### **Supplement File 1: Five main ICD 10 diagnosis categories.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | ICD-10 codes | Number deaths | Organ donors | Documented LSTL |
| 1 | CNS disease:D33.9, G00.9, G03.9, G91.9, G93.1, G93.5, G93.6, G93.8 | 177 | 65 | 124 |
| 2 | Cerebrovascular disease:I60.9, I61.2, I61.3, I61.4, I61.5, I62.0, I62.9, I63.9, I67.9, I71.0, I74.9 | 814 | 185 | 650 |
| 3 | Injury, poisoning, and other external causes:S01.9, S06.1, S06.4, S06.5, S06.9, T07.9, T14.9, T17.9, T39.1, T43.6, T58.9, T71.9, T75.1, T81.0 | 489 | 76 | 375 |
| 4 | Heart disease:I21.9, I26.9, I33.0, I42.9, I46.9, I50.9 | 2519 | 84 | 2003 |
| 5 | Other (197 different ICD-10 codes) | 5572 | 9 | 4713 |
| Total |  | **9571** | **419** | **7865** |

ICU admissions were given diagnoses according to the International Classification of Diseases version 10
(ICD-10) reflecting the clinical course on ICU as specified by SIR guidelines. Diagnoses were grouped into five main categories. LSTL life-sustaining treatment limitations.

### **Supplement File 2:** **Category of life-sustaining treatment limitation and relationship to organ donation after brain death.**

|  |  |  |  |
| --- | --- | --- | --- |
| Category of LSTL | N | Odds ratio | 95% CI |
| No LSTL | 1706 | Reference |  |
| LSTL: |  |  |  |
| - WH with details | 3078 | 0.54 | 0.43 – 0.67 |
| - WD with details | 300 | 0.13 | 0.05 – 0.35 |
| - WH + WD with details  | 2533 | 0.06 | 0.03 – 0.10 |
| - WH/WD without details | 1954 | 0.39 | 0.29 – 0.51 |
|  | **9571** |  |  |

Note that all LSTL groups had an odds ratio less than 1.0. Since their association with DBD was in the same direction we grouped the four LSTL combinations of WH and WD together. LSTL = Life-sustaining treatment limitations. WH = Withholding medical treatment. WD = Withdrawing medical treatment.

### **Supplement File 3:** **Documentation of stated goals of treatment in ICU deaths per study year.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **Number deaths** | **Missing stated goals of treatment a** | **Number deaths** | **LSTL b** | **No LSTL b** |
| **2014** | 2875 | 832 (28.9 %) | 2043 | 1643 (80.4 %) | 400 (19.6 %) |
| **2015** | 3066 | 815 (26.6 %) | 2251 | 1848 (82.1 %) | 403 (17.9 %) |
| **2016** | 2970 | 515 (17.3 %) | 2455 | 1972 (80.3 %) | 483 (19.7 %) |
| **2017** | 3161 | 339 (10.7 %) | 2822 | 2402 (85.1 %) | 420 (14.9 %) |
| **Total** | **12,072** | **2501 (20.7 %)** | **9571** | **7865 (82.2 %)** | **1706 (17.8 %)** |

a n (% of deaths in study cohort, n=12,072).
b n (% of deaths with stated goals of treatment, n=9571).
LSTL life-sustaining treatment limitations
Note that there was gradual improvement in documentation with a reduction in missing stated goals of treatment each year.

###

### **Supplement File 4:** **Medical treatment limitation rates for each treatment category.**

|  |  |  |  |
| --- | --- | --- | --- |
| Medical treatment: | WH | WD | Total |
| Invasive mechanical ventilation, n | 1946 | 1050 | 2996 |
| Non-invasive mechanical ventilation, n | 812 | 265 | 1077 |
| Continuous or intermittent renal replacement therapy, n | 2869 | 312 | 3181 |
| Vasoactive drugs, n | 1217 | 1185 | 2402 |
| Cardiopulmonary resuscitation, n | 5497 |  | 5497 |
| Other, n | 472 | 304 | 776 |

WH = Withholding medical treatment. WD = Withdrawing medical treatment.
Other = Surgery, blood transfusion, antibiotics or pacemaker.

