## **Table S1** Baseline characteristics of all patients undergoing major abdominal surgery.

|  | Total, n | Missing N | levels | Total |
| --- | --- | --- | --- | --- |
| Age (years) | 24,123 (99.6%) | 104 | 18-40 | 3607 (14.9%) |
|  |  |  | 41-60 | 8273 (34.1%) |
|  |  |  | 61-80 | 10,515 (43.4%) |
|  |  |  | ≥81 | 1728 (7.1%) |
|  |  |  | (Missing) | 104 (0.4%) |
| Sex | 24,227 (100.0%) | 0 | Male | 11,447 (47.2%) |
|  |  |  | Female | 12,780 (52.8%) |
| ASA grade | 24,217 (100.0%) | 10 | I | 3975 (16.4%) |
|  |  |  | II | 11,983 (49.5%) |
|  |  |  | III | 7335 (30.3%) |
|  |  |  | IV/V | 924 (3.8%) |
|  |  |  | (Missing) | 10 (0.0%) |
| BMI | 22,410 (92.5%) | 1817 | 18.5 - 24.9 (normal) | 566 (2.3%) |
|  |  |  | < 18.5 (underweight) | 8161 (33.7%) |
|  |  |  | 25 - 29.9 (overweight) | 7979 (32.9%) |
|  |  |  | ≥ 30.0 (obese) | 5704 (23.5%) |
|  |  |  | (Missing) | 1817 (7.5%) |
| Smoking | 20,704 (85.5%) | 3523 | Not Current | 16,209 (66.9%) |
|  |  |  | Current | 4495 (18.6%) |
|  |  |  | (Missing) | 3523 (14.5%) |
| Frailty Score | 24,221 (100.0%) | 6 | 1-3 | 20,676 (85.3%) |
|  |  |  | 4-6 | 3281 (13.5%) |
|  |  |  | 7-9 | 264 (1.1%) |
|  |  |  | (Missing) | 6 (0.0%) |
| Operative urgency | 24,220 (100.0%) | 7 | Elective | 17,362 (71.7%) |
|  |  |  | Emergency | 6858 (28.3%) |
|  |  |  | (Missing) | 7 (0.0%) |
| Operative Indication | 24,209 (99.9%) | 18 | Benign | 14,405 (59.5%) |
|  |  |  | Malignant | 9804 (40.5%) |
|  |  |  | (Missing) | 18 (0.1%) |
| Operative approach | 24,224 (100.0%) | 3 | Minimally-invasive | 13,905 (57.4%) |
|  |  |  | Open | 10,319 (42.6%) |
|  |  |  | (Missing) | 3 (0.0%) |
| Operative Contamination | 24,195 (99.9%) | 32 | Clean | 10009 (41.3%) |
|  |  |  | Clean-Contaminated | 12,271 (50.7%) |
|  |  |  | Contaminated/Dirty | 1915 (7.9%) |
|  |  |  | (Missing) | 32 (0.1%) |
| Operative Specialty | 24,227 (100.0%) | 0 | Upper GI | 1688 (7.0%) |
|  |  |  | HPB | 7024 (29.0%) |
|  |  |  | Lower GI | 10,301 (42.5%) |
|  |  |  | Gynaecology | 3419 (14.1%) |
|  |  |  | Urology | 1795 (7.4%) |
| Assessment | 24,227 (100.0%) | 0 | None | 6708 (27.7%) |
|  |  |  | Preoperative assessment (Elective only) | 14,386 (59.4%) |
|  |  |  | Inpatient assessment (Emergency only) | 3133 (12.9%) |

## 

## **Table S2** Summary of long-term health conditions in patients undergoing major abdominal surgery ranked by frequency and stratified by urgency.

# 

|  | Total,  n = 24,220 | Elective,  n = 17,362  (71.7%) | Emergency,  n = 6858  (28.3%) |
| --- | --- | --- | --- |
| Cancer | 9596 (39.6%) | 8046 (46.3%) | 1550 (22.6%) |
| Hypertension | 9170 (37.9%) | 6865 (39.5%) | 2305 (33.6%) |
| Chronic kidney disease | 4215 (17.4%) | 2935 (16.9%) | 1280 (18.7%) |
| Diabetes mellitus (i.e., Type 1 or Type 2) | 3724 (15.4%) | 2792 (16.1%) | 932 (13.6%) |
| Other respiratory disease | 2400 (9.9%) | 1685 (9.7%) | 715 (10.4%) |
| Chronic obstructive pulmonary disease | 1447 (6.0%) | 998 (5.7%) | 449 (6.5%) |
| Atrial fibrillation | 1295 (5.3%) | 904 (5.2%) | 391 (5.7%) |
| Coronary artery disease |  |  |  |
| Ischemic heart disease | 1080 (4.5%) | 753 (4.3%) | 327 (4.8%) |
| Angina | 750 (3.1%) | 542 (3.1%) | 208 (3.0%) |
| Inflammatory bowel disease | 1051 (4.3%) | 762 (4.4%) | 289 (4.2%) |
| Cerebrovascular disease | 696 (2.9%) | 463 (2.7%) | 233 (3.4%) |
| Chronic liver disease | 587 (2.4%) | 353 (2.0%) | 234 (3.4%) |
| Congestive heart failure | 560 (2.3%) | 379 (2.2%) | 181 (2.6%) |
| Venous thromboembolic disease |  |  |  |
| Deep vein thrombosis | 459 (1.9%) | 347 (2.0%) | 112 (1.6%) |
| Pulmonary embolism | 326 (1.3%) | 253 (1.5%) | 73 (1.1%) |

## **Table S3** Univariable and adjusted multivariable and multilevel logistic regression model for the 30-day mortality in patients undergoing major abdominal surgery.

## 

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 6698 (99.6%) | 27 (0.4%) | - | - | - | - |
|  | 1 | 6898 (98.6%) | 98 (1.4%) | 3.52 (2.33-5.51, p < 0.001) | 1.81 (1.03-3.34, p = 0.047) | 1.98 (1.20-3.40, p = 0.010) | 1.93 (1.16-3.23, p = 0.012) |
|  | ≥ 2 | 10,138 (96.8%) | 338 (3.2%) | 8.27 (5.70-12.54, p < 0.001) | 1.83 (1.07-3.35, p = 0.037) | 2.20 (1.36-3.73, p = 0.002) | 2.22 (1.35-3.64, p = 0.002) |
| Age (years) | 18-40 | 3700 (99.8%) | 8 (0.2%) | - | - | - | - |
|  | 41-60 | 8197 (99.2%) | 66 (0.8%) | 3.72 (1.90-8.42, p < 0.001) | 3.47 (1.37-11.73, p = 0.020) | 3.38 (1.46-9.84, p = 0.011) | 3.40 (1.36-8.47, p = 0.009) |
|  | 61-80 | 10,249 (97.6%) | 255 (2.4%) | 11.51 (6.09-25.41, p < 0.001) | 6.13 (2.46-20.53, p = 0.001) | 6.01 (2.64-17.31, p < 0.001) | 5.96 (2.42-14.69, p < 0.001) |
|  | ≥ 81 | 1588 (92.2%) | 134 (7.8%) | 39.03 (20.38-86.94, p < 0.001) | 10.83 (4.19-37.03, p < 0.001) | 10.45 (4.48-30.62, p < 0.001) | 10.05 (3.98-25.40, p < 0.001) |
| Sex | Male | 11,170 (97.7%) | 258 (2.3%) | - | - | - | - |
|  | Female | 12,564 (98.4%) | 205 (1.6%) | 0.71 (0.59-0.85, p < 0.001) | 0.84 (0.65-1.07, p = 0.166) | 0.88 (0.70-1.09, p = 0.234) | 0.90 (0.72-1.12, p = 0.328) |
| ASA | I | 3962 (99.8%) | 9 (0.2%) | - | - | - | - |
|  | II | 11,908 (99.5%) | 64 (0.5%) | 2.37 (1.24-5.10, p = 0.016) | 1.11 (0.50-2.97, p = 0.809) | 1.26 (0.60-3.10, p = 0.571) | 1.35 (0.61-2.98, p = 0.461) |
|  | III | 7105 (97.1%) | 215 (2.9%) | 13.32 (7.26-28.05, p < 0.001) | 2.44 (1.11-6.48, p = 0.044) | 2.91 (1.40-7.10, p = 0.009) | 3.23 (1.47-7.13, p = 0.004) |
|  | IV/V | 749 (81.1%) | 175 (18.9%) | 102.86 (55.60-217.70, p < 0.001) | 6.53 (2.87-17.72, p < 0.001) | 7.83 (3.67-19.47, p < 0.001) | 9.30 (4.10-21.11, p < 0.001) |
| BMI | 18.5 - 24.9 (normal) | 7983 (98.0%) | 167 (2.0%) | - | - | - | - |
|  | < 18.5 (underweight) | 527 (93.3%) | 38 (6.7%) | 3.45 (2.37-4.90, p < 0.001) | 2.03 (1.27-3.17, p = 0.003) | 1.71 (1.10-2.60, p = 0.014) | 1.75 (1.12-2.72, p = 0.013) |
|  | 25 - 29.9 (overweight) | 7852 (98.5%) | 116 (1.5%) | 0.71 (0.56-0.90, p = 0.004) | 0.75 (0.56-1.00, p = 0.049) | 0.72 (0.56-0.94, p = 0.014) | 0.72 (0.56-0.93, p = 0.013) |
|  | ≥ 30.0 (obese) | 5615 (98.5%) | 88 (1.5%) | 0.75 (0.58-0.97, p = 0.030) | 0.80 (0.57-1.11, p = 0.185) | 0.84 (0.63-1.12, p = 0.239) | 0.86 (0.65-1.15, p = 0.323) |
| Smoking | Not Current | 15,907 (98.3%) | 282 (1.7%) | - | - | - | - |
|  | Current | 4418 (98.4%) | 73 (1.6%) | 0.93 (0.71-1.20, p = 0.595) | 1.18 (0.87-1.58, p = 0.277) | - | - |
| Frailty Score | 1-3 | 20442 (99.0%) | 208 (1.0%) | - | - | - | - |
|  | 4-6 | 3085 (94.1%) | 193 (5.9%) | 6.15 (5.03-7.51, p < 0.001) | 1.81 (1.38-2.39, p < 0.001) | 1.65 (1.29-2.11, p < 0.001) | 1.66 (1.29-2.13, p < 0.001) |
|  | 7-9 | 201 (76.4%) | 62 (23.6%) | 30.31 (21.98-41.37, p < 0.001) | 4.41 (2.76-6.96, p < 0.001) | 4.14 (2.74-6.19, p < 0.001) | 4.07 (2.64-6.26, p < 0.001) |
| Urgency | Elective | 17,218 (99.2%) | 132 (0.8%) | - | - | - | - |
|  | Emergency | 6509 (95.2%) | 331 (4.8%) | 6.63 (5.42-8.16, p < 0.001) | 2.80 (1.95-4.00, p < 0.001) | 2.68 (1.94-3.69, p < 0.001) | 2.58 (1.85-3.61, p < 0.001) |
| Operative Indication | Benign | 14,116 (98.1%) | 268 (1.9%) | - | - | - | - |
|  | Malignant | 9600 (98.0%) | 195 (2.0%) | 1.07 (0.89-1.29, p = 0.477) | 1.38 (1.06-1.81, p = 0.017) | - | - |
| Operative approach | Minimally-invasive | 13,816 (99.5%) | 74 (0.5%) | - | - | - | - |
|  | Open | 9915 (96.2%) | 389 (3.8%) | 7.32 (5.74-9.47, p < 0.001) | 2.98 (2.19-4.12, p < 0.001) | 3.20 (2.43-4.28, p < 0.001) | 3.17 (2.39-4.21, p < 0.001) |
| Operative Contamination | Clean | 9904 (99.0%) | 98 (1.0%) | - | - | - | - |
|  | Clean-Contaminated | 12,051 (98.3%) | 209 (1.7%) | 1.75 (1.38-2.24, p < 0.001) | 1.29 (0.94-1.77, p = 0.116) | 1.39 (1.07-1.83, p = 0.016) | 1.37 (1.04-1.80, p = 0.027) |
|  | Contaminated/Dirty | 1747 (91.8%) | 156 (8.2%) | 9.02 (6.99-11.71, p < 0.001) | 2.29 (1.59-3.30, p < 0.001) | 2.60 (1.91-3.56, p < 0.001) | 2.44 (1.76-3.38, p < 0.001) |
| Operative Speciality | Upper GI | 1607 (95.3%) | 80 (4.7%) | - | - | - | - |
|  | HPB | 6905 (98.5%) | 108 (1.5%) | 0.31 (0.23-0.42, p < 0.001) | 1.12 (0.75-1.69, p = 0.596) | - | - |
|  | Lower GI | 10,023 (97.5%) | 261 (2.5%) | 0.52 (0.41-0.68, p < 0.001) | 1.10 (0.78-1.58, p = 0.591) | - | - |
|  | Gynaecology | 3412 (99.8%) | 6 (0.2%) | 0.04 (0.01-0.07, p < 0.001) | 0.22 (0.05-0.64, p = 0.014) | - | - |
|  | Urology | 1787 (99.6%) | 8 (0.4%) | 0.09 (0.04-0.18, p < 0.001) | 0.43 (0.16-0.98, p = 0.066) | - | - |
| Assessment | None | 6533 (97.5%) | 170 (2.5%) | - | - | - | - |
|  | Preoperative assessment (Elective only) | 14,250 (99.1%) | 123 (0.9%) | 0.33 (0.26-0.42, p < 0.001) | 0.90 (0.63-1.28, p = 0.547) | 0.80 (0.58-1.09, p = 0.157) | 0.78 (0.56-1.10, p = 0.157) |
|  | Inpatient assessment (Emergency only) | 2951 (94.6%) | 170 (5.4%) | 2.21 (1.78-2.75, p < 0.001) | 1.05 (0.77-1.44, p = 0.736) | 1.09 (0.83-1.42, p = 0.550) | 1.18 (0.89-1.59, p = 0.253) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S4** Multilevel adjusted logistic regression model for the 30-day mortality in patients undergoing major abdominal surgery excluding potential mediators (presence of frailty and ASA grade).

