

Impact of COVID-19 on hospital admissions for acute coronary syndromes (updated analyses including admissions up to 17 January 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 between October 2020 and January 2021 (Figures 1 and 2). Weekly numbers of admissions with ST-elevation myocardial infarction (STEMI) remained stable during this period. The number of ACS admissions involving a coronary artery bypass graft were below expected during December 2020 and January 2021 (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 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 17 January 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

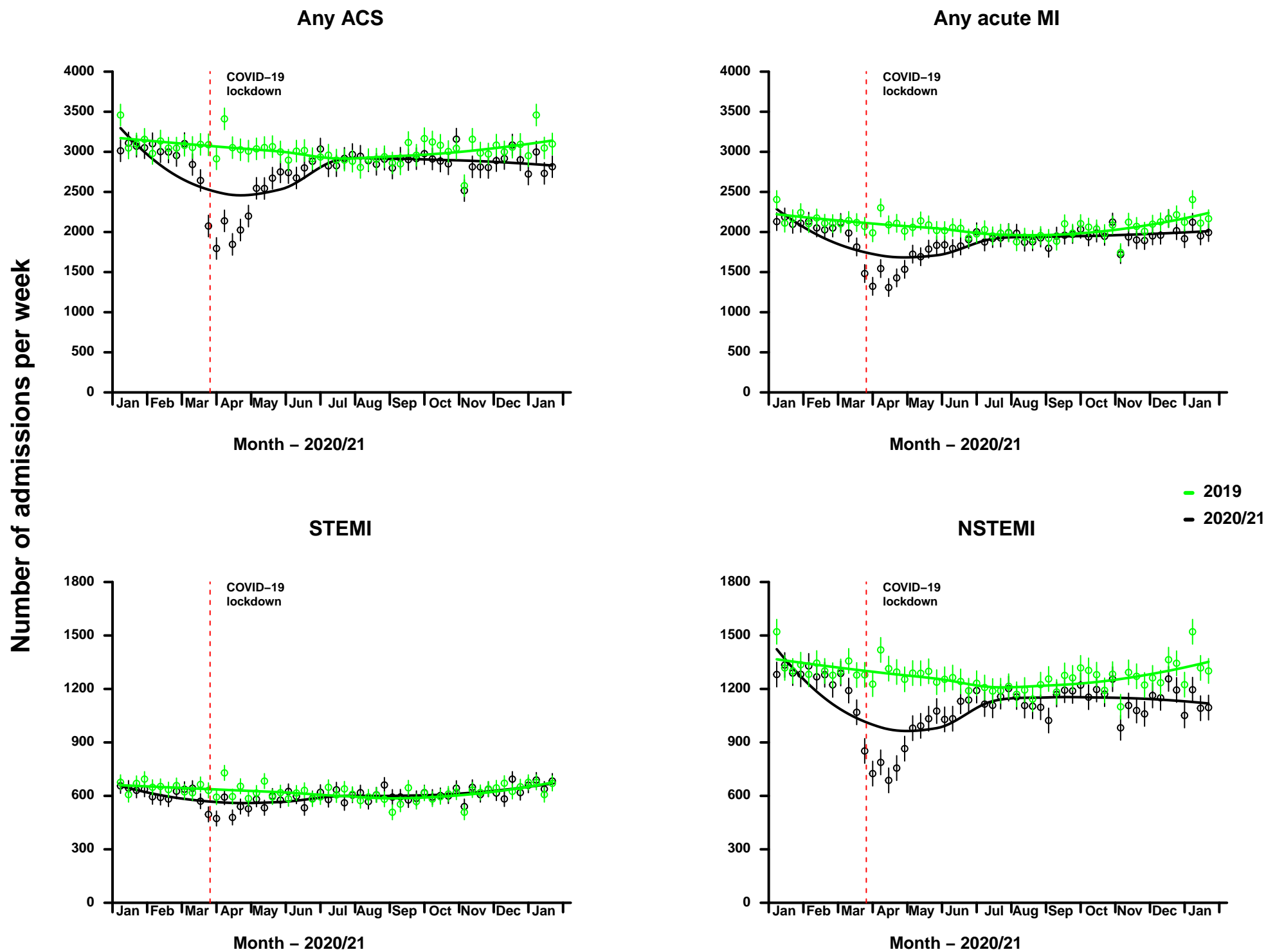
Figure 6: Weekly median and interquartile range of length of stay for admissions to acute NHS hospital trusts with an acute coronary syndrome, by type

