Impact of COVID-19 on hospital admissions for acute coronary syndromes (updated analyses including admissions up to 20 December 2020)

Introduction

Researchers in the Nuffield Department of Population Health and the Radcliffe Department of Medicine, working with NHS Digital and a team of experts from other UK universities, analysed the number of admissions to hospitals in England for acute coronary syndrome (ACS) during the COVID-19 pandemic.

Results based on data collected by NHS Digital from NHS Hospital Trusts in England up to 24 May 2020 were published in The Lancet on 14 July 2020.[1] Updated monthly analyses (**Figures 1-8**) are published here.

Summary

The impact of the COVID-19 pandemic on the number of ACS admissions during the period February to May 2020 was previously described in the main publication.[1] Weekly ACS admissions had approximately returned to the 2019 expected numbers by August 2020 (Figure 1). This updated analysis suggests that, after accounting for incomplete coding and delayed reporting by NHS hospitals (see online supplementary methods[1] and additional adjustment described below), the numbers of admissions with non-ST-elevation myocardial infarction (NSTEMI) was slightly below expected levels between October and December 2020, coinciding with the second rise in COVID-19 case numbers in the UK (Figures 1 and 2). Weekly numbers of admissions with ST-elevation myocardial infarction (STEMI) remained similar to 2019 numbers during this period. The number of ACS admissions involving a coronary artery bypass graft were below expected during November and December 2020 (Figure 3). Updated analyses will be made available at https://www.ctsu.ox.ac.uk/research/covid-19-acute-coronary-syndromes.

Updated Methods

The study methods are described in the main publication and supplementary appendix, including the adjustment that was made for incomplete clinical coding for the 8 most recent weeks.[1] For the analyses reported here, an additional adjustment is made to the estimated number of ACS admissions (for the 4 most recent weeks of data only) to account for delays in the reporting of admissions by NHS hospitals. This was done by estimating the *additional* number of ACS admissions that tend to be identified when a subsequent monthly data extract becomes available, as described below.

For each of the monthly data extracts between July 2020 and January 2021, we first calculated the percentage increase in the number of reported ACS admissions seen in that data extract compared with the previous month's extract, for the last 4 weeks reported in the previous month's extract (**Table 1**). For example, for the week commencing 15th June 2020 (which was week '-1' for the July data extract), the number of reported ACS admissions was 2694 in the July data extract but 2891 by the time of the August data extract. Therefore, the 'August vs July' inflation factor for week -1 was 7.3% (since 2891/2694=1.073). By estimating each of these statistics seven times (ie, July vs June to January vs December), and taking the average of the seven values, we were able to calculate *average* inflation factors for each of weeks -1 through -4, which were then used to adjust the reported number of ACS admissions for the four most recent weeks of data.

Table 1: Proportional increase in weekly ACS admissions observed with subsequent data extract

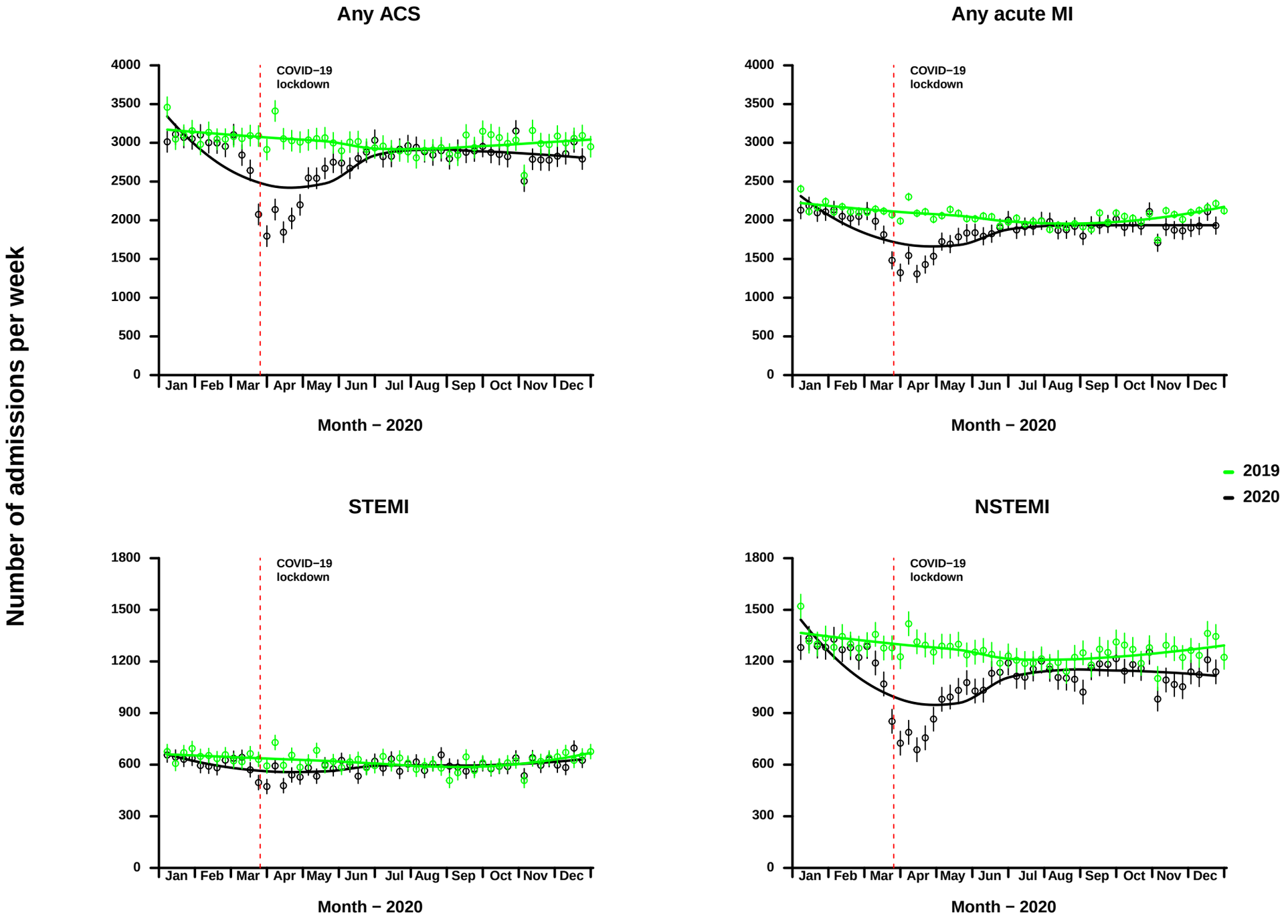
Week number (relative to earlier data extract)	Jul vs. Jun	Aug vs. Jul	Sept vs. Aug	Oct vs. Sept	Nov vs. Oct	Dec vs. Nov	Jan vs. Dec	Average % of seven estimates
-1	9.2%	7.3%	6.4%	4.2%	5.7%	4.9%	7.7%	**6.5%**
-2	4.9%	2.7%	3.2%	1.1%	6.4%	3.2%	4.3%	**3.7%**
-3	2.8%	1.3%	2.3%	1.3%	3.8%	2.6%	2.6%	**2.4%**
-4	1.7%	1.2%	0.6%	0.1%	1.6%	1.8%	1.4%	**1.2%**