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 6698 (99.6%) | 27 (0.4%) | - | - | - |
|  | 1 | 6898 (98.6%) | 98 (1.4%) | 3.52 (2.33-5.51, p < 0.001) | 2.48 (1.52-4.21, p < 0.001) | 2.46 (1.48-4.11, p = 0.001) |
|  | ≥ 2 | 10138 (96.8%) | 338 (3.2%) | 8.27 (5.70-12.54, p < 0.001) | 3.99 (2.53-6.66, p < 0.001) | 4.09 (2.50-6.67, p < 0.001) |
| Age (years) | 18-40 | 3700 (99.8%) | 8 (0.2%) | - | - | - |
|  | 41-60 | 8197 (99.2%) | 66 (0.8%) | 3.72 (1.90-8.42, p < 0.001) | 4.18 (1.82-12.12, p = 0.003) | 4.27 (1.68-10.85, p = 0.002) |
|  | 61-80 | 10249 (97.6%) | 255 (2.4%) | 11.51 (6.09-25.41, p < 0.001) | 8.66 (3.85-24.82, p < 0.001) | 8.84 (3.52-22.16, p < 0.001) |
|  | ≥ 81 | 1588 (92.2%) | 134 (7.8%) | 39.03 (20.38-86.94, p < 0.001) | 20.57 (8.96-59.59, p < 0.001) | 20.62 (8.07-52.64, p < 0.001) |
| Sex | Male | 11170 (97.7%) | 258 (2.3%) | - | - | - |
|  | Female | 12564 (98.4%) | 205 (1.6%) | 0.71 (0.59-0.85, p < 0.001) | 0.87 (0.70-1.07, p = 0.197) | 0.88 (0.71-1.10, p = 0.263) |
| BMI | 18.5 - 24.9 (normal) | 7983 (98.0%) | 167 (2.0%) | - | - | - |
|  | < 18.5 (underweight) | 527 (93.3%) | 38 (6.7%) | 3.45 (2.37-4.90, p < 0.001) | 2.46 (1.62-3.66, p < 0.001) | 2.46 (1.60-3.79, p < 0.001) |
|  | 25 - 29.9 (overweight) | 7852 (98.5%) | 116 (1.5%) | 0.71 (0.56-0.90, p = 0.004) | 0.70 (0.54-0.90, p = 0.005) | 0.69 (0.54-0.90, p = 0.006) |
|  | ≥ 30.0 (obese) | 5615 (98.5%) | 88 (1.5%) | 0.75 (0.58-0.97, p = 0.030) | 0.89 (0.67-1.17, p = 0.413) | 0.91 (0.68-1.21, p = 0.507) |
| Urgency | Elective | 17218 (99.2%) | 132 (0.8%) | - | - | - |
|  | Emergency | 6509 (95.2%) | 331 (4.8%) | 6.63 (5.42-8.16, p < 0.001) | 3.65 (2.70-4.93, p < 0.001) | 3.55 (2.57-4.91, p < 0.001) |
| Operative approach | Minimally-invasive | 13816 (99.5%) | 74 (0.5%) | - | - | - |
|  | Open | 9915 (96.2%) | 389 (3.8%) | 7.32 (5.74-9.47, p < 0.001) | 3.93 (3.00-5.23, p < 0.001) | 4.01 (3.02-5.33, p < 0.001) |
| Operative Contamination | Clean | 9904 (99.0%) | 98 (1.0%) | - | - | - |
|  | Clean-Contaminated | 12051 (98.3%) | 209 (1.7%) | 1.75 (1.38-2.24, p < 0.001) | 1.38 (1.06-1.81, p = 0.017) | 1.36 (1.03-1.80, p = 0.030) |
|  | Contaminated/Dirty | 1747 (91.8%) | 156 (8.2%) | 9.02 (6.99-11.71, p < 0.001) | 3.01 (2.23-4.08, p < 0.001) | 2.84 (2.05-3.92, p < 0.001) |
| Assessment | None | 6533 (97.5%) | 170 (2.5%) | - | - | - |
|  | Preoperative assessment (Elective only) | 14250 (99.1%) | 123 (0.9%) | 0.33 (0.26-0.42, p < 0.001) | 0.70 (0.52-0.94, p = 0.019) | 0.70 (0.50-0.97, p = 0.032) |
|  | Inpatient assessment (Emergency only) | 2951 (94.6%) | 170 (5.4%) | 2.21 (1.78-2.75, p < 0.001) | 1.16 (0.90-1.50, p = 0.256) | 1.30 (0.97-1.73, p = 0.077) |

## **Table S5** Mediation models examining effects of potential mediators on 30-day postoperative mortality.

**A** Natural effects mediation model for Frailty. Exposure: Multimorbidity (multicategorical: 0, 1, ≥ 2). Confounders: age, sex, BMI, operative urgency, operative approach, and operative contamination), assessment. Mediators: frailty. Outcome: 30-day postoperative mortality.

|  | One long-term health condition | | Two or more long-term health condition (Multimorbidity) | |
| --- | --- | --- | --- | --- |
|  | OR (Natural Effect) | Percentage Mediated | OR (Natural Effect) | Percentage Mediated |
| total direct effect | 1.84 (95%CI: 1.10 to 3.06, p = 0.020) | 75.4% | 2.14 (95%CI: 1.28 to 3.58, p = 0.004) | 60.7% |
| total indirect effect | 1.14 (95%CI: 1.02 to 1.28, p = 0.023) | 16.7% | 1.23 (95%CI: 1.10 to 1.37, p < 0.001) | 16.3% |

**B** Natural effects mediation model for Frailty and ASA grade. Exposure: Multimorbidity (multicategorical: 0, 1, ≥ 2). Confounders: age, sex, BMI, operative urgency, operative approach, and operative contamination), assessment. Mediators: frailty\*ASA. Outcome: 30-day postoperative mortality.

|  | One long-term health condition | | Two or more long-term health condition (Multimorbidity) | |
| --- | --- | --- | --- | --- |
|  | OR (Natural Effect) | Percentage Mediated | OR (Natural Effect) | Percentage Mediated |
| total direct effect | 1.62 (95%CI: 0.96 to 2.74, p = 0.070) | 58.8% | 1.75 (95%CI: 1.03 to 2.99, p = 0.040) | 43.3% |
| total indirect effect | 1.30 (95%CI: 1.12 to 1.51, p < 0.001) | 31.7% | 1.61 (95%CI: 1.36 to 1.91, p < 0.001) | 36.9% |