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

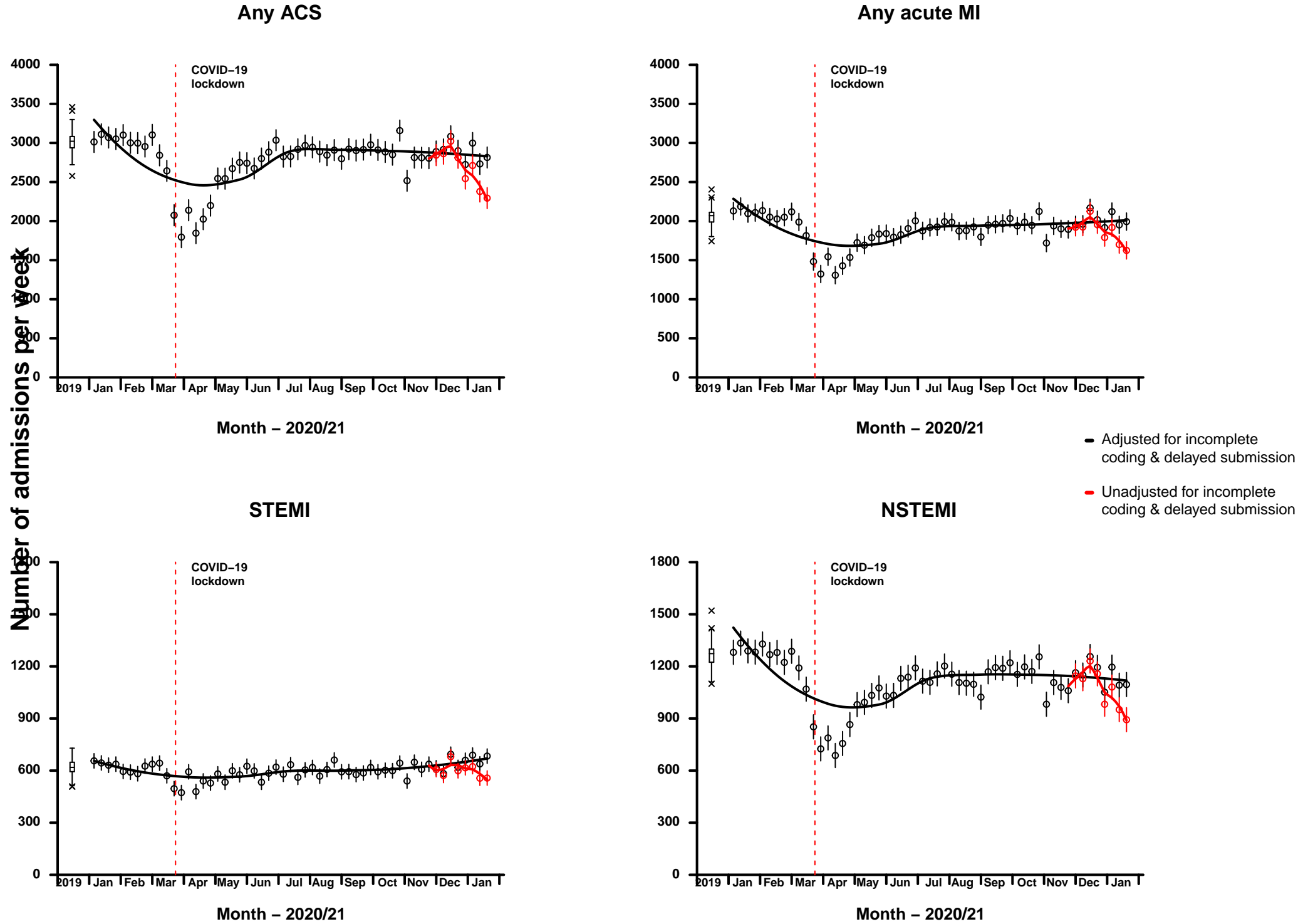
¹ Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, Hollings S, Roebuck C, Gale CP, Mamas MA, Deanfield JE, de Belder MA, Luescher TF, Denwood T, Landray MJ, Emberson JR, Collins R, Morris EJA, Casadei B, Baigent C. COVID-19 pandemic and admission rates for and management of acute coronary syndromes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



