SAGES - Predicting GCP slope

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# Goals

## Overall goal

The overall goal is to build the two best prediction models for delirium and cognitive decline as possible given the data we collected. This is intended for a research audience because many of the variables going into this model would be difficult for clinicians to obtain.

## Today’s (2024-04-05) goal

Review the variables the expert panel voted to keep and the resulting principal compenent analysis.

## Today’s (2024-02-02) goal

Review the variables that made it through our selection process for inclusion into the model.

# Background

There are many interesting variables that could possibly included in our model. There are too many to reasonably include in any type of model given our sample size. So, we need a process to trim down our candidate variable list. The process we will use involves two (three?, four?) steps.

1. Variables with more than 50% missingness will be dropped. Those with less than 50% missingness will have values imputed using predictive mean matching.
2. Variables that lack any variability will be dropped. If a variable is an indicator for whether something happened, and only a few participants experienced the event, then even if the indicator is clinically meaningful, it will be dropped because it will make a poor predictor in the model.
3. Variables that are redundant with each other will be dropped. If a variable that can be reasonably well predicted by other variables in the model, then that variable is not providing much more to the model.
4. The remaining variables will be combined into principal components.

# The data

The data comes from the patient interview, the medcial record review, including lab values and peri-operative data.

# Summary of lab values

## Missing values

These are the lab values that were dropped for having more than 50% missing values:

| **Characteristic** | **N = 560** |
| --- | --- |
| ALT (IU/L) (Pre-op) | 20 (9) |
| Unknown | 375 |
| AST (IU/L) (Pre-op) | 22.6 (7.8) |
| Unknown | 377 |
| Bilirubin (mg/dL) (Pre-op) | 0.45 (0.23) |
| Unknown | 403 |
| Albumin (g/dL) (Pre-op) | 4.24 (0.38) |
| Unknown | 404 |
| ABG: pH (POD1) | 7.37 (0.09) |
| Unknown | 534 |
| p02 (mmHg) (POD1) | 165 (82) |
| Unknown | 533 |
| pCO2 (mmHg) (POD1) | 41 (7) |
| Unknown | 534 |

Imputation was done on the remaining lab values using predictive mean matching.

## Indicator variables

Indicator variables for low and high values were created for the lab values.

This section provides summary statistics of whether the lab values met a clinically relevant cutoff.

## Pre-op labs

### Pre-op labs - any abnormality

Note: BUN/CRE ratio and Anion Gap thresholds were not updated and used values from previous work.

| **Characteristic** | **N = 560** |
| --- | --- |
| Abnormal labs: WBC <= 2 or WBC >= 15 (Pre-op) |  |
| WBC normal | 555 (99%) |
| WBC abnormal | 5 (0.9%) |
| Abnormal labs: HCT <= 21 or HCT >= 62 (Pre-op) |  |
| HCT normal | 560 (100%) |
| HCT abnormal | 0 (0%) |
| Abnormal labs: BUN >= 50 (Pre-op) |  |
| BUN normal | 554 (99%) |
| BUN abnormal | 6 (1.1%) |
| Abnormal labs: CRE >= 5 (Pre-op) |  |
| CRE normal | 560 (100%) |
| CRE abnormal | 0 (0%) |
| Abnormal labs: SOD <= 120 or SOD >= 160 (Pre-op) |  |
| SOD normal | 560 (100%) |
| SOD abnormal | 0 (0%) |
| Abnormal labs: POT <= 2.9 or POT >= 6.0 (Pre-op) |  |
| POT normal | 557 (99%) |
| POT abnormal | 3 (0.5%) |
| Abnormal labs: CHL <= 85 or CHL >= 115 (Pre-op) |  |
| CHL normal | 560 (100%) |
| CHL abnormal | 0 (0%) |
| Abnormal labs: BIC <= 10 or BIC >= 40 (Pre-op) |  |
| BIC normal | 560 (100%) |
| BIC abnormal | 0 (0%) |
| Abnormal labs: GLU <= 40 or GLU >= 400 (Pre-op) |  |
| GLU normal | 559 (100%) |
| GLU abnormal | 1 (0.2%) |
| Abnormal labs: O2 <= 87 (Pre-op) |  |
| O2 normal | 560 (100%) |
| O2 abnormal | 0 (0%) |
| Abnormal labs: BUN/CRE >= 18 (Pre-op) |  |
| BUN/CRE normal | 135 (24%) |
| BUN/CRE abnormal | 425 (76%) |
| Abnormal labs: Anion Gap >= 16 (Pre-op) |  |
| Anion Gap normal | 458 (82%) |
| Anion Gap abnormal | 102 (18%) |