## **Table S6** Full adjusted logistic regression model for the presence of major complications in patients undergoing major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 6422 (95.5%) | 303 (4.5%) | - | - | - | - |
|  | 1 | 6346 (90.7%) | 650 (9.3%) | 2.17 (1.89-2.50, p < 0.001) | 1.53 (1.28-1.83, p < 0.001) | 1.66 (1.40-1.99, p < 0.001) | 1.61 (1.35-1.92, p < 0.001) |
|  | ≥ 2 | 9026 (86.2%) | 1450 (13.8%) | 3.40 (3.00-3.88, p < 0.001) | 1.70 (1.41-2.05, p < 0.001) | 1.90 (1.59-2.27, p < 0.001) | 1.77 (1.48-2.13, p < 0.001) |
| Age (years) | 18-40 | 3521 (95.0%) | 187 (5.0%) | - | - | - | - |
|  | 41-60 | 7616 (92.2%) | 647 (7.8%) | 1.60 (1.36-1.90, p < 0.001) | 1.09 (0.89-1.34, p = 0.393) | 1.13 (0.93-1.39, p = 0.222) | 1.10 (0.90-1.35, p = 0.346) |
|  | 61-80 | 9242 (88.0%) | 1262 (12.0%) | 2.57 (2.20-3.02, p < 0.001) | 1.20 (0.98-1.48, p = 0.086) | 1.27 (1.04-1.56, p = 0.023) | 1.25 (1.01-1.54, p = 0.036) |
|  | ≥81 | 1415 (82.2%) | 307 (17.8%) | 4.09 (3.38-4.96, p < 0.001) | 1.18 (0.91-1.53, p = 0.222) | 1.25 (0.97-1.62, p = 0.090) | 1.20 (0.92-1.57, p = 0.167) |
| Sex | Male | 10047 (87.9%) | 1381 (12.1%) | - | - | - | - |
|  | Female | 11747 (92.0%) | 1022 (8.0%) | 0.63 (0.58-0.69, p < 0.001) | 0.81 (0.73-0.90, p < 0.001) | 0.80 (0.72-0.89, p < 0.001) | 0.81 (0.73-0.91, p < 0.001) |
| ASA | I | 3817 (96.1%) | 154 (3.9%) | - | - | - | - |
|  | II | 11102 (92.7%) | 870 (7.3%) | 1.94 (1.64-2.32, p < 0.001) | 1.24 (1.01-1.54, p = 0.044) | 1.24 (1.01-1.54, p = 0.043) | 1.17 (0.94-1.45, p = 0.149) |
|  | III | 6290 (85.9%) | 1030 (14.1%) | 4.06 (3.42-4.85, p < 0.001) | 1.61 (1.29-2.02, p < 0.001) | 1.61 (1.29-2.01, p < 0.001) | 1.46 (1.16-1.84, p < 0.001) |
|  | IV/V | 579 (62.7%) | 345 (37.3%) | 14.77 (12.01-18.24, p < 0.001) | 3.10 (2.34-4.10, p < 0.001) | 3.04 (2.30-4.03, p < 0.001) | 2.84 (2.12-3.80, p < 0.001) |
| BMI | 18.5 - 24.9 (normal) | 7306 (89.6%) | 844 (10.4%) | - | - | - | - |
|  | < 18.5 (underweight) | 465 (82.3%) | 100 (17.7%) | 1.86 (1.48-2.33, p < 0.001) | 1.29 (0.98-1.67, p = 0.065) | 1.27 (0.97-1.65, p = 0.079) | 1.26 (0.96-1.65, p = 0.094) |
|  | 25 - 29.9 (overweight) | 7231 (90.8%) | 737 (9.2%) | 0.88 (0.80-0.98, p = 0.018) | 0.86 (0.76-0.97, p = 0.012) | 0.85 (0.75-0.95, p = 0.006) | 0.88 (0.78-0.99, p = 0.034) |
|  | ≥ 30.0 (obese) | 5175 (90.7%) | 528 (9.3%) | 0.88 (0.79-0.99, p = 0.033) | 0.93 (0.81-1.06, p = 0.275) | 0.90 (0.79-1.03, p = 0.134) | 0.94 (0.82-1.08, p = 0.407) |
| Smoking | Not Current | 14607 (90.2%) | 1582 (9.8%) | - | - | - | - |
|  | Current | 4059 (90.4%) | 432 (9.6%) | 0.98 (0.88-1.10, p = 0.760) | 1.04 (0.92-1.18, p = 0.528) | 1.03 (0.91-1.16, p = 0.676) | 1.03 (0.90-1.16, p = 0.691) |
| Frailty Score | 1-3 | 18949 (91.8%) | 1701 (8.2%) | - | - | - | - |
|  | 4-6 | 2688 (82.0%) | 590 (18.0%) | 2.45 (2.21-2.71, p < 0.001) | 1.29 (1.13-1.47, p < 0.001) | 1.27 (1.11-1.45, p < 0.001) | 1.33 (1.16-1.53, p < 0.001) |
|  | 7-9 | 152 (57.8%) | 111 (42.2%) | 8.14 (6.33-10.43, p < 0.001) | 2.90 (2.07-4.04, p < 0.001) | 2.87 (2.05-3.99, p < 0.001) | 2.99 (2.11-4.24, p < 0.001) |
| Urgency | Elective | 15986 (92.1%) | 1364 (7.9%) | - | - | - | - |
|  | Emergency | 5801 (84.8%) | 1039 (15.2%) | 2.10 (1.93-2.29, p < 0.001) | 1.58 (1.36-1.84, p < 0.001) | 1.51 (1.30-1.75, p < 0.001) | 1.44 (1.22-1.69, p < 0.001) |
| Operative Indication | Benign | 13151 (91.4%) | 1233 (8.6%) | - | - | - | - |
|  | Malignant | 8626 (88.1%) | 1169 (11.9%) | 1.45 (1.33-1.57, p < 0.001) | 1.34 (1.20-1.51, p < 0.001) | - |  |
| Operative approach | Minimally-invasive | 13084 (94.2%) | 806 (5.8%) | - | - | - |  |
|  | Open | 8707 (84.5%) | 1597 (15.5%) | 2.98 (2.73-3.26, p < 0.001) | 2.00 (1.79-2.22, p < 0.001) | 2.01 (1.81-2.24, p < 0.001) | 2.12 (1.89-2.37, p < 0.001) |
| Operative Contamination | Clean | 9317 (93.2%) | 685 (6.8%) | - | - | - | - |
|  | Clean-Contaminated | 10994 (89.7%) | 1266 (10.3%) | 1.57 (1.42-1.73, p<0.001) | 1.35 (1.20-1.52, p<0.001) | 1.41 (1.26-1.59, p < 0.001) | 1.43 (1.26-1.62, p < 0.001) |
|  | Contaminated/Dirty | 1454 (76.4%) | 449 (23.6%) | 4.20 (3.68-4.79, p < 0.001) | 2.30 (1.93-2.74, p < 0.001) | 2.33 (1.95-2.77, p < 0.001) | 2.44 (2.03-2.94, p < 0.001) |
| Operative Speciality | Upper GI | 1333 (79.0%) | 354 (21.0%) | - | - | - | - |
|  | HPB | 6294 (89.7%) | 719 (10.3%) | 0.43 (0.37-0.50, p < 0.001) | 0.90 (0.76-1.08, p = 0.261) | 0.86 (0.72-1.02, p = 0.084) | 0.85 (0.71-1.02, p = 0.076) |
|  | Lower GI | 9173 (89.2%) | 1111 (10.8%) | 0.46 (0.40-0.52, p < 0.001) | 0.67 (0.57-0.79, p < 0.001) | 0.66 (0.56-0.78, p < 0.001) | 0.68 (0.58-0.81, p < 0.001) |
|  | Gynaecology | 3306 (96.7%) | 112 (3.3%) | 0.13 (0.10-0.16, p < 0.001) | 0.41 (0.31-0.53, p < 0.001) | 0.41 (0.31-0.53, p < 0.001) | 0.42 (0.32-0.55, p < 0.001) |
|  | Urology | 1688 (94.0%) | 107 (6.0%) | 0.24 (0.19-0.30, p < 0.001) | 0.47 (0.36-0.61, p < 0.001) | 0.49 (0.37-0.64, p < 0.001) | 0.47 (0.36-0.63, p < 0.001) |
| Assessment | None | 5994 (89.4%) | 709 (10.6%) | - | - | - | - |
|  | Preoperative assessment (Elective only) | 13166 (91.6%) | 1207 (8.4%) | 0.78 (0.70-0.85, p < 0.001) | 1.06 (0.93-1.22, p = 0.374) | 1.09 (0.95-1.25, p = 0.201) | 1.11 (0.96-1.29, p = 0.173) |
|  | Inpatient assessment (Emergency only) | 2634 (84.4%) | 487 (15.6%) | 1.56 (1.38-1.77, p < 0.001) | 1.06 (0.90-1.26, p = 0.478) | 1.04 (0.88-1.24, p = 0.619) | 1.21 (1.01-1.45, p = 0.042) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S7** Full adjusted logistic regression model for the presence of any complications in patients undergoing major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 5121 (76.1%) | 1604 (23.9%) | - | - | - | - |
|  | 1 | 4505 (64.4%) | 2491 (35.6%) | 1.77 (1.64-1.90, p < 0.001) | 1.27 (1.16-1.40, p < 0.001) | 1.40 (1.28-1.54, p < 0.001) | 1.37 (1.23-1.52, p < 0.001) |
|  | ≥ 2 | 5630 (53.7%) | 4846 (46.3%) | 2.75 (2.57-2.94, p < 0.001) | 1.51 (1.36-1.67, p < 0.001) | 1.72 (1.56-1.90, p < 0.001) | 1.68 (1.51-1.88, p < 0.001) |
| Age (years) | 18-40 | 2783 (75.1%) | 925 (24.9%) | - | - | - | - |
|  | 41-60 | 5614 (67.9%) | 2649 (32.1%) | 1.42 (1.30-1.55, p < 0.001) | 1.06 (0.95-1.18, p = 0.315) | 1.09 (0.98-1.22, p = 0.113) | 1.17 (1.04-1.32, p = 0.009) |
|  | 61-80 | 6056 (57.7%) | 4448 (42.3%) | 2.21 (2.03-2.40, p < 0.001) | 1.13 (1.00-1.26, p = 0.044) | 1.19 (1.07-1.34, p = 0.002) | 1.31 (1.15-1.48, p < 0.001) |
|  | ≥ 81 | 803 (46.6%) | 919 (53.4%) | 3.44 (3.05-3.88, p < 0.001) | 1.25 (1.06-1.47, p = 0.008) | 1.33 (1.13-1.57, p < 0.001) | 1.51 (1.26-1.80, p < 0.001) |
| Sex | Male | 6681 (58.5%) | 4747 (41.5%) | - | - | - | - |
|  | Female | 8575 (67.2%) | 4194 (32.8%) | 0.69 (0.65-0.73, p < 0.001) | 0.93 (0.87-1.00, p = 0.050) | 0.92 (0.86-0.99, p = 0.022) | 0.92 (0.86-0.99, p = 0.032) |
| ASA | I | 3139 (79.0%) | 832 (21.0%) | - | - | - | - |
|  | II | 7958 (66.5%) | 4014 (33.5%) | 1.90 (1.75-2.07, p < 0.001) | 1.38 (1.24-1.53, p < 0.001) | 1.38 (1.24-1.54, p < 0.001) | 1.25 (1.11-1.41, p < 0.001) |
|  | III | 3876 (53.0%) | 3444 (47.0%) | 3.35 (3.07-3.67, p < 0.001) | 1.60 (1.42-1.81, p < 0.001) | 1.60 (1.42-1.81, p < 0.001) | 1.54 (1.35-1.77, p < 0.001) |
|  | IV/V | 278 (30.1%) | 646 (69.9%) | 8.77 (7.48-10.30, p < 0.001) | 2.68 (2.17-3.30, p < 0.001) | 2.63 (2.14-3.24, p < 0.001) | 2.71 (2.16-3.41, p < 0.001) |
| BMI | 18.5 - 24.9 (normal) | 5106 (62.7%) | 3044 (37.3%) | - | - | - | - |
|  | < 18.5 (underweight) | 290 (51.3%) | 275 (48.7%) | 1.59 (1.34-1.89, p < 0.001) | 1.17 (0.96-1.43, p = 0.115) | 1.16 (0.95-1.41, p = 0.152) | 1.15 (0.93-1.42, p = 0.211) |
|  | 25 - 29.9 (overweight) | 5079 (63.7%) | 2889 (36.3%) | 0.95 (0.89-1.02, p = 0.151) | 0.93 (0.86-1.00, p = 0.039) | 0.91 (0.85-0.98, p = 0.014) | 0.94 (0.86-1.01, p = 0.102) |
|  | ≥ 30.0 (obese) | 3644 (63.9%) | 2059 (36.1%) | 0.95 (0.88-1.02, p = 0.135) | 0.98 (0.90-1.06, p = 0.576) | 0.95 (0.88-1.03, p = 0.226) | 0.96 (0.87-1.05, p = 0.352) |
| Smoking | Not Current | 10172 (62.8%) | 6017 (37.2%) | - | - | - | - |
|  | Current | 2841 (63.3%) | 1650 (36.7%) | 0.98 (0.92-1.05, p = 0.600) | 1.06 (0.98-1.14, p = 0.146) | 1.04 (0.97-1.13, p = 0.278) | 1.08 (0.99-1.17, p = 0.079) |
| Frailty Score | 1-3 | 13620 (66.0%) | 7030 (34.0%) | - | - | - | - |
|  | 4-6 | 1550 (47.3%) | 1728 (52.7%) | 2.16 (2.01-2.33, p < 0.001) | 1.24 (1.13-1.36, p < 0.001) | 1.22 (1.11-1.34, p < 0.001) | 1.30 (1.17-1.45, p < 0.001) |
|  | 7-9 | 83 (31.6%) | 180 (68.4%) | 4.20 (3.25-5.48, p < 0.001) | 1.70 (1.23-2.38, p = 0.002) | 1.67 (1.20-2.34, p = 0.002) | 1.97 (1.38-2.82, p < 0.001) |
| Urgency | Elective | 11540 (66.5%) | 5810 (33.5%) | - | - | - | - |
|  | Emergency | 3709 (54.2%) | 3131 (45.8%) | 1.68 (1.58-1.78, p < 0.001) | 1.54 (1.39-1.70, p < 0.001) | 1.48 (1.34-1.63, p < 0.001) | 1.34 (1.19-1.50, p < 0.001) |
| Operative Indication | Benign | 9783 (68.0%) | 4601 (32.0%) | - | - | - | - |
|  | Malignant | 5458 (55.7%) | 4337 (44.3%) | 1.69 (1.60-1.78, p < 0.001) | 1.41 (1.31-1.52, p < 0.001) | - |  |
| Operative approach | Minimally-invasive | 9963 (71.7%) | 3927 (28.3%) | - | - | - |  |
|  | Open | 5290 (51.3%) | 5014 (48.7%) | 2.40 (2.28-2.54, p < 0.001) | 1.89 (1.77-2.02, p < 0.001) | 1.90 (1.78-2.02, p < 0.001) | 2.06 (1.91-2.21, p < 0.001) |
| Operative Contamination | Clean | 7093 (70.9%) | 2909 (29.1%) | - | - | - | - |
|  | Clean-Contaminated | 7372 (60.1%) | 4888 (39.9%) | 1.62 (1.53-1.71, p < 0.001) | 1.35 (1.26-1.44, p < 0.001) | 1.40 (1.31-1.50, p < 0.001) | 1.44 (1.32-1.56, p < 0.001) |
|  | Contaminated/Dirty | 769 (40.4%) | 1134 (59.6%) | 3.60 (3.25-3.98, p < 0.001) | 2.17 (1.91-2.47, p < 0.001) | 2.19 (1.92-2.49, p < 0.001) | 2.48 (2.14-2.88, p < 0.001) |
| Operative Speciality | Upper GI | 759 (45.0%) | 928 (55.0%) | - | - | - | - |
|  | HPB | 4552 (64.9%) | 2461 (35.1%) | 0.44 (0.40-0.49, p < 0.001) | 0.85 (0.74-0.96, p = 0.013) | 0.77 (0.68-0.88, p < 0.001) | 0.71 (0.61-0.82, p < 0.001) |
|  | Lower GI | 6015 (58.5%) | 4269 (41.5%) | 0.58 (0.52-0.64, p < 0.001) | 0.79 (0.69-0.89, p < 0.001) | 0.76 (0.67-0.86, p < 0.001) | 0.73 (0.64-0.83, p < 0.001) |
|  | Gynaecology | 2753 (80.5%) | 665 (19.5%) | 0.20 (0.17-0.22, p < 0.001) | 0.44 (0.37-0.51, p < 0.001) | 0.42 (0.36-0.49, p < 0.001) | 0.37 (0.31-0.44, p < 0.001) |
|  | Urology | 1177 (65.6%) | 618 (34.4%) | 0.43 (0.37-0.49, p < 0.001) | 0.65 (0.55-0.76, p < 0.001) | 0.68 (0.58-0.80, p < 0.001) | 0.66 (0.54-0.79, p < 0.001) |
| Assessment | None | 4230 (63.1%) | 2473 (36.9%) | - | - | - | - |
|  | Preoperative assessment (Elective only) | 9352 (65.1%) | 5021 (34.9%) | 0.92 (0.86-0.98, p = 0.006) | 1.08 (1.00-1.17, p = 0.063) | 1.10 (1.02-1.20, p = 0.018) | 1.08 (0.97-1.19, p = 0.160) |
|  | Inpatient assessment (Emergency only) | 1674 (53.6%) | 1447 (46.4%) | 1.48 (1.36-1.61, p < 0.001) | 1.06 (0.93-1.20, p = 0.375) | 1.03 (0.91-1.17, p. =0.635) | 1.08 (0.94-1.25, p = 0.274) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S8** Clinical characteristics of patients undergoing elective major abdominal surgery stratified by number of long-term health conditions.

