimated spending reductions over this period; larger correction factors applied to less complete claims produced a slightly smaller spending reduction (44.1%) than our estimate based on more complete claims (46.0%). In turn, our study estimates may slightly underestimate pandemic-associated spending reductions from week 9 to 14 that would be observed with 100% complete data. In sum, the results of this validation analysis suggest that greater proportions of claims in weeks 9-14 were reported by May 25 in 2020 than by May 25 in 2019. The increase in reporting was slightly greater for week 14 than for week 9. This pattern is consistent with accelerated payments and results in an underestimation of the spending reduction from week 9 to 14 when using correction factors based on the 2019 proportions. When use a longer run-out to include more complete data (i.e., when we use claims reported by June 25), the expected proportion of unreported claims is smaller, reducing any bias from the correction that is due to accelerated payments. Consistent with this expectation, we find a slightly greater reduction of -46.0%. If our reported estimates using claims reported by June 25, 2020, remains biased by accelerated payments (relative to estimates based on 100% complete data), we would expect the bias to be directionally similar and small in magnitude. In contrast, if claims processing and reporting in late March and early April (by providers or insurers) had been

initially slowed by the pandemic, we would expect to see higher spending estimates in later weeks when allowing more time for claims processing to catch up (right column). Thus, this validation analysis is more consistent with accelerated rather than delayed processing of claims.

Randomization Inference

We quantified the extremeness of relative percentage changes using a randomization inference approach in which we calculated differences in spending totals between all possible permutations of pairs of the 46 weeks in 2019 without a major national holiday (2070 permutations) and compared our study estimates against this distribution of between-week spending differences under the null (no pandemic). For example, a spending reduction from week 9 to 14 of 2020 that is more extreme than any value in this distribution would correspond to the <0.05th percentile ([1/2070] ×100) in this distribution.

States categorized by COVID-19 activity and social distancing policies

Category	States
NY	NY
High COVID-19 activity	CO, CT, DE, IL, LA, MA, MD, MI, NJ, PA, RI, WA, DC
Low COVID-19 activity, early social distancing policies	AL, AK, AZ, CA, HI, ID, IN, IA, KS, KY, ME, MN, MT, NV, NH, NM, NC, OH, OR, VT, VA, WV, WI
Low COVID-19 activity, late social distancing policies	AR, FL, GA, MO, MS, NE, ND, OK, SC, SD, TN, TX, UT, WY

COVID activity was based on cumulative confirmed cases per capita as of April 7, 2020 (source: https://www.usatoday.com/story/money/2020/04/17/states-with-the-highest-number-of-COVID-19-cases/111552340/). High-activity states and Washington, DC had the 12 highest rankings after NY. As of April 13, 2020, cumulative confirmed cases ranged from 135 to 725 per 100,000 and cumulative confirmed deaths ranged from 5.4 to 27.4 per 100,000 in high-activity states, compared with 29.4 to 124.8 cases and 1.2 to 4.6 deaths per 100,000 in low-activity states. Timing of social distancing was determined from the Boston University School of Public Health COVID-19 US State Policy (CUSP) Database (source: https://docs.google.com/spreadsheets/d/1zu9qEWI8PsOI_i8nI_S29HDGHlIp2lfVMsGxpQ5tvAQ/edit#gid=0). We categorized states as implementing social distancing measures early (relative to our study period) if the state issued a stay at home or shelter in place advisory or closed nonessential businesses before April 1, 2020.

Spending categories by type of service

Type of Service	Claims included in category spending total
Inpatient (professional and facility)	Facility (UB-04) claims with bill type of 11x or 12x. Professional (CMS-1500) claims with place of service of 21 (Inpatient Hospital).
Emergency department (professional and facility)	Facility (UB-04) claims with bill type of 13x and a revenue code of 045x. Professional (CMS-1500) claims with: 1) place of service of 23 (Emergency Room – Hospital), or 2) place of service of either 19 (Off Campus-Outpatient Hospital) or 22 (On Campus-Outpatient Hospital) AND an emergency room CPT code (99281-85, 99288, 99291-99292, G0380-84), or 3) a modifier of ET.
Post-acute care in a facility (professional and facility)	Facility (UB-04) claims with a bill type of 1) 2x - Skilled Nursing Facility, or 2) 11x or 12x AND a Revenue Code of 0024 (Inpatient Rehabilitation Facility), or 3) 11T – Inpatient Rehabilitation Facility – Acute Care Facility, or 4) 11R – Inpatient Rehabilitation Facility – Critical Access Hospital. Professional (CMS-1500) claims with place of service of 31 (Skilled Nursing Facility) or 61 (Comprehensive Inpatient Rehabilitation Facility)
Ambulatory surgical center (professional and facility)	Facility (UB-04) claims with a bill type of 83x - Special Facility Ambulatory Surgical Center. Professional (CMS-1500) claims with a place of service of 24 (Ambulatory Surgical Center)
Outpatient care in hospital-owned facility (professional and facility)	Facility (UB-04) claims with a bill type of 13x - Hospital Outpatient. Professional (CMS-1500) claims with a place of service of 19 (Off Campus-Outpatient Hospital) or 22 (On Campus-Outpatient Hospital) (excluding claims designated as emergency department claims per definition above)
Outpatient care in office setting (professional only)	Professional (CMS-1500) claims with a place of service of 11 (Office)
Urgent care centers and retail clinics (professional only)	Professional (CMS-1500) claims with a place of service of 20 (Urgent Care Center) or 17 (Retail Clinic)