### POD1 labs

| **Characteristic** | **N = 560** |
| --- | --- |
| Abnormal labs: WBC <= 2 or WBC >= 15 (POD1) |  |
| WBC normal | 512 (91%) |
| WBC abnormal | 48 (8.6%) |
| Abnormal labs: HCT <= 21 or HCT >= 62 (POD1) |  |
| HCT normal | 556 (99%) |
| HCT abnormal | 4 (0.7%) |
| Abnormal labs: BUN >= 50 (POD1) |  |
| BUN normal | 556 (99%) |
| BUN abnormal | 4 (0.7%) |
| Abnormal labs: CRE >= 5 (POD1) |  |
| CRE normal | 560 (100%) |
| CRE abnormal | 0 (0%) |
| Abnormal labs: SOD <= 120 or SOD >= 160 (POD1) |  |
| SOD normal | 560 (100%) |
| SOD abnormal | 0 (0%) |
| Abnormal labs: POT <= 2.9 or POT >= 6.0 (POD1) |  |
| POT normal | 552 (99%) |
| POT abnormal | 8 (1.4%) |
| Abnormal labs: BIC <= 10 or BIC >= 40 (POD1) |  |
| BIC normal | 560 (100%) |
| BIC abnormal | 0 (0%) |
| Abnormal labs: O2 <= 87 (POD1) |  |
| O2 normal | 548 (98%) |
| O2 abnormal | 12 (2.1%) |

### POD2 labs

| **Characteristic** | **N = 560** |
| --- | --- |
| Abnormal labs: HCT <= 21 or HCT >= 62 (POD2) |  |
| HCT normal | 550 (98%) |
| HCT abnormal | 10 (1.8%) |
| Abnormal labs: BUN >= 50 (POD2) |  |
| BUN normal | 547 (98%) |
| BUN abnormal | 13 (2.3%) |
| Abnormal labs: CRE >= 5 (POD2) |  |
| CRE normal | 559 (100%) |
| CRE abnormal | 1 (0.2%) |
| Abnormal labs: SOD <= 120 or SOD >= 160 (POD2) |  |
| SOD normal | 557 (99%) |
| SOD abnormal | 3 (0.5%) |

# Non-lab data

## Missingness

These were the variables that were dropped for having more than 50% missingness: **none**.

Imputation was done on the remaining lab values using predictive mean matching.

# The variables

There are 133 variables being considered for this analysis.

