

# COVID-19 and cardiac surgery: investigating the effect of short-term delay of elective cardiac surgery on mortality rate and hospital capacity

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## Abstract

The Royal College of Surgeons recently published new guidelines and protocols attempting to reduce the risk of COVID-19 for patients and staff without compromising the quality of care and treatment for patients who require cardiac surgery. The guidelines introduced a new classification system to categorise patients based on their need of surgery, which led to the postponement of all elective cardiac surgery. This article investigates the effect of this categorisation system on cardiac surgery, focusing firstly on the effect of short-term delay of elective cardiac surgery on mortality rate and secondly how postponement may have helped establish a COVID-19-free environment and increased hospital capacity. A search was conducted using the PubMed database and five articles were selected. It has been found that the new guidelines helped to increase hospital capacity and establishing a COVID-19-free environment. Due to the lack of evidence, it is still unknown whether the new guidelines may have led to higher mortality rates. It is concluded that further research is needed to investigate the effect of short-term delay of elective cardiac surgery on mortality rate.

## Abbreviations

ACE2 - Angiotensin-converting enzyme 2 receptors

CABAG - Coronary artery bypass graft

CVD - Cardiovascular diseases

ICU - Intensive Care Unit

PCI - Percutaneous coronary intervention

## Introduction and background information

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has had a significant effect on global healthcare services, requiring the need for unparalleled healthcare system adaptations.<sup>1</sup> With the rapid increase in COVID-19 cases, and the drastic strain on healthcare systems, it was important to reallocate intensive care services to cope with the accelerating burden raised by COVID-19. As of March, 2020, in the UK, 97 patients needed hospital admission every day and, of those, 76 patients needed ventilation.<sup>2</sup> As a result, the pandemic has led to a lack of ventilators, intensive care units, personal protective equipment, and health care staff.<sup>2</sup> These limitations have potentiated the need to introduce drastic new measures to the medical care of surgical patients, especially in cardiac surgery, which is largely dependent on intensive care resources.<sup>2</sup>

A meta-analysis of observational studies evaluating cardiovascular complications in hospitalised COVID-19 patients found that those with pre-existing cardiovascular disorders were at higher risk of mortality.<sup>3</sup> In addition, an exacerbated course of pneumonia was observed in patients with underlying cardiovascular diseases (CVD), which required admission to the intensive care unit (ICU) and prolonged hospital stay. SARS-CoV-2 uses angiotensin-converting enzyme 2 receptors (ACE2) to enter the host cell. The exacerbated course of pneumonia in those with CVD has been attributed to the increased expression of ACE2 receptors as a consequence of renin-angiotensin-aldosterone inhibitors widely used in the treatment of cardiovascular conditions. Higher expression of ACE2 receptors might

lead to more severe SARS-CoV-2 infection and explain why patients with pre-existing CVD have a higher mortality rate.<sup>4</sup> Establishing a COVID-19-free environment was, therefore, deemed key to reducing the risk of complications and rate of mortality in those with CVD.

## The new guidelines released by the Royal College of Surgeons in the UK

In order to establish a safe environment and increase hospital capacity, a nationwide assessment was carried out in the UK. The resulting plan involved converting surgical intensive care units into overflow intensive care units to increase capacity for patients with COVID-19. In addition, building centralised units for subspecialties, such as cardiac surgery, aimed to provide a safe but limited environment for patients who needed to undergo cardiac surgery. This reconfiguration resulted in a significant reduction in the number of operations that could be carried out per day. The reduction was up to 80% in some centres meaning that many elective surgeries had to be cancelled to focus on life-saving procedures.<sup>5</sup> Therefore, a new categorisation system was developed to redefine the urgency of elective cardiac surgeries; this classified patients into four levels (Table 1).<sup>6,7</sup>

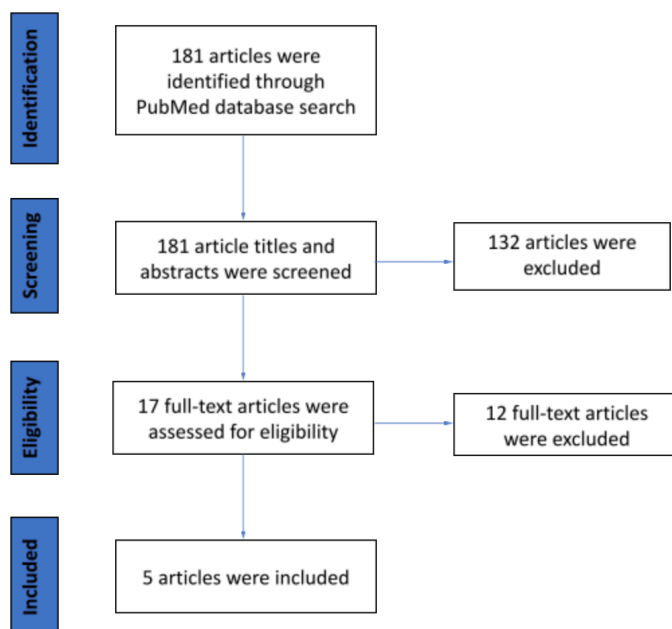
**Table 1. The four urgency levels of elective cardiac surgeries.<sup>6</sup>**

