# HSMR 2010

## methodological report

*Abby Israëls, Jan van der Laan, Agnes de Bruin,*
*Janneke Ploemacher and Gerard Verweij*

**Statistiscal Methods (201122)**

Statistics Netherlands

The Hague/Heerlen, 2011

## Explanation of symbols

| | |
|---|---|
| . | = data not available |
| * | = provisional figure |
| ** | = revised provisional figure |
| x | = publication prohibited (confidential figure) |
| – | = nil or less than half of unit concerned |
| – | = (between two figures) inclusive |
| 0 (0,0) | = less than half of unit concerned |
| blank | = not applicable |
| 2010–2011 | = 2010 to 2011 inclusive |
| 2010/2011 | = average of 2010 up to and including 2011 |
| 2010/'11 | = crop year, financial year, school year etc. beginning in 2010 and ending in 2011 |
| 2008/'09–2010/'11 | = crop year, financial year, etc. 2008/'09 to 2010/'11 inclusive |

Due to rounding, some totals may not correspond with the sum of the separate figures.

**Publisher**
Statistics Netherlands
Henri Faasdreef 312
2492 JP The Hague

**Prepress**
Statistics Netherlands
Facility Services

**Cover**
Teldesign, Rotterdam

**Information**
Telephone .. +31 88 570 70 70
Telefax .. +31 70 337 59 94
Via contact form:
www.cbs.nl/information

**Where to order**
E-mail: verkoop@cbs.nl
Telefax .. +31 45 570 62 68

**Internet**
www.cbs.nl

ISSN: 1876-0333



60165201122 X-37

# Contents

## List of tables



## List of figures

# 1. Introduction

Statistics Netherlands (CBS) has calculated the Hospital Standardised Mortality Ratios (HSMRs) for Dutch hospitals for the period 2008-2010. The HSMRs are ratios of observed and expected number of deaths and aim to present comparable hospital mortality figures. This report describes the methods that were used.

In this introductory chapter, section 1.1 deals with the definition of the HSMR and the diagnosis specific SMR, section 1.2 with the purpose of the HSMR and section 1.3 with its history. Authorization was asked from the hospitals to deliver the HSMR figures (section 1.4). Section 1.5 gives an overview of the types of figures CBS has produced and section 1.6 presents some limitations of the HSMR as a quality indicator.

The methodological aspects of the model used to calculate the HSMRs are described in chapter 2. The model outcomes are evaluated in chapter 3. Chapter 4 deals with limitations of the HSMR, and possibilities for the future follow in chapter 5. Finally, there are four appendices. Appendix 1 presents the definitions of the covariates (explanatory variables, predictors) used in the regression models. For some hospitals no HSMRs are calculated, for various reasons. Appendix 2 gives the "exclusion criteria" for this. In Appendix 3 the differences in methodology with former years, when Kiwa Prismant was responsible for the calculations, are mentioned. Extensive results of the regression models are found in Appendix 4.

## 1.1 What is the (H)SMR?

Hospital mortality can be measured as the ratio of the number of hospital deaths and the number of hospital admissions (hospital stays) in the same period. This is generally referred to as the "gross mortality rate".

Judging hospital performance on the basis of gross mortality rates is unfair, since one hospital may have had more life-threatening cases than another hospital. For this purpose, it is more appropriate to adjust (standardise) the mortality rates across hospitals as much as possible for differences in characteristics of the patients admitted to those hospitals ("casemix"). To this end, the *SMR* (Standardised Mortality Ratio) of a hospital *h* for diagnosis *d* is defined as

$$SMR_{dh} = 100 \text{ x (Observed mortality)}_{dh} \text{ / (Expected mortality)}_{dh} .$$

The numerator is the *observed* number of deaths with main diagnosis *d* in hospital *h*. The denominator is the *expected* number of deaths for this type of admissions under the assumption that individual mortality probabilities (per admission) do *not* depend on the hospital, i.e. are equal to mortality probabilities of identical cases in other hospitals. The denominator is therefore based on a model based on data of all hospitals, in which the mortality of an admission is explained by characteristics of the patient, such as age, and characteristics of the admission, such as diagnosis and whether it is an acute, unplanned admission or a planned admission. Characteristics of the hospital, such as the number of doctors per bed, are generally not incorporated into the model, since these can be related to the quality of care in the hospitals, which is meant to be the outcome of the indicator. The model thus produces an expected (estimated) mortality probability for each admission. Adding up these probabilities per hospital gives the total expected mortality over all admissions of that hospital. For each diagnosis *d*, the average $SMR_d$ across the hospitals is equal to 100, when weighting each hospital with its (relative) expected mortality.

Not all diagnoses are inspected, but only 50 "diagnosis groups *d*" that cover about 80% of the entire hospital mortality. Also day admissions are excluded.

The *HSMR* of hospital *h* is defined as

$$HSMR_h = 100 \text{ x (Observed mortality)}_h \text{ / (Expected mortality)}_h ,$$

in which both the numerator and denominator are sums across all admissions for all considered diagnoses. The HSMR has thus a weighted average of 100 as well.

HSMRs may also be different from 100 only by chance. Therefore, confidence intervals of the SMRs and HSMRs are calculated, so that hospitals can see whether they have a (statistically) significantly high (low) adjusted mortality rate as compared with the average of 100.

## 1.2 Purpose of the HSMR

In the Netherlands, like all other western countries, there is a great interest in measuring the quality of health care. Hospitals can be assessed on various quality indicators, such as the number of medical personnel per bed or the presence of certain facilities. These indicators, however, do not measure the outcomes of the medical performance. A good indicator for the performance of a hospital is the extent to which its patients recover, given the diagnoses and other important characteristics, e.g. age, gender and comorbidity, of the patients. Unfortunately, recovery is hard to measure and mostly takes place after patients are discharged from the hospital. Hospital mortality is a much more limited quality indicator, but well measurable. That is why this indicator is now used in several countries, using the HSMR and SMRs as defined in section 1.1. If these instruments were totally valid, i.e. the calculations would perfectly adjust for everything that cannot be influenced by the hospital, a value above 100 would always point to inferior care quality, and one could consider the difference between numerator and denominator as an estimate of "avoidable mortality"[1]. However, a perfect instrument for measuring the quality of health care is impossible. A significantly high (H)SMR will at most be an indication of possible shortcomings in hospital care. But the high value may also be due to coding errors in the data or to the lack of essential covariates in the model, which are related to mortality. Still, a significantly high

[1] This would only be possible if the measurement were perfect and mortality by unforeseen complications, after adjustment for differences in casemix, would be equally distributed across hospitals.

(H)SMR is often seen as a warning sign, a reason for further investigation into the causes.

## 1.3 History of the HSMR

In 1999 Jarman initiated the calculation of the (H)SMR for hospitals in England (Jarman et al., 1999). In the following years the model for estimating the mortality probabilities was improved by incorporating additional covariates into the model. Analogous models were adopted by some other countries.

In 2005 Jarman started to calculate the (H)SMR for the Netherlands. Later on, the (H)SMRs for the hospitals in the Netherlands were calculated by Kiwa Prismant, in collaboration with Jarman and his colleagues of the Imperial College London, Dr Foster Intelligence in London and De Praktijk Index in the Netherlands. Their method is described in Jarman et al. (2010) and is slightly adapted by Kiwa Prismant (Prismant, 2008) up to reporting year 2009. Dutch Hospital Data (DHD, Utrecht), the holder of the national hospital discharge data, asked CBS to calculate the (H)SMRs in the coming years, starting with the period 2008-2010. CBS is an independent public body and is already familiar with the input data for the HSMR, i.e. the hospital discharge register (LMR; Landelijke Medische Registratie), as it uses this data source for a number of health statistics (see www.statline.nl).

The starting point for CBS was the HSMR methods previously used by Kiwa Prismant. Advancing insight caused CBS to introduce some changes in the model for the HSMR 2008-2010. This was done in close collaboration with, and largely based on the extensive research of the Dutch scientific Expert group set up by the hospital branch organizations. This Expert group has studied the HSMR methodology and works on its further development.

## 1.4 Privacy

According to the Statistics Netherlands Act, CBS is obliged to keep all data from individuals, households, companies or institutions confidential. Therefore it normally does not deliver recognisable data from institutions to third parties, unless the institutions concerned have stated that they do not have any objections to this. For this reason, CBS asked all hospitals for a written authorization to deliver their hospital specific (H)SMR figures to DHD, who in turn will send each hospital its individual (H)SMR outcome report. This was done in a joint letter with DHD. Outcome data of hospitals that did not give an authorization, are not supplied by CBS. In the letter to the hospitals it was also made clear that CBS will not publish data about identifiable hospitals, but that the hospital branch organisations governing DHD (i.e. NVZ – *Nederlandse Vereniging van Ziekenhuizen*, and NFU – *Nederlandse Federatie van Universitair Medische Centra*) could jointly publish the individual hospital data.

## 1.5 Output by CBS

After deciding about the HSMR methodology to be used in close collaboration with the Dutch HSMR Expert group, CBS estimated the models for the expected mortality per diagnosis. It then calculated the HSMRs and SMRs for all hospitals that (1) had authorized CBS, (2) had registered all or a sufficient part of its admissions in the LMR in the relevant period 2008-2010, and (3) had passed the exclusion criteria for quality and comparability in 2010, which means that the hospital's LMR data were not too deviant in some respects (see Appendix 2).

CBS has produced the following output:

1. A hospital-specific report for each hospital, sent via DHD, containing the HSMR and the diagnosis specific SMR figures for 2008-2010 and separate years. SMRs are also presented for different patient groups (by age, sex and urgency of the admission). The hospitals can see how they score as compared with the national average, overall, and per diagnosis and patient group. CBS only made reports for the hospitals that passed the exclusion criteria and signed the authorization letter.
2. Report on the methods used for calculating the HSMR for 2008-2010 and separate years, including the model results and parameters (this document; see www.cbs.nl).

## 1.6 Limitations of the HSMR

In section 1.2 we argued that the HSMR is not the only indicator to measure quality of hospital care. Furthermore, the quality and limitations of the HSMR (and the SMR) instrument are debated. After all it is based on a statistical model (i.e. the denominator), and a model is always a simplification of reality. Chapter 4 elaborates on the limitations of the present HSMR instrument, which in summary are:

- There are large differences between hospitals in coding the covariates.
- It is impossible to perfectly adjust for differences in casemix (the type of patients treated by a hospital) simply because patients are not randomized to hospitals. There are patient factors (related to mortality) that are not coded in the LMR and therefore cannot be included in the expected mortality model (denominator of the HSMR). So essential covariates are missing. Therefore, if the casemix between hospitals differs too much, standardisation cannot solve this problem completely.
- Hospitals differ not only in casemix, but also in the type of surgical procedures they are permitted to perform. Not all hospitals are e.g. authorized to perform risky interventions as open heart surgery. Therefore the HSMR of hospitals that have a licence to perform such interventions may be unjustly higher than that of hospitals that do not perform these interventions.
- Hospitals can differ in their policies regarding admission and discharge, which can affect the in-hospital mortality. One hospital may discharge a patient earlier

than another hospital because there are, for instance, external terminal care facilities in the neighbourhood.

