OXFORD

BJS, 2021, **108**, 88–96
DOI: 10.1093/bjs/znaa051
Advance Access Publication Date: 11 November 2020
Original Article

Preoperative nasopharyngeal swab testing and postoperative pulmonary complications in patients undergoing elective surgery during the SARS-CoV-2 pandemic

COVIDSurg Collaborative*

Members of the COVIDSurg Collaborative are co-authors of this study and are listed in *Appendix S1*

*Correspondence to: NIHR Global Health Research Unit on Global Surgery, Heritage Building, University of Birmingham, Mindelsohn Way, Birmingham B15 2TH, UK (e-mail: a.a.bhangu@bham.ac.uk)

Abstract

Background: Surgical services are preparing to scale up in areas affected by COVID-19. This study aimed to evaluate the association between preoperative SARS-CoV-2 testing and postoperative pulmonary complications in patients undergoing elective cancer surgery.

Methods: This international cohort study included adult patients undergoing elective surgery for cancer in areas affected by SARS-CoV-2 up to 19 April 2020. Patients suspected of SARS-CoV-2 infection before operation were excluded. The primary outcome measure was postoperative pulmonary complications at 30 days after surgery. Preoperative testing strategies were adjusted for confounding using mixed-effects models.

Results: Of 8784 patients (432 hospitals, 53 countries), 2303 patients (26.2 per cent) underwent preoperative testing: 1458 (16.6 per cent) had a swab test, 521 (5.9 per cent) CT only, and 324 (3.7 per cent) swab and CT. Pulmonary complications occurred in 3.9 per cent, whereas SARS-CoV-2 infection was confirmed in 2.6 per cent. After risk adjustment, having at least one negative preoperative nasopharyngeal swab test (adjusted odds ratio 0.68, 95 per cent confidence interval 0.68 to 0.98; $P = 0.040$) was associated with a lower rate of pulmonary complications. Swab testing was beneficial before major surgery and in areas with a high 14-day SARS-CoV-2 case notification rate, but not before minor surgery or in low-risk areas. To prevent one pulmonary complication, the number needed to swab test before major or minor surgery was 18 and 48 respectively in high-risk areas, and 73 and 387 in low-risk areas.

Conclusion: Preoperative nasopharyngeal swab testing was beneficial before major surgery and in high SARS-CoV-2 risk areas. There was no proven benefit of swab testing before minor surgery in low-risk areas.

Introduction

Globally, at least 28 million elective operations have been cancelled as a result of the first SARS-CoV-2 pandemic wave[1]. During the initial phases, operations in affected hospitals were identified as carrying significant risk, with perioperative SARS-CoV-2 infection leading to a far higher rate of pulmonary complications than before the pandemic[2]. Once established, a SARS-CoV-2 postoperative pulmonary complication was associated with a 23.8 per cent mortality rate, compared with a rate of 2 per cent without SARS-CoV-2[3]. Because of this, restarting elective surgery has proved challenging, with many millions more operations being postponed every month.

Healthcare providers have continued some time-dependent surgery (such as operations for cancer) and are gearing up to provide other essential types of elective surgery. The role of preoperative testing for SARS-CoV-2 in these surgical pathways is unproven. On one hand, it has the potential to optimize outcomes by identifying presymptomatic patients with SARS-CoV-2 infection for whom surgery can be postponed. On the other, there is a time and cost burden of testing, with uncertainty around the best strategy and variable global availability[4–6]. The mainstay of testing is nasopharyngeal swab test with quantitative reverse transcriptase–PCR (RT–qPCR) to detect SARS-CoV-2 viral RNA[7,8], although preoperative CT has also been suggested, especially before major surgery[9].

To support the global implementation of testing before elective surgery, better evidence is needed to support its role and to identify patients who will benefit most. This includes the role of routine testing before major and minor surgery, and in high and low SARS-CoV-2 risk areas. Elective cancer surgery performed during the early pandemic allows assessment of the performance of preoperative testing, and acts as a surrogate for other elective operations. This study aimed to evaluate the association between preoperative testing and postoperative pulmonary complications

Received: September 15, 2020. **Accepted:** September 22, 2020

in patients undergoing elective cancer surgery in areas affected by the SARS-CoV-2 pandemic.

Methods

This was an international multicentre cohort study of adults undergoing elective cancer surgery in areas affected by the SARS-CoV-2 pandemic who were not suspected of SARS-CoV-2 infection before surgery. Local investigators were responsible for obtaining local approvals in line with applicable regulations. Data were collected online and stored on a secure data server running the Research Electronic Data Capture (REDCap) web application[10]. The study protocol was registered at ClinicalTrials.gov (NCT04384926) and has been reported in detail previously[11].

Patients and procedures

Adult patients (18 years and over) undergoing elective surgery with curative intent for a suspected cancer were included. Centres were required to include consecutive patients undergoing surgery for an eligible cancer type. Ten common surgical oncology disciplines were included spanning colorectal, oesophagogastric, head and neck, thoracic, hepatopancreatobiliary, urological, gynaecological, breast, sarcoma, and intracranial tumours. Participating centres were allowed to include one or more cancer types. Eligible patients were identified from multidisciplinary team meeting lists, operating lists, outpatient clinics, and inpatient wards. Patients were followed for up to 30 days from the day of surgery (day 0).

Patients who had symptoms of COVID-19 or who were confirmed to have SARS-CoV-2 infection at the time of surgery (by qRT–PCR and/or imaging by thoracic CT in the 7 days before surgery) were excluded from this study. This study therefore included only patients who were not suspected of having SARS-CoV-2 at the time of surgery. Data were not collected on patients who were identified as being SARS-CoV-2-positive and for whom surgery was postponed.

Centres and settings

Any hospital performing elective cancer surgery during the SARS-CoV-2 pandemic was eligible to participate. Centres enrolled consecutive patients from the date the first patient infected with SARS-CoV-2 was admitted to their hospital up to 19 April 2020.

Preoperative testing strategies

Preoperative testing was defined as any test used for the identification of a patient's SARS-CoV-2 status in the 7 days before surgery. Four preoperative testing strategies were included in this analysis: swab test, defined as nasopharyngeal swab and identification of viral RNA by RT–qPCR, according to local protocols; imaging by thoracic CT only; swab test and CT; and no test. The timing of swab testing was categorized as: single swab test on day 4–7 before operation; single swab test on day 1–3 before operation; or repeat swab, defined as one or more swabs on day 1–3 and day 4–7 before surgery.

Outcome measures

The primary outcome measure was the rate of postoperative pulmonary complications within 30 days after surgery. This included pneumonia, acute respiratory distress syndrome, and/or unexpected postoperative ventilation. The secondary outcome measures were postoperative SARS-CoV-2 infection and mortality within 30 days after surgery. Postoperative SARS-CoV-2 infection was defined by a positive swab test, thoracic CT, or clinical diagnosis of symptomatic COVID-19 in patients for whom a swab test and CT were unavailable.

Variables used in patient-level risk adjustment

Clinically plausible variables likely to be associated with the primary outcome measure were collected to allow risk adjustment. A patient's preoperative health and functional status was summarized using age, sex, BMI, respiratory condition, Revised Cardiac Risk Index score, and ASA fitness grade. The body cavity accessed during surgery was classified as thoracic or thoracoabdominal, abdominal or other. To account for different tumour staging systems across cancer types, disease status was classified as early stage (organ-confined, non-nodal, non-metastatic, fully resectable) or advanced stage (growth beyond organ, nodal, metastatic operated with curative intent). Grade of surgery was assigned based on the Clinical Coding & Schedule Development Group classification[12] as either minor (minor/intermediate) or major (major/complex major). The community SARS-CoV-2 14-day case notification rate at the time of surgery in each participating hospital's local community was extracted from WHO[13], European Centre for Disease Prevention and Control[14], or US Centers for Disease Control and Prevention statistics. Hospitals were classified as being in communities with either a low (fewer than 25 cases per 100 000 population) or high (25 or more cases per 100 000 population) SARS-CoV-2 risk. Each patient was classified as undergoing surgery within a COVID-19-free surgical pathway or with no defined pathway[11]. Patients were considered to have been treated within a COVID-19-free pathway if there was a policy of complete segregation from patients with COVID-19 away from the operating room, critical care, and inpatient ward.

Data validation

Studies adopting this collaborative cohort study methodology have achieved high levels of case ascertainment and data accuracy with external validation[15,16]. In the present study, low-volume centres (fewer than 5 patients per specialty group) were identified, and reviewed independently to confirm complete case ascertainment. Where specialty teams could not confirm complete case ascertainment, all data were excluded from analysis.

Statistical analysis

The study was conducted according to STROBE[17] and reported according to SAMPL[18] guidelines. Missing data were recorded in summary tables where applicable. The χ^2 test was used for analysis of categorical data.

Hierarchical, multilevel univariable and multivariable logistic regression models were used to examine associations between preoperative testing strategy and the primary outcome measure, summarized as adjusted odds ratios (ORs) with 95 per cent confidence intervals. Clinically plausible patient-, disease-, operation- and location-specific factors were selected *a priori* for inclusion in adjusted analyses in order to identify independent predictors of postoperative pulmonary complications (primary outcome). Country was included as a random effect in the adjusted models. Number needed to test (NNT) was calculated as 1/ARR, where ARR is the adjusted absolute risk reduction. NNT is interpreted as the number of subjects who need to be tested to prevent an additional pulmonary complication. As the mainstay of current testing protocols, it was predicted that the most common preoperative test would be nasopharyngeal swab test. It was preplanned to explore the impact of swab tests on two key

subgroups: high *versus* low SARS-CoV-2 risk, and major *versus* minor operations.

Analyses were carried out using the R version 3.1.1 (packages finalfit, tidyverse and ggplot2) (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of 9171 patients included in this study, 8784 (95.8 per cent) had data available on preoperative testing and were included in the analysis. Operations were performed in 432 hospitals from 53 countries, of which 6746 (76.8 per cent) were major, and 1087 (12.4 per cent) were performed in high SARS-CoV-2 risk areas. A full list of included operations grouped by preoperative testing strategy is shown in *Table S1*.

Preoperative testing strategies

Overall, 2303 of 8784 patients (26.2 per cent) underwent preoperative testing. This included 1458 (16.6 per cent) who had a swab test, 521 (5.9 per cent) who had CT only, and 324 (3.7 per cent) who had a swab and CT. There was significant variation in the proportion of patients who underwent testing at country level (*Fig. 1*). The overall proportion of patients tested increased over the study period (*Fig. S1*).

There were several differences between groups with different preoperative testing strategies. Patients undergoing testing were more likely to have surgery in a high SARS-CoV-2 risk area and be treated within a COVID-19-free surgical pathway (*Table 1*). In general, higher-risk patients (for example with a higher performance score or advanced cancer) were more likely to have a swab test than no test. Of 1458 patients who had swab testing, 164 (11.2 per cent) were tested on preoperative day 4–7, 1213 (83.2 per cent) had a single swab on preoperative day 1–3, and just 63 (4.3 per cent) had repeat swabs. The groups undergoing CT either alone or with a swab test more commonly underwent thoracic or thoracoabdominal surgery, or had advanced disease.

Pulmonary complications

The overall postoperative pulmonary complication rate was 3.9 per cent (346 of 8784). This was higher in patients who had no test (4.2 per cent, 272 of 6481) or CT only (4.8 per cent, 25 of 521) than in those who had a swab test (2.8 per cent, 41 of 1458), or swab and CT (2.5 per cent, 8 of 324) ($P=0.031$). After adjustment, a swab test was associated with reduced pulmonary complications (adjusted OR 0.68, 95 per cent c.i. 0.47 to 0.98, $P=0.040$) (*Table S2*); CT only, or swab and CT were not (*Fig. 2*). This was consistent in a sensitivity analysis with potentially missing data excluded (*Table S7*). There was no additional benefit from repeat swab testing beyond a single swab on preoperative day 1–3 (*Table 2*).

Subgroup analyses

Swab testing was associated with a reduction in pulmonary complications in high-risk areas (adjusted OR 0.25, 95 per cent c.i. 0.09 to 0.76; $P=0.014$) (*Table S3*), but not in low-risk areas (adjusted OR 0.72, 0.48 to 1.08, $P=0.108$) (*Table S4*). Swab testing was associated with a reduction in pulmonary complications after major surgery (adjusted OR 0.63, 0.42 to 0.93; $P=0.019$) (*Table S5*), but not after minor surgery (adjusted OR 0.58, 0.16 to 2.13; $P=0.413$) (*Table S6*). A summary of subgroup models is shown in *Fig. 3*.

The NNT to prevent one postoperative pulmonary complication across subgroups is shown in *Table 3*. This reduced across major (NNT 18) and minor (NNT 48) surgery in high-risk areas, and major (NNT 73) and minor (NNT 387) surgery in low-risk areas.

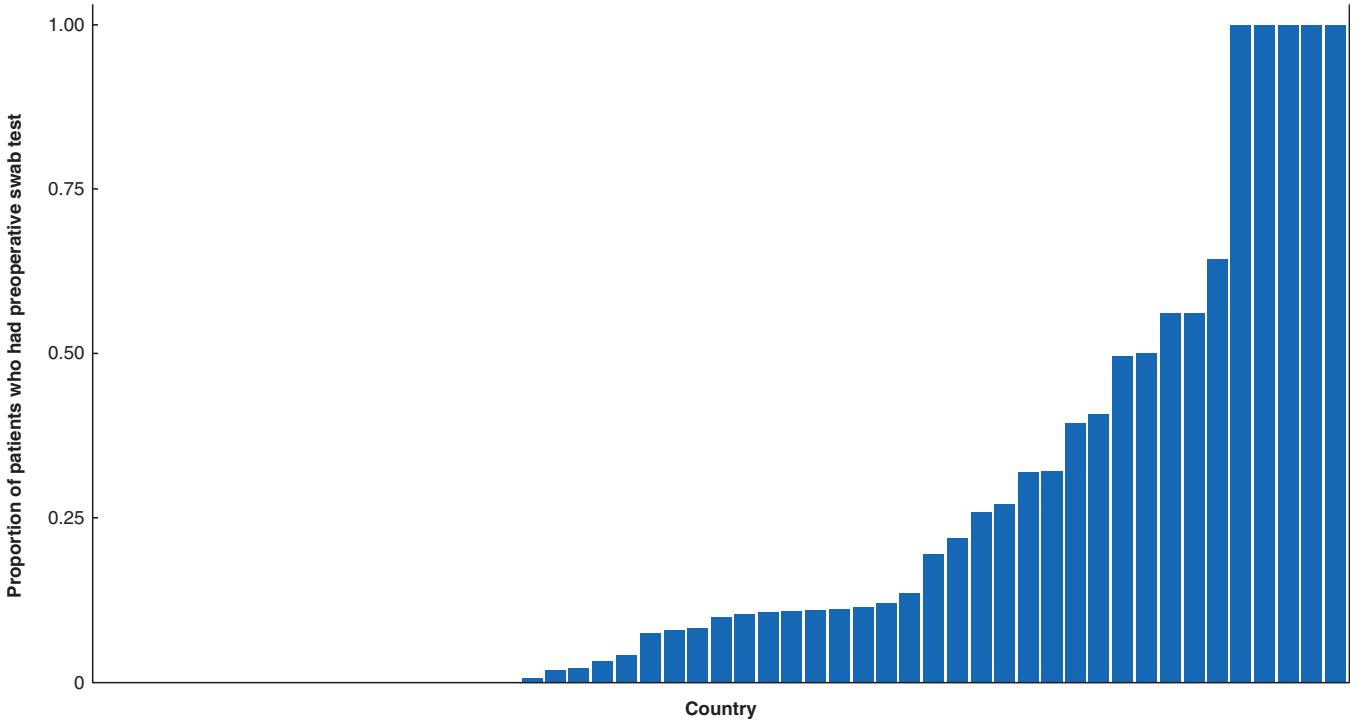


Fig. 1 Variation in preoperative swab testing rates across included countries

Each bar represents one country. Contributing countries were anonymized in accordance with the study protocol. Swab, nasopharyngeal swab and identification of viral RNA by reverse transcriptase– quantitative PCR, according to local protocols, with or without addition of thoracic CT.

Table 1. Comparison of patients by type of preoperative testing

	No test ($n=6481$)	Swab only ($n=1458$)	CT only ($n=521$)	Swab + CT ($n=324$)	P^*
Age (years)					0.069
< 50	1212 (18.7)	227 (15.6)	95 (18.2)	52 (16.0)	
50–59	1393 (21.5)	296 (20.3)	120 (23.0)	84 (25.9)	
60–69	1786 (27.6)	413 (28.3)	140 (26.9)	93 (28.7)	
70–79	1571 (24.2)	381 (26.1)	128 (24.6)	73 (22.5)	
≥ 80	519 (8.0)	141 (9.7)	38 (7.3)	22 (6.8)	
Sex					0.056
Female	4000 (61.7)	844 (57.9)	320 (61.4)	195 (60.2)	
Male	2479 (38.3)	614 (42.1)	201 (38.6)	129 (39.8)	
Missing	2	0	0	0	
BMI					< 0.001
Normal	2406 (40.4)	665 (46.4)	227 (44.6)	114 (35.5)	
Overweight	1974 (33.2)	467 (32.6)	184 (36.1)	123 (38.3)	
Obese	1421 (23.9)	262 (18.3)	83 (16.3)	75 (23.4)	
Underweight	149 (2.5)	38 (2.7)	15 (2.9)	9 (2.8)	
Missing	531	26	12	3	
ASA fitness grade					< 0.001
I–II	4655 (72.2)	999 (68.5)	412 (79.2)	257 (79.3)	
III–V	1792 (27.8)	459 (31.5)	108 (20.8)	67 (20.7)	
Missing	34	0	1	0	
Revised Cardiac Risk Index score					< 0.001
0	2147 (33.1)	482 (33.1)	125 (24.0)	43 (13.3)	
1	3175 (49.0)	727 (49.9)	301 (57.8)	220 (67.9)	
2	923 (14.2)	212 (14.5)	81 (15.5)	49 (15.1)	
≥ 3	236 (3.6)	37 (2.5)	14 (2.7)	12 (3.7)	
Respiratory co-morbidity					0.915
No	5771 (89.0)	1302 (89.3)	469 (90.0)	289 (89.2)	
Yes	710 (11.0)	156 (10.7)	52 (10.0)	35 (10.8)	
ECOG performance score					< 0.001
0	4115 (64.7)	842 (58.1)	338 (64.9)	220 (67.9)	
≥ 1	2247 (35.3)	606 (41.9)	183 (35.1)	104 (32.1)	
Missing	119	10	0	0	
Cancer type					< 0.001
Abdominal	3430 (52.9)	784 (53.8)	327 (62.8)	238 (73.5)	
Thoracic or thoracoabdominal	471 (7.3)	79 (5.4)	44 (8.4)	38 (11.7)	
Other	2580 (39.8)	595 (40.8)	150 (28.8)	48 (14.8)	
Disease stage					< 0.001
Early	4664 (72.0)	1029 (70.6)	356 (68.3)	193 (59.8)	
Advanced	1814 (28.0)	429 (29.4)	165 (31.7)	130 (40.2)	
Missing	3	0	0	1	
Anaesthetic					< 0.001
General	6137 (94.7)	1365 (93.6)	510 (97.9)	316 (97.5)	
Regional/local	344 (5.3)	93 (6.4)	11 (2.1)	8 (2.5)	
Operation grade					< 0.001
Minor	1529 (23.7)	349 (24.0)	90 (17.3)	37 (11.4)	
Major	4921 (76.3)	1107 (76.0)	431 (82.7)	287 (88.6)	
Missing	31	2	0	0	
Hospital type					< 0.001
No defined pathway	5033 (77.7)	1070 (73.4)	217 (41.7)	120 (37.0)	
COVID-19-free surgical pathway	1447 (22.3)	388 (26.6)	304 (58.3)	204 (63.0)	
Community SARS-CoV-2 risk					< 0.001
Low	5907 (91.1)	1258 (86.3)	331 (63.5)	201 (62.0)	
High	575 (8.9)	200 (13.7)	190 (36.5)	123 (38.0)	

Values in parentheses are percentages. CT, imaging by thoracic CT; ECOG, Eastern Cooperative Oncology Group.
*χ^2 test.

Postoperative detection of SARS-CoV-2 and mortality

SARS-CoV-2 infection and mortality rates by preoperative testing strategy are reported in *Table 4*. The unadjusted rate of SARS-CoV-2 was lower in all groups that were tested before surgery than among those who were not tested ($P < 0.001$). The difference was greatest between swab test only (0.5 per cent, 7 of 1458) and no test (3.2 per cent, 209 of 6481). The mortality rate was lower in the group that had swab tests (0.8 per cent, 12 of 1458) or swab test and CT (0.6 per cent, 2 of 324) than in patients who were not

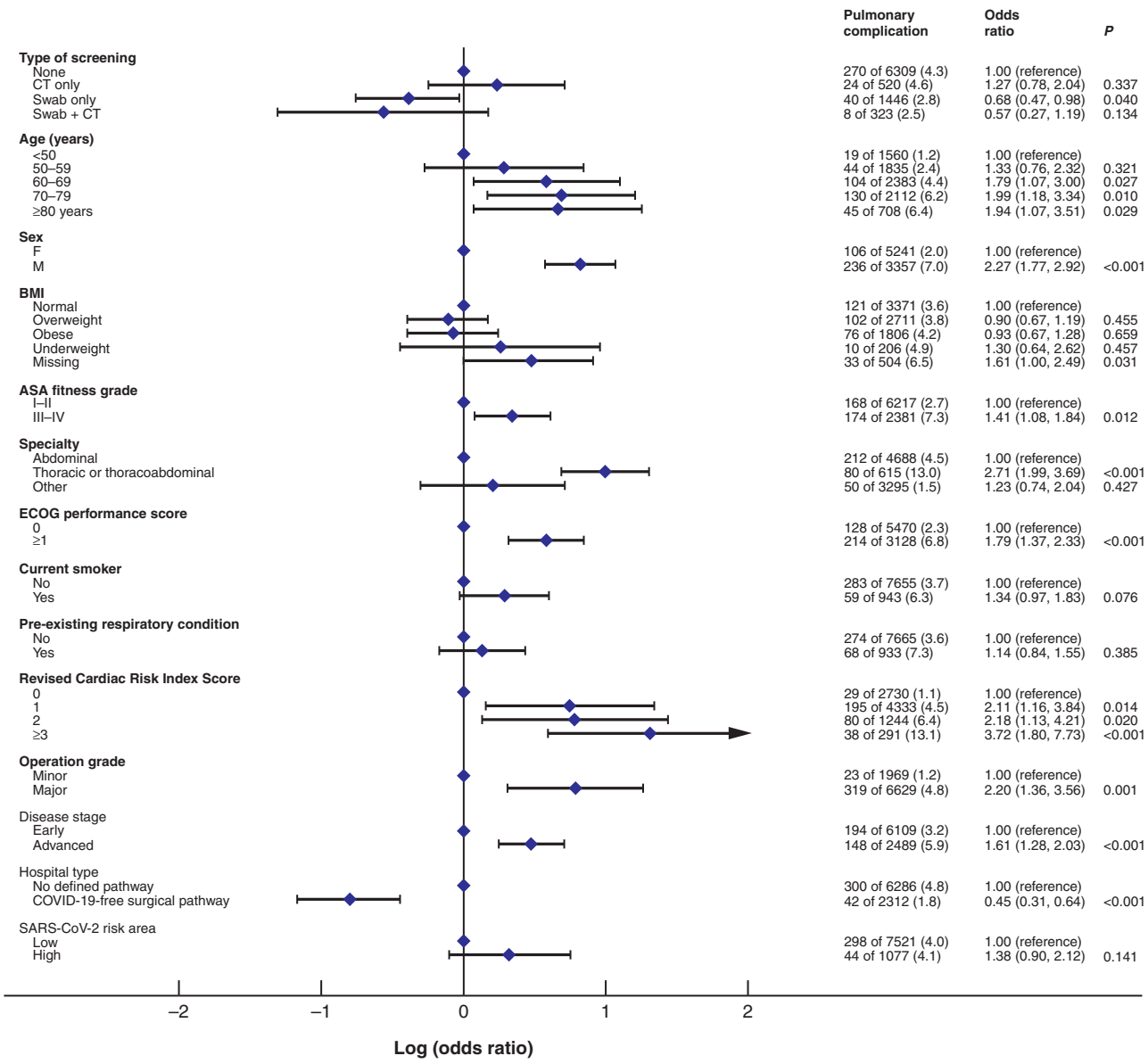


Fig. 2 Factors associated with postoperative pulmonary complications in the mixed-effects model.

Values in parentheses are *percentages and †95 per cent confidence intervals. The rate of missing data for variables included in the model was less than 1 per cent, except for BMI (6 per cent), where 'missing' was included as an additional factor level. Area under the receiver operating characteristic curve for model is 0.81 (excellent discrimination). CT, imaging by thoracic CT; ECOG, Eastern Cooperative Oncology Group.

tested (1.6 per cent, 104 of 6841), although this was not statistically significant ($P = 0.072$).