| variable | label |
| --- | --- |
| vdage | Age at This Visit |
| vdfemale | Female |
| vdnonwhite | Nonwhite |
| vdeduc\_r | Respondent's Education, Years |
| vdlivesalone | Lives alone |
| vdsmokingstatus | Smoking status |
| vdalcohol | Alcohol |
| vdmlta\_metmins | MLTA |
| vdgcp\_rta | Baseline GCP |
| wtar01 | WTAR |
| vdadlany | ADL (any) |
| vdiadlanyc | IADL cognitive (any) |
| vdgds15 | Geriatric Depression Scale Score (/15 Points) |
| vdsf12pcs | SF12 physical composite T-score |
| vdsf12mcs | SF12 mental composite T-score |
| vdhearingimp | Hearing impairment |
| vddrisk93\_1 | Vision Impairment |
| vdfriedfrail1 | Frailty - Weight Loss |
| vdfriedfrail2 | Frailty - Exhaustion |
| vdfriedfrail3 | Frailty - Low Physical Activity |
| vdfriedfrail4 | Frailty - Low Grip Strength |
| vdfriedfrail5 | Frailty - Low Timed Walk |
| vdsurg | Surgery |
| vdcrp\_preop | CRP - preop |
| vdcrp\_pod2 | CRP - POD2 |
| vd3ms | 3MS Score |
| vdbmi3 | BMI |
| vdesl | English is second language |
| apoe4 | APOE 4 |
| vdiqc\_proxy | IQCODE, Proxy Report |
| vdcci | Charlson Comorbidity Index |
| vdvascom | Vascular Comorbidity |
| vdapache | Postoperative APACHE II Score |
| ins01 | No Insurance |
| ins02 | Has Medicare |
| ins03 | Has Private Insurance |
| ins04 | Has Medicaid |
| ins05 | Has Other Insurance |
| ci01 | Evidence of Cognitive Impairment |
| dep01 | Evidence of Depression |
| lab01a | WBC (x103) (Pre-op) |
| lab02a | Hematocrit (%) (Pre-op) |
| lab03a | BUN (mg/dL) (Pre-op) |
| lab04a | Creatinine (mg/dL) (Pre-op) |
| lab05a | Sodium (mEq/L) (Pre-op) |
| lab06a | Potassium (mEq/L) (Pre-op) |
| lab07a | Chloride (mEq/L) (Pre-op) |
| lab08a | Bicarbonate mEq/L) (Pre-op) |
| lab09a | Glucose (mg/dL) (Pre-op) |
| lab14a | Calcium (mg/dL) (Pre-op) |
| lab15a | O2 saturation (%) (Pre-op) |
| lab01c | WBC (x103) (POD1) |
| lab02c | Hematocrit (%) (POD1) |
| lab03c | BUN (mg/dL) (POD1) |
| lab04c | Creatinine (mg/dL) (POD1) |
| lab05c | Sodium (mEq/L) (POD1) |
| lab06c | Potassium (mEq/L) (POD1) |
| lab08c | Bicarbonate (mEq/L) (POD1) |
| lab15c | O2 saturation (%) (POD1) |
| lab02e | Hematocrit (%) (POD2) |
| lab03e | BUN (mg/dL) (POD2) |
| lab04e | Creatinine (mg/dL) (POD2) |
| lab05e | Sodium (mEq/L) (POD2) |
| lab.bun.cre.ratio.1 | BUN/creatinine ratio (Pre-op) |
| lab.anion.gap.1 | Anion Gap (Pre-op) |
| op01\_3 | ASA class |
| vdanesth\_spi | Anesthesia Type |
| vdp41101 | (op10) Estimated Blood Loss (EBL) (cc) |
| vdp41301 | Anesthesia: general |
| vdp41302 | Anesthesia: spinal |
| vdp41303 | Anesthesia: regional |
| vdp41304 | Anesthesia: local |
| vdp41305 | Anesthesia time (ln(hours)) |
| vdp41311 | Anesthesia: propofol |
| vdp41312 | Anesthesia: midazolam |
| vdp41313 | Anesthesia: fentanyl |
| vdp41314 | Anesthesia: remifentanil |
| vdp41315 | Anesthesia: hydromorphone |
| vdp41316 | Anesthesia: morphine |
| vdp41317 | Anesthesia: nitrous |
| vdp41318 | Anesthesia: desflurane |
| vdp41319 | Anesthesia: succinycholine |
| vdp41320 | Anesthesia: vecuronium |
| vdp41321 | Anesthesia: bupivacaine |
| vdp41322 | Anesthesia: cefazolin |
| vdp41323 | Anesthesia: ephedrine |
| vdp41324 | Anesthesia: glycopyrrolate |
| vdp41325 | Anesthesia: lidocaine |
| vdp41326 | Anesthesia: mepivacaine |
| vdp41327 | Anesthesia: neostigmine |
| vdp41328 | Anesthesia: ondansetron |
| vdp41329 | Anesthesia: phenylephrine |
| vdp41330 | Anesthesia: rocuronium |
| vdp41331 | Anesthesia: vancomycin |
| vdp41501 | Presence of beta blocker in pre-hospital medication list |
| vdp41502 | Presence of NSAID in pre-hospital medication list |
| vdp41503 | Presence of statin in pre-hospital medication list |
| vdp41504 | Presence of benzodiazepine in pre-hospital medication list |
| vdp41505 | Presence of opioid in pre-hospital medication list |
| vdp41506 | total Anticholinergic Drug Scale (ADS) score |
| vdp41507 | number of medications contributing points to ADS score |
| vdp41508 | total number of pre-hospital medications in patient's record |
| vdp41509 | average ADS score per medication (computed as score/Med\_num) |
| vdp41510 | Number of medications with ADS activity >1 |
| vdp41511 | ADS score if excluding medications scoring 1 on the ADS activity scale |
| vdp41512 | total Anticholinergic Cognitive Burden (ACB) scale score |
| vdp41513 | total number of medications contributing to ACB score |
| vdp41514 | average ADS score per medication (computed as ACB/Num\_med) |
| vdp41515 | Number of medications with ACB activity >1 |
| vdp41516 | ADS score if excluding medications scoring 1 on the ACB scale |
| vdp41721 | antipsychotics use in days 1-7 |
| vdp41722 | benzodiazepines use in days 1-7 |
| vdp41723 | hydromorphone use in days 1-7 |
| vdp41724 | morphine use in days 1-7 |
| vdp41725 | oxycodone use in days 1-7 |
| vdp41726 | tramadol use in days 1-7 |
| vdp41727 | other opioid use in days 1-7 |
| vdp41901 | ASA Class >=3 (vs <=2) |
| vdp42101 | Surgery time (hours) |
| vdp42303 | Intraop complication - bradycardia requiring new permanent pacemaker |
| vdp42304 | Intraop complication - uncontrolled bleeding |
| vdp42305 | Intraop complication - prolonged severe hypotension |
| vdp42309 | Intraop complication - other |
| vdp42701 | Post-operative hypotension (SBP<90 or DBP<60) |
| vdp42702 | Post-operative hypertension (SBP>140 or DBP>90) |
| vdp42901 | (ptvi01) Post op vital signs temperature (°F) - highest |
| vdp42902 | (ptvi02) Post op vital signs temperature (°F) - lowest |
| vdp42903 | (ptvi03) Post op vital signs pulse (per min) - highest |
| vdp42904 | (ptvi04) Post op vital signs pulse (per min) - lowest |
| vdp42905 | (ptvi09) Post op vital signs Respirations (per min) - highest |
| vdp42906 | (ptvi10) Post op vital signs Respirations (per min) - lowest |
| vdp43101 | Days from surgery to first ambulation |
| vdp43301 | (icu01 recode) Was the patient ever in the ICU or CCU? |