The current updated analysis includes admissions for ACS from all 147 acute hospital NHS trusts in England from 1 January 2019 to 20 December 2020. To investigate the effect of season on expected ACS admissions, weekly ACS admissions during 2019 are also shown (Figure 1). In the current updated analysis, the error bars of the weekly numbers of admissions represent plus/minus one standard deviation of the (pre-covid) 2019 weekly counts (ie, allowing for over-dispersed Poisson distribution). An additional analysis (Figure 8) was undertaken to explore changes in weekly number of ACS admissions in different regions of England. In order to account for differences in population size, weekly ACS admissions are shown as number of admissions, per week, per 100,000 people based on publically available population demographic data.

Updated figures

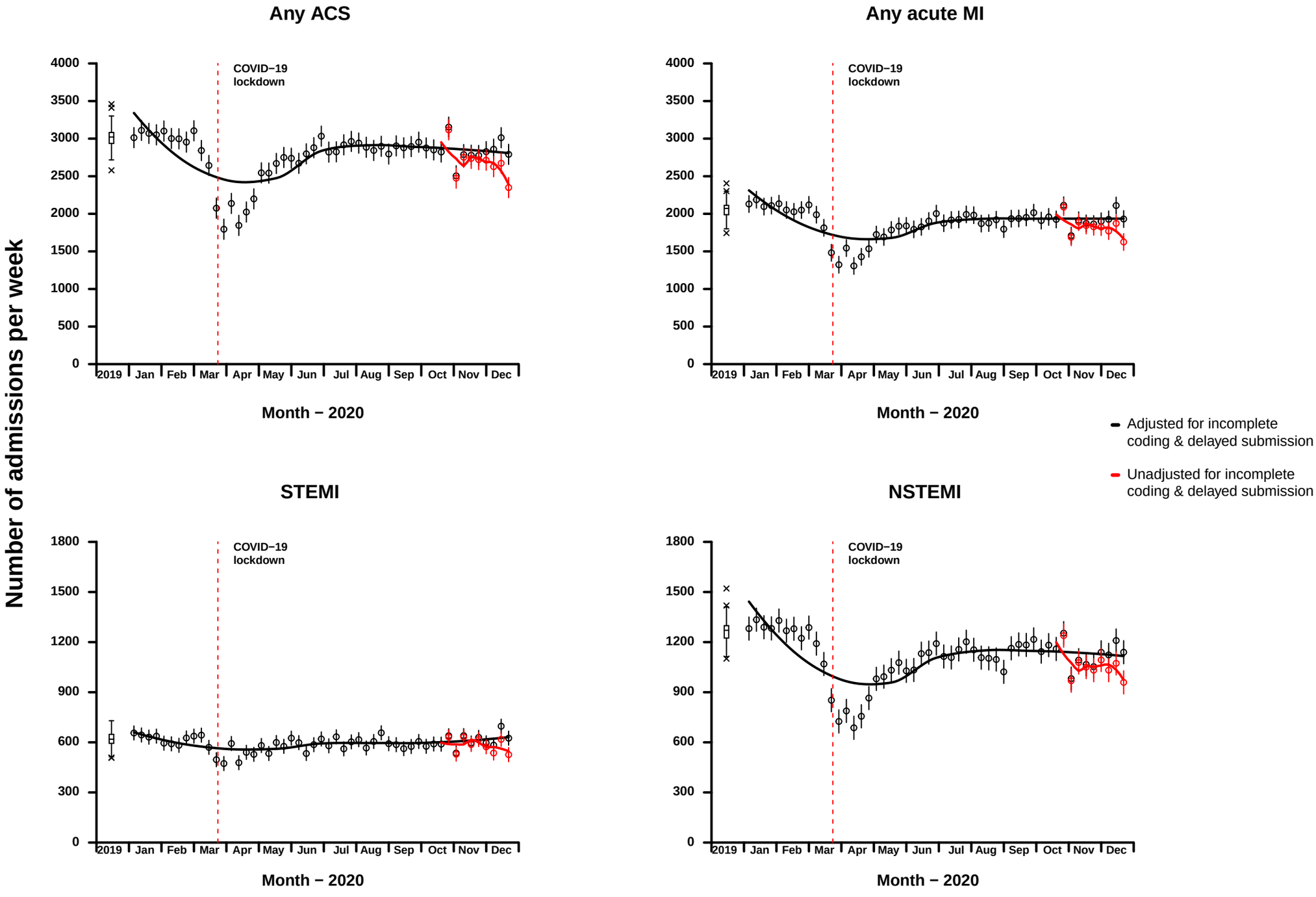
[1] Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, Hollings S, Roebuck C, Gale CP, Mamas MA, Deanfield JE, de Belder MA, Luescher TF, Denwood T, Landray MJ, Emberson JR, Collins R, Morris EJA, Casadei B, Baigent C. COVID-19 pandemic and admission rates for and management of acute coronary syndromes in England. Lancet. 2020 Aug 8;396(10248):381-389.

Figure 1: Weekly numbers of admissions to acute NHS hospital trusts with an acute coronary syndrome, by type



For both 2019 and 2020, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID−19 lockdown (March 23, 2020) is shown with a vertical dotted line.
ACS=acute coronary syndrome. STEMI=ST−elevation myocardial infarction. NSTEMI=non−ST−elevation myocardial infarction. LOESS=locally estimated scatterplot smoothing.

