

Impact of COVID-19 on hospital admissions for acute coronary syndromes (updated analyses including admissions up to 15 November 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 1-7**) are published here.

Summary

Weekly ACS admissions had approximately returned to the 2019 expected numbers by August 2020 (Figure 1), but updated analyses now suggest that the numbers of these admissions are once again falling. In particular, non-ST-elevation myocardial infarction (NSTEMI) **fell below expected levels again at the end of October 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 stable during this period. The number of ACS admissions involving a coronary artery bypass graft were also below expected during November 2020 (Figure 3). Although uncertainties around the completeness of the most recent data mean that these results should be viewed as preliminary, the findings reported here suggest that patients with ACS are again failing to receive the urgent care they need.

Updated analyses will be continue to be published at <https://www.ctsu.ox.ac.uk/research/covid-19-acute-coronary-syndromes> as they become available during 2021.

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 July, August, September, October and November data extracts, 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 six times (ie, July vs June to December vs November), and taking the average of the six 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)	July vs. June	August vs. July	September vs. August	October vs. September	November vs. October	December vs. November	Average % of four estimates
-1	9.2%	7.3%	6.4%	4.2%	5.7%	4.9%	6.3%
-2	4.9%	2.7%	3.2%	1.1%	6.4%	3.2%	3.6%
-3	2.8%	1.3%	2.3%	1.3%	3.8%	2.6%	2.4%
-4	1.7%	1.2%	0.6%	0.1%	1.6%	1.8%	1.2%

The current updated analysis includes admissions for ACS from all 147 acute hospital NHS trusts in England from 1 January 2019 to 15 November 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 with the assumption that weekly rates follow an over-dispersed Poisson distribution (with dispersion parameter estimated from the [pre-covid] 2019 weekly counts).

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

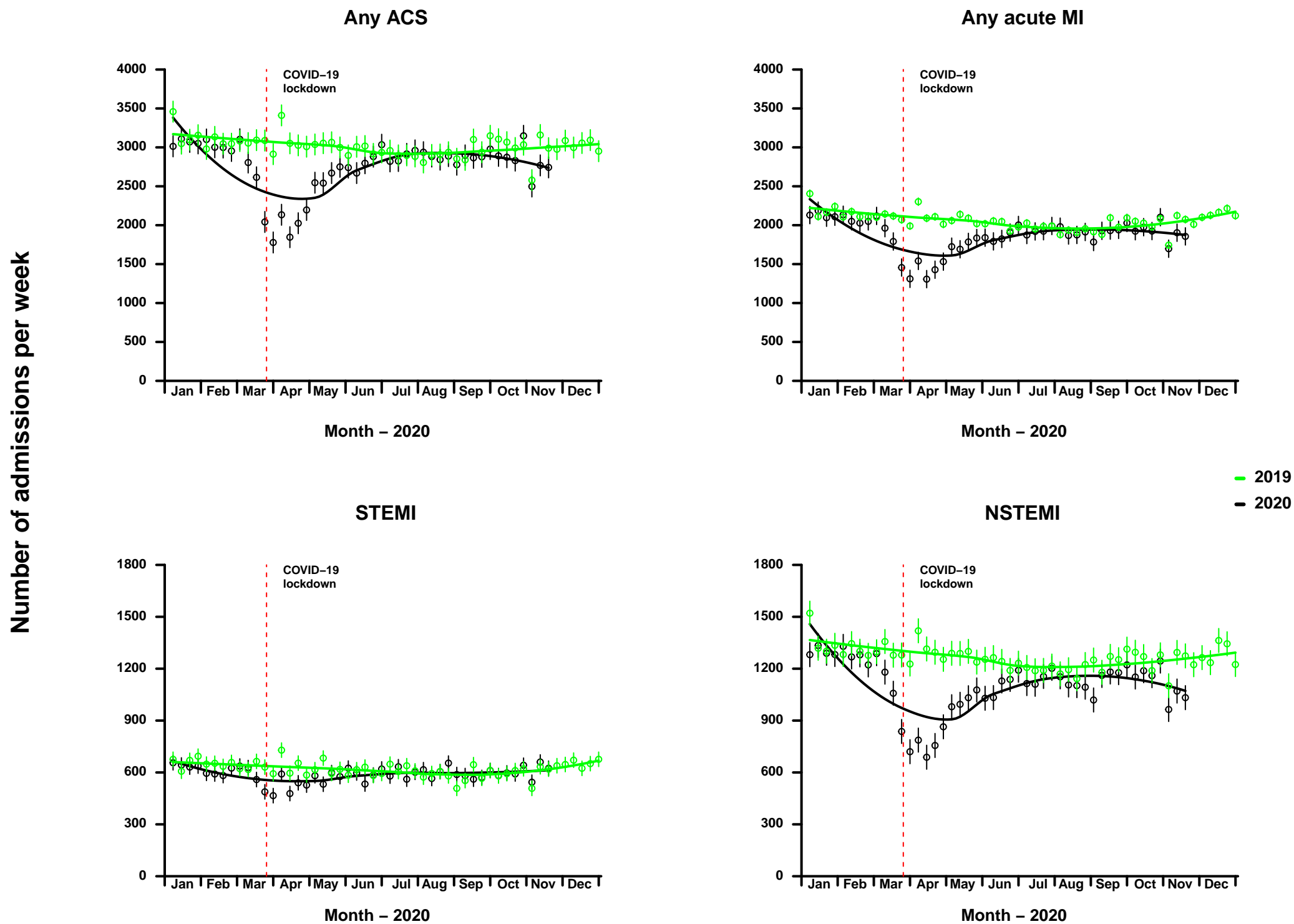
Figure 5: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received any percutaneous coronary intervention