# Variable reduction

This section details the variable reduction technique from Harrell’s Regression Modeling Strategies that we used to reduce the number of variables used in the analysis.

Of the 133 variables we start with, we dropped 25 of them for having a low amount of variability.

These are the variables that were dropped:

| **Characteristic** | **N = 560** |
| --- | --- |
| Vision Impairment |  |
| No\_impairment | 556 (99%) |
| Impairment | 4 (0.7%) |
| No Insurance |  |
| Insurance | 560 (100%) |
| No Insurance | 0 (0%) |
| Has Medicaid |  |
| No Medicaid | 552 (99%) |
| Medicaid | 8 (1.4%) |
| Evidence of Cognitive Impairment |  |
| No Cognitive Impairment | 558 (100%) |
| Cognitive Impairment (Chart) | 2 (0.4%) |
| Anesthesia: local |  |
| No | 543 (97%) |
| Yes | 17 (3.0%) |
| Anesthesia: midazolam |  |
| No | 539 (96%) |
| Yes | 21 (3.8%) |
| Anesthesia: remifentanil |  |
| No | 557 (99%) |
| Yes | 3 (0.5%) |
| Anesthesia: hydromorphone |  |
| No | 539 (96%) |
| Yes | 21 (3.8%) |
| Anesthesia: nitrous |  |
| No | 558 (100%) |
| Yes | 2 (0.4%) |
| Anesthesia: desflurane |  |
| No | 553 (99%) |
| Yes | 7 (1.3%) |
| Anesthesia: succinycholine |  |
| No | 554 (99%) |
| Yes | 6 (1.1%) |
| Anesthesia: vecuronium |  |
| No | 556 (99%) |
| Yes | 4 (0.7%) |
| Anesthesia: bupivacaine |  |
| No | 545 (97%) |
| Yes | 15 (2.7%) |
| Anesthesia: cefazolin |  |
| No | 542 (97%) |
| Yes | 18 (3.2%) |
| Anesthesia: ephedrine |  |
| No | 541 (97%) |
| Yes | 19 (3.4%) |
| Anesthesia: lidocaine |  |
| No | 551 (98%) |
| Yes | 9 (1.6%) |
| Anesthesia: mepivacaine |  |
| No | 559 (100%) |
| Yes | 1 (0.2%) |
| Anesthesia: neostigmine |  |
| No | 539 (96%) |
| Yes | 21 (3.8%) |
| Anesthesia: rocuronium |  |
| No | 545 (97%) |
| Yes | 15 (2.7%) |
| Anesthesia: vancomycin |  |
| No | 555 (99%) |
| Yes | 5 (0.9%) |
| Intraop complication - bradycardia requiring new permanent pacemaker |  |
| No | 559 (100%) |
| Yes | 1 (0.2%) |
| Intraop complication - uncontrolled bleeding |  |
| No | 558 (100%) |
| Yes | 2 (0.4%) |
| Intraop complication - prolonged severe hypotension |  |
| No | 555 (99%) |
| Yes | 5 (0.9%) |
| Intraop complication - other |  |
| No | 548 (98%) |
| Yes | 12 (2.1%) |
| Post-operative hypertension (SBP>140 or DBP>90) |  |
| No | 554 (99%) |
| Yes | 6 (1.1%) |