|  |  |  |  | **Long-term health conditions** | | | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | None,  n=4,392  (23.6%) | One,  n=5,638  (30.3%) | Two or more,  n=8,608  (46.2%) | p-value |
| **Patient factors** |  | **Total, n (%)** | **Missing, n** |  |  |  |  |
| Age (years) | 18-40 | 17336 (99.9%) | 26 | 1138 (59.1%) | 616 (32.0%) | 172 (8.9%) | < 0.001 |
|  | 41-60 |  |  | 2211 (35.3%) | 2218 (35.4%) | 1839 (29.3%) |  |
|  | 61-80 |  |  | 768 (9.5%) | 2249 (27.9%) | 5047 (62.6%) |  |
|  | ≥ 81 |  |  | 42 (3.9%) | 177 (16.4%) | 859 (79.7%) |  |
|  | (Missing) |  |  | 14 (53.8%) | 11 (42.3%) | 1 (3.8%) |  |
| Sex | Male | 17362 (100.0%) | 0 | 1177 (15.0%) | 2294 (29.2%) | 4396 (55.9%) | < 0.001 |
|  | Female |  |  | 2996 (31.6%) | 2977 (31.4%) | 3522 (37.1%) |  |
| ASA Grade | I | 17357 (100.0%) | 5 | 1463 (58.2%) | 742 (29.5%) | 309 (12.3%) | < 0.001 |
|  | II |  |  | 2294 (24.4%) | 3333 (35.5%) | 3762 (40.1%) |  |
|  | III |  |  | 403 (7.8%) | 1154 (22.4%) | 3597 (69.8%) |  |
|  | IV/V |  |  | 11 (3.7%) | 41 (13.7%) | 248 (82.7%) |  |
|  | (Missing) |  |  | 2 (40.0%) | 1 (20.0%) | 2 (40.0%) |  |
| BMI | < 18.5 (underweight) | 16513 (95.1%) | 849 | 79 (21.8%) | 138 (38.0%) | 146 (40.2%) | < 0.001 |
|  | 18.5 - 24.9 (normal) |  |  | 1511 (26.3%) | 1974 (34.3%) | 2267 (39.4%) |  |
|  | 25 - 29.9 (overweight) |  |  | 1380 (23.0%) | 1743 (29.0%) | 2890 (48.1%) |  |
|  | ≥ 30.0 (obese) |  |  | 968 (22.1%) | 1150 (26.2%) | 2267 (51.7%) |  |
|  | (Missing) |  |  | 235 (27.7%) | 266 (31.3%) | 348 (41.0%) |  |
| Smoking | Not Current | 15232 (87.7%) | 2130 | 2690 (22.3%) | 3674 (30.5%) | 5678 (47.2%) | < 0.001 |
|  | Current |  |  | 934 (29.3%) | 948 (29.7%) | 1308 (41.0%) |  |
|  | (Missing) |  |  | 549 (25.8%) | 649 (30.5%) | 932 (43.8%) |  |
| Frailty Score | 1-3 | 17358 (100.0%) | 4 | 4014 (26.5%) | 4867 (32.1%) | 6285 (41.4%) | < 0.001 |
|  | 4-6 |  |  | 144 (6.9%) | 388 (18.5%) | 1570 (74.7%) |  |
|  | 7-9 |  |  | 14 (15.6%) | 16 (17.8%) | 60 (66.7%) |  |
|  | (Missing) |  |  | 1 (25.0%) | 0 (0.0%) | 3 (75.0%) |  |
| **Operative factors** |  |  |  |  |  |  |  |
| Indication | Benign | 17351 (99.9%) | 11 | 3819 (42.2%) | 2661 (29.4%) | 2561 (28.3%) | < 0.001 |
|  | Malignant |  |  | 350 (4.2%) | 2604 (31.3%) | 5356 (64.5%) |  |
|  | (Missing) |  |  | 4 (36.4%) | 6 (54.5%) | 1 (9.1%) |  |
| Approach | Minimally invasive | 17360 (100.0%) | 2 | 2914 (28.1%) | 3147 (30.4%) | 4308 (41.5%) | < 0.001 |
|  | Open |  |  | 1259 (18.0%) | 2123 (30.4%) | 3609 (51.6%) |  |
|  | (Missing) |  |  | 0 (0.0%) | 1 (50.0%) | 1 (50.0%) |  |
| Contamination | Clean | 17334 (99.8%) | 28 | 2359 (30.3%) | 2265 (29.1%) | 3159 (40.6%) | <0.001 |
|  | Clean-Contaminated |  |  | 1725 (19.3%) | 2808 (31.3%) | 4427 (49.4%) |  |
|  | Contaminated/Dirty |  |  | 85 (14.4%) | 186 (31.5%) | 320 (54.1%) |  |
|  | (Missing) |  |  | 4 (14.3%) | 12 (42.9%) | 12 (42.9%) |  |
| Specialty | Upper GI | 17362 (100.0%) | 0 | 89 (8.5%) | 349 (33.2%) | 614 (58.4%) | < 0.001 |
|  | HPB |  |  | 1733 (32.7%) | 1503 (28.3%) | 2071 (39.0%) |  |
|  | Lower GI |  |  | 888 (14.0%) | 2016 (31.9%) | 3424 (54.1%) |  |
|  | Gynaecology |  |  | 1334 (43.6%) | 912 (29.8%) | 816 (26.6%) |  |
|  | Urology | 17258 (99.4%) | 104 | 129 (8.0%) | 491 (30.4%) | 993 (61.6%) |  |
| Pre-admission anaesthetic assessment clinic | No | 17258 (99.4%) | 104 | 1070 (28.5%) | 1143 (30.4%) | 1544 (41.1%) | < 0.001 |
|  | Yes |  |  | 3075 (22.8%) | 4097 (30.3%) | 6329 (46.9%) |  |
|  | (Missing) |  |  | 28 (26.9%) | 31 (29.8%) | 45 (43.3%) |  |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S9** Clinical characteristics of patients undergoing emergency major abdominal surgery stratified by number of long-term health conditions.

|  |  |  |  | **Long-term health conditions** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | None,  n=2,562  (37.4%) | One,  n=1,733  (25.3%) | Two or more n=2,563  (37.4%) | p-value |
| **Patient factors** |  | **Total, n (%)** | **Missing, n** |  |  |  |  |
| Age (years) | 18-40 | 6780 (98.9%) | 78 | 1290 (76.8%) | 316 (18.8%) | 74 (4.4%) | < 0.001 |
|  | 41-60 |  |  | 815 (40.7%) | 638 (31.9%) | 549 (27.4%) |  |
|  | 61-80 |  |  | 344 (14.0%) | 640 (26.1%) | 1465 (59.8%) |  |
|  | ≥ 81 |  |  | 48 (7.4%) | 128 (19.7%) | 473 (72.9%) |  |
|  | (Missing) |  |  | 65 (83.3%) | 11 (14.1%) | 2 (2.6%) |  |
| Sex | Male | 6858 (100.0%) | 0 | 1261 (35.3%) | 851 (23.8%) | 1464 (40.9%) | < 0.001 |
|  | Female |  |  | 1301 (39.6%) | 882 (26.9%) | 1099 (33.5%) |  |
| ASA Grade | I | 6853 (99.9%) | 5 | 1169 (80.0%) | 229 (15.7%) | 63 (4.3%) | < 0.001 |
|  | II |  |  | 1010 (39.0%) | 839 (32.4%) | 744 (28.7%) |  |
|  | III |  |  | 324 (14.9%) | 537 (24.7%) | 1314 (60.4%) |  |
|  | IV/V |  |  | 58 (9.3%) | 126 (20.2%) | 440 (70.5%) |  |
|  | (Missing) |  |  | 1 (20.0%) | 2 (40.0%) | 2 (40.0%) |  |
| BMI | < 18.5 (underweight) | 5890 (85.9%) | 968 | 48 (23.6%) | 67 (33.0%) | 88 (43.3%) | < 0.001 |
|  | 18.5 - 24.9 (normal) |  |  | 1063 (44.2%) | 584 (24.3%) | 760 (31.6%) |  |
|  | 25 - 29.9 (overweight) |  |  | 639 (32.5%) | 509 (25.9%) | 816 (41.5%) |  |
|  | ≥ 30.0 (obese) |  |  | 359 (27.3%) | 322 (24.5%) | 635 (48.3%) |  |
|  | (Missing) |  |  | 453 (46.8%) | 251 (25.9%) | 264 (27.3%) |  |
| Smoking | Not Current | 5465 (79.7%) | 1393 | 1479 (35.5%) | 1032 (24.8%) | 1650 (39.7%) | < 0.001 |
|  | Current |  |  | 557 (42.7%) | 307 (23.5%) | 440 (33.7%) |  |
|  | (Missing) |  |  | 526 (37.8%) | 394 (28.3%) | 473 (34.0%) |  |
| Frailty Score | 1-3 | 6856 (100.0%) | 2 | 2456 (44.6%) | 1465 (26.6%) | 1584 (28.8%) | < 0.001 |
|  | 4-6 |  |  | 87 (7.4%) | 238 (20.2%) | 852 (72.4%) |  |
|  | 7-9 |  |  | 18 (10.3%) | 29 (16.7%) | 127 (73.0%) |  |
|  | (Missing) |  |  | 1 (50.0%) | 1 (50.0%) | 0 (0.0%) |  |
| **Operative factors** |  |  |  |  |  |  |  |
| Indication | Benign | 6856 (100.0%) | 2 | 2459 (45.8%) | 1259 (23.5%) | 1646 (30.7%) | < 0.001 |
|  | Malignant |  |  | 102 (6.8%) | 474 (31.8%) | 916 (61.4%) |  |
|  | (Missing) |  |  | 1 (50.0%) | 0 (0.0%) | 1 (50.0%) |  |
| Approach | Minimally invasive | 6857 (100.0%) | 1 | 1826 (51.7%) | 831 (23.5%) | 877 (24.8%) | < 0.001 |
|  | Open |  |  | 735 (22.1%) | 902 (27.1%) | 1686 (50.7%) |  |
|  | (Missing) |  |  | 1 (100.0%) | 0 (0.0%) | 0 (0.0%) |  |
| Contamination | Clean | 6854 (99.9%) | 4 | 900 (40.5%) | 548 (24.7%) | 775 (34.9%) | < 0.001 |
|  | Clean-Contaminated |  |  | 1216 (36.8%) | 850 (25.7%) | 1241 (37.5%) |  |
|  | Contaminated/Dirty |  |  | 444 (33.5%) | 335 (25.3%) | 545 (41.2%) |  |
|  | (Missing) |  |  | 2 (50.0%) | 0 (0.0%) | 2 (50.0%) |  |
| Specialty | Upper GI | 6858 (100.0%) | 0 | 141 (22.2%) | 175 (27.5%) | 320 (50.3%) | < 0.001 |
|  | HPB |  |  | 508 (29.6%) | 449 (26.2%) | 758 (44.2%) |  |
|  | Lower GI |  |  | 1709 (43.1%) | 963 (24.3%) | 1296 (32.7%) |  |
|  | Gynaecology |  |  | 192 (53.8%) | 94 (26.3%) | 71 (19.9%) |  |
|  | Urology |  |  | 12 (6.6%) | 52 (28.6%) | 118 (64.8%) |  |
| Inpatient perioperative or elderly medicine assessment | No | 5494 (80.1%) | 1364 | 1033 (43.0%) | 564 (23.5%) | 808 (33.6%) | < 0.001 |
| Yes |  |  | 1281 (41.5%) | 777 (25.2%) | 1031 (33.4%) |  |
| (Missing) |  |  | 248 (18.2%) | 392 (28.7%) | 724 (53.1%) |  |