## 2. (H)SMR model

For each diagnosis group, we have to determine the expected hospital mortality, i.e. the denominator of the SMR. To this end we use logistic regression models with mortality as the target (dependent) variable and with various variables that are available in the LMR as covariates.

The regression models use LMR data of the last four years, i.e. the period 2007-2010. From these, SMRs and HSMRs are calculated for the period 2008-2010 and for the three separate years.

Previously, Kiwa Prismant based the (H)SMR model on LMR data from 2003 onwards. So the HSMR 2006-2008 was based on the expected mortality model (denominator) using the LMR 2003-2008, and the HSMR 2007-2009 was based on the model using the LMR 2003-2009. After study, CBS decided to base the current HSMR model on the last available four years of the LMR, to make the model more up-to date while preserving sufficient stability and accuracy. The (H)SMR figures of 2008 and 2009 can therefore differ from those previously produced by Kiwa Prismant for several reasons. Firstly, adding a new year (2010) to the model will always result in (relatively small) differences in outcomes of previous years. Secondly, CBS used fewer LMR years in the model. Thirdly, differences are a result of changes in the model itself. Mostly based on the extensive research of the Dutch HSMR Expert group, CBS has decided to introduce some changes. In the following sections the current model is explained in detail. The differences with the Kiwa Prismant model are explained in Appendix 3.

### 2.1 Target population and data file

#### *2.1.1 Hospitals*

"Hospital" is the primary observation unit. Hospitals report admission data (hospital stay data) in the LMR. However, not all hospitals participate in the LMR. In Table 1 the response numbers for 2010 are given.

*Table 1. Participation of hospitals in the LMR 2010*

| Type of hospital | Total hospital population | LMR population | Total participating hospitals in LMR | Participating hospitals with partial response |
|---|---|---|---|---|
| General hospitals | 84 | 84 | 74 | 6 |
| University hospitals | 8 | 8 | 8 | 1 |
| Specialised hospitals | 8[a)] | 4[b)] | 2 | 0 |
| Total hospitals | 100 | 96 | 84 | 7 |

a) Hospitals with a long-stay character are not included. Excluded are epilepsy clinics and long-stay centres for rehabilitation and asthma treatment. (Semi-)private clinics are also excluded; these mainly have outpatients and day cases.
b) Included are specialised hospitals for (1) lung diseases, (2) cancer, (3) rheumatic diseases, orthopedics and rehabilitation, and (4) eye diseases.

In the HSMR model all short-stay hospitals with inpatient admissions participating in the LMR in 2007-2010 are included in principle. The target population thus includes all general, university and short stay specialised hospitals with inpatient admissions. One of the 84 general hospitals participating in the LMR has day admissions only, and is therefore excluded from the model. In 2010 twelve hospitals did not participate in the LMR. The admissions of these hospitals cannot be analysed. Another seven hospitals were partial non-respondents in 2010, in the sense that they only provided information on part of their inpatient admissions. Although imputations are made for these missing admissions in the LMR data file, these imputations are not appropriate for model building. However, the registered LMR admissions of the partial non-respondents are included in the HSMR model (with two exceptions, see below). In total, the number of hospitals included in the HSMR model was 83 in 2010, 82 in 2009, 81 in 2008, and 85 in 2007.

In 2010, for two partial non-responding hospitals only the fully registered months were included in the model, as in the other months there were indications that fatal cases were registered completely and the non-fatal cases partially. The partially registered months of these hospitals were removed from the model as these would otherwise unjustly influence the estimates. As only three fully registered months were available for these hospitals, no (H)SMRs were calculated for them. The figures would have been relatively unreliable and not based on the same period length as the other hospitals. Also, no (H)SMR figures were computed for several other hospitals, but for different reasons (see Appendix 2). However, the data of these hospitals was kept in the model.

### *2.1.2 Admissions*

We considered both the population of hospitals and the population of admissions. Our target population of admissions consists of "all hospital stays (inpatient admissions) of Dutch residents in short stay Dutch hospitals during a certain period". The date of discharge, and not the day of admission, determines the year a record is assigned to. So the 2010 population of hospital stays comprises all inpatient admissions that ended in 2010. For the sake of convenience, we will sometimes name these hospital stays as "admissions", thus meaning the hospital stay instead of its very beginning.

Day admissions are excluded because these are in principle non-life-threatening cases with hardly any mortality.

Since there are many diagnoses with very low mortality, only the 50 diagnosis groups with the highest (absolute) mortality are analysed. These diagnosis groups (see section 2.3 for a further specification) cover 79.7% of the entire inpatient hospital mortality and 36.1% of the inpatient admissions in 2008-2010. Moreover, some registered admissions of two partially non-responding hospitals were excluded because of over-reporting fatal cases (see subsection 2.1.1).

Lastly, admissions of foreigners are excluded from the HSMR model. This is partly done in the context of possible future modifications of the model, when other data can be linked to the admissions of Dutch residents (see Appendix 3). The number of admissions of foreigners is relatively small (27 508 inpatient admissions in 2007-2010).

Altogether, 2 387 604 inpatient admissions, that are registered in the LMR within the 50 CCS diagnosis groups considered, were included in the model of 2007-2010.

## 2.2 Target variable (dependent variable)

The target variable for the regression analysis is the "in-hospital mortality". As this variable is binary, logistic regressions have been performed.

The crude mortality rate for the population of 2 387 604 inpatient admissions mentioned in section 2.1 is 4.7%. But, of course, rates are different for different diseases.

## 2.3 Stratification

Instead of performing one logistic regression for all admissions, a separate logistic regression has been performed for each of the selected diagnosis groups *d*. These sub-populations of admissions are more homogeneous than the entire population. Hence, this stratification may improve the precision of the estimated mortality probabilities. As a result of the stratification, covariates are allowed to have different regression coefficients across diagnosis groups.

The diagnosis groups are clusters of ICD9-CM (International Classification of Diseases, 9th Revision, Clinical Modification) codes registered in the LMR. Here the main diagnosis of the admission is used, i.e. the main reason for the hospital stay, which is determined at discharge. The CCS (Clinical Classifications Software[2]) is used for the clustering. This clusters ICD diagnoses into a manageable number of clinically meaningful categories. For the HSMR, we selected the CCS groups with the highest mortality covering about 80% of the total hospital mortality. The 50 CCS groups are listed in Table 4 in section 3.2. The ICD9-CM codes of these 50 CCS groups are available in a separate file published together with this report.

Actually, these 50 CCS diagnosis groups have been kept constant over the last few years. Although the real "top-50" of CCS groups with highest mortality has changed slightly in the course of years, CBS decided to use the same groups as Kiwa Prismant had, for reasons of continuity. So the model includes 50 separate logistic regressions, one for each CCS diagnosis group *d* that was selected.

---

[2] *See http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccsfactsheet.jsp*

## 2.4 Covariates (explanatory variables or predictors of in-hospital mortality)

By including covariates of patient and admission characteristics in the model, the in-hospital mortality is adjusted for these characteristics. As a result, the (H)SMRs are adjusted for these covariates as well. For this one obviously chooses those variables (available in the LMR) that are associated with patient's in-hospital mortality. The more the covariates discriminate between hospitals, the bigger the effect on the (H)SMR. CBS used the same types of covariates that Kiwa Prismant had used before, but changed some operationalisations, especially with respect to the way severity of the main diagnosis and comorbidities were included in the model, as suggested by the Dutch HSMR Expert group.
Here follows a listing of the covariates used. More information about these covariates and their use in the analysis is found in Appendix 1. Differences with the covariates that Kiwa Prismant had used before are explained in Appendix 3.

The following LMR-variables are included in the model as covariates:

- Age at admission (21 categories);
- Sex of the patient (2 categories);
- SES (Socio-Economic Status) of the postal area of patient's address (6 categories). The SES classification per postal code is from The Netherlands Institute for Social Research (*Sociaal Cultureel Planbureau*, SCP);
- Severity of main diagnosis (9 categories). Instead of CCS diagnosis subgroups, we used a new classification of severity of the main diagnosis in terms of mortality rates, as suggested by Van den Bosch et al. (2011); see Appendix 1.
- Urgency of the admission (planned, not planned);
- Comorbidity_1 – Comorbidity_17, i.e. a separate dummy variable (indicator variable) for each of the 17 comorbidity groups that are part of the "Charlson index". The groups are listed in Table A1.1 in Appendix 1. Each dummy variable indicates whether the patient suffers from the specific comorbidity (e.g. diabetes), based on the secondary diagnoses registered in the LMR. The procedure with separate dummy variables has been suggested by Lingsma and Pouw, who did research for the Dutch HSMR Expert group; see Appendices 1 and 3; Finally, we collapsed the 17 comorbidity groups to 15 groups, as described in Appendix 1.
- Source of admission (4 categories: home, nursing home, general hospital, academic or top-clinical hospital), indicating the patient's location before the admission;
- Year of discharge (4 categories: 2007-2010);
- Month of admission (6 categories of two months).

Non-significant covariates ($\alpha$=.05) are dropped during the backward elimination method (see subsection 2.5.2). Only "Year of discharge" is never dropped, as it guarantees that the SMRs and HSMRs have an average of 100. Information on collapsing categories is also found in section 2.5.2.

## 2.5 Computation of the model and the (H)SMR

### *2.5.1 SMR and HSMR*

According to the first formula in section 1.1, the SMR of hospital *h* for diagnosis *d* is written as

$$SMR_{dh} = 100\frac{O_{dh}}{E_{dh}} , \tag{2.1}$$

with $O_{dh}$ the observed number of deaths with diagnosis *d* and hospital *h*, and $E_{dh}$ the expected number of deaths in a certain period. We can denote these, respectively, as

$$O_{dh} = \sum_i D_{dhi} \tag{2.2}$$

and

$$E_{dh} = \sum_i \hat{p}_{dhi} , \tag{2.3}$$

where $D_{dhi}$ denotes the observed mortality for the $i^{th}$ admission of the combination (*d*,*h*), with scores 1 (death) and 0 (survival), and $\hat{p}_{dhi}$ the mortality probability for this admission, as estimated by the logistic regression of "mortality diagnosis *d*" on the set of covariates mentioned in section 2.4. This gives

$$\hat{p}_{dhi} = \text{Prob}(D_{dhi} = 1 \mid X_{dhi}) = \frac{1}{1+\exp(-\hat{\beta}'_d X_{dhi})} , \tag{2.4}$$

with $X_{dhi}$ the scores of admission *i* of hospital *h* on the set of covariates, and $\hat{\beta}$ the maximum likelihood estimates of the corresponding regression coefficients, i.e. the so-called log-odds.