Discussion

In this study, a preoperative nasopharyngeal swab test with RT–qPCR to detect SARS-CoV-2 in asymptomatic patients was associated with a reduced rate of postoperative pulmonary complications. The main benefit was seen in major surgery and in areas with a high 14-day case notification rate. No clear benefit was seen in minor surgery performed in low-risk areas. There was no benefit from the addition of preoperative thoracic CT or repeat swabs. The results allow the authors to make practice-changing recommendations. A single preoperative swab should be performed for patients with no clinical suspicion of COVID-19 before major surgery in both high- and low-risk areas, and before minor surgery in high-risk areas. The NNT values presented for these groups provide evidence to support implementation by healthcare providers, based on locally available resources.

The beneficial effect of swab testing was likely to result from identification of presymptomatic or asymptomatic patients before admission, who could then have surgery delayed. This effect is mediated by two mechanisms. First, it stops presymptomatic patients developing severe, symptomatic disease (COVID-19) after operation. Second, it prevents cross-infection from asymptomatic patients to other patients scheduled for elective surgery on admission to hospital. To reinforce these benefits, preoperative swab testing should not be considered in isolation, but as part of a broader strategy to reduce SARS-CoV-2 exposure, including dedicated COVID-19-free surgical pathways[11].

Table 2. Univariable and multivariable logistic regression analyses of association between timing and number of preoperative swab tests and postoperative pulmonary complications

	Odds ratio		*P*
	Unadjusted model	Adjusted model	
Screening type			
None	1.00 (reference)	1.00 (reference)	
1 swab, 4–7 days before surgery	0.36 (0.11, 1.13)	0.33 (0.10, 1.08)	0.067
1 swab, 1–3 days before surgery	0.65 (0.46, 0.91)	0.66 (0.46, 0.94)	0.023
Repeat swabs*	0.30 (0.04, 2.15)	0.34 (0.05, 2.50)	0.288
Age (years)			
< 50	1.00 (reference)	1.00 (reference)	
50–59	1.77 (0.97, 3.24)	1.24 (0.67, 2.29)	0.498
60–69	3.50 (2.04, 6.00)	1.79 (1.02, 3.14)	0.042
70–79	4.84 (2.84, 8.24)	1.93 (1.10, 3.40)	0.023
≥ 80	4.81 (2.65, 8.73)	1.84 (0.97, 3.51)	0.064
Sex			
Female	1.00 (reference)	1.00 (reference)	
Male	3.41 (2.63, 4.42)	2.15 (1.63, 2.83)	< 0.001
BMI			
Normal	1.00 (reference)	1.00 (reference)	
Overweight	1.06 (0.78, 1.45)	0.88 (0.64, 1.22)	0.445
Obese	1.23 (0.89, 1.71)	0.92 (0.65, 1.31)	0.652
Underweight	1.22 (0.55, 2.67)	1.12 (0.50, 2.53)	0.786
Missing	1.75 (1.15, 2.64)	1.63 (1.05, 2.53)	0.030
ASA fitness grade			
I–II	1.00 (reference)	1.00 (reference)	
III–V	2.61 (2.05, 3.33)	1.27 (0.96, 1.70)	0.097
Specialty			
Abdominal	1.00 (reference)	1.00 (reference)	
Thoracic or thoracoabdominal	3.05 (2.23, 4.18)	2.62 (1.86, 3.69)	< 0.001
Other	0.33 (0.23, 0.46)	1.13 (0.65, 1.97)	0.674
ECOG performance score			
0	1.00 (reference)	1.00 (reference)	
≥ 1	2.99 (2.33, 3.85)	1.87 (1.40, 2.49)	< 0.001
Current smoker			
No	1.00 (reference)	1.00 (reference)	
Yes	1.68 (0.23, 2.58)	1.34 (0.94, 1.91)	0.108
Pre-existing respiratory condition			
No	1.00 (reference)	1.00 (reference)	
Yes	2.20 (1.62, 2.98)	1.29 (0.92, 1.80)	0.138
Revised Cardiac Risk Index score			
0	1.00 (reference)	1.00 (reference)	
1	4.18 (2.73, 6.40)	1.97 (1.02, 3.78)	0.042
2	6.10 (3.82, 9.74)	2.05 (1.00, 4.18)	0.050
≥ 3	10.83 (6.16, 19.02)	2.86 (1.27, 6.42)	0.011
Operation grade			
Minor	1.00 (reference)	1.00 (reference)	
Major	4.22 (2.66, 6.67)	2.23 (1.33, 3.74)	0.002
Disease stage			
Early	1.00 (reference)	1.00 (reference)	
Advanced	2.15 (1.69, 2.75)	1.74 (1.35, 2.25)	< 0.001
Hospital type			
No defined pathway	1.00 (reference)	1.00 (reference)	
COVID-19-free surgical pathway	0.40 (0.26, 0.59)	0.55 (0.36, 0.84)	0.006
Community SARS-CoV-2 risk			
Low	1.00 (reference)	1.00 (reference)	
High	1.43 (1.01, 2.02)	1.54 (1.06, 2.22)	0.023

Values in parentheses are 95 per cent confidence intervals. Data from 6217 patients with complete data were included in the analysis.
*One or more swabs on day 1–3 and day 4–7 before surgery. CT, imaging by thoracic CT; ECOG, Eastern Cooperative Oncology Group. Area under the receiver operating characteristic curve for model is 0.80 (excellent discrimination).

This study did not aim to evaluate the diagnostic accuracy of swab testing, which has been explored in detail elsewhere[7,8,19,20]. Although the present data did not show a clear benefit to repeat swab testing, only a small group of patients received two or more tests. There is a documented false-negative rate of RT–qPCR from a nasopharyngeal swab test, with an estimated sensitivity of 73.3 (95 per cent c.i. 68.1 to 78.0) per cent[20]. For those identified to be at highest baseline risk of pulmonary complications and/or SARS-CoV-2 infection, for example older patients, those with worse functional status, or those undergoing thoracoabdominal surgery, there may still be a role for selective repeat swabbing. As understanding of the diagnostic accuracy of SARS-CoV-2 tests evolves over time, new testing strategies (such as serology) may be integrated into this pathway.

This study demonstrated major country-by-country variation in the application of preoperative testing. The results call for global expansion and standardization of swab testing worldwide. The reasons for this variation need to be better understood, including relationships with health system resourcing and policy[4,5]. In the present data, the testing rate increased over time from less

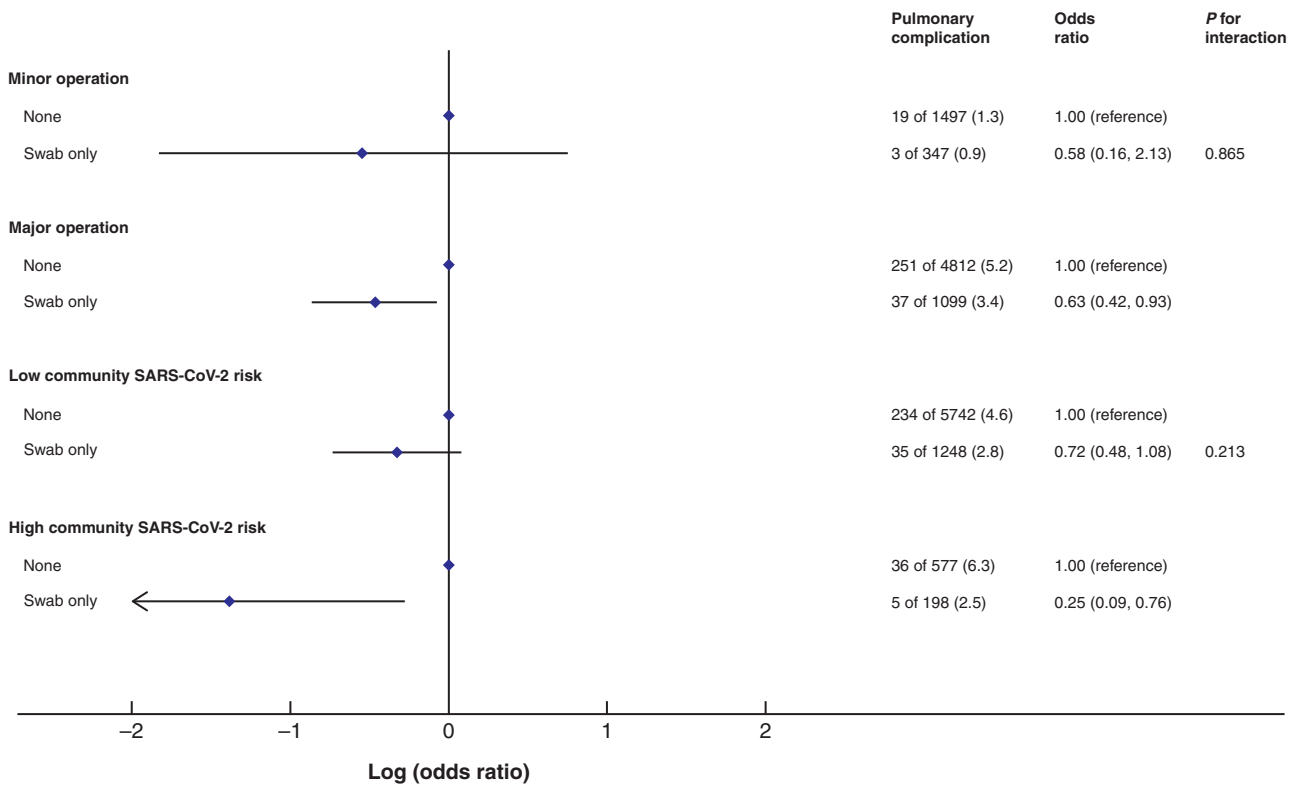


Fig. 3 Summary of subgroup analyses of swab testing in different patient populations

Values in parentheses are *percentages and †95 per cent confidence intervals. Grade of surgery was assigned based on the Clinical Coding & Schedule Development Group categories as either minor (minor/intermediate) or major (major/complex major). The community SARS-CoV-2 risk at the time of surgery within each participating hospital's local community was classified as either low (fewer than 25 cases per 100 000 population) or high (25 or more cases per 100 000 population).

Table 3. Number needed to test to prevent one postoperative pulmonary complication through preoperative SARS-CoV-2 swab testing

	Pulmonary complications		Adjusted ARR (%)	NNT
	No test	Swab test		
Major surgery, high-risk area	33 of 429 (7.7)	5 of 134 (3.7)	5.67	18
Minor surgery, high-risk area	3 of 144 (2.1)	0 of 66 (0)	2.10*	48
Major surgery, low-risk area	219 of 4492 (4.9)	33 of 973 (3.4)	1.37	73
Minor surgery, low-risk area	16 of 1385 (1.2)	3 of 283 (1.1)	0.26	387

Values in parentheses are percentages.
*Estimate from unadjusted model as model adjustment not possible. ARR, absolute risk reduction; NNT, number needed to test, rounded up to nearest whole person. Grade of surgery was assigned based on the Clinical Coding & Schedule Development Group categories as either minor (minor/intermediate) or major (major/complex major). The community SARS-CoV-2 risk at the time of surgery within each participating hospital's local community was classified as either low (fewer than 25 cases per 100 000 population) or high (25 or more cases per 100 000 population).

than 10 per cent at the end of February, to almost 40 per cent in the middle of April 2020. Although this indicates a growing uptake of preoperative swab testing internationally, implementation remained incomplete, with 18 countries reporting a testing rate of zero. Care providers should now upscale the provision of routine preoperative testing to provide safe elective surgery during the pandemic.

CT remains controversial as it is resource-intensive and its validity in detection of COVID-19 has not been demonstrated, despite proposed scoring systems[21–23]. A systematic review[23] of diagnostic accuracy studies failed to demonstrate the accuracy of thoracic CT as a screening tool in asymptomatic patients. In the present study, CT was used more commonly in groups undergoing thoracoabdominal surgery and those with advanced disease. There may be a selective role for dual-purpose imaging before surgery that can both restage disease after a delay to surgery, and identify characteristic changes of COVID-19. This study showed no additional benefit to performing CT in addition to a single swab test, meaning that the additional cost and organizational burden of CT as a screening test in asymptomatic patients is unlikely to be justified. This corroborates the findings of a multicentre study of 2093 patients undergoing surgery in the

Table 4. Unadjusted outcomes by type of preoperative testing

	No test ($n=6481$)	Swab only ($n=1458$)	CT only ($n=521$)	Swab + CT ($n=324$)	P^*
Pulmonary complications					0.031
No	6209 (95.8)	1417 (97.2)	496 (95.2)	316 (97.5)	
Yes	272 (4.2)	41 (2.8)	25 (4.8)	8 (2.5)	
SARS-CoV-2 infection					< 0.001
No	6345 (98.4)	1451 (99.5)	516 (99.0)	319 (98.5)	
Yes	209 (3.2)	7 (0.5)	5 (1.0)	5 (1.5)	
Mortality					0.072
No	6272 (98.4)	1437 (99.2)	514 (98.8)	315 (99.4)	
Yes	104 (1.6)	12 (0.8)	6 (1.2)	2 (0.6)	
Missing	105	9	1	7	

Values in parentheses are percentages. CT, imaging by thoracic CT.
*χ^2 test.

Netherlands, in which the incremental yield of thoracic CT in asymptomatic patients was slight, at 0.4 per cent[9]. Similarly, in a small series[22], high-resolution CT chest added very little additional value and a high resource cost, with just 3 of 386 patients with a negative swab who had thoracic CT having surgery postponed.

There were limitations to this study. First, its observational nature may have left a residual risk of selection bias, despite use of statistical techniques to take this into account. However, patients undergoing preoperative testing were at higher, rather than lower, risk of pulmonary complications at baseline, so this is unlikely to have influenced the effect observed. Second, some of the subgroup sizes were small (for example CT, repeat swab test), meaning there were risks of type II errors. Third, cancer surgery was used in this study as a surrogate for elective operations, and its findings could be extrapolated to other types of elective surgery in order to support restarts and upscaling. In some instances, this may need to be done with caution, owing to differences in operation and patient profiles. Finally, this study was designed as a pragmatic, real-world analysis of the effectiveness of testing in patients who were not suspected of having COVID-19 before elective surgery. It was not designed to test the diagnostic accuracy of different testing protocols.

The strengths of this study lie in the large number of patients, a pansurgical oncology approach, and multinational nature, which provide a route for future research. The role of preoperative isolation in combination with negative swab findings needs urgent assessment, as this is highly burdensome for patients and organizationally challenging. Urgent research is also needed to identify the optimum delay to surgery for patients who have a positive swab test. Symptom questionnaires or clinical assessment were not evaluated as a method of identifying patients infected with SARS-CoV-2. Although these may prove effective in identifying some subtly symptomatic patients, they are currently not standardized and reproducibility is therefore uncertain.

Acknowledgements

Data-sharing requests will be considered by the management group on written request to the corresponding author. If agreed, deidentified participant data will be available subject to a data-sharing agreement. This report was funded by a National Institute for Health Research (NIHR) Global Health Research Unit Grant (NIHR 16.136.79) using UK aid from the UK Government to support global health research; Association of Coloproctology of Great Britain and Ireland; Bowel & Cancer Research; Bowel Disease Research Foundation; Association of Upper Gastrointestinal Surgeons; British Association of Surgical Oncology; British Gynaecological Cancer Society; European Society of Coloproctology; NIHR Academy; Sarcoma UK; Urology Foundation; Vascular Society for Great Britain and Ireland; and Yorkshire Cancer Research. The funders had no role in study design, data collection, analysis and interpretation, or writing of this report.

Disclosure. The authors declare no conflicts of interest.

Supplementary material

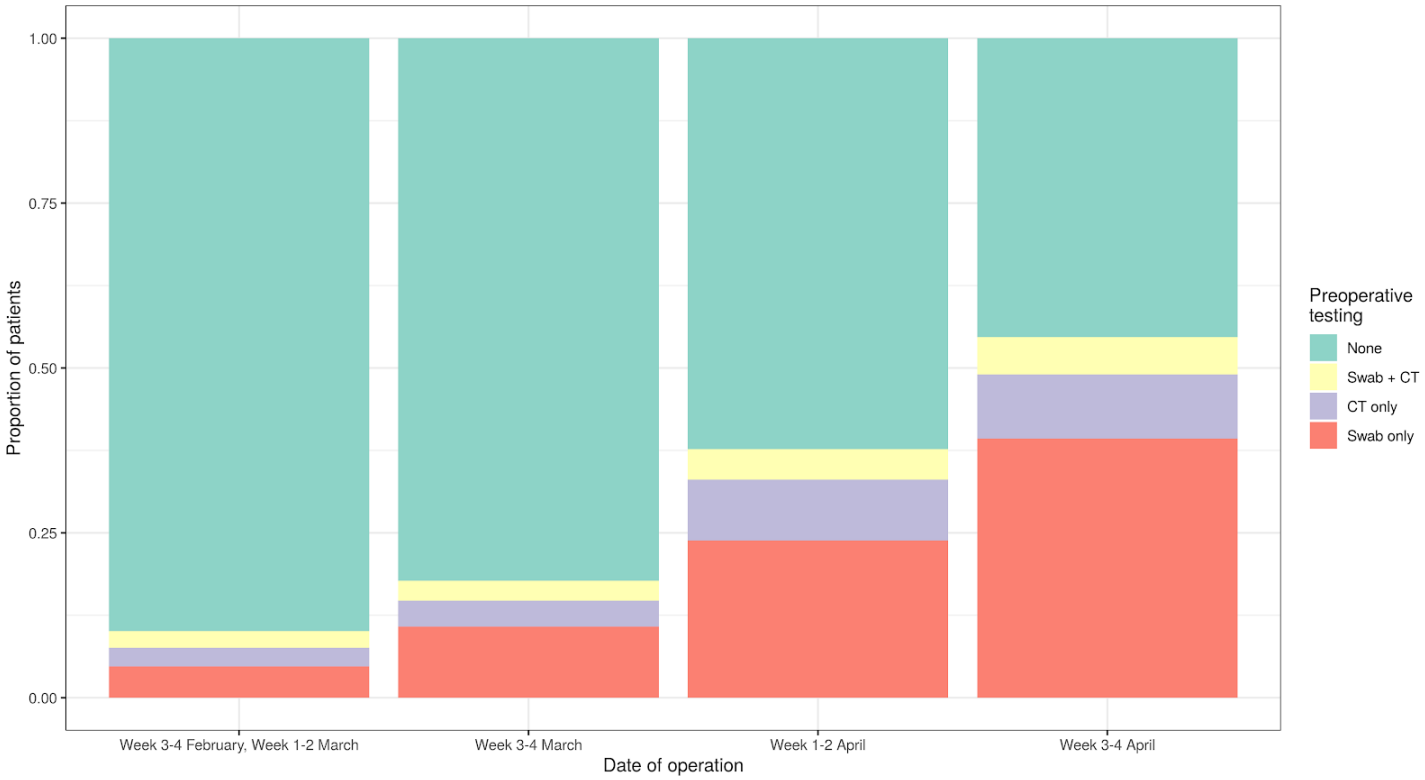
Supplementary material is available at *BJS* online.

References

1. COVIDSurg Collaborative. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. Br J Surg 2020;**107**:1440–1449
2. COVIDSurg Collaborative. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. Lancet 2020;**396**:27–38
3. Neto AS, da Costa LGV, Hemmes SNT, Canet J, Hedenstierna G, Jaber S et al. The LAS VEGAS risk score for prediction of postoperative pulmonary complications: an observational study. Eur J Anaesthesiol 2018;**35**:691–701
4. Shuchman M. Low- and middle-income countries face up to COVID-19. Nat Med 2020;**26**:986–988
5. Hopman J, Allegranzi B, Mehtar S. Managing COVID-19 in low- and middle-income countries. JAMA 2020;**323**:1549–1550
6. Bong CL, Brasher C, Chikumba E, McDougall R, Mellin-Olsen J, Enright A. The COVID-19 pandemic: effects on low- and middle-income countries. Anesth Analg 2020;**131**:86–92
7. Watson J, Whiting PF, Brush JE. Interpreting a covid-19 test result. BMJ 2020;**369**:m1808
8. Woloshin S, Patel N, Kesselheim AS. False negative tests for SARS-CoV-2 infection—challenges and implications. N Engl J Med 2020;**383**:e38
9. Guylaert CAJ, Scheijmans JCG, Borgstein ABJ, Andeweg CS, Bartels-Rutten A, Beets GL et al. Yield of screening for COVID-19 in asymptomatic patients prior to elective or emergency surgery using chest CT and RT–PCR (SCOUT) multicenter study. Ann Surg 2020; DOI:10.1097/SLA.0000000000004218 [Epub ahead of print]

10. Lyon JA, Garcia-Milian R, Norton HF, Tennant MR. The use of research electronic data capture (REDCap) software to create a database of librarian-mediated literature searches. Med Ref Serv Q 2014;**33**:241–252
11. COVIDSurg Collaborative. Elective cancer surgery in COVID-19 free surgical pathways during the SARS-CoV-2 pandemic: an international, multi-centre, comparative cohort study. J Clin Oncol 2020:JCO2001933
12. BUPA. BUPA Code search. https://codes.bupa.co.uk/home (accessed 8 August 2020)
13. WHO. WHO Coronavirus Disease (COVID-19) Dashboard. https://covid19.who.int/ (accessed 11 August 2020)
14. European Centre for Disease Prevention and Control. COVID-19 Pandemic. https://www.ecdc.europa.eu/en/covid-19-pandemic (accessed 8 August 2020)
15. STARSurg Collaborative. Challenges of one-year longitudinal follow-up of a prospective, observational cohort study using an anonymised database: recommendations for trainee research collaboratives. BMC Med Res Methodol 2019;**19**:237
16. COVIDSurg Collaborative. Prognostic model to predict postoperative acute kidney injury in patients undergoing major gastrointestinal surgery based on a national prospective observational cohort study. BJS Open 2018;**2**:400–410
17. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. Strengthening the reporting of observational studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ 2007; **335**:806–808
18. Lang TA, Altman DG. Basic statistical reporting for articles published in biomedical journals: the 'Statistical Analyses and Methods in the Published Literature' or the SAMPL guidelines'. Int J Nurs Stud 2015;**52**:5–9
19. Garnett L, Bello A, Tran KN, Audet J, Leung A, Schiffman Z et al. Comparison analysis of different swabs and transport mediums suitable for SARS-CoV-2 testing following shortages. J Virol Methods 2020;**285**:113947
20. Böger B, Fachi MM, Vilhena RO, Cobre AF, Tonin FS, Pontarolo R. Systematic review with meta-analysis of the accuracy of diagnostic tests for COVID-19. Am J Infect Control 2020; DOI: 10.1016/j.ajic.2020.07.011 [Epub ahead of print]
21. American College of Radiology. ACR Recommendations for the Use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection. https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection#:~:text=The%20ACR%20believes%20that%20the,only%20specific%20method%20of%20diagnosis (accessed 14 August 2020)
22. Huybens EM, Bus MPA, Massaad RA, Wijers L, van der Voet JA, Delfos NM et al. Screening with HRCT chest and PCR testing for COVID-19 in asymptomatic patients undergoing a surgical or diagnostic procedure. Br J Surg 2020;**107**:e384–e385
23. Shao JM, Ayuso SA, Deerenberg EB, Elhage SA, Augenstein VA, Heniford BT. A systematic review of CT chest in COVID-19 diagnosis and its potential application in a surgical setting. Colorectal Dis 2020; DOI:10.1111/codi.15252 [Epub ahead of print]

Supplementary Figure 1. Preoperative testing rates over time



CT=Imaging by computed tomography (CT) thorax.