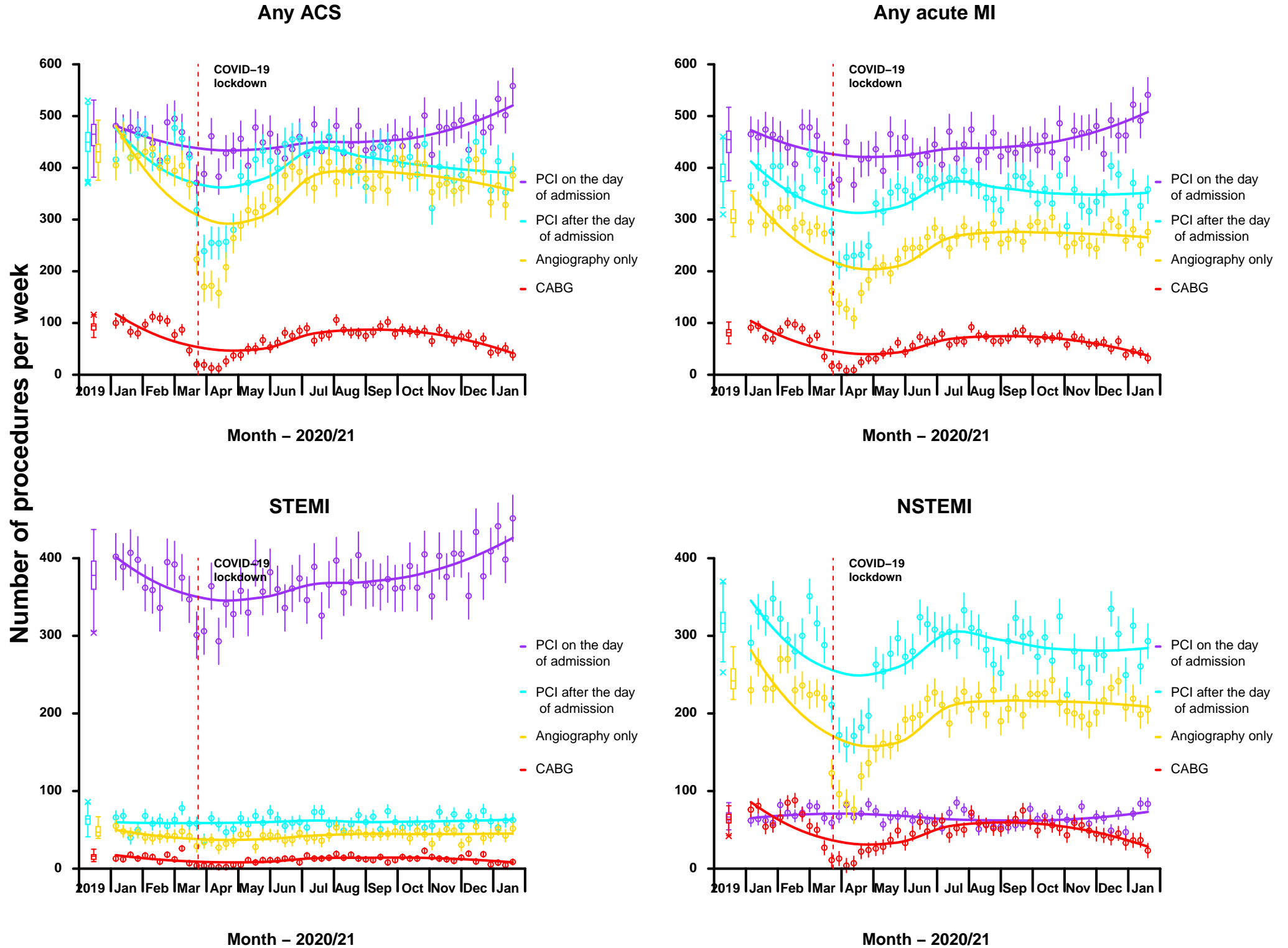
For both 2019 and 2020/21, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation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



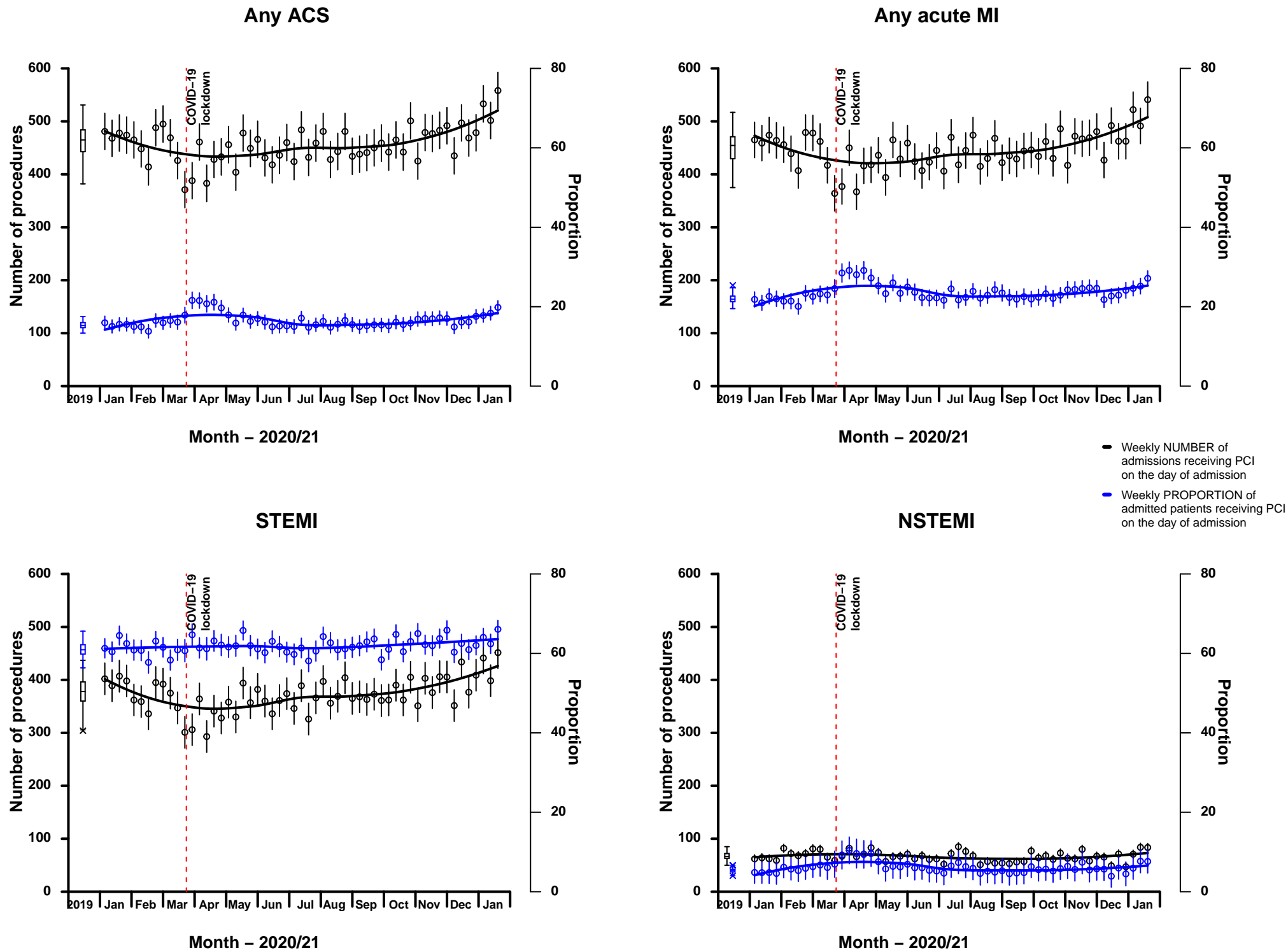
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020, a LOESS smoothing spline is fitted through the weekly reported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