Figure 2: Weekly numbers of admissions to acute NHS hospital trusts with an acute coronary syndrome, by type



For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID−19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST−elevation myocardial infarction. NSTEMI=non−ST−elevation myocardial infarction. LOESS=locally estimated scatterplot smoothing.

Figure 3: Weekly admissions to acute NHS hospital trusts with an acute coronary syndrome that received a particular coronary procedure

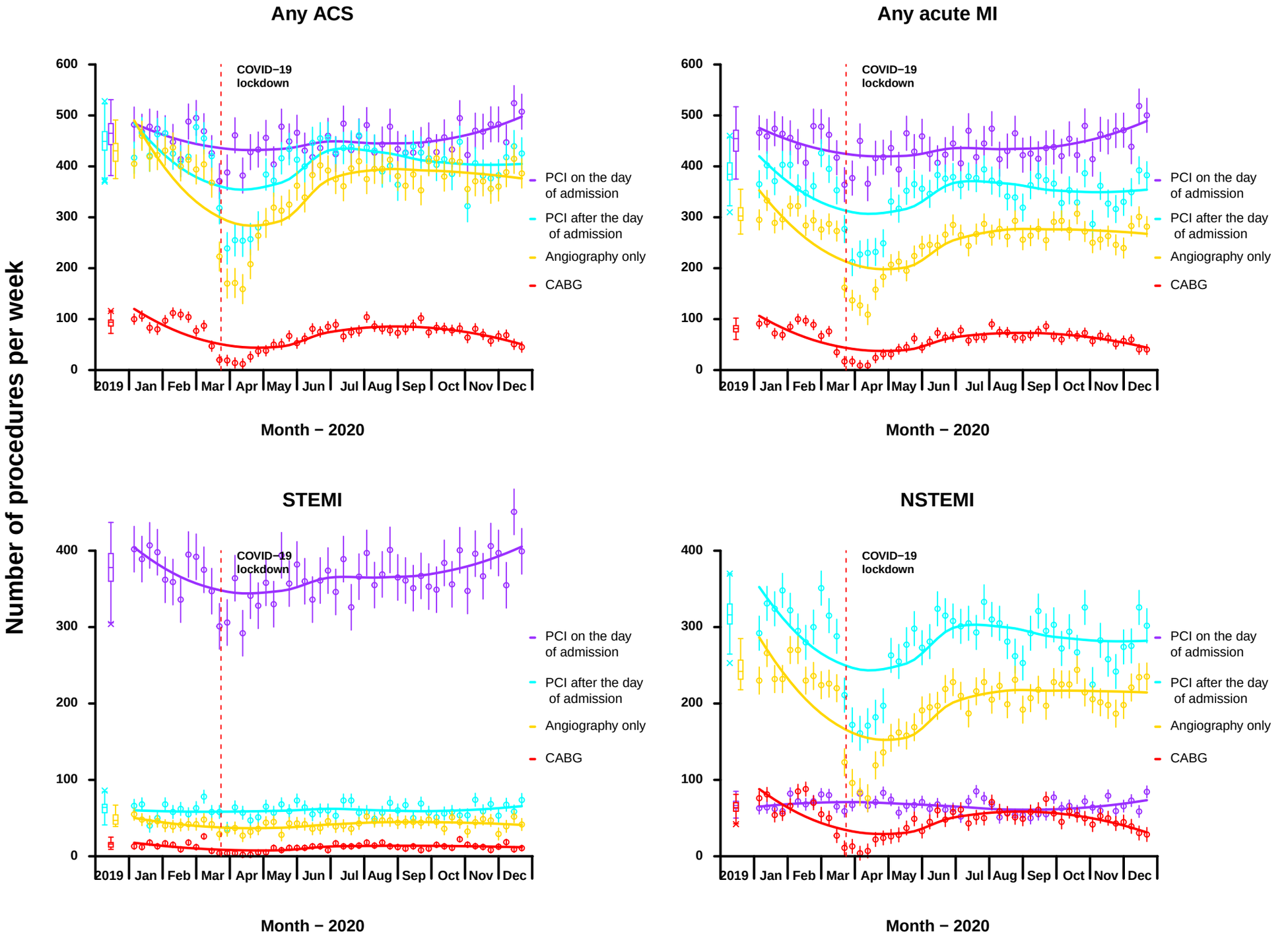


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Figure 4: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received percutaneous coronary intervention on day of admission

