# Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Days Alive and at Home after Surgery

**Proposed Method of Calculation of "Days at Home within 30 days of Surgery" (DAH$_{30}$)**

DAH$_{30}$ is a composite measure incorporating hospital length of stay in the hospital following the index surgery, re-admission to either the index or any other hospital, and including post-acute hospital discharge to a rehabilitation centre/hospital or other nursing facility, and early deaths after surgery, into a single outcome metric.

DAH$_{30}$ is a numerical outcome measure that provides greater statistical power to detect clinically important differences in outcome. It is likely that a 0.5 day difference would be clinically important and valued by most people. A hospital bed day has been costed at £400 by the NHS in the UK, and $1800 in the US. It has the potential to increase the available hospital beds by about 8%.

By its very nature, DAH$_{30}$ will be left-skewed with a spike at 0 (reflecting in-hospital deaths and those still admitted to hospital or other nursing facility at 30 days after surgery).

DAH$_{30}$ is calculated using mortality and hospitalisation data from the date of the index surgery (= Day 0). For example, if a patient died on day 2 after their surgery whilst still an inpatient, they would be assigned 0 DAH$_{30}$; if a patient was discharged from hospital on Day 6 after surgery but was subsequently readmitted for 4 days before their second hospital discharge, then they would be assigned 20 DAH$_{30}$. If a patient has complications and spends 16 days in hospital, and then is transferred to a nursing facility for rehabilitation, and spend 24 days there before finally being discharged to their own home, they would be assigned 0 DAH$_{30}$. (30-16-24 = -10, but the minimum value of DAH$_{30}$ should be zero*).

Patients having a planned re-admission (eg. removal of a stent or secondary closure of a fistula) within 30 days of surgery should have these days subtracted from the total DAH$_{30}$. That is, if a patient is discharged from hospital on Day 13, and is electively re-admitted two weeks later (Day 27) for a further 2 days, their DAH$_{30}$ will be calculated as 30-13-2 (=15).

**Important:** If a patient dies within 30 days of surgery, irrespective of whether they have spent some time at home, DAH$_{30}$ should be scored as zero (0).

*an alternative would be to use DAH$_{90}$ (up to 90 days after surgery) as an outcome metric in circumstances where a longer postoperative recovery is expected.

**Table S1. Trial Data Sources**

| Trial | N | Reference |
|---|---|---|
| 1. Tranexamic acid in coronary artery surgery | 613 | N Engl J Med 2016; Oct |
| 2. The safety of addition of nitrous oxide to general anaesthesia in at-risk patients having major non-cardiac surgery (ENIGMA-II): a randomised, single-blind trial | 516 | Lancet 2014; 384:1446-54. |
| 3. An enhanced recovery after surgery (ERAS) program for hip and knee arthroplasty | 310 | Med J Aust 2015; 202:363-8. |
| 4. Experience of an enhanced recovery after surgery (ERAS) program for elective abdominal surgery | 71 | Anaesth Intensive Care 2012; 40:450-9. |
| 5. The measurement of disability-free survival after surgery | 163 | Anesthesiology 2015; 122:524-36. |
| 6. Perioperative management of patients treated with angiotensin converting enzyme inhibitors and angiotensin II receptor blockers: a quality improvement audit | 263 | Anaesth Intensive Care 2016; 44:346-52. |
| 7. Restrictive versus liberal fluid therapy in major abdominal surgery | 173 | ClinicalTrials.gov NCT01424150 |