GI, gastrointestinal; HPB, hepatobiliary

**Table S10** Full adjusted logistic regression model for the 30-day mortality in patients undergoing elective major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 4164 (99.9%) | 6 (0.1%) | - | - | - | - |
| 1 | 5246 (99.5%) | 24 (0.5%) | 3.17 (1.38-8.58, p = 0.011) | 1.74 (0.63-6.19, p = 0.331) | 2.41 (0.90-8.36, p = 0.112) | 2.52 (0.86-7.41, p = 0.093) |
| ≥ 2 | 7808 (98.7%) | 102 (1.3%) | 9.07 (4.34-23.23, p < 0.001) | 1.91 (0.71-6.77, p = 0.250) | 2.95 (1.15-10.11, p = 0.046) | 3.67 (1.28-10.54, p = 0.016) |
| Age (years) | 18-40 | 1922 (99.8%) | 4 (0.2%) | - | - | - | - |
| 41-60 | 6250 (99.8%) | 14 (0.2%) | 1.08 (0.39-3.80, p = 0.897) | 0.81 (0.24-3.67, p = 0.749) | 0.93 (0.29-4.14, p = 0.912) | 0.92 (0.30-2.83, p = 0.887) |
| 61-80 | 7975 (99.0%) | 84 (1.0%) | 5.06 (2.11-16.59, p = 0.002) | 2.38 (0.81-10.18, p = 0.165) | 2.80 (0.99-11.80, p = 0.092) | 2.28 (0.79-6.51, p. =0.126) |
| ≥8 1 | 1045 (97.2%) | 30 (2.8%) | 13.79 (5.43-46.54, p < 0.001) | 4.39 (1.35-19.87, p = 0.026) | 5.13 (1.67-22.54, p = 0.011) | 4.60 (1.52-13.93, p = 0.007) |
| Sex | Male | 7771 (98.9%) | 89 (1.1%) | - | - | - | - |
| Female | 9447 (99.5%) | 43 (0.5%) | 0.40 (0.27-0.57, p < 0.001) | 0.55 (0.35-0.84, p = 0.007) | 0.54 (0.36-0.79, p = 0.002) | 0.68 (0.48-0.97, p = 0.033) |
| ASA | I | 2508 (99.8%) | 5 (0.2%) | - | - | - | - |
|  | II | 9351 (99.6%) | 33 (0.4%) | 1.77 (0.76-5.18, p = 0.234) | 0.72 (0.27-2.51, p = 0.555) | 0.95 (0.36-3.26, p = 0.924) | 1.02 (0.35-2.98, p = 0.965) |
|  | III | 5077 (98.6%) | 71 (1.4%) | 7.01 (3.13-20.02, p < 0.001) | 1.42 (0.53-4.97, p = 0.526) | 1.78 (0.68-6.12, p = 0.294) | 2.20 (0.75-6.42, p = 0.149) |
|  | IV/V | 277 (92.3%) | 23 (7.7%) | 41.65 (17.01-124.79, p < 0.001) | 3.95 (1.26-15.15, p = 0.027) | 4.61 (1.52-17.35, p = 0.012) | 5.54 (1.72-17.85, p = 0.004) |
| BMI | < 18.5 | 351 (97.0%) | 11 (3.0%) | - | - | - | - |
|  | 18.5 - 24.9 | 5697 (99.1%) | 51 (0.9%) | 0.29 (0.15-0.58, p < 0.001) | 0.32 (0.16-0.70, p = 0.003) | 0.33 (0.17-0.69, p = 0.002) | 0.44 (0.22-0.88, p = 0.021) |
|  | 25 - 29.9 | 5972 (99.4%) | 34 (0.6%) | 0.18 (0.09-0.38, p < 0.001) | 0.22 (0.10-0.49, p < 0.001) | 0.19 (0.10-0.42, p < 0.001) | 0.28 (0.13-0.57, p = 0.001) |
|  | ≥ 30.0 | 4359 (99.4%) | 26 (0.6%) | 0.19 (0.10-0.40, p < 0.001) | 0.23 (0.11-0.55, p < 0.001) | 0.23 (0.11-0.50, p < 0.001) | 0.30 (0.14-0.64, p = 0.002) |
| Smoking | Not Current | 11938 (99.2%) | 97 (0.8%) | - | - | - | - |
|  | Current | 3168 (99.4%) | 19 (0.6%) | 0.74 (0.44-1.18, p = 0.228) | 0.81 (0.46-1.37, p = 0.458) | - | - |
| Frailty Score | 1-3 | 15081 (99.5%) | 76 (0.5%) | - | - | - | - |
|  | 4-6 | 2050 (97.6%) | 50 (2.4%) | 4.84 (3.36-6.91, p < 0.001) | 1.82 (1.16-2.83, p = 0.009) | 2.05 (1.34-3.10, p = 0.001) | 1.88 (1.27-2.76, p = 0.001) |
|  | 7-9 | 83 (93.3%) | 6 (6.7%) | 14.34 (5.45-31.31, p < 0.001) | 3.26 (0.88-9.28, p = 0.045) | 4.17 (1.31-10.80, p = 0.007) | 3.32 (1.28-8.66, p = 0.014) |
| Operative Indication | Benign | 9003 (99.6%) | 32 (0.4%) | - | - | - | - |
| Malignant | 8204 (98.8%) | 100 (1.2%) | 3.43 (2.33-5.19, p < 0.001) | 1.70 (1.06-2.80, p = 0.032) | - | - |
| Operative approach | Minimally invasive | 10326 (99.6%) | 39 (0.4%) | - | - | - | - |
| Open | 6890 (98.7%) | 93 (1.3%) | 3.57 (2.48-5.26, p < 0.001) | 2.72 (1.78-4.26, p < 0.001) | 2.66 (1.80-4.01, p < 0.001) | 3.14 (2.13-4.62, p < 0.001) |
| Operative Contamination | Clean | 7737 (99.5%) | 42 (0.5%) | - | - | - | - |
| Clean-Contaminated | 8875 (99.1%) | 83 (0.9%) | 1.72 (1.19-2.52, p = 0.004) | 1.30 (0.83-2.06, p = 0.260) | 1.31 (0.89-1.97, p = 0.179) | 1.41 (0.96-2.06, p = 0.080) |
| Contaminated/Dirty | 578 (98.8%) | 7 (1.2%) | 2.23 (0.91-4.68, p = 0.051) | 0.92 (0.30-2.30, p = 0.875) | 0.82 (0.27-1.98, p = 0.691) | 0.91 (0.39-2.12, p = 0.824) |
| Operative Speciality | Upper GI | 1038 (98.7%) | 14 (1.3%) | - | - | - | - |
| HPB | 5252 (99.1%) | 48 (0.9%) | 0.68 (0.38-1.28, p = 0.203) | 1.49 (0.77-3.09, p = 0.259) | - | - |
| Lower GI | 6264 (99.1%) | 60 (0.9%) | 0.71 (0.41-1.33, p = 0.252) | 1.01 (0.54-2.05, p = 0.968) | - | - |
| Gynaecology | 3058 (99.9%) | 3 (0.1%) | 0.07 (0.02-0.22, p < 0.001) | 0.30 (0.04-1.17, p = 0.125) | - | - |
| Urology | 1606 (99.6%) | 7 (0.4%) | 0.32 (0.12-0.78, p = 0.015) | 0.63 (0.21-1.69, p = 0.373) | - | - |
| Pre-admission anaesthetic assessment clinic | No | 3729 (99.3%) | 27 (0.7%) | - | - | - |  |
| Yes | 13386 (99.2%) | 104 (0.8%) | 1.07 (0.71-1.67, p = 0.745) | 1.03 (0.64-1.75, p = 0.898) | 0.93 (0.61-1.48, p = 0.759) | 0.95 (0.62-1.48, p = 0.833) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S11** Full adjusted logistic regression model for the presence of major complications in patients undergoing elective major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 4017 (96.3) | 153 (3.7) | - | - | - | - |
| 1 | 4869 (92.4) | 401 (7.6) | 2.16 (1.79-2.62, p<0.001) | 1.41 (1.12-1.78, p=0.004) | 1.64 (1.32-2.06, p<0.001) | 1.56 (1.25-1.95, p<0.001) |
| ≥ 2 | 7100 (89.8) | 810 (10.2) | 3.00 (2.52-3.59, p<0.001) | 1.47 (1.16-1.88, p=0.002) | 1.77 (1.42-2.23, p<0.001) | 1.66 (1.32-2.08, p<0.001) |
| Age (years) | 18-40 | 1831 (95.1) | 95 (4.9) | - | - | - | - |
| 41-60 | 5883 (93.9) | 381 (6.1) | 1.25 (1.00-1.58, p=0.060) | 0.93 (0.72-1.21, p=0.584) | 0.94 (0.73-1.22, p=0.639) | 0.94 (0.72-1.21, p=0.621) |
| 61-80 | 7311 (90.7) | 748 (9.3) | 1.97 (1.59-2.47, p<0.001) | 1.03 (0.80-1.35, p=0.809) | 1.08 (0.84-1.41, p=0.545) | 1.10 (0.85-1.43, p=0.479) |
| ≥ 81 | 937 (87.2) | 138 (12.8) | 2.84 (2.16-3.74, p<0.001) | 1.10 (0.79-1.55, p=0.572) | 1.16 (0.83-1.62, p=0.381) | 1.15 (0.82-1.62, p=0.407) |
| Sex | Male | 7056 (89.8) | 804 (10.2) | - | - | - | - |
| Female | 8930 (94.1) | 560 (5.9) | 0.55 (0.49-0.62, p<0.001) | 0.73 (0.63-0.83, p<0.001) | 0.67 (0.59-0.76, p<0.001) | 0.69 (0.60-0.78, p<0.001) |
| ASA | I | 2418 (96.2) | 95 (3.8) | - | - | - | - |
|  | II | 8752 (93.3) | 632 (6.7) | 1.84 (1.48-2.30, p<0.001) | 1.18 (0.92-1.53, p=0.200) | 1.22 (0.95-1.58, p=0.122) | 1.14 (0.88-1.47, p=0.327) |
|  | III | 4578 (88.9) | 570 (11.1) | 3.17 (2.55-3.98, p<0.001) | 1.51 (1.16-1.99, p=0.003) | 1.63 (1.25-2.15, p<0.001) | 1.42 (1.08-1.88, p=0.013) |
|  | IV/V | 235 (78.3) | 65 (21.7) | 7.04 (4.98-9.90, p<0.001) | 2.57 (1.69-3.87, p<0.001) | 2.83 (1.87-4.24, p<0.001) | 2.56 (1.68-3.89, p<0.001) |
| BMI | < 18.5 | 315 (87.0) | 47 (13.0) | - | - | - | - |
|  | 18.5 - 24.9 | 5241 (91.2) | 507 (8.8) | 0.65 (0.48-0.90, p=0.008) | 0.80 (0.56-1.15, p=0.213) | 0.79 (0.56-1.14, p=0.195) | 0.83 (0.58-1.19, p=0.308) |
|  | 25 - 29.9 | 5561 (92.6) | 445 (7.4) | 0.54 (0.39-0.75, p<0.001) | 0.64 (0.45-0.93, p=0.016) | 0.62 (0.44-0.89, p=0.008) | 0.67 (0.47-0.97, p=0.035) |
|  | ≥ 30.0 | 4084 (93.1) | 301 (6.9) | 0.49 (0.36-0.69, p<0.001) | 0.65 (0.46-0.95, p=0.023) | 0.61 (0.43-0.89, p=0.007) | 0.67 (0.46-0.97, p=0.033) |
| Smoking | Not Current | 11074 (92.0) | 961 (8.0) | - | - | - | - |
|  | Current | 2945 (92.4) | 242 (7.6) | 0.95 (0.82-1.09, p=0.466) | 1.00 (0.86-1.17, p=0.957) | 0.99 (0.85-1.16, p=0.907) | 0.99 (0.85-1.16, p=0.905) |
| Frailty Score | 1-3 | 14076 (92.9) | 1081 (7.1) | - | - | - | - |
|  | 4-6 | 1838 (87.5) | 262 (12.5) | 1.86 (1.61-2.14, p<0.001) | 1.24 (1.04-1.47, p=0.017) | 1.23 (1.03-1.46, p=0.019) | 1.28 (1.07-1.53, p=0.006) |
|  | 7-9 | 68 (76.4) | 21 (23.6) | 4.02 (2.40-6.47, p<0.001) | 2.25 (1.22-3.97, p=0.007) | 2.27 (1.23-3.97, p=0.006) | 2.24 (1.23-4.11, p=0.009) |
| Operative Indication | Benign | 8553 (94.7) | 482 (5.3) | - | - | - |  |
| Malignant | 7423 (89.4) | 881 (10.6) | 2.11 (1.88-2.36, p<0.001) | 1.46 (1.26-1.70, p<0.001) | - |  |
| Operative approach | Minimally invasive | 9770 (94.3) | 595 (5.7) | - | - | - | - |