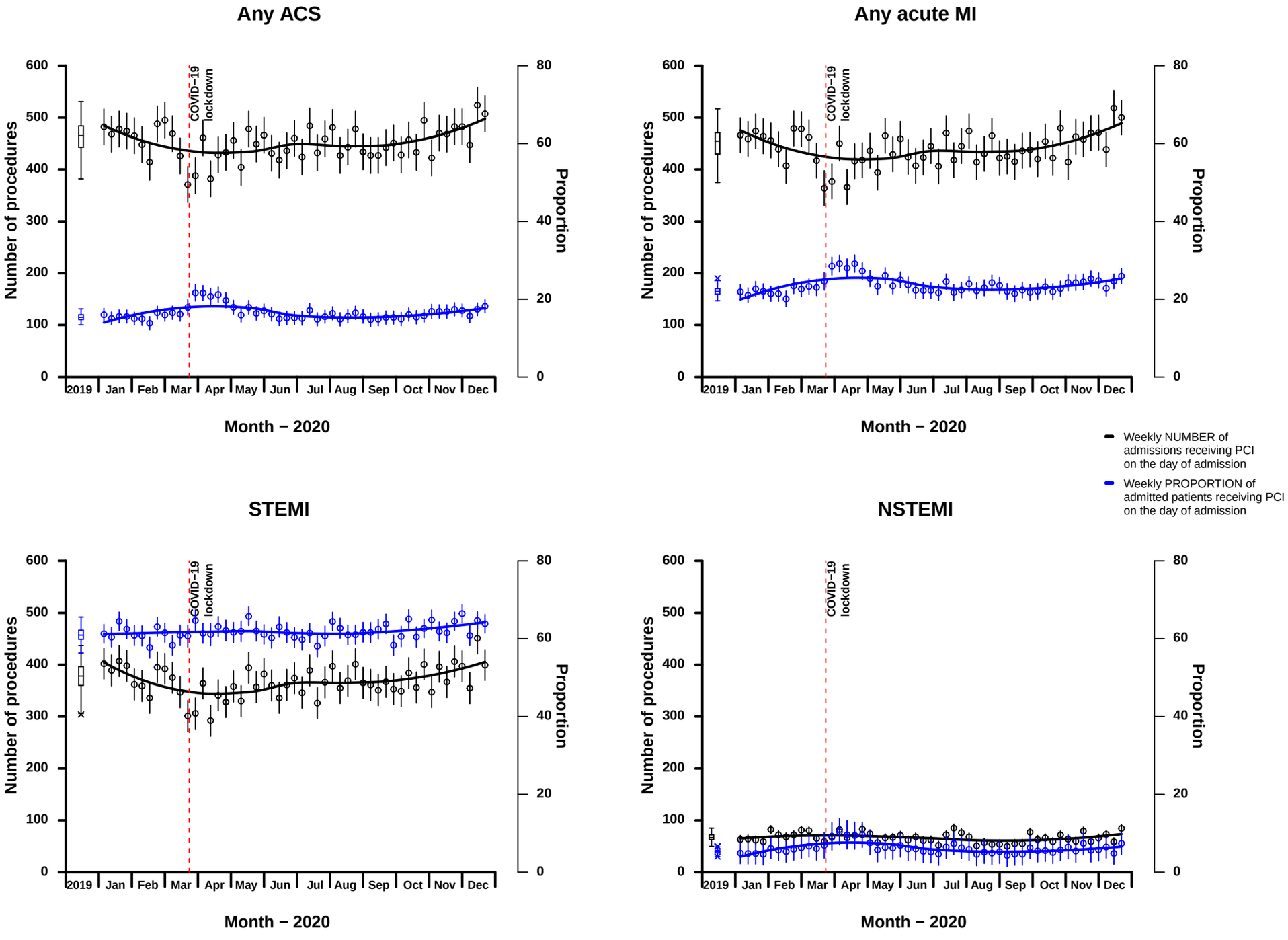

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Figure 5: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received any percutaneous coronary intervention

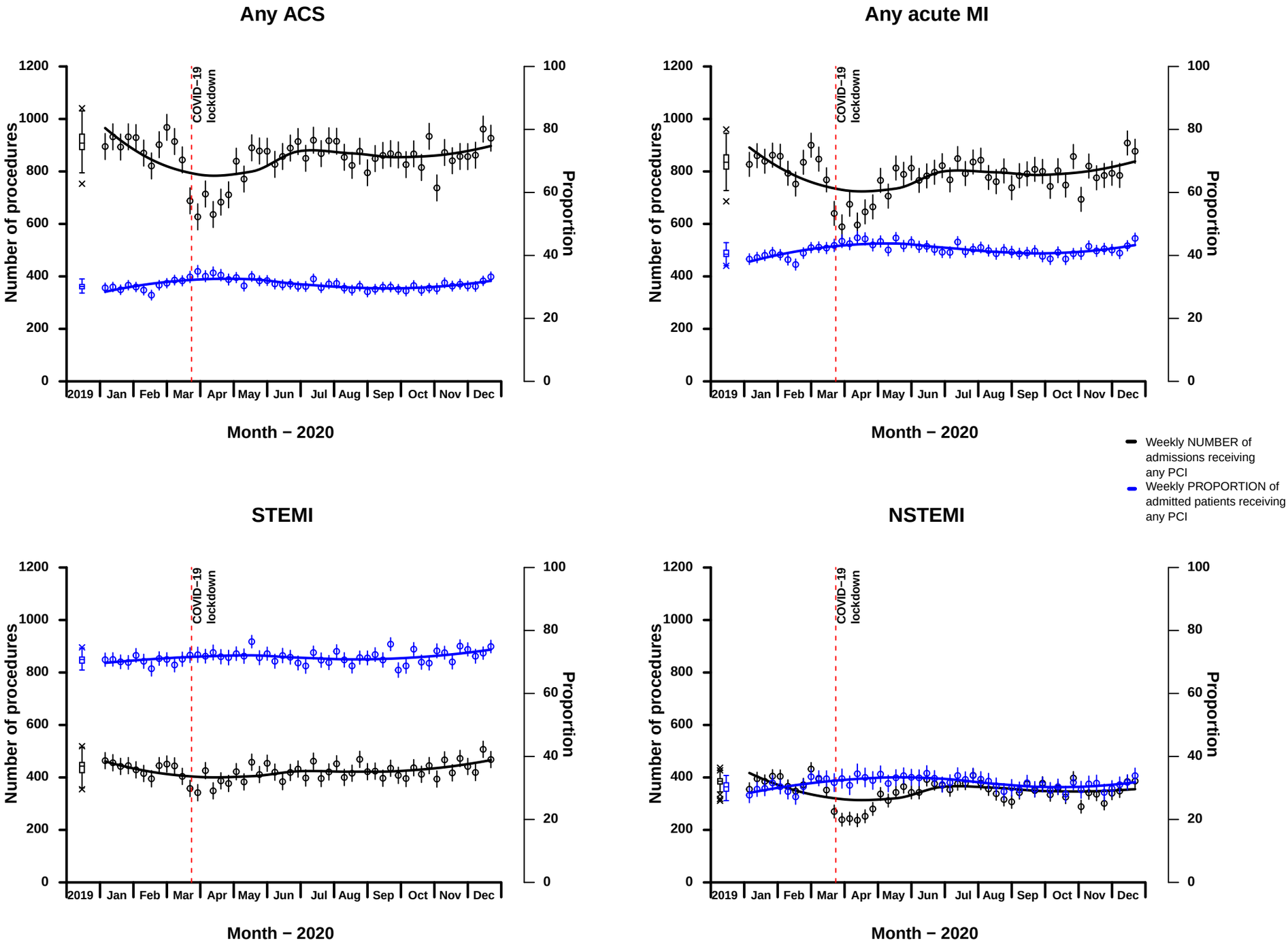

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Figure 6: Weekly median and interquartile range of length of stay for admissions to acute NHS hospital trusts with an acute coronary syndrome, by type