**Figure S1.** The impact of the quantile (50th – 75th percentile) choice for days at home up to 30 days (here, DAAH30) on the associations of patient age category, ASA physical status and surgical duration, demonstrating the covariates are reasonably stable over this range.
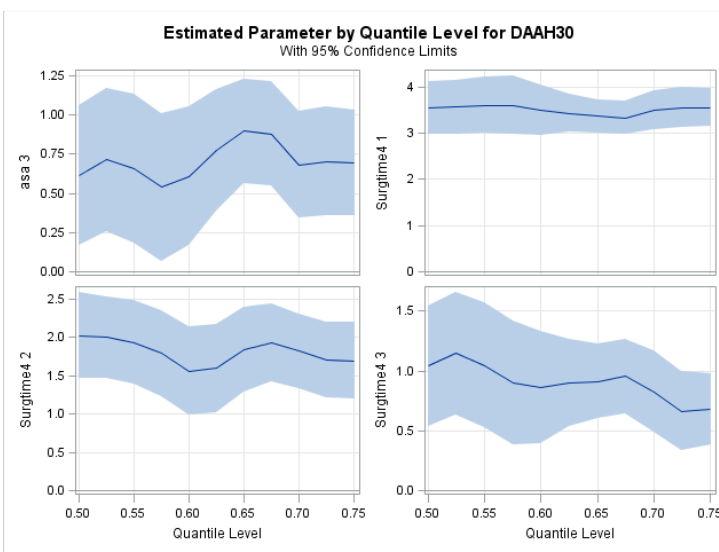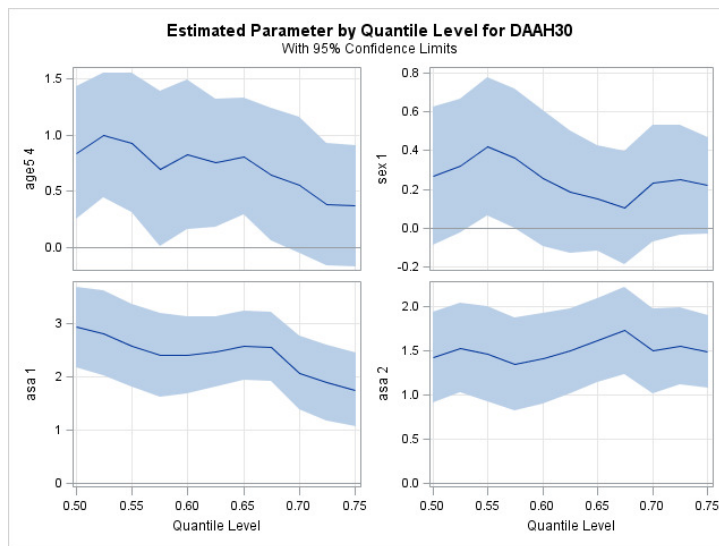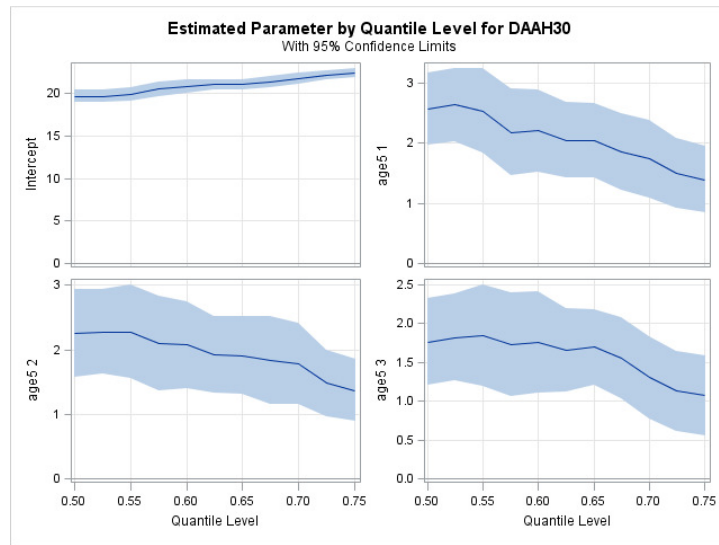
**Table S2. Third Quartile (Q3) Days at Home up to 30 Days after Surgery (DAH$_{30}$) According to Patient and Perioperative Characteristics.#**

