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The impact of COVID-19 prevention measures on surgical wound infection rates post-cardiac surgery

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Abstract

The COVID-19 pandemic had a huge impact on medical services. Several measures have been implemented to reduce the risk of viral transmission. In this paper, we assessed the impact of these measures on surgical wound infection rates in patients post-cardiac surgery. Hypothesis testing was used to compare post-cardiac operation infection rates between the year prior to the COVID-19 pandemic being declared and the first 13 months of the pandemic. The infection rates in 969 patients with operations between 01/03/2019 and 29/02/2020 were compared to those of 925 patients with cardiac surgery between 01/03/2020 and 31/03/2021. Infection rates for various operative urgencies and infection types were analysed. To compare infection rates, a two-tailed pooled z-test using the difference in infection proportions was performed. A 5% significance level was used and only categories with at least 10 patients in both the pre-covid and covid populations were tested. For leg infections, only operations involving coronary artery bypass grafting were included. To ensure that any differences in outcomes were not due to differences in patient demographics resulting in unequal operative risks, Euroscore II values, a measure of cardiac operative risk, were compared between the pre-covid and post-covid cohorts. The Mann-Whitney U-test was used to determine whether the distributions of Euroscore II values were likely to be drawn from the same population. A significance level of 5% was used. A total of 1901 patients (932 during the COVID-19 pandemic) were included in this study. Significant reduction in post-operative infections for all patients undergoing cardiac surgery from 4.3% of patients before COVID to 1.5% during the pandemic. During the pandemic, fewer elective and more urgent operations were performed. This study suggests a significant role of iatrogenic causes in wound infections prior to the pandemic. The implementation of COVID-19 prevention measures in healthcare providers can reduce surgical infection rates. As COVID-19-related restrictions have been eased, we suggest maintaining them in healthcare providers to reduce the incidence of surgical wound infections.

Key words: Cardiac surgery, wound infection, COVID-19, infection control, postoperative complications

Introduction

Surgical site infection (SSI) post-cardiac surgery can have a detrimental impact on patient morbidity and mortality [1]. They are also associated with an increased length of hospital stay, long-term antibiotic use, further surgical intervention and increased costs [1-3]. SSI in patients' post-cardiac surgery can include sternal wound infections (SWI) and leg wound infections in patients requiring coronary artery bypass grafting (CABG). Fortunately, the incidence of SWI is relatively low in comparison to other surgical wounds with the incidence ranging from 0.5% to 6.0% (2,4). There is an extensive list of modifiable and non-modifiable risk factors which include: poor glucose control; *Staphylococcus aureus* skin colonisation; smoking; inadequate skin preparation; hypoor hyperthermia; and hypoxia [1,5]. The World Health Organisation has released guidelines that endorse the use of skin barriers, skin decontamination and intraoperative homeothermy, in addition to hand hygiene measures for the prevention of SSIs [6]. Many of these measures were more rigorously implemented during the COVID-19 pandemic in 2020/21.

The COVID-19 pandemic had a sweeping impact on all aspects of society, most notably healthcare. In an attempt to curb transmission of the virus in healthcare settings and therefore protect both patients and staff members, a variety of measures were implemented. Visitors were prohibited from visiting hospitals to visit their relatives; routine work was cancelled; and crucially, scrupulous hygiene measures were enforced. This included more frequent hand washing, fewer physical interactions between healthcare workers and patients and greater use of personal protective equipment (PPE). These measures represent the basic level of infection control precautions that should be applied at all times during the care of all patients. Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed.

Hand hygiene is one of the most effective precautionary measures to prevent the spread of the virus [7]. The rationale and the correct use of PPE played a leading role in slowing down the virus spread. The proper training of the staff, the appropriate selection of different types of masks according to the situation, and the high compliance of the staff and the community establish hygienic habits in the hospital setting [8,9].

Despite the effects of the pandemic, our center was still performing cardiac surgery, mostly for patients requiring urgent or emergency operations. It was noted locally that the rates of SSIs appeared to be lower during the COVID-19 pandemic. Therefore, the aim of this study is to compare the rates of SSIs during the COVID-19 pandemic when intensified hygiene measures were being implemented, with those rates observed prior to the pandemic.