Typically-elective surgical procedure codes

Type of elective procedure	Codes included in elective procedure spending total (professional or facility claims with one of the listed codes)
Lower extremity joint replacements and arthroscopies	DRG Codes, ICD-10 Procedure Codes and CPT/HCPCS codes for Hip Arthroscopy, Hip or Knee Replacement, Hip Replacement, Knee Replacement, Hip or Knee Revision, Hip Revision, Knee Revision and Knee Arthroscopy
Cardiac valve replacements	DRG Codes, ICD-10 Procedure Codes and CPT/HCPCS codes for Cardiac Valve and Other Major Cardiothoracic Procedures, Endovascular Cardiac Replacement and Cardiac Valve Replacement
Spine injections and surgeries	DRG Codes, ICD-10 Procedure Codes and CPT/HCPCS codes for Spinal Procedures, Spinal Fusion, Cervical Spinal Fusion, Lumbar/Lumbarsacral Laminectomy, Lumbar Fusion and Spinal Injection
Weight loss surgery	DRG Codes, ICD-10 Procedure Codes and CPT/HCPCS codes for OR Procedures for Obesity, Bariatric Surgery, Gastric Restrictive Procedure, Bypass Stomach and Restriction/Stomach
Cataract surgery	ICD-10 Procedure Codes and CPT/HCPCS codes representing Cataract Surgery

Telemedicine visit codes[*]

Procedure Code	Description
98966	NON-FACE-TO-FACE NONPHYSICIAN TELEPHONE SERVICES
98967	NON-FACE-TO-FACE NONPHYSICIAN TELEPHONE SERVICES
98968	NON-FACE-TO-FACE NONPHYSICIAN TELEPHONE SERVICES
98969	ONLINE DIGITAL E&M SERVICES (Deleted 12/31/2019 – replaced by 98970 and 98971)
98970	NON-FACE-TO-FACE NONPHYSICIAN ONLINE E&M SERVICES
98971	NON-FACE-TO-FACE NONPHYSICIAN ONLINE E&M SERVICES
98972	NON-FACE-TO-FACE NONPHYSICIAN ONLINE E&M SERVICES
99091	REMOTE PHYS MONITORING
99421	ONLINE DIGITAL E&M SERVICES
99422	ONLINE DIGITAL E&M SERVICES
99423	ONLINE DIGITAL E&M SERVICES
99441	NON-FACE-TO-FACE TELEPHONE SERVICES
99442	NON-FACE-TO-FACE TELEPHONE SERVICES
99443	NON-FACE-TO-FACE TELEPHONE SERVICES
99444	ONLINE DIGITAL E&M SERVICES (Deleted 12/31/2019 – replaced by 99421-99423)
99446	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
99447	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
99448	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
99449	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
99451	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
99452	INTERPROFESSIONAL TELEPHONE/INTERNET/ELECTRONIC HEALTH RECORD CONSULTATIONS
G2010	REMOTE IMAGE/VIDEO EVALUATION
G2012	VIRTUAL CHECK IN BY PHYS OR QUAL HEALTH CARE PROF E&M
G2061	QUAL NONPHYS HEALTH PROF ONLINE ASSESS & MANAGEMENT SVC, EST PT 5-10M
G2062	QUAL NONPHYS HEALTH PROF ONLINE ASSESS & MANAGEMENT SVC, EST PT 11-20M
G2063	QUAL NONPHYS HEALTH PROF ONLINE ASSESS & MANAGEMENT SVC, EST PT >21M

[*]Telemedicine visits included claims with 1) the above codes, 2) modifiers GT, GQ, or 95, or 3) place of service 02