###

### **Supplement File 5: Relevant time intervals (hours).**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Time to first LSTL | Time to death b | Time from first LSTL to death | Length of stay on ICU c |
| LSTL | N | 5911 | 7865 | 5911 | 7865 |
| p50 | 14.0 | 45.9 | 16.1 | 49.8 |
| p25 | 1.2 | 16.3 | 4.0 | 19.3 |
| p75 | 58.5 | 120.3 | 46.3 | 123.4 |
| No LSTL | N |  | 1706 |  | 1706 |
| p50 |  | 18.6 |  | 25.4 |
| p25 |  | 4.2 |  | 7.9 |
| p75 |  | 57.7 |  | 67.3 |
| Cases with information missing a | N |  | 2501 |  | 2501 |
| p50 |  | 21.0 |  | 26.2 |
| p25 |  | 4.9 |  | 7.8 |
| p75 |  | 67.5 |  | 72.5 |

a Regarding LSTL data. b From ICU admission.
c Calculated as discharge time (the deceased leaves ICU to cold-storage room) – admission time (time of arrival to ICU). The deceased usually returns from operating theatre to the ICU after organ harvesting, a time for next-of-kin’s farewell.
Times are expressed as median (IQR) hours. LSTL=Life-sustaining treatment limitations.

### **Supplement File 6: ICU personnel and individuals involved in LSTL decisions.**

|  |  |  |
| --- | --- | --- |
| The ICU physician primarily responsible conferred with: | N | % a |
| 1) Senior physician from admitting clinic *only* | 3003 | 50.8 |
| 2) Patient’s next-of-kin *and* senior physician from admitting clinic | 2392 | 40.5 |
| 3) Patient *and* next-of-kin *and* senior physician from admitting clinic | 241 | 4.1 |
| 4) Patient’s next-of-kin *only* | 182 | 3.1 |
| 5) Patient *and* patient’s physician from admitting clinic | 64 | 1.1 |
| 6) Patient *only* | 18 | 0.3 |
| 7) Patient *and* next-of-kin | 11 | 0.2 |
| 8) No other person involved other than the ICU physician responsible | 0 | 0.0 |
|  | **5911** | **100.0** |

a Per cent of all documented life-sustaining treatment limitations, LSTL (n=5911).

### **Supplement File 7:** **Will of the deceased to donate organs, with outcome.**

Death diagnosed by direct criteria and discussion with next-of-kin regarding the possibility of organ donation.

|  |  |  |
| --- | --- | --- |
| **Will of the deceased**  | **Organ donation** | **Tot** |
| **Yes** | **No** |
| Unknown | 199 a | 126 | 325 |
| Positive | 220 | 28 b | 248 |
| Negative | 0 | 70 | 70 |
| Tot | 419 | 224 | 643 |

a Presumed consent prevailed: next-of-kin were informed of organ donation and did not claim their right to deny.

b Compare table below (Reasons given for no organ donation, despite positive will of the deceased)

**Reasons given for no organ donation, despite positive will of the deceased**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Combination of reasons** | **WH/WD** | **Medicallyunsuitable** | **New medicalreason** | **Recipientmissing** | **Coroner objection** | **Organisationallimitations** | **n** |
| **1** | **Yes** |  |  |  |  |  | **4** |
| **2** | **Yes** |  |  |  |  | **Yes** | **4** |
| **3** |  | **Yes** | **Yes** |  |  |  | **4** |
| **4** | **Yes** | **Yes** |  |  |  |  | **3** |
| **5** | **Yes** | **Yes** | **Yes** |  |  |  | **3** |
| **6** | **Yes** |  | **Yes** |  |  |  | **2** |
| **7** |  | **Yes** |  |  |  |  | **2** |
| **8** |  |  | **Yes** |  |  | **Yes** | **2** |
| **9** | **Yes** |  |  | **Yes** |  |  | **1** |
| **10** |  |  |  |  | **Yes** |  | **1** |
| **11** |  |  |  |  |  | **Yes** | **1** |
| **12** | **Yes** | **Yes** | **Yes** |  |  | **Yes** | **1** |
|  |  |  |  |  |  |  | **28** |

**Way of expressing positive will (multiple choices possible):**

|  |  |
| --- | --- |
| **Form** | **n** |
| Verbal information | 203 |
| Donor card | 8 |
| Donor Register | 70 |
|  | **281** |