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, ethnicity and region

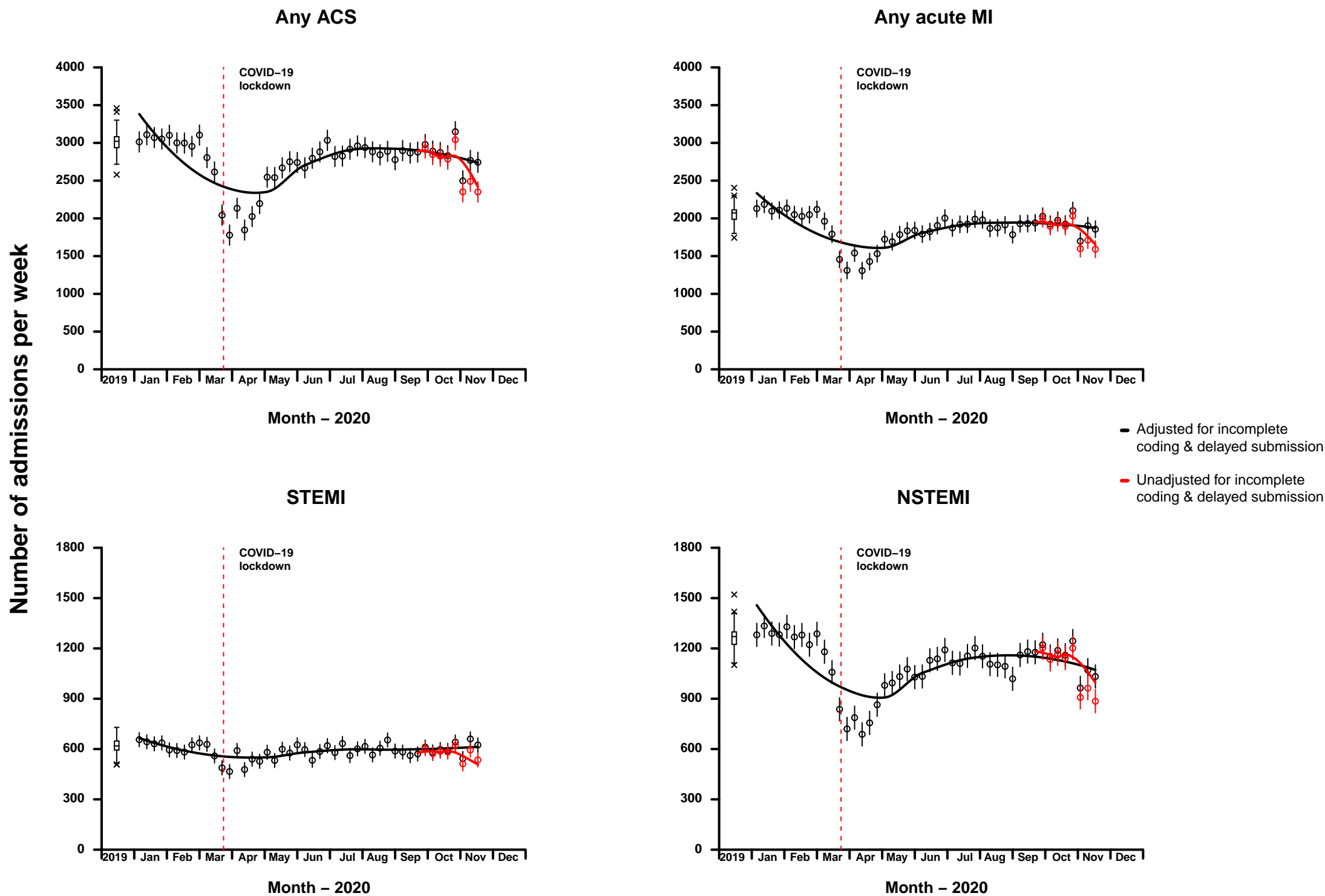
¹ Mafham MM, Spata E, Goldacre R, Gair D, Curnow P, Bray M, Hollings S, Roebuck C, Gale CP, Mamas MA, Deanfield JE, de Belder MA, Luescher TF, Denwood T, Landray MJ, Emberson JR, Collins R, Morris EJA, Casadei B, Baigent C. COVID-19 pandemic and admission rates for and management of acute coronary syndromes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