Supplementary Table 1. Preoperative testing performed across included operations

Operation	No test	Swab	CT only	Swab + CT
A021 Excision Of Lesion Of Tissue Of Frontal Lobe Of Brain	30 (85.7)	4 (11.4)	1 (2.9)	
A022 Excision Of Lesion Of Tissue Of Temporal Lobe Of Brain	9 (75.0)	3 (25.0)		
A023 Excision Of Lesion Of Tissue Of Parietal Lobe Of Brain	9 (90.0)		1 (10.0)	
A024 Excision Of Lesion Of Tissue Of Occipital Lobe Of Brain	2 (66.7)		1 (33.3)	
A025 Excision Of Lesion Of Tissue Of Cerebellum	7 (100.0)			
A026 Excision Of Lesion Of Tissue Of Brain Stem	1 (50.0)	1 (50.0)		
A032 Stereotactic Ablation Of Tissue Of Thalamus		1 (100.0)		
A042 Open Biopsy Of Lesion Of Tissue Of Temporal Lobe Of Brain	1 (100.0)			
A081 Biopsy Of Lesion Of Tissue Of Frontal Lobe Of Brain		1 (100.0)		
A107 Stereotactic Radiosurgery On Tissue Of Brain	2 (100.0)			
A171 Endoscopic Extirpation Of Lesion Of Ventricle Of Brain	1 (100.0)			
A295 Excision Of Lesion Of Acoustic Nerve (Viii)	3 (75.0)	1 (25.0)		
A298 Excision Of Lesion Of Specified Cranial Nerve	1 (100.0)			
A381 Extirpation Of Lesion Of Meninges Of Cortex Of Brain	9 (100.0)			
A382 Extirpation Of Lesion Of Meninges Of Sphenoidal Ridge Of Cranium	5 (83.3)	1 (16.7)		
A383 Extirpation Of Lesion Of Meninges Of Subfrontal Region Of Br	5 (100.0)			
A384 Extirpation Of Lesion Of Meninges Of Parasagittal Region	5 (100.0)			
A422 Biopsy Of Lesion Of Meninges Of Brain	2 (100.0)			
A511 Extirpation Of Lesion Of Meninges Of Spinal Cord	1 (100.0)			
A604 Radiofrequency Controlled Thermal Destruction Of Peripheral	1 (100.0)			
A611 Excision Of Lesion Of Peripheral Nerve	1 (100.0)			
B041 Excision Of Lesion Of Pituitary Gland	24 (96.0)	1 (4.0)		
B081 Total Thyroidectomy	110 (73.3)	31 (20.7)	7 (4.7)	2 (1.3)
B082 Subtotal Thyroidectomy	2 (100.0)			
B083 Hemithyroidectomy	28 (75.7)	7 (18.9)	2 (5.4)	
B084 Lobectomy Of Thyroid Gland	13 (92.9)		1 (7.1)	
B085 Isthmectomy Of Thyroid Gland		4 (100.0)		
B086 Partial Thyroidectomy	1 (100.0)			
B122 Biopsy Of Lesion Of Thyroid Gland	4 (100.0)			
B142 Global Parathyroidectomy				1 (100.0)
B181 Trans-Sternal Thymectomy	7 (70.0)	1 (10.0)	2 (20.0)	
B182 Transcervical Thymectomy	1 (50.0)	1 (50.0)		
B222 Bilateral Adrenalectomy	1 (100.0)			
B223 Unilateral Adrenalectomy		1 (100.0)		
B271 Total Mastectomy And Excision Of Both Pectoral Muscles And	18 (90.0)	1 (5.0)	1 (5.0)	
B272 Total Mastectomy And Excision Of Both Pectoral Muscles	14 (82.4)		1 (5.9)	2 (11.8)

B273 Total Mastectomy And Excision Of Pectoralis Minor Muscle	47 (95.9)			2 (4.1)
B274 Total Mastectomy	453 (79.9)	73 (12.9)	33 (5.8)	8 (1.4)
B275 Subcutaneous Mastectomy	71 (66.4)	18 (16.8)	14 (13.1)	4 (3.7)
B276 Skin Sparing Mastectomy	104 (88.9)	11 (9.4)	2 (1.7)	
B282 Partial Excision of Breast	582 (74.6)	141 (18.1)	49 (6.3)	8 (1.0)
B292 Reconstruction Of Breast Using Local Flap Of Skin	3 (100.0)			
B294 Reconstruction Of Breast Using Distant Flap Of Skin	1 (100.0)			
B296 Reconstruction Of Breast Using Glandular Remodelling		1 (33.3)	1 (33.3)	1 (33.3)
B297 Reconstruction Of Breast Using Dermoglandular Flap	6 (85.7)		1 (14.3)	
B301 Insertion Of Prosthesis For Breast	1 (100.0)			
B311 Reduction Mammoplasty	4 (66.7)	2 (33.3)		
B322 Biopsy Of Lesion Of Breast	23 (100.0)			
B323 Wire Guided Biopsy Of Lesion Of Breast	68 (94.4)	4 (5.6)		
B393 Reconstruction Of Breast Using Free Deep Inferior Epigastric	1 (100.0)			
B411 Radionuclide Guided Excision Of Lesion Of Breast	27 (96.4)	1 (3.6)		
B412 Radionuclide Guided Partial Excision Of Breast	18 (85.7)	3 (14.3)		
C011 Exenteration Of Orbit	2 (66.7)	1 (33.3)		
C061 Biopsy Of Lesion Of Orbit	1 (100.0)			
C121 Excision Of Lesion Of Eyelid	2 (100.0)			
C391 Excision Of Lesion Of Conjunctiva		1 (100.0)		
D012 Partial Excision Of External Ear	1 (100.0)			
D021 Excision Of Lesion Of External Ear	3 (50.0)	3 (50.0)		
D101 Radical Mastoidectomy	5 (100.0)			
D104 Simple Mastoidectomy	7 (100.0)			
E011 Total Excision Of Nose	4 (100.0)			
E101 Biopsy Of Lesion Of Nose	2 (100.0)			
E132 Excision Of Lesion Of Maxillary Antrum	10 (37.0)	17 (63.0)		
E191 Total Pharyngectomy	2 (100.0)			
E192 Partial Pharyngectomy	1 (33.3)	2 (66.7)		
E242 Endoscopic Extirpation Of Lesion Of Pharynx	2 (100.0)			
E291 Total Laryngectomy	23 (71.9)	7 (21.9)	1 (3.1)	1 (3.1)
E294 Partial Laryngectomy	4 (80.0)	1 (20.0)		
E295 Laryngofissure And Cordectomy Of Vocal Cord	8 (38.1)	10 (47.6)	2 (9.5)	1 (4.8)
E296 Laryngectomy	2 (40.0)	3 (60.0)		
E303 Open Destruction Of Lesion Of Larynx	3 (100.0)			
E361 Diagnostic endoscopic Examination Of Larynx And Biopsy Of Lesion	6 (54.5)	5 (45.5)		
E391 Open Excision Of Lesion Of Trachea	1 (100.0)			
E461 Sleeve Resection Of Bronchus And Anastomosis	2 (50.0)	1 (25.0)		1 (25.0)
E463 Excision Of Lesion Of Bronchus	1 (100.0)			

E541 Total Pneumonectomy	7 (100.0)			
E542 Bilobectomy Of Lung	8 (72.7)	1 (9.1)		2 (18.2)
E543 Lobectomy Of Lung	229 (76.8)	30 (10.1)	19 (6.4)	20 (6.7)
E544 Excision Of Segment Of Lung	63 (67.7)	16 (17.2)	10 (10.8)	4 (4.3)
E545 Partial Lobectomy Of Lung	30 (78.9)	4 (10.5)	1 (2.6)	3 (7.9)
E552 Open Excision Of Lesion Of Lung	2 (50.0)		2 (50.0)	
E593 Biopsy Of Lesion Of Lung	3 (100.0)			
E621 Endoscopic Extirpation Of Lesion Of Mediastinum	1 (100.0)			
E641 Endoscopic Extirpation Of Lesion Of Nasal Cavity	2 (66.7)	1 (33.3)		
F011 Excision Of Vermilion Border Of Lip And Advancement Of Mucosa	1 (33.3)	2 (66.7)		
F021 Excision Of Lesion Of Lip	13 (65.0)	6 (30.0)		1 (5.0)
F221 Total Glossectomy	6 (100.0)			
F222 Partial Glossectomy	70 (72.2)	22 (22.7)	3 (3.1)	2 (2.1)
F231 Excision Of Lesion Of Tongue	42 (62.7)	19 (28.4)	4 (6.0)	2 (3.0)
F241 Biopsy Of Lesion Of Tongue	1 (100.0)			
F281 Excision Of Lesion Of Palate	7 (70.0)	3 (30.0)		
F341 Bilateral Dissection Tonsillectomy	7 (100.0)			
F343 Bilateral Laser Tonsillectomy	1 (100.0)			
F344 Bilateral Excision Of Tonsil	1 (50.0)	1 (50.0)		
F362 Biopsy Of Lesion Of Tonsil	1 (100.0)			
F366 Excision Of Lesion Of Tonsil	13 (72.2)	5 (27.8)		
F421 Biopsy Of Lesion Of Mouth	4 (80.0)	1 (20.0)		
F441 Total Excision Of Parotid Gland	18 (75.0)	6 (25.0)		
F442 Partial Excision Of Parotid Gland	20 (90.9)	2 (9.1)		
F443 Excision Of Parotid Gland	6 (100.0)			
F444 Excision Of Submandibular Gland	3 (75.0)		1 (25.0)	
F445 Excision Of Sublingual Gland	2 (100.0)			
F451 Excision Of Lesion Of Parotid Gland	1 (33.3)	2 (66.7)		
F452 Excision Of Lesion Of Submandibular Gland		1 (50.0)	1 (50.0)	
F454 Excision Of Lesion Of Salivary Gland		1 (100.0)		
G011 Oesophagogastrectomy And Anastomosis Of Oesophagus To Stomach	30 (66.7)	13 (28.9)	1 (2.2)	1 (2.2)
G012 Oesophagogastrectomy And Anastomosis Of Oesophagus To Transposed Jejunum	1 (100.0)			
G013 Oesophagogastrectomy And Anastomosis Of Oesophagus To Jejunum	5 (71.4)	1 (14.3)	1 (14.3)	
G021 Total Oesophagectomy And Anastomosis Of Pharynx To Stomach	15 (68.2)	4 (18.2)	2 (9.1)	1 (4.5)
G022 Total Oesophagectomy/Interposition Of Microvascularly Attached Jejunum	1 (100.0)			
G031 Partial Oesophagectomy And End To End Anastomosis Of Oesophagus	8 (80.0)	1 (10.0)	1 (10.0)	
G033 Partial Oesophagectomy And Anastomosis Of Oesophagus To Transposed Jejunum	4 (66.7)	2 (33.3)		
G034 Partial Oesophagectomy And Anastomosis Of Oesophagus To Jejunum	7 (87.5)	1 (12.5)		
G052 Bypass Of Oesophagus By Anastomosis Of Oesophagus To Stomach	3 (60.0)			2 (40.0)

G271 Total Gastrectomy And Excision Of Surrounding Tissue		1 (100.0)		
G272 Total Gastrectomy And Anastomosis Of Oesophagus To Duodenum	5 (83.3)	1 (16.7)		
G274 Total Gastrectomy And Anastomosis Of Oesophagus To Transposed Jejunum	3 (100.0)			
G275 Total Gastrectomy And Anastomosis Of Oesophagus To Jejunum	44 (49.4)	35 (39.3)	4 (4.5)	6 (6.7)
G281 Partial Gastrectomy And Anastomosis Of Stomach To Duodenum	6 (75.0)	1 (12.5)	1 (12.5)	
G282 Partial Gastrectomy And Anastomosis Of Stomach To Transposed Jejunum	8 (57.1)	2 (14.3)	2 (14.3)	2 (14.3)
G283 Partial Gastrectomy And Anastomosis Of Stomach To Jejunum	56 (57.7)	33 (34.0)	6 (6.2)	2 (2.1)
G285 Sleeve Gastrectomy	7 (87.5)	1 (12.5)		
G292 Open Excision Of Lesion Of Stomach	6 (100.0)			
G454 Fibreoptic Endoscopic Examination Of Upper Gastrointestinal Tract And Staining Of Gastric Mucosa	1 (100.0)			
G491 Gastroduodenectomy	1 (100.0)			
G493 Partial Excision Of Duodenum	2 (50.0)	1 (25.0)	1 (25.0)	
G501 Excision Of Lesion Of Duodenum	1 (100.0)			
G511 Bypass Of Duodenum By Anastomosis Of Stomach To Jejunum	2 (40.0)	2 (40.0)	1 (20.0)	
G582 Total Jejunectomy And Anastomosis Of Duodenum To Ileum	1 (100.0)			
G584 Partial Jejunectomy And Anastomosis Of Jejunum To Ileum	1 (50.0)	1 (50.0)		
G612 Bypass Of Jejunum By Anastomosis Of Jejunum To Ileum	1 (100.0)			
G692 Ileectomy And Anastomosis Of Duodenum To Ileum	1 (100.0)			
G693 Ileectomy And Anastomosis Of Ileum To Ileum	1 (20.0)	2 (40.0)	2 (40.0)	
G694 Ileectomy And Anastomosis Of Ileum To Colon				1 (100.0)
G702 Excision Of Lesion Of Ileum	1 (33.3)		1 (33.3)	1 (33.3)
G721 Anastomosis Of Ileum To Caecum	1 (100.0)			
G723 Anastomosis Of Ileum To Colon	4 (100.0)			
G734 Resection Of Ileocolic Anastomosis	3 (100.0)			
G742 Creation Of Temporary Ileostomy	3 (60.0)	1 (20.0)		1 (20.0)
G743 Creation Of Defunctioning Ileostomy	4 (100.0)			
G753 Closure Of Ileostomy	2 (66.7)	1 (33.3)		
H041 Panproctocolectomy And Ileostomy	7 (70.0)	3 (30.0)		
H042 Panproctocolectomy And Anastomosis Of Ileum To Anus And Creation of Pouch	1 (33.3)		1 (33.3)	1 (33.3)
H051 Total Colectomy And Anastomosis Of Ileum To Rectum	12 (66.7)	1 (5.6)	2 (11.1)	3 (16.7)
H052 Total Colectomy And Ileostomy And Creation Of Rectal Fistula		1 (100.0)		
H053 Total Colectomy And Ileostomy	6 (100.0)			
H061 Extended Right Hemicolectomy And End To End Anastomosis	14 (93.3)	1 (6.7)		
H062 Extended Right Hemicolectomy And Anastomosis Of Ileum To Colon	116 (73.4)	30 (19.0)	10 (6.3)	2 (1.3)
H063 Extended Right Hemicolectomy And Anastomosis	42 (73.7)	13 (22.8)	2 (3.5)	
H064 Extended Right Hemicolectomy And Ileostomy Hfq	5 (100.0)			
H065 Extended Right Hemicolectomy And End To Side Anastomosis	9 (90.0)	1 (10.0)		
H073 Right hemicolectomy and anastomosis	328 (72.4)	79 (17.4)	22 (4.9)	24 (5.3)
H074 Right hemicolectomy and ileostomy	10 (66.7)	2 (13.3)	3 (20.0)	

H081 Transverse Colectomy And End To End Anastomosis	5 (62.5)	2 (25.0)	1 (12.5)	
H082 Transverse Colectomy And Anastomosis Of Ileum To Colon	1 (33.3)	2 (66.7)		
H083 Transverse Colectomy And Anastomosis	2 (66.7)	1 (33.3)		
H084 Transverse Colectomy And Ileostomy				1 (100.0)
H085 Transverse Colectomy And Exteriorisation Of Bowel	1 (50.0)	1 (50.0)		
H086 Transverse Colectomy And End To Side Anastomosis	3 (100.0)			
H091 Left Hemicolectomy And End To End Anastomosis Of Colon To Rectum	44 (60.3)	14 (19.2)	8 (11.0)	7 (9.6)
H092 Left Hemicolectomy And End To End Anastomosis Of Colon To Colon	40 (67.8)	13 (22.0)	6 (10.2)	
H093 Left Hemicolectomy And Anastomosis	21 (84.0)	3 (12.0)	1 (4.0)	
H094 Left Hemicolectomy And Ileostomy	3 (50.0)	2 (33.3)	1 (16.7)	
H095 Left Hemicolectomy And Exteriorisation Of Bowel	8 (61.5)	2 (15.4)	1 (7.7)	2 (15.4)
H096 Left Hemicolectomy And End To Side Anastomosis	6 (66.7)	3 (33.3)		
H101 Sigmoid Colectomy And End To End Anastomosis Of Ileum To Rectum	4 (100.0)			
H102 Sigmoid Colectomy And Anastomosis Of Colon To Rectum	105 (71.9)	23 (15.8)	14 (9.6)	4 (2.7)
H103 Sigmoid Colectomy And Anastomosis	11 (73.3)	4 (26.7)		
H104 Sigmoid Colectomy And Ileostomy	3 (100.0)			
H105 Sigmoid Colectomy And Exteriorisation Of Bowel	10 (58.8)	4 (23.5)	2 (11.8)	1 (5.9)
H106 Sigmoid Colectomy And End To Side Anastomosis	4 (66.7)	2 (33.3)		
H122 Excision Of Lesion Of Colon	1 (100.0)			
H201 Fibreoptic Endoscopic Snare Resection Of Lesion Of Colon	1 (100.0)			
H293 Subtotal Excision Of Colon And Creation Of Colonic Pouch And Anastomosis of Colon to Rectum	1 (100.0)			
H295 Subtotal Excision Of Colon And Anastomosis Of Colon To Ileum	9 (81.8)	1 (9.1)	1 (9.1)	
H321 Resiting Of Colostomy	2 (66.7)	1 (33.3)		
H331 Abdominoperineal Excision Of Rectum And End Colostomy	110 (69.2)	29 (18.2)	14 (8.8)	6 (3.8)
H332 Proctectomy And Anastomosis Of Colon To Anus	6 (85.7)		1 (14.3)	
H333 Anterior Resection Of Rectum And Anastomosis Of Colon To Rectum	286 (67.5)	85 (20.0)	24 (5.7)	29 (6.8)
H334 Anterior Resection Of Rectum And Anastomosis	128 (78.0)	20 (12.2)	8 (4.9)	8 (4.9)
H335 Rectosigmoidectomy And Closure Of Rectal Stump And Exteriorisation of Bowel	9 (75.0)	1 (8.3)	2 (16.7)	
H336 Anterior Resection Of Rectum And Exteriorisation Of Bowel	88 (71.0)	22 (17.7)	11 (8.9)	3 (2.4)
H337 Perineal Resection Of Rectum	2 (100.0)			
H341 Open Excision Of Lesion Of Rectum	2 (66.7)		1 (33.3)	
H401 Trans-Sphincteric Excision Of Mucosa Of Rectum	2 (100.0)			
H402 Trans-Sphincteric Excision Of Lesion Of Rectum	1 (100.0)			
H404 Trans-Sphincteric Anastomosis Of Colon To Anus	1 (100.0)			
H411 Rectosigmoidectomy And Peranal Anastomosis	6 (60.0)	1 (10.0)	2 (20.0)	1 (10.0)
H412 Peranal Excision Of Lesion Of Rectum	12 (60.0)	4 (20.0)	1 (5.0)	3 (15.0)
H413 Peranal Destruction Of Lesion Of Rectum		1 (100.0)		
H414 Peranal Mucosal Proctectomy And Endoanal Anastomosis		1 (100.0)		
J015 Orthotopic Transplantation Of Whole Liver	3 (60.0)	1 (20.0)	1 (20.0)	

J021 Right Hemihepatectomy	35 (74.5)	10 (21.3)	1 (2.1)	1 (2.1)
J022 Left Hemihepatectomy	35 (71.4)	10 (20.4)	2 (4.1)	2 (4.1)
J023 Resection Of Segment Of Liver	78 (70.3)	18 (16.2)	13 (11.7)	2 (1.8)
J024 Wedge Excision Of Liver	41 (65.1)	9 (14.3)	11 (17.5)	2 (3.2)
J026 Extended Right Hemihepatectomy	9 (52.9)	6 (35.3)	2 (11.8)	
J027 Extended Left Hemihepatectomy	3 (42.9)	2 (28.6)	1 (14.3)	1 (14.3)
J031 Excision Of Lesion Of Liver	25 (83.3)	4 (13.3)		1 (3.3)
J033 Thermal Ablation Of Single Lesion Of Liver	5 (100.0)			
J035 Excision Of Multiple Lesions Of Liver	15 (45.5)	14 (42.4)	4 (12.1)	
J053 Open Wedge Biopsy Of Lesion Of Liver	3 (100.0)			
J083 Endoscopic Microwave Ablation Lesion Liver Using Laparoscope	2 (100.0)			
J092 Laparoscopic Ultrasound Examination Of Liver And Biopsy Of L	1 (100.0)			
J181 Total Cholecystectomy And Excision Of Surrounding Tissue	2 (100.0)			
J182 Total Cholecystectomy And Exploration Of Common Bile Duct	1 (100.0)			
J183 Total Cholecystectomy	5 (83.3)			1 (16.7)
J273 Partial Excision/Bile Duct And Anastomosis/Bile Duct To Jejunum	1 (100.0)			
J281 Excision Of Lesion Of Bile Duct	1 (100.0)			
J292 Anastomosis Of Hepatic Duct To Jejunum	2 (66.7)	1 (33.3)		
J302 Anastomosis Of Common Bile Duct To Transposed Jejunum	1 (100.0)			
J303 Anastomosis Of Common Bile Duct To Jejunum	1 (100.0)			
J551 Total Pancreatectomy And Excision Of Surrounding Tissue	10 (66.7)	5 (33.3)		
J561 Pancreaticoduodenectomy And Excision Of Surrounding Tissue	118 (77.1)	28 (18.3)	6 (3.9)	1 (0.7)
J564 Subtotal Excision Of Head Of Pancreas With Preservation Of Duodenum and Drainage	2 (100.0)			
J571 Subtotal Pancreatectomy	13 (81.2)	1 (6.2)		2 (12.5)
J573 Left Pancreatectomy	27 (75.0)	9 (25.0)		
J575 Excision Of Tail Of Pancreas	7 (77.8)	1 (11.1)	1 (11.1)	
J582 Excision Of Lesion Of Pancreas	4 (100.0)			
J671 Diagnostic Percutaneous Aspiration Of Lesion Of Pancreas	1 (100.0)			
J692 Total Splenectomy		1 (100.0)		
M021 Nephrectomy And Excision Of Perirenal Tissue	35 (76.1)	5 (10.9)	5 (10.9)	1 (2.2)
M022 Nephroureterectomy	27 (69.2)	6 (15.4)	6 (15.4)	
M023 Bilateral Nephrectomy		1 (100.0)		
M025 Nephrectomy	67 (84.8)	5 (6.3)	1 (1.3)	6 (7.6)
M182 Excision Of Segment Of Ureter	2 (100.0)			
M183 Secondary Ureterectomy			1 (100.0)	
M341 Cystoprostatectomy	28 (93.3)	1 (3.3)	1 (3.3)	
M342 Cystourethrectomy	3 (100.0)			
M343 Cystectomy	16 (84.2)	1 (5.3)	1 (5.3)	1 (5.3)
M344 Simple Cystectomy	2 (100.0)			

M421 Endoscopic Resection Of Lesion Of Bladder	42 (97.7)			1 (2.3)
M422 Endoscopic Cauterisation Of Lesion Of Bladder	5 (100.0)			
M423 Endoscopic Destruction Of Lesion Of Bladder	2 (100.0)			
M455 Diagnostic endoscopic Examination Of Bladder Using Rigid Cystoscope	8 (100.0)			
M611 Total Excision Of Prostate And Capsule Of Prostate	48 (100.0)			
M612 Retropubic Prostatectomy	54 (79.4)	2 (2.9)	10 (14.7)	2 (2.9)
M614 Perineal Prostatectomy	10 (90.9)		1 (9.1)	
M651 Endoscopic Resection Of Prostate Using Electrotome	1 (100.0)			
M653 Endoscopic Resection Of Prostate	3 (75.0)	1 (25.0)		
M723 Excision Of Lesion Of Urethra				1 (100.0)
N261 Total Amputation Of Penis	2 (100.0)			
N271 Excision Of Lesion Of Penis		1 (100.0)		
Other (not otherwise classified)	107 (77.5)	20 (14.5)		11 (8.0)
P051 Total Excision Of Vulva	10 (50.0)	5 (25.0)	3 (15.0)	2 (10.0)
P052 Partial Excision Of Vulva	17 (68.0)	4 (16.0)	1 (4.0)	3 (12.0)
P054 Excision Of Lesion Of Vulva	12 (92.3)	1 (7.7)		
P065 Excision Of Lesion Of Labia	1 (100.0)			
P091 Biopsy Of Lesion Of Vulva	1 (100.0)			
P201 Excision Of Lesion Of Vagina				1 (100.0)
P317 Extirpation Of Lesion Of Pouch Of Douglas	1 (100.0)			
Q011 Amputation Of Cervix Uteri	2 (50.0)	1 (25.0)	1 (25.0)	
Q013 Excision Of Lesion Of Cervix Uteri	1 (33.3)		2 (66.7)	
Q014 Large Loop Excision Of Transformation Zone	1 (100.0)			
Q033 Cone Biopsy Of Cervix Uteri	4 (100.0)			
Q071 Abdominal Hysterocolpectomy And Excision Of Periuterine Tissue	21 (84.0)	1 (4.0)	1 (4.0)	2 (8.0)
Q072 Abdominal Hysterectomy And Excision Of Periuterine Tissue	213 (67.6)	55 (17.5)	39 (12.4)	8 (2.5)
Q073 Abdominal Hysterocolpectomy	32 (86.5)	3 (8.1)		2 (5.4)
Q074 Total Abdominal Hysterectomy	178 (71.2)	22 (8.8)	11 (4.4)	39 (15.6)
Q075 Subtotal Abdominal Hysterectomy	2 (100.0)			
Q081 Vaginal Hysterocolpectomy And Excision Of Periuterine Tissue		1 (100.0)		
Q082 Vaginal Hysterectomy And Excision Of Periuterine Tissue	2 (50.0)	2 (50.0)		
Q083 Vaginal Hysterocolpectomy	1 (50.0)	1 (50.0)		
Q176 Endoscopic Microwave Ablation Of Endometrium		1 (100.0)		
Q181 Diagnostic Endoscopic Examination Of Uterus And Biopsy Of Le	1 (100.0)			
Q221 Bilateral Salpingoophorectomy	31 (70.5)	4 (9.1)	6 (13.6)	3 (6.8)
Q231 Unilateral Salpingoophorectomy	10 (76.9)			3 (23.1)
Q233 Unilateral Salpingectomy	2 (66.7)			1 (33.3)
Q235 Unilateral Oophorectomy	1 (50.0)	1 (50.0)		
Q432 Excision Of Lesion Of Ovary	4 (44.4)	3 (33.3)		2 (22.2)