Of the 108 variables retained, 16 were dropped due to redundancy.

These are the variables that were dropped:

| **Characteristic** | **N = 560** |
| --- | --- |
| Frailty - Low Physical Activity |  |
| 0 | 207 (37%) |
| 1 | 353 (63%) |
| Creatinine (mg/dL) (Pre-op) | 1.00 (0.32) |
| Bicarbonate mEq/L) (Pre-op) | 27.78 (2.64) |
| BUN (mg/dL) (POD1) | 18 (8) |
| Creatinine (mg/dL) (POD1) | 0.96 (0.36) |
| Creatinine (mg/dL) (POD2) | 1.02 (0.52) |
| Anesthesia Type |  |
| General Anesthesia only | 479 (86%) |
| Any Spinal Anesthesia | 81 (14%) |
| Anesthesia: general |  |
| No | 80 (14%) |
| Yes | 480 (86%) |
| Anesthesia time (ln(hours)) | 1.11 (0.35) |
| total Anticholinergic Drug Scale (ADS) score |  |
| 0 | 167 (30%) |
| 1 | 165 (29%) |
| 2 | 107 (19%) |
| 3 | 55 (9.8%) |
| 4 | 41 (7.3%) |
| 5 | 13 (2.3%) |
| 6 | 5 (0.9%) |
| 7 | 2 (0.4%) |
| 8 | 5 (0.9%) |
| number of medications contributing points to ADS score |  |
| 0 | 167 (30%) |
| 1 | 189 (34%) |
| 2 | 132 (24%) |
| 3 | 51 (9.1%) |
| 4 | 18 (3.2%) |
| 5 | 2 (0.4%) |
| 6 | 1 (0.2%) |
| Number of medications with ADS activity >1 |  |
| 0 | 467 (83%) |
| 1\_2 | 93 (17%) |
| total Anticholinergic Cognitive Burden (ACB) scale score | 1.66 (1.70) |
| average ADS score per medication (computed as ACB/Num\_med) | 0.21 (0.21) |
| ADS score if excluding medications scoring 1 on the ACB scale |  |
| 0 | 479 (86%) |
| 1 | 0 (0%) |
| 2 | 12 (2.1%) |
| 3 | 56 (10%) |
| 4\_9 | 13 (2.3%) |
| ASA Class >=3 (vs <=2) |  |
| No | 207 (37%) |
| Yes | 353 (63%) |

### List of predictive features after dropping for missingness, low variance, and redundancy:

There are 92 variables retained after the redundancy analysis.