Level of urgency	Required time for surgery
Level 1	Surgeries needed within 72 hours
Level 2	Surgeries that can be postponed up to 4 weeks
Level 3	Surgeries that can be delayed up to 3 months
Level 4	Surgeries that can be deferred for more than 3 months

It is important to mention that postponement of elective cardiac surgery was not applied in the UK alone but mirrored an international call to postpone elective cardiac surgery.<sup>5</sup> While these new guidelines may help to provide a COVID-19-free environment and prevent hospitals from being overwhelmed, postponing elective surgery may increase the risk of cardiovascular deterioration and, also, mortality rate. This article examines whether postponing elective cardiac surgery helped in establishing a COVID-19-free environment and investigates the effect of short-term postponement (less than 52 weeks) of elective cardiac surgery on mortality rate.

## Literature search

A search of the peer-reviewed database PubMed was conducted using a combination of the terms "COVID-19", "elective cardiac surgery", "postponing", "short waiting times", "COVID-19 free environment" and "hospital capacity". Only articles in the English language were included. No exclusions were made based on publication date. The literature search results were screened in two stages; the first stage involved initial inspection of the study titles and abstracts to identify relevant articles and, as a result, 132 articles were excluded. The second stage involved in-depth reading of the full-text articles, which led to the exclusion of 12 articles (Figure 1). In total, 5 studies were found that fit the search criteria (see Table 2).



**Figure 1. Flow chart of search strategy.** A flow chart illustrating the search strategy used to identify articles relevant to the effect of postponing elective cardiac surgery on mortality rate and hospital capacity.

**Table 2. A summary of the studies found by the literature review.**

Selected studies	Research method(s)	Sample size (n)	Content/theme
Harky <i>et al</i> , 2020 <sup>8</sup>	A survey of patients who underwent aortovascular intervention during the COVID-19 pandemic	59 patients	Investigating the outcomes and characteristics of patients who underwent elective cardiac surgery
Head <i>et al</i> , 2017 <sup>9</sup>	A systemic review and meta-analysis of 22 articles	66410 patients	Exploring the effect of different waiting times and adverse event rates
Metelmann <i>et al</i> , 2020 <sup>10</sup>	A two-centre analysis of postponed cardiac operations	109 patients	Investigating postponed elective cardiac surgery
Peters <i>et al</i> , 2020 <sup>11</sup>	A descriptive study		How postponing elective cardiac surgery helped in increasing hospital capacity
Sobolev <i>et al</i> , 2006 <sup>12</sup>	A population-based prospective study	8325 patients	The effect of delaying cardiac surgery

## Establishing a safer environment and increasing hospital capacity

In a cohort study, the outcomes of 29 elective cardiac surgery cases were examined at Liverpool Heart and Chest Hospital in the UK, analysing patient outcomes after applying the new guidelines. Post-operatively, none of the patients experienced COVID-19-related pneumonia nor were any deaths attributed to COVID-19 infection. The results were seen as a validation of the new categorisation system, which helped to prioritise patients with life-threatening conditions and provide a safer environment.<sup>8</sup>

During the COVID-19 pandemic in March 2020, at New York–Presbyterian Weill Cornell Medical Center, the demand for beds in ICUs and for mechanical ventilation devices exceeded baseline capacity. Postponement of elective surgeries allowed conversion of operating rooms not in use into ICUs. This involved repurposing ventilation and anaesthesia machines for patients critically ill with COVID-19. In addition, it yielded 60 extra beds, increasing hospital capacity by 52% percent. This study provides further evidence in support of the new categorisation system and suggests that without the cancellation of elective surgeries, increased ICU capacity would not have been possible.<sup>9</sup>