| Variable | no. (%) | Raw Q3 DAH$_{30}$ (95% CI) | P value | Adjusted Q3 DAH$_{30}$ (95% CI)* | P-value |
|---|---|---|---|---|---|
| Patient age | | | | | |
|   <50 years | 220 (11) | 27.2 ( 26.5 , 27.9 ) | <.0001 | 26.1 ( 25.8 , 26.5 ) | <0.0001 |
|   50-60 years | 396 (19) | 25.9 ( 25.5 , 26.4 ) | | 26.1 ( 25.9 , 26.4 ) | |
|   60-70 years | 612 (29) | 25.7 ( 25.0 , 26.4 ) | | 25.8 ( 25.6 , 26.1 ) | |
|   70-80 years | 653 (31) | 25.0 ( 24.6 , 25.4 ) | | 25.1 ( 24.8 , 25.4 ) | |
|   ≥80 years | 228 (11) | 24.8 ( 24.3 , 25.3 ) | | 24.7 ( 24.1 , 25.4 ) | |
| | | | | | |
| Sex | | | | | |
|   Male | 1427 (68) | 25.1 ( 24.8 , 25.4 ) | <.0001 | 25.6 ( 25.5 , 25.8 ) | 0.146 |
|   Female | 682 (32) | 26.2 ( 25.6 , 26.8 ) | | 25.4 ( 25.2 , 25.7 ) | |
| | | | | | |
| Smoker | | | | | |
|   yes | 787 (37) | 25.0 ( 24.8 , 25.1 ) | <.0001 | not done | |
|   no | 1322 (63) | 26.0 ( 25.7 , 26.2 ) | | not done | |
| | | | | | |
| Diabetes | | | | | |
|   yes | 697 (33) | 25.8 ( 25.1 , 26.5 ) | >.99 | not done | |
|   no | 1412 (67) | 25.8 ( 25.6 , 26.0 ) | | not done | |
| | | | | | |
| Heart failure | | | | | |
|   yes | 365 (17) | 25.9 ( 25.2 , 26.7 ) | 0.39 | not done | |
|   no | 1744 (83) | 25.8 ( 25.4 , 26.2 ) | | not done | |
| | | | | | |
| ASA physical status | | | | | |
|   1 | 41 (1.9) | 29.0 ( 28.8 , 29.3 ) | <.0001 | 26.6 ( 26.0 , 27.2 ) | <0.0001 |
|   2 | 530 (25) | 27.0 ( 26.9 , 27.1 ) | | 26.3 ( 26.0 , 26.6 ) | |
|   3 | 1024 (51) | 25.8 ( 25.3 , 26.3 ) | | 25.5 ( 25.3 , 25.8 ) | |
|   4 | 510 (24) | 23.9 ( 23.8 , 24.0 ) | | 24.8 ( 24.5 , 25.1 ) | |
| | | | | | |
| Duration of Surgery, h | | | | | |
|   <2.0 | 581 (29) | 28.1 ( 27.7 , 28.6 ) | <.0001 | 27.6 ( 27.3 , 28.0 ) | <0.0001 |
|   2.0-2.99 | 412 (20) | 26.1 ( 25.6 , 26.5 ) | | 25.8 ( 25.4 , 26.2 ) | |
|   3.0-3.99 | 551 (26) | 24.8 ( 24.7 , 24.9 ) | | 24.8 ( 24.5 , 25.0 ) | |
|   ≥4.0 | 565 (27) | 23.9 ( 23.8 , 23.9 ) | | 24.1 ( 23.8 , 24.4 ) | |

**#** The effect of the different covariates were largely consistent across a large range of meaningful percentile values (e.g. 50th – 75th) with a slightly smaller effect for age categories as the percentile gets higher but for simplicity we only present the results for Q3 (75th percentile). This percentile is also close to the main mode of the distribution.

**\*** covariates including in the multivariable adjustment were: patient age, sex, American Society of Anesthesiologists (ASA) physical status and duration of surgery

**Table S3. Third Quartile (Q3) (95% CI) Days at Home up to 30 Days after Surgery According to Postoperative Complications.**

| Variable (no. [%]) | No. with complete data | Yes | No | P value[a] |
|---|---|---|---|---|
| Myocardial infarction (120 [6.5]) | 1846 | 22.9 (22.2 - 23.5) | 25.8 (25.4 - 26.2) | <0.0001 |
| Stroke (13 [0.7]) | 1846 | 18.9 (10.0 - 27.8) | 25.2 (24.6 - 25.7) | 0.019 |
| Pulmonary embolism (7 [0.4]) | 1846 | 23.1 (16.1 - 30.1) | 25.2 (24.6 - 25.7) | 0.19 |
| Cardiac arrest (3 [0.2]) | 1846 | 20.1 (8.0 - 32.1) | 25.2 (24.6 - 25.7) | 0.052 |
| Surgical site infection (129 [7.0]) | 1846 | 24.8 (23.7 - 26.0) | 25.3 (24.7 - 25.9) | <0.0001 |
| Any of the above (263 [14.2]) | 1846 | 23.7 (23.0 - 24.5) | 25.8 (25.6 - 26.1) | <0.0001 |
| Hospital readmission (150 [7.1]) | 2090 | 21.7 (20.8 - 22.7) | 25.9 (25.8 - 26.0) | <0.0001 |

[a] P values calculated using likelihood ratio test.

