

Impact of COVID-19 on hospital admissions for acute coronary syndromes (updated analyses including admissions up to 28 March 2021)

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 methods¹ and additional adjustment described below), the numbers of admissions with non-ST-elevation myocardial infarction (NSTEMI) was slightly below expected levels in January 2021, but subsequently increased (Figures 1 and 2). Weekly numbers of admissions with ST-elevation myocardial infarction (STEMI) has remained similar to 2019 weekly admission numbers since August 2020. The suggestion of an increase in weekly admissions for STEMI above 2019 levels in March 2021 may be due to random variation or difficulties in accurately estimating the number of admissions in the most recent data (see updated methods) but should be monitored. 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 February 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 eight times (ie, July vs June to February vs January), and taking the average of the eight 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	Feb vs. Jan	Average % of seven estimates
-1	9.2%	7.3%	6.4%	4.2%	5.7%	4.9%	7.7%	7.5%	6.6%
-2	4.9%	2.7%	3.2%	1.1%	6.4%	3.2%	4.3%	6.6%	4.0%
-3	2.8%	1.3%	2.3%	1.3%	3.8%	2.6%	2.6%	4.1%	2.6%
-4	1.7%	1.2%	0.6%	0.1%	1.6%	1.8%	1.4%	2.6%	1.4%

The current updated analysis includes admissions for ACS from all 147 acute hospital NHS trusts in England from 1 January 2019 to 28 March 2021. 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

Figure 1: Weekly numbers of admissions to acute NHS hospital trusts for acute coronary syndrome between January and July in 2019 and 2020

Figure 2: Weekly numbers of admissions with an acute coronary syndrome, by type

Figure 3: Weekly numbers of admissions with an acute coronary syndrome that received a particular coronary procedure

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

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

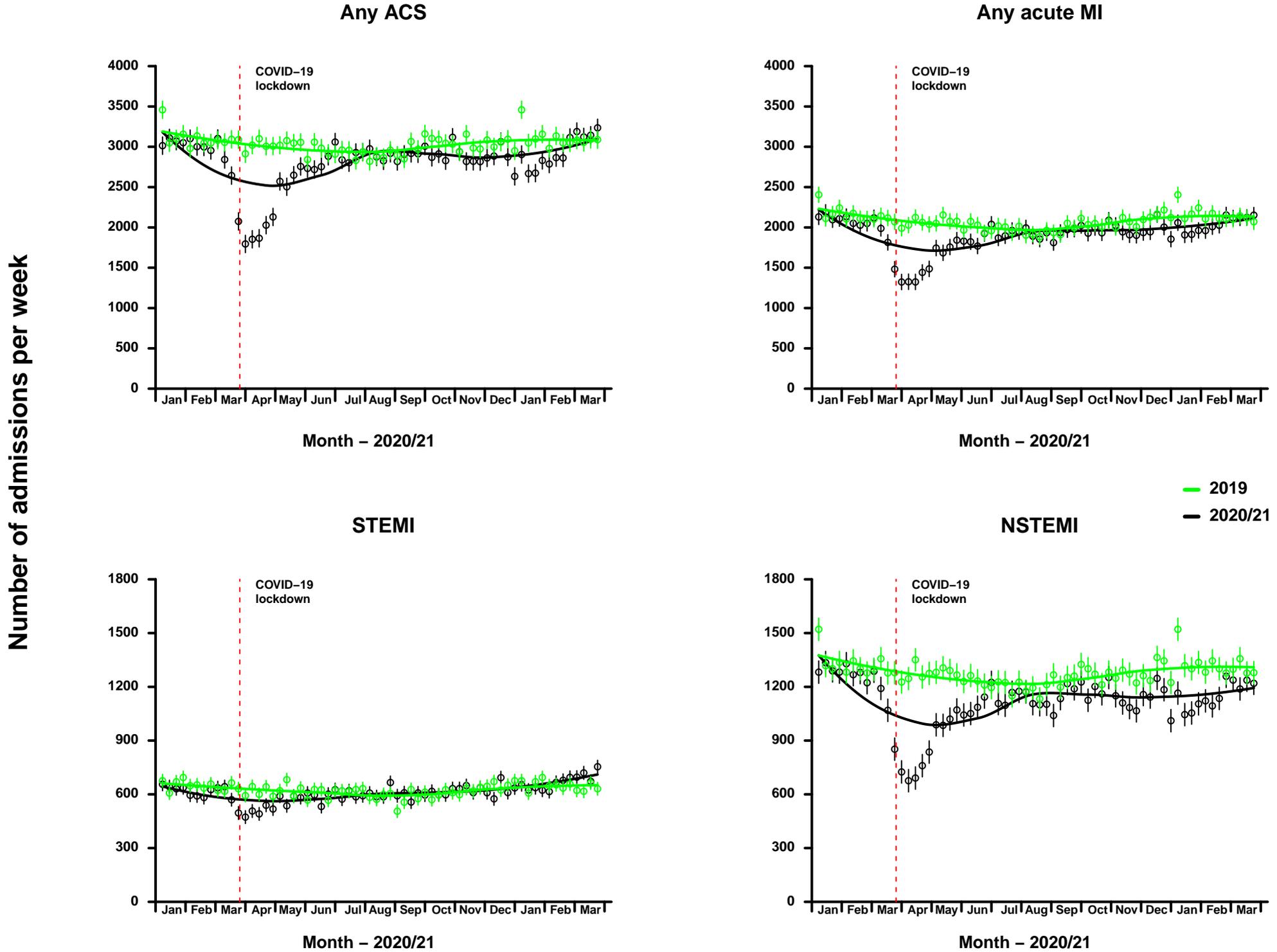
Figure 6: Weekly median and interquartile range of length of stay for admissions to acute NHS hospital trusts with an acute coronary syndrome, by type

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

Figure 8: Weekly number of admissions to acute NHS hospital trusts with an acute coronary syndrome, by region