For the HSMR of hospital *h*, we have accordingly

$$HSMR_h = 100\frac{O_h}{E_h} = 100\frac{\sum_d O_{dh}}{\sum_d E_{dh}} = 100\frac{\sum_d \sum_i O_{dhi}}{\sum_d \sum_i \hat{p}_{dhi}} . \tag{2.5}$$

It follows from the above formulae that:

$$HSMR_h = 100\frac{\sum_d E_{dh}\frac{O_{dh}}{E_{dh}}}{E_h} = \sum_d \frac{E_{dh}}{E_h} SMR_{dh} . \tag{2.6}$$

Hence, an HSMR is a weighted mean of the SMRs, with the expected mortalities across diagnoses as the weights.

### 2.5.2 Modelling and model-diagnostics

For each of the 50 CCS diagnosis groups, first the full model has been estimated, using all categorical covariates mentioned in section 2.4. Subsequently, reduced models are estimated, dropping non-significant covariates ($\alpha$=.05) by using the "fastbw" method of Lawless and Singhal (1978). This backward stepwise elimination procedure uses the Wald statistic as a testing criterion. Finally, Year of discharge is added to the reduced model if it was dropped during the stepwise procedure.

Appendix 1 gives an overview of the covariates and their categories. Categories, including the reference category, are collapsed if the number of admissions is smaller than 50, thus preventing the standard errors of the regression coefficients to become too large. This collapsing is performed starting from the smallest category, which is combined with the smaller nearby category, etc. For technical reasons dealing with the chosen R-software, collapsing also took also place when there were no deaths in the category. For the comorbidity variables a comparable method of collapsing was performed; see Appendix 1. All regression coefficients are presented in Appendix 4.

For evaluating the 50 models, the following statistics are presented:

- standard errors for all regression coefficients, as well as the odds, which are the exponents of the regression coefficients;
- Wald statistics for the overall effect and the significance testing of categorical variables;
- C-statistics for the overall fit. The C-statistic is a measure for the predictive validity of, in our situation, a logistic regression. Its maximum value of 1 points to perfect discriminating power and 0.5 points to a discriminating power not better than expected by chance, which will be the situation if no appropriate covariates are found. We present the C-statistics as an evaluation criterion for the 50 logistic regressions; see Table 4 in section 3.2.

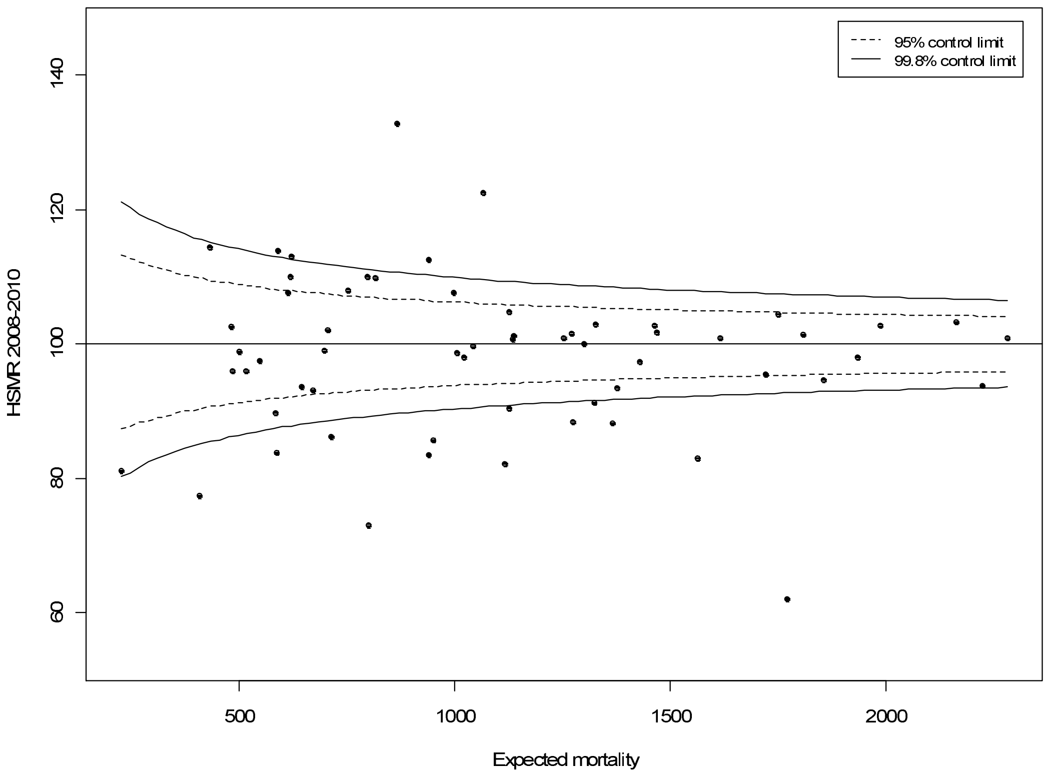
### 2.5.3 Confidence intervals and control limits

For each SMR and HSMR a 95% confidence interval is calculated, i.e. an upper and lower confidence limit. These limits are mentioned in the specific reports for the hospitals. A lower limit above 100 points to a statistically significantly high (H)SMR, and an upper limit below 100 points to a statistically significantly low (H)SMR. For the calculation of these confidence intervals, a Poisson distribution is assumed for the numerator of the (H)SMR, whereas the denominator is assumed to have no variation. This is a good approximation, since the variance of the denominator is small. As a result of these assumptions, exact confidence limits could be computed.

HSMRs can be presented in a funnel plot (see Figure 1). This is a plot of hospitals, where the vertical axis represents the HSMRs and the horizontal axis the expected mortalities. Points above the horizontal axis (HSMR=100) have a higher observed than expected mortality. As this might be a non-significant feature, due to chance, control limits are shown in the plot for each possible expected mortality. HSMRs within these control limits do not deviate significantly from 100. In the case of 95% control limits, about 2.5% of the points would lie above the upper limit if there is no reason for differences between HSMRs, and about 2.5% of the points below the lower limit. The same holds, mutatis mutandis, for the 99.8 control limits. Here about 0.1% of the points would lie above the upper line, if there is no reason for differences in standardised mortality rates. Most attention will be paid to this line, as points above this line have a high HSMR that is statistically very significant, which can hardly be the result of chance alone. These hospitals would be advised to investigate the possible reasons for the significantly high values: coding errors, unmeasured casemix variables and/or suboptimal quality of care.

Figure 1 gives the funnel plot of the HSMRs 2008-2010. Exact control limits have been computed. As mentioned before, hospitals are excluded if their data did not pass the exclusion criteria or if they did not authorize CBS. As some of these hospitals are still represented in the expected mortality model, the (weighted) average HSMR of the displayed hospitals will not be exactly equal to 100. Actually, the weighted average HSMR of  the displayed hospitals in 2008-2010 (n=60) is 97.8. Also for the year 2010 the average HSMR of the non-excluded hospitals (n=68) is 97.8. Restriction of the models to the non-excluded hospitals would not have changed the general picture in the funnel plot, apart from the small effect on the HSMR averages.

*Figure 1. Funnel plot HSMR 2008-2010*



The precision of the HSMR is much greater for a three-year period than for a single year, reflected by a smaller range between the control limits. The confidence intervals of the HSMR are smaller as well. This is the reason why HSMRs and corresponding funnel plots of three-year periods are more often presented than one-year figures. Of course, drawbacks are that two progressive three-year figures (e.g. 2007-2009 and 2008-2010) are overlapping, and that the three-year figure is less up-to-date than the figure of the last year. Therefore we have also calculated the figures for the last available year (funnel plot of 2010 not presented). Observed mortality (numerator) and expected mortality (denominator) are then calculated for this year, whereas the expected mortality model of the HSMR still uses the 2007-2010 data. If a hospital has a significantly high HSMR in 2010, but not for 2008-2010, this is a signal for further investigation, as the quality of care may have deteriorated. On the other hand, if a hospital has a significantly high HSMR in 2008-2010, but not in 2010, this does not necessarily mean that the situation has improved in 2010, as the one-year figures are less often significant because of the larger margins. In such cases one should not only take into account the significance, but also look at the HSMR levels over the years.

## 3. Model results and evaluation

In this chapter the model results are described and evaluated. Some summary measures are presented of the 50 logistic regressions, one for each CCS group, with inpatient mortality as the dependent variable and the variables mentioned in section 2.4 as explanatory variables. The more detailed results, such as the regression coefficients, are presented in Appendix 4.

The computations have been performed using the procedure "lrm" from the R-package "rms".

### 3.1 Impact of the covariates on mortality

Table A4.1 of Appendix 4 shows for each CCS diagnosis group which covariates are preserved in the regression models, which implies that they have a statistically significant impact on in-hospital mortality: "1" points to (statistical) significance, and "0" to non-significance. As an exception, Year of discharge automatically gets a "1", as this covariate has been preserved even when it is not statistically significant. This guarantees that the overall expected and observed mortalities are equal for each year considered.

The last line of Table A4.1 gives the numbers of significant results across the CCS groups for each covariate. These values are presented again in Table 2 below, as a summary, but ordered with respect to the number of times a covariate is significant. So it shows how many times each covariate is used in the final regressions, i.e. after implementation of the stepwise procedure. Age, Urgency of the admission and Severity of the main diagnosis are significant for the great majority of the 50 diagnosis groups. This is also true for the comorbidity groups 2, 13 and 16, i.e. for Congestive heart failure, Renal disease and Metastatic cancer. The impact of SES is very limited. Comorbidity 15, HIV, was never significant. It was seldom registered as a comorbidity; most CCS groups had less than 50 admissions with HIV comorbidity.

The relative impact of the covariates is better judged by considering the Wald (chi-square) statistics for each covariate; see Table A4.2A of Appendix 4. The Wald statistic has been used for testing whether the covariates had a significant impact on mortality. But it can also be used as a measure of association. A large value of a Wald statistic points to a strong impact of that covariate on mortality, adjusted for the impact of the other covariates. It is a kind of "explained chi-square". As the number of categories may "benefit" covariates having many categories, the corresponding numbers of degrees of freedom (df) are presented in Table A4.2B, where df is the number of categories in the final model, minus 1.