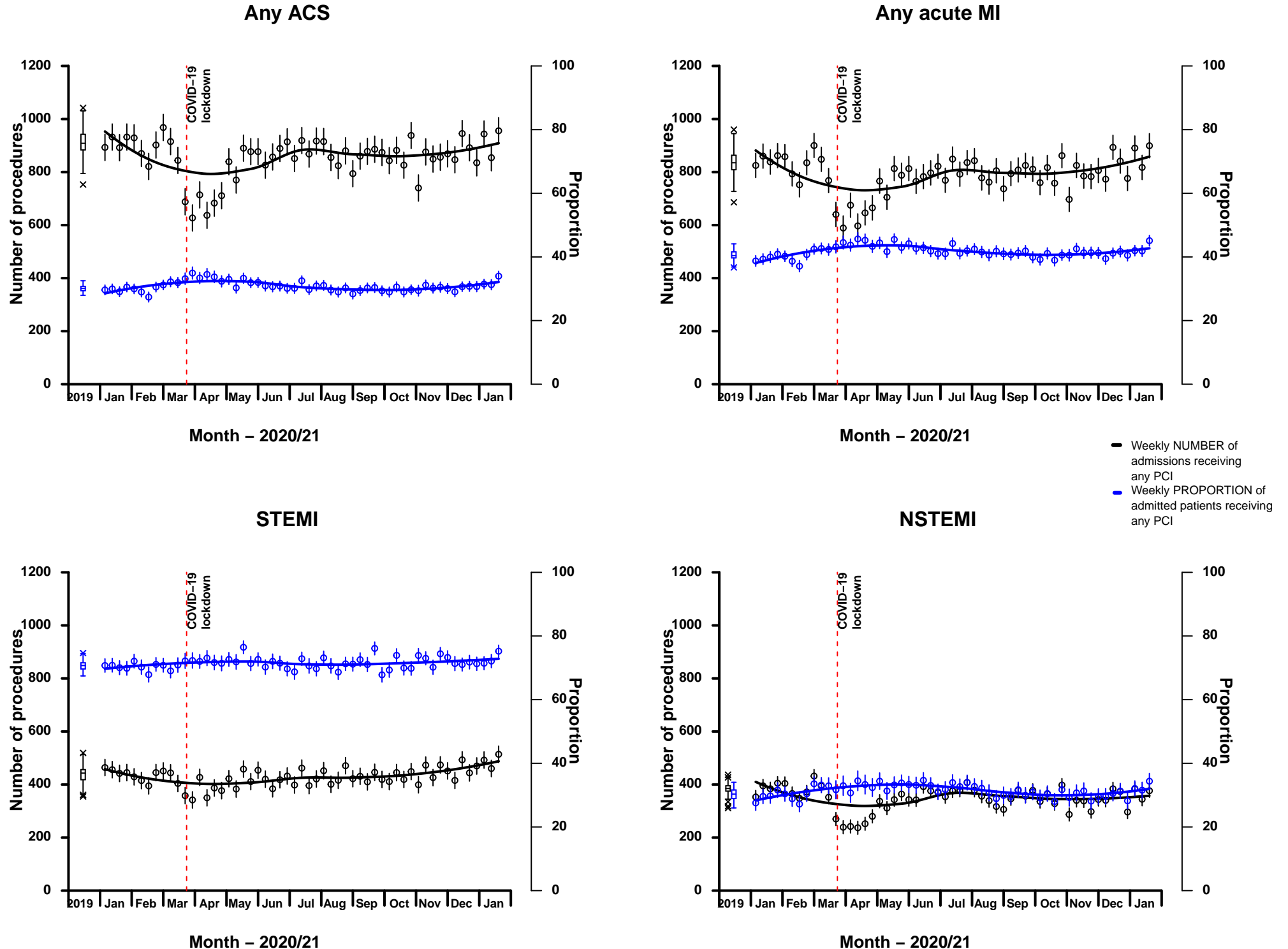
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported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