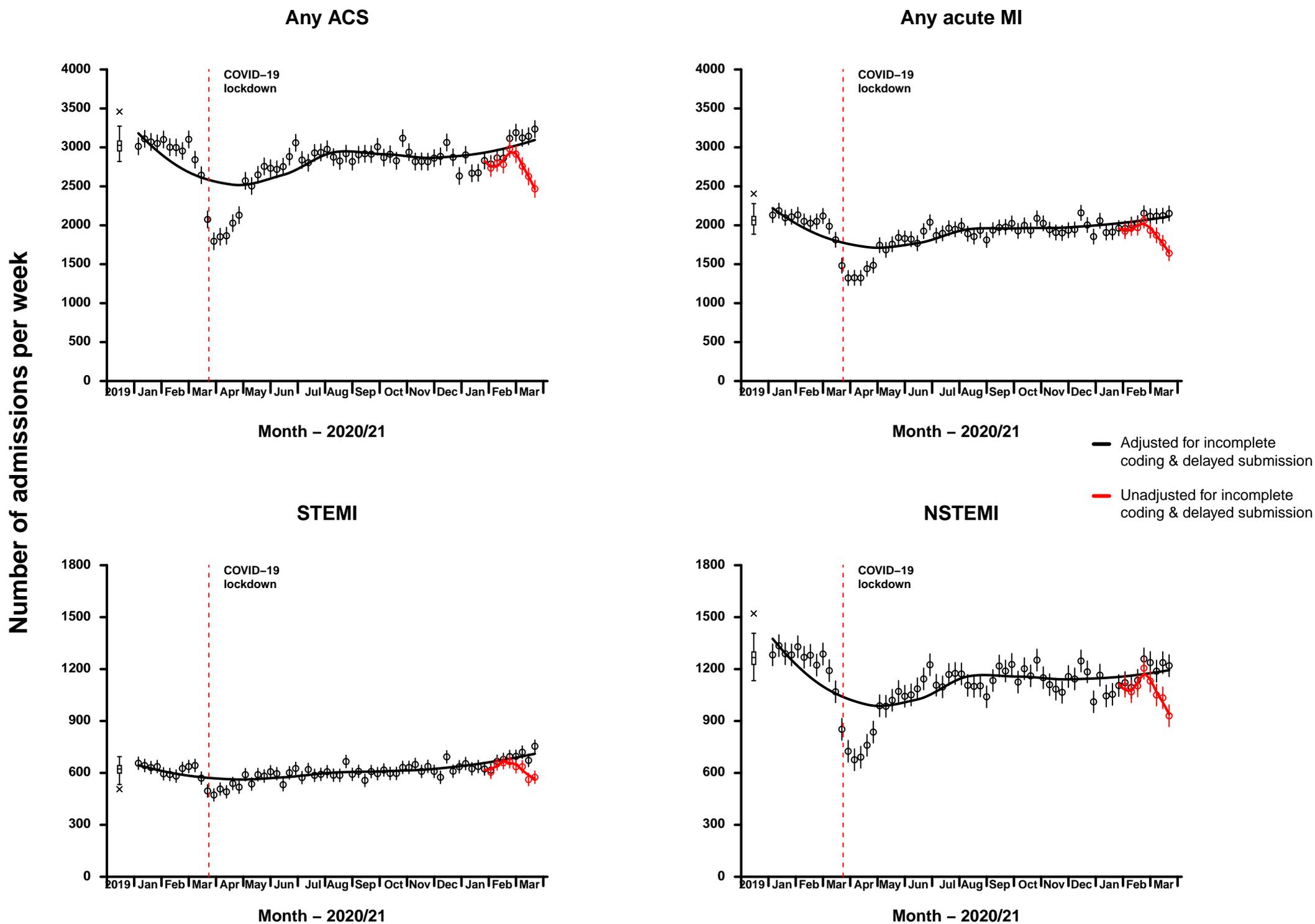
¹ Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, Hollings S, Roebuck C, Gale CP, Mamas MA, Deanfield JE, de Belder MA, Luescher TF, Denwood T, Landray MJ, Emberson JR, Collins R, Morris EJA, Casadei B, Baigent C. COVID-19 pandemic and admission rates for and management of acute coronary syndromes 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



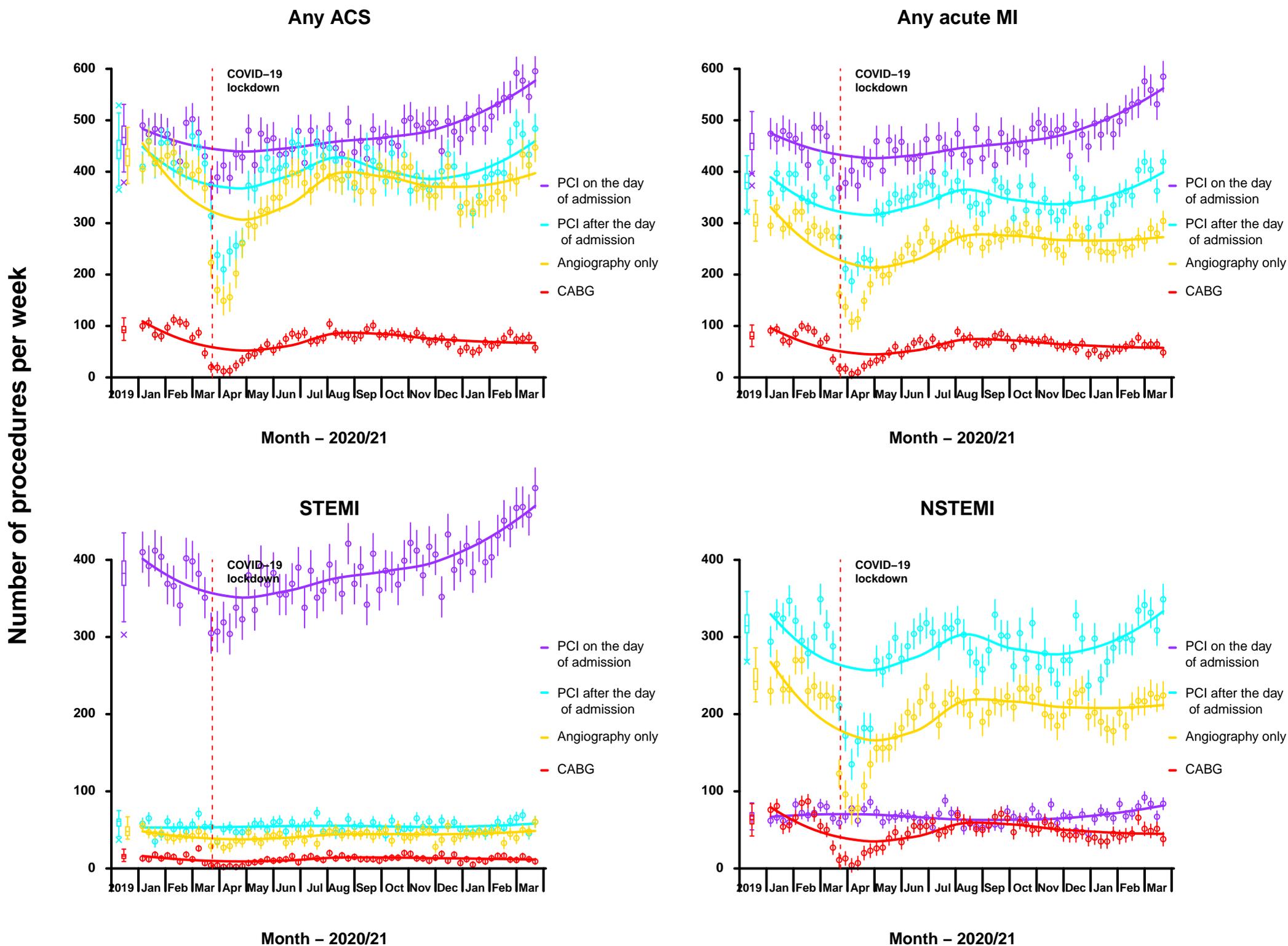
For both 2019 and 2020/21, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation 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



