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## Decrease in cardiac catheterization and MI during COVID pandemic

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### ABSTRACT

The consequences of severe acute viral respiratory syndrome (COVID 19) pandemic include collateral effects, one of which has been the significant reduction in routine hospital work. With widespread reports indicating reduction of cardiac procedures including MI presentation to hospitals, we aimed to analyze the local data over a 10-week period during lockdown in a tertiary cardiac centre Catheter Laboratory in England.

**Methods:** We conducted a retrospective review of the coronary catheterisation procedures and admissions with MI over the peak COVID-19 pandemic 10-week period (23rd March-30th May) in 2020, compared with the same 10-week period (25th March-2nd June) in 2019.

**Results:** In 2019, 539 patients were admitted to the Cath lab for coronary catheterisation (M = 385:F = 154; mean age 65 years; STEMI = 186, NSTEMI = 192, elective = 161). In 2020, during peak period of COVID19 pandemic in England, a total of 278 patients were admitted for coronary catheterisation over the 10-week period (M = 201:F = 77; mean age 60.5 years; STEMI = 132, NSTEMI = 118, elective = 28). During peak COVID19 pandemic, this represents a 48.4% drop in all coronary catheterisations. The reduction in STEMI was 29% (54 less), in NSTEMI was 38.9% (74 less) and elective procedures dropped by 83% (133 less).

**Conclusion:** During peak COVID hospital admission period in England, we report a 48.5% reduction in coronary catheterisation in our tertiary hospital. These results are consistent with reports from other countries, and highlight the worrying potential consequences for these patients arising from delays in presentation with MI, and the challenges for restoring services post-pandemic.

### 1. Introduction

Coronavirus disease 2019 (COVID-19), caused by the SARS-CoV-2 virus, has been certified as primarily a severe acute viral respiratory syndrome and a global pandemic by the World Health Organization (WHO) [1]. In the UK, the first case was confirmed on 29th January 2020 [2]. On March 23rd 2020 on the advice of the government, Public Health England (PHE) recommended a lockdown policy with severe curtailment of movement for everyone to reduce transmission rates, including suspension of all clinical services to create extra capacity for COVID-19 related admissions/hospitalisations within the National Health Service (NHS). This is also assumed to have discouraged patients from visiting hospitals or seeking urgent medical advice even whilst having symptoms of MI, with consequent decrease in cardiac catheterisation (percutaneous cardiac intervention-PCI) procedures. The precise extent and longer-term implications of the suspension of cardiac services remain as yet undefined.

A recent survey by Adlan et al looking at the impact of Covid-19 on primary PCI centres in UK, confirmed that only 64% of Cath labs in UK remained open to work during the COVID-19 pandemic period, and primary PCI remained first-line treatment for STEMI [3]. Another survey, under the auspices of the European Society of Cardiology (ESC), similarly reported that STEMI were down by at least 40% since the start of the pandemic, as compared with prepandemic, and 62.2% respondents reported that patients with STEMI were being admitted later than usual [4]. Both surveys relied on respondents self-reporting information and did not include the precise impact on management of Non-STEMI patients during the pandemic period. A more recent review article confirmed a decrease in both STEMI and NSTEMI admissions but did not evaluate for consequences on elective work [5].

In the present study we investigate for the precise impact of COVID 19 on cardiac presentations requiring cardiac catheterisation (primary, urgent and elective PCI) procedures at a tertiary cardiac hospital, England over a 10-week period (23rd March-30th May 2020), compared to historical data for the same period in 2019.

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## 2. Methods

We audited hospital admissions for cardiac catheterisation retrospectively for the 10-week period, starting with the date of enforcement of lockdown in England (23rd March 2020) till 30th May 2020, compared to the same 10-week period in 2019. Data was obtained from the hospital's electronic databases for all patients admitted to the cardiac unit with ICD-11 codes of coronary artery disease presentation [6]. Patients admitted to intensive care or intubated, including OOHCA (out of hospital cardiac arrest) were excluded. Standard international diagnostic criteria for MI were used, with data tabulated as ST-elevation MI (STEMI), non-ST-elevation MI (NSTEMI) and elective Percutaneous Coronary Intervention (PCI) procedure. Demographic data collated included gender and age.

## 3. Patient and public engagement

No patient involved.

## 4. Trial registration number

Not applicable.

## 5. Statistical analysis

All medical records were cross-checked by a clinical Cardiologist to confirm diagnosis of STEMI and NSTEMI data, gender and mean age (represented as mean with age range).