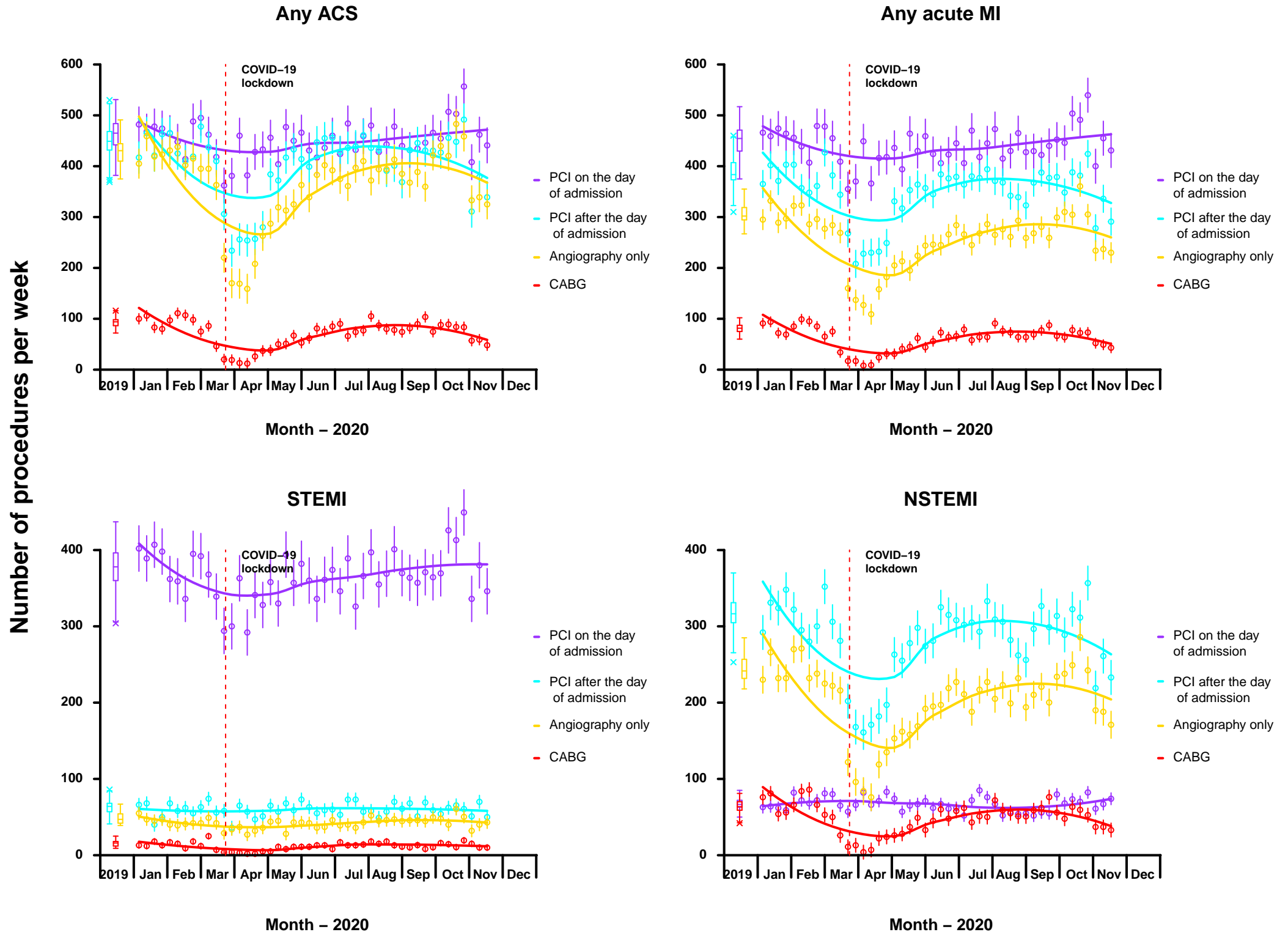
For both 2019 and 2020, a LOESS smoothing spline is fitted through the weekly reported counts, with datapoints and SEs plotted. The date of the UK COVID-19 lockdown (March 23, 2020) is shown with a vertical dotted line. ACS=acute coronary syndrome. STEMI=ST-elevation myocardial infarction. NSTEMI=non-ST-elevation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