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



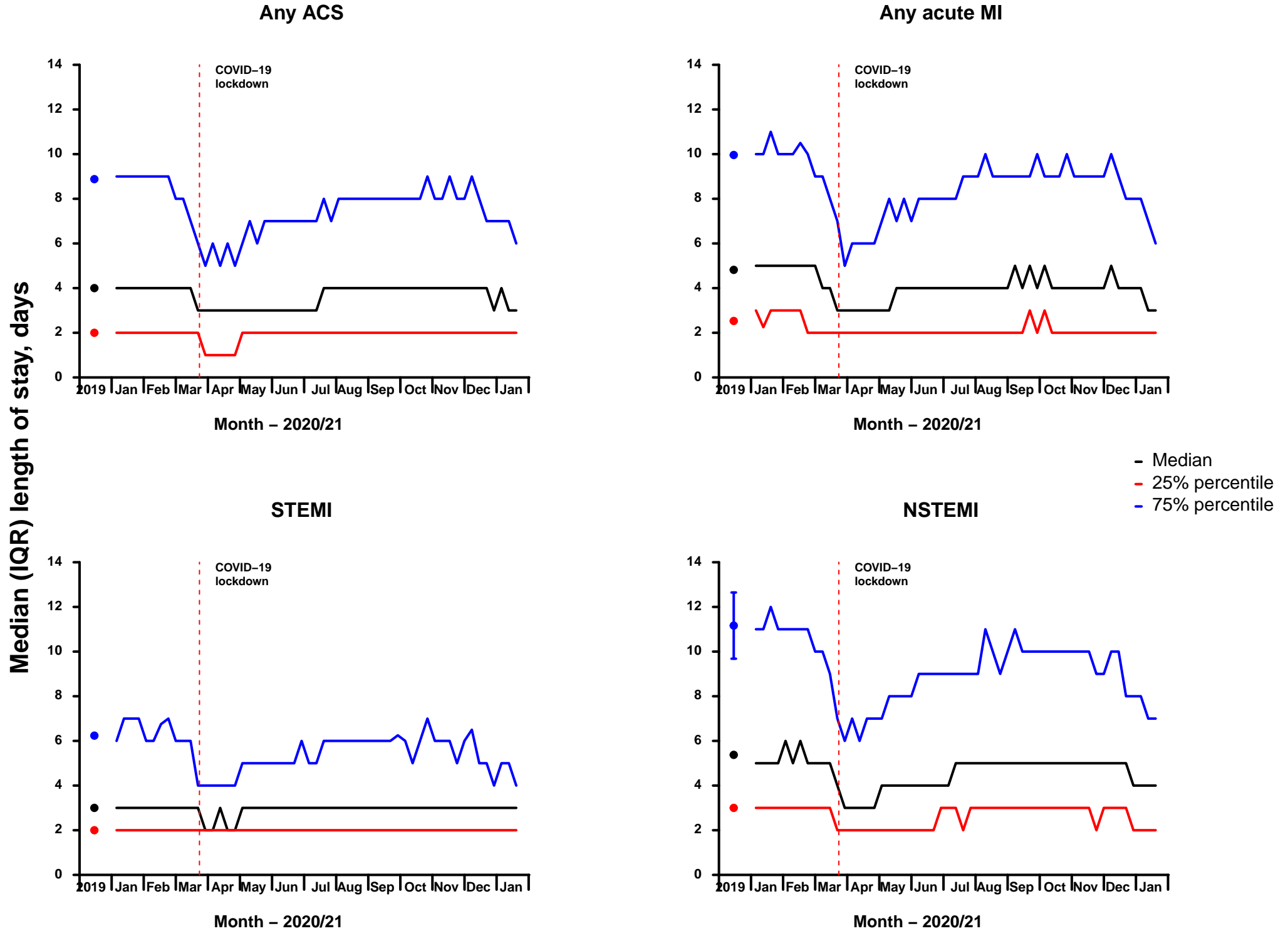
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported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