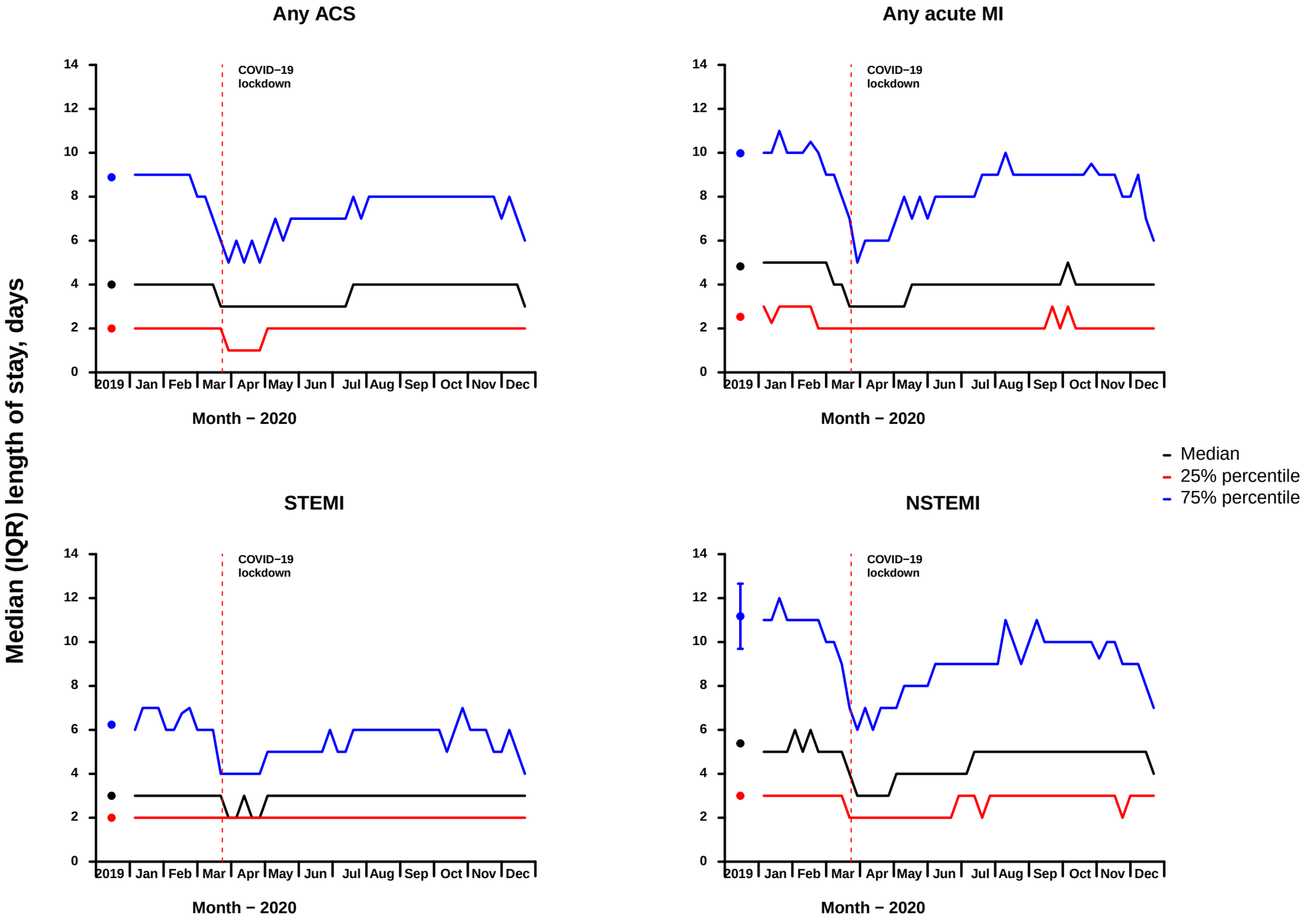

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Figure 7: Weekly number of admissions to acute NHS hospital trusts with an acute coronary syndrome, by age, sex, Charlson index and ethnicity