**Table S4. Days at Home up to 30 Days after Surgery (DAH$_{30\text{-rehab}}$), Assuming 5 Days' Admission to a Rehabilitation Facility if it Occurred, According to Types of Surgery.**

| Surgery | No. admitted to a rehabilitation hospital (%) | Mean (95% CI) DAH$_{30\text{-rehab}}$ |
|---|---|---|
| Cardiac (n=679) | 54 (8.0) | 22.8 (22.7-22.9) |
| Orthopaedic (n=289) | 122 (42) | 21.9 (21.2-22.6) |
| Neurosurgery (n=220) | 9 (4.0) | 22.8 (22.2-23.5) |
| Colorectal (n=118) | 8 (6.8) | 24.9 (24.1-25.8) |
| Urology (n=315) | 26 (8.3) | 23.8 (23.0-24.5) |
| Vascular (n=56) | 1 (1.8) | 26.0 (24.4-27.6) |
| Ear, nose, throat (n=99) | 17 (17) | 25.8 (24.3-27.3) |
| Oesophagogastric/hepatobiliary (n=253) | 4 (1.6) | 24.9 (23.8-26.1) |
| Thoracic (n=28) | 2 (7.1) | 22.8 (17.9-27.8) |
| Other (n=52) | 2 (3.8) | 28.8 (27.7-30.0) |

**Table S5. Days at Home up to 30 Days after Surgery (DAH$_{30}$), Assuming 5 Days' Admission to a Rehabilitation Facility if it Occurred, According to Patient and Perioperative Characteristics.∞**

| Variable | no. (%) | Raw median DAH$_{30\text{-rahab}}$ (95% CI) | P value | Adjusted median DAH$_{30\text{-rehab}}$ (95% CI)* | P value# |
|---|---|---|---|---|---|
| Patient age | | | <0.0001 | | <0.0001 |
| <50 years | 220 (11) | 24.9 (24.5 - 25.2) | | 24.6 (24.2 - 25.1) | |
| 50-60 years | 396 (19) | 23.9 (23.5 - 24.3) | | 24.5 (24.0 - 25.0) | |
| 60-70 years | 612 (29) | 23.8 (23.5 - 24.1) | | 23.6 ( 23.2 - 24.0) | |
| 70-80 years | 653 (31) | 22.0 (21.5 - 22.4) | | 22.5 (21.9 - 23.1) | |
| ≥80 years | 228 (11) | 20.9 (19.6 - 22.2) | | 21.4 (20.4 - 22.4) | |
| | | | | | |
| Sex | | | 0.90 | | 0.0052 |
| male | 1427 (68) | 23.0 (22.6 - 23.4) | | 23.6 (23.3 - 23.9) | |
| female | 682 (32) | 23.0 (22.4 - 23.6) | | 22.7 (22.2 - 23.3) | |
| | | | | | |
| Smoker | | | >0.99 | | |
| yes | 787 (37) | 23.0 (22.5 - 23.5) | | | |
| no | 1322 (63) | 23.0 (22.6 - 23.4) | | | |
| | | | | | |
| Diabetes | | | 0.091 | | |
| yes | 697 (33) | 22.8 (22.6 - 23.1) | | | |
| no | 1412 (67) | 23.2 (22.6 - 23.8) | | | |
| | | | | | |
| Heart failure | | | 0.16 | | |
| yes | 365 (17) | 22.8 (22.3 - 23.3) | | | |
| no | 1744 (83) | 23.1 (22.6 - 23.7) | | | |
| | | | | | |
| ASA physical status | | | | | |
| 1 | 41 (1.9) | 27.9 (26.1 - 29.7) | | 25.3 (24.3 - 26.3) | <0.0001 |
| 2 | 530 (25) | 24.9 (24.6 - 25.1) | <0.0001 | 24.0 (23.6 - 24.5) | |
| 3 | 1024 (51) | 22.9 (22.7 - 23.1) | | 23.1 (22.7 - 23.5) | |
| 4 | 510 (24) | 21.9 (21.5 - 22.3) | | 22.9 (22.4 - 23.4) | |
| | | | | | |
| Duration of Surgery, h | | | <0.0001 | | <0.0001 |
| <2.0 | 581 (29) | 25.8 (25.1 - 26.4) | | 25.4 (24.9 - 26.0) | |
| 2.0-2.99 | 412 (20) | 23.8 (23.3 - 24.3) | | 23.6 (23.2 - 24.0) | |
| 3.0-3.99 | 551 (26) | 22.8 (22.7 - 23.0) | | 22.7 (22.3 - 23.1) | |
| ≥4.0 | 565 (27) | 21.8 (21.0 - 22.5) | | 21.6 (20.9 - 22.2) | |

*covariates including in the multivariable adjustment were: patient age, sex, American Society of Anesthesiologists (ASA) physical status and duration of surgery

#P values calculated using the quasi-likelihood ratio test.