| variable | label |
| --- | --- |
| vdage | Age at This Visit |
| vdfemale | Female |
| vdnonwhite | Nonwhite |
| vdeduc\_r | Respondent's Education, Years |
| vdlivesalone | Lives alone |
| vdsmokingstatus | Smoking status |
| vdalcohol | Alcohol |
| vdmlta\_metmins | MLTA |
| vdgcp\_rta | Baseline GCP |
| wtar01 | WTAR |
| vdadlany | ADL (any) |
| vdiadlanyc | IADL cognitive (any) |
| vdgds15 | Geriatric Depression Scale Score (/15 Points) |
| vdsf12pcs | SF12 physical composite T-score |
| vdsf12mcs | SF12 mental composite T-score |
| vdhearingimp | Hearing impairment |
| vdfriedfrail1 | Frailty - Weight Loss |
| vdfriedfrail2 | Frailty - Exhaustion |
| vdfriedfrail4 | Frailty - Low Grip Strength |
| vdfriedfrail5 | Frailty - Low Timed Walk |
| vdsurg | Surgery |
| vdcrp\_preop | CRP - preop |
| vdcrp\_pod2 | CRP - POD2 |
| vd3ms | 3MS Score |
| vdbmi3 | BMI |
| vdesl | English is second language |
| apoe4 | APOE 4 |
| vdiqc\_proxy | IQCODE, Proxy Report |
| vdcci | Charlson Comorbidity Index |
| vdvascom | Vascular Comorbidity |
| vdapache | Postoperative APACHE II Score |
| ins02 | Has Medicare |
| ins03 | Has Private Insurance |
| ins05 | Has Other Insurance |
| dep01 | Evidence of Depression |
| lab01a | WBC (x103) (Pre-op) |
| lab02a | Hematocrit (%) (Pre-op) |
| lab03a | BUN (mg/dL) (Pre-op) |
| lab05a | Sodium (mEq/L) (Pre-op) |
| lab06a | Potassium (mEq/L) (Pre-op) |
| lab07a | Chloride (mEq/L) (Pre-op) |
| lab09a | Glucose (mg/dL) (Pre-op) |
| lab14a | Calcium (mg/dL) (Pre-op) |
| lab15a | O2 saturation (%) (Pre-op) |
| lab01c | WBC (x103) (POD1) |
| lab02c | Hematocrit (%) (POD1) |
| lab05c | Sodium (mEq/L) (POD1) |
| lab06c | Potassium (mEq/L) (POD1) |
| lab08c | Bicarbonate (mEq/L) (POD1) |
| lab15c | O2 saturation (%) (POD1) |
| lab02e | Hematocrit (%) (POD2) |
| lab03e | BUN (mg/dL) (POD2) |
| lab05e | Sodium (mEq/L) (POD2) |
| lab.bun.cre.ratio.1 | BUN/creatinine ratio (Pre-op) |
| lab.anion.gap.1 | Anion Gap (Pre-op) |
| op01\_3 | ASA class |
| vdp41101 | (op10) Estimated Blood Loss (EBL) (cc) |
| vdp41302 | Anesthesia: spinal |
| vdp41303 | Anesthesia: regional |
| vdp41311 | Anesthesia: propofol |
| vdp41313 | Anesthesia: fentanyl |
| vdp41316 | Anesthesia: morphine |
| vdp41324 | Anesthesia: glycopyrrolate |
| vdp41328 | Anesthesia: ondansetron |
| vdp41329 | Anesthesia: phenylephrine |
| vdp41501 | Presence of beta blocker in pre-hospital medication list |
| vdp41502 | Presence of NSAID in pre-hospital medication list |
| vdp41503 | Presence of statin in pre-hospital medication list |
| vdp41504 | Presence of benzodiazepine in pre-hospital medication list |
| vdp41505 | Presence of opioid in pre-hospital medication list |
| vdp41508 | total number of pre-hospital medications in patient's record |
| vdp41509 | average ADS score per medication (computed as score/Med\_num) |
| vdp41511 | ADS score if excluding medications scoring 1 on the ADS activity scale |
| vdp41513 | total number of medications contributing to ACB score |
| vdp41515 | Number of medications with ACB activity >1 |
| vdp41721 | antipsychotics use in days 1-7 |
| vdp41722 | benzodiazepines use in days 1-7 |
| vdp41723 | hydromorphone use in days 1-7 |
| vdp41724 | morphine use in days 1-7 |
| vdp41725 | oxycodone use in days 1-7 |
| vdp41726 | tramadol use in days 1-7 |
| vdp41727 | other opioid use in days 1-7 |
| vdp42101 | Surgery time (hours) |
| vdp42701 | Post-operative hypotension (SBP<90 or DBP<60) |
| vdp42901 | (ptvi01) Post op vital signs temperature (°F) - highest |
| vdp42902 | (ptvi02) Post op vital signs temperature (°F) - lowest |
| vdp42903 | (ptvi03) Post op vital signs pulse (per min) - highest |
| vdp42904 | (ptvi04) Post op vital signs pulse (per min) - lowest |
| vdp42905 | (ptvi09) Post op vital signs Respirations (per min) - highest |
| vdp42906 | (ptvi10) Post op vital signs Respirations (per min) - lowest |
| vdp43101 | Days from surgery to first ambulation |
| vdp43301 | (icu01 recode) Was the patient ever in the ICU or CCU? |