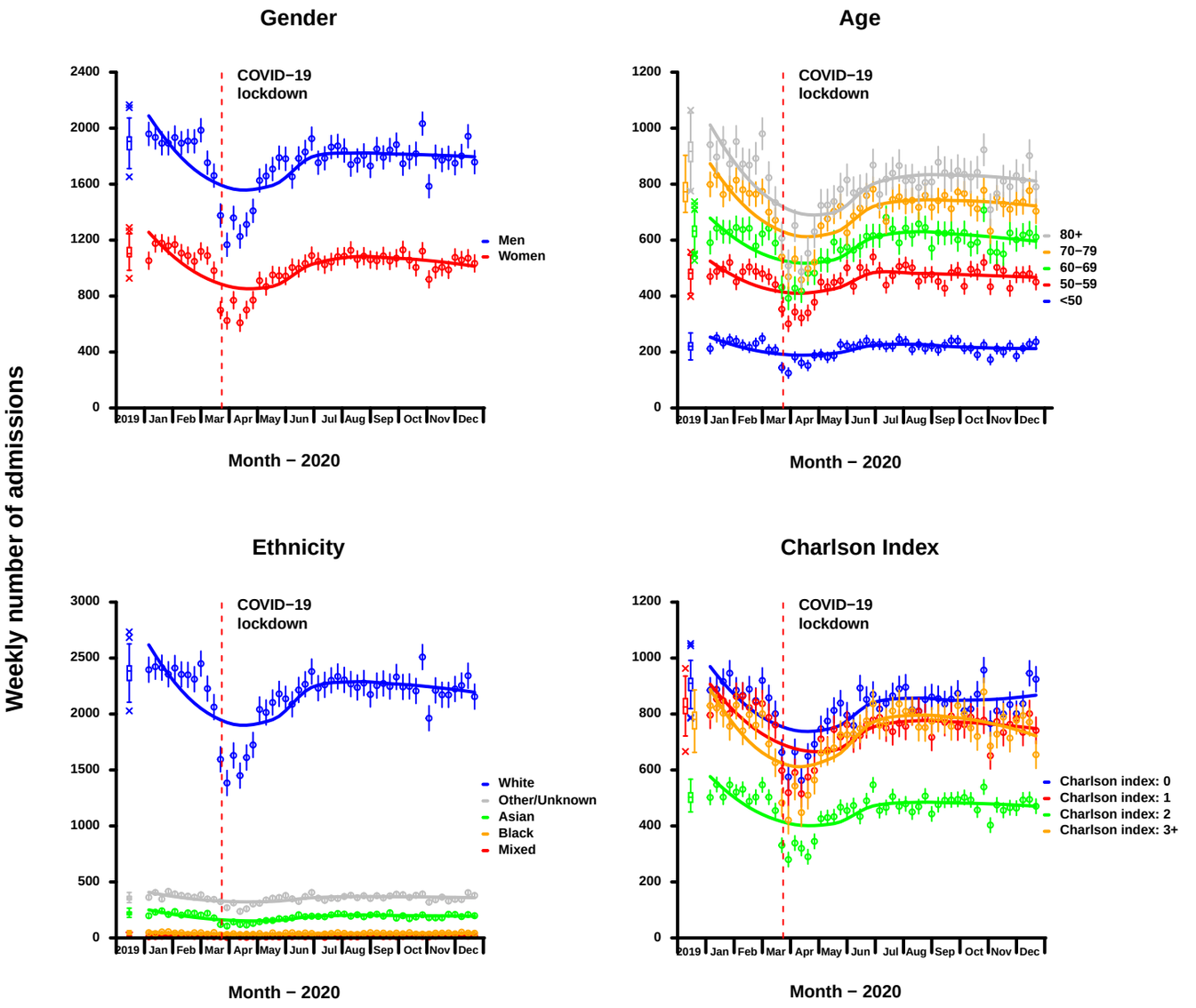

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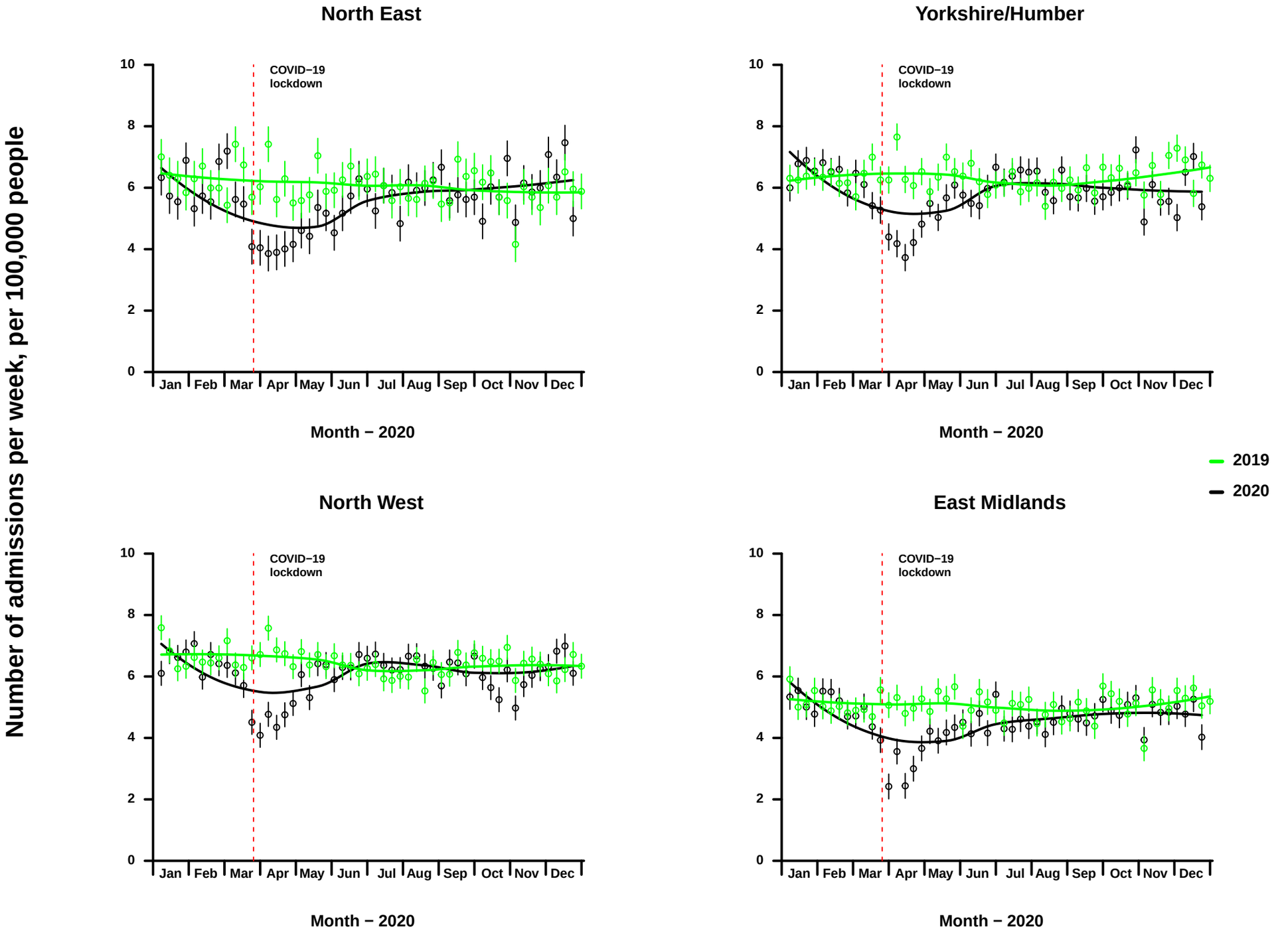
Figure 8(a): Weekly admissions rates to acute NHS hospital trusts with any acute coronary syndrome, by region



For both 2019 and 2020, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID−19 lockdown (March 23, 2020) is shown with a vertical dotted line.
ACS=acute coronary syndrome. STEMI=ST−elevation myocardial infarction. NSTEMI=non−ST−elevation myocardial infarction. LOESS=locally estimated scatterplot smoothing.