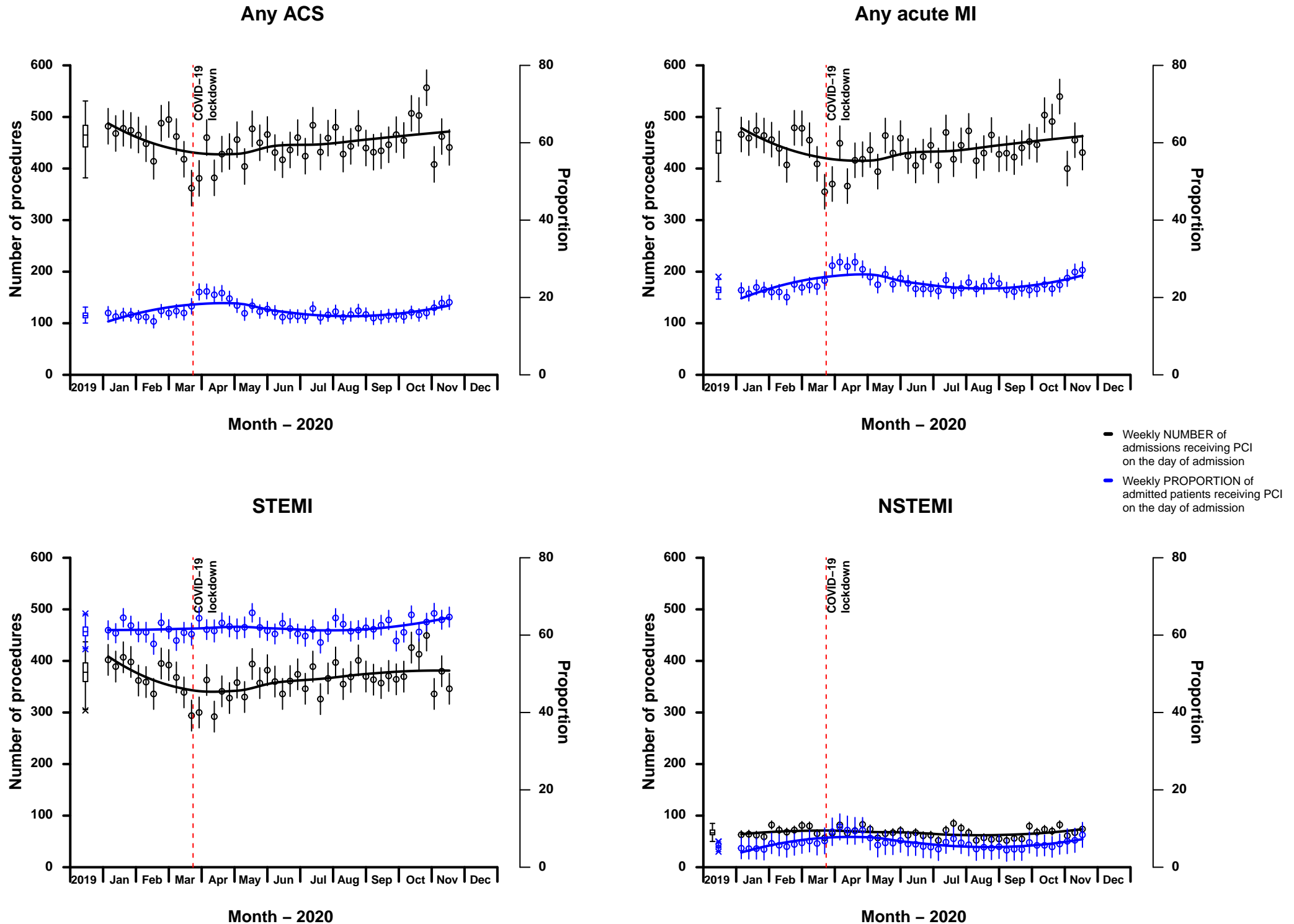
For weekly admissions in 2019, boxplots shows the median and IQR, with whiskers extending (up to) 1.5 times the IQR above the upper quartile and below the lower quartile, with any weekly counts beyond those ranges indicated by x. For 2020, a LOESS smoothing spline is fitted through the weekly reported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