*Table 2. Statistical significance of the covariates for the 50 logistic regressions (summary)*

| Covariate | No. of significant results | Covariate | No. of significant results |
|---|---|---|---|
| Year of discharge[a)] | 50 | Comorbidity_9 | 23 |
| Age | 49 | Sex | 21 |
| Comorbidity_16 | 47 | Comorbidity_8 | 15 |
| Comorbidity_2 | 45 | Month of admission | 14 |
| Urgency | 44 | Comorbidity_5 | 11 |
| Comorbidity_13 | 44 | SES | 9 |
| Severity main diagnosis | 43 | Comorbidity_7 | 4 |
| Comorbidity_4 | 39 | Comorbidity_10 | 2 |
| Comorbidity_6 | 37 | Comorbidity_12 | 2 |
| Comorbidity_14 | 37 | Comorbidity_15 | 0 |
| Comorbidity_1 | 35 | Comorbidity_11[b)] | - |
| Source of admission | 33 | Comorbidity_17[b)] | - |
| Comorbidity_3 | 25 | | |

a) Year of discharge has been preserved in all 50 regressions.

b) Comorbidity_17 "Severe liver disease" and Comorbidity_11 "Diabetes complications" are always added to Comorbidity_9 "Liver diseases" and Comorbidity_10 "Diabetes", respectively.

Since no influence on mortality has been assessed for non-significant covariates, the Wald statistics for these covariates are left out and these values are counted as zero in the column sums. For the numbers of degrees of freedom, we have presented the number of categories minus 1 in the *final* models. Hence, Age may have its maximum of 20 df, as it has 21 categories, but when categories are collapsed, df will be smaller than 20. For Severity of main diagnosis, df also depends on the CCS main diagnosis group, as the (severity of) subdiagnoses differ, resulting in different numbers of categories.

The last line of Table A4.2A gives the sum of the Wald statistics across the 50 regressions for each covariate, as a kind of "explained chi-square". In Table 3 below, these are presented again, as a summary, but now ordered by value. The sums of the degrees of freedom, the last line of Table A4.2B, are added to Table 3. It shows that Age has the highest explanatory power, with 28 081 as the sum of the Wald statistics. But Age has the most parameters by far. Severity of main diagnosis is also a covariate with a large impact on mortality and has fewer categories. Urgency of the admission is also an important variable. The explanatory power of Sex, Month of admission and SES is relatively small. This is also true for some comorbidity groups. Like in Table 2, comorbidity groups 2, 13 and 16 are the groups with the most impact on mortality. The sum of all Wald statistics for the 15 comorbidity groups considered is equal to 18 827, but due to interference of comorbidities this only can give an indication of their combined effect. Anyway, it can be concluded that several comorbidity groups also contribute importantly to the model.

As mentioned before, Table 3 only gives a summary of Table A4.2. The effect of a covariate on mortality can be very different for different CCS groups.

*Table 3. Wald chi-square statistics for the 50 logistic regressions*

| Covariate | Sum of Wald statistics | Sum of df | Covariate | Sum of Wald statistics | Sum of df |
|---|---|---|---|---|---|
| Age | 28081.3 | 768 | Sex | 661.2 | 21 |
| Severity main diagnosis | 24363.1 | 141 | Comorbidity_3 | 478.0 | 25 |
| Urgency | 15009.9 | 44 | Month of admission | 359.8 | 70 |
| Comorbidity_2 | 6042.2 | 45 | Comorbidity_8 | 294.8 | 15 |
| Comorbidity_16 | 3209.2 | 47 | Comorbidity_5 | 166.2 | 11 |
| Comorbidity_13 | 2698.9 | 44 | SES | 154.0 | 42 |
| Source of admission | 1613.4 | 95 | Comorbidity_7 | 30.0 | 4 |
| Comorbidity_4 | 1556.9 | 39 | Comorbidity_10 | 14.5 | 2 |
| Comorbidity_14 | 1548.1 | 37 | Comorbidity_12 | 11.5 | 2 |
| Year of discharge[a)] | 1496.5 | 150 | Comorbidity_15 | - | - |
| Comorbidity_1 | 1039.8 | 35 | Comorbidity_11[b)] | - | - |
| Comorbidity_9 | 920,1 | 23 | Comorbidity_17[b)] | - | - |
| Comorbidity_6 | 816.5 | 37 | | | |

a) Year of discharge has been preserved in all 50 regressions.

b) Comorbidity_17 "Severe liver disease" and Comorbidity_11 "Diabetes complications" are always added to Comorbidity_9 "Liver diseases" and Comorbidity_10 "Diabetes", respectively.

### 3.2 Model evaluation for the 50 regression analyses

Table 4 gives the CCS diagnosis groups and the values of the C-statistic; see section 2.5.2 for its meaning. Nearly all values of the C-statistic lie between 0.7 and 0.9. The highest values are found for the CCS groups "Intracranial injury" (C=.93), "Cancer of breast" (C=.93) and "Biliary tract disease" (C=.91). For these three CCS groups the covariates strongly reduce the uncertainty in predicting patient's mortality. The lowest values are found for "Congestive heart failure; nonhypertensive" (C=.66), "Aspiration pneumonitis; food/vomitus" (C=.68) and "Liver disease; alcohol-related" (C=.71).

*Table 4. C-statistics for the logistic regressions of the 50 CCS main diagnosis groups*

| CCS-group no. | Description CCS diagnosis group | Number of admissions | C-statistic |
|---|---|---|---|
| 2 | Septicemia (except in labour) | 15,450 | 0.77 |
| 12 | Cancer of esophagus | 10,596 | 0.74 |
| 13 | Cancer of stomach | 14,564 | 0.78 |
| 14 | Cancer of colon | 40,199 | 0.79 |
| 15 | Cancer of rectum and anus | 21,207 | 0.80 |
| 17 | Cancer of pancreas | 10,774 | 0.72 |
| 19 | Cancer of bronchus; lung | 72,238 | 0.82 |
| 24 | Cancer of breast | 57,519 | 0.93 |
| 29 | Cancer of prostate | 23,081 | 0.89 |
| 32 | Cancer of bladder | 41,505 | 0.89 |
| 38 | Non-Hodgkins lymphoma | 20,110 | 0.81 |
| 39 | Leukemias | 19,229 | 0.84 |
| 42 | Secondary malignancies | 67,710 | 0.77 |
| 44 | Neoplasms of unspecified nature or uncertain behavior | 20,895 | 0.81 |
| 50 | Diabetes mellitus with complications | 32,495 | 0.86 |
| 55 | Fluid and electrolyte disorders | 26,922 | 0.83 |
| 59 | Deficiency and other anemia | 45,376 | 0.78 |
| 85 | Coma; stupor; and brain damage | 3,983 | 0.80 |
| 96 | Heart valve disorders | 33,780 | 0.79 |
| 100 | Acute myocardial infarction | 87,847 | 0.77 |
| 101 | Coronary atherosclerosis and other heart disease | 228,060 | 0.79 |
| 103 | Pulmonary heart disease | 26,062 | 0.78 |
| 106 | Cardiac dysrhythmias | 180,951 | 0.85 |
| 107 | Cardiac arrest and ventricular fibrillation | 8,251 | 0.77 |
| 108 | Congestive heart failure; nonhypertensive | 99,716 | 0.66 |
| 109 | Acute cerebrovascular disease | 95,070 | 0.76 |
| 114 | Peripheral and visceral atherosclerosis | 40,469 | 0.90 |
| 115 | Aortic; peripheral; and visceral artery aneurysms | 26,282 | 0.88 |
| 116 | Aortic and peripheral arterial embolism or thrombosis | 28,569 | 0.89 |
| 117 | Other circulatory disease | 21,765 | 0.85 |
| 122 | Pneumonia (except that caused by tuberculosis or sexually transmitted diseases) | 118,913 | 0.78 |
| 127 | Chronic obstructive pulmonary disease and bronchiectas | 76,096 | 0.71 |
| 129 | Aspiration pneumonitis; food/vomitus | 4,518 | 0.68 |
| 130 | Pleurisy; pneumothorax; pulmonary collapse | 22,683 | 0.83 |
| 133 | Other lower respiratory disease | 97,754 | 0.86 |
| 145 | Intestinal obstruction without hernia | 32,213 | 0.83 |
| 146 | Diverticulosis and diverticulitis | 32,658 | 0.86 |
| 149 | Biliary tract disease | 122,765 | 0.91 |
| 150 | Liver disease; alcohol-related | 4,848 | 0.71 |
| 151 | Other liver diseases | 16,369 | 0.80 |
| 153 | Gastrointestinal hemorrhage | 33,657 | 0.79 |
| 155 | Other gastrointestinal disorders | 45,745 | 0.90 |
| 157 | Acute and unspecified renal failure | 9,766 | 0.75 |
| 158 | Chronic renal failure | 18,683 | 0.85 |

| CCS-group no. | Description CCS diagnosis group | Number of admissions | C-statistic |
|---|---|---|---|
| 159 | Urinary tract infections | 62,266 | 0.83 |
| 226 | Fracture of neck of femur (hip) | 66,420 | 0.79 |
| 233 | Intracranial injury | 56,990 | 0.93 |
| 237 | Complication of device; implant or graft | 74,632 | 0.84 |
| 238 | Complications of surgical procedures or medical care | 67,041 | 0.86 |
| 249 | Shock | 2,912 | 0.73 |

### 3.3 Regression coefficients

Table A4.3 of Appendix 4 contains the output from the R-package rms. For each of the 50 logistic regressions it contains

- the formula of the model, which shows the covariates that are preserved in the model after the stepwise backward procedure,
- some general information about the data and model fit,
- the (estimated) regression coefficients, also called "log-odds", their standard errors (S.E.) and the odds, which are the exponents of the regression coefficients. The regression coefficients are the elements from the vector $\hat{\beta}_d$ from formula (2.4), for each diagnosis *d*. Notice that a $\beta$-coefficient has to be interpreted as the difference in log-odds between the category in question and the reference category (first category, which is not shown in the output) of the same covariate. Non-significant coefficients are left out and in many cases categories are collapsed (see also section 2.5.2).

## 4. Limitations of the HSMR

From the first publication of the HSMR in England on, there have been discussions about the quality of the HSMR as an instrument. Pro and contra agree that the HSMR is not a unique, ideal measure, but at most a possible indicator for the quality of health care, next to other possible indicators. But even in considering the HSMR with a more limited purpose, i.e. standardising hospital mortality rates for unwanted side-effects, the interpretation of HSMRs has some problems. We mention some of these.