Patients and Methods

Hypothesis testing was used to compare post-cardiac operation infection rates between the year prior to the COVID-19 pandemic being declared and the first 13 months of the pandemic. The infection rates in 969 patients with operations between 01/03/2019 and 29/02/2020 were compared to those of 925 patients with cardiac surgery between

01/03/2020 and 31/03/2021. Infection rates for various operative urgencies and infection types were analysed. To compare infection rates, a two-tailed pooled z-test using the difference in infection proportions was performed. A 5% significance level was used and only categories with at least 10 patients in both the pre-covid and covid populations were tested. For leg infections, only operations involving coronary artery bypass grafting were included.

To ensure that any differences in outcomes were not due to differences in patient demographics resulting in unequal operative risks, Euroscore II values (Figure 1), a measure of cardiac operative risk, were compared between the pre-covid and post-covid cohorts. The Mann-Whitney U-test was used to determine whether the distributions of Euroscore II values were likely to be drawn from the same population. This test is analogous to the *t*-test but does not make the assumption that the underlying distribution is normal. In this case, the distributions were frequently long-tailed. A significance level of 5% was used. For leg infections, only operations involving coronary artery bypass grafting were included.

Results

Significant reduction in post-operative infections for all patients undergoing cardiac surgery from 4.3% of patients before COVID to 1.5% during the pandemic (Figures 2 and 3). The proportion of patients developing a post-operative infection is similar or reduced when comparing pre- and during-pandemic operations for all urgency levels and infection categories (where sufficient data was available for testing). Notably, during the pandemic, fewer elective and more urgent operations were performed (Figure 4).

Discussion

Surgical site infections in cardiac surgery can be categorised by location and depth. Both graft site infections and sternal wound infections can be classified as either superficial or deep. Superficial sternal wound infections involve the skin, subcutaneous tissue and pectoralis fascia, whereas deep sternal wound infections (DSWI) or mediastinitis, involves any tissue deep to the subcutaneous tissue [10]. This can include any of the great vessels, trachea, oesophagus and the heart itself. The incidence of deep sternal wound infections is reported to be 0.2-3% compared to 2-6% for superficial infections

[11,12]. Although relatively uncommon, they have a significant effect on morbidity, mortality and duration of hospital stay [10,13,14]. One-year mortality rates have been reported to be around 10% for patients with DSWI compared to controls [15] with hospital stays reported to be four times longer (32 days) [16]. DSWI's are predominantly caused by *Staphylococcus* species such as coagulase negative staphylococci and *Staphylococcus aureus* (17), although other species such as *Escherichia coli*, *Pseudomonas aeruginosa* and Klebsiella are also commonly cultured [18]. There are a number of perioperative measures that can be implemented to reduce the risk of developing such infections. Patients are routinely screened for nasal carriers of *S. aureus* in order to identify those that need eradication therapy and appropriate prophylactic antibiotics. Patients should also be optimised in relation to glycemic control, nutrition and smoking [17].

Diabetes mellitus and obesity are both well-established risk factors for developing DSWI. Multiple studies [19-21] have demonstrated Diabetes as a significant risk factor and those diabetics with a pre-operative blood glucose concentration $\geq$11.1 mmol\L are as much as ten times more likely to develop DSWI. Obesity increases the odds of DSWI by up to 2.6 times [22]. The same systematic review found no significant relationship between smoking and sternal wound infection, however only a small number of studies were included. Numerous papers have found it to be an independent risk factor for developing other SSI's and smaller studies have found it to be a risk factor for DSWI [23,24]. Routine nasal swabs for Staphylococcus colonization and routine intranasal mupirocin administration in combination with chlorhexidine gluconate bathing in the absence of nasal cultures or nasal cultures positive has been shown to significantly decrease the incidence of deep sternal wound infections following cardiac surgery [25].

During the pandemic, additional precautions were implemented within all hospital settings in the UK to minimise the risk of spreading COVID-19 (Table 1). These predominantly came in the form of additional PPE (including disposable gloves and aprons), for all clinical staff during patient interactions. The implementation of stricter hand-washing policies and reduced skin-to-skin contact (including post-operative physical examinations) was also adopted. Furthermore, face masks were mandatory for all hospital staff in all clinical areas and visitor numbers and the duration of visits were significantly lower.