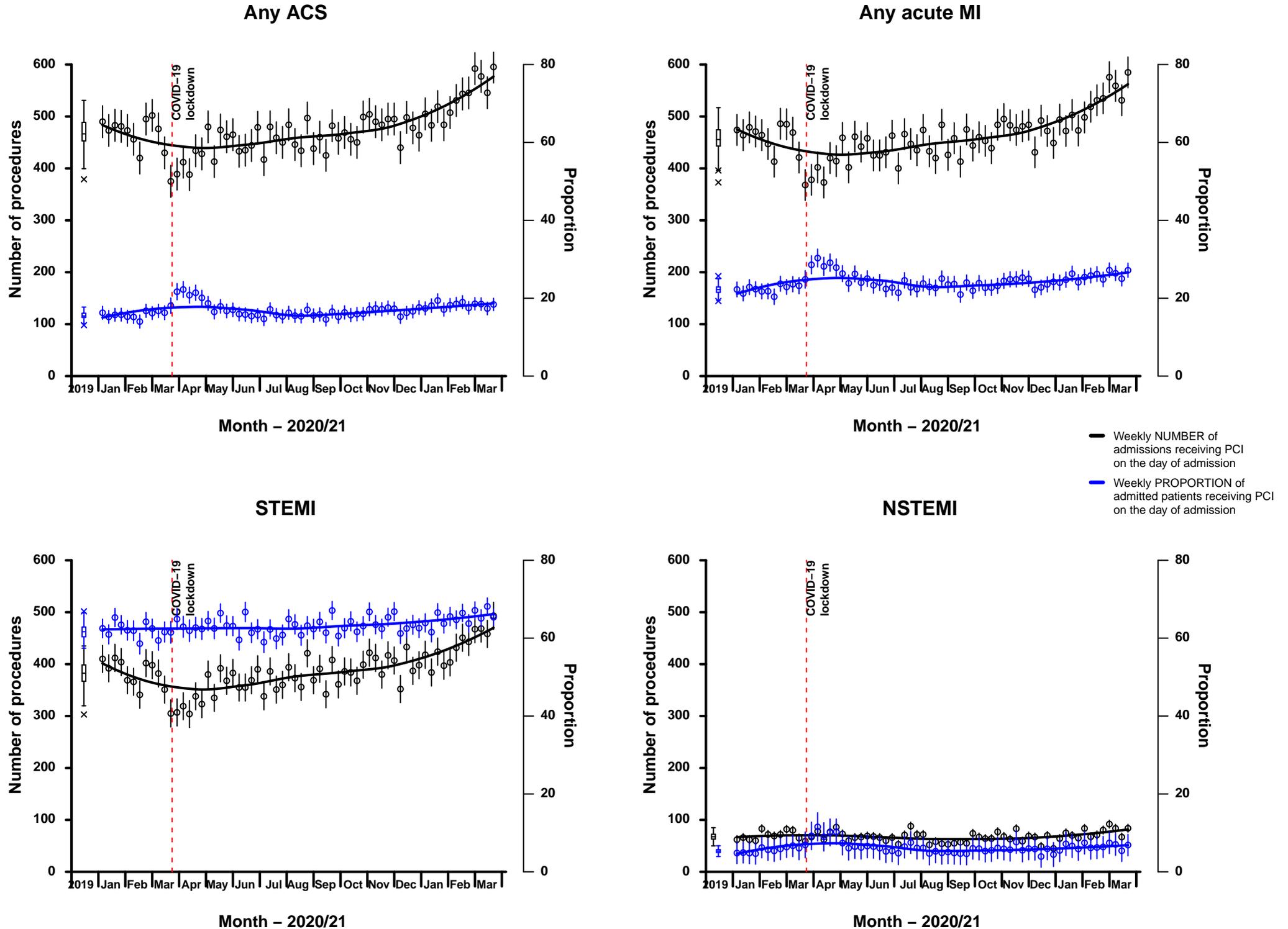
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported 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