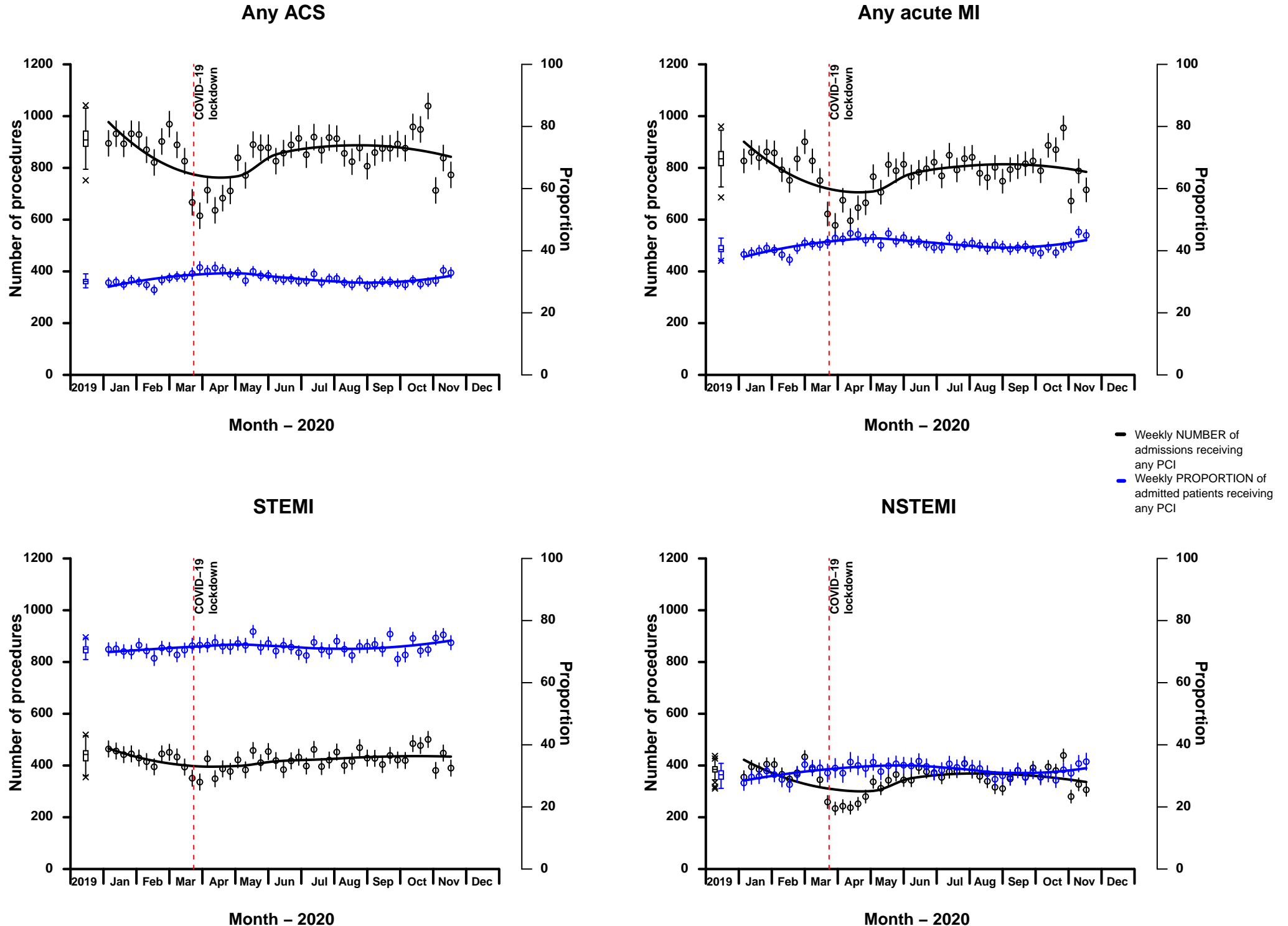
Figure 4: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received percutaneous coronary intervention on day of admission