| Open | 6214 (89.0) | 769 (11.0) | 2.03 (1.82-2.27, p<0.001) | 1.79 (1.57-2.03, p<0.001) | 1.84 (1.63-2.09, p<0.001) | 1.95 (1.71-2.22, p<0.001) |
| Operative Contamination | Clean | 7328 (94.2) | 451 (5.8) | - | - | - | - |
| Clean-Contaminated | 8123 (90.7) | 835 (9.3) | 1.67 (1.48-1.88, p<0.001) | 1.41 (1.23-1.63, p<0.001) | 1.48 (1.30-1.69, p<0.001) | 1.51 (1.32-1.74, p<0.001) |
| Contaminated/Dirty | 510 (87.2) | 75 (12.8) | 2.39 (1.83-3.08, p<0.001) | 1.63 (1.20-2.19, p=0.001) | 1.66 (1.22-2.21, p=0.001) | 1.76 (1.30-2.39, p<0.001) |
| Operative Speciality | Upper GI | 883 (83.9) | 169 (16.1) | - | - | - |  |
| HPB | 4860 (91.7) | 440 (8.3) | 0.47 (0.39-0.57, p<0.001) | 0.86 (0.69-1.08, p=0.204) | - |  |
| Lower GI | 5764 (91.1) | 560 (8.9) | 0.51 (0.42-0.61, p<0.001) | 0.64 (0.52-0.79, p<0.001) | - | - |
| Gynaecology | 2961 (96.7) | 100 (3.3) | 0.18 (0.14-0.23, p<0.001) | 0.45 (0.33-0.60, p<0.001) | - | - |
| Urology | 1518 (94.1) | 95 (5.9) | 0.33 (0.25-0.43, p<0.001) | 0.46 (0.34-0.62, p<0.001) | - | - |
| Pre-admission anaesthetic assessment clinic | No | 3496 (93.1) | 260 (6.9) | - | - | - | - |
| Yes | 12395 (91.9) | 1095 (8.1) | 1.19 (1.03-1.37, p=0.016) | 1.14 (0.97-1.34, p=0.120) | 1.14 (0.97-1.34, p=0.110) | 1.16 (0.97-1.40, p=0.108) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S12** Full adjusted logistic regression model for the presence of any complications in patients undergoing elective major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 4017 (96.3%) | 153 (3.7%) | - | - | - | - |
| 1 | 4869 (92.4%) | 401 (7.6%) | 2.16 (1.79-2.62, p < 0.001) | 1.41 (1.12-1.78, p = 0.004) | 1.64 (1.32-2.06, p < 0.001) | 1.56 (1.25-1.95, p < 0.001) |
| ≥ 2 | 7100 (89.8%) | 810 (10.2%) | 3.00 (2.52-3.59, p < 0.001) | 1.47 (1.16-1.88, p = 0.002) | 1.77 (1.42-2.23, p < 0.001) | 1.66 (1.32-2.08, p < 0.001) |
| Age (years) | 18-40 | 1831 (95.1%) | 95 (4.9%) | - | - | - | - |
| 41-60 | 5883 (93.9%) | 381 (6.1%) | 1.25 (1.00-1.58, p = 0.060) | 0.93 (0.72-1.21, p = 0.584) | 0.94 (0.73-1.22, p = 0.639) | 0.94 (0.72-1.21, p = 0.621) |
| 61-80 | 7311 (90.7%) | 748 (9.3%) | 1.97 (1.59-2.47, p p < 0.001) | 1.03 (0.80-1.35, p = 0.809) | 1.08 (0.84-1.41, p = 0.545) | 1.10 (0.85-1.43, p = 0.479) |
| ≥ 81 | 937 (87.2%) | 138 (12.8%) | 2.84 (2.16-3.74, p < 0.001) | 1.10 (0.79-1.55, p = 0.572) | 1.16 (0.83-1.62, p = 0.381) | 1.15 (0.82-1.62, p = 0.407) |
| Sex | Male | 7056 (89.8%) | 804 (10.2%) | - | - | - | - |
| Female | 8930 (94.1%) | 560 (5.9%) | 0.55 (0.49-0.62, p < 0.001) | 0.73 (0.63-0.83, p < 0.001) | 0.67 (0.59-0.76, p < 0.001) | 0.69 (0.60-0.78, p < 0.001) |
| ASA | I | 2418 (96.2%) | 95 (3.8%) | - | - | - | - |
|  | II | 8752 (93.3%) | 632 (6.7%) | 1.84 (1.48-2.30, p < 0.001) | 1.18 (0.92-1.53, p = 0.200) | 1.22 (0.95-1.58, p = 0.122) | 1.14 (0.88-1.47, p = 0.327) |
|  | III | 4578 (88.9%) | 570 (11.1%) | 3.17 (2.55-3.98, p < 0.001) | 1.51 (1.16-1.99, p = 0.003) | 1.63 (1.25-2.15, p < 0.001) | 1.42 (1.08-1.88, p = 0.013) |
|  | IV/V | 235 (78.3%) | 65 (21.7%) | 7.04 (4.98-9.90, p < 0.001) | 2.57 (1.69-3.87, p < 0.001) | 2.83 (1.87-4.24, p < 0.001) | 2.56 (1.68-3.89, p < 0.001) |
| BMI | < 18.5 | 315 (87.0%) | 47 (13.0%) | - | - | - | - |
|  | 18.5 - 24.9 | 5241 (91.2%) | 507 (8.8%) | 0.65 (0.48-0.90, p = 0.008) | 0.80 (0.56-1.15, p = 0.213) | 0.79 (0.56-1.14, p = 0.195) | 0.83 (0.58-1.19, p = 0.308) |
|  | 25 - 29.9 | 5561 (92.6%) | 445 (7.4%) | 0.54 (0.39-0.75, p < 0.001) | 0.64 (0.45-0.93, p = 0.016) | 0.62 (0.44-0.89, p = 0.008) | 0.67 (0.47-0.97, p = 0.035) |
|  | ≥ 30.0 | 4084 (93.1%) | 301 (6.9%) | 0.49 (0.36-0.69, p < 0.001) | 0.65 (0.46-0.95, p = 0.023) | 0.61 (0.43-0.89, p = 0.007) | 0.67 (0.46-0.97, p = 0.033) |
| Smoking | Not Current | 11074 (92.0%) | 961 (8.0%) | - | - | - | - |
|  | Current | 2945 (92.4%) | 242 (7.6%) | 0.95 (0.82-1.09, p = 0.466) | 1.00 (0.86-1.17, p = 0.957) | 0.99 (0.85-1.16, p = 0.907) | 0.99 (0.85-1.16, p = 0.905) |
| Frailty Score | 1-3 | 14076 (92.9%) | 1081 (7.1%) | - | - | - | - |
|  | 4-6 | 1838 (87.5%) | 262 (12.5%) | 1.86 (1.61-2.14, p < 0.001) | 1.24 (1.04-1.47, p = 0.017) | 1.23 (1.03-1.46, p = 0.019) | 1.28 (1.07-1.53, p = 0.006) |
|  | 7-9 | 68 (76.4%) | 21 (23.6%) | 4.02 (2.40-6.47, p < 0.001) | 2.25 (1.22-3.97, p = 0.007) | 2.27 (1.23-3.97, p = 0.006) | 2.24 (1.23-4.11, p = 0.009) |
| Operative Indication | Benign | 8553 (94.7%) | 482 (5.3%) | - | - | - | - |
| Malignant | 7423 (89.4%) | 881 (10.6%) | 2.11 (1.88-2.36, p < 0.001) | 1.46 (1.26-1.70, p < 0.001) | - | - |
| Operative approach | Minimally invasive | 9770 (94.3%) | 595 (5.7%) | - | - | - | - |
| Open | 6214 (89.0%) | 769 (11.0%) | 2.03 (1.82-2.27, p < 0.001) | 1.79 (1.57-2.03, p < 0.001) | 1.84 (1.63-2.09, p < 0.001) | 1.95 (1.71-2.22, p < 0.001) |
| Operative Contamination | Clean | 7328 (94.2%) | 451 (5.8%) | - | - | - | - |
| Clean-Contaminated | 8123 (90.7%) | 835 (9.3%) | 1.67 (1.48-1.88, p < 0.001) | 1.41 (1.23-1.63, p < 0.001) | 1.48 (1.30-1.69, p < 0.001) | 1.51 (1.32-1.74, p < 0.001) |
| Contaminated/Dirty | 510 (87.2%) | 75 (12.8%) | 2.39 (1.83-3.08, p < 0.001) | 1.63 (1.20-2.19, p = 0.001) | 1.66 (1.22-2.21, p = 0.001) | 1.76 (1.30-2.39, p < 0.001) |
| Operative Specialty | Upper GI | 883 (83.9%) | 169 (16.1%) | - | - | - | - |
| HPB | 4860 (91.7%) | 440 (8.3%) | 0.47 (0.39-0.57, p < 0.001) | 0.86 (0.69-1.08, p = 0.204) | - | - |
| Lower GI | 5764 (91.1%) | 560 (8.9%) | 0.51 (0.42-0.61, p < 0.001) | 0.64 (0.52-0.79, p < 0.001) | - | - |
| Gynaecology | 2961 (96.7%) | 100 (3.3%) | 0.18 (0.14-0.23, p < 0.001) | 0.45 (0.33-0.60, p < 0.001) | - | - |
| Urology | 1518 (94.1%) | 95 (5.9%) | 0.33 (0.25-0.43, p < 0.001) | 0.46 (0.34-0.62, p < 0.001) | - | - |
| Pre-admission anaesthetic assessment clinic | No | 3496 (93.1%) | 260 (6.9%) | - | - | - | - |
| Yes | 12395 (91.9%) | 1095 (8.1%) | 1.19 (1.03-1.37, p = 0.016) | 1.14 (0.97-1.34, p = 0.120) | 1.14 (0.97-1.34, p = 0.110) | 1.16 (0.97-1.40, p = 0.108) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S13** Full adjusted logistic regression model for the 30-day mortality in patients undergoing emergency major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 2534 (99.2%) | 21 (0.8%) | - | - | - | - |
| 1 | 1650 (95.7%) | 74 (4.3%) | 5.41 (3.38-9.04, p < 0.001) | 1.90 (0.96-4.00, p = 0.074) | 1.85 (1.04-3.46, p = 0.044) | 1.86 (0.98-3.54, p = 0.058) |
| ≥ 2 | 2325 (90.8%) | 236 (9.2%) | 12.25 (8.01-19.79, p < 0.001) | 1.63 (0.85-3.37, p = 0.160) | 1.93 (1.12-3.54, p = 0.024) | 1.81 (0.98-3.36, p = 0.060) |
| Age (years) | 18-40 | 1673 (99.8%) | 4 (0.2%) | - | - | - | - |
| 41-60 | 1944 (97.4%) | 52 (2.6%) | 11.19 (4.57-37.05, p < 0.001) | 10.43 (2.11-189.28, p = 0.024) | 7.02 (2.09-43.71, p = 0.008) | 13.31 (1.59-111.66, p = 0.017) |
| 61-80 | 2272 (93.0%) | 171 (7.0%) | 31.48 (13.31-102.38, p < 0.001) | 15.23 (3.11-275.75, p = 0.008) | 9.84 (2.97-61.01, p = 0.002) | 19.48 (2.33-162.73, p = 0.006) |
| ≥ 81 | 542 (83.9%) | 104 (16.1%) | 80.25 (33.48-262.86, p < 0.001) | 22.20 (4.36-407.19, p = 0.003) | 16.33 (4.80-102.51, p < 0.001) | 29.26 (3.44-248.87, p = 0.002) |
| Sex | Male | 3395 (95.3%) | 169 (4.7%) | - | - | - | - |
| Female | 3114 (95.1%) | 162 (4.9%) | 1.05 (0.84-1.30, p = 0.696) | 0.94 (0.67-1.32, p = 0.739) | 1.11 (0.85-1.46, p = 0.435) | 1.04 (0.77-1.42, p = 0.778) |
| ASA | I | 1454 (99.7%) | 4 (0.3%) | - | - | - | - |
|  | II | 2556 (98.8%) | 31 (1.2%) | 4.41 (1.74-14.85, p = 0.005) | 1.58 (0.43-10.27, p = 0.550) | 1.50 (0.51-6.44, p = 0.518) | 1.49 (0.40-5.57, p = 0.549) |
|  | III | 2022 (93.4%) | 144 (6.6%) | 25.89 (10.91-84.34, p < 0.001) | 3.40 (0.95-21.83, p = 0.107) | 3.85 (1.34-16.29, p = 0.028) | 3.58 (0.98-13.06, p = 0.053) |
|  | IV/V | 472 (75.6%) | 152 (24.4%) | 117.06 (49.17-382.02, p < 0.001) | 9.68 (2.66-62.60, p = 0.003) | 10.41 (3.58-44.43, p < 0.001) | 10.85 (2.92-40.32, p < 0.001) |