Q501 Diagnostic Endoscopic Examination Of Ovary And Biopsy Of Lesion	2 (100.0)			
S022 Abdominolipectomy	1 (100.0)			
S083 Curettage Of Lesion Of Skin Of Head Or Neck	1 (100.0)			
S151 Biopsy Of Lesion Of Skin Of Head Or Neck	24 (50.0)	24 (50.0)		
S152 Biopsy Of Lesion Of Skin	6 (100.0)			
T013 Excision Of Lesion Of Chest Wall	2 (33.3)	1 (16.7)	3 (50.0)	
T071 Decortication Of Pleura	1 (50.0)	1 (50.0)		
T072 Open Excision Of Lesion Of Pleura	1 (50.0)	1 (50.0)		
T102 Endoscopic Pleurodesis Using Talc				1 (100.0)
T111 Diagnostic endoscopic Examination Of Pleura And Biopsy Of Lesion	1 (100.0)			
T301 Reopening Of Abdomen And Re-Exploration Of Intra-abdominal Operation Site	1 (100.0)			
T303 Reopening Of Abdomen	1 (50.0)	1 (50.0)		
T304 Opening Of Abdomen And Exploration Of Groin	4 (100.0)			
T331 Open Excision Of Lesion Of Peritoneum	7 (77.8)		2 (22.2)	
T332 Open Destruction Of Lesion Of Peritoneum	2 (66.7)			1 (33.3)
T362 Excision Of Lesion Of Omentum	7 (77.8)	1 (11.1)		1 (11.1)
T364 Biopsy Of Lesion Of Omentum	5 (83.3)			1 (16.7)
T371 Excision Of Lesion Of Mesentery Of Small Intestine			1 (100.0)	
T381 Excision Of Lesion Of Mesentery Of Colon	1 (100.0)			
T383 Biopsy Of Lesion Of Mesentery Of Colon	1 (50.0)	1 (50.0)		
T391 Excision Of Lesion Of Posterior Peritoneum	12 (80.0)	2 (13.3)		1 (6.7)
T393 Biopsy Of Lesion Of Posterior Peritoneum	2 (25.0)			6 (75.0)
T421 Endoscopic Resection Of Lesion Of Peritoneum			1 (100.0)	
T423 Endoscopic Division Of Adhesions Of Peritoneum				1 (100.0)
T425 Endoscopic Excision Of Peritoneum	2 (100.0)			
T431 Diag.endo.exam/Peritoneum And Biopsy Of Lesion Of Peritoneum	3 (100.0)			
T432 Diag.endo.exam/Peritoneum/Biopsy/Lesion Intra-Abdominal Organ		1 (100.0)		
T482 Introduction Of Cytotoxic Substance Into Peritoneal Cavity	5 (62.5)			3 (37.5)
T512 Excision Of Fascia Of Pelvis	2 (100.0)			
T531 Excision Of Lesion Of Fascia	1 (50.0)		1 (50.0)	
T772 Wide Excision Of Muscle	16 (72.7)	4 (18.2)	2 (9.1)	
T851 Block Dissection Of Cervical Lymph Nodes	55 (71.4)	16 (20.8)	5 (6.5)	1 (1.3)
T852 Block Dissection Of Axillary Lymph Nodes	27 (67.5)	11 (27.5)	2 (5.0)	
T853 Block Dissection Of Mediastinal Lymph Nodes	2 (100.0)			
T854 Block Dissection Of Para-Aortic Lymph Nodes	13 (86.7)	1 (6.7)		1 (6.7)
T855 Block Dissection Of Inguinal Lymph Nodes	10 (100.0)			
T856 Block Dissection Of Pelvic Lymph Nodes	1 (50.0)		1 (50.0)	
T861 Sampling Of Cervical Lymph Nodes		1 (50.0)		1 (50.0)
T862 Sampling Of Axillary Lymph Nodes		1 (100.0)		

T866 Sampling Of Para-Aortic Lymph Nodes	3 (100.0)			
T872 Excision Or Biopsy Of Cervical Lymph Node	3 (50.0)	3 (50.0)		
T873 Excision Or Biopsy Of Axillary Lymph Node	10 (66.7)	5 (33.3)		
T874 Excision Or Biopsy Of Mediastinal Lymph Node	3 (100.0)			
T875 Excision Or Biopsy Of Para-Aortic Lymph Node	2 (100.0)			
T876 Excision Or Biopsy Of Porta Hepatis Lymph Node	1 (100.0)			
T877 Excision Or Biopsy Of Inguinal Lymph Node		1 (100.0)		
T911 Biopsy Of Sentinel Lymph Node	13 (52.0)	10 (40.0)		2 (8.0)
T926 Excision Of Lymphoedematous Tissue		1 (100.0)		
T962 Excision Of Lesion Of Soft Tissue	67 (72.0)	17 (18.3)	6 (6.5)	3 (3.2)
T966 Biopsy Of Soft Tissue	1 (100.0)			
V032 Reopening Of Cranium And Re-Exploration Of Intracranial Operation Site	3 (75.0)	1 (25.0)		
V037 Decompressive Craniectomy	5 (100.0)			
V071 Extensive Excision Of Bone Of Face	1 (100.0)			
V072 Partial Excision Of Bone Of Face	1 (33.3)	2 (66.7)		
V073 Excision Of Lesion Of Bone Of Face	2 (100.0)			
V074 Excision Of Lesion Of Infratemporal Fossa	1 (100.0)			
V141 Hemimandibulectomy	19 (70.4)	5 (18.5)	2 (7.4)	1 (3.7)
V142 Extensive Excision Of Mandible	11 (45.8)	12 (50.0)	1 (4.2)	
V143 Partial Excision Of Mandible	6 (42.9)	8 (57.1)		
V144 Excision Of Lesion Of Mandible	12 (48.0)	13 (52.0)		
V191 Reconstruction Of Mandible	3 (100.0)			
V194 Biopsy Of Lesion Of Mandible	1 (100.0)			
V433 Excision Of Lesion Of Lumbar Vertebra	2 (100.0)			
W062 Total Excision Of Rib	1 (100.0)			
W067 Total Excision Of Pelvic Bones		1 (100.0)		
W091 Excision Of Lesion Of Bone	6 (100.0)			
W095 Curettage Of Tumour Of Bone And Graft	2 (100.0)			
W096 Curettage Of Tumour Of Bone	1 (100.0)			
W097 Excision Of Tumour Of Bone	7 (53.8)		3 (23.1)	3 (23.1)
X071 Forequarter Amputation	1 (50.0)		1 (50.0)	
X073 Amputation Of Arm Above Elbow	2 (100.0)			
X091 Hindquarter Amputation	1 (33.3)		1 (33.3)	1 (33.3)
X093 Amputation Of Leg Above Knee	2 (66.7)	1 (33.3)		
X095 Amputation Of Leg Below Knee	1 (100.0)			
X141 Total Exenteration Of Pelvis	6 (54.5)	2 (18.2)	2 (18.2)	1 (9.1)
X142 Anterior Exenteration Of Pelvis	6 (100.0)			
X143 Posterior Exenteration Of Pelvis	7 (87.5)	1 (12.5)		
X531 Excision Of Unspecified Organ	5 (71.4)	2 (28.6)		

X532 Excision Of Lesion Of Unspecified Organ	19 (76.0)	5 (20.0)	1 (4.0)	
Y052 Partial Excision Of Organ	2 (100.0)			
Y063 Enucleation Of Lesion Of Organ			1 (100.0)	
Y067 Radiofrequency Excision Of Lesion Of Organ Noc	3 (30.0)	7 (70.0)		
Y201 Stereotactic Biopsy Of Lesion Of Organ Noc	1 (100.0)			

Supplementary Table 2. Factors associated with postoperative pulmonary complications after elective surgery. Model summary presented in forest plot in *Figure 2*.

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=8256)	Pulmonary Complications (N=342)			
Screening type	None	6039 (95.7)	270 (4.3)	-	-	-
	Swab only	1406 (97.2)	40 (2.8)	0.67 (0.47 to 0.96)	0.68 (0.47 to 0.98)	0.040
	CT only	496 (95.4)	24 (4.6)	1.20 (0.77 to 1.88)	1.27 (0.78 to 2.04)	0.337
	Swab + CT	315 (97.5)	8 (2.5)	0.61 (0.30 to 1.28)	0.57 (0.27 to 1.19)	0.134
Age	<50 years	1541 (98.8)	19 (1.2)	-	-	-
	50-59 years	1791 (97.6)	44 (2.4)	2.07 (1.23 to 3.47)	1.33 (0.76 to 2.32)	0.321
	60-69 years	2279 (95.6)	104 (4.4)	3.77 (2.34 to 6.06)	1.79 (1.07 to 3.00)	0.027
	70-79 years	1982 (93.8)	130 (6.2)	5.31 (3.32 to 8.50)	1.99 (1.18 to 3.34)	0.010
	≥80 years	663 (93.6)	45 (6.4)	5.42 (3.20 to 9.16)	1.94 (1.07 to 3.51)	0.029
Sex	Female	5135 (98.0)	106 (2.0)	-	-	-
	Male	3121 (93.0)	236 (7.0)	3.51 (2.81 to 4.38)	2.27 (1.77 to 2.92)	<0.001
Body Mass Index	Normal	3250 (96.4)	121 (3.6)	-	-	-
	Overweight	2609 (96.2)	102 (3.8)	1.09 (0.85 to 1.40)	0.90 (0.68 to 1.19)	0.455
	Obese	1730 (95.8)	76 (4.2)	1.19 (0.90 to 1.57)	0.93 (0.67 to 1.28)	0.659
	Underweight	196 (95.1)	10 (4.9)	1.24 (0.64 to 2.40)	1.30 (0.64 to 2.62)	0.457
	Missing	471 (93.5)	33 (6.5)	1.45 (0.99 to 2.13)	1.61 (1.00 to 2.49)	0.031
ASA Grade	Grade 1-2	6049 (97.3)	168 (2.7)	-	-	-
	Grade 3-5	2207 (92.7)	174 (7.3)	2.87 (2.32 to 3.55)	1.41 (1.08 to 1.84)	0.012
Specialty	Abdominal	4476 (95.5)	212 (4.5)	-	-	-
	Thoracic or thoracoabdominal	535 (87.0)	80 (13.0)	2.69 (2.05 to 3.53)	2.71 (1.99 to 3.69)	<0.001
	Other	3245 (98.5)	50 (1.5)	0.33 (0.24 to 0.44)	1.23 (0.74 to 2.04)	0.427
ECOG Performance Score	0	5342 (97.7)	128 (2.3)	-	-	-
	≥1	2914 (93.2)	214 (6.8)	2.83 (2.29 to 3.50)	1.79 (1.37 to 2.33)	<0.001
Current smoker	No	7372 (96.3)	283 (3.7)	-	-	-
	Yes	884 (93.7)	59 (6.3)	1.57 (1.19 to 2.08)	1.34 (0.97 to 1.83)	0.076
Pre-existing respiratory condition	No	7391 (96.4)	274 (3.6)	-	-	-
	Yes	865 (92.7)	68 (7.3)	2.05 (1.58 to 2.66)	1.14 (0.84 to 1.55)	0.385
Revised Cardiac Risk Index	0	2701 (98.9)	29 (1.1)	-	-	-
	1	4138 (95.5)	195 (4.5)	4.05 (2.80 to 5.85)	2.11 (1.16 to 3.84)	0.014
	2	1164 (93.6)	80 (6.4)	6.04 (4.03 to 9.05)	2.18 (1.13 to 4.21)	0.020
	≥3	253 (86.9)	38 (13.1)	12.65 (7.85 to 20.38)	3.72 (1.80 to 7.73)	<0.001
Operation grade	Minor	1946 (98.8)	23 (1.2)	-	-	-
	Major	6310 (95.2)	319 (4.8)	4.01 (4.00 to 4.02)	2.20 (1.36 to 3.56)	0.001
Disease stage	Early stage	5915 (96.8)	194 (3.2)	-	-	-
	Advanced stage	2341 (94.1)	148 (5.9)	1.84 (1.49 to 2.26)	1.61 (1.28 to 2.03)	<0.001
Hospital type	No defined pathway	5986 (95.2)	300 (4.8)	-	-	-
	COVID-19 free surgical pathway	2270 (98.2)	42 (1.8)	0.48 (0.35 to 0.66)	0.45 (0.31 to 0.64)	<0.001
Community SARS-Cov-2 risk	Low	7223 (96.0)	298 (4.0)	-	-	-
	High	1033 (95.9)	44 (4.1)	1.04 (0.71 to 1.51)	1.38 (0.90 to 2.12)	0.141

Data included from 8598 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.81 (excellent discrimination). A summary of a sensitivity analysis for potentially missing data is presented in *Supplementary Table 7*.

Supplementary Table 3. Subgroup analysis of factors associated with postoperative pulmonary complications after elective surgery in high risk areas.

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=724)	Pulmonary Complications (N=41)			
Screening type	None	531 (93.7)	36 (6.3)	-	-	-
	Swab only	193 (97.5)	5 (2.5)	0.38 (0.15 to 0.99)	0.25 (0.09 to 0.76)	0.014
Age	<50 years	115 (96.6)	4 (3.4)	-	-	-
	50-59 years	149 (98.7)	2 (1.3)	0.38 (0.07 to 2.14)	0.21 (0.03 to 1.23)	0.083
	60-69 years	201 (93.1)	15 (6.9)	2.14 (0.69 to 6.61)	1.04 (0.30 to 3.62)	0.955
	70-79 years	178 (92.2)	15 (7.8)	2.43 (0.79 to 7.50)	0.79 (0.21 to 3.02)	0.731
	≥80 years	81 (94.2)	5 (5.8)	1.77 (0.46 to 6.81)	0.52 (0.11 to 2.55)	0.421
Sex	Female	467 (97.3)	13 (2.7)	-	-	-
	Male	257 (90.2)	28 (9.8)	3.91 (1.99 to 7.69)	2.77 (1.28 to 5.99)	0.010
Body Mass Index	Normal	346 (94.5)	20 (5.5)	-	-	-
	Overweight	209 (96.3)	8 (3.7)	0.66 (0.29 to 1.53)	0.47 (0.19 to 1.16)	0.102
	Obese	114 (96.6)	4 (3.4)	0.61 (0.20 to 1.81)	0.50 (0.15 to 1.59)	0.239
	Underweight	11 (84.6)	2 (15.4)	3.15 (0.65 to 15.16)	5.20 (0.89 to 30.47)	0.068
	Missing	44 (86.3)	7 (13.7)	2.75 (1.10 to 6.88)	1.47 (0.50 to 4.33)	0.486
ASA Grade	Grade 1-2	544 (96.6)	19 (3.4)	-	-	-
	Grade 3-5	180 (89.1)	22 (10.9)	3.50 (1.85 to 6.61)	2.86 (1.23 to 6.65)	0.014
Specialty	Abdominal	362 (92.3)	30 (7.7)	-	-	-
	Thoracic or thoracoabdominal	15 (83.3)	3 (16.7)	2.41 (0.66 to 8.81)	2.59 (0.60 to 11.20)	0.204
	Other	347 (97.7)	8 (2.3)	0.28 (0.13 to 0.62)	0.56 (0.10 to 2.97)	0.491
ECOG Performance Score	0	423 (95.9)	18 (4.1)	-	-	-
	≥1	301 (92.9)	23 (7.1)	1.80 (0.95 to 3.39)	1.16 (0.49 to 2.75)	0.739
Current smoker	No	638 (94.9)	34 (5.1)	-	-	-
	Yes	86 (92.5)	7 (7.5)	1.53 (0.66 to 3.55)	1.09 (0.41 to 2.90)	0.863
Pre-existing respiratory condition	No	657 (94.5)	38 (5.5)	-	-	-
	Yes	67 (95.7)	3 (4.3)	0.77 (0.23 to 2.58)	0.24 (0.06 to 0.93)	0.039
Revised Cardiac Risk Index	0	300 (98.0)	6 (2.0)	-	-	-
	1	315 (92.9)	24 (7.1)	3.81 (1.54 to 9.45)	1.22 (0.21 to 7.28)	0.826
	2	88 (92.6)	7 (7.4)	3.98 (1.30 to 12.14)	0.65 (0.08 to 5.25)	0.687
	≥3	21 (84.0)	4 (16.0)	9.52 (2.49 to 36.38)	1.00 (0.10 to 10.31)	0.998
Operation grade	Minor	206 (98.6)	3 (1.4)	-	-	-
	Major	518 (93.2)	38 (6.8)	5.04 (1.54 to 16.50)	2.53 (0.61 to 10.41)	0.199
Disease stage	Early stage	546 (95.6)	25 (4.4)	-	-	-
	Advanced stage	178 (91.8)	16 (8.2)	1.96 (1.02 to 3.77)	1.35 (0.65 to 2.82)	0.424
Hospital type	No defined pathway	499 (93.1)	37 (6.9)	-	-	-
	COVID-19 free surgical pathway	225 (98.3)	4 (1.7)	0.24 (0.08 to 0.68)	0.23 (0.08 to 0.68)	0.008

Data included from 765 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.85 (excellent discrimination).

Supplementary Table 4. Subgroup analysis of factors associated with postoperative pulmonary complications after elective surgery in low risk areas.

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=6721)	Pulmonary Complications (N=269)			
Screening type	None	5508 (95.9)	234 (4.1)	-	-	-
	Swab only	1213 (97.2)	35 (2.8)	0.66 (0.45 to 0.97)	0.72 (0.48 to 1.08)	0.108
Age	<50 years	1280 (98.9)	14 (1.1)	-	-	
	50-59 years	1444 (97.5)	37 (2.5)	2.24 (1.21 to 4.13)	1.51 (0.80 to 2.86)	0.205
	60-69 years	1856 (95.9)	79 (4.1)	3.69 (2.09 to 6.52)	1.79 (0.98 to 3.26)	*0.057*
	70-79 years	1614 (93.9)	104 (6.1)	5.43 (3.10 to 9.51)	2.09 (1.15 to 3.80)	*0.016*
	≥80 years	527 (93.8)	35 (6.2)	5.51 (2.94 to 10.33)	2.11 (1.06 to 4.17)	*0.032*
Sex	Female	4166 (98.1)	81 (1.9)	-	-	
	Male	2555 (93.1)	188 (6.9)	3.67 (2.81 to 4.80)	2.31 (1.74 to 3.06)	*<0.001*
Body Mass Index	Normal	2578 (96.7)	87 (3.3)	-	-	
	Overweight	2101 (96.1)	86 (3.9)	1.26 (0.93 to 1.70)	1.05 (0.76 to 1.45)	0.762
	Obese	1466 (95.8)	64 (4.2)	1.36 (0.97 to 1.89)	1.01 (0.70 to 1.43)	0.977
	Underweight	162 (95.9)	7 (4.1)	1.26 (0.58 to 2.77)	1.12 (0.49 to 2.56)	0.796
	Missing	414 (94.3)	25 (5.7)	1.59 (0.99 to 2.55)	1.70 (1.03 to 2.81)	*0.037*
ASA Grade	Grade 1-2	4860 (97.5)	126 (2.5)	-	-	
	Grade 3-5	1861 (92.9)	143 (7.1)	3.08 (2.39 to 3.97)	1.39 (1.03 to 1.88)	*0.029*
Specialty	Abdominal	3570 (95.7)	162 (4.3)	-	-	
	Thoracic or thoracoabdominal	446 (86.6)	69 (13.4)	3.13 (2.29 to 4.27)	2.83 (2.01 to 3.98)	*<0.001*
	Other	2705 (98.6)	38 (1.4)	0.34 (0.24 to 0.49)	1.27 (0.72 to 2.24)	0.407
ECOG Performance Score	0	4376 (97.8)	97 (2.2)	-	-	
	≥1	2345 (93.2)	172 (6.8)	3.19 (2.47 to 4.12)	1.85 (1.37 to 2.49)	*<0.001*
Current smoker	No	6006 (96.4)	223 (3.6)	-	-	
	Yes	715 (94.0)	46 (6.0)	1.64 (1.18 to 2.28)	1.40 (0.98 to 2.01)	0.067
Pre-existing respiratory condition	No	6005 (96.7)	208 (3.3)	-	-	
	Yes	716 (92.1)	61 (7.9)	2.21 (1.64 to 2.98)	1.39 (1.00 to 1.93)	*0.052*
Revised Cardiac Risk Index	0	2236 (99.1)	21 (0.9)	-	-	
	1	3324 (95.7)	150 (4.3)	4.37 (2.76 to 6.91)	2.20 (1.12 to 4.34)	*0.023*
	2	951 (93.3)	68 (6.7)	7.25 (4.42 to 11.89)	2.49 (1.19 to 5.20)	*0.015*
	≥3	210 (87.5)	30 (12.5)	13.94 (7.79 to 24.94)	3.99 (1.76 to 9.06)	*0.001*
Operation grade	Minor	1616 (98.8)	19 (1.2)	-	-	
	Major	5105 (95.3)	250 (4.7)	4.04 (2.53 to 6.44)	2.12 (1.25 to 3.62)	*0.006*
Disease stage	Early stage	4838 (97.0)	151 (3.0)	-	-	
	Advanced stage	1883 (94.1)	118 (5.9)	1.94 (1.51 to 2.48)	1.70 (1.30 to 2.20)	*<0.001*
Hospital type	No defined pathway	5174 (95.6)	240 (4.4)	-	-	
	COVID-19 free surgical pathway	1547 (98.2)	29 (1.8)	0.50 (0.33 to 0.76)	0.53 (0.34 to 0.81)	*0.003*

Data included from 6990 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.81 (excellent discrimination).

Supplementary Table 5. Subgroup analysis of factors associated with postoperative pulmonary complications after major surgery

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=5623)	Pulmonary Complications (N=288)			
Screening type	None	4561 (94.8)	251 (5.2)	-	-	-
	Swab only	1062 (96.6)	37 (3.4)	0.58 (0.40 to 0.85)	0.63 (0.42 to 0.93)	*0.019*
Age	<50 years	1022 (98.4)	17 (1.6)	-	-	-
	50-59 years	1149 (97.0)	35 (3.0)	1.70 (0.95 to 3.04)	1.12 (0.61 to 2.05)	0.717
	60-69 years	1569 (94.9)	85 (5.1)	3.00 (1.78 to 5.07)	1.51 (0.87 to 2.63)	0.144
	70-79 years	1426 (92.6)	114 (7.4)	4.25 (2.54 to 7.11)	1.75 (1.00 to 3.04)	*0.05*
	≥80 years	457 (92.5)	37 (7.5)	4.29 (2.39 to 7.70)	1.63 (0.86 to 3.10)	0.135
Sex	Female	3281 (97.6)	82 (2.4)	-	-	-
	Male	2342 (91.9)	206 (8.1)	3.38 (2.60 to 4.40)	2.45 (1.85 to 3.23)	*<0.001*
BMI	Normal	2213 (95.7)	99 (4.3)	-	-	-
	Overweight	1746 (95.2)	88 (4.8)	1.15 (0.86 to 1.55)	0.96 (0.70 to 1.31)	0.782
	Obese	1224 (95.1)	63 (4.9)	1.18 (0.85 to 1.64)	0.93 (0.66 to 1.32)	0.692
	Underweight	133 (93.7)	9 (6.3)	1.55 (0.77 to 3.16)	1.55 (0.73 to 3.29)	0.256
	Missing	307 (91.4)	29 (8.6)	1.93 (1.24 to 3.02)	1.68 (1.05 to 2.70)	*0.03*
ASA Grade	Grade 1-2	3993 (96.8)	131 (3.2)	-	-	-
	Grade 3-5	1630 (91.2)	157 (8.8)	2.99 (2.34 to 3.82)	1.60 (1.19 to 2.13)	*0.002*
Specialty	Abdominal	3620 (95.0)	189 (5.0)	-	-	-
	Thoracic or thoracoabdominal	456 (86.5)	71 (13.5)	2.90 (2.13 to 3.93)	2.63 (1.88 to 3.66)	*<0.001*
	Other	1547 (98.2)	28 (1.8)	0.40 (0.27 to 0.60)	1.02 (0.53 to 1.96)	0.960
ECOG Performance Score	0	3526 (97.1)	107 (2.9)	-	2.63 (1.88 to 3.66)	-
	≥1	2097 (92.1)	181 (7.9)	2.71 (2.12 to 3.46)	1.65 (1.23 to 2.20)	*0.001*
Current smoker	No	5048 (95.5)	239 (4.5)	-	-	-
	Yes	575 (92.1)	49 (7.9)	1.73 (1.25 to 2.38)	1.32 (0.93 to 1.88)	0.119
Pre-existing respiratory condition	No	5028 (95.7)	228 (4.3)	-	-	-
	Yes	595 (90.8)	60 (9.2)	2.00 (1.48 to 2.70)	1.19 (0.86 to 1.66)	0.293
Revised Cardiac Risk Index	0	1317 (98.7)	17 (1.3)	-	-	-
	1	3170 (95.0)	167 (5.0)	3.54 (2.14 to 5.86)	1.99 (0.89 to 4.47)	0.093
	2	930 (92.8)	72 (7.2)	5.46 (3.20 to 9.31)	2.09 (0.88 to 4.95)	0.094
	≥3	206 (86.6)	32 (13.4)	10.52 (5.71 to 19.37)	3.07 (1.21 to 7.80)	*0.018*
Disease stage	Early stage	3839 (96.0)	161 (4.0)	-	-	-
	Advanced stage	1784 (93.4)	127 (6.6)	1.67 (1.31 to 2.12)	1.60 (1.25 to 2.07)	*<0.001*
Hospital type	No defined pathway	4314 (94.4)	258 (5.6)	-	-	-
	COVID-19 free surgical pathway	1309 (97.8)	30 (2.2)	0.47 (0.31 to 0.70)	0.49 (0.32 to 0.74)	*0.001*
Community SARS-Cov-2 risk	Low	5105 (95.3)	250 (4.7)	-	-	-
	High	518 (93.2)	38 (6.8)	1.47 (0.95 to 2.26)	1.60 (1.01 to 2.54)	0.044

Data included from 5911 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.79 (excellent discrimination).