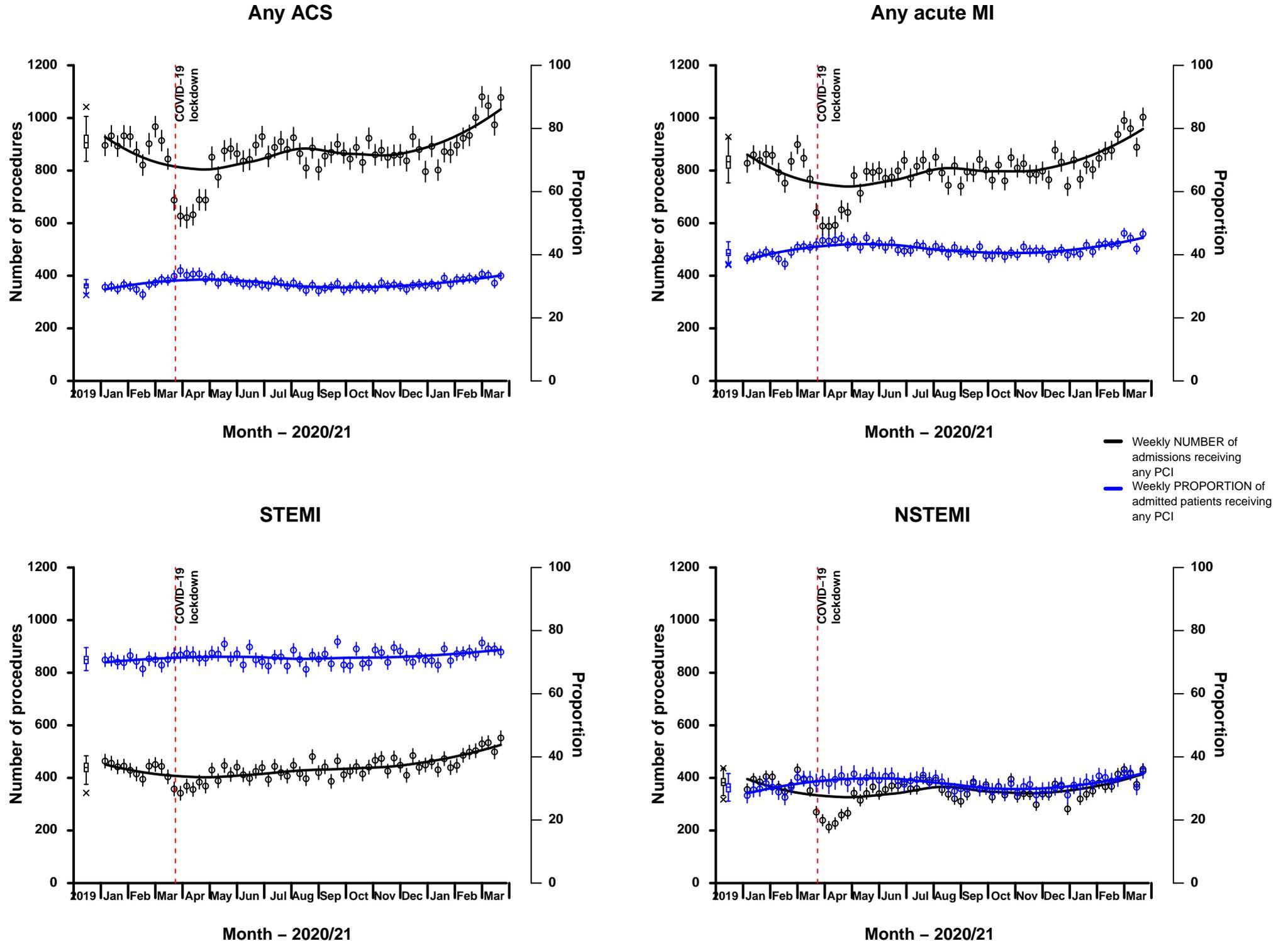
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Figure 4: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received percutaneous coronary intervention on day of admission



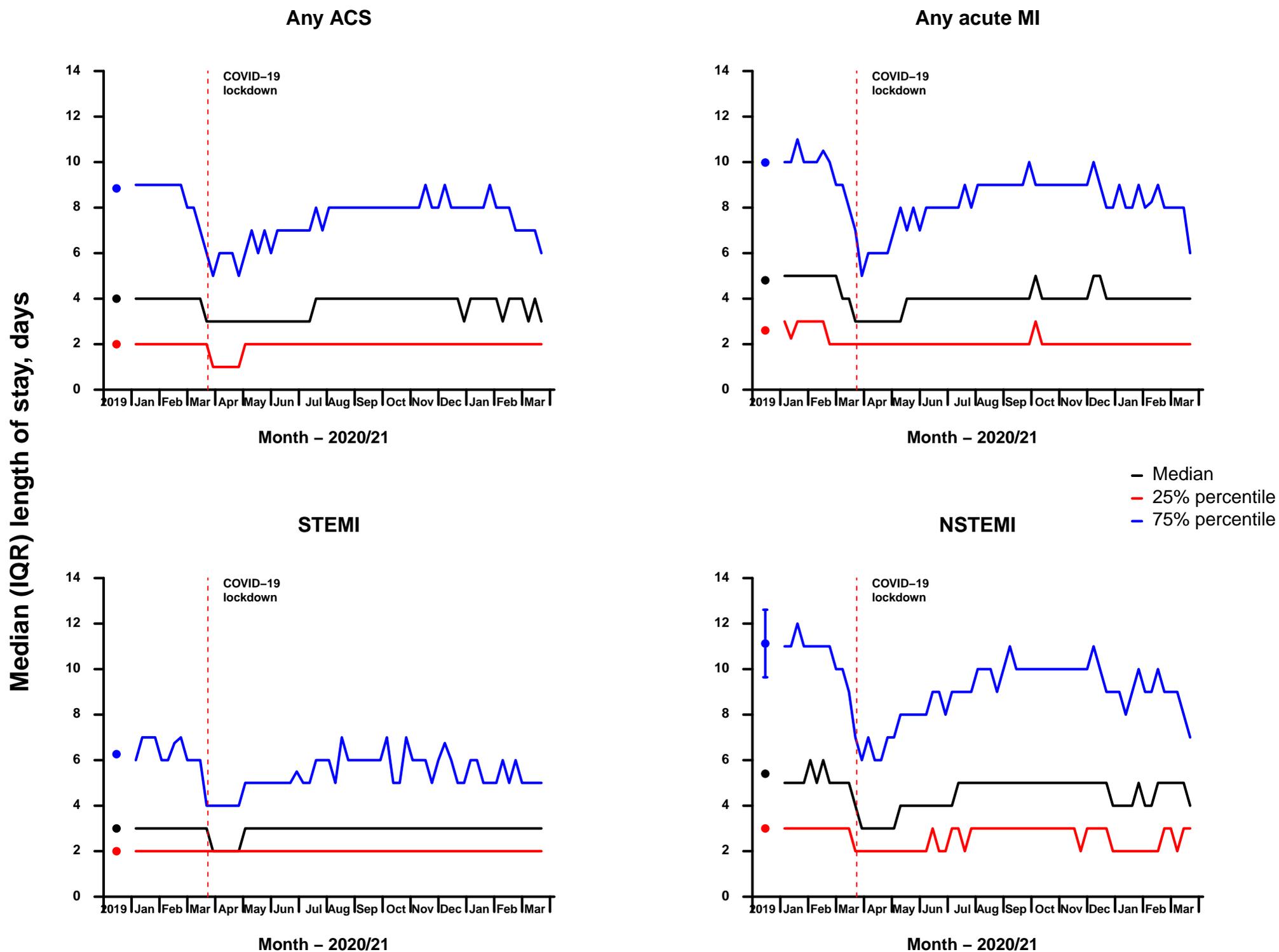
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Figure 5: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received any percutaneous coronary intervention