## Principal component analysis

After the redundancy analysis, several versions of a principal components analysis was done that made linear combinations of various groupings of the remaining variables.

The first group of principal components used all 93 variables. The second group of principal components used 7 variables that received 3 or more votes from the expert panel. The second group of principal components used 14 variables that received 2 or more votes from the expert panel. The second group of principal components used 28 variables that received 1 or more votes from the expert panel.

Prior to the PCA factor variables were turned into dummy indicator variables and then all variables were centered and scaled.

### Complete variable set

There are 94 variables and thus principal components in total.

|  |
| --- |
| Amount of variance explained by the prinicpal components |

The first 25 components explain 59.3 percent of the variance.

### Expert panel variable sets

After the previous PCA showed that the first several principal components don’t explain as much variance as expected, the expert panel voted on which variables to keep. These are the results.

|  |  | Expert panel | | |
| --- | --- | --- | --- | --- |
| Variable | Label | Received 3+ votes | Received 2+ votes | Received 1+ votes |
| vdage | Age at This Visit | TRUE | TRUE | TRUE |
| vdeduc\_r | Respondent's Education, Years | TRUE | TRUE | TRUE |
| vdgcp\_rta | Baseline GCP | TRUE | TRUE | TRUE |
| vdiadlanyc | IADL cognitive (any) | TRUE | TRUE | TRUE |
| vdcci | Charlson Comorbidity Index | TRUE | TRUE | TRUE |
| vdp41721 | antipsychotics use in days 1-7 | TRUE | TRUE | TRUE |
| vdp43301 | (icu01 recode) Was the patient ever in the ICU or CCU? | TRUE | TRUE | TRUE |
| vdfemale | Female | FALSE | TRUE | TRUE |
| vdsf12pcs | SF12 physical composite T-score | FALSE | TRUE | TRUE |
| vdfriedfrail5 | Frailty - Low Timed Walk | FALSE | TRUE | TRUE |
| vdsurg | Surgery | FALSE | TRUE | TRUE |
| vdapache | Postoperative APACHE II Score | FALSE | TRUE | TRUE |
| vdp41508 | total number of pre-hospital medications in patient's record | FALSE | TRUE | TRUE |
| vdnonwhite | Nonwhite | FALSE | FALSE | TRUE |
| vdlivesalone | Lives alone | FALSE | FALSE | TRUE |
| wtar01 | WTAR | FALSE | FALSE | TRUE |
| vdadlany | ADL (any) | FALSE | FALSE | TRUE |
| vdgds15 | Geriatric Depression Scale Score (/15 Points) | FALSE | FALSE | TRUE |
| vdhearingimp | Hearing impairment | FALSE | FALSE | TRUE |
| ins03 | Has Private Insurance | FALSE | FALSE | TRUE |
| lab01a | WBC (x103) (Pre-op) | FALSE | FALSE | TRUE |
| lab05a | Sodium (mEq/L) (Pre-op) | FALSE | FALSE | TRUE |
| lab15c | O2 saturation (%) (POD1) | FALSE | FALSE | TRUE |
| lab.bun.cre.ratio.1 | BUN/creatinine ratio (Pre-op) | FALSE | FALSE | TRUE |
| vdp41509 | average ADS score per medication (computed as score/Med\_num) | FALSE | FALSE | TRUE |
| vdp41722 | benzodiazepines use in days 1-7 | FALSE | FALSE | TRUE |
| vdp43101 | Days from surgery to first ambulation | FALSE | FALSE | TRUE |

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| Amount of variance explained by the prinicpal components (3+ votes by expert panel) |

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| Amount of variance explained by the prinicpal components (2+ votes by expert panel) |

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| Amount of variance explained by the prinicpal components (1+ votes by expert panel) |