- Appendix 1 contains the list of covariates included in the regression model. Hospitals do not always code these variables in the same way. Variables such as Age and Gender do not give any problems. But coding e.g. unplanned admissions, main diagnosis and comorbidity may depend on the physician and the coder. Lilford and Pronovost (2010) argue that when the quality of the source data is insufficient, the regression model should not adjust for such erroneously coded covariates. Van den Bosch et al. (2010) make extensive reference to the influence of coding errors. Exclusion criteria for outliers can partially address this problem, but not completely.
- Some hospitals can have more seriously ill patients than other hospitals, on average, even when having the same set of scores on the covariates. University hospitals may have more serious cases than other hospitals, while it is questionable whether the model adjusts satisfactorily for this phenomenon. Some essential covariates that are related to mortality are then missing. This can be due to the fact that some of the desired covariates are not (yet) measured in the LMR. Some factors will be hard to measure at all. But there are also important missed variables that may be measured in future years by the hospitals, such as palliative care.
- The same problem occurs when certain high risk surgical procedures are only performed in certain hospitals. For instance, open heart surgery only occurs in authorized cardiac centres. These hospitals may have higher SMRs for heart diseases due to the more dangerous interventions. This could be solved by including a covariate in the model that indicates whether such a procedure was performed. The disadvantage of this is that a method of treatment is used as a covariate, while this should ideally not be part of the model as it is a feature of hospital care. Furthermore, a practical problem is that the registration of surgical procedures in the LMR has been far from complete in recent years.
- Hospitals can differ in admission and discharge policy. For instance, one hospital may admit the same patient more frequently but for shorter stays than the other. Or it discharges a patient earlier than the other because there are external terminal care facilities in the neighbourhood. Besides, hospitals may also allocate health care in a different way, paying more or less attention to less

acute cases. Obviously, all these situations influence the outcome of the HSMR, as it influences the observed mortality numbers, but cannot be translated in terms of quality of care.

- Hospitals can compare their HSMR and SMRs with the national average of 100. The *mutual* comparison between (H)SMRs of two or more hospitals is more complicated. There is no complete adjustment for differences in casemix between pairs of hospitals. Theoretically, it is even possible that hospital A has higher SMRs than hospital B for all diagnosis groups, but a lower HSMR. Although this is rather theoretically, one should still be careful with mutual comparison of HSMRs (Heijink et al., 2008).

## 5. Possibilities for the future

We have implemented some improvements in the present HSMR model, of which the most important are a different classification of the severity of main diagnosis and a different way of processing the comorbidities. The HSMR model can be further developed in the coming years, depending on the practical possibilities for this (e.g. availability of data on extra yet missing covariates) and the added value compared to the present HSMR model. On the one hand, stability of the model is advisable, so that HSMRs are better comparable across years. This would argue in favour of not drastically changing the current model for the next few years. On the other hand, new insights may be reason to further improve the HSMR instrument. Some ideas for improvement are mentioned here. These ideas are largely based on international literature and discussions with the Dutch HSMR Expert group.

- Mortality is presently restricted to in-hospital mortality. In the United Kingdom there will be a change this year from the HSMR (Aylin et al., 2010) to the so called "Summary Hospital-Level Mortality Indicator" or SHMI (Campbell et al., 2011). One of the main differences is that the SHMI includes mortality within 30 days after discharge. The reason for this is that mortality after discharge may also be a result of hospital quality. Apart from this, the 30-day mortality may also tackle the problem of variety in the availability of terminal care outside the hospital. In the Netherlands 30-day mortality can be measured by linking the LMR with the Municipal Personal Records Database (GBA). This linkage is not yet complete, because a unique identifier is missing in the LMR data. In the coming years such an identifier will be introduced in the LMR.
- The 50 CCS diagnosis groups used were the "top-50" several years ago. Although they still cover nearly 80% of hospital mortality, this top-50 does not fully correspond with the present top-50. So, there are diagnosis groups in the present top-50 that are not included in the 50 diagnosis groups selected for the HSMR. The selection of diagnosis groups could therefore be updated to a new top-50, or extended to the top-70, or include all inpatient mortality.
- HSMRs are generally calculated for the entire target population of hospitals. All (H)SMRs are thus compared with the average mortality rate of 100. It could be considered to estimate models and calculate (H)SMRs for more homogeneous groups of hospitals, since the type of standardisation used does not completely adjust for differences in casemix. Examples of such "peer groups" are university hospitals and cardiac centres, which may have more life-threatening cases, for which the model does not sufficiently adjust when all hospitals are modelled together. Hospitals are then compared with the average mortality in their peer group. Relations *between* peer groups will then be lost, however. This will not be the case when, instead, hospitals that belong to the same peer group are marked in the general HSMR figures of all hospitals.

Another option is to add covariates that discriminate between peer groups and their complementary groups. One may e.g. use as covariate whether the hospital is a university hospital or not, or whether or not the hospital is permitted to perform certain cardiac procedures such as open heart surgery or percutaneous coronary interventions. This, however, has the drawback that one adjusts for hospital characteristics that may be linked to hospital quality.

- Linking the LMR with the GBA and other databases available at CBS, can give extra patient variables to adjust for, such as ethnicity or socio-economic variables. Also, the "number of previous hospital admissions" can then be calculated, which can also be done with the LMR dataset only, when a unique personal identifier is included. CBS already links the LMR to the GBA for its health statistics, where date of birth, sex and postal code are used as linkage key. However, because of the limited resolution power of this key, the linkage is not complete. For use for the HSMR it is desirable that (nearly) all hospital patients can be linked. To this end, each person should have a unique identifier in the LMR.

More research is necessary before introducing these and other possible changes into the HSMR-model.

## 6. References


Aylin, P., A. Bottle, M.H. Jen and S. Middleton (2010). *HSMR mortality indicators*. Technical document, Dr Foster Unit at Imperial, Imperial College, London.

Campbell, M.J., R.M. Jacques, J. Fotheringham, T. Pearson, R. Maheswaran and J. Nicholl (2011). *An evaluation of the Summary Hospital Mortality Index*. School of Health and Related Research, The University of Sheffield.

Heijink, R., X. Koolman, D. Pieter, A. van der Veen, B. Jarman and G. Westert (2008). Measuring and explaining mortality in Dutch hospitals; The Hospital Standardized Mortality Rate between 2003 and 2005. *BMC Health Services Research* 8:73.

Jarman, B., D. Pieter, A.A. van der Veen, R.B. Kool, P. Aylin, A. Bottle and G.P. Westert (2010). The hospital standardised mortality ratio: a powerful tool for Dutch hospitals to assess their quality of care? *Qual Saf Healthcare* 19, 9-13.

Jarman, B., S. Gault, B. Alves, A. Hider, S. Dolan, A. Cook, B. Hurwitz and L.I. Iezzoni (1999). Explaining differences in English hospital death rates using routinely collected data, *BMJ* 318, 1515-1519.

Lawless, J.F. and K. Singhal (1978). Efficient screening of nonnormal regression models. *Biometrics* 34, 318-327.

Lilford, R. and P. Pronovost (2010). Using hospital mortality rates to judge hospital performance: a bad idea that just won't go away. *BMJ* 340:c2016.

Prismant (2008). *De toepasbaarheid van de HSMR in het toezicht van de inspectie voor de gezondheidszorg*. Prismant, Utrecht.

Van den Bosch, W.F., J. Silberbusch, K.J. Roozendaal en C. Wagner (2010). Variatie in codering patiëntengegevens beïnvloedt gestandaardiseerd ziekenhuissterftecijfer. *Ned Tijdschr Geneeskd.* 154 (2), 1-9.

Van den Bosch, W.F., P. Spreeuwenberg en C. Wagner (2011). Gestandaardiseerd ziekenhuissterftecijfer (HSMR): correctie voor ernst hoofddiagnose kan beter. *Ned Tijdschr Geneeskd.* 155:A3299, 66-75.



***Acknowledgement***

The authors would like to thank the Dutch HSMR Expert Group for their advice. They have done much research into improving the HSMR model, the results of which we gratefully used. We especially thank Mr M.E. Pouw, MSc, Dr H.F. Lingsma and Dr W.F. van den Bosch for their input and Prof. K.G.M. Moons for his comments.

## Appendix 1. Covariates: definitions and use in regression analyses

In this appendix detailed information is given on the definitions and categories of the covariates, and their use in the regression analyses.

For the regressions, all categorical covariates are transformed into dummy variables (indicator variables), having scores 0 and 1. A patient scores 1 on a dummy variable if he/she belongs to the corresponding category, and 0 otherwise. As the dummy variables for a covariate are linearly dependent, one dummy variable is left out for each categorical covariate. The corresponding category is the so-called *reference category*. We took the *first* category of each covariate as the reference category.

The general procedure for collapsing categories is described in section 2.5.2. Special (deviant) cases of collapsing are mentioned below.

**Age at admission** (in years): *0, 1-4, 5-9, 10-14, ..., 90-94, 95+*.

**Sex** of the patient: *male, female.*

If Sex is unknown, “female” has been imputed; this happened only twice.

**SES (Socio-Economic Status)** of the postal area of patient’s address: *lowest, below average, average, above average, highest, unknown.*

The SES variable has been added to the LMR dataset on the basis of the postal code of the patient’s residence. The SES variable was derived from The Netherlands Institute for Social Research (SCP)[3], who collected SES data in 2006 and performed a principal component analysis on variables that deal with Income, Employment and Education level. Each four-letter postal area thus obtained a component score. Out of these scores, population-weighted quintiles are calculated, resulting in the six SES categories mentioned above. Patients for whom the postal area does not exist in the dataset of the SCP (category “unknown”), are added to the category “average” if collapsing was necessary.

**Severity of main diagnosis** groups: *[0-0.01), [0.01-0.02), [0.02-0.05), [0.05-0.1), [0.1-0.2), [0.2-0.3), [0.3-0.4), [0.4-1], Others*. This is a categorisation in mortality rates. Each ICD9-CM main diagnosis code is classified in one of these groups, as explained below.

A separate model has been estimated for each CCS diagnosis group. Most groups have many sub-diagnoses (individual ICD9-CM codes), which may differ in seriousness (mortality risk). To classify the severity of the sub-diagnosis, we used the method suggested by Van den Bosch (2011). He suggested to categorize the ICD9-CM codes into mortality rate categories. To this end, we computed inpatient mortality rates for all ICD9-CM sub-diagnoses for the period 2005-2009, and chose

3 see http://www.scp.nl/content.jsp? objectid=default:20133

the following boundaries for the mortality rate intervals: 0, .01, .02, .05, .1, .2, .3, .4 and 1. ('0' means 0% mortality; '1' means 100% mortality). These boundaries are used for all CCS diagnosis groups. The higher severity categories only occur for a few diagnosis groups. The individual ICD9-CM codes with the corresponding severity category are available in a separate file published together with this report.

A limitation of this procedure is that partially the same dataset is used for calculating the mortality rates for the severity variable (2005-2009) and for the mortality target variable of the HSMR (2008-2010). This overlap will automatically wash out when HSMRs are calculated for later years. To diminish its effect on the SMRs, ICD9-CM codes that have admissions in less than five different hospitals were put in the category "others", as suggested by Van den Bosch. It is actually a category of admissions with ICD9-CM codes for which the mortality rates are unreliable.

Just like for the other covariates, categories are collapsed with nearby categories if the number of admissions is smaller than 50 or when there are no deaths. The category "others", however, does not have a natural nearby category. We decided to collapse "others" with the category having the highest frequency (i.e. the mode), if necessary.