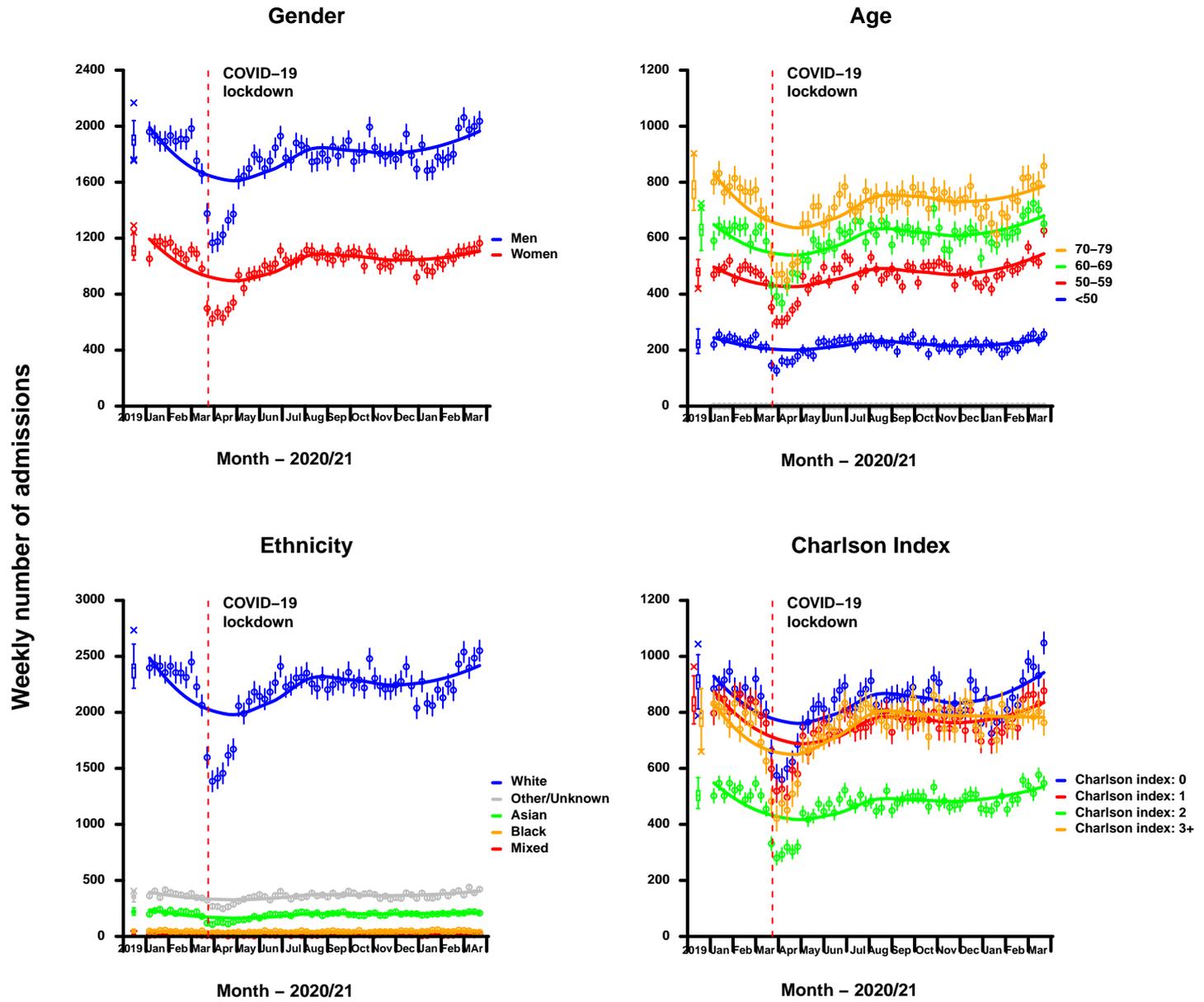
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Figure 6: Weekly median and interquartile range of length of stay for admissions to acute NHS hospital trusts with an acute coronary syndrome, by type



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 2020/21, 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.