There is an abundance of literature [7,8,17-19,25-27] focussing on pre-operative and operative techniques to minimise the risks of general surgical site infections and sternal wound infections. However, there are fewer studies [28-32] that focus on the impact of COVID-19 prevention measures on surgical site infection rates. Our results are consistent with findings by Hussain [28] who noticed a decrease in the incidence of sternal wound infection during the pandemic. It has been demonstrated that the consumption of personal protective equipment and products (PPEP) during the COVID-19 pandemic has led to a decrease in surgical site infections in patients after caesarean delivery [29] as well as after spinal surgery [30]. Hand hygiene is considered the cornerstone of the prevention of surgical wound infections [7,26]. It has been shown that hand hygiene's quality and frequency have significantly improved during the COVID-19 pandemic which led to a reduction in hospital infections [30,33].The use of personal protective equipment (PPE) was an essential addition to daily practice during the COVID-19 pandemic. Non-medical (fabric) masks were used by all workers working indoors or in close proximity to clients and co-workers as per WHO guidelines [34]. Despite the wide use of disposable surgical masks, its efficacy in wound infection prevention is unclear, and data are limited [35]. Nevertheless, the significant reduction in wound infections rates could be related to the routine use of PPE during the COVID-19 pandemic [30].

While some of the COVID-19 prevention measures have been eased (physical distancing, family visiting), this paper highlights the benefit of keeping others (rigorous hand hygiene, PPE in clinical areas, frequent cleaning and disinfection of environmental surfaces) in surgical departments.

References

1. Sharif M, Wong CHM, Harky A. Sternal wound infections, risk factors and management-how far are we? A literature review. Heart Lung Circ 2019;28:835-43.
2. Schiraldi L, Jabbour G, Centofanti P, et al. Deep sternal wound infections: Evidence for prevention, treatment, and reconstructive surgery. Arch Plast Surg 2019;46:291-302.
3. Cayci C, Russo M, Cheema F, et al. Risk analysis of deep sternal wound infections and their impact on long-term survival: a propensity analysis. Ann Plast Surg 2008;61:294-301.

4. Hever P, Singh P, Eiben I, et al. The management of deep sternal wound infection: Literature review and reconstructive algorithm. JPRAS Open 2021;28:77-89.
5. Jayakumar S, Khoynezhad A, Jahangiri M. Surgical site infections in cardiac surgery. Crit Care Clin 2020;36:581-92.
6. World Health Organization. Global guidelines for the prevention of surgical site infection. Available from: https://apps.who.int/iris/handle/10665/277399
7. World Health Organization. Patient safety. WHO guidelines on hand hygiene in health care: first global patient safety challenge clean care is safer care. Available from: https://apps.who.int/iris/bitstream/handle/10665/44102/9789241597906_eng.pdf
8. World Health Organization. Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19): interim guidance, 19 March 2020. Available from: https://apps.who.int/iris/handle/10665/331498
9. Honda H, Iwata K. Personal protective equipment and improving compliance among healthcare workers in high-risk settings. Curr Opin Infect Dis 2016;29:400-6.
10. Sharif M, Wong CHM, Harky A. Sternal wound infections, risk factors and management-how far are we? A literature review. Heart Lung Circ 2019;28:835-43.
11. Crabtree TD, Codd JE, Fraser VJ, et al. Multivariate analysis of risk factors for deep and superficial sternal infection after coronary artery bypass grafting at a tertiary care medical center. Semin Thorac Cardiovasc Surg 2004;16:53-61.
12. Ridderstolpe L, Gill H, Granfeldt H, et al. Superficial and deep sternal wound complications: incidence, risk factors and mortality. Eur J Cardiothorac Surg 2001;20:1168-75.
13. Schiraldi L, Jabbour G, Centofanti P, et al. Deep sternal wound infections: Evidence for prevention, treatment, and reconstructive surgery. Arch Plast Surg 2019;46:291-302.
14. Cayci C, Russo M, Cheema F, et al. Risk analysis of deep sternal wound infections and their impact on long-term survival: a propensity analysis. Ann Plast Surg 2008;61:294-301.
15. Sears ED, Wu L, Waljee JF, et al. The impact of deep sternal wound infection on mortality and resource utilization: a population-based study. World J Surg 2016;40:2673-80.
16. Graf K, Ott E, Vonberg RP, et al. Economic aspects of deep sternal wound infections. Eur J Cardiothorac Surg 2010;37:893-6.
17. Phoon PHY, Hwang NC. Deep sternal wound infection: diagnosis, treatment and prevention. J Cardiothorac Vasc Anesth 2020;34:1602-13.
18. Pradeep A, Rangasamy J, Varma PK. Recent developments in controlling sternal wound infection after cardiac surgery and measures to enhance sternal healing. Med Res Rev 2021;41:709-24.