Supplementary Table 6. Subgroup analysis of factors associated with postoperative pulmonary complications after minor surgery.

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=1822)	Pulmonary complications (N=22)			
Screening type	None	1478 (98.7)	19 (1.3)	-	-	-
	Swab only	344 (99.1)	3 (0.9)	0.68 (0.20 to 2.31)	0.58 (0.16 to 2.13)	0.413
Age	<50 years	373 (99.7)	1 (0.3)	-	-	-
	50-59 years	444 (99.1)	4 (0.9)	3.31 (0.37 to 29.77)	2.18 (0.24 to 20.19)	0.491
	60-69 years	488 (98.2)	9 (1.8)	6.77 (0.85 to 53.64)	3.23 (0.39 to 27.17)	0.280
	70-79 years	366 (98.7)	5 (1.3)	5.05 (0.59 to 43.46)	1.69 (0.17 to 16.46)	0.651
	≥80 years	151 (98.1)	3 (1.9)	7.32 (0.76 to 70.95)	1.91 (0.17 to 21.59)	0.600
Sex	Female	1352 (99.1)	12 (0.9)	-	-	-
	Male	470 (97.9)	10 (2.1)	2.46 (1.05 to 5.72)	1.32 (0.51 to 3.42)	0.571
BMI	Normal	711 (98.9)	8 (1.1)	-	-	-
	Overweight	564 (98.9)	6 (1.1)	0.94 (0.33 to 2.73)	0.84 (0.28 to 2.57)	0.766
	Obese	356 (98.6)	5 (1.4)	1.24 (0.40 to 3.82)	1.01 (0.30 to 3.41)	0.988
	Underweight	40 (100.0)	0 (0)	*Not estimated*	*Not estimated*	
	Missing	151 (98.1)	3 (1.9)	1.70 (0.45 to 6.47)	1.65 (0.38 to 7.05)	0.502
ASA Grade	Grade 1-2	1411 (99.0)	14 (1.0)	-	-	-
	Grade 3-5	411 (98.1)	8 (1.9)	1.98 (0.82 to 4.75)	0.68 (0.22 to 2.11)	0.509
Specialty	Abdominal	312 (99.0)	3 (1.0)	-	-	-
	Thoracic or thoracoabdominal	5 (83.3)	1 (16.7)	21.20 (1.87 to 240.67)	33.78 (2.27 to 503.51)	*0.011*
	Other	1505 (98.8)	18 (1.2)	1.24 (0.36 to 4.25)	3.68 (0.89 to 15.15)	0.071
ECOG Performance Score	0	1273 (99.4)	8 (0.6)	-	-	-
	≥1	549 (97.5)	14 (2.5)	4.05 (1.69 to 9.71)	3.57 (1.28 to 9.90)	*0.015*
Current smoker	No	1596 (98.9)	18 (1.1)	-	-	-
	Yes	226 (98.3)	4 (1.7)	1.59 (0.53 to 4.75)	1.47 (0.43 to 4.95)	0.538
Pre-existing respiratory condition	No	1634 (98.9)	18 (1.1)	-	-	-
	Yes	188 (97.9)	4 (2.1)	1.97 (0.66 to 5.89)	1.64 (0.50 to 5.34)	0.412
Revised Cardiac Risk Index	0	1219 (99.2)	10 (0.8)	-	-	-
	1	469 (98.5)	7 (1.5)	1.82 (0.69 to 4.81)	2.05 (0.65 to 6.52)	0.222
	2	109 (97.3)	3 (2.7)	3.39 (0.92 to 12.50)	3.45 (0.70 to 17.01)	0.128
	≥3	25 (92.6)	2 (7.4)	9.94 (2.07 to 47.75)	10.88 (1.55 to 76.57)	*0.017*
Disease stage	Early stage	1545 (99.0)	15 (1.0)	-	-	-
	Advanced stage	277 (97.5)	7 (2.5)	2.58 (1.04 to 6.39)	2.35 (0.86 to 6.38)	0.094
Hospital type	No defined pathway	1359 (98.6)	19 (1.4)	-	-	-
	COVID-19 free surgical pathway	463 (99.4)	3 (0.6)	0.47 (0.14 to 1.59)	0.44 (0.12 to 1.60)	0.211
Community SARS-Cov-2 risk	Low	1616 (98.8)	19 (1.2)	-	-	-
	High	206 (98.6)	3 (1.4)	1.26 (0.37 to 4.29)	1.80 (0.49 to 6.70)	0.378

Data included from 1844 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.84 (excellent discrimination).

Supplementary Table 7. Sensitivity analysis of factors associated with postoperative pulmonary complications with exclusion of potentially missing data for the primary outcome measure

Factor	Level	Outcome		Unadjusted model (Odds ratio, 95% CI)	Adjusted model (Odds ratio, 95% CI)	P-value
		None (N=8173)	Pulmonary Complications (N=342)			
Screening type	None	5984 (95.7)	270 (4.3)	-	-	-
	CT only	494 (95.4)	24 (4.6)	1.20 (0.76 to 1.88)	1.26 (0.78 to 2.03)	0.353
	Swab only	1389 (97.2)	40 (2.8)	0.67 (0.48 to 0.97)	0.68 (0.47 to 0.99)	0.044
	Swab + CT	306 (97.5)	8 (2.5)	0.63 (0.30 to 1.30)	0.56 (0.27 to 1.18)	0.128
Age	<50 years	1530 (98.8)	19 (1.2)	-	-	-
	50-59 years	1772 (97.6)	44 (2.4)	2.08 (1.23 to 3.51)	1.33 (0.76 to 2.33)	0.313
	60-69 years	2256 (95.6)	104 (4.4)	3.79 (2.34 to 6.13)	1.80 (1.07 to 3.01)	0.026
	70-79 years	1956 (93.8)	130 (6.2)	5.36 (3.32 to 8.63)	2.00 (1.19 to 3.38)	0.009
	≥80 years	659 (93.6)	45 (6.4)	5.43 (3.19 to 9.25)	1.94 (1.07 to 3.52)	0.028
Sex	Female	5091 (98.0)	106 (2.0)	-	-	-
	Male	3082 (92.9)	236 (7.1)	3.53 (2.82 to 4.41)	2.28 (1.78 to 2.92)	<0.001
BMI	Normal	3207 (96.4)	121 (3.6)	-	-	-
	Overweight	2587 (96.2)	102 (3.8)	1.09 (0.84 to 1.40)	0.90 (0.68 to 1.19)	0.446
	Obese	1724 (95.8)	76 (4.2)	1.18 (0.89 to 1.56)	0.92 (0.67 to 1.26)	0.613
	Underweight	194 (95.1)	10 (4.9)	1.24 (0.64 to 2.41)	1.29 (0.64 to 2.59)	0.479
	Missing	461 (93.3)	33 (6.7)	1.47 (1.00 to 2.16)	1.62 (1.04 to 2.50)	0.031
ASA Grade	Grade 1-2	5990 (97.3)	168 (2.7)	-	-	-
	Grade 3-5	2183 (92.6)	174 (7.4)	2.87 (2.32 to 3.55)	1.41 (1.08 to 1.84)	0.012
Specialty	Abdominal	4421 (95.4)	212 (4.6)	-	-	-
	Thoracic or thoracoabdominal	527 (86.8)	80 (13.2)	2.71 (2.06 to 3.56)	2.70 (1.98 to 3.68)	<0.001
	Other	3225 (98.5)	50 (1.5)	0.33 (0.24 to 0.44)	1.22 (0.73 to 2.02)	0.451
ECOG Performance Score	0	5288 (97.6)	128 (2.4)	-	-	-
	≥1	2885 (93.1)	214 (6.9)	2.84 (2.29 to 3.51)	1.78 (1.37 to 2.32)	<0.001
Current smoker	No	7301 (96.3)	283 (3.7)	-	-	-
	Yes	872 (93.7)	59 (6.3)	1.58 (1.20 to 2.10)	1.33 (0.97 to 1.83)	0.077
Pre-existing respiratory condition	No	7313 (96.4)	274 (3.6)	-	-	-
	Yes	860 (92.7)	68 (7.3)	2.04 (1.57 to 2.65)	1.13 (0.84 to 1.54)	0.418
RCRI	0	2683 (98.9)	29 (1.1)	-	-	-
	1	4092 (95.5)	195 (4.5)	4.06 (2.80 to 5.90)	2.11 (1.16 to 3.83)	0.014
	2	1147 (93.5)	80 (6.5)	6.08 (4.04 to 9.16)	2.19 (1.13 to 4.22)	0.020
	≥3	251 (86.9)	38 (13.1)	12.61 (7.79 to 20.40)	3.68 (1.77 to 7.64)	<0.001
Operation grade	Minor	1932 (98.8)	23 (1.2)	-	-	-
	Major	6241 (95.1)	319 (4.9)	4.02 (2.71 to 5.98)	2.19 (1.35 to 3.54)	0.001
Disease stage	Early stage	5857 (96.8)	194 (3.2)	-	-	-
	Advanced stage	2316 (94.0)	148 (6.0)	1.84 (1.49 to 2.27)	1.61 (1.28 to 2.03)	<0.001
Hospital type	No defined pathway	5928 (95.2)	300 (4.8)	-	-	-
	COVID-19 free surgical pathway	2245 (98.2)	42 (1.8)	0.48 (0.35 to 0.66)	0.45 (0.31 to 0.65)	<0.001
Community SARS-Cov-2 risk	Low	7154 (96.0)	298 (4.0)	-	-	-
	High	1019 (95.9)	44 (4.1)	1.05 (0.72 to 1.52)	1.38 (0.90 to 2.12)	0.139

When recording postoperative complications on the REDCap database, investigators were able to select a tick-box to indicate that a specific complication had occurred within 30-days of surgery. A second tick-box was available to confirm the absence of complications where no complications were recorded. For the purpose of the main model, patients with no tick-box selected were analysed as having no pulmonary complications. A sensitivity analysis was completed where patients were excluded when no complication was selected, and the absence of complications was not confirmed (n=83, 0.9%). There were no changes to directions of effect and/or significance of effect. Data included from 8515 patients with complete data. COVID-19=Coronavirus disease 2019. ASA=American Society of Anaesthesiologists. RCRI= Revised Cardiac Risk Index. ECOG=Eastern Cooperative Oncology Group. Percentages calculated as a proportion of row total. Area under the Receiver Operating Characteristic curve for model: 0.80 excellent discrimination).

Appendix: Collaborators (PubMed-citable)

*Writing group (*denotes joint first authors)*

*James C Glasbey (UK), *Omar Omar (UK), Dmitri Nepogodiev (UK), Ana Minaya-Bravo (Spain), Brittany Kay Bankhead-Kendall (US), Marco Fiore (Italy), Kaori Futaba (Hong Kong), Alodia Gabre-Kidan (USA), Rohan R Gujjuri (UK), Arda Isik (Turkey), Haytham MA Kaafarani (USA), Sivesh K Kamarajah (UK), Elizabeth Li (UK), Markus W Löffler (Germany), Kenneth A McLean (UK), Oumaima Outani (Morocco), Faustin Ntirenganya (Rwanda), Sohei Satoi (Japan), Richard Shaw (UK), Joana FF Simoes (Portugal), Grant D Stewart (UK), Stephen Tabiri (Ghana), Isobel M Trout (UK), Aneel A Bhangu (UK, ***Overall guarantor***).

Statistical analysis

James C Glasbey, Omar Omar (***Lead statistician***), Aneel A Bhangu

CovidSurg Operations Committee

Kwabena Siaw-Acheampong, Ruth A Benson, Edward Bywater, Daoud Chaudhry, Brett E Dawson, Jonathan P Evans, James C Glasbey, Rohan R Gujjuri, Emily Heritage, Conor S Jones, Sivesh K Kamarajah, Chetan Khatri, Rachel A Khaw, James M Keatley, Andrew Knight, Samuel Lawday, Elizabeth Li, Harvinder S Mann, Ella J Marson, Kenneth A McLean, Siobhan C Mckay, Emily C Mills, Dmitri Nepogodiev, Gianluca Pellino, Maria Picciochi, Elliott H Taylor, Abhinav Tiwari, Joana FF Simoes, Isobel M Trout, Mary L Venn, Richard JW Wilkin, Aneel Bhangu.

*International Cancer Leads (*denotes specialty Principal Investigators)*

James C Glasbey (***Chair***); **Colorectal:** Neil J Smart*, Ana Minaya-Bravo*, Jonathan P Evans, Gaetano Gallo, Susan Moug, Francesco Pata, Peter Pockney, Salomone Di Saverio, Abigail Vallance, Dale Vimalchandran; **Oesophagogastric**: Ewen A Griffiths*, Sivesh K Kamarajah, Richard PT Evans, Philip Townend; **Hepatopancreatobilary**: Keith Roberts*, Siobhan McKay*, John Isaac, Sohei Satoi; **Thoracic:** John Edwards*, Aman S Coonar, Adrian Marchbank, Edward J Caruana, Georgia R Layton, Akshay Patel, Alessandro Brunelli; **Sarcoma:** Samuel Ford*, Anant Desai*, Alessandro Gronchi*, Marco Fiore, Max Almond, Fabio Tirotta, Sinziana Dumitra; **Neurosurgery:** Angelos Kolias*, Stephen J Price, Daniel M Fountain, Michael D

Jenkinson, Peter Hutchinson, Hani J Marcus, Rory J Piper, Laura Lippa, Franco Servadei, Ignatius Esene, Christian Freyschlag, Iuri Neville, Gail Rosseau, Karl Schaller, Andreas K Demetriades, Faith Robertson, Alex Alamri; **Head and neck:** Richard Shaw*, Andrew G Schache, Stuart C Winter, Michael Ho, Paul Nankivell, Juan Rey Biel, Martin Batstone, Ian Ganly; **Breast:** Raghavan Vidya*, Alex Wilkins, Jagdeep K Singh, Dinesh Thekinkattil; **Gynaecology:** Sudha Sundar*, Christina Fotopoulou*, Elaine Leung, Tabassum Khan, Luis Chiva, Jalid Sehouli, Anna Fagotti, Paul Cohen, Murat Gutelkin, Rahel Ghebre, Thomas Konney, Rene Pareja, Rob Bristow, Sean Dowdy, Shylasree TS Rajkumar, Joe Ng, Keiiji Fujiwara; **Urology:** Grant D Stewart*, Benjamin Lamb, Krishna Narahari, Alan McNeill, Alexandra Colquhoun, John McGrath, Steve Bromage, Ravi Barod, Veeru Kasivisvanathan, Tobias Klatte.

Dissemination Committee

Joana FF Simoes (***Chair***); Tom EF Abbott, Sadi Abukhalaf, Michel Adamina, Adesoji O Ademuyiwa, Arnav Agarwal, Murat Akkulak, Ehab Alameer, Derek Alderson, Felix Alakaloko, Markus Albertsmeiers, Osaid Alser, Muhammad Alshaar, Sattar Alshryda, Alexis P Arnaud, Knut Magne Augestad, Faris Ayasra, José Azevedo, Brittany K Bankhead-Kendall, Emma Barlow, David Beard, Ruth A Benson, Ruth Blanco-Colino, Amanpreet Brar, Ana Minaya-Bravo, Kerry A Breen, Chris Bretherton, Igor Lima Buarque, Joshua Burke, Edward J Caruana, Mohammad Chaar, Sohini Chakrabortee, Peter Christensen, Daniel Cox, Moises Cukier, Miguel F Cunha, Giana H Davidson, Anant Desai, Salomone Di Saverio, Thomas M Drake, John G Edwards, Muhammed Elhadi, Sameh Emile, Shebani Farik, Marco Fiore, J Edward Fitzgerald, Samuel Ford, Tatiana Garmanova, Gaetano Gallo, Dhruv Ghosh, Gustavo Mendonça Ataíde Gomes, Gustavo Grecinos, Ewen A Griffiths, Madalegna Gründl, Constantine Halkias, Ewen M Harrison, Intisar Hisham, Peter J Hutchinson, Shelley Hwang, Arda Isik, Michael D Jenkinson, Pascal Jonker, Haytham MA Kaafarani, Debby Keller, Angelos Kolias, Schelto Kruijff, Ismail Lawani, Hans Lederhuber, Sezai Leventoglu, Andrey Litvin, Andrew Loehrer, Markus W Löffler, Maria Aguilera Lorena, Maria Marta Modolo, Piotr Major, Janet Martin, Hassan N Mashbari, Dennis Mazingi, Symeon Metallidis, Ana Minaya-Bravo, Helen M Mohan, Rachel Moore, David Moszkowicz, Susan Moug, Joshua S Ng-Kamstra, Mayaba Maimbo, Ionut Negoi, Milagros Niquen, Faustin Ntirenganya, Maricarmen Olivos, Kacimi Oussama, Oumaima Outani, Marie Dione Parreno-Sacdalanm, Francesco Pata, Carlos Jose Perez Rivera, Thomas D Pinkney, Willemijn van der Plas, Peter Pockney, Ahmad Qureshi, Dejan Radenkovic, Antonio Ramos-De la Medina, Keith Roberts, April C Roslani, Martin Rutegård, Juan José Segura-Sampedro, Irène

Santos, Sohei Satoi, Raza Sayyed, Andrew Schache, Andreas A Schnitzbauer, Justina O. Seyi-Olajide, Neil Sharma, Richard Shaw, Sebastian Shu, Kjetil Soreide, Antonino Spinelli, Grant D Stewart, Malin Sund, Sudha Sundar, Stephen Tabiri, Philip Townend, Georgios Tsoulfas, Gabrielle H van Ramshorst, Raghavan Vidya, Dale Vimalachandran, Oliver J Warren, Duane Wedderburn, Naomi Wright, EuroSurg, European Society of Coloproctology (ESCP), Global Initiative for Children's Surgery (GICS), GlobalSurg, GlobalPaedSurg, ItSURG, PTSurg, SpainSurg, Italian Society of Colorectal Surgery (SICCR), Association of Surgeons in Training (ASiT), Irish Surgical Research Collaborative (ISRC), Transatlantic Australasian Retroperitoneal Sarcoma Working Group (TARPSWG), Italian Society of Surgical Oncology (SICO).

*Collaboratoring authors (*denotes Site Principal Investigators)*

Argentina: Allemand C, Boccalatte L*, Figari M, Lamm M, Larrañaga J, Marchitelli C, Noll F*, Odetto D, Perrotta M, Saadi J, Zamora L (***Hospital Italiano De Buenos Aires***); Alurralde C, Caram EL, Eskinazi D*, Mendoza JP, Usandivaras M (***Sanatorio 9 De Julio Sa***); Badra R, Esteban A, García JS, García PM, Gerchunoff JI, Lucchini SM*, NIgra MA, Vargas L (***Sanatorio Allende***).
Armenia: Hovhannisyan T*, Stepanyan A* (***Nairi Medical Center***).
Australia: Gould T, Gourlay R*, Griffiths B (***Calvary Mater Newcastle***); Gananadha S*, McLaren M (***Canberra Hospital***); Cecire J, Joshi N, Salindera S*, Sutherland A (***Coffs Harbour Health Campus***); Ahn JH, Charlton G, Chen S, Gauri N, Hayhurst R, Jang S, Jia F, Mulligan C, Yang W, Ye G, Zhang H (***Concord Repatriation General Hospital***); Ballal M, Gibson D, Hayne D, Moss J*, Richards T, Viswambaram P, Vo UG* (***Fiona Stanley Hospital***); Bennetts J*, Bright T*, Brooke-Smith M*, Fong R, Gricks B, Lam YH, Ong BS, Szpytma M, Watson D (***Flinders Medical Centre***); Bagraith K, Caird S, Chan E, Dawson C, Ho D, Jeyarajan E, Jordan S, Lim A, Nolan GJ, Oar A, Parker D, Puhalla H, Quennell A, Rutherford L, Townend P*, Von Papen M, Wullschleger M (***Gold Coast University Hospital***); Blatt A*, Cope D, Egoroff N, Fenton M, Gani J, Lott N, Pockney P*, Shugg N (***John Hunter Hospital***); Elliott M, Phung D (***Lifehouse***); Phan D, Townend D* (***Lismore Base Hospital***); Bong C, Gundara J* (***Logan Hospital***); Frankel A* (***Princess Alexandra Hospital***); Bowman S*, Guerra GR (***Queen Elizabeth II Jubilee Hospital***); Bolt J, Buddingh K, Dudi-Venkata NN, Jog S, Kroon HM*, Sammour T, Smith R, Stranz C (***Royal Adelaide Hospital***); Batstone M*, Lah K*, McGahan W*, Mitchell D*, Morton A, Pearce A, Roberts M*, Sheahan G*, Swinson B (***Royal Brisbane And Women's Hospital***);

Alam N, Banting S, Chong L, Choong P*, Clatworthy S, Foley D, Fox A, Hii MW, Knowles B, Mack J, Read M, Rowcroft A, Ward S*, Wright G* (***St Vincent's Hospital***).

Austria: Lanner M* (***Kardinal Schwarzenberg Klinikum***); Königsrainer I* (***Landeskrankenhaus Feldkirch***); Bauer M, Freyschlag C, Kafka M, Messner F, Öfner D*, Tsibulak I (***Medical University Of Innsbruck***); Emmanuel K, Grechenig M, Gruber R, Harald M, Öhlberger L, Presl J*, Wimmer A (***Paracelsus Medical University Salzburg***).

Azerbaijan: Namazov İ, Samadov E (***Leyla Medical Centerl***).

Barbados: Barker D, Boyce R, Corbin S, Doyle A, Eastmond A, Gill R, Haynes A, Millar S, O'Shea M, Padmore G*, Paquette N, Phillips E, St. John S, Walkes K (***Queen Elizabeth Hospital***).

Belgium: Flamey N, Pattyn P* (***Az Delta***); Oosterlinck W*, Van den Eynde J, Van den Eynde R (***Uz Leuven***).

Brazil: Gatti A*, Nardi C, Oliva R (***Hospital Geral De Pirajussara***); De Cicco R* (***Instituto De Câncer Dr Arnaldo Vieira De Carvalho***); Cecconello I, Gregorio P, Pontual Lima L, Ribeiro Junior U, Takeda F*, Terra RM* (***Instituto Do Câncer De Estado De São Paulo***).

Bulgaria: Sokolov M* (***University Hospital Alexandrovska***).

Canada: Kidane B*, Srinathan S (***Health Sciences Centre***); Boutros M*, Caminsky N, Ghitulescu G, Jamjoum G, Moon J, Pelletier J, Vanounou T, Wong S (***Jewish General Hospital***); Boutros M*, Dumitra S, Kouyoumdjian A (***Mcgill University Health Center***); Johnston B*, Russell C (***Saint John Regional Hospital***); Boutros M*, Demyttenaere S*, Garfinkle R (***St. Mary's Hospital***); Abou-Khalil J, Nessim C*, Stevenson J (***The Ottawa Hospital***).

Chile: Heredia F* (***Clínica Universitaria De Concepción***).

Colombia: Almeciga A*, Fletcher A*, Merchan A* (***Centro De Investigaciones Oncológicas Clínica San Diego - Ciosad***); Puentes LO* (***Hospital San José***); Mendoza Quevedo J* (***Subred Sur Occidente De Kennedy (Hospital De Kennedy)***).

Croatia: Bačić G, Karlović D, Kršul D, Zelić M* (***University Hospital Center Rijeka***); Luksic I*, Mamic M (***University Hospital Dubrava***); Bakmaz B, Ćoza I, Dijan E, Katusic Z, Mihanovic J*, Rakvin I (***Zadar General Hospital***).

Cyprus: Frantzeskou K, Gouvas N*, Kokkinos G, Papatheodorou P, Pozotou I, Stavrinidou O, Yiallourou A* (***Nicosia General Hospital***).

Czechia: Martinek L, Skrovina M*, Szubota I (***Hospital & Oncological Centre Novy Jicin***); Žatecký J* (***Slezská Nemocnice V Opavě, P.o.***); Javurkova V, Klat J* (***University Hospital Ostrava***).

Denmark: Avlund T, Christensen P*, Harbjerg JL, Iversen LH, Kjaer DW, Kristensen HØ, Mekhael M (***Aarhus University Hospital***); Ebbehøj AL, Krarup P, Schlesinger N, Smith H* (***Bispebjerg Hospital***).

Egypt: Abdelsamed A, Azzam AY*, Salem H*, Seleim A (***Al Azhar University Hospitals***); Abdelmajeed A, Abdou M, Abosamak NE, AL Sayed M, Ashoush F*, Atta R, Elazzazy E, Elhoseiny M, Elnemr M, Elqasabi MS, Elsayed Hewalla ME, Elsherbini I, Essam E, Eweda M, Ghallab I, Hassan E, Ibrahim M, Metwalli M, Mourad M, Qatora MS, Ragab M, Sabry A*, Saifeldin H, Saleh Mesbah Mohamed Elkaffas M, Samih A, Samir Abdelaal A, Shehata S*, Shenit K (***Alexandria Main University Hospital***); Attia D, Kamal N, Osman N* (***Alexandria Medical Research Institute***); Abbas AM*, Abd Elazeem HAS, Abdelkarem MM, Alaa S*, Ali AK, Ayman A, Azizeldine MG, Elkhayat H*, M.elghazaly S, Monib FA, Nageh MA, Saad MM*, Salah M, Shahine M*, Yousof EA, Youssef A (***Assiut University Hospital***); Eldaly A* (***El-Menshawy Hospital***); ElFiky M*, Nabil A (***Kasr Alainy Faculty Of Medicine, Cairo University***); Amira G, Sallam I*, Sherief M, Sherif A (***Misr Cancer Center***); Abdelrahman A, Aboulkassem H, Ghaly G*, Hamdy R, Morsi A, Salem H*, Sherif G (***National Cancer Institute***); Abdeldayem H, Abdelkader Salama I*, Balabel M, Fayed Y, Sherif AE* (***National Liver Institute, Menoufia University***).