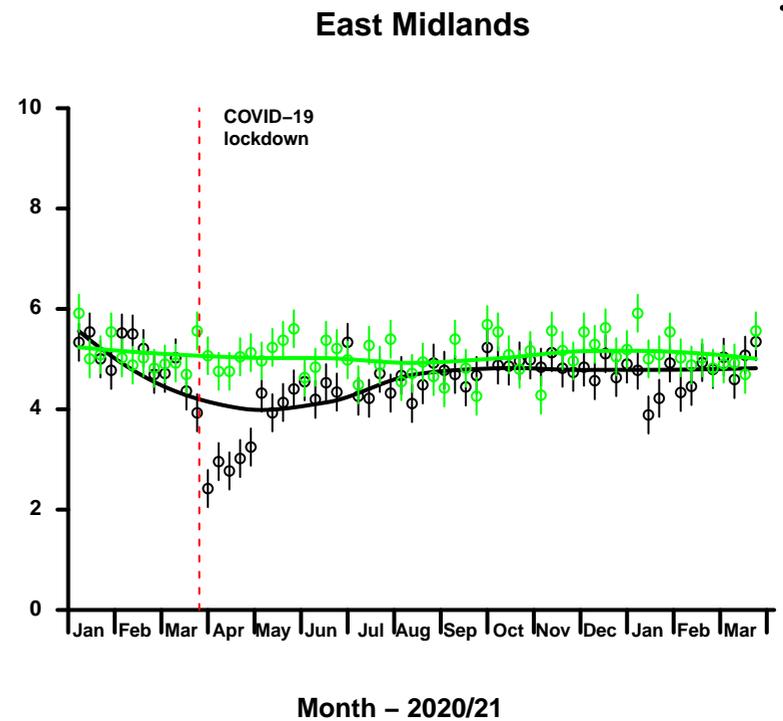
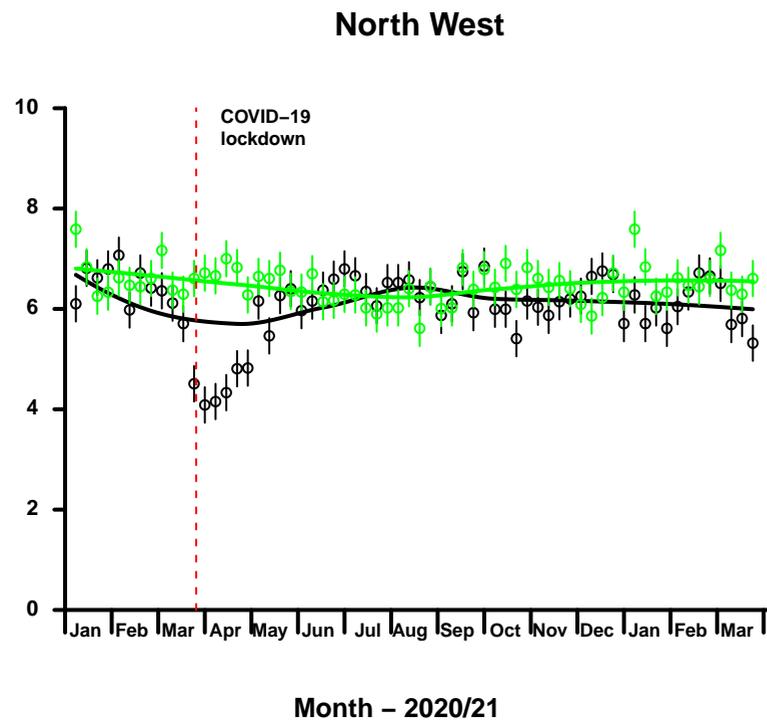
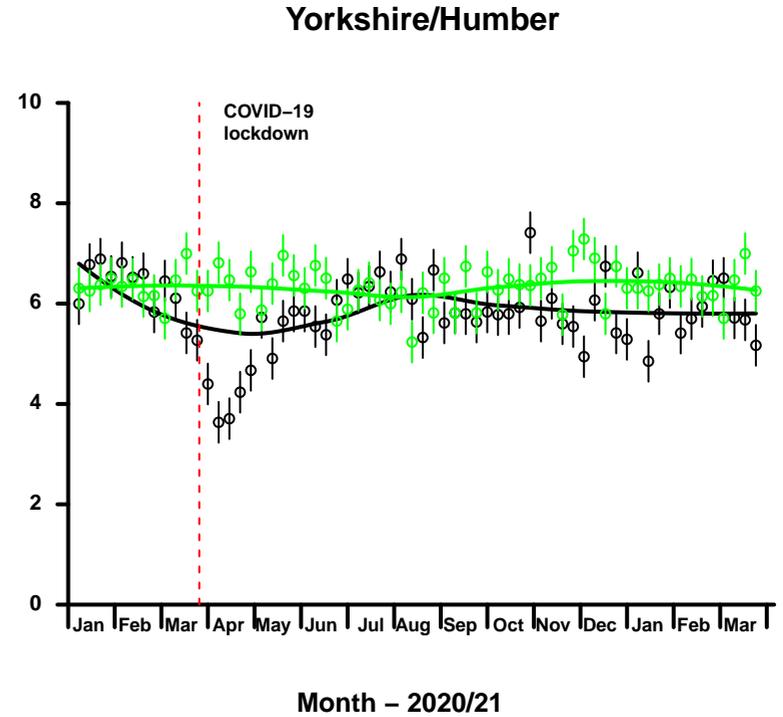
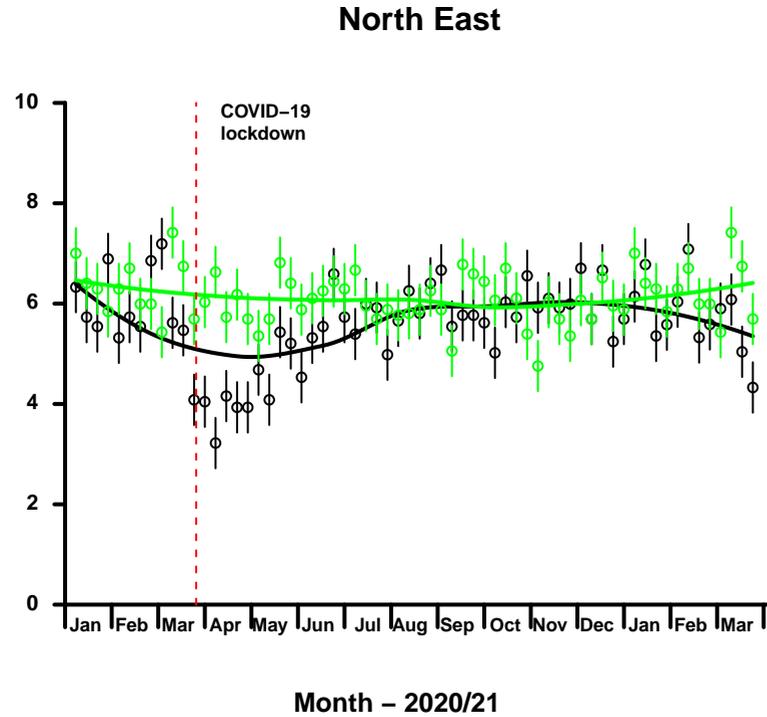
Figure 7: Weekly number of admissions to acute NHS hospital trusts with an acute coronary syndrome, by age, sex, Charlson index and ethnicity



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 2020/21, 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(a): Weekly admissions rates to acute NHS hospital trusts with any acute coronary syndrome, by region