| BMI | < 18.5 | 176 (86.7%) | 27 (13.3%) | - | - | - | - |
|  | 18.5 - 24.9 | 2284 (95.2%) | 116 (4.8%) | 0.33 (0.21-0.53, p < 0.001) | 0.51 (0.29-0.94, p = 0.026) | 0.72 (0.43-1.23, p = 0.222) | 0.60 (0.34-1.08, p = 0.090) |
|  | 25 - 29.9 | 1878 (95.8%) | 82 (4.2%) | 0.28 (0.18-0.46, p < 0.001) | 0.38 (0.21-0.72, p = 0.002) | 0.58 (0.34-1.01, p = 0.048) | 0.48 (0.26-0.87, p = 0.017) |
|  | ≥ 30.0 | 1253 (95.3%) | 62 (4.7%) | 0.32 (0.20-0.53, p < 0.001) | 0.43 (0.23-0.83, p = 0.010) | 0.68 (0.39-1.20, p = 0.171) | 0.58 (0.31-1.08, p = 0.084) |
| Smoking | Not Current | 3963 (95.5%) | 185 (4.5%) | - | - | - | - |
|  | Current | 1249 (95.9%) | 54 (4.1%) | 0.93 (0.67-1.25, p = 0.627) | 1.38 (0.93-2.03, p = 0.108) | - | - |
| Frailty Score | 1-3 | 5356 (97.6%) | 132 (2.4%) | - | - | - | - |
|  | 4-6 | 1033 (87.8%) | 143 (12.2%) | 5.62 (4.39-7.19, p < 0.001) | 2.00 (1.37-2.92, p < 0.001) | 1.50 (1.10-2.03, p = 0.010) | 1.59 (1.12-2.26, p = 0.010) |
|  | 7-9 | 118 (67.8%) | 56 (32.2%) | 19.26 (13.35-27.57, p < 0.001) | 5.71 (3.26-9.94, p < 0.001) | 4.08 (2.58-6.42, p < 0.001) | 4.70 (2.79-7.93, p < 0.001) |
| Operative Indication | Benign | 5113 (95.6%) | 236 (4.4%) | - | - | - | - |
| Malignant | 1394 (93.6%) | 95 (6.4%) | 1.48 (1.15-1.88, p = 0.002) | 1.34 (0.92-1.94, p = 0.125) | - | - |
| Operative approach | Minimally invasive | 3488 (99.0%) | 35 (1.0%) | - | - | - | - |
| Open | 3020 (91.1%) | 296 (8.9%) | 9.77 (6.96-14.15, p < 0.001) | 2.83 (1.74-4.82, p < 0.001) | 3.76 (2.53-5.79, p < 0.001) | 3.37 (2.11-5.40, p < 0.001) |
| Operative Contamination | Clean | 2164 (97.5%) | 56 (2.5%) | - | - | - | - |
| Clean-Contaminated | 3172 (96.2%) | 126 (3.8%) | 1.53 (1.12-2.13, p = 0.009) | 1.30 (0.80-2.14, p = 0.299) | 1.32 (0.90-1.95, p = 0.156) | 1.16 (0.74-1.82, p = 0.518) |
| Contaminated/Dirty | 1169 (88.7%) | 149 (11.3%) | 4.93 (3.62-6.80, p < 0.001) | 2.57 (1.61-4.22, p < 0.001) | 2.77 (1.89-4.12, p < 0.001) | 2.55 (1.63-3.99, p < 0.001) |
| Operative Speciality | Upper GI | 569 (89.6%) | 66 (10.4%) | - | - | - | - |
| HPB | 1651 (96.5%) | 60 (3.5%) | 0.31 (0.22-0.45, p < 0.001) | 1.13 (0.64-2.02, p = 0.679) | 0.78 (0.50-1.23, p = 0.284) | 0.87 (0.51-1.47, p = 0.596) |
| Lower GI | 3754 (94.9%) | 201 (5.1%) | 0.46 (0.35-0.62, p < 0.001) | 1.29 (0.82-2.08, p = 0.276) | 1.00 (0.70-1.43, p = 0.980) | 1.07 (0.72-1.59, p = 0.742) |
| Gynaecology | 354 (99.2%) | 3 (0.8%) | 0.07 (0.02-0.20, p < 0.001) | 0.62 (0.03-3.68, p = 0.660) | 0.31 (0.05-1.09, p = 0.121) | 0.60 (0.06-5.76, p = 0.657) |
| Urology | 181 (99.5%) | 1 (0.5%) | 0.05 (0.00-0.22, p = 0.003) | 0.00 (0.00-0.00, p = 0.969) | 0.00 (0.00-0.00, p = 0.973) | 0.00 (0.00-Inf, p = 0.985) |
| Inpatient perioperative or elderly medicine assessment | No | 2267 (94.4%) | 134 (5.6%) | - | - | - | - |
| Yes | 2907 (94.5%) | 170 (5.5%) | 0.99 (0.78-1.25, p = 0.928) | 0.87 (0.63-1.21, p = 0.399) | - | 1.05 (0.76-1.46, p = 0.765) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S14** Full adjusted logistic regression model for the presence of major complications in patients undergoing emergency major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 2405 (94.1%) | 150 (5.9%) | - | - | - | - |
| 1 | 1475 (85.6%) | 249 (14.4%) | 2.71 (2.19-3.35, p < 0.001) | 1.42 (1.03-1.98, p = 0.035) | 1.47 (1.07-2.04, p = 0.019) | 1.46 (1.05-2.03, p = 0.024) |
| ≥ 2 | 1921 (75.0%) | 640 (25.0%) | 5.34 (4.44-6.46, p < 0.001) | 1.87 (1.35-2.60, p < 0.001) | 1.93 (1.40-2.68, p < 0.001) | 1.87 (1.34-2.61, p < 0.001) |
| Age (years) | 18-40 | 1587 (94.6%) | 90 (5.4%) | - | - | - | - |
| 41-60 | 1730 (86.7%) | 266 (13.3%) | 2.71 (2.12-3.49, p < 0.001) | 1.23 (0.85-1.79, p = 0.270) | 1.26 (0.87-1.83, p = 0.220) | 1.20 (0.82-1.74, p = 0.347) |
| 61-80 | 1929 (79.0%) | 514 (21.0%) | 4.70 (3.74-5.97, p < 0.001) | 1.28 (0.87-1.88, p = 0.212) | 1.31 (0.90-1.93, p = 0.162) | 1.24 (0.84-1.83, p = 0.280) |
| ≥ 81 | 477 (73.8%) | 169 (26.2%) | 6.25 (4.76-8.26, p < 0.001) | 0.96 (0.60-1.54, p = 0.865) | 0.99 (0.62-1.59, p = 0.967) | 0.92 (0.57-1.50, p = 0.753) |
| Sex | Male | 2987 (83.8%) | 577 (16.2%) | - | - | - | - |
| Female | 2814 (85.9%) | 462 (14.1%) | 0.85 (0.74-0.97, p = 0.016) | 1.01 (0.83-1.24, p = 0.910) | 1.00 (0.82-1.23, p = 0.981) | 0.98 (0.80-1.21, p = 0.859) |
| ASA | I | 1399 (96.0%) | 59 (4.0%) | - | - | - | - |
|  | II | 2349 (90.8%) | 238 (9.2%) | 2.40 (1.81-3.25, p < 0.001) | 1.14 (0.76-1.75, p = 0.539) | 1.15 (0.76-1.76, p = 0.519) | 1.13 (0.74-1.72, p = 0.578) |
|  | III | 1706 (78.8%) | 460 (21.2%) | 6.39 (4.87-8.54, p < 0.001) | 1.53 (0.99-2.41, p = 0.059) | 1.54 (1.00-2.42, p = 0.055) | 1.51 (0.96-2.37, p = 0.076) |
|  | IV/V | 344 (55.1%) | 280 (44.9%) | 19.30 (14.33-26.38, p < 0.001) | 3.33 (2.07-5.44, p < 0.001) | 3.33 (2.07-5.44, p < 0.001) | 3.40 (2.05-5.63, p < 0.001) |
| BMI | < 18.5 | 150 (73.9%) | 53 (26.1%) | - | - | - | - |
|  | 18.5 - 24.9 | 2063 (86.0%) | 337 (14.0%) | 0.46 (0.33-0.65, p < 0.001) | 0.77 (0.49-1.22, p = 0.255) | 0.77 (0.49-1.22, p = 0.255) | 0.77 (0.48-1.24, p = 0.288) |
|  | 25 - 29.9 | 1668 (85.1%) | 292 (14.9%) | 0.50 (0.36-0.70, p < 0.001) | 0.73 (0.46-1.17, p = 0.184) | 0.72 (0.46-1.16, p = 0.173) | 0.73 (0.45-1.18, p = 0.199) |
|  | ≥ 30.0 | 1088 (82.7%) | 227 (17.3%) | 0.59 (0.42-0.84, p = 0.003) | 0.91 (0.56-1.47, p = 0.686) | 0.88 (0.55-1.43, p = 0.608) | 0.92 (0.56-1.51, p = 0.744) |
| Smoking | Not Current | 3527 (85.0%) | 621 (15.0%) | - | - | - | - |
|  | Current | 1113 (85.4%) | 190 (14.6%) | 0.97 (0.81-1.15, p = 0.730) | 1.18 (0.93-1.48, p = 0.168) | 1.17 (0.92-1.47, p = 0.197) | 1.15 (0.90-1.45, p = 0.264) |
| Frailty Score | 1-3 | 4868 (88.7%) | 620 (11.3%) | - | - | - | - |
|  | 4-6 | 848 (72.1%) | 328 (27.9%) | 3.04 (2.61-3.54, p < 0.001) | 1.52 (1.19-1.93, p = 0.001) | 1.51 (1.19-1.93, p = 0.001) | 1.62 (1.26-2.08, p < 0.001) |
|  | 7-9 | 84 (48.3%) | 90 (51.7%) | 8.41 (6.18-11.47, p < 0.001) | 3.99 (2.50-6.40, p < 0.001) | 3.98 (2.49-6.38, p < 0.001) | 4.18 (2.54-6.88, p < 0.001) |
| Operative Indication | Benign | 4598 (86.0%) | 751 (14.0%) | - | - | - | - |
| Malignant | 1201 (80.7%) | 288 (19.3%) | 1.47 (1.26-1.70, p < 0.001) | 1.22 (0.94-1.57, p = 0.129) | - | - |
| Operative approach | Minimally invasive | 3312 (94.0%) | 211 (6.0%) | - | - | - | - |
| Open | 2488 (75.0%) | 828 (25.0%) | 5.22 (4.46-6.14, p < 0.001) | 2.57 (2.01-3.29, p < 0.001) | 2.60 (2.04-3.34, p < 0.001) | 2.77 (2.14-3.59, p < 0.001) |
| Operative Contamination | Clean | 1986 (89.5%) | 234 (10.5%) | - | - | - | - |
| Clean-Contaminated | 2867 (86.9%) | 431 (13.1%) | 1.28 (1.08-1.51, p = 0.005) | 1.21 (0.93-1.58, p = 0.160) | 1.22 (0.94-1.60, p = 0.132) | 1.25 (0.95-1.65, p = 0.117) |
| Contaminated/Dirty | 944 (71.6%) | 374 (28.4%) | 3.36 (2.81-4.03, p < 0.001) | 2.56 (1.94-3.39, p < 0.001) | 2.56 (1.94-3.39, p < 0.001) | 2.70 (2.00-3.64, p < 0.001) |
| Operative Specialty | Upper GI | 450 (70.9%) | 185 (29.1%) | - | - | - | - |
| HPB | 1432 (83.7%) | 279 (16.3%) | 0.47 (0.38-0.59, p < 0.001) | 1.24 (0.88-1.75, p = 0.215) | 1.23 (0.88-1.74, p = 0.235) | 1.20 (0.84-1.72, p = 0.326) |
| Lower GI | 3404 (86.1%) | 551 (13.9%) | 0.39 (0.32-0.48, p < 0.001) | 0.86 (0.64-1.16, p = 0.315) | 0.89 (0.66-1.19, p = 0.425) | 0.93 (0.69-1.25, p = 0.624) |
| Gynaecology | 345 (96.6%) | 12 (3.4%) | 0.08 (0.04-0.15, p < 0.001) | 0.17 (0.03-0.60, p = 0.019) | 0.18 (0.03-0.64, p = 0.024) | 0.19 (0.04-0.81, p = 0.025) |
| Urology | 170 (93.4%) | 12 (6.6%) | 0.17 (0.09-0.30, p < 0.001) | 0.38 (0.05-1.85, p = 0.274) | 0.39 (0.05-1.91, p = 0.288) | 0.35 (0.06-2.08, p = 0.249) |
| Inpatient perioperative or elderly medicine assessment | No | 2026 (84.4%) | 375 (15.6%) | - | - | - | - |
| Yes | 2594 (84.3%) | 483 (15.7%) | 1.01 (0.87-1.17, p = 0.937) | 0.97 (0.80-1.19, p = 0.790) | 0.98 (0.80-1.20, p = 0.844) | 1.10 (0.88-1.37, p = 0.411) |