Figure 8 (b): Weekly admissions rates to acute NHS hospital trusts with any acute coronary syndrome, by region

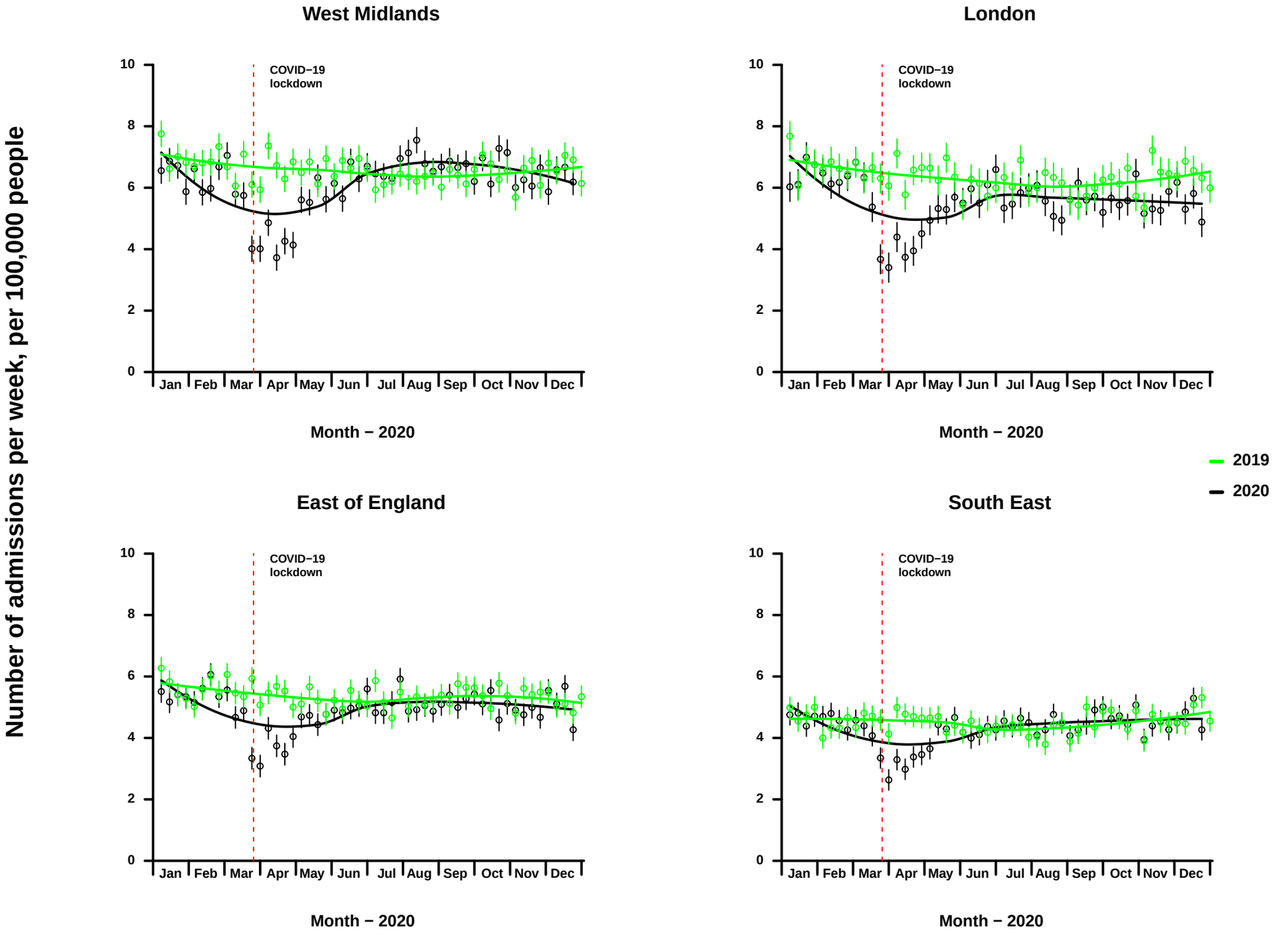


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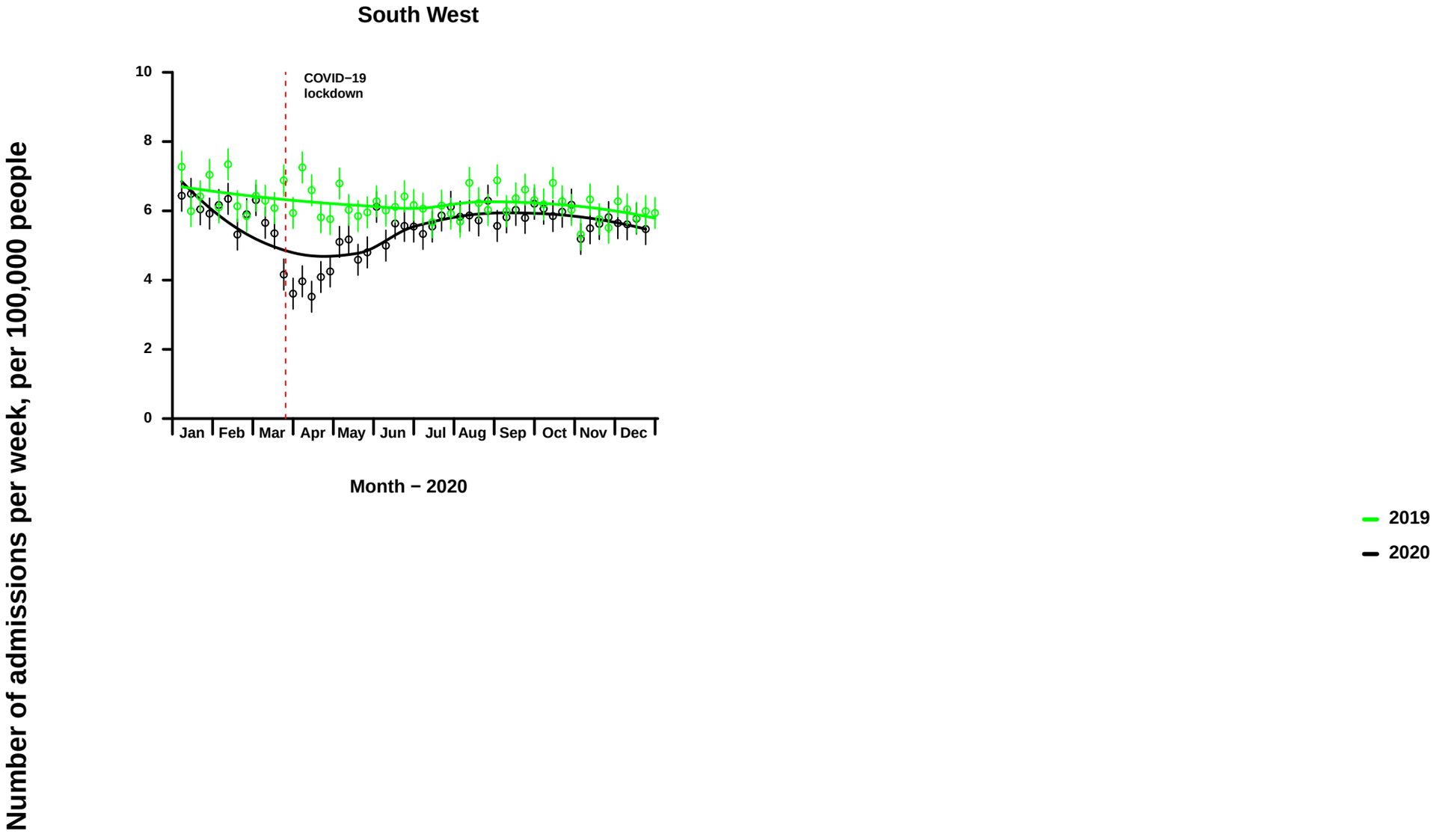
Figure 8(c): Weekly admissions rates to acute NHS hospital trusts with any acute coronary syndrome, by region