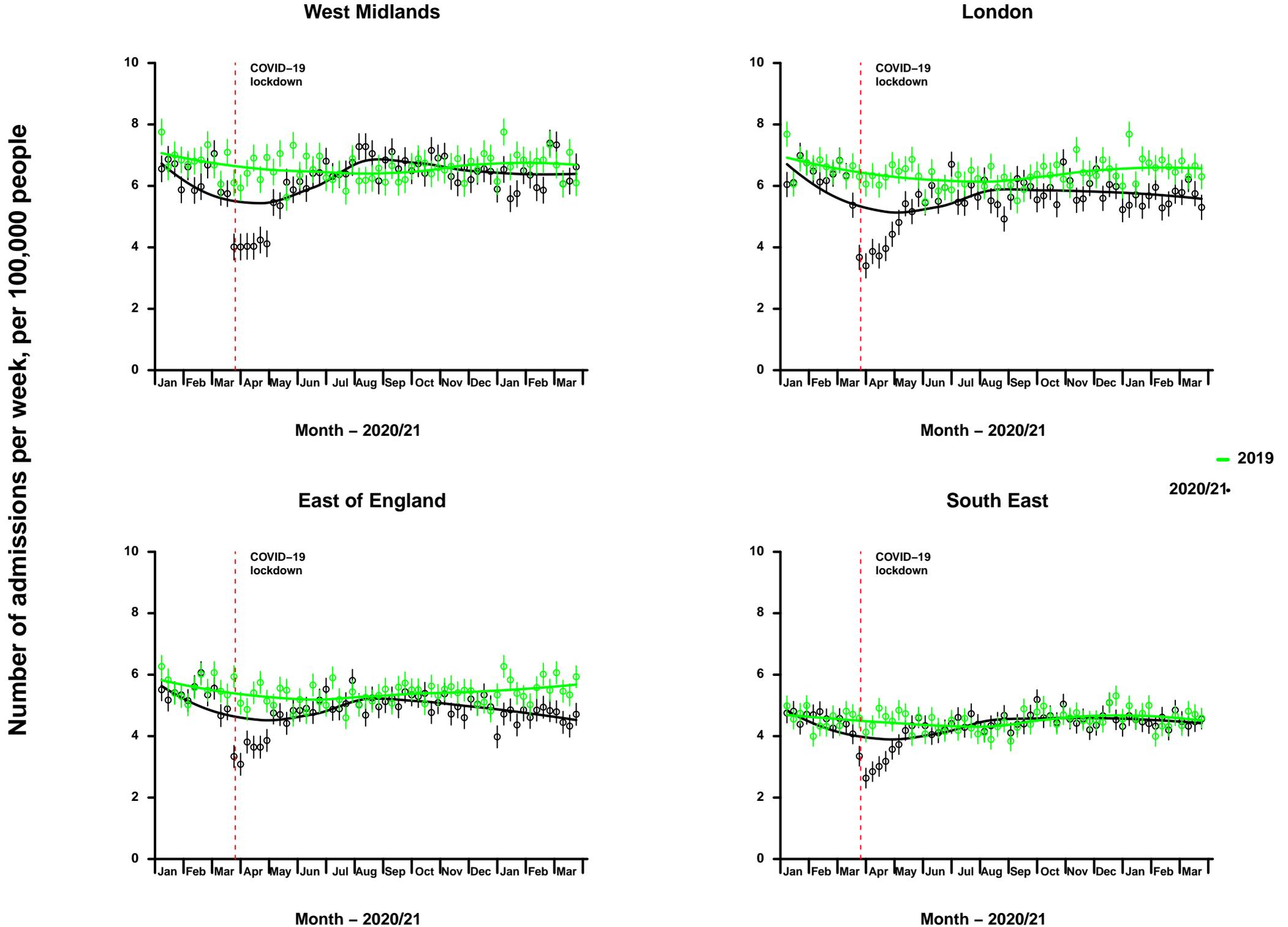
Number of admissions per week, per 100,000 people



— 2019
— 2020/21

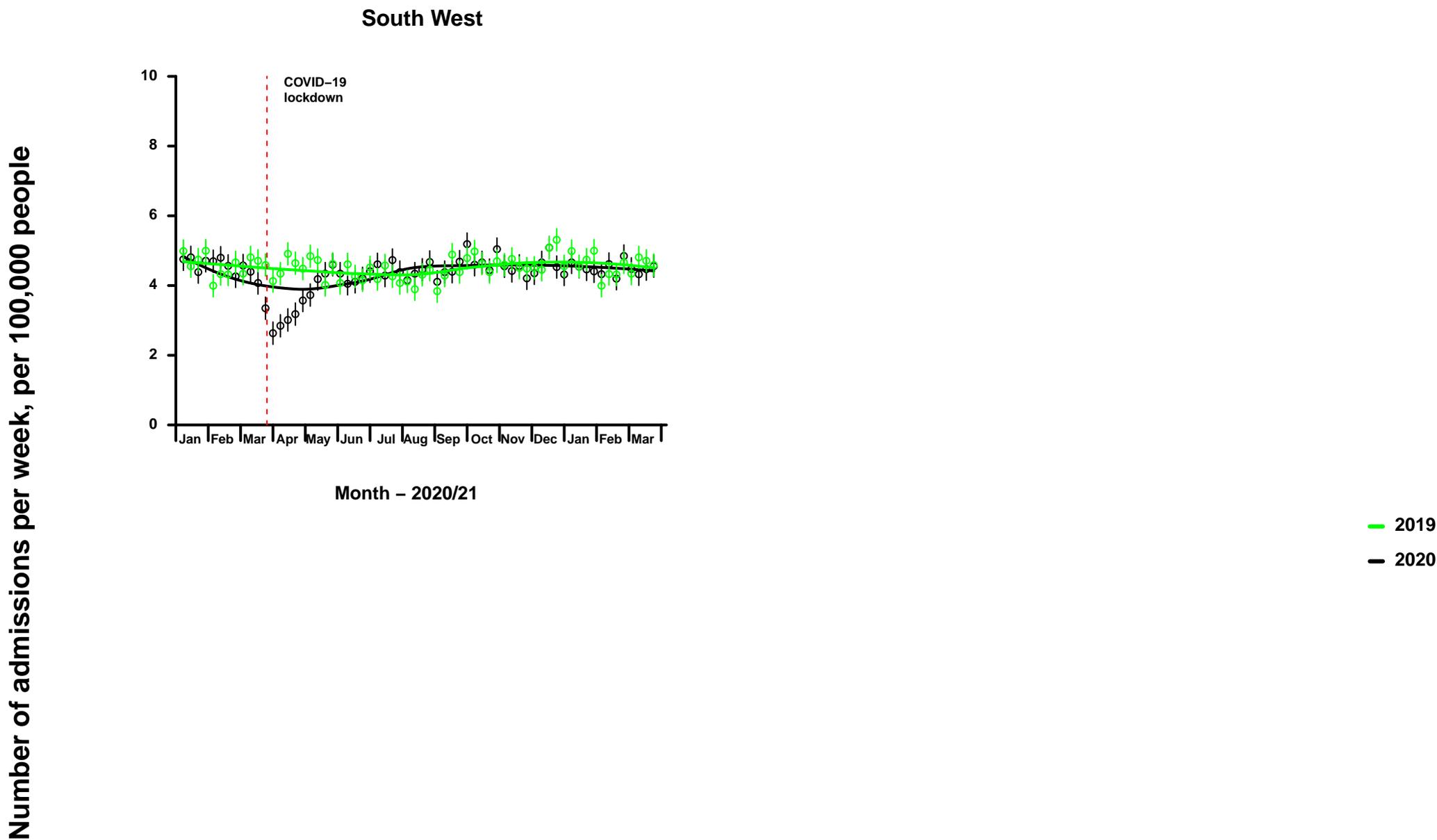
For both 2019 and 2020/21, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation 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