19. Trick WE, Scheckler WE, Tokars JI, et al. Modifiable risk factors associated with deep sternal site infection after coronary artery bypass grafting. J Thorac Cardiovasc Surg 2000;119:108-14.
20. Martin ET, Kaye KS, Knott C, et al. Diabetes and risk of surgical site infection: a systematic review and meta-analysis. Infect Control Hosp Epidemiol 2016;37:88-99.
21. Furui M, Kong PK, Moorthy PSK, et al. Risk factors for sternal wound infection after coronary artery bypass grafting in patients with and without diabetes. Int Heart J 2022;63:426-32.
22. Balachandran S, Lee A, Denehy L, et al. Risk factors for sternal complications after cardiac operations: a systematic review. Ann Thorac Surg 2016;102:2109-17.
23. Colombier S, Kessler U, Ferrari E, et al. Influence of deep sternal wound infection on long-term survival after cardiac surgery. Med Sci Monit 2013;19:668.
24. Olsen MA, Lock-Buckley P, Hopkins D, et al. The risk factors for deep and superficial chest surgical-site infections after coronary artery bypass graft surgery are different. J Thorac Cardiovasc Surg 2002;124:136-45.
25. Bode LGM, Kluytmans JAJW, Wertheim HFL, et al. Preventing surgical-site infections in nasal carriers of Staphylococcus aureus. N Engl J Med 2010;362:9-17.
26. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. J Hosp Infect 2009;73:305-15.
27. Assadian O, Golling M, Krüger CM, et al. Surgical site infections: guidance for elective surgery during the SARS-CoV-2 pandemic - international recommendations and clinical experience. J Hosp Infect 2021;111: 89-99.
29. Hussain A, Ike DI, Durand-Hill M, Ibrahim S, Roberts N. Sternal wound infections during the COVID-19 pandemic: an unexpected benefit. Asian Cardiovasc Thorac Ann 2021;29:376-80.
30. Antonello VS, Dallé J, Antonello ICF, et al. Surgical site infection after cesarean delivery in times of COVID-19. Rev Bras Ginecol Obstet 2021;43:374-6.
31. Perna A, Maruccia F, Gorgoglione FL, et al. Increased frequency of hand hygiene and other infection prevention practices correlates with reduced surgical wound infection rates in spinal surgery during the COVID-19 pandemic. J Clin Med 2022;11:7528.
32. Sybert M, Oakley CT, Christensen T, et al. Impact of COVID-19 protocols on primary and revision total hip arthroplasty. J Arthroplasty 2022;37:2193-8.
33. Lazar HL. Commentary: Compliance with the American Association for Thoracic Surgery guidelines will prevent sternal wound infections and minimize postoperative complications in cardiac surgery patients during the COVID-19 pandemic. J Thorac Cardiovasc Surg 2020;160:e44-8.

34. Roshan R, Feroz AS, Rafique Z, Virani N. Rigorous hand hygiene practices among health care workers reduce hospital-associated infections during the COVID-19 pandemic. J Prim Care Community Health 2020;11:2150132720943331.
35. World Health Organization. Preventing and mitigating COVID-19 at work: policy brief, 19 May 2021. Available from: https://apps.who.int/iris/handle/10665/341328
36. Vincent M, Edwards P. Disposable surgical face masks for preventing surgical wound infection in clean surgery. Cochrane Database Syst Rev 2016;4:CD002929.