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ACS=acute coronary syndrome. STEMI=ST−elevation myocardial infarction. NSTEMI=non−ST−elevation myocardial infarction. LOESS=locally estimated scatterplot smoothing.

Table 2: Weekly number of admissions from acute coronary syndrome, any acute myocardial infarction, ST-elevation myocardial infarction and non-ST-elevation myocardial infarction in 2019 and 2020

Weekly admissions in 2020 are adjusted for incomplete coding and delayed reporting (see methods above)

Week	Any ACS		Any acute MI		STEMI		NSTEMI	
	2019	2020	2019	2020	2019	2020	2019	2020
1	3,459	3,013	2,405	2,130	676	656	1,521	1,281
2	3,048	3,110	2,111	2,187	607	644	1,318	1,334
3	3,098	3,070	2,166	2,096	670	631	1,301	1,289
4	3,156	3,051	2,241	2,109	694	637	1,335	1,282
5	2,980	3,101	2,105	2,134	648	595	1,282	1,329
6	3,135	3,002	2,175	2,051	653	591	1,345	1,268
7	3,047	2,998	2,109	2,027	635	582	1,301	1,280
8	3,047	2,954	2,105	2,050	658	626	1,277	1,223
9	3,081	3,105	2,102	2,119	622	637	1,298	1,287
10	3,055	2,842	2,144	1,988	617	643	1,357	1,191
11	3,093	2,643	2,118	1,814	664	570	1,278	1,069
12	3,088	2,075	2,070	1,482	631	496	1,279	852
13	2,913	1,795	1,990	1,323	593	473	1,227	725
14	3,411	2,138	2,302	1,544	729	593	1,419	788
15	3,052	1,846	2,090	1,307	596	478	1,314	687
16	3,026	2,024	2,109	1,428	654	540	1,295	756
17	3,009	2,199	2,012	1,535	585	528	1,254	865
18	3,037	2,545	2,059	1,724	616	581	1,289	980
19	3,054	2,542	2,139	1,692	683	533	1,288	993
20	3,065	2,670	2,090	1,785	594	599	1,300	1,032
21	2,999	2,750	2,020	1,835	618	576	1,238	1,077
22	2,896	2,739	2,018	1,839	584	625	1,254	1,028
23	3,008	2,672	2,055	1,793	616	598	1,264	1,033
24	3,017	2,798	2,047	1,826	631	533	1,242	1,131
25	2,916	2,880	1,926	1,904	582	586	1,190	1,137
26	2,935	3,033	1,976	2,003	594	620	1,232	1,191
27	2,959	2,821	2,028	1,875	648	579	1,207	1,114
28	2,897	2,825	1,952	1,918	605	633	1,188	1,108
29	2,897	2,918	1,985	1,925	639	561	1,190	1,156
30	2,883	2,963	1,989	1,992	609	603	1,215	1,202
31	2,806	2,941	1,878	1,982	573	616	1,170	1,154
32	2,903	2,885	1,936	1,870	594	566	1,194	1,107
33	2,908	2,843	1,907	1,877	605	605	1,142	1,103
34	2,937	2,898	1,955	1,921	580	657	1,224	1,096
35	2,854	2,795	1,915	1,796	508	592	1,250	1,022
36	2,839	2,904	1,881	1,935	553	586	1,179	1,163
37	3,101	2,878	2,095	1,938	645	562	1,271	1,186
38	2,938	2,895	1,974	1,952	566	575	1,252	1,183

Week	Any ACS		Any acute MI		STEMI		NSTEMI	
	2019	2020	2019	2020	2019	2020	2019	2020
39	3,149	2,953	2,094	2,015	611	605	1,313	1,216
40	3,105	2,876	2,050	1,910	580	576	1,295	1,143
41	3,067	2,850	2,027	1,959	593	590	1,270	1,182
42	2,992	2,822	1,978	1,925	611	589	1,189	1,159
43	3,034	3,153	2,084	2,113	621	639	1,280	1,253
44	2,579	2,505	1,744	1,709	508	536	1,101	981
45	3,159	2,788	2,124	1,914	633	640	1,294	1,092
46	2,990	2,779	2,074	1,873	619	596	1,274	1,066
47	2,976	2,776	2,011	1,864	639	630	1,223	1,053
48	3,087	2,827	2,101	1,901	646	597	1,264	1,139
49	2,998	2,859	2,127	1,926	671	583	1,235	1,123
50	3,056	3,013	2,165	2,110	624	697	1,363	1,209
51	3,093	2,791	2,215	1,931	651	625	1,344	1,139
52	2,951		2,122		676		1,224	