**Urgency** of the admission: *planned, not planned (acute)*.

The definition of an acute admission is: an admission that was not planned (for that moment) and cannot be postponed since immediate aid (observation, examination or treatment) is necessary.

**Comorbidity_1 – Comorbidity_17**. All these 17 covariates are dummy-variables, having categories: *0* (*no*) and *1* (*yes*).

The 17 comorbidity groups are listed in Table A1.1, with their corresponding ICD9-CM codes. These are the same comorbidity groups as used in the Charlson index. However, separate dummy variable are used for each of the 17 comorbidity groups, as advised by the Dutch HSMR Expert group.

All secondary diagnoses registered in the LMR and belonging to the 17 comorbidity groups are used, but if a secondary diagnosis is identical to the main diagnosis, it is not considered a comorbidity. Secondary diagnoses referring to a complication (occurring during the hospital stay), external cause, or the morphological typing of a cancer are also excluded.

In conformity with the collapsing procedure for other covariates, comorbidity groups that are registered in less than 50 admissions are left out, as the two categories of the dummy variable are then collapsed. Comorbidity groups without deaths do not discriminate between admissions either and are left out as well.

However, combining different comorbidity groups has always been done for Comorbidity_17 (Severe liver disease) and for Comorbidity_11 (Diabetes complications), even in case there were 50 or more admissions. Comorbidity_17 has been added to Comorbidity_9 (Liver diseases), and Comorbidity_11 to Comorbidity_10 (Diabetes). So, finally we used 15 comorbidity groups.

*Table A1.1. Comorbidity groups of Charlson index and the corresponding ICD9-CM codes*

| No. | Comorbidity groups (Charlson variables) | ICD9-CM codes |
|---|---|---|
| 1 | Acute myocardial infarction | 410, 412 |
| 2 | Congestive heart failure | 428 |
| 3 | Peripheral vascular disease | 441, 4439, 7854, V434 |
| 4 | Cerebral vascular accident | 430–438 |
| 5 | Dementia | 290 |
| 6 | Pulmonary disease | 490, 491, 492, 493, 494, 495, 496, 500, 501, 502, 503, 504, 505 |
| 7 | Connective tissue disorder | 7100, 7101, 7104, 7140, 7141, 7142, 71481, 5171, 725 |
| 8 | Peptic ulcer | 531, 532, 533, 534 |
| 9 | Liver disease | 5712, 5714, 5715, 5716 |
| 10 | Diabetes | 2500, 2501, 2502, 2503, 2507 |
| 11 | Diabetes complications | 2504, 2505, 2506 |
| 12 | Paraplegia | 342, 3441 |
| 13 | Renal disease | 582, 5830, 5831, 5832, 5836, 5837, 5834, 585, 586, 588 |
| 14 | Cancer | 14, 15, 16, 18, 170, 171, 172, 174, 175, 176, 179, 190, 191, 192, 193, 194, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 200, 201, 202, 203, 204, 205, 206, 207, 208 |
| 15 | HIV | 042, 043, 044 |
| 16 | Metastatic cancer | 196, 197, 198, 1990, 1991 |
| 17 | Severe liver disease | 5722, 5723, 5724, 5728 |

**Source of admission**: *home, nursing home, general hospital, academic or top-clinical hospital*.

This variable indicates the patient's location before the admission.

**Year of discharge**: *2007, 2008, 2009, 2010*.

This variable is never left out at the stepwise procedure, since (H)SMRs have to be calculated for the separate years 2008 to 2010. Inclusion of the year guarantees the number of observed and expected (predicted) deaths to be equal for that year. This makes the yearly (H)SMRs have an average of 100, when weighting the hospitals proportional to their expected mortality.

**Month of admission:** *January/February, ..., November/December*.

The months of admission are combined into 2-month periods.

## Appendix 2. Exclusion criteria for the calculation of HSMRs

Although all hospitals mentioned in section 2.1.1 are included in the model, HSMR outcome data were not produced for all hospitals. HSMRs were only calculated for hospitals that met the criteria for LMR participation, data quality and casemix. For this we used the same exclusion criteria as Kiwa Prismant did last year. In addition to this, only HSMRs were calculated for hospitals that authorized CBS to deliver their HSMR figures to DHD.

Criteria used for excluding a hospital from calculating HSMRs were:

*No inpatient admissions*

0. Hospitals treating only day cases or outpatients are excluded, as calculation of the HSMR is not relevant then. Actually, these hospitals do not belong to the HSMR population. Therefore, a code "0" has been assigned to this criterion.

*Insufficient participation in the LMR*

1. Hospitals with a LMR response rate of less than 50% for inpatient admissions are excluded. Hospitals with less than 6 completely registered months in a year and a selective registration of the fatal cases in the other months are also excluded (see also section 2.1.1).

*Data quality*

Hospitals are excluded if:

2. ≥2% of the inpatient admissions have a vague diagnosis code (ICD9-CM codes 799.8 and 799.9).
3. ≤30% of the inpatient admissions are coded as acute (not planned).
4. ≤0.5 secondary diagnoses are registered per inpatient admission, on average per hospital.[4]

*Casemix*

Hospitals are excluded if:

5. The expected mortality is 50 or less, i.e. $E_{dh} \leq 50$.
6. ≤70% of the inpatient hospital deaths are within the 50 CCS diagnosis groups considered.

In addition to the above mentioned criteria, hospitals are also excluded if they did not authorize CBS to deliver their HSMR figures.

Table A2.1 gives a summary of the hospitals by the different criteria for exclusion for 2010, and Table A2.2 for 2008-2010. (H)SMRs for 2008-2010 are only

[4] For this criterion all secondary diagnoses are considered, also when they do not belong to the 17 comorbidity groups that are used as covariates. If identical secondary diagnoses (identical ICD9-CM codes) are registered within one admission, only one is counted. If a secondary admission is identical to the main diagnosis of the admission, it is not counted as a secondary diagnosis.

calculated if hospitals fulfill the criteria in 2010 and in the three year period as a whole, and have responded in all three years.

*Table A2.1. Number of hospitals according to exclusion criteria, 2010*

| No. | Criterion | Authorization | No authorization | Total hospitals |
|---|---|---|---|---|
| 0 | No inpatient admissions | 1 | 0 | 1 |
| 1 | No/partial participation (<50%) LMR | 9 | 7 | 16 |
| | *of which no participation in one or more years* | *5* | *7* | *12* |
| | *of which partial (<50%) response in one or more years*[a)] | *3* | *0* | *3* |
| | *of which <6 months complete registration + selective registration of mortality* | *1* | *0* | *1* |
| 2 | ≥2% vague diagnosis code | 2 | 0 | 2 |
| 3 | ≤30% admissions coded as acute | 0 | 0 | 0 |
| 4 | ≤ 0.5 secondary diagnoses per inpatient admission (average per hospital) | 3 | 0 | 3 |
| 5 | ≤50 expected mortality | 1 | 0 | 1 |
| 6 | ≤ 70% hospital deaths within the 50 diagnosis groups considered[b)] | 0 | 0 | 0 |
| | Does not fulfill >1 of above-mentioned exclusion criteria (1-6) | 2 | 1 | 3 |
| | Meet all criteria | 68[b)] | 2 | 70 |
| | Total hospitals | 86 | 10 | 96 |

a) For one hospital with <50% response, the registered data are also selective with respect to mortality.
b) For one hospital (H)SMRs are calculated although the percentage of deaths in the 50 diagnosis groups was slightly lower than 70% in 2010. This hospital is grouped under “Meet all criteria”.

*Table A2.2. Number of hospitals according to exclusion criteria, 2008-2010*

| No. | Criterion | Authorization | No authorization | Total hospitals |
|---|---|---|---|---|
| 0 | No inpatient admissions | 1 | 0 | 1 |
| 1 | No/partial participation (<50%) LMR | 12 | 5 | 17 |
| | *of which no participation in one or more years* | *9* | *5* | *14* |
| | *of which partial (<50%) response in one or more years*[a)] | *2* | *0* | *2* |
| | *of which <6 months complete registration + selective registration of mortality* | *1* | *0* | *1* |
| 2 | ≥2% vague diagnosis code | 3 | 0 | 3 |
| 3 | ≤30% admissions coded as acute | 0 | 0 | 0 |
| 4 | ≤ 0,5 secondary diagnoses per inpatient admission (average per hospital) | 5 | 0 | 5 |
| 5 | ≤50 expected mortality | 1 | 0 | 1 |
| 6 | ≤ 70% hospital deaths within the 50 diagnosis groups considered[b)] | 0 | 0 | 0 |
| | Does not fulfill >1 of above-mentioned exclusion criteria (1-6) | 4 | 3 | 7 |
| | Meet all criteria | 60[b)] | 2 | 62 |
| | Total hospitals | 86 | 10 | 96 |

a) For one hospital with <50% response, the registered data are also selective with respect to mortality.
b) For one hospital (H)SMRs are calculated although the percentage of deaths in the 50 diagnosis groups was slightly lower than 70% in 2008-2010. This hospital is grouped under "Meet all criteria".

From Table A2.1 it can be concluded that 68 hospitals met all criteria in 2010 and have given authorization. For the period 2008-2010 this is the case for 60 hospitals (see Table A2.2). So HSMR 2010 figures were produced for 68 hospitals, and HSMR 2008-2010 figures for 60 hospitals.

## Appendix 3. Differences with the previously used method

The HSMR method described in this report basically resembles the method previously used by Kiwa Prismant, but there are some differences. After investigating different possible improvements to the method, CBS has introduced some changes in the method. Some of these modifications were suggested by, and based on extensive research of, the Dutch HSMR Expert group.

For transparency, the differences with the previously used method are listed below:

1. For the regression modelling, previously all LMR data from 2003 onwards were used. To update the model, CBS has used LMR data of the last available four years only, i.c. 2007-2010 for the HSMR 2010. This is mainly a choice between stability and actuality. Four years of data gave enough stability and accuracy of the estimates while keeping the model up to date.
2. Previously, day admissions were included in the numerator (observed mortality) of the (H)SMR, but not in the regressions and in the denominator (expected mortality). CBS left out day admissions in both numerator and denominator. This was done because day admissions have a very low mortality. Fatal day cases may be the result of coding errors, or else can indicate a need for investigating the causes. When a hospital had relatively high mortality in day admissions (compared to other hospitals), it has been noted as a separate item in the HSMR 2010 report of that hospital.
3. Foreign patients have been excluded for two reasons. Firstly, the HSMR for foreign patients may be different from that for inhabitants in the Netherlands. Hospitals have different fractions of foreign patients and the distribution of diagnoses for foreign patients is very different from that for Dutch inhabitants. Secondly, foreign people cannot be matched to the Municipal Personal Records Database (GBA). In the future, this matching will be possible, which will enable incorporating extra variables in the HSMR model (e.g. ethnicity) and publishing HSMRs for more patient groups (see also chapter 5).
4. CBS has split the age category 90+ into the categories [90-95) and 95+. The possibility of using age as a continuous variable (restricted cubic spline) in the model had also been investigated. However, this did not improve the model, while introducing problems with presenting the model results.
5. For Severity of main diagnosis, a categorisation of mortality rates for the ICD9-CM sub-diagnoses has been used, as suggested by Van den Bosch (2011) and explained in Appendix 1. Previously the CCS sub-diagnoses groups were used. In the current method the boundaries used to define the mortality groups differ from the boundaries suggested by Van den Bosch. Preliminary research by CBS showed that the latter intervals were too wide at higher mortality rates and too narrow at low mortality rates. The modified intervals gave a better fit.