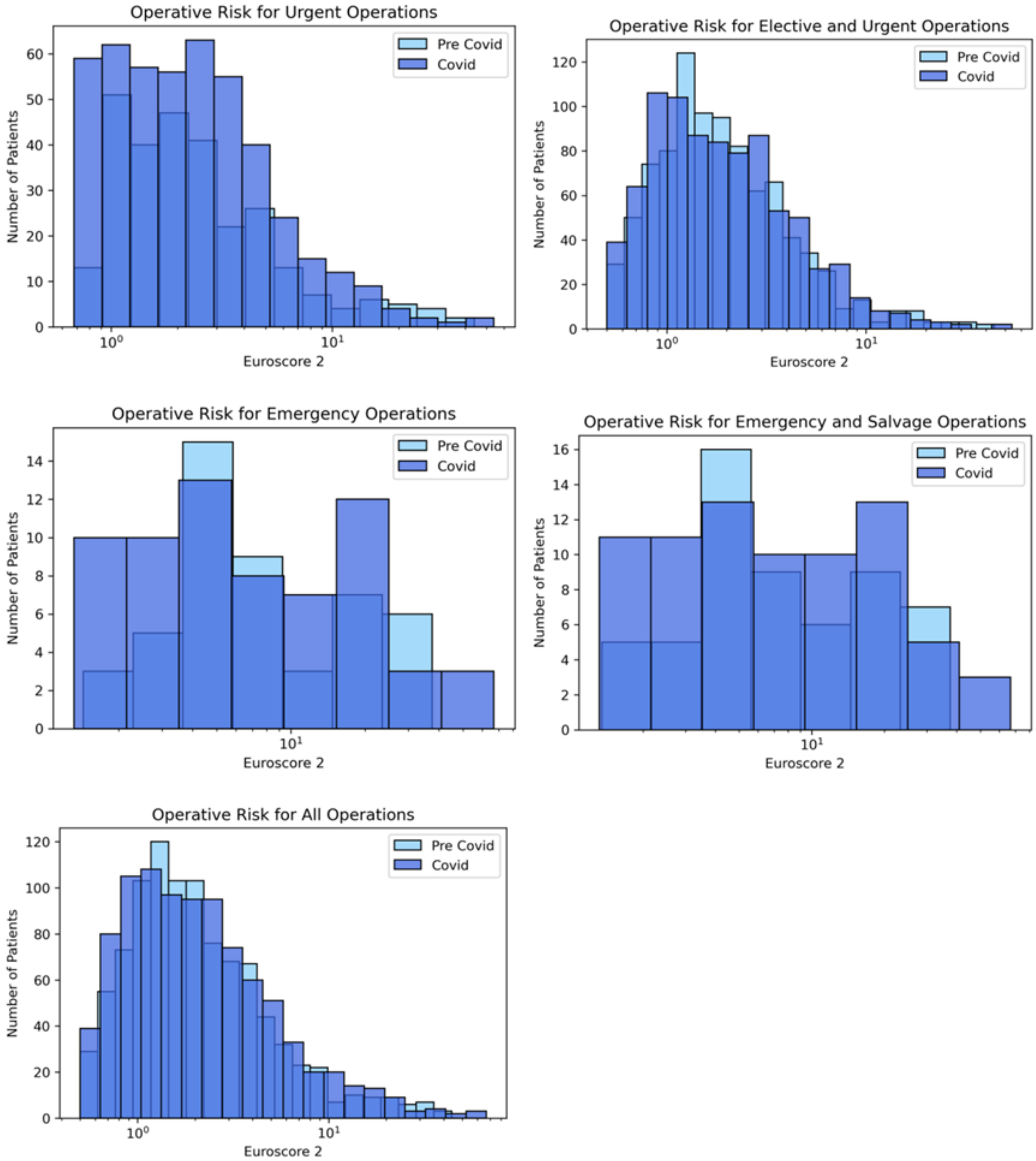

Figure 1. Euroscore II distributions: Distributions statistically similar enough to have come from the same parent distribution for the following urgency categories: Urgent, Emergency, Elective & Urgent, Emergency & Salvage and All.