Ethiopia: Bekele D* (***Maddawalabu University Goba Referral Hospital***).

Finland: Kauppila J*, Sarjanoja E (***Länsi-Pohja Central Hospital***); Helminen O, Huhta H, Kauppila JH* (***Oulu University Hospital***).

France: Beyrne C, Jouffret L*, Lugans L, Marie-Macron L (***Centre Hospitalier Avignon***); Chouillard E*, De Simone B* (***Centre Hospitalier Intercommunal Poissy Saint Germain En Laye***); Bettoni J, Dakpé S, Devauchelle B, Lavagen N, Testelin S* (***Chu Amiens***); Boucher S*, Breheret R, Gueutier A, Kahn A, Kün-Darbois J (***Chu Angers***); Barrabe A, Lakkis Z*, Louvrier A, Manfredelli S, Mathieu P (***Chu Besançon***); Chebaro A*, Drubay V, El amrani M, Eveno C, Lecolle K, Legault G, Martin L, Piessen G*, Pruvot FR, Truant S, Zerbib P (***Chu Lille***); Ballouhey Q*, Barrat B, Laloze J, Salle H, Taibi A, Usseglio J (***Chu Limoges***); Bergeat D, Merdrignac A (***Chu Rennes - General Surgery***); Le Roy B, Perotto LO, Scalabre A* (***Chu Saint Etienne***); Aimé A, Ezanno A*, Malgras B (***Hia Begin***); Bouche P*, Tzedakis S* (***Hôpital Cochin - Aphp***); Cotte E, Glehen O, Kepenekian V, Lifante J, Passot G (***Hopital Lyon Sud***); D'Urso A, Felli E, Mutter D, Pessaux P, Seeliger B* (***Hus, Pole Hépato-Digestif / Ihu-Strasbourg***); Bardet J, Berry R, Boddaert G, Bonnet S, Brian E, Denet C, Fuks D, Gossot D, Grigoroiu M, Laforest A, Levy-Zauberman Y, Louis-Sylvestre C, Moumen A, Pourcher G,

Seguin-givelet A*, Tribillon E (***Institut Mutualiste Montsouris***); Duchalais E*, Espitalier F, Ferron C, Malard O* (***Nantes University Hospital***).

Germany: Bork U*, Distler M, Fritzmann J, Kirchberg J, Praetorius C, Riediger C, Weitz J, Welsch T, Wimberger P* (***University Hospital Carl Gustav Carus, TU Dresden***); Beyer K, Kamphues C*, Lauscher J, Loch FN, Schineis C (***Charité University Medicine, Campus Benjamin Franklin***); Albertsmeier M*, Angele M, Kappenberger A, Niess H, Schiergens T, Werner J (***Department of General, Visceral and Transplantation Surgery, Ludwig-Maximilians-Universitat Munich***);Becker R*, Jonescheit J (***Heilig-Geist Hospital Bensheim***); Pergolini I, Reim D* (***Klinikum Rechts Der Isar Tum School Of Medicine***); Boeker C, Hakami I*, Mall J* (***Krh Nordstadt-Siloah Hospitals***); Liokatis P*, Smolka W (***LMU Klinikum Campus Innenstadt***); Nowak K*, Reinhard T* (***Romed Klinikum Rosenheim***); Hölzle F, Modabber A*, Winnand P (***University Hospital Aachen***); Knitschke M* (***University Hospital Giessen And Marburg***); Kauffmann P, Wolfer S* (***University Hospital Goettingen / Universitätsmedizin Goettingen***); Kleeff J, Lorenz K, Michalski C, Ronellenfitsch U*, Schneider R (***University Hospital Halle (Saale)***); Bertolani E, Königsrainer A*, Löffler MW, Quante M*, Steidle C, Überrück L, Yurttas C (***University Hospital Tuebingen***); Betz CS, Bewarder J, Böttcher A, Burg S, Busch C, Gosau M*, Heuer A, Izbicki J, Klatte TO, Koenig D, Moeckelmann N, Nitschke C, Priemel M, Smeets R, Speth U, Thole S, Uzunoglu FG*, Vollkommer T, Zeller N (***University Medical Center Hamburg-Eppendorf***); Battista MJ*, Gillen K, Hasenburg A, Krajnak S, Linz V, Schwab R (***University Of Mainz, Department Of Gynaecology And Obstetrics***).

Greece: Angelou K, Haidopoulos D*, Rodolakis A (***Alexandra General Hospital***); Antonakis P, Bramis K, Chardalias L, Contis I, Dafnios N, Dellaportas D, Fragulidis G, Gklavas A, Konstadoulakis M, Memos N*, Papaconstantinou I*, Polydorou A, Theodosopoulos T, Vezakis A (***Aretaieion Hospital***); Antonopoulou MI, Manatakis DK*, Tasis N (***Athens Naval And Veterans Hospital***); Arkadopoulos N, Danias N, Economopoulou P, Kokoropoulos P, Larentzakis A, Michalopoulos N*, Selmani J, Sidiropoulos T, Tsaousis V, Vassiliu P (***Attikon University General Hospital***); Bouchagier K*, Klimopoulos S, Paspaliari D, Stylianidis G (***Evaggelismos General Hospital***); Baxevanidou K, Bouliaris K, Chatzikomnitsa P, Efthimiou M, Giaglaras A, Kalfountzos C*, Koukoulis G, Ntziovara AM, Petropoulos K, Soulikia K, Tsiamalou I, Zervas K, Zourntou S (***General Hospital Of Larissa "Koutlimpaneio And Triantafylleio"***); Baloyiannis I, Diamantis A, Gkrinia E, Hajiioannou J*, Korais C, Koukoura O, Perivoliotis K, Saratziotis A, Skoulakis C, Symeonidis D, Tepetes K, Tzovaras G*, Zacharoulis D (***General University Hospital Of Larissa***); Alexoudi V, Antoniades K*, Astreidis I, Christidis P, Deligiannidis D, Grivas T, Ioannidis O*, Kalaitsidou I, Loutzidou L, Mantevas A, Michailidou D,

Paraskevopoulos K, Politis S, Stavroglou A, Tatsis D, Tilaveridis I, Vahtsevanos K, Venetis G (***George Papanikolaou General Hospital Of Thessaloniki***); Karaitianos I*, Tsirlis T (***Henry Dunant Hospital Center***); Charalabopoulos A, Liakakos T, Mpaili E, Schizas D*, Spartalis E, Syllaios A, Zografos C (***Laiko University Hospital***); Anthoulakis C, Christou C, Papadopoulos V, Tooulias A, Tsolakidis D*, Tsoulfas G*, Zouzoulas D (***Papageorgiou General Hospital***); Athanasakis E, Chrysos E, Tsiaoussis J, Xenaki S*, Xynos E* (***University Hospital Of Heraklion Crete And Interclinic Hospital Of Crete***).

Hong Kong: Futaba K*, Ho MF, Hon SF, Mak TWC, Ng SSM (***Prince Of Wales Hospital***); Foo CC* (***Queen Mary Hospital***).

Hungary: Banky B*, Suszták N (***Szent Borbála Kórház***).

Ireland: Aremu M*, Canas-Martinez A, Cullivan O, Murphy C, Owens P, Pickett L (***Connolly Hospital Blanchardstown***); Akmenkalne L, Byrne J, Corrigan M*, Cullinane C, Daly A, Fleming C*, Jordan P, Killeen S, Lynch N, McCarthy A, Mustafa H, O'Brien S, O'Leary P, Syed WAS, Vernon L (***Cork University Hospital***); Callanan D, Huang L, Ionescu A, Sheahan P* (***South Infirmary Victoria University Hospital***); Balasubramanian I, Boland M, Conlon K, Evoy D, Fearon N, Gallagher T, Geraghty J, Heneghan H*, Kennedy N, Maguire D, McCartan D, McDermott EW, Prichard RS, Winter D* (***St Vincent's University Hospital***); Alazawi D, Barry C*, Boyle T, Butt W, Connolly EM, Donlon N, Donohue C, Fahey BA, Farrell R, Fitzgerald C, Kinsella J, Larkin JO*, Lennon P, Maguire PJ*, Mccormick P, Mehigan BJ, Mohan H, Nugent T, O'Sullivan H, Ravi N, Reynolds JV*, Rogers A, Shokuhi P, Smith J, Smith LA, Timon C (***St. James's Hospital***); Bashir Y, Bass G, Connelly T, Creavin B, Earley H, Elliott JA*, Gillis A, Kavanagh D, Neary P, O'riordan J, Reynolds IS, Rice D, Ridgway P, Umair M, Whelan M (***Tallaght Hospital***); Carroll P, Collins C, Corless K, Finnegan L, Fowler A, Hogan A, Kerin M, Lowery A*, McAnena P, McKevitt K*, Nizami K, Ryan É, Samy A (***University Hospital Galway***); Coffey JC, Cunningham R, Devine M, Nally D*, Peirce C, Tormey S (***University Hospital Limerick***); Hardy N, Neary P, O'Malley S*, Ryan M (***University Hospital Waterford/University College Cork***).

Italy: Macina S* (***Asst Mantua***); Mariani NM*, Opocher E, Pisani Ceretti A (***Asst Santi Paolo E Carlo***); Ferrari F*, Odicino F, Sartori E* (***Asst Spedali Civili, Ospedale Di Brescia***); Cotsoglou C*, Granieri S (***Asst Vimercate***); Bianco F*, Camillo' A, Colledan M*, Tornese S, Zambelli MF (***Asst-Papa Giovanni Xxiii- Bergamo***); Bissolotti G, Fusetti S, Lemma F* (***Azienda Ospedaliera Di Padova***); Marino MV*, Mirabella A, Vaccarella G (***Azienda Ospedaliera Ospedali Riuniti Villa Sofia-Cervello, Palermo***); Agostini C, Alemanno G, Bartolini I, Bergamini C, Bruscino A, Checcucci C, De Vincenti R, Di Bella A, Fambrini M, Fortuna L,

Maltinti G, Muiesan P*, Petraglia F, Prosperi P*, Ringressi MN, Risaliti M, Sorbi F*, Taddei A*, Tucci R (***Azienda Ospedaliera Universitaria Careggi***); Bassi C, Bortolasi L, Campagnaro T*, Casetti L, De Pastena M, Esposito A, Fontana M, Guglielmi A, Landoni L, Malleo G, Marchegiani G, Nobile S, Paiella S, Pedrazzani C, Rattizzato S, Ruzzenente A, Salvia R*, Turri G, Tuveri M (***Azienda Ospedaliera Universitaria Integrata Di Verona***); Bellora P, D'Aloisio G, Ferrari M, Francone E, Gentilli S*, Nikaj H (***Azienda Ospedaliero Universitaria Maggiore Della Carità***); Bianchini M, Chiarugi M, Coccolini F, Di Franco G, Furbetta N, Gianardi D, Guadagni S, Morelli L*, Palmeri M, Tartaglia D* (***Azienda Ospedaliero Universitaria Pisana***); Anania G*, Carcoforo P*, Chiozza M, De Troia A, Koleva Radica M, Portinari M, Sibilla MG, Urbani A (***Azienda Ospedaliero Universitaria Sant'anna***); Fabbri N, Feo CV*, Gennari S, Parini S, Righini E (***Azienda Unità Sanitaria Locale di Ferrara - University of Ferrara***); Ampollini L*, Bellanti L, Bergonzani M, Bertoli G, Bocchialini G, D'Angelo G*, Lanfranco D, Musini L, Poli T, Santoro GP, Varazzani A* (***Azienda Ospedaliero-Universitaria Di Parma***); Aguzzoli L, Borgonovo G, Castro Ruiz C, Coiro S, Falco G*, Mandato VD*, Mastrofilippo V, Montella MT, Annessi V, Zizzo M* (***Azienda Unità Sanitaria Locale - Irccs Di Reggio Emilia***); Grossi U, Novello S, Romano M, Rossi S, Zanus G* (***Ca' Foncello Treviso-DISCOG-Universit Di Padova***); Esposito G, Frongia F, Pisanu A, Podda M* (***Cagliari University Hospital***); Belluco C, Lauretta A*, Montori G, Moras L, Olivieri M (***Centro Di Riferimento Oncologico Di Aviano (Cro) Irccs***); Bussu F, Carta AG, Cossu ML, Cottu P, Fancellu A, Feo CF, Ginesu GC, Giuliani G, Madonia M, Perra T*, Piras A, Porcu A*, Rizzo D, Scanu AM, Tedde A, Tedde M (***Cliniche San Pietro, A.o.u. Sassari***); Delrio P*, Rega D* (***Colorectal Surgical Oncology Unit - Istituto Nazionale Tumori Fondazione, Pascale-I.r.c.c.s.***); Badalamenti G, Campisi G, Cordova A, Franza M, Maniaci G, Rinaldi G, Toia F* (***Department Of Surgical, Oncological And Oral Sciences. University Of Palermo***); Calabrò M*, Farnesi F, Lunghi EG, Muratore A*, Pipitone Federico NS (***Edoardo Agnelli***); Bàmbina F, D'Andrea G, Familiari P*, Picotti V (***Fabrizio Spaziani***); De Palma G, Luglio G*, Pagano G, Tropeano FP (***Federico II University Hospital***); Baldari L*, Beltramini GA, Boni L*, Cassinotti E*, Gianni' A*, Pignataro L*, Torretta S (***Fondazione Irccs Ca' Granda - Ospedale Maggiore Policlinico***); Abatini C, Baia M, Biasoni D, Bogani G, Cadenelli P, Capizzi V*, Cioffi SPB, Citterio D*, Comini LV, Cosimelli M, Fiore M*, Folli S, Gennaro M, Giannini L*, Gronchi A, Guaglio M*, Macchi A*, Martinelli F*, Mazzaferro V, Mosca A, Pasquali S, Piazza C, Raspagliesi F, Rolli L*, Salvioni R, Sarpietro G, Sarre C, Sorrentino L (***Fondazione Irccs Istituto Nazionale Dei Tumori, Milano***); Agnes A, Alfieri S, Belia F, Biondi A, Cozza V, D'Amore A, D'Ugo D, De Simone V, Fagotti A*, Gasparini G, Gordini L*, Litta F, Lombardi CP, Lorenzon L, Marra AA, Marzi F, Moro A, Parello A, Perrone E, Persiani

R, Ratto C, Rosa F, Saponaro G, Scambia G*, Scrima O, Sganga G, Tudisco R (***Fondazione Policlinico Universitario Agostino Gemelli***); Belli A*, Granata V, Izzo F, Palaia R, Patrone R (***Hpb Surgical Oncology Unit - Istituto Nazionale Tumori Fondazione, Pascale-I.r.c.c.s.***); Carrano FM, Carvello MM, De Virgilio A, Di Candido F, Ferreli F, Gaino F, Mercante G*, Rossi V, Spinelli A*, Spriano G (***Humanitas Clinical And Research Center Irccs, Rozzano (Mi) & Humanitas University, Department Of Biomedical Sciences, Pieve Emanuele (Mi)***); Donati DM*, Frisoni T, Palmerini E (***Irccs Istituto Ortopedico Rizzoli***); Aprile A, Barra F*, Batistotti P, Ferrero S, Fregatti P*, Scabini S*, Sparavigna M (***Irccs Ospedale Policlinico San Martino***); Asti E, Bernardi D, Bonavina L*, Lovece A **(*University of Milan, IRCCS Policlinico San Donato*)**; Adamoli L, Ansarin M*, Cenciarelli S, Chu F, De Berardinis R, Fumagalli Romario U*, Mastrilli F, Pietrobon G, Tagliabue M (***Istituto Europeo Di Oncologia - Irccs -Milano***); Badellino E, Ferrero A*, Massobrio R (***Mauriziano Hospital Torino; Italy***); De Manzoni Garberini A* (***Ospedale Civile Spirito Santo***); Federico P, Maida P, Marra E, Marte G, Petrillo A, Tammaro T, Tufo A* (***Ospedale Del Mare***); Berselli M*, Borroni G*, Cocozza E, Conti L, Desio M, Livraghi L*, Quintodei V, Rizzi A, Zullo A (***Ospedale Di Circolo E Fondazione Macchi (Varese)***); Baldi C*, Corbellini C, Sampietro GM (***Ospedale Di Rho - Asst Rhodense***); Cellerino P* (***Ospedale Fatebenefratelli E Oftalmico***); Baldini E*, Capelli P, Conti L, Isolani SM, Ribolla M (***Ospedale Guglielmo Da Saliceto Piacenza***); Bondurri A, Colombo F*, Ferrario L, Guerci C, Maffioli A (***Ospedale Luigi Sacco Milano***); Armao T, Ballabio M*, Bisagni P, Gagliano A, Longhi M, Madonini M, Pizzini P (***Ospedale Maggiore Di Lodi***); Baietti AM, Biasini M, Maremonti P, Neri F, Prucher GM*, Ricci S, Ruggiero F, Zarabini AG (***Ospedale Maggiore/Bellaria Carlo Alberto Pizzardi Ausl Bologna***); Barmasse R, Mochet S*, Morelli L, Usai A (***Ospedale Regionale Umberto Parini***); Bianco F*, Incollingo P (***Ospedale S. Leonardo - Asl Napoli 3 Sud, Castellammare Di Stabia***); Mancini S, Marino Cosentino L*, Sagnotta A* (***Ospedale San Filippo Neri***); Fruscio R*, Grassi T, Nespoli LC, Tamini N* (***Ospedale San Gerardo***); Anastasi A, Bartalucci B, Bellacci A, Canonico G*, Capezzuoli L, Di Martino C, Ipponi P, Linari C, Montelatici M, Nelli T, Spagni G, Tirloni L, Vitali A (***Ospedale San Giovanni Di Dio***); Abate E, Casati M*, Casiraghi T, Laface L, Schiavo M (***Ospedale Vittorio Emanuele Iii - Carate Brianza***); Arminio A, Cotoia A, Lizzi V*, Vovola F (***Ospedali Riuniti Azienda Ospedaliera Universitaria Foggia***); Vergari R* (***Ospedali Riuniti Di Ancona***); D'Ugo S*, Depalma N, Spampinato MG (***P.o."Vito Fazzi"***); Bartolucci P, Brachini G, Bruzzaniti P, Chiappini A, Chiarella V, Ciccarone F, Cicerchia PM, Cirillo B, De Toma G, Di bartolomeo A, Fiori E, Fonsi GB, Franco G, Frati A, Giugliano M, Iannone I, La Torre F, Lapolla P*, Leonardo C, Marruzzo G, Meneghini S, Mingoli A, Ribuffo D, Salvati M, Santoro A, Sapienza P, Scafa AK,

Simonelli L, Zambon M (***Policlinico Umberto I Sapienza University Of Rome***); Capolupo GT*, Carannante F, Caricato M*, Mascianà G, Mazzotta E (***Policlinico Universitario Campus Bio Medico Of Rome***); Gattolin A, Migliore M, Rimonda R, Sasia D*, Travaglio E (***Regina Montis Regalis Hospital, Mondovì***); Cervellera M, Gori A, Sartarelli L, Tonini V* (***S.orsola-Malpighi Hospital***); Giacometti M*, Zonta S (***Ospedale San Biagio, ASL VCO***); Chessa A*, Fiorini A, Norcini C (***San Giovanni Di Dio***); Colletti G, Confalonieri M, Costanzi A*, Frattaruolo C, Mari G, Monteleone M (***San Leopoldo Mandic***); Bandiera A, Bocciolone L, Bonavina G, Candiani M*, Candotti G, De Nardi P*, Gagliardi F, Medone M, Mortini P*, Negri G*, Parise P, Piloni M, Sileri P, Vignali A (***San Raffaele Scientific Institute, Milan***); Belvedere A, Bernante P, Bertoglio P, Boussedra S, Brunocilla E, Cipriani R, Cisternino G, De Crescenzo E, De Iaco P*, Dondi G, Frio F*, Jovine E, Mineo Bianchi F, Neri J, Parlanti D, Perrone AM, Pezzuto AP, Pignatti M*, Pinto V, Poggioli G, Ravaioli M, Rottoli M*, Schiavina R, Serenari M*, Serra M, Solli P*, Taffurelli M*, Tanzanu M, Tesei M, Violante T, Zanotti S (***Azienda Osepdaliero - Universitaria di Bologna, Via Albertoni 15, Bologna, Italy***); Borghi F, Cianflocca D, Di Maria Grimaldi S, Donati D, Gelarda E, Geretto P, Giraudo G, Giuffrida MC, Marano A*, Palagi S, Pellegrino L, Peluso C, Testa V* (***Santa Croce E Carle Hospital, Cuneo***); Agresta F*, Prando D*, Zese M* (***Santa Maria Degli Angeli Hospital Ulss5 - Adria***); Aquila F, Gambacciani C, Lippa L, Pieri F, Santonocito OS* (***Spedali Riuniti Di Livorno***); Armatura G*, Bertelli G, Frena A, Marinello P, Notte F, Patauner S, Scotton G* (***St. Moritz Hospital***); Fulginiti SF, Gallo G*, Sammarco G, Vescio G (***University 'Magna Graecia' Of Catanzaro***); Balercia P, Catarzi L, Consorti G* (***University Hospital Umberto I Ancona***); Di Marzo F* (***Valtiberina***); Fontana T* (***Vittorio Emanuele***).

Japan: Daiko H*, Ishikawa M, Ishiyama K, Iwata S, Kanematsu K, Kanemitsu Y*, Kato T*, Kawai A*, Kobayashi E, Kobayashi Kato M, Moritani K, Nakatani F, Oguma J, Tanase Y, Uno M (***National Cancer Center Hospital***).

Jordan: Al Abdallah M*, Ayasra F, Ayasra Y, Qasem A (***Al-Basheer Hospital***); Abu Za'nouneh FJ, Fahmawee T, Hmedat A, Ibrahim A, Obeidat K* (***King Abdullah University Hospital***); Abdel Al S, Abdel Jalil R, Abou Chaar MK, Al-Masri M*, Al-Najjar H, Alawneh F, Alsaraireh O, Elayyan M, Ghanem R, Lataifeh I (***King Hussein Cancer Center***).

Libya: Alkadeeki GZ*, Al Maadany FS (***Al-Jalaa Hospital***); Aldokali N, Senossi O, Subhi MT (***Alkhadra Hospital***); Burgan D*, Kamoka E, Kilani AI, Salamah A, Salem M, Shuwayyah A (***National Cancer Institute, Sabratha - Libya***); Abdulwahed E*, Alshareea E, Aribi N, Aribi S, Biala M, Ghamgh R, Morgom M (***Tripoli Central Hospital***); Aldayri Z, Ellojli I*, Kredan A (***Tripoli University Hospital***).