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



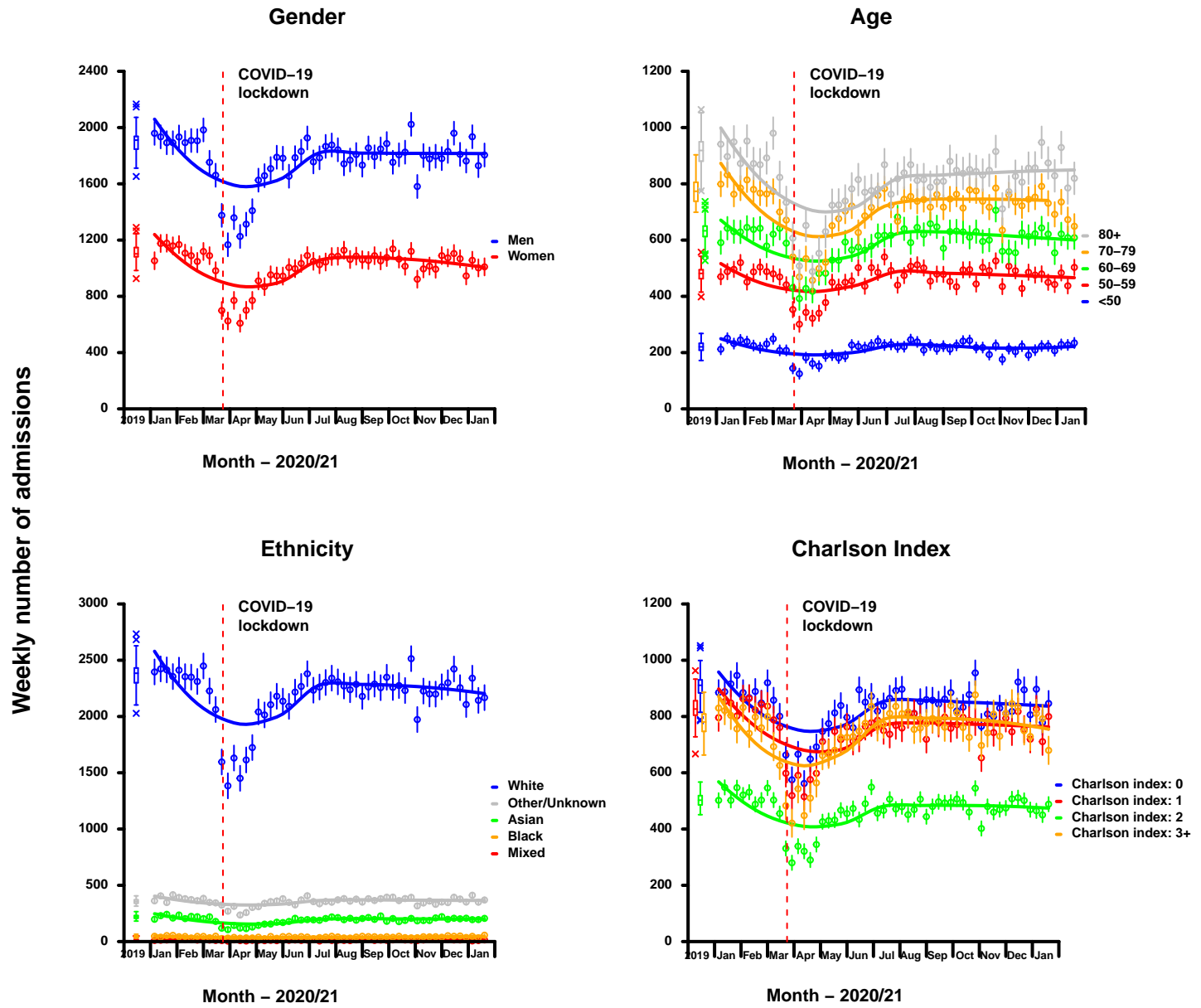
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported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