For both 2019 and 2020/21, 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(c): Weekly admissions rates to acute NHS hospital trusts with any acute coronary syndrome, by region



For both 2019 and 2020/21, 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.

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, 2020 and 2021. Weekly admissions in 2020 and 2021 are adjusted for incomplete coding and delayed reporting (see methods above)

WEEK	Any ACS			Any acute MI			STEMI			NSTEMI		
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
1	3,459	3,014	2,904	2,405	2,131	2,058	676	656	654	1,521	1,282	1,165
2	3,048	3,110	2,668	2,111	2,187	1,907	607	643	624	1,318	1,335	1,045
3	3,098	3,070	2,674	2,166	2,096	1,913	670	631	637	1,301	1,289	1,054
4	3,157	3,051	2,831	2,242	2,109	1,963	694	637	623	1,336	1,282	1,105
5	2,980	3,101	2,786	2,105	2,134	1,960	648	595	615	1,282	1,329	1,122
6	3,135	3,002	2,865	2,175	2,051	2,009	653	591	667	1,345	1,268	1,094
7	3,047	2,998	2,861	2,109	2,027	2,027	635	582	678	1,301	1,280	1,135
8	3,047	2,954	3,115	2,105	2,050	2,154	658	626	695	1,277	1,223	1,259
9	3,081	3,103	3,189	2,102	2,119	2,117	622	637	696	1,298	1,287	1,238
10	3,055	2,842	3,122	2,144	1,988	2,118	617	643	720	1,357	1,191	1,188
11	3,093	2,643	3,143	2,117	1,814	2,124	664	570	672	1,277	1,069	1,237
12	3,088	2,075	3,235	2,070	1,482	2,152	631	496	754	1,279	852	1,220
13	2,913	1,795		1,990	1,323		593	473		1,227	725	
14	3,020	1,853		2,029	1,326		644	507		1,246	676	
15	3,100	1,866		2,124	1,324		600	491		1,351	691	
16	3,006	2,028		2,062	1,442		642	539		1,255	760	
17	3,008	2,130		2,038	1,486		589	518		1,275	836	
18	3,019	2,571		2,050	1,744		620	590		1,281	988	
19	3,077	2,504		2,155	1,685		682	536		1,306	985	
20	3,046	2,648		2,075	1,757		589	590		1,291	1,020	
21	3,055	2,756		2,076	1,842		635	582		1,266	1,071	
22	2,841	2,732		1,967	1,830		568	607		1,230	1,043	
23	3,058	2,718		2,075	1,822		627	596		1,263	1,051	
24	2,983	2,753		2,028	1,769		626	532		1,233	1,086	
25	2,920	2,882		1,933	1,925		567	601		1,210	1,143	
26	2,909	3,059		1,959	2,039		622	626		1,196	1,225	
27	2,960	2,838		2,018	1,869		620	573		1,228	1,107	
28	2,956	2,803		2,007	1,896		616	620		1,224	1,097	
29	2,832	2,929		1,934	1,962		627	586		1,150	1,169	
30	2,935	2,935		2,015	1,948		632	592		1,226	1,175	
31	2,819	2,976		1,904	1,994		583	607		1,175	1,172	
32	2,884	2,875		1,917	1,891		572	587		1,194	1,106	
33	2,867	2,826		1,885	1,855		599	586		1,133	1,100	
34	2,957	2,919		1,963	1,934		605	666		1,212	1,103	
35	2,896	2,818		1,935	1,812		506	592		1,267	1,040	
36	2,850	2,906		1,910	1,937		556	609		1,198	1,134	
37	3,065	2,918		2,052	1,972		627	557		1,252	1,218	
38	2,969	2,913		1,996	1,978		576	608		1,260	1,189	
39	3,160	3,008		2,113	2,024		612	596		1,325	1,227	
40	3,103	2,869		2,034	1,928		570	617		1,301	1,125	
41	3,090	2,912		2,049	1,999		597	597		1,271	1,202	
42	3,043	2,828		2,008	1,933		626	597		1,212	1,161	
43	3,033	3,118		2,075	2,089		609	632		1,282	1,252	
44	2,938	2,939		1,999	2,025		598	632		1,248	1,150	
45	3,157	2,818		2,123	1,944		633	649		1,293	1,110	
46	2,985	2,820		2,070	1,908		619	609		1,271	1,084	
47	2,973	2,816		2,009	1,902		639	638		1,222	1,066	
48	3,084	2,862		2,098	1,936		645	609		1,262	1,157	
49	2,998	2,885		2,127	1,945		671	575		1,235	1,143	
50	3,057	3,063		2,166	2,160		624	693		1,364	1,247	
51	3,094	2,873		2,216	2,004		651	610		1,345	1,184	
52	2,950	2,633		2,122	1,855		676	636		1,224	1,011	