● Weekly NUMBER of admissions receiving PCI on the day of admission
 ● Weekly PROPORTION of admitted patients receiving PCI on the day of admission

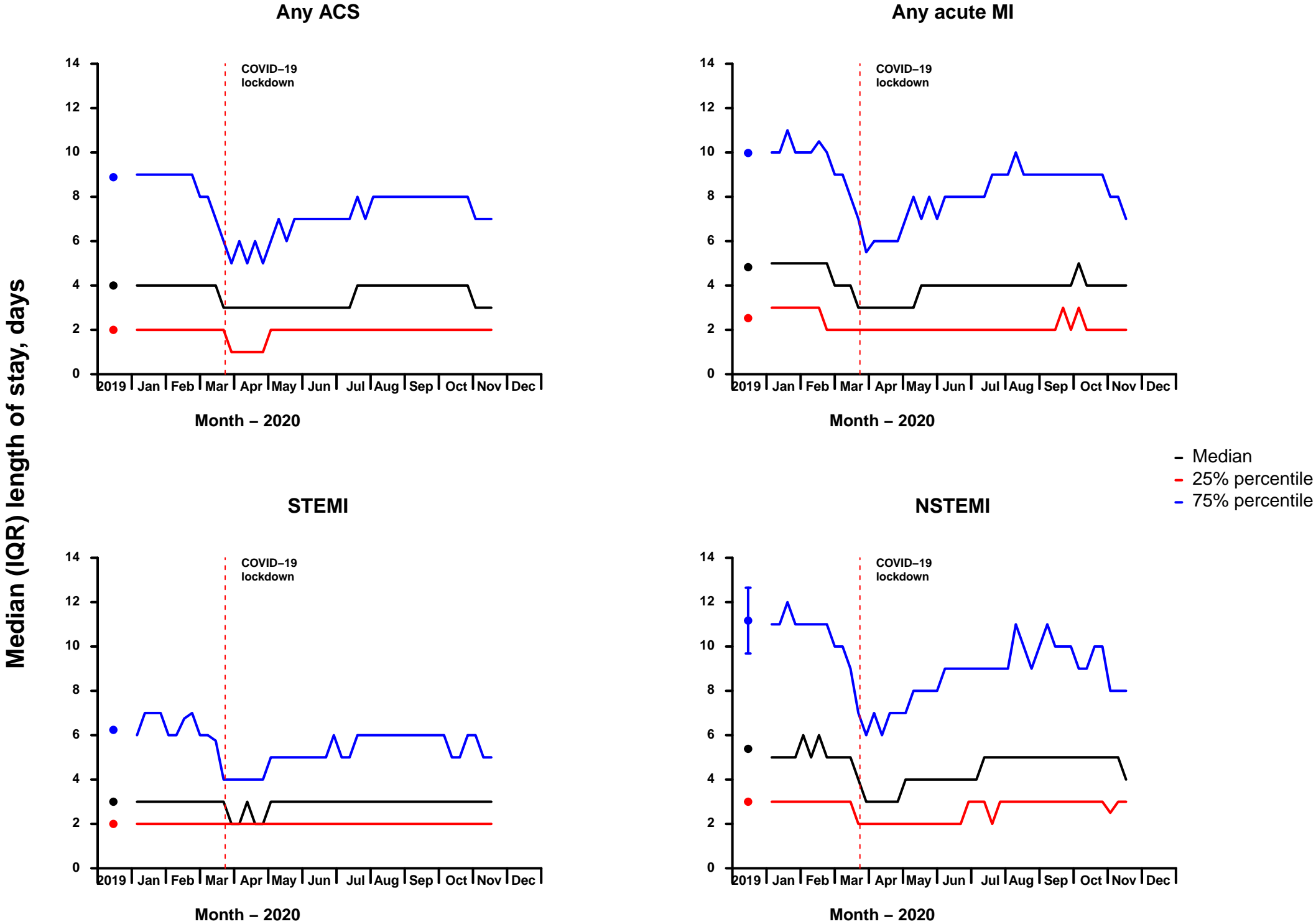
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Figure 5: (a) Weekly numbers and (b) weekly proportions of admissions to acute NHS hospital trusts with an acute coronary syndrome that received any percutaneous coronary intervention