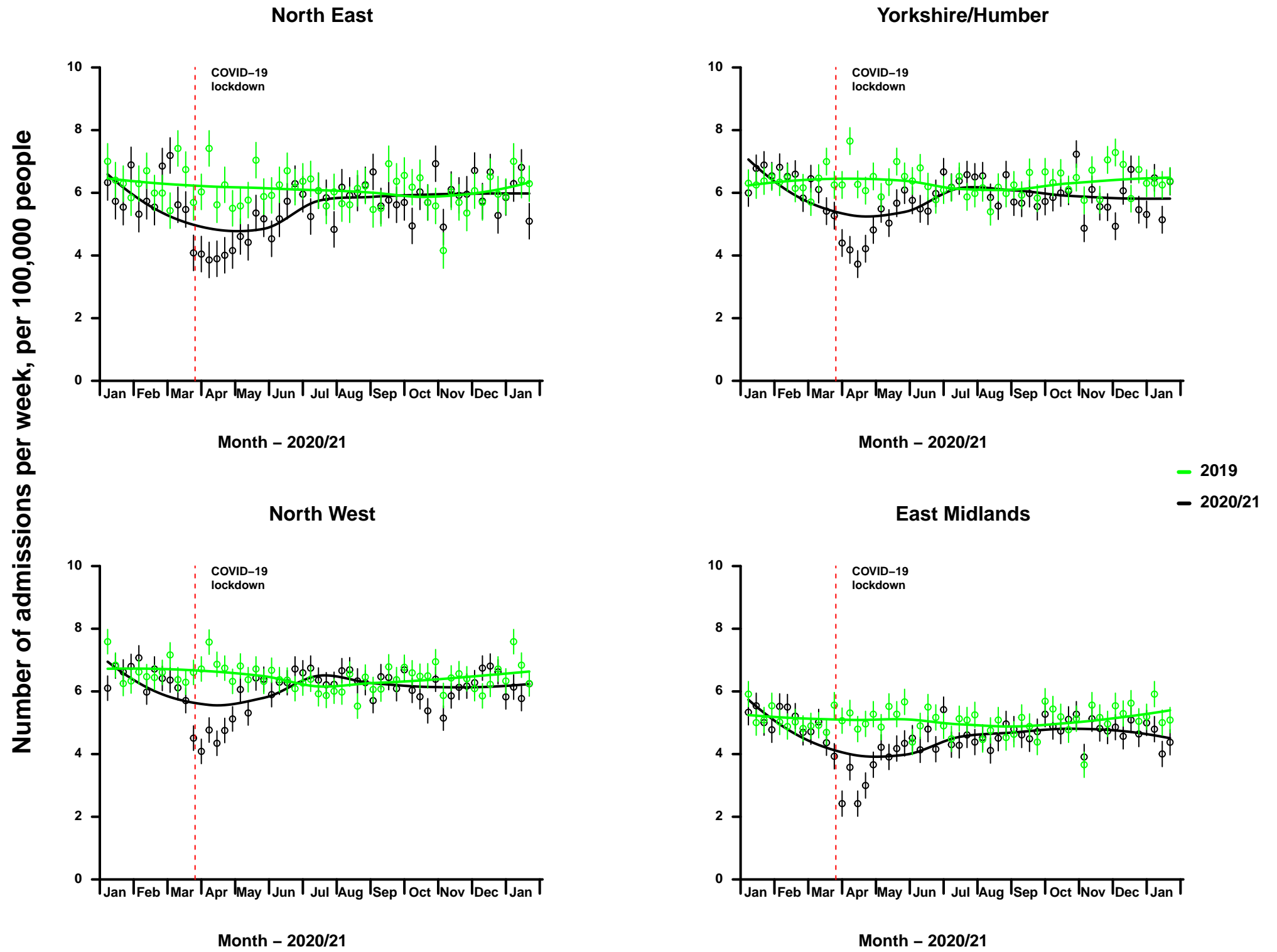
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported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



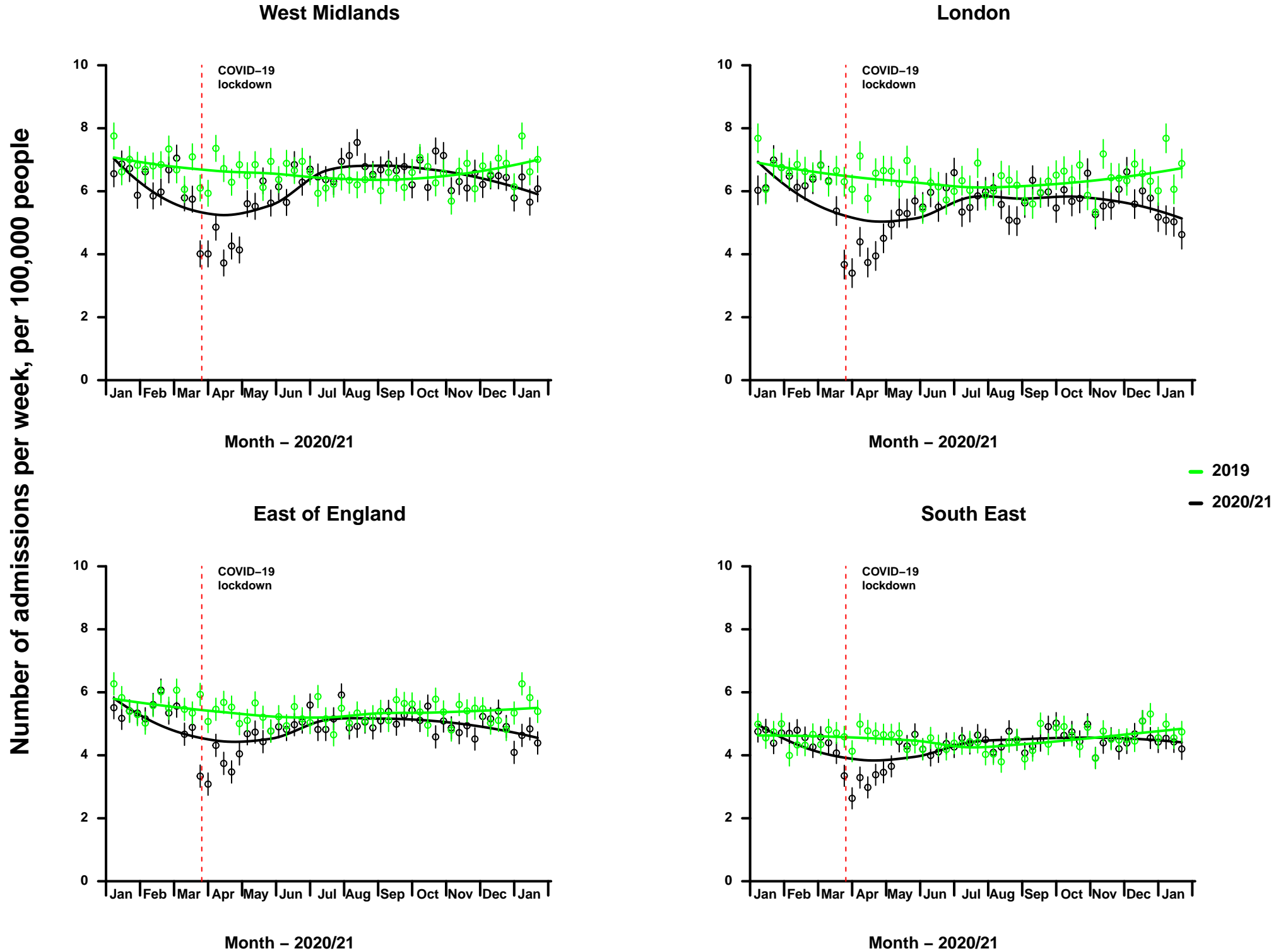
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020/21, a LOESS smoothing spline is fitted through the weekly reported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