GI, gastrointestinal; HPB, hepatobiliary

## **Table S15** Full adjusted logistic regression model for the presence of any complications in patients undergoing emergency major abdominal surgery.

|  |  | No | Yes | OR (univariable) | OR (multivariable full) | OR (multivariable reduced) | OR (multilevel) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of long-term health conditions | 0 | 1813 (71.0%) | 742 (29.0%) | - | - | - | - |
| 1 | 927 (53.8%) | 797 (46.2%) | 2.10 (1.85-2.39, p < 0.001) | 1.26 (1.03-1.56, p = 0.028) | 1.30 (1.06-1.59, p = 0.013) | 1.32 (1.05-1.66, p = 0.018) |
| ≥2 | 969 (37.8%) | 1592 (62.2%) | 4.01 (3.57-4.51, p < 0.001) | 1.58 (1.26-1.98, p < 0.001) | 1.62 (1.30-2.03, p < 0.001) | 1.56 (1.21-2.01, p = 0.001) |
| Age (years) | 18-40 | 1234 (73.6%) | 443 (26.4%) | - | - | - | - |
| 41-60 | 1103 (55.3%) | 893 (44.7%) | 2.26 (1.96-2.60, p < 0.001) | 1.15 (0.93-1.44, p = 0.203) | 1.18 (0.95-1.47, p = 0.141) | 1.26 (0.99-1.61, p = 0.059) |
| 61-80 | 1073 (43.9%) | 1370 (56.1%) | 3.56 (3.11-4.07, p < 0.001) | 1.14 (0.90-1.46, p = 0.275) | 1.17 (0.92-1.49, p = 0.201) | 1.29 (0.99-1.70, p = 0.063) |
| ≥ 81 | 236 (36.5%) | 410 (63.5%) | 4.84 (3.99-5.88, p < 0.001) | 1.24 (0.88-1.74, p = 0.224) | 1.27 (0.91-1.79, p = 0.164) | 1.49 (1.01-2.19, p = 0.042) |
| Sex | Male | 1884 (52.9%) | 1680 (47.1%) | - | - | - | - |
| Female | 1825 (55.7%) | 1451 (44.3%) | 0.89 (0.81-0.98, p = 0.018) | 1.00 (0.86-1.16, p = 0.966) | 0.99 (0.85-1.16, p = 0.933) | 1.01 (0.86-1.20, p = 0.867) |
| ASA | I | 1129 (77.4%) | 329 (22.6%) | - | - | - | - |
|  | II | 1550 (59.9%) | 1037 (40.1%) | 2.30 (1.99-2.66, p < 0.001) | 1.47 (1.17-1.84, p = 0.001) | 1.48 (1.18-1.86, p = 0.001) | 1.34 (1.04-1.73, p = 0.024) |
|  | III | 871 (40.2%) | 1295 (59.8%) | 5.10 (4.40-5.93, p < 0.001) | 1.99 (1.52-2.60, p < 0.001) | 2.00 (1.53-2.62, p < 0.001) | 2.02 (1.49-2.74, p < 0.001) |
|  | IV/V | 157 (25.2%) | 467 (74.8%) | 10.21 (8.22-12.73, p < 0.001) | 3.26 (2.27-4.71, p < 0.001) | 3.28 (2.28-4.73, p < 0.001) | 4.03 (2.64-6.15, p < 0.001) |
| BMI | < 18.5 | 88 (43.3%) | 115 (56.7%) | - | - | - | - |
|  | 18.5 - 24.9 | 1310 (54.6%) | 1090 (45.4%) | 0.64 (0.48-0.85, p = 0.002) | 1.00 (0.66-1.51, p = 0.986) | 1.01 (0.67-1.52, p = 0.968) | 1.04 (0.66-1.64, p = 0.871) |
|  | 25 - 29.9 | 1059 (54.0%) | 901 (46.0%) | 0.65 (0.49-0.87, p = 0.004) | 0.92 (0.60-1.38, p = 0.678) | 0.91 (0.60-1.38, p = 0.663) | 0.99 (0.62-1.57, p = 0.953) |
|  | ≥ 30.0 | 684 (52.0%) | 631 (48.0%) | 0.71 (0.52-0.95, p = 0.022) | 0.95 (0.62-1.45, p = 0.821) | 0.94 (0.61-1.43, p = 0.759) | 0.97 (0.60-1.56, p = 0.900) |
| Smoking | Not Current | 2225 (53.6%) | 1923 (46.4%) | - | - | - | - |
|  | Current | 727 (55.8%) | 576 (44.2%) | 0.92 (0.81-1.04, p = 0.173) | 0.97 (0.82-1.16, p = 0.749) | 0.96 (0.81-1.15, p = 0.678) | 0.98 (0.81-1.19, p = 0.849) |
| Frailty Score | 1-3 | 3267 (59.5%) | 2221 (40.5%) | - | - | - | - |
|  | 4-6 | 397 (33.8%) | 779 (66.2%) | 2.89 (2.53-3.30, p < 0.001) | 1.11 (0.89-1.38, p = 0.349) | 1.11 (0.89-1.38, p = 0.346) | 1.30 (1.01-1.66, p = 0.039) |
|  | 7-9 | 45 (25.9%) | 129 (74.1%) | 4.22 (3.02-6.00, p < 0.001) | 1.46 (0.89-2.44, p = 0.140) | 1.46 (0.89-2.45, p = 0.140) | 1.71 (0.98-2.99, p = 0.061) |
| Operative Indication | Benign | 3073 (57.4%) | 2276 (42.6%) | - | - | - | - |
| Malignant | 635 (42.6%) | 854 (57.4%) | 1.82 (1.62-2.04, p < 0.001) | 1.20 (0.97-1.50, p = 0.098) | - | - |
| Operative approach | Minimally invasive | 2461 (69.9%) | 1062 (30.1%) | - | - | - | - |
| Open | 1247 (37.6%) | 2069 (62.4%) | 3.84 (3.48-4.25, p < 0.001) | 2.83 (2.40-3.32, p < 0.001) | 2.87 (2.45-3.37, p < 0.001) | 2.72 (2.24-3.30, p < 0.001) |
| Operative Contamination | Clean | 1365 (61.5%) | 855 (38.5%) | - | - | - | - |
| Clean-Contaminated | 1849 (56.1%) | 1449 (43.9%) | 1.25 (1.12-1.40, p < 0.001) | 1.10 (0.92-1.31, p = 0.308) | 1.11 (0.93-1.33, p = 0.249) | 1.19 (0.96-1.48, p = 0.111) |
| Contaminated/Dirty | 492 (37.3%) | 826 (62.7%) | 2.68 (2.33-3.09, p < 0.001) | 2.05 (1.66-2.54, p < 0.001) | 2.04 (1.65-2.53, p < 0.001) | 2.45 (1.90-3.16, p < 0.001) |
| Operative Specialty | Upper GI | 224 (35.3%) | 411 (64.7%) | - | - | - | - |
| HPB | 908 (53.1%) | 803 (46.9%) | 0.48 (0.40-0.58, p < 0.001) | 1.10 (0.82-1.47, p = 0.521) | 1.09 (0.82-1.46, p = 0.545) | 0.87 (0.62-1.21, p = 0.406) |
| Lower GI | 2205 (55.8%) | 1750 (44.2%) | 0.43 (0.36-0.51, p < 0.001) | 0.87 (0.67-1.12, p = 0.280) | 0.89 (0.69-1.15, p = 0.377) | 0.84 (0.63-1.11, p = 0.226) |
| Gynaecology | 268 (75.1%) | 89 (24.9%) | 0.18 (0.13-0.24, p < 0.001) | 0.24 (0.12-0.44, p < 0.001) | 0.25 (0.13-0.45, p < 0.001) | 0.18 (0.09-0.35, p < 0.001) |
| Urology | 104 (57.1%) | 78 (42.9%) | 0.41 (0.29-0.57, p < 0.001) | 0.83 (0.23-3.18, p = 0.771) | 0.87 (0.24-3.36, p = 0.832) | 0.68 (0.17-2.68, p = 0.585) |
| Inpatient perioperative or elderly medicine assessment | No | 1341 (55.9%) | 1060 (44.1%) | - | - | - | - |
| Yes | 1649 (53.6%) | 1428 (46.4%) | 1.10 (0.98-1.22, p = 0.095) | 1.04 (0.89-1.21, p = 0.626) | 1.04 (0.90-1.21, p = 0.595) | 1.14 (0.94-1.37, p = 0.188) |

GI, gastrointestinal; HPB, hepatobiliary