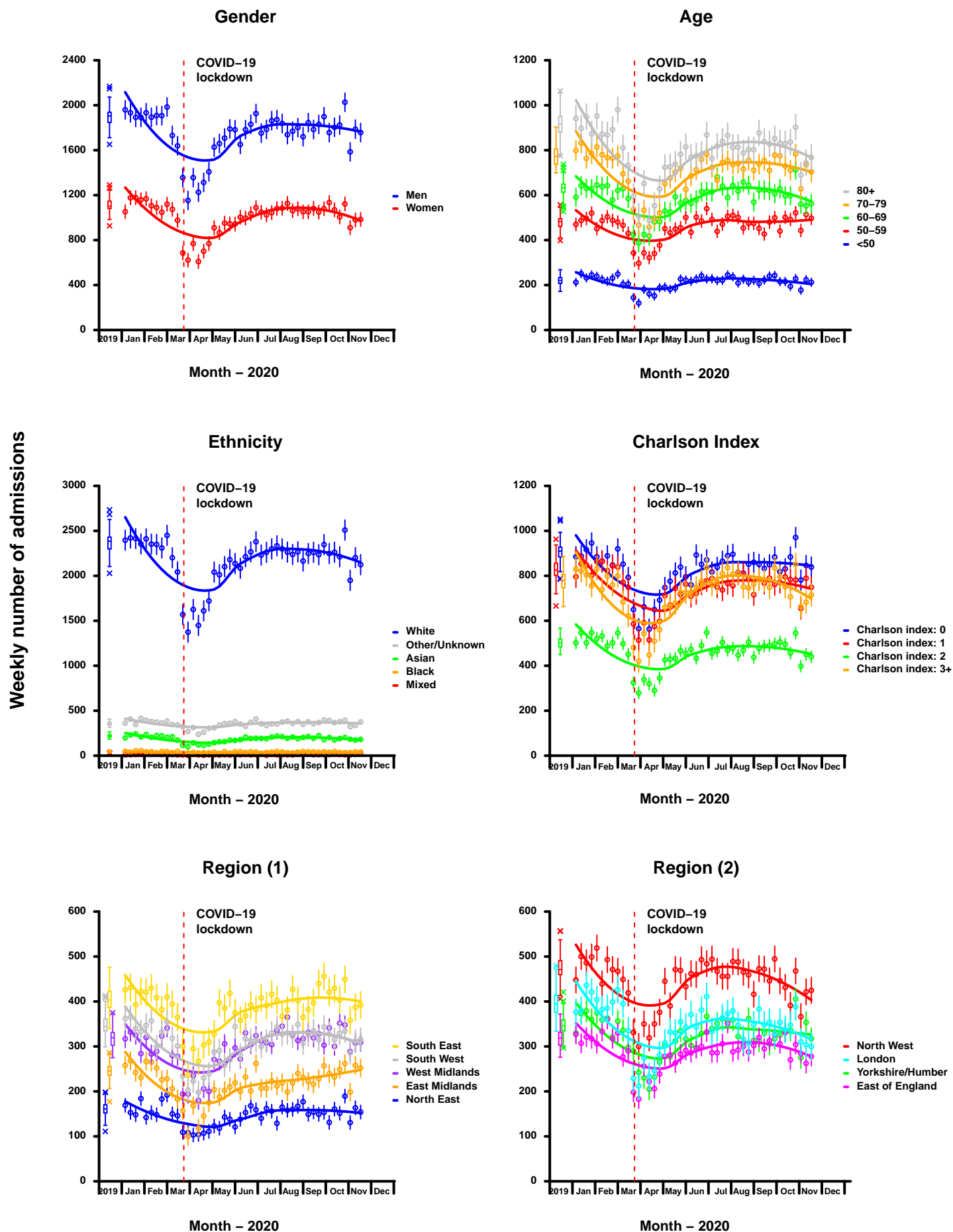
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Figure 6: Weekly median and interquartile range of length of stay for admissions to acute NHS hospital trusts with an acute coronary syndrome, by type