Lithuania: Bradulskis S, Dainius E, Kubiliute E, Kutkevičius J, Parseliunas A, Subocius A, Venskutonis D* (***Lithuanian University Of Health Sciences Kaunas Clinical Hospital***).
Madagascar: Rasoaherinomenjanahary F*, Razafindrahita JB, Samison LH (***Joseph Ravoahangy Andrianavalona Hospital***).
Malaysia: Ong EC (***Bintulu***); Hamdan KH, Ibrahim MR, Tan JA, Thanapal MR* (***Hospital Kuala Lumpur***); Amin Sahid N, Hayati F*, Jayasilan J, Sriram RK*, Subramaniam S (***Queen Elizabeth Hospital & Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia***); Che Jusoh A, Hussain AH, Mohamed Sidek AS, Mohd Yunus MF, Soh JY, Wong MPK, Zakaria AD*, Zakaria Z (***School Of Medical Sciences & Hospital, Universiti Sains Malaysia***); Fadzli A*, Fathi NQ, Koh PS, Liew YT*, Roslani AC*, Tang CY, Teoh LY*, Wong WJ*, Yahaya AS (***University Malaya Medical Centre***).
Mexico: Alvarez MR, Arrangoiz R, Cordera F*, De la Rosa Abaroa MA, Gómez-Pedraza A, Hernandez R, Maffuz-Aziz A, Posada JA (***Abc Medical Center***); Becerra García FC* (***Hospital San Ángel Inn Chapultepec***); Alfaro-Goldaracena A, Buerba GA, Castillejos-Molina RA, Chan C, Dominguez-Rosado I, Medina-Franco H, Mercado MÁ*, Oropeza-Aguilar M, Peña Gómez Portugal E, Posadas-Trujillo OE, Rodriguez-Covarrubias F, Salgado-Nesme N, Sarre C, Vilatoba M (***Instituto Nacional De Ciencias Médicas Y Nutrición "Salvador Zubirán"***).
Morocco: Arkha Y, Bechri H, El Ouahabi A, Oudrhiri MY* (***Centre Hospitalier Universitaire Ibn Sina Rabat***); Derkaoui hassani F*, El abbadi N (***Cheikh Zaid International University Hospital***); Amrani L, Belkhadir ZH, Benkabbou A, Chakib O, El Ahmadi B, El Bouazizi Y, Essangri H, Ghannam A*, Majbar AM, Mohsine R, Souadka A* (***Institut National D'oncologie***).
Netherlands: Hompes R*, Meima-van Praag EM, Pronk AJM, Sharabiany S (***Amsterdam Umc, University Of Amsterdam***); Grotenhuis B*, Hartveld L, Reijers S, Van Houdt W* (***Antoni Van Leeuwenhoek Ziekenhuis***); Baaij J, Bolster-van Eenennaam M*, De Graaff M, Sloothaak D, Van Duijvendijk P* (***Gelre Ziekenhuis***); Posma-Bouman L* (***Slingeland Ziekenhuis***); Derksen T, Franken J, Oosterling S* (***Spaarne Gasthuis***); De Bree R* (***University Medical Center Utrecht***); Konsten J*, Van Heinsbergen M (***Viecuri Medisch Centrum***).
Nigeria: Fidelis L, Sholadoye TT*, Tolani MA* (***Ahmadu Bello University Teaching Hospital***); Olaogun J* (***Ekiti State University Teaching Hospital***); Egbuchulem IK*, Lawal TA*, Ogundoyin O*, Olulana DI (***University College Hospital***); Abdur-Rahman L*, Adeyeye A*, Aremu I, Bello J, Olasehinde O, Popoola A (***University Of Ilorin Teaching Hospital***).
Oman: Massoud J*, Massoud R, Sorour TM (***Khoula Hospital***).
Pakistan: Jamal A, Kerawala AA* (***Cancer Foundation Hospital***); Memon AS*, Nafees Ahmed R, Rai L* (***Dr Ruth K.m. Pfau Civil Hospital***); Ayub B, Hassan N*, Martins RS, Ramesh P,

Sayyed R* (***Patel Hospital***); Butt U*, Kashif M, Kashif M*, Khan WH*, Qureshi A*, Umar M, Waris Farooka M*, Wasim T* (***Services Hospital Lahore***); Ayubi A, Rashid I, Waqar SH* (***The Pakistan Institute Of Medical Sciences***).

Peru: Falcon GM*, Robles R (***Instituto Regional De Enfermedades Neoplásicas Del Sur***).

Philippines: Jocson R, Teh C* (***National Kidney & Transplant Institute***).

Poland: Major P (***Jagiellonian University Medical College***); Bobiński M*, Kotarski J*, Rasoul-Pelińska K* (***Medical University Of Lublin, Chair And Department Of Gynaecological Oncology And Gynaecology***).

Portugal: Azevedo C, Machado D, Mendes F* (***Centro Hospitalar Cova Da Beira***); De Sousa X* (***Centro Hospitalar De Setúbal***); Fernandes U, Ferreira C*, Guidi G, Leal C, Marçal A, Marques R, Martins D, Melo A, Tenreiro N, Vaz Pereira R, Vieira B (***Centro Hospitalar De Trás-Os-Montes E Alto Douro, E.p.e.***); Almeida JI, Correia de Sá T, Costa MJMA, Fernandes V, Ferraz I, Gil CG, Lima da Silva C, Lopes L, Machado N, Marialva J, Nunes Coelho M, Pedro J, Pereira C, Reis R*, Ribeiro A, Santos R, Saraiva P, Silva R, Tavares F, Teixeira M (***Centro Hospitalar Do Tamega E Sousa***); Almeida AC, Amaral MJ, Andrade R, Athayde Nemésio R, Breda D, Camacho C, Canhoto C, Colino M, Correia S, Costa M, De Barros J, De Oliveira López AL, Duque M, Garrido S, Guerreiro P, Guimarães A, Lázaro A*, Lopes C, Martins R, Nogueira O, Oliveira A, Oliveira JM, Rodrigues M, Ruivo A, Santos E, Silva M, Simões J, Valente da Costa A (***Centro Hospitalar E Universitário De Coimbra***); Almeida A, Cavaleiro S, Devezas V, Faria CS, Jácome F, Magalhães Maia M, Nogueiro J, Pereira A, Pereira-Neves A, Pina-Vaz T, Santos-Sousa H*, Silveira H, Vaz S, Vieira P (***Centro Hospitalar E Universitário De São João***); Gomes da Costa A, Lobo Antunes I* (***Centro Hospitalar Lisboa Norte***); Pinto J, Tojal A* (***Centro Hospitalar Tondela-Viseu***); Cardoso N, Cardoso P*, Domingues JC, Henriques P, Manso MI, Martins dos Santos G, Martins R, Morais H*, Pereira R, Revez T, Ribeiro R, Ribeiro VI, Soares A, Sousa S, Teixeira J (***Centro Hospitalar Universitário Do Algarve - Unidade De Faro***); Amorim E, Baptista VH, Cunha MF*, Dias B, Fazenda A, Melo Neves JP, Policarpo F, Sampaio da Nóvoa Gomes Miguel II, Veiga D (***Centro Hospitalar Universitario Do Algarve - Unidade De Portimão***); Andrade AK, Bandovas JP, Borges N*, Branquinho A, Chumbinho B, Correia J, Fidalgo H, Figueiredo de Barros I, Frade S, Gomes J, Maciel J, Pina S, Rodrigues A, Silva N*, Silveira Nunes I, Sousa R (***Centro Hospitalar Universitário Lisboa Central***); Ascensão J, Azevedo P, Costeira B, Cunha C, Garrido R*, Gomes H, Lourenço I, Mendinhos G*, Miranda P, Nobre Pinto A, Peralta Ferreira M, Ribeiro J, Rio Rodrigues L, Sousa Fernandes M (***Hospital Beatriz Angelo***); Azevedo J* (***Hospital Da Horta, E.p.e.***); Galvão D, Soares AC, Vieira A*, Vieira B (***Hospital De Santo Espirito Da Ilha***

Terceira); Patrício B, Santos PMDD*, Vieira Paiva Lopes AC (***Hospital De Torres Vedras - Centro Hospitalar Do Oeste***); Cunha R, Faustino A, Freitas A, Martins AB, Mendes JR*, Parreira R, Rosa J, Teves M (***Hospital Do Divino Espírito Santo***); Abreu da Silva A*, Claro M, Costa Santos D, Deus AC, Grilo JV (***Hospital Do Litoral Alentejano***); Borges F*, Corte Real J, Henriques S, Lima MJ, Matos Costa P (***Hospital Garcia De Orta***); Brito da Silva F, Caiado A*, Fonseca F (***Instituto Português De Oncologia De Lisboa Francisco Gentil***); Ângelo M, Baiao JM, Martins Jordão D*, Vieira Caroço T (***Ipo Coimbra***); Messias J, Millan A, Salgado I, Santos P* (***Ipo Lisboa***); Baía C, Canotilho R, Correia AM, Ferreira Pinto AP, Peyroteo M, Videira JF* (***Ipo Porto***).

Puerto Rico: Escobar P*, Maldonado Santiago M (***Instituto Gineco Oncologico***).

Réunion: Kassir R*, Sauvat F (***Chu Reunion***).

Romania: Bezede C, Chitul A, Ciofic E, Cristian D, Grama F* (***Coltea Clinical Hospital***); Pirtea L*, Secosan C (***Emergency Clinical City Hospital***); Bonci E*, Gata V*, Titu S* (***Prof. Dr. Ion Chiricuta Institute Of Oncology***); Ginghina O*, Iordache N, Iosifescu RV (***Saint John Emergency Hospital***).

Russia: Garmanova T, Kazachenko E, Markaryan D, Rodimov S, Tsarkov P*, Tulina I (***Clinic Of Coloproctology And Minimally Invasive Surgery, Sechenov Medical State University***); Litvina Y, Provozina A (***Immanuel Kant Baltic Federal University, Regional Clinical Hospital***); Agapov M*, Galliamov E, Kakotkin V, Kubyshkin V, Камалов А (***Moscow Research And Educational Center, Lomonosov Moscow State University***).

Saudi Arabia: Alshahrani M*, Alsharif F, Eskander M (***Aseer Central Hospital***); Al Raddadi R, Majrashi S*, Mashat A (***East Jeddah General Hospital***); Akeel N, Alharthi M, Aljiffry M, Basendowah M, Farsi A, Ghunaim M, Khoja A, Maghrabi A, Malibary N*, Nassif M, Nawawi A, Saleem A, Samkari A, Trabulsi N* (***King Abdulaziz University Hospital***); Al Awwad S*, Alghamdi M*, Alnumani T*, Nasser M*, Said bayazeed A* (***King Fahad General Hospital***); Alhefdhi A*, Almalik O, Alomair A, Alotaibi N, Alresaini F, Alsalamah R, Alsobhi S, Mahasin Z, Othman E, Velagapudi S (***King Faisal Specialist Hospital***); Ghedan S, Alharthi R, Awad S*, I Sharara M, Abdelrahman S, Althobaiti W (***King Faisal Medical Complex***); Al Habes H, Alamri A, Alkarak S, Alqannas M*, Alyami M*, Alzamanan M, Cortés Guiral D*, Elawad A (***King Khalid Hospital***); AlAamer O, Alriyees L, Alselaim N* (***King Saud Bin Abdulaziz University For Health Sciences, King Abdullah International Medical Research Center, Ministry Of National Guard, Health Affairs, General Surgery Department.***); Abdulkareem A, Ajlan A, Akkour K, Al-Habib A, Al-Khayal K, Alatar A, Alburakan A, Alhalal H, Alhassan B, Alhassan N, Alobeed O, Alsaif A, Alsaif F, Alshammari S, Alshaygy I, Barry M, Bin Nasser A*, Bin Traiki T,

Bokhari A, Elwatidy S, Helmi H, Madkhali A, Nouh T*, Rabah PD, Zubaidi A (***King Saud University***).

Serbia: Paunovic I*, Slijepcevic N (***Centre For Endocrine Surgery, Clinical Centre Of Serbia***); Aleksić L, Antic A, Barisic G*, Ceranic M, Galun D*, Grubač Ž, Jelenkovic J, Kecmanović D, Kmezić S, Knezevic D*, Krivokapic Z*, Latinčić S, Markovic V*, Matić S*, Miladinov M, Pavlov M*, Pejovic I, Radenkovic D*, Tadic B, Vasljević J, Velickovic D, Zivanovic M (***Clinic For Digestive Surgery, Clinical Centre Of Serbia***); Perovic M, Srbinovic L (***Clinic For Gynecology And Obstetrics Narodni Front***); Andrijasevic S, Bozanovic T, Cerovic Popovic R, Dokic M, Janjic T, Jeremic K, Kadija S, Ladjevic Likic I, Mirkovic L, Pantovic S, Pilic I, Radojevic M, Stefanovic A*, Vidakovic S, Vilendecic Z (***Clinic For Gynecology And Obstetrics, Clinical Center Of Serbia***); Antic S, Dunđerović D, Jelovac D*, Jezdic Z, Konstantinovic V, Kotlar B, Kuzmanovic C, Lazić M, Petrovic M, Popovic F, Pucar A, Romic M, Sumrak S, Vujanac V (***Clinic For Maxillofacial Surgery, School Of Dental Medicine, University Of Belgrade***); Bascarevic V, Bogdanović I, Grujičić D*, Ilic R*, Milićević M, Milisavljević F, Miljković A, Paunovic A, Šćepanović V, Stanimirovic A, Todorovic M (***Clinic For Neurosurgery, Clinical Center Of Serbia***); Jotic A, Milovanovic J*, Trivic A (***Clinic For Otorhinolaryngology And Maxillofacial Surgery, Clinical Center Of Serbia***); Bumbasirevic U*, Dzamic Z, Kajmaković B, Prijović N, Zivkovic M (***Clinic Of Urology, Clinical Center Of Serbia***); Buta M, Cvetkovic A, Djurisic I, Gacic S, Goran M, Inic Z, Jeftic N, Jevric M, Jokic V, Markovic I*, Milanović M, Nikolic S, Pejnovic L, Savković N, Spurnic I, Stevic D, Stojiljkovic D, Vucic N, Zegarac M (***Institute For Oncology And Radiology Of Serbia***); Karamarkovic A, Kenic M, Kovacevic B, Krdzic I*, Milutinović V (***Zvezdara University Medical Center***).

Singapore: Chan CW, Lieske B* (***National University Hospital***).

Slovakia: Gális B, Šimko K (***University Hospital Bratislava***).

South Africa: Almgla N*, Bernon M, Boutall A, Cairncross L*, Herman A, Hilton T, Jonas E, Kloppers C*, Malherbe F, Mugla W*, Nel D, Rayamajhi S, Van Wyngaard T, Vogel J (***Groote Schuur Hospital***).

Spain: Castaño-Leon AM*, Delgado Fernandez J, Eiriz Fernandez C, Espino Segura-Illa M, Esteban Sinovas O, Garcia Perez D, Gomez P, Jimenez-Roldan L, Lagares A, Moreno-Gomez L, Paredes I, Pérez Núñez A, Sánchez Aniceto G*, Santas M (***12 De Octubre University Hospital***); Fernández Rodríguez P, Paniagua García Señorans M*, Sanchez-Santos R, Vigorita V (***Álvaro Cunqueiro Hospital***); Acrich E, Baena Sanfeliu E, Barrios O, Golda T*, Santanach C, Serrano-Navidad M, Sorribas Grifell M, Vives RV (***Bellvitge University Hospital***); Escolà D, Jiménez A* (***Comarcal Alt Penedés***); Cayetano Paniagua L, Gómez Fernández L* (***Consorci***

Sanitari De Terrassa); Artigues E, Bernal-Sprekelsen JC*, Catalá Bauset JC (***Consorcio Hospital General Universitario***); Collera P, Diaz Del Gobbo R, Farre Font R, Flores Clotet R, Gómez Díaz CJ*, Guàrdia N, Guariglia CA, Osorio A, Sanchez Jimenez R, Sanchon L, Soto Montesinos C (***Fundació Althaia - Xarxa Assistencial Universitària De Manresa***); Albi Martin B, García Villayzán JE* (***Fundación Jimenez Diaz University Hospital***); Alonso-Lamberti L, Assaf M, Baeza Pintado N, Carabias A, García-Quijada J, Huertas Fernandez MA, Jimenez Miramón J, Jimenez V*, Jover JM, Landeo Agüero SA, Leon R, Martín Salamanca MB*, Pérez Simón V, Ponce S, Rodriguez JL, Salazar A, Valle Rubio A (***Getafe University Hospital***); Aguado H* (***Hellín Hospital***); Aldecoa Ansorregui I, Bravo Infante R, De Lacy FB, Di Somma A*, Díaz-Feijoo B*, Enseñat Nora J*, Fabregas N, Ferrés A, Gil Ibañez B, Gonzalez Sanchez JJ*, Gracia I, Hoyos Castro JA, Lacy AM*, Langdon C, Momblán D, Morales X, Oleaga L, Otero A, Pedrosa L, Poblete Carrizo J, Reyes Figueroa LA, Roldan Ramos P, Rumia-Arboix J, Tercero-Uribe AI, Topczewski TE, Torales J, Torne A, Torné R, Turrado-Rodriguez V*, Valero R, Valverde S (***Hospital Clinic Barcelona***); Anula R, Cano-Valderrama O, Del Campo Martín M, Díez-Valladares L, Domínguez I, Dziakova J, García Alonso M, García Romero E, Gómez Latorre L, Muguerza JM*, Pizarro MJ, Saez Carlin P, Sánchez del Pueblo C, Sánchez-Pernaute A, Sanz Ortega G, Sanz-Lopez R, Torres A (***Hospital Clínico De Madrid***); Garcés-Albir M*, Lopez F*, Martín-Arévalo J, Moro-Valdezate D*, Pla-Marti V (***Hospital Clínico Universitario De Valencia***); Beltrán de Heredia J, De Andrés Asenjo B*, Gómez Sanz T, Jezieniecki C, Nuñez Del Barrio H, Ortiz de Solórzano Aurusa FJ, Romero de Diego A, Ruiz Soriano M, Trujillo Díaz J, Vazquez fernandez A (***Hospital Clínico Universitario De Valladolid***); Lora-Cumplido P, Sosa MV* (***Hospital De Cabueñes***); Gonzalez-Gonzalez E, Minaya Bravo AM* (***Hospital Del Henares***); Alonso de la Fuente N, Cazador Labat M, Cecchini L, Espinosa CA*, Jimenez Toscano M*, López Campillo A, Mancebo G, Martorell P, Munarriz M (***Hospital Del Mar***); Grau-Talens EJ, Martin-Perez B* (***Hospital Don Benito-Villanueva***); Benavides Buleje JA, Carrasco Prats M*, Fernández PV, Fernández-López A*, García Escudero D*, García Porcel VJ, Garcia Soria V*, Giménez Francés C*, González Valverde FM, Gurrea E, López-Morales P, Marco Garrido A, Martínez Alonso JA, Medina E, Muñoz Camarena JM, Parra Baños PA, Peña Ros E, Ramirez Faraco M, Ruiz-Marín M*, Sanchez Rodriguez C, Valero Soriano M (***Hospital General Reina Sofía***); Estaire Gómez M*, Fernández Camuñas Á, Garcia Santos EP, Jimenez Higuera E, Martínez-Pinedo C, Muñoz-Atienza V, Padilla-Valverde D*, Picón Rodríguez R, Redondo Calvo FJ, Sánchez-García S, Sanchez-Pelaez D (***Hospital General Universitario De Ciudad Real***); Colombari RC, Del valle E, Fernández M, Lozano Lominchar P*, Martín L, Rey Valcarcel C, Steiner MA, Tudela M, Zorrilla Ortúzar J (***Hospital General Universitario Gregorio***

Marañón); Alcaide Matas F, García Pérez JM, Troncoso Pereira P* (***Hospital Mateu Orfila***); Mora-Guzmán I* (***Hospital Santa Bárbara***); Abellán M, Achalandabaso Boira M*, Jorba R, Memba Ikuga R, Olona C, Sales Mallafré R (***Hospital Universitari De Tarragona Joan Xxiii***); Cavallé Busquets P, Gavalda Pellice MGP*, Salinas Peña J (***Hospital Universitari Sant Joan***); Aragon Achig EJ*, Barbier L, Caja Vivancos P*, Gainza A, García Gutierrez JJ, Mallabiabarrena Ormaechea G*, Marín H, Martin Playa P*, Melchor Corcóstegui I, Prieto Calvo M, Rodriguez Fraga A, Villalabeitia Ateca I* (***Hospital Universitario Cruces***); De Andres Olabarria U, Durán Ballesteros M, Fernández Pablos FJ, Ibáñez-Aguirre FJ, Sanz Larrainzar A, Ugarte-Sierra B* (***Hospital Universitario De Galdakao***); De la Hoz Rodríguez Á, Di Martino M*, García Septiem J*, Martin-Perez E, Muñoz de Nova JL (***Hospital Universitario De La Princesa***); Calvo Espino P*, Guillamot Ruano P (***Hospital Universitario De Móstoles***); Colao García L, Díaz Pérez D*, Esteban Agustí E, Galindo Jara P, Gutierrez Samaniego M*, Hernandez Bartolome MA*, Serrano González J (***Hospital Universitario De Torrejón De Ardoz***); Alonso Poza A, Diéguez B, García-Conde M, Hernández-García M, Losada M* (***Hospital Universitario Del Sureste***); Chiesa-Estomba CM, González García JÁ, Larruscain E, Sistiaga-Suárez JA* (***Hospital Universitario Donostia***); Alvarez E, Chavarrias N, Frías L, García Pineda V, Gegúndez Simón A, Gortázar S, Gracia M, Guevara J, Hernández Gutierrez A, Loayza A, María Dolores DT, Martí C, Melendez M, Moreno-Palacios E, Perez Y, Prieto Nieto MI, Ramos-Martín P, Rubio-Perez I*, Saavedra J, Sanchez-Mendez JI, Siegrist Ridruejo J, Urbieta A, Zapardiel I* (***Hospital Universitario La Paz***); Cantalejo diaz M, De Miguel Ardevines MDC, Duque-Mallén V*, Gascon Ferrer I, González-Nicolás Trébol MT, Gracia-Roche C, Herrero Lopez M, Jariod Ferrer UM*, Lanzon A, Martinez German A, Matute M, Redondo C, Sánchez Fuentes N, Sánchez-Rubio M, Santero-Ramirez MS, Saudí S, Simón Sanz MV, Uson-Bouthelier T (***Hospital Universitario Miguel Servet***); Blazquez Martin A, Diez Alonso M*, García Rico E, Garcia-Loarte Gomez E, Garcia-Moreno Nisa F, Gutierrez Calvo A, Hernandez P, Lasa I, Mendoza-Moreno F, Morales Palacios N*, Ovejero Merino E, Vera Mansilla C (***Hospital Universitario Principe De Asturias***); Acebes García F, Bailón M, Bueno Cañones AD, Choolani Bhojwani E, Marcos-Santos P, Miguel T, Pacheco Sánchez D, Pérez-Saborido B, Sanchez Gonzalez J, Tejero-Pintor FJ* (***Hospital Universitario Río Hortega***); Alconchel F*, Conesa A, Gil Martínez J*, Gutiérrez Fernández AI, Lopez Abad A, Nicolás-López T*, Ramirez Romero P, Roca Calvo MJ, Rodrigues K*, Ruiz Manzanera JJ, Soriano AI (***Hospital Universitario Virgen De La Arrixaca***); Cano A, Capitan-Morales L, Cintas Catena J, Gomez-Rosado J*, Oliva Mompean F, Pérez Sánchez MA, Río Lafuente FD, Torres Arcos C, Valdes-Hernandez J (***Hospital Universitario Virgen Macarena***); Cholewa H, Domingo S*, Frasson M, Lago V*, Marina Martin T*, Martínez

Chicote C, Sancho-Muriel J* (***Hospital Universitario Y Politécnico La Fe***); Landaluce-olavarria A*, Lecumberri D (***Hospital Urduliz***); Abad Gurumeta A, Abad-Motos A, Martínez-Hurtado E, Ripollés-Melchor J*, Ruiz Escobar A (***Infanta Leonor University Hospital***); Cuadrado-García A*, Garcia-Sancho Tellez L*, Heras Aznar J*, Maté P, Ortega Vázquez I*, Picardo AL, Rojo López JA, Sanchez Cabezudo Noguera F*, Serralta de Colsa D* (***Infanta Sofía University Hospital***); Anchuelo Latorre J, Cagigas Fernandez C, Caiña Ruiz R, Gomez Ruiz M, Hernanz F, Jimeno Fraile J*, Martínez-Pérez P, Poch C, Santarrufina Martinez S*, Valbuena Jabares V (***Marqués De Valdecilla University Hospital***); Moliner-Sánchez C, Pingarron-Martin L, Rey-Biel J, Ruiz Martin I (***Rey Juan Carlos University Hospital***); Blas Laina JL, Cros B, Escartin J*, Garcia Egea J, Nogués A, Talal El-Abur I, Yánez C (***Royo Villanova***); Cagigal Ortega EP, Cervera I, Díaz Peña P, Elena GDCR, Enjuto D*, Fernández Bernabé P, Garcés García R, Gonzalez J, Hernández I, Herrera-Merino N, Marqueta De Salas M, Martinez Pascual P, Perez Gonzalez M*, Ramos Bonilla A, Rodríguez Gómez L (***Severo Ochoa University Hospital***); Bescós C*, Blanco-Colino R, Brana I, Caimari B, De Pablo García-Cuenca A, Duran-Valles F, Espin-Basany E*, Giralt López de Sagredo J, Pamias J, Pellino G, Prat N, Pujol Pina R, Saez barba M (***Vall D'hebron University Hospital***).

Sri Lanka: Arulanantham A, Bandara GBK, Jayarajah U*, Ravindrakumar S, Rodrigo VS (***District General Hospital Chilaw***); Srishankar S* (***Teaching Hospital Anuradhapura***).

Sudan: Ali karar AA (***Al-Rajhi***).

Sweden: Elbe P*, Lindqvist EK* (***Karolinska University Hospital***); Taflin H* (***Sahlgrenska University Hospital***); Älgå A*, Heinius G, Nordberg M, Pieniowski E (***South General Hospital***); Gkekas I, Löfgren N, Rutegård M*, Sund M* (***Umea University Hospital***).

Switzerland: Arigoni M, Bernasconi M, Christoforidis D*, Di Giuseppe M, La Regina D, Mongelli F (***Ente Ospedaliero Cantonale***); Chevallay M, Dwidar O, Gialamas E, Sauvain M (***Hopital De Pourtales***); Klenke F, Kollàr A*, Kurze C (***Inselspital, Bern University Hospital, University Of Bern***); Adamina M*, Bächler T, Crugnale AS, Giardini M, Guglielmetti L, Peros G, Solimene F (***Kantonsspital Winterthur***).