∞ If a patient has spent less than 5 days at home and went to rehab, DAH$_{30\text{-rehab}}$ is set to 0 to avoid negative values.

**Table S6. Median (95% CI) Days at Home up to 30 Days after Surgery, Assuming 5 Days' Admission to a Rehabilitation Facility if it Occurred, According to Postoperative Complications.***

| Variable (no. [%]) | No. with complete data | Yes | No | P value[a] |
|---|---|---|---|---|
| Myocardial infarction (120 [6.5]) | 1846 | 19.0 (16.6 - 21.5) | 23.1 (22.6 - 23.7) | <0.0001 |
| Stroke (13 [ 0.7]) | 1846 | 10.1 (3.7 - 16.5) | 23.0 (22.8 - 23.2) | <0.0001 |
| Pulmonary embolism (7 [ 0.4]) | 1846 | 17.1 (8.0 - 26.3) | 23.0 (22.7 - 23.2) | 0.032 |
| Cardiac arrest (3 [0.2]) | 1846 | 15.1 (0.7 - 29.4) | 23.0 (22.8 - 23.2) | 0.0065 |
| Surgical site infection (129 [ 7.0]) | 1846 | 20.7 (18.9 - 22.6) | 23.1 (22.6 - 23.6) | <0.0001 |
| Any of the above (263 [ 14.2]) | 1846 | 19.1 (17.5 - 20.8) | 23.7 (23.3 - 24.1) | <0.0001 |
| Hospital readmission (150 [ 7.1]) | 2090 | 17.2 (15.4 - 19.0) | 23.7 (23.3 - 24.1)[b] | <0.0001 |

[a] P values calculated using the quasi-likelihood ratio test.
[b] days calculated for those without readmission after excluding postoperative deaths.

* If a patient has spent less than 5 days at home and went to rehab, $DAH_{30\text{-}rehab}$ is set to 0 to avoid negative values.

**Table S7. Days at Home up to 30 Days after Surgery (DAH$_{30\text{-rehab}}$), Assuming 14 Days' Admission to a Rehabilitation Facility if it Occurred, According to Types of Surgery.***

| Surgery | No. admitted to a rehabilitation hospital (%) | Median (95% CI) DAH$_{30\text{-rehab}}$ |
|---|---|---|
| Cardiac (n=679) | 54 (8.0) | 22.8 (22.6-22.9) |
| Orthopedic (n=289) | 122 (42) | 20.9 (17.5-24.4) |
| Neurosurgery (n=220) | 9 (4.0) | 22.8 (22.2-23.5) |
| Colorectal (n=118) | 8 (6.8) | 24.9 (23.9-26.0) |
| Urology (n=315) | 26 (8.3) | 23.8 (23.0-24.5) |
| Vascular (n=56) | 1 (1.8) | 26.0 (24.4-27.6) |
| Ear, nose, throat (n=99) | 17 (17) | 25.8 (24.3-27.3) |
| Oesophagogastric/hepatobiliary (n=253) | 4 (1.6) | 24.9 (23.8-26.1) |
| Thoracic (n=28) | 2 (7.1) | 22.8 (17.8-27.8) |
| Other (n=52) | 2 (3.8) | 28.8 (27.7-30.0) |

*If a patient has spent less than 5 days at home and went to rehab, DAH$_{30\text{-rehab}}$ is set to 0 to avoid negative values.

**Table S8. Days at Home up to 30 Days after Surgery (DAH$_{30}$), Assuming 14 Days' Admission to a Rehabilitation Facility if it Occurred, According to Patient and Perioperative Characteristics.#**