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, 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, ethnicity and region



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.

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	3,109	2,111	2,186	607	643	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	3,001	2,175	2,050	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	2,049	658	625	1,277	1,222
9	3,081	3,104	2,102	2,119	622	637	1,298	1,287
10	3,055	2,805	2,144	1,962	617	628	1,357	1,180
11	3,093	2,615	2,118	1,791	664	559	1,278	1,058
12	3,088	2,042	2,070	1,456	631	488	1,279	837
13	2,913	1,778	1,990	1,311	593	466	1,227	720
14	3,411	2,134	2,302	1,541	729	591	1,419	787
15	3,052	1,846	2,090	1,307	596	478	1,314	688
16	3,026	2,025	2,109	1,428	654	540	1,295	756
17	3,009	2,196	2,012	1,532	585	527	1,254	864
18	3,037	2,546	2,059	1,724	616	581	1,289	980
19	3,054	2,541	2,139	1,691	683	532	1,288	994
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	2,740	2,018	1,840	584	625	1,254	1,029
23	3,008	2,670	2,055	1,792	616	597	1,264	1,033
24	3,017	2,796	2,047	1,824	631	533	1,242	1,129
25	2,916	2,881	1,926	1,905	582	585	1,190	1,138
26	2,935	3,034	1,976	2,003	594	620	1,232	1,191
27	2,959	2,820	2,028	1,874	648	579	1,207	1,114
28	2,897	2,825	1,952	1,920	605	633	1,188	1,110
29	2,897	2,916	1,985	1,923	639	561	1,190	1,155
30	2,883	2,961	1,989	1,990	609	601	1,215	1,202
31	2,806	2,938	1,878	1,981	573	616	1,170	1,153
32	2,903	2,882	1,936	1,868	594	565	1,194	1,106
33	2,908	2,842	1,907	1,875	605	605	1,142	1,102
34	2,937	2,888	1,955	1,913	580	654	1,224	1,093
35	2,854	2,777	1,915	1,784	508	588	1,250	1,019
36	2,839	2,897	1,881	1,928	553	582	1,179	1,161
37	3,101	2,865	2,095	1,931	645	561	1,271	1,181
38	2,938	2,878	1,974	1,940	566	571	1,252	1,177

Week	Any ACS		Any acute MI		STEMI		NSTEMI	
	2019	2020	2019	2020	2019	2020	2019	2020
39	3,149	2,978	2,094	2,028	611	611	1,313	1,222
40	3,105	2,891	2,050	1,923	580	582	1,295	1,152
41	3,067	2,873	2,027	1,975	593	597	1,270	1,188
42	2,992	2,830	1,978	1,925	611	591	1,189	1,159
43	3,034	3,148	2,084	2,103	621	642	1,280	1,244
44	2,579	2,497	1,744	1,698	508	544	1,101	964
45	3,159	2,768	2,124	1,903	633	660	1,294	1,071
46	2,990	2,743	2,074	1,856	619	624	1,274	1,032
47	2,976		2,011		639		1,223	
48	3,087		2,101		646		1,264	
49	2,998		2,127		671		1,235	
50	3,056		2,165		624		1,363	
51	3,093		2,215		651		1,344	
52	2,951		2,122		676		1,224	