### **Supplement File 8:** **Multivariable analysis of factors related to DBD** **in** **cohort with presumed severe brain injury (compare methods, n=2346).**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Adjusted Odds Ratio | 95 % CI | P-value |
| Age, per year | 0.98 | 0.97 - 0.99 | <0.001 |
| Sex |  |  |  |
| Male | 1 |  |  |
| Female | 1.25 | 0.96 - 1.63 | NS |
| SAPS3a score, per point | 0.99 | 0.98 – 1.01 | NS |
| Cancer c |  |  |  |
| No | 1 |  |  |
| Yes | 0.28 | 0.14 - 0.55 | <0.001 |
| LSTL |  |  |  |
| No | 1 |  |  |
| Yes | 0.35 | 0.26- 0.47 | <0.001 |
| Major diagnostic categories |  |  |  |
| CNS disease | 1 |  |  |
| Cerebrovascular disease | 0.63 | 0.39 - 1.01 | NS |
| Injury or poisoning | 0.33 | 0.20 - 0.55 | <0.001 |
| Heart disease | 0.10 | 0.06 - 0.16 | <0.001 |
| Other | 0.08 | 0.03 - 0.19 | <0.001 |
| Hospital type |  |  |  |
| Local | 1 |  |  |
| County | 1.85 | 1.10 - 3.10 | <0.05 |
| Regional | 1.99 | 1.17 - 3.37 | <0.05 |

a Age, malignancy and cancer (see footnote b) deducted from score, b Cancer was defined as cancer or cancer therapy or haematological cancer as defined in the SAPS3 model.
SAPS3=Simplified Acute Physiology 3, CI=confidence interval, NS=not significant. LSTL=Life-sustaining treatment limitation.
Note that the presence of life-sustainment treatment limitation (LSTL) was still associated with reduced likelihood of DBD when analysed in a cohort with presumed new severe brain injury (n=2346).

### **Supplement File 9: Multivariable analysis of factors associated with DBD when analysed for year 2017 only (n=2822).**

|  |  |  |  |
| --- | --- | --- | --- |
|  | AdjustedOdds Ratio | 95 % CI | P-value |
| Age, per year | 0.96 | 0.95 - 0.97 | <0.001 |
| SAPS3 score, per point | 1.01 | 0.99 - 1.03 | NS |
| Sex |  |  |  |
| Male | 1 |  |  |
| Female | 1.33 | 0.88 - 2.02 | NS |
| Cancer a |  |  |  |
| No | 1 |  |  |
| Yes | 0.13 | 0.04 - 0.49 | <0.01 |
| LSTL |  |  |  |
| No | 1 |  |  |
| Yes | 0.36 | 0.22 - 0.58 | <0.001 |
| Major diagnostic categories |  |  |  |
| CNS disease | 1 |  |  |
| Cerebrovascular disease | 0.68 | 0.33 - 1.39 | NS |
| Injury or poisoning | 0.18 | 0.08 - 0.41 | <0.001 |
| Heart disease | 0.05 | 0.03 - 0.12 | <0.001 |
| Other | 0.001 | 0.00 - 0.01 | <0.001 |
| Hospital type |  |  |  |
| Local | 1 |  |  |
| County | 2.25 | 1.07 - 4.73 | NS |
| Regional | 2.52 | 1.21 – 5.23 | <0.05 |

a Cancer was defined as the presence of cancer or cancer therapy or haematological cancer as defined in the SAPS3 model. SAPS3 = Simplified Acute Physiology 3, CI = confidence interval, NS = not significant.
Note that the presence of life-sustaining treatment limitation (LSTL) was still associated with a 64 % reduced likelihood of DBD when analysing year 2017 only.

Authors:
Thomas Nolin1,2, MD; Corresponding author: nolin.thomas@gmail.com
Sten Walther3, MD PhD

Affiliations and addresses:

1. Department of Anaesthesiology, Central Hospital, SE-29185 Kristianstad, Sweden.
2. The Swedish Intensive Care Register (<http://www.icuregswe.org>)
3. Department of Cardiovascular Anaesthesia and Intensive Care and Department of Medicine and Care, Linköping University, SE-581 85 Linköping, Sweden.