| Variable | no. (%) | Raw median DAH$_{30\text{-rahab}}$ (95% CI) | P value | Adjusted median DAH$_{30\text{-rahab}}$ (95% CI)* | P value |
|---|---|---|---|---|---|
| Patient age | | | <0.0001 | | <0.0001 |
| <50 years | 220 (11) | 24.9 (24.4 - 25.3) | | 24.6 (24.2 - 25.1) | |
| 50-60 years | 396 (19) | 23.9 (23.6 - 24.3) | | 24.5 (24.0 - 25.0) | |
| 60-70 years | 612 (29) | 23.8 (23.5 - 24.1) | | 23.6 (23.3 - 24.0) | |
| 70-80 years | 653 (31) | 22.0 (21.5 - 22.4) | | 22.5 (21.9 - 23.1) | |
| ≥80 years | 228 (11) | 20.9 (19.6 - 22.2) | | 21.5 (20.5 , 22.4) | |
| | | | | | |
| Sex | | | 0.84 | | 0.0065 |
| male | 1427 (68) | 23.0 (22.6 - 23.4) | | 23.6 (23.3 - 23.9) | |
| female | 682 (32) | 23.0 (22.3 - 23.6) | | 22.7 (22.2 - 23.3) | |
| | | | | | |
| Smoker | | | 0.92 | | |
| yes | 787 (37) | 23.0 (22.5 - 23.5) | | | |
| no | 1322 (63) | 23.0 (22.5 - 23.4) | | | |
| | | | | | |
| Diabetes | | | 0.12 | | |
| yes | 697 (33) | 22.8 (22.6 - 23.1) | | | |
| no | 1412 (67) | 23.2 (22.5 - 23.8) | | | |
| | | | | | |
| Heart failure | | | 0.19 | | |
| yes | 365 (17) | 22.8 (22.3 - 23.3) | | | |
| no | 1744 (83) | 23.1 (22.6 - 23.7) | | | |
| | | | | | |
| ASA physical status | | | <0.0001 | | <0.0001 |
| 1 | 41 (1.9) | 27.9 (26.0 - 29.8) | | 25.3 (24.2 - 26.3) | |
| 2 | 530 (25) | 24.9 (24.6 - 25.1) | | 24.1 (23.6 - 24.6) | |
| 3 | 1024 (51) | 22.9 (22.7 - 23.1) | | 23.1 (22.7 - 23.5) | |
| 4 | 510 (24) | 21.9 (21.5 - 22.4) | | 22.9 (22.4 - 23.4) | |
| | | | | | |
| Duration of Surgery, h | | | <0.0001 | | <0.0001 |
| <2.0 | 581 (29) | 25.8 (25.1 - 26.4) | | 25.4 (24.9 - 26.0) | |
| 2.0-2.99 | 412 (20) | 23.8 (23.3 - 24.4) | | 23.6 (23.2 - 24.1) | |
| 3.0-3.99 | 551 (26) | 22.8 (22.7 - 23.0) | | 22.7 (22.3 - 23.1) | |
| ≥4.0 | 565 (27) | 21.8 (21.0 - 22.5) | | 21.6 (20.9 - 22.2) | |

*covariates including in the multivariable adjustment were: patient age, sex, American Society of Anesthesiologists (ASA) physical status and duration of surgery.

#If a patient has spent less than 5 days at home and went to rehab, DAH$_{30\text{-rehab}}$ is set to 0 to avoid negative values.

**Table S9. Median (95% CI) Days at Home up to 30 Days after Surgery, Assuming 14 Days' Admission to a Rehabilitation Facility if it Occurred, According to Postoperative Complications.**

| Variable (no. [%]) | No. with complete data | Yes | No | P value[a] |
|---|---|---|---|---|
| Myocardial infarction (120 [6.5]) | 1846 | 19.0 ( 16.5 , 21.6 ) | 23.1 ( 22.6 , 23.7 ) | <0.0001 |
| Stroke (13 [ 0.7]) | 1846 | 10.1 ( 3.4 , 16.9 ) | 23.0 ( 22.8 , 23.2 ) | <0.0001 |
| Pulmonary embolism (7 [ 0.4]) | 1846 | 17.1 ( 8.3 , 26.0 ) | 23.0 ( 22.7 , 23.2 ) | 0.032 |
| Cardiac arrest (3 [0.2]) | 1846 | 15.1 ( 0.4 , 29.8 ) | 23.0 ( 22.8 , 23.2 ) | 0.0065 |
| Surgical site infection (129 [ 7.0]) | 1846 | 20.7 ( 19.0 , 22.5 ) | 23.1 ( 22.6 , 23.6 ) | <0.0001 |
| Any of the above (263 [ 14.2]) | 1846 | 19.1 ( 17.5 , 20.8 ) | 23.7 ( 23.3 , 24.1 ) | <0.0001 |
| Hospital readmission (150 [ 7.1]) | 2090 | 17.2 ( 15.4 , 18.9 ) | 23.7 ( 23.3 , 24.1 )[b] | <0.0001 |

[a] P values calculated using the quasi-likelihood ratio test.
[b] Days calculated for those without readmission after excluding postoperative deaths. If a patient has spent less than 5 days at home and went to rehab, $DAH_{30-rehab}$ is set to 0 to avoid negative values.