Operative Urgency	Infection Type	Number of Operations Pre Covid	Number of Operations Post Covid	Infecion Proportion Pre Covid	Infecion Proportion Post Covid	p-value for Differences in Infection Proportion	Euroscore II Welsch t-test p-value	Significant Difference in Euroscore II Distributions?
Elective	Superficial Chest	631	388	0.00792393	0.005154639	0.603277483	0.059680687	Yes
Elective	Deep Chest	631	388	0.020602219	0.00257732	0.016387107	0.059680687	Yes
Elective	Mediastinitis	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Elective	Superficial Leg	333	206	0.018018018	0.009708738	0.438213586	0.059680687	Yes
Elective	Deep Leg	333	206	0.006006006	0	0.265115735	0.059680687	Yes
Elective	Any Chest	631	388	0.026941363	0.005154639	0.012542325	0.059680687	Yes
Elective	Any Leg	333	206	0.024024024	0.009708738	0.231383737	0.059680687	Yes
Elective	Any	631	388	0.041204437	0.010309278	0.004611082	0.059680687	Yes
Urgent	Superficial Chest	281	461	0.007117438	0.00867679	0.818047595	0.321319391	No
Urgent	Deep Chest	281	461	0.021352313	0.006507592	0.073155198	0.321319391	No
Urgent	Mediastinitis	281	461	0.007117438	0.002169197	0.302858274	0.321319391	No
Urgent	Superficial Leg	216	359	0.018518519	0	0.009669885	0.321319391	No
Urgent	Deep Leg	216	359	0	0.002785515	0.437542284	0.321319391	No
Urgent	Any Chest	281	461	0.03202847	0.017353579	0.19499401	0.321319391	No
Urgent	Any Leg	216	359	0.018518519	0.002785515	0.049082571	0.321319391	No
Urgent	Any	281	461	0.049822064	0.019522777	0.020888847	0.321319391	No
Emergency	Superficial Chest	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency	Deep Chest	48	68	0	0.014705882	0.398773883	0.712882564	No
Emergency	Mediastinitis	48	68	0.020833333	0	0.231930076	0.712882564	No
Emergency	Superficial Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency	Deep Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency	Any Chest	48	68	0.020833333	0.014705882	0.80282027	0.712882564	No
Emergency	Any Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency	Any	48	68	0.020833333	0.014705882	0.80282027	0.712882564	No
Salvage	Superficial Chest	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Deep Chest	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Mediastinitis	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Superficial Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Deep Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Any Chest	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Any Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Salvage	Any	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Elective & Urgent	Superficial Chest	912	849	0.007675439	0.007067138	0.881548039	0.999377851	No
Elective & Urgent	Deep Chest	912	849	0.020833333	0.004711425	0.002905654	0.999377851	No
Elective & Urgent	Mediastinitis	912	849	0.002192982	0.001177856	0.605745527	0.999377851	No
Elective & Urgent	Superficial Leg	549	565	0.018214936	0.003539823	0.017682064	0.999377851	No
Elective & Urgent	Deep Leg	549	565	0.003642987	0.001769912	0.546440923	0.999377851	No
Elective & Urgent	Any Chest	912	849	0.028508772	0.011778563	0.013173027	0.999377851	No
Elective & Urgent	Any Leg	549	565	0.021857923	0.005309735	0.016582033	0.999377851	No
Elective & Urgent	Any	912	849	0.043859649	0.015312132	0.000458974	0.999377851	No
Emergency & Salvage	Superficial Chest	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency & Salvage	Deep Chest	57	83	0	0.012048193	0.405590953	0.57224968	No
Emergency & Salvage	Mediastinitis	57	83	0.01754386	0	0.225880344	0.57224968	No
Emergency & Salvage	Superficial Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency & Salvage	Deep Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency & Salvage	Any Chest	57	83	0.01754386	0.012048193	0.787760853	0.57224968	No
Emergency & Salvage	Any Leg	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Emergency & Salvage	Any	57	83	0.01754386	0.012048193	0.787760853	0.57224968	No
All	Superficial Chest	969	932	0.007223942	0.006437768	0.835287461	0.272571438	No
All	Deep Chest	969	932	0.019607843	0.005364807	0.005427223	0.272571438	No
All	Mediastinitis	969	932	0.003095975	0.001072961	0.335914936	0.272571438	No
All	Superficial Leg	568	588	0.017605634	0.003401361	0.017214955	0.272571438	No
All	Deep Leg	568	588	0.003521127	0.00170068	0.543056721	0.272571438	No
All	Any Chest	969	932	0.027863777	0.011802575	0.012378876	0.272571438	No
All	Any Leg	568	588	0.021126761	0.005102041	0.016092068	0.272571438	No
All	Any	969	932	0.042311662	0.015021459	0.000387124	0.272571438	No

Figure 2. Cardiac surgical patients stratified by operative urgency and wound infection type.