## 6. Results

Over a 10-week period in 2019 a total of 539 patients requiring cardiac catheterisation were admitted, with 71% (385) male and 29% (154) female (mean age 65 years; range 22 years–94 years). Over the peak COVID19 pandemic 10-week period in 2020 in England, a total of 278 patients were admitted for coronary catheterisation, with 72% (201) male and 28% (77) female (mean age 60.5 years; range 20 years–92 years). This is a drop of 48.5% in cardiac catheterisation procedures in the unit over the 10-week period in 2020. The reduction in catheterisation procedures for STEMI was 29.0% (54 less procedures), 39.9% for NSTEMI (74 less procedures) and 83.0% for elective procedures (133 less procedures). Analysis of outcome data from all catheterisation procedures showed that PCI with stent implantation was 40.5% less, whilst the angiogram-only outcome was 61.0% less, compared to activity during the same period in 2019 (Table 1).

## 7. Discussion

We document a 48.5% drop in admissions for all cardiac catheterisations in the unit (from 539 to 278 patients) in a single hospital in England during the COVID peak period (23rd March–30th May 2020), compared to the same

**Table 1**

Catheterisation data for the 10-week period in 2019, corresponding to the same period in 2020 (i.e. peak COVID admission). Summary of definitions used.

	25th March–2nd June 2019	23rd March–30th May 2020	% drop decrease	P < 0.05
STEMI	186	132	29.0%	
NSTEMI	192	118	38.9%	
Elective	161	28	83.0%	
Total	539	278	48.5%	
Outcomes				
PCI	331	197	40.5%	
Angiography alone	208	81	61.0%	

STEMI: new ST elevation in at least 2 contiguous leads with > 2 mm, NSTEMI: anginal symptoms with elevated Troponin levels +/- ECG changes.

months in 2019. The drop in STEMI was 29.0% and drop in NSTEMI was 40.0%. The fall in elective procedures was 83.0%, with only 28 patients (17.0%) certified as 'clinically very urgent' and already accepted for catheterisation procedure by supervising consultant cardiologist. There were no differences in age or sex distribution between 2019 and 2020. Lastly, the outcomes data confirmed a reduction in actual percutaneous coronary interventions (PCI) carried out was 40.0%, whilst the angiogram procedures dropped by 61.0%. Our results are in keeping with various international reports from Italy [7], Austria [7], Spain [8] and New York, USA [9].

There are two main worrying aspects of a decrease in presentations of patients with MIs and drop in cardiac catheterisation procedures. First, this decrease in presentations to Catheter laboratory activity does not imply that the patients are not suffering MI. Plausible explanations for patients avoiding hospital attendance/admission would include fear of being exposed to a potentially fatal and untreatable COVID 19 infection (whilst in hospital) as well as individual patient's decision not to put additional pressures on the NHS/hospitals during this period of severe demand. Moreover, patients may simply be complying with the advice from Public Health England (PHE) to observe strict severe lockdown conditions. They may even have found it difficult to access emergency care or seek their usual healthcare professional (GP or specialist clinic). Potentially, the consequence on such patients with 'missed/untreated MI' would include irreversible negative impact on their cardiac health and eventual increased mortality thereof. Specifically, for a foreseeable period we are likely to see complications associated with their missed MI, such as increased hospitalisations with heart failure, arrhythmias as well as increased mortality rates.

Second, the impact of the sudden disruption of established cardiac services and pathways in favor of the increased COVID-19 emergency admissions/care is expected to have much wider and longer term consequences. Specifically, implications on hospital services when they are restored remains worrisome. In particular, it would require time to 're-organize' and 're-establish' specialist cardiac services before routine cardiac work can be started at previous levels. In addition, as expected, cardiac patients who have missed cardiac care/input including those with recent MIs (i.e. unattended to hospital), would likely become sicker to the point of increasing the need for more critical/urgent services, especially at the time when services are restarting. The consequences of previously planned cardiac investigations/ treatments/ procedures that were suddenly canceled would also have to be added to the considerable longer-term burden of cardiac services. It would therefore be expected that this would result in services focusing on such sicker patients rather than resuming services for all those patients who would normally require such services. Such consequences would be further exaggerated by the need to offer only reduced level of services (for reasons of social distancing and greater use of personal protective equipment). Unfortunately, the eventual impact of such stretched and lower levels of cardiac services on these patients would cause further delays in achieving diagnosis and treatment leading to poorer prognosis for some time into the future.