6. Previously the Charlson index was used for comorbidity, which is a weighted indicator for 17 comorbidity groups. The weights of the Charlson index were mostly determined long ago and could therefore be out-dated. Instead of these a priori weights, the current model uses the comorbidity groups as separate explanatory variables, following a suggestion by Lingsma and Pouw who did research for the Dutch HSMR Expert group. Results showed that the predictive power of the model increased when switching to the separate variables. The same 17 comorbidity groups have been used as before, but the comorbidity groups for ‘diabetes’ and ‘diabetes complications’ were combined, and this was also done for ‘liver disease’ and ‘severe liver disease’.
7. Instead of 12 categories for Month of admission, this covariate has been restricted to 6 two-month periods in the current method. This gives a more parsimonious model and it hardly changed the expected probabilities and (H)SMRs.
8. In previous years categories of a covariate were collapsed if a category has fewer than 20 deaths. In the current method categories are collapsed if a category has fewer than 50 admissions or if there are no deaths in a category. Stability of regression coefficients depends on the number admissions rather than on the number of deaths.
9. In the stepwise backward elimination procedure for dropping non-significant covariates, 0.05 was used as significance criterion instead of 0.1 used before. The faster “fastbw” method of Lawless and Singhal (1978) was used, as an approximation of the backward Wald procedure previously used. However, Year of discharge has been excluded from the backward procedure. Preliminary research of CBS showed that allowing Year of discharge to be dropped introduced a bias in estimates of the HSMR.

## Appendix 4. Results of the logistic regressions

*Table A4.1. Statistical significance of the covariates for the 50 logistic regressions (1=significant; 0=non-significant)*

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 1 |
| 12 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 13 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 14 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 15 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 17 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 19 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 24 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 29 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 32 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 38 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 39 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 42 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 44 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 50 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| 55 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | - | 0 | 0 | 1 | 0 | 1 | - | 0 | 1 | 1 |
| 59 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 85 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | 0 | 0 | - | 0 | 1 | 0 |
| 96 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | - | 0 | 1 | 1 | 0 | 0 | - | 1 | 1 | 0 |
| 100 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 101 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 103 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 106 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 108 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 109 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | - | 1 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 114 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 115 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 0 | 1 | 0 |
| 116 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| 117 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 122 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 127 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 129 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | 1 | 1 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| 130 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 133 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 145 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| 146 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 149 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 150 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | - | 0 | 1 | 0 | 0 | 0 | - | 0 | 1 | 0 |
| 151 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | - | 0 | 1 | 0 | 0 | 1 | - | 1 | 1 | 0 |
| 153 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 155 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| 157 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | - | 0 | 0 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 158 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | - | 0 | 0 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 159 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | -- | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 226 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 0 | 1 | 1 |
| 233 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 1 | 1 | 0 | 1 | -- | 1 | 1 | 0 |
| 237 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 1 |
| 238 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | - | 0 | 1 | 1 | 0 | 1 | - | 1 | 1 | 0 |
| 249 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | - | 0 | 0 | 1 | 0 | 1 | - | 0 | 1 | 0 |
| Total | 49 | 21 | 9 | 43 | 44 | 35 | 45 | 25 | 39 | 11 | 37 | 4 | 15 | 23 | 2 | - | 2 | 44 | 37 | 0 | 47 | - | 33 | 50 | 14 |

*Table A4.2. Wald chi-square statistics for the 50 logistic regressions and degrees of freedom*

*A. Wald statistics*

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 900 | 15 | - | 924 | - | 16 | 47 | 37 | 22 | - | - | - | - | 99 | - | - | - | 33 | 76 | - | 55 | - | - | 20 | 13 |
| 12 | 23 | - | - | - | 325 | 6 | - | - | - | - | 10 | - | - | - | - | - | - | - | - | - | 53 | - | 14 | 5 | - |
| 13 | 116 | - | - | - | 343 | - | 11 | - | 13 | - | 7 | - | - | - | - | - | - | 21 | - | - | 65 | - | - | 5 | - |
| 14 | 540 | 18 | - | 34 | 747 | 47 | 107 | 10 | 10 | 6 | 6 | - | 6 | 28 | - | - | - | 48 | - | - | 228 | - | 18 | 27 | - |
| 15 | 200 | 13 | - | 7 | 300 | 26 | 24 | - | 8 | - | 6 | - | - | - | - | - | - | 42 | - | - | 59 | - | 31 | 18 | - |
| 17 | 38 | - | - | 16 | 213 | 23 | - | - | 25 | - | 19 | - | - | - | - | - | - | 34 | - | - | 103 | - | - | 1 | - |
| 19 | 262 | 7 | 13 | 124 | 3966 | 12 | 64 | 14 | 26 | - | 13 | - | 12 | 20 | - | - | - | 71 | 13 | - | 253 | - | 43 | 65 | 25 |
| 24 | 58 | - | - | 52 | 1155 | - | - | - | 8 | - | - | - | - | - | - | - | - | 14 | - | - | 224 | - | - | 11 | - |
| 29 | 48 | - | - | - | 351 | 40 | 38 | - | - | - | - | - | - | - | - | - | - | 13 | - | - | 171 | - | - | 20 | - |
| 32 | 37 | - | 10 | 49 | 788 | 15 | 13 | - | 11 | - | 10 | - | - | - | - | - | - | 32 | - | - | 219 | - | - | 13 | - |
| 38 | 177 | - | - | 56 | 533 | - | 52 | - | 14 | - | 23 | - | - | - | - | - | - | 48 | 22 | - | 10 | - | 57 | 13 | - |
| 39 | 376 | - | - | 108 | 291 | - | 34 | - | 66 | - | 6 | - | - | - | - | - | - | 34 | - | - | 13 | - | 29 | 7 | - |
| 42 | 277 | - | 14 | 135 | 1815 | 22 | 99 | 11 | 58 | - | 13 | - | - | 31 | - | - | - | 70 | - | - | 253 | - | 14 | 39 | - |
| 44 | 70 | - | - | 64 | 143 | - | 52 | 7 | 15 | - | 8 | - | - | - | - | - | - | 7 | 5 | - | 5 | - | 17 | 13 | - |
| 50 | 324 | 7 | - | 140 | 41 | 43 | 140 | 22 | - | - | 10 | - | - | 14 | - | - | - | 40 | 21 | - | 10 | - | - | 18 | - |
| 55 | 430 | 22 | 16 | 615 | - | 5 | 106 | - | 8 | - | - | - | - | 24 | - | - | - | - | 23 | - | 27 | - | - | 22 | 18 |
| 59 | 94 | 8 | - | 116 | 117 | - | 172 | - | 17 | - | - | - | - | - | - | - | - | 19 | 15 | - | 28 | - | 13 | 21 | - |
| 85 | 106 | - | - | 516 | 11 | - | 15 | - | - | 7 | 11 | - | - | - | - | - | - | - | 16 | - | - | - | - | 2 | - |
| 96 | 310 | - | - | 237 | 130 | - | 133 | 29 | 60 | - | - | - | 20 | - | - | - | - | 103 | 7 | - | - | - | 93 | 23 | - |
| 100 | 2115 | - | 24 | 628 | 19 | 22 | 533 | 13 | 158 | 9 | 9 | - | 6 | - | - | - | - | 131 | 22 | - | 42 | - | 33 | 90 | 15 |
| 101 | 885 | - | - | 67 | 100 | 20 | 437 | 29 | 76 | 27 | 36 | - | 38 | 10 | - | - | - | 71 | 34 | - | 6 | - | 148 | 40 | - |
| 103 | 465 | - | - | 109 | 7 | 40 | 96 | - | 53 | - | - | - | - | - | - | - | - | 12 | 17 | - | 87 | - | 53 | 24 | - |
| 106 | 911 | 18 | 35 | 912 | 88 | - | 235 | 11 | 78 | 16 | 55 | - | 25 | - | 8 | - | - | 84 | 53 | - | 50 | - | 11 | 33 | 18 |
| 107 | 242 | - | - | 818 | 143 | 26 | - | 4 | 10 | - | 15 | - | - | - | 7 | - | - | 11 | 6 | - | 4 | - | 67 | 41 | - |
| 108 | 1432 | 39 | - | - | 112 | 17 | - | 17 | 192 | 18 | 55 | 3 | 28 | 39 | - | - | - | 498 | 58 | - | 35 | - | 50 | 87 | 51 |
| 109 | 2697 | - | - | 7310 | 56 | 80 | 455 | 5 | - | - | 78 | - | 9 | - | - | - | 7 | 46 | 129 | - | 74 | - | 55 | 82 | - |