Operative Urgency	Infection Type	Number of Operations Pre Covid	Number of Operations Post Covid	Infecion Proportion Pre Covid	Infecion Proportion Post Covid	p-value for Differences in Infection	Euroscore II Welsch t-test p-value	Significant Difference in Euroscore II
Urgent	Superficial Leg	216	359	0.018518519	0	0.009669885	0.321319391	No
Urgent	Any Leg	216	359	0.018518519	0.002785515	0.049082571	0.321319391	No
Urgent	Any	281	461	0.049822064	0.019522777	0.020888847	0.321319391	No
Elective & Urgent	Deep Chest	912	849	0.020833333	0.004711425	0.002905654	0.999377851	No
Elective & Urgent	Superficial Leg	549	565	0.018214936	0.003539823	0.017682064	0.999377851	No
Elective & Urgent	Any Chest	912	849	0.028508772	0.011778563	0.013173027	0.999377851	No
Elective & Urgent	Any Leg	549	565	0.021857923	0.005309735	0.016582033	0.999377851	No
Elective & Urgent	Any	912	849	0.043859649	0.015312132	0.000458974	0.999377851	No
All	Deep Chest	969	932	0.019607843	0.005364807	0.005427223	0.272571438	No
All	Superficial Leg	568	588	0.017605634	0.003401361	0.017214955	0.272571438	No
All	Any Chest	969	932	0.027863777	0.011802575	0.012378876	0.272571438	No
All	Any Leg	568	588	0.021126761	0.005102041	0.016092068	0.272571438	No
All	Any	969	932	0.042311662	0.015021459	0.000387124	0.272571438	No

Figure 3. Statistically significant differences in infection rates.

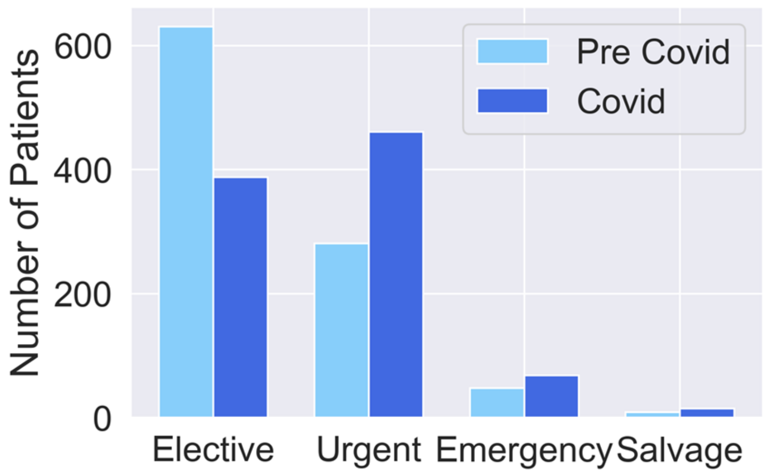

Figure 4. Operative urgency.

Table 1. COVID-19 prevention measures applied in our Trust during the pandemic.

Measure	Pre COVID	During COVID
Physical distancing	Not applied	Applied at least 6 inches
Hand hygiene	After patient physical contact and after touching any soiled equipment	Mandatory after dealing with any patients up to patient files
Cleaning and disinfection of environmental surfaces	Routine decontamination and sterilization of surfaces and equipment	More frequent decontamination of surfaces, walls, keyboards, personal equipment including phones and luggage of the patients and the healthcare professionals
Personal protective equipment	Only on designated clinical areas (theatres, Intensive care)	In all clinical and non-clinical areas with upgrade to higher protective equipment (FFP3) when dealing with covid positive patients or in COVID wards
Family visiting	Relaxed visiting policy with no restriction in time or number of visitors	It varied during the COVID period and ranged from non-visiting policy, moving to limited in number and timing with COVID negative proof