Turkey: Aghayeva A*, Hamzaoglu I, Sahin I (***Acibadem Altunizade Hospital***); Akaydin E, Aliyeva Z, Aytac E, Baca B, Dülgeroğlu O, Ozben V*, Ozmen BB, Uras C (***Acibadem Atakent Hospital***); Arikan AE*, Bilgin IA*, Bozkırlı B*, Ceyhan GO, Kara H, Karahasanoğlu T, Uras C (***Acibadem Maslak Hospital***); Celik H* (***Adana Baskent University***); Meydanli MM* (***Ankara City Hospital***); Akilli H*, Ayhan A*, Kuscu E* (***Baskent University***); Onan MA* (***Gazi University Medical Faculty Hospital***); Akgor U*, Dincer HA, Erol T, Gultekin M*, Orhan N, Ozgul N*, Salman MC*, Soyak B* (***Hacettepe University Hospital***); Alhamed A, Ergün S*,

OZcelık MF, Sanli AN, Uludağ SS*, Velidedeoglu M*, Zengin AK (***Istanbul Universty - Cerrahpaşa Medical Faculty***); Bozkurt MA, Kara Y*, Kocataş A (***Kanuni Sultan Suleyman Training And Research Hospital***); Cimenoglu B, Demirhan R, Saracoglu K* (***Kartal Dr. Lutfi Kirdar Training And Research Hospital***); Azamat İF, Balik E*, Buğra D, Giray B, Kulle CB, Taskiran C*, Vatansever D (***Koç University Medical School***); Gözal K, Güler SA, Köken H, Tatar OC*, Utkan NZ, Yıldırım A, Yüksel E (***Kocaeli University Teaching Hospital***); Akin E, Altintoprak F*, Bayhan Z, Cakmak G, Çapoğlu R, Çelebi F, Demir H, Dikicier E, Firat N, Gönüllü E, Kamburoğlu MB, Kocer B, Küçük IF, Mantoglu B (***Sakarya University Faculty Of Medicine***); Çolak E*, Kucuk GO, Uyanik MS (***Samsun Training And Research Hospital***); Göksoy B* (***Sehit Prof.dr. İlhan Varank Training And Research Hospital***); Bozkurt E, Citgez B, Mihmanli M, Tanal M*, Yetkin G (***Sisli Hamidiye Etfal Training And Research Hospital***); Akalin M, Arican C, Avci EK, Aydin C, Demirli Atıcı S*, Emiroglu M, Kaya T*, Kebabçı E, Kilinc G, Kirmizi Y, Öğücü H, Salimoğlu S, Sert İ, Tugmen C, Tuncer K, Uslu G, Yeşilyurt D (***University Of Health Sciences Tepecik Training And Research Hospital***); Karaman E*, Kolusarı A (***Van Yuzuncu Yil University, Medical Faculty***); Yildiz A* (***Yildirim Beyazit University Yenimahalle Training And Research Hospital***).

Uganda: Benson O*, Lule H* (***Kampala International University Teaching Hospital***).

United Kingdom: Agilinko J, Ahmeidat A, Barabasz M, Bekheit M*, Cheung LK, Colloc T, Cymes W, Elhusseini M, Gradinariu G, Hannah A, Kamera BS, Mignot G, Shaikh S*, Sharma P (***Aberdeen Royal Infirmary***); Abu-Nayla I, Agrawal A*, Al-Mohammad A, Ali S, Ashcroft J, Azizi A, Baker O, Balakrishnan A*, Byrne M, Colquhoun A, Cotter A, Coughlin P, Davies RJ*, Durrani A, Elshaer M, Fordington S, Forouhi P*, Georgiades F, Grimes H, Habeeb A, Hudson V, Hutchinson P*, Irune E, Jah A*, Khan DZ, Kolias A, Kyriacou H, Lamb B, Liau S*, Luke L, Mahmoud R, Mannion R, Masterson L*, Mitrofan CG, Mohan M, Morris A, Murphy S, O'Neill R*, Price S, Pushpa-rajah J, Raby-Smith W, Ramzi J, Rooney S, Santarius T, Singh A, Stewart GD*, Tan XS, Townson A, Tweedle E, Walker C, Waseem S, Yordanov S (***Addenbrooke's Hospital***); Jones T, Kattakayam A, Loh C, Lunevicius R, Pringle S, Schache A, Shaw R*, Sheel A (***Aintree University Hospital***); Rossborough C (***Altnagelvin Area Hospital***); Angelou D, Choynowski M, McAree B*, McCanny A, Neely D (***Antrim Area Hospital- Northern Health And Social Care Trust***); Tutoveanu G* (***Barnsley Hospital Nhs Foundation Trust***); Ahad S, De La Cruz Monroy MFI, Mosley F*, Oktseloglou V* (***Bradford Royal Infirmary***); Alanbuki A*, Patel M, Shabana A (***Brighton And Sussex Nhs Trust, Princess Royal Hospital***); Perera E, Raveendran D, Ravi-Shankar K, Thiruchelvam J* (***Broomfield Hospital***); Arrowsmith L*, Campbell W* (***Causeway Hospital***); Grove T, Kontovounisios C, Warren O* (***Chelsea And***

Westminster Hospital); Rolland P* (***Cheltenham General Hospital***); Aggarwal A, Brown S, Jelley C, Neal N* **(*Churchill Hospital*);** Clifford R, Eardley N, Krishnan E, Manu N, Martin E, Roy Mahapatra S, Serevina OL, Smith C, Vimalachandran D* (***Countess Of Chester Hospital***); Bordenave M*, Houston R, Putnam G, Robson A*, Tustin H (***Cumberland Infirmary***); Emslie K*, Labib PL*, Marchbank A, Miller D, Minto G, Natale J, Nwinee H, Panahi P, Rogers L* (***Derriford Hospital***); Abubakar A*, Akhter Rahman MM, Chan E, Ko KYK, O'Brien H, Sasapu K*, Woodun H (***Diana Princess Of Wales Hospital Grimsby***); Inglis R, Ng HJ* (***Dumfries And Galloway Royal Infirmary***); De Gea Rico A, Ghazali N*, Lambert J, Markose G, Math S, Sarantitis I, Shrestha D, Sultana A*, Taggarsi M, Timbrell S, Vaz OP, Vitone L* (***East Lancashire Hospitals Nhs Trust***); Day A*, Dent H, Fahim M, Waheed S* (***East Surrey Hospital***); Hunt A, Laskar N* (***East Sussex Healthcare (Conquest Hospital And Eastbourne District General Hospital)***); Gupta A*, Steinke J, Thrumurthy S (***Epsom & St Helier University Hospitals Nhs Trust***); Massie E, McGivern K, Rutherford D, Wilson M* (***Forth Valley Royal Hospital***); Hardie J, Kazzaz S* (***Frimley Health Nhs Ft - Frimley Park***); Handa S, Kaushal M, Kler A, Patel P*, Redfern J, Tezas S (***Furness General Hospital***); Aawsaj Y, Amonkar S, Barry C, Blackwell L, Blake D, Carter J, Emerson H, Fisher A*, Katory M, Korompelis P, McCormick W, Mustafa A, Pearce L, Ratnavelu N*, Reehal R (***Gateshead Health Nhs Foundation Trust***); Kretzmer L*, Lalou L, Manku B, Parwaiz I, Stafford J (***George Eliot Hospital***); Abdelkarim M, Asqalan A, Gala T, Ibrahim S, Maw A*, Mithany R, Morgan R*, Sundaram Venkatesan G (***Glan Clwyd Hospital***); Ang K, Caruana EJ*, Chowdhry MF, Mohammad A, Nakas A, Rathinam S (***Glenfield Hospital***); Boal M*, Brown O, Dwerryhouse S*, Higgs S, Vallance A (***Gloucestershire Royal Hospital***); Boyd E, Irvine V, Kirk A* (***Golden Jubilee National Hospital***); Bakolas G, Boulton A, Chandock A*, Khan T, Kumar M* (***Good Hope Hospital***); Agoston P, Billè A, Challacombe B*, Fraser S, Harrison-Phipps K, King J, Mehra G, Mills L, Najdy M, Nath R, Okiror L, Pilling J, Rizzo V, Routledge T, Sayasneh A*, Stroman L*, Wali A (***Guy's Hospital***); Fehervari M*, Fotopoulou C*, Habib N, Hamrang-Yousefi S, Jawad Z, Jiao L, Pai M, Ploski J, Rajagopal P, Saso S, Sodergren M, Spalding D (***Hammersmith Hospital***); Laws S* (***Hampshire Hospitals Nhs Trust***); Hardie C, McNaught C* (***Harrogate District Hospital***); Alam R, Budacan A, Cahill J, Kalkat M*, Karandikar S*, Kenyon L, Naumann D, Patel A (***Heartlands Hospital***); Ayorinde J, Chase T, Cuming T, Ghanbari A, Humphreys L, Tayeh S* (***Homerton University Hospital***); Aboelkassem Ibrahim A, Bichoo R, Cao H, Chai AKW, Choudhury J, Evans C, Fitzjohn H, Ikram H, Langstroth M, Loubani M*, McMillan A, Nazir S, Qadri SSA, Robinson A, Ross E, Sehgal T, Wilkins A (***Hull University Teaching Hospitals Nhs Trust***); Dixon J*, Dunning J, Freystaetter K, Jha M, Lester

S*, Madhavan A, Thulasiraman SV, Viswanath Y* (***James Cook University Hospital***); Curl-Roper T, Delimpalta C, Liao CCL*, Velchuru V, Westwood E (***James Paget Univeristy Nhs Foundation Trust Hospital***); Belcher E*, Bond-Smith G*, Chidambaram S, Di Chiara F, Fasanmade K, Fraser L, Fu H, Ganau M*, Gore S, Graystone J, Jeyaretna D, Khatkar H, Lami M, Maher M, Mastoridis S, Mihai R, Piper R*, Prabhu S, Risk OBF, Selbong U, Shah K, Smillie R, Soleymani majd H, Sravanam S, Stavroulias D, Tebala GD, Vatish M*, Verberne C, Wallwork K, Winter S* (***Oxford University Hospitals NHS Foundation Trust***); Bhatti MI, Boyd-Carson H, Elsey E, Gemmill E, Herrod P*, Jibreel M, Lenzi E, Saafan T, Sapre D, Sian T, Watson N (***King's Mill Hospital***); Athanasiou A*, Bourke G, Bradshaw L, Brunelli A*, Burke J, Coe P*, Costigan F, Elkadi H, Ho M*, Johnstone J, Kanatas A, Kantola V, Kaufmann A, Laios A, Lam S, MacInnes E*, Munot S, Nahm C, Otify M, Pompili C, Smith I, Theophilou G*, Toogood G, Wade R*, Ward D, West C (***Leeds Teaching Hospitals Trust***); Annamalai S, Ashmore C, Boddy A, Hossain T*, Kourdouli A (***Leicester Royal Infirmary***); Gvaramadze A, Jibril A, Prusty L, Thekkinkattil D* (***Lincoln County Hospital***); Harky A, Shackcloth M* (***Liverpool Heart And Chest Hospital***); Askari A, Chan C*, Cirocchi N, Kudchadkar S, Patel K, Sagar J*, Shaw S, Talwar R* (***Luton And Dunstable University Hospital***); Abdalla M, Edmondson R, Ismail O, Jones D, Newton K, Stylianides N* (***Manchester Royal Infirmary***); Aderombi A, Andaleeb U, Bajomo O, Beatson K, Garrett W*, Mehmood M, Ng V (***Medway Hospital***); Al-Habsi R, Divya GS, Keeler B* (***Milton Keynes University Hospital***); Al-Sarireh B*, Egan R, Harries R*, Henry A, Kittur M*, Li Z, Parkins K, Soliman F, Spencer N, Thompson D (***Morriston Hospital Swansea***); Burgess C*, Gemmell C, Grieco C, Hollyman M*, Hunt L*, Morrison J*, Ojha S, Ryan N (***Musgrove Park Hospital***); Abbadessa F, Barnard S, Chan C, Dawe N, Hammond J, Mahmoud Ali F, McPherson I, Mellor C, Moir J, Pandanaboyana S*, Powell J, Rai B*, Rogers A*, Roy C, Sachdeva A, Saleh C, Tingle S, Williams T (***Newcastle Upon Tyne Hospitals Nhs Foundation Trust.***); Manickavasagam J*, McDonald C*, McGrath N, McSorley N, Ragupathy K*, Ramsay L, Solth A (***Ninewells Hospital***); Kakisi O, Seebah K, Shaikh I*, Sreedharan L, Youssef M* (***Norfolk And Norwich University Hospital***); Shah J* (***North Manchester General Hospital***); Ameerally P (***Northampton General Hospital***); McLarty N, Mills S*, Shenfine A (***Northumbria Nhs Hospital Trust***); Sahnan K (***Northwick Park Hospital***); Abu J, Addae-Boateng E, Bratt D, Brock L, Burnside N*, Cadwell-Sneath S, Gajjar K*, Gan C, Grundy C, Hallam K, Hassell K, Hawari M, Joshi A, Khout H, Konstantinidi K, Lee RXN, Nunns D, Schiemer R, Walton T*, Weaver H, Whisker L*, Williamson K (***Nottingham City Hospital***); McVeigh J, Myatt R*, Williams MA (***Nuffield Orthopaedic Centre***); Kaur R, Leung E*, Sundar S* (***Pan-Birmingham Gynaecological Cancer Centre***); Michel M, Patil S, Ravindran S,

Sarveswaran J*, Scott L (***Pinderfields Hospital***); Edmond M, King E* (***Poole Hospital***); Almond M*, Bhangu A*, Breik O, Cato LD, Desai A*, Ford S*, Griffiths E*, Idle M, Kamal M, Kisiel A, Kulkarni R, Mak JKC, Martin T, Nankivell P*, Parente A, Parmar S, Pathanki AM, Phelan L, Praveen P, Saeed S, Sharma N, Singh J*, Tirotta F, Vijayan D (***Queen Elizabeth Hospital Birmingham***); Geddes A, McCaul J*, McMahon J (***Queen Elizabeth University Hospital***); Khan AH, Khan F, Mansuri A, Mukherjee S*, Patel M, Sarigul M, Singh S, Tan KL, Woodham A (***Queen's Hospital Romford***); Adiamah A, Brewer H, Chowdhury A*, Evans J, Humes D*, Jackman J, Koh A, Lewis-Lloyd C, Oyende O, Reilly J, Worku D (***Queens Medical Centre***); Cool P, Cribb G, Shepherd K* (***Robert Jones And Agnes Hunt Orthopaedic Hospital***); Bisset C, Moug S* (***Royal Alexandra Hospital***); Elson N, Faulkner G*, Saleh P, Underwood C (***Royal Bolton Hospital***); Brixton G, Findlay L, Klatte T*, Majkowska A, Manson J*, Potter R (***Royal Bournemouth Hospital***); Bhalla A*, Chia Z, Daliya P, Goyal A*, Grimley E, Hamad A, Kumar A*, Malcolm FL, Theophilidou E (***Royal Derby Hospital***); Bowden J, Campain N, Daniels I, Evans C, Fowler G, John J, Massey L, McDermott F*, McGrath J*, McLennan A, Ng M, Pascoe J, Rajaretnam N (***Royal Devon And Exeter Hospital***); Bulathsinhala S, Davidson B, Fusai G, Hidalgo Salinas C, Machairas N, Pissanou T, Pollok JM*, Raptis DA, Soggiu F, Tzerbinis H, Xyda SE (***Royal Free Hospital***); Beamish A, Davies E, Foulkes R*, Magowan D, Nassa H, Ooi R, Price C, Smith L, Solari F, Tang A, Williams G* (***Royal Gwent Hospital***); Al-Tamimi Y, Bacon A, Beasley N, Chew D, Crank M, Ilenkovan N, Macdonald M, Narice B, Rominiyi O, Thompson A, Varley I* (***Royal Hallamshire Hospital***); Drake T*, Harrison E*, Linder G, Mayes J, McGregor R, Skipworth R*, Zamvar V* (***Royal Infirmary Of Edinburgh***); Davies E*, Hawkin P, Raymond T, Ryska O (***Royal Lancaster Infirmary***); Baron R*, Dunne D, Gahunia S, Halloran C, Howes N*, McKinney R, McNicol F*, Russ J, Szatmary P, Tan JR, Thomas A, Whelan P (***Royal Liverpool University Hospital***); Anzak A, Banerjee A, Fuwa O, Hughes F*, Jayasinghe JD, Knowles C, Kocher H*, Leal Silva I, Ledesma FS, Minicozzi A*, Navaratne L, Rahman R, Ramamoorthy R, Sohrabi C, Thaha M*, Thakur B*, Venn M, Yip V* (***Royal London Hospital***); Baumber R, Parry J* (***Royal National Orthopaedic Hospital***); Evans S, Jeys L, Morris G, Parry M*, Stevenson J (***Royal Orthopaedic Hospital***); Ahmadi N, Aresu G, Barrett-Brown ZM, Coonar AS*, Durio Yates H, Gearon D, Hogan J, King M, Peryt A, Pradeep IS, Smith C (***Royal Papworth Hospital***); Adishesh M*, Atherton R*, Baxter K, Brocklehurst M, Chaudhury M, Krishnamohan N*, McAleer J, Owens G, Parkin E*, Patkar P, Phang I* (***Royal Preston Hospital***); Aladeojebi A, Ali M, Barmayehvar B, Gaunt A*, Gowda M, Halliday E, Kitchen M*, Mansour F, Thomas M*, Zakai D* (***Royal Stoke University Hospital***); Abbassi-Ghadi N, Assalaarachchi H, Currie A, Flavin M, Frampton A*, Hague M, Hammer C,

Hopper J, Horsnell J*, Humphries S, Kamocka A, Madhuri TK*, Preston S, Singh P*, Stebbing J, Tailor A, Walker D* (***Royal Surrey County Hospital***); Aljanadi F, Jones M*, Mhandu P, O'Donnell C, Turkington R* (***Royal Victoria Hospital, Belfast***); Al-Ishaq Z, Bhasin S, Bodla AS, Burahee A, Crichton A, Fossett R, Pigadas N*, Pickford S, Rahman E, Snee D, Vidya R, Yassin N* (***Royal Wolverhampton Nhs Trust***); Colombo F, Fountain D, Hasan MT, Karabatsou K*, Laurente R, Pathmanaban O* (***Salford Royal Hospital***); Al-mukhtar A, Brown S*, Edwards J*, Giblin A, Kelty C, Lee M, Lye G, Newman T, Sharkey A, Steele C, Sureshkumar Shah N, Whitehall E (***Sheffield Teaching Hospital Nhs Foundation Trust***); Athwal R*, Baker A, Jones L, Konstantinou C, Ramcharan S*, Singh S, Vatish J, Wilkin R (***South Warwickshire Nhs Foundation Trust***); Ethunandan M, Sekhon GK, Shields H, Singh R*, Wensley F (***Southampton General Hospital***); Lawday S, Lyons A* (***Southmead Hospital***); Abbott T, Anwar S, Ghufoor K*, Sohrabi C (***St Bartholomew's Hospital (Non-Cardiac Unit)***); Chung E, Hagger R, Hainsworth A, Karim A, Owen H, Ramwell A, Williams K* (***St George's Hospital***); Baker C, Davies A, Gossage J, Kelly M*, Knight W (***St Thomas' Hospital***); Hall J (***Stepping Hill Hospital***); Harris G, James G, Kang C, Lin DJ, Rajgor AD, Royle T*, Scurrah R, Steel B, Watson LJ (***Sunderland Royal Hospital***); Choi D, Hutchison R, Jain A, Luoma V, Marcus H*, May R, Menon A, Pramodana B, Webber L (***The National Hospital For Neurology And Neurosurgery***); Aneke IA, Asaad P, Brown B, Collis J, Duff S*, Khan A, Moura F, Wadham B, Warburton H (***The University Hospital Of South Manchester***); Elmoslemany T, Jenkinson M*, Millward C, Zakaria R (***The Walton Centre Nhs Foundation Trust***); Mccluney S, Parmar C*, Shah S (***The Whittington Hospital***); Allison J, Babar MS, Collard B, Goodrum S, Lau K, Patel A, Scott R*, Thomas E, Whitmore H (***Torbay And South Devon Nhs Trust***); Balasubramaniam D*, Jayasankar B*, Kapoor S, Ramachandran A (***Tunbridge Wells Hospital***); Elhamshary A, Imam SMB, Kapriniotis K, Kasivisvanathan V*, Lindsay J, Rakhshani-Moghadam S (***University College London Hospital At Westmoreland Street***); Beech N, Chand M*, Green L, Kalavrezos N*, Kiconco H, McEwen R, Schilling C, Sinha D (***University College London Hospital***); Pereca J*, Singh J (***University Hospital Ayr***); Chopra S, Egbeare D*, Thomas R (***University Hospital Llandough***); Combellack T*, Jones SEF*, Kornaszewska M, Mohammed M, Sharma A, Tahhan G, Valtzoglou V, Williams J (***University Hospital Of Wales***); Eskander P, Gash K*, Gourbault L, Hanna M, Maccabe T, Newton C*, Olivier J, Rozwadowski S, Teh E, West D* (***University Hospitals Bristol NHS Foundation Trust***); Al-omishy H, Baig M, Bates H, Di Taranto G, Dickson K, Dunne N, Gill C, Howe D*, Jeevan D*, Khajuria A, Martin-Ucar A*, McEvoy K, Naredla P, Ng V, Robertson S*, Sait M, Sarma DR, Shanbhag S*, Shortland T, Simmonds S, Skillman J, Tewari N*, Walton G (***University Hospitals Coventry And***

Warwickshire Nhs Trusts); Akhtar MA*, Brunt A, McIntyre J, Milne K, Rashid MM, Sgrò A, Stewart KE, Turnbull A (***Victoria Hospital Kirkcaldy***); Aguilar Gonzalez M*, Talukder S* (***West Suffolk Hospital***); Boyle C, Fernando D, Gallagher K, Laird A*, Tham D (***Western General Hospital***); Bath M, Patki P*, Sohrabi C, Tanabalan C (***Whipps Cross University Hospital***); Arif T, Magee C*, Nambirajan T*, Powell S*, Vinayagam R* (***Wirral University Teaching Hospital***); Flindall I, Hanson A, Mahendran V (***Worcestershire Royal Hospital***); Green S, Lim M, MacDonald L, Miu V, Onos L, Sheridan K, Young R* (***York Teaching Hospitals Nhs Trust***); Alam F, Griffiths O, Houlden C, Jones R*, Kolli VS, Lala AK, Leeson S, Peevor R, Seymour Z* (***Ysbyty Gwynedd***).

United States of America: Chen L, Henderson E*, Loehrer A* (***Dartmouth-Hitchcock Medical Center***); Brown K*, Fleming D*, Haynes A*, Heron C, Hill C, Kay H, Leede E, McElhinney K, Olson K, Osterberg EC*, Riley C, Srikanth P, Thornhill M (***Dell Seton Medical Center At The University Of Texas***); Blazer D*, DiLalla G*, Hwang ES*, Lee W, Lidsky M*, Plichta J, Rosenberger L*, Scheri R, Shah K*, Turnage K, Visgauss J, Zani S (***Duke University Medical Center***); Farma J* (***Fox Chase Cancer Center***); Clark J, Kwon D* (***Henry Ford Hospital***); Etchill E, Gabre-Kidan A*, Jenny HE, Kent A, Ladd M, Long C, Malapati H, Margalit A, Rapaport S, Rose J, Stevens K, Tsai L, Vervoort D, Yesantharao P (***Johns Hopkins Hospital***); Dehal A* (***Kaiser Permanente Panorama City Medical Center***); Klaristenfeld D* (***Kaiser Permanente San Diego Medical Center***); Huynh K (***Kaiser Permanente West Los Angeles***); Brown L, Ganly I* (***Memorial Sloan Kettering Cancer Center***); Mullinax J* (***Moffitt Cancer Center***); Gusani N, Hazelton J*, Maines J, Oh JS, Ssentongo A, Ssentongo P (***Pennsylvania State University***); Azam M, Choudhry A*, Marx W (***Suny Upstate University Hospital***); Fleming J, Fuson A, Gigliotti J, Ovaitt A, Ying Y* (***University Of Alabama Birmingham***); Abel MK, Andaya V, Bigay K, Boeck MA, Chen L, Chern H, Corvera C, El-sayed I, Glencer A, Ha P, Hamilton BCS, Heaton C, Hirose K, Jablons DM, Kirkwood K, Kornblith LZ*, Kratz JR, Lee R, Miller PN, Nakakura E, Nunez-Garcia B, O'Donnell R, Ozgediz D, Park P, Robinson B, Sarin A, Sheu B, Varma M, Wai K, Wustrack R, Xu MJ (***University Of California, San Francisco (UCSF)***); Beswick D*, Goddard J, Manor J, Song J (***University Of Colorado Hospital/Memorial Hospital/Medical Center Of The Rockies (All Within Uchealth System)***); Fullmer T, Gaskill C, Gross N*, Kiong K, Roland CL*, Zafar SN (***University Of Texas Md Anderson Cancer Center***); Abdallah M, Abouassi A, Almasri M, Kulkarni G, Marwan H*, Mehdi M (***University Of Texas Medical Branch***); Aoun S, Ban VS*, Batjer HH, Caruso J (***University Of Texas Southwestern***); Abbott D, Acher A, Aiken T, Barrett J, Foley E, Schwartz P, Zafar SN* (***University Of Wisconsin***); Hawkins A*, Maiga A (***Vanderbilt University Medical Center***).

Uruguay: Laufer J*, Scasso S* (***Hospital Pereira Rossell, Montevideo***).

Acknowledgements (not PubMed citable)

We are grateful to the Saudi Arabia Ministry of Health for facilitating nationwide study approval and to the Royal College of Surgeons of England COVID-19 Research Group for their support.