## The new guidelines may have increased the mortality rate

After the publication of the new categorisation system, surgeons were confronted with the difficult decision of cancelling or postponing elective surgeries. It is clear that 'elective' does not mean a non-essential procedure; therefore, delaying elective surgeries might have increased the rate of mortality and morbidity. This argument emerges from previous studies, including randomised trials and observational studies estimating the conditional probability of death in relation to delay times for patients who required cardiac revascularisation surgery. One prospective study included 3825 patients registered to undergo cardiovascular pulmonary bypass graft (CABAG). The study looked at the number of patients who died when CABAG was not done at specific times over 52 weeks of taking the decision to postpone treatment. The study concluded that as the waiting time increased, probability of death increased.<sup>10</sup> However, the waiting time in this study was up to 52 weeks, which is much longer than the waiting time during the COVID-19 pandemic. An alternative comparison is a study that assessed the effect of short-term postponement of elective surgeries on mortality rate.<sup>11</sup> In this study, data was analysed from two centres in Germany (the University Hospitals of Leipzig and Greifswald). In Leipzig University Hospital, 89 elective operations were postponed, while in Greifswald, 92 elective procedures were postponed from March 16th to April 20th 2020. The postponement decision was made following the new guidelines released by the German Society of Surgery.<sup>11</sup> The research revealed that one patient with severe obesity died during the postponement period due to cardiovascular complications but that, overall, short-term delay did not lead to higher rates of morbidity and mortality. It is important to note some limitations of this study, particularly that both hospitals had very low COVID-19 infection rates, which ensured a high capacity of ICUs and ventilation units for performing surgery, even at short notice. In addition, data from out-patients who had their surgeries postponed were not included. Therefore, based on these data, a link between the delay of elective surgery and mortality rate is inconclusive.

A meta-analysis of 22 studies investigated the rate of adverse events while awaiting percutaneous coronary intervention (PCI) and CABAG.<sup>12</sup> The study found that mortality in patients awaiting revascularisation surgery was infrequent but that mortality rates were higher in a specific group of patients. The key findings of the study were that the most significant predictors of death were the patient's status, namely the severity of angina and left ventricular dysfunction. The study results highlight the significance of recommending a

maximum waiting time for CABAG and PCI surgeries. One of the limitations in trying to establish the effect of waiting time on mortality rate is the variability in waiting times between studies, coupled with different inclusion criteria and study designs. Therefore, further investigations and studies are required to establish the effect of short-term delay of elective surgeries on mortality rates.

## Evaluation

Undoubtedly, the pandemic has transformed the practice of cardiac surgery around the world. Shortage and limitations of health-care facilities led to the introduction of new guidelines aimed to utilise resources, prioritise patients and provide safer environments. Preliminary evidence suggests that the new guidelines released by the Royal College of Surgeons led to a reduction in the volume of operations, which helped to increase hospital capacity to treat patients critically ill with COVID-19.<sup>9</sup> This also helped minimise the spread of COVID-19 in hospitals, providing a safer environment with reduced risk of COVID-19 infection.<sup>9</sup>

With regard to the link between waiting times and mortality, evidence supports prolonged waiting times being linked to higher rates of mortality. However, it is important to focus on the impact of short waiting time (less than 52 weeks) because, during the pandemic, waiting times were not very long. Due to the lack of evidence, it was not possible to reach to a definitive conclusion regarding the impact of a short delay of elective cardiac surgery on mortality rate.

Since the continuity of surgical excellence is needed in any circumstances, more plans should be developed for any potential crisis in the future. The first step to achieve this is by exploring the impact of COVID-19 on the surgical field, which will allow us to fill major knowledge gaps that currently exist. For instance, more research is needed to examine the impact of short-term delay of elective surgeries on mortality rate; this would enable us to determine the optimal time to perform elective surgical interventions. As a result, the Royal College of Surgeons might then be able to include maximum waiting times in their guidelines.

## Conclusion

During the pandemic, the Royal College of Surgeons reacted quickly and effectively despite the shortage of equipment and amid the uncertainty of the situation. The new guidelines they released were beneficial as they led to a reduction in the volume of operations and, consequently, the repurposing of operating rooms into ICUs, increasing hospital capacity and reducing risk of COVID-19 infection. The effect of short-term delay of elective surgery on mortality rate is still unknown. More research is needed in order to fill this knowledge gap and develop new strategies and guidelines for any similar crisis in the future.

**Acknowledgements** I would like to thank Dr John Chilton (Peninsula Medical School, University of Plymouth, UK) for his supervision and guidance. I am also very thankful to the editors of the INSPIRE Student Health Sciences Research Journal for providing constructive feedback.

**Contribution statement** The author of this article has contributed substantially to the conception, design, drafting and editing of this work. Final approval of the version for inclusion in Inspire has been provided by the author.

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