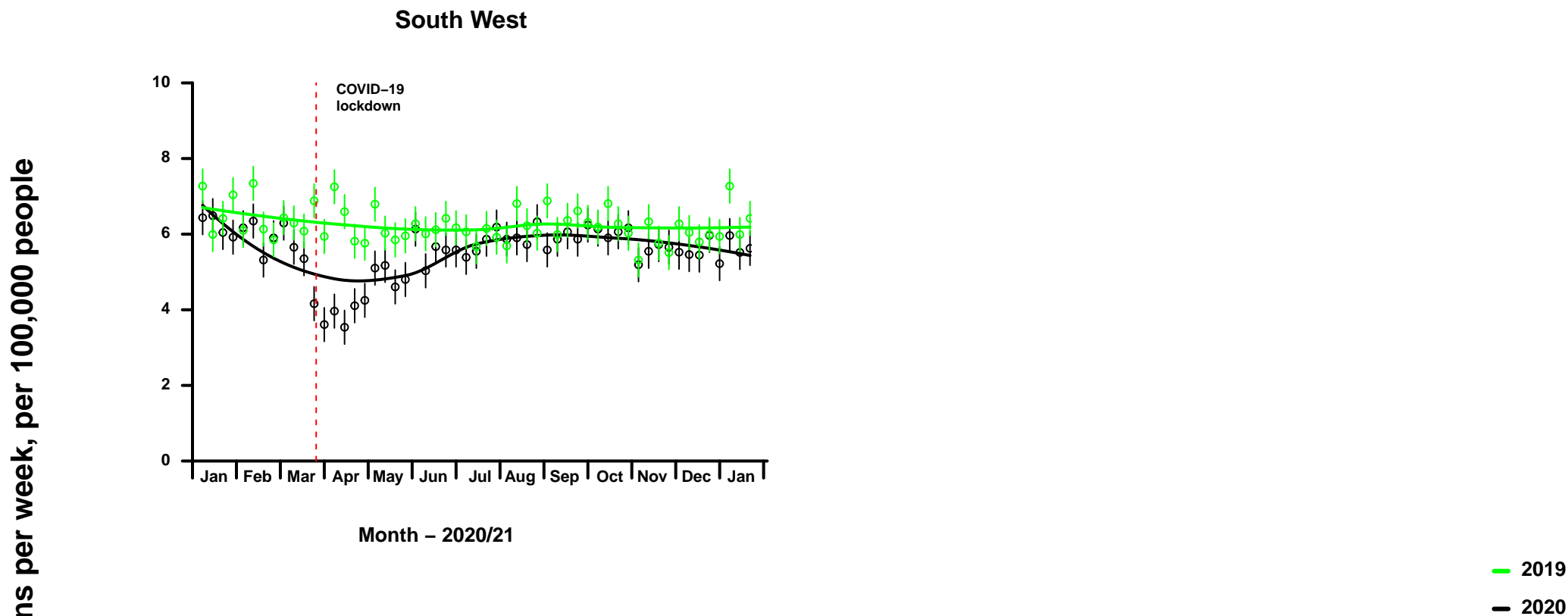
For both 2019 and 2020, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation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



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	3,013	2,967	2,405	2,130	2,018	676	656	655	1,521	1,281	1,147
2	3,048	3,110	2,902	2,111	2,187	1,996	607	644	662	1,318	1,334	1,112
3	3,098	3,070	2,874	2,166	2,096	2,022	670	631	670	1,301	1,289	1,128
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			NTSTEMI		
	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
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	2,835		2,165	2,027		624	630		1,363	1,190	
51	3,093	2,870		2,215	2,048		651	631		1,344	1,200	
52	2,951	2,963		2,122	2,034		676	657		1,224	1,167	