Finally, the challenges of restoring cardiac services post-COVID and dealing with the expected surge in work arising from the backlog and ongoing new referrals, in the face of pre-existing (i.e. pre-COVID) staffing shortages, would suggest that it will be difficult to deliver effective and timely resumption of services for a considerable time. Such a challenge would therefore require a substantial increase in levels of medical and allied professional staffing. In the absence of such an increase in staffing, and therefore costs, the potential impact on existing staff for the medium to long term would include a continued commitment to 7-day normal working (i.e. including weekend and evening hours) patterns to have any chance of success in restoring the services to an even keel. For the patients, the challenge is in convincing them that they can undergo safe cardiac procedures, especially elective procedures, without returning to the pre-COVID often 'over-crowded hospital' environments. In the same light, plans to restore normal cardiac services post-pandemic should include serious discussions on the scale of financial commitments needed to achieve these goals safely and expeditiously.

## 8. Conclusion

The pandemic of COVID 19 has implications beyond those of the acute respiratory viral illness, and include indirect consequences on acute cardiac conditions with 48.5% drop in admissions for all cardiac catheterisations in a single hospital. We report a 29.0% drop in patients presenting with a STEMI, 40.0% drop in all percutaneous coronary interventions (PCI), with a 61.0% reduction of angiogram procedures whilst considering some of the challenge in post-COVID resumption of services, including plausible economic impact.

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## Study approval and consent

Ethical approval was not required as this study constitutes a quality improvement in healthcare and did not involve patient participants. Consent was therefore not required.

## Contributorship statement

The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

## CRediT authorship contribution statement

Malik N, Holt CM and Ullah A: Conceptualization, Methodology, Ullah A: Data curation, Writing - Original draft preparation. Fraser DGW, Fath-Ordoubadi F: Visualization, Investigation. Malik N, Holt CM: Supervision. Malik N, Holt CM and Ullah A: Writing - Reviewing and Editing.

## Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that

any discrepancies from the study as planned (and, if relevant, registered) have been explained.

## Data sharing statement

The corresponding author (N Malik) hereby confirms that I have full access to all the data in the study and have final responsibility for the decision to submit for publication.

## Declaration of competing interest

None declared by all the authors.

## References

- [1] WHO announces COVID-19 outbreak a pandemic, Published online 2020 <http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic>.
- [2] P. Moss, G. Barlow, N. Easom, P. Lillie, A. Samson, Lessons for managing high-consequence infections from first COVID-19 cases in the UK, *Lancet* 395 (10227) (2020) e46, [https://doi.org/10.1016/S0140-6736\(20\)30463-3](https://doi.org/10.1016/S0140-6736(20)30463-3).
- [3] A.M. Adlan, V.G. Lim, G. Dhillon, H. Kurdi, G. Doolub, N. Elamin, A. Aziz, S. Shastry, G. Davis, Impact of COVID-19 on primary percutaneous coronary intervention centres in the UK: a survey, *Br. J. Cardiol.* 27 (2020) 49–52.
- [4] G. Pessoa-Amorim, C.F. Camm, P. Gajendragadkar, G.L. De Maria, C. Arsac, C. Laroche, J.L. Zamorano, F. Weidinger, S. Achenbach, A.P. Maggioni, C.P. Gale, A. Poppas, B. Casadei, Admission of patients with STEMI since outbreak of the COVID-19 pandemic: a survey by the European Society of Cardiology, *Eur Heart J Qual Care Clin Outcomes.* 6 (3) (July 2020) 210–216.
- [5] K. Huynh, Reduced hospital admissions for ACS — more collateral damage from COVID-19, *Nat. Rev. Cardiol.* 17 (2020) 453, <https://doi.org/10.1038/s41569-020-0409-5>.
- [6] ICD-11: 5.62/ICD-10:12-9, Editorial *Lancet* 2018; 391: 2476
- [7] O. De Filippo, F.A. D'Ascenzo, A. Filippo, P.P. Bocchino, F. Contotto, et al., Reduced rate of hospital admissions for ACS during Covid-19 outbreak in Northern Italy, *N Engl J Med* (2020)<https://doi.org/10.1056/NEJMc200916> NEJMc2009166.
- [8] O. Rodríguez-Leor, B. Cid-Álvarez, S. Ojeda, J. Martín-Moreiras, J.R. Rumoroso, R. Lopez-Palop, A. Serrador, A. Cequier, R. Romaguera, I. Cruz, P. Prado, R. Moreno, Impact of the COVID-19 pandemic on interventional cardiology activity in Spain, *Rec Interv Cardiol.* 2 (2) (2020) 82–89.
- [9] N. Braiteh, W. Rehman, M. Alom, V. Skovira, N. Breiteh, I. Rehman, A. Yarkoni, H. Khsou, A. Rehman, Decrease in acute coronary syndrome presentations during the COVID19 pandemic in Upstate New York, *Am. Heart J.* (2020)<https://doi.org/10.1016/j.ahj.2020.05.009>.