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114 | 485 | - | - | 1180 | 446 | 43 | 91 | 53 | 15 | - | 13 | 6 | 31 | - | - | - | - | 82 | 19 | - | 18 | - | 59 | 33 | - |
| 115 | 811 | 18 | - | 1612 | 458 | 21 | 17 | - | 16 | 7 | 8 | - | - | - | - | - | - | 22 | - | - | 21 | - | - | 30 | - |
| 116 | 264 | 14 | - | 225 | 391 | 13 | 96 | 47 | 26 | - | 23 | - | - | - | - | - | - | 78 | 11 | - | 22 | - | - | 15 | - |
| 117 | 188 | 7 | - | 253 | 19 | - | 58 | 14 | 7 | - | - | - | - | - | - | - | - | 29 | 6 | - | 24 | - | 37 | 17 | - |
| 122 | 3696 | 39 | - | 227 | - | 108 | 434 | 37 | 174 | 44 | 83 | - | 11 | 118 | - | - | - | 122 | 301 | - | 255 | - | 59 | 63 | 42 |
| 127 | 610 | - | - | 82 | 140 | 28 | 302 | - | 27 | - | 16 | - | 19 | 13 | - | - | - | 65 | 26 | - | 31 | - | 44 | 94 | 67 |
| 129 | 202 | 4 | - | - | - | 12 | 12 | - | - | - | 5 | - | - | - | - | - | 5 | 5 | 12 | - | 19 | - | - | 9 | - |
| 130 | 321 | - | - | 63 | 78 | - | 16 | - | - | - | 32 | - | - | 8 | - | - | - | 47 | 31 | - | 50 | - | 20 | 20 | - |
| 133 | 1231 | 27 | 16 | 1140 | 771 | - | 122 | - | 23 | - | 41 | - | - | 40 | - | - | - | 38 | 237 | - | 132 | - | 163 | 86 | 29 |
| 145 | 1175 | - | - | 308 | - | 8 | 72 | - | 31 | 8 | 49 | - | - | - | - | - | - | 53 | 37 | - | 99 | - | - | 12 | - |
| 146 | 418 | - | - | 162 | 24 | 27 | 89 | - | 5 | - | 10 | 8 | - | - | - | - | - | 51 | 24 | - | 43 | - | 17 | 21 | 12 |
| 149 | 593 | - | 11 | 220 | 46 | 34 | 137 | 6 | 20 | - | 8 | - | 11 | 57 | - | - | - | 127 | 11 | - | 48 | - | 10 | 26 | - |
| 150 | - | - | - | 42 | 96 | - | 20 | - | - | - | - | - | - | 112 | - | - | - | 36 | - | - | - | - | - | 6 | - |
| 151 | 184 | - | - | 652 | 99 | - | 15 | - | 8 | - | - | - | - | 14 | - | - | - | 59 | - | - | 75 | - | 31 | 20 | - |
| 153 | 371 | 14 | 14 | 302 | 15 | 13 | 195 | 5 | 18 | - | 24 | - | - | 86 | - | - | - | 57 | 113 | - | 43 | - | 18 | 47 | 19 |
| 155 | 373 | - | - | 1280 | 38 | 7 | 37 | - | 25 | 5 | - | - | - | 16 | - | - | - | 9 | 22 | - | 52 | - | - | 18 | - |
| 157 | 342 | - | - | - | 40 | - | 109 | 10 | - | - | - | - | - | 15 | - | - | - | - | 6 | - | 35 | - | 28 | 11 | 23 |
| 158 | 296 | 5 | - | 6 | 336 | 16 | 34 | 16 | - | - | 6 | - | - | - | - | - | - | - | 9 | - | 14 | - | 45 | 17 | - |
| 159 | 568 | 11 | - | 86 | 29 | 63 | 154 | 12 | 73 | - | 14 | - | 15 | 14 | - | - | - | 30 | 13 | - | 47 | - | 27 | 14 | - |
| 226 | 983 | 327 | - | 20 | 6 | 130 | 860 | 19 | 72 | - | 53 | - | 45 | 67 | - | - | - | 190 | 32 | - | 25 | - | - | 104 | 16 |
| 233 | 574 | 33 | - | 2617 | 24 | 9 | 35 | - | 16 | - | - | - | - | - | - | - | - | 10 | 8 | - | 10 | - | 18 | 30 | - |
| 237 | 373 | 15 | - | 314 | 146 | 13 | 191 | 29 | 40 | 20 | 19 | 12 | - | 19 | - | - | - | 40 | 26 | - | 13 | - | 54 | 23 | 11 |
| 238 | 618 | - | - | 535 | 11 | 18 | 70 | 20 | 33 | - | 13 | - | 19 | 61 | - | - | - | 67 | 72 | - | 30 | - | 236 | 27 | - |
| 249 | 276 | - | - | - | - | 17 | 8 | - | - | - | 9 | - | - | 18 | - | - | - | - | 18 | - | 29 | - | - | 14 | - |
| Total | 28081 | 661 | 154 | 24363 | 15010 | 1040 | 6042 | 478 | 1557 | 166 | 817 | 30 | 295 | 920 | 15 | - | 11 | 2699 | 1548 | - | 3209 | - | 1613 | 1497 | 360 |

*B. Degrees of freedom*

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 20 | 1 | - | 4 | - | 1 | 1 | 1 | 1 | - | - | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | - | 3 | 5 |
| 12 | 11 | - | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | 1 | - | 2 | 3 | - |
| 13 | 13 | - | - | - | 1 | - | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 14 | 14 | 1 | - | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | - | - | 1 | - | - | 1 | - | 2 | 3 | - |
| 15 | 12 | 1 | - | 2 | 1 | 1 | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | 2 | 3 | - |
| 17 | 11 | - | - | 2 | 1 | 1 | - | - | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 19 | 13 | 1 | 4 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 24 | 13 | - | - | 2 | 1 | - | - | - | 1 | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 29 | 8 | - | - | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 32 | 11 | - | 4 | 2 | 1 | 1 | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 38 | 18 | - | - | 5 | 1 | - | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 39 | 19 | - | - | 6 | 1 | - | 1 | - | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | 3 | 3 | - |
| 42 | 18 | - | 5 | 4 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | 1 | - | - | - | 1 | - | - | 1 | - | 3 | 3 | - |
| 44 | 20 | - | - | 3 | 1 | - | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 50 | 15 | 1 | - | 4 | 1 | 1 | 1 | 1 | - | - | 1 | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | - | 3 | - |
| 55 | 15 | 1 | 4 | 3 | - | 1 | 1 | - | 1 | - | - | - | - | 1 | - | - | - | - | 1 | - | 1 | - | - | 3 | 5 |
| 59 | 19 | 1 | - | 2 | 1 | - | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 85 | 19 | - | - | 1 | 1 | - | 1 | - | - | 1 | 1 | - | - | - | - | - | - | - | 1 | - | - | - | - | 3 | - |
| 96 | 16 | - | - | 4 | 1 | - | 1 | 1 | 1 | - | - | - | 1 | - | - | - | - | 1 | 1 | - | - | - | 3 | 3 | - |
| 100 | 15 | - | 5 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 101 | 14 | - | - | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 103 | 18 | - | - | 3 | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 106 | 19 | 1 | 5 | 2 | 1 | - | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 107 | 15 | - | - | 2 | 1 | 1 | - | 1 | 1 | - | 1 | - | - | - | 1 | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 108 | 17 | 1 | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |

| No. CCS-group | Age | Sex | SES | Severity of main diagnosis | Urgency | Comorbidity_1* | Comorbidity_2* | Comorbidity_3* | Comorbidity_4* | Comorbidity_5* | Comorbidity_6* | Comorbidity_7* | Comorbidity_8* | Comorbidity_9* | Comorbidity_10* | Comorbidity_11* | Comorbidity_12* | Comorbidity_13* | Comorbidity_14* | Comorbidity_15* | Comorbidity_16* | Comorbidity_17* | Source of admission | Year of discharge | Month of admission |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109 | 20 | - | - | 3 | 1 | 1 | 1 | 1 | - | - | 1 | - | 1 | - | - | - | 1 | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 114 | 15 | - | - | 4 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 115 | 13 | 1 | - | 5 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | - | - | - | - | - | 1 | - | - | 1 | - | - | 3 | - |
| 116 | 11 | 1 | - | 3 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 | - | - | 3 | - |
| 117 | 17 | 1 | - | 4 | 1 | - | 1 | 1 | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 122 | 20 | 1 | - | 4 | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 127 | 14 | - | - | 3 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 129 | 17 | 1 | - | - | - | 1 | 1 | - | - | - | 1 | - | - | - | - | - | 1 | 1 | 1 | - | 1 | - | - | 3 | - |
| 130 | 16 | - | - | 3 | 1 | - | 1 | - | - | - | 1 | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 133 | 20 | 1 | 5 | 5 | 1 | - | 1 | - | 1 | - | 1 | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 145 | 15 | - | - | 3 | - | 1 | 1 | - | 1 | 1 | 1 | - | - | - | - | - | - | 1 | 1 | - | 1 | - | - | 3 | - |
| 146 | 12 | - | - | 2 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | - | - | 1 | 1 | - | 1 | - | 2 | 3 | 5 |
| 149 | 14 | - | 5 | 4 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 150 | - | - | - | 2 | 1 | - | 1 | - | - | - | - | - | - | 1 | - | - | - | 1 | - | - | - | - | - | 3 | - |
| 151 | 19 | - | - | 6 | 1 | - | 1 | - | 1 | - | - | - | - | 1 | - | - | - | 1 | - | - | 1 | - | 3 | 3 | - |
| 153 | 14 | 1 | 5 | 5 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 155 | 16 | - | - | 5 | 1 | 1 | 1 | - | 1 | 1 | - | - | - | 1 | - | - | - | 1 | 1 | - | 1 | - | - | 3 | - |
| 157 | 17 | - | - | - | 1 | - | 1 | 1 | - | - | - | - | - | 1 | - | - | - | - | 1 | - | 1 | - | 3 | 3 | 5 |
| 158 | 17 | 1 | - | 1 | 1 | 1 | 1 | 1 | - | - | 1 | - | - | - | - | - | - | - | 1 | - | 1 | - | 3 | 3 | - |
| 159 | 16 | 1 | - | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 226 | 11 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | - | 3 | 5 |
| 233 | 20 | 1 | - | 8 | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 237 | 18 | 1 | - | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | 5 |
| 238 | 20 | - | - | 5 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | - | - | 1 | 1 | - | 1 | - | 3 | 3 | - |
| 249 | 13 | - | - | - | - | 1 | 1 | - | - | - | 1 | - | - | 1 | - | - | - | - | 1 | - | 1 | - | - | 3 | - |
| Total | 768 | 21 | 42 | 141 | 44 | 35 | 45 | 25 | 39 | 11 | 37 | 4 | 15 | 23 | 2 | - | 2 | 44 | 37 | - | 47 | - | 95 | 150 | 70 |

* The numbers of the comorbidity groups in the header of tables A4.1 and A4.2 are the following comorbidities:

Comorbidity_1 - Acute myocardial infarction
Comorbidity_2 - Congestive heart failure
Comorbidity_3 - Peripheral vascular disease
Comorbidity_4 - Cerebral vascular accident
Comorbidity_5 - Dementia
Comorbidity_6 - Pulmonary disease
Comorbidity_7 - Connective tissue disorder
Comorbidity_8 - Peptic ulcer
Comorbidity_9 - Liver disease / Severe liver disease
Comorbidity_10 - Diabetes / Diabetes complications
Comorbidity_11 - Diabetes complications (has been combined with Comorbidity 10)
Comorbidity_12 - Paraplegia
Comorbidity_13 - Renal disease
Comorbidity_14 - Cancer
Comorbidity_15 - HIV
Comorbidity_16 - Metastatic cancer
Comorbidity_17 - Severe liver disease (has been combined with Comorbidity 9)

## Summaries of individual models

In Table A4.3 the coefficients for the logistic regressions of inpatient mortality are presented for each CCS diagnosis group, as well as some summary measures. The CCS group number is mentioned between brackets in the title of each logistic regression. The regression coefficients (log-odds) are presented in the column "Coef".

*Table A4.3. Regression coefficients and summary measures for the 50 logistic regressions*

### [2] Septicemia (except in labour)

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_9 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Month +
    Year, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes           Indexes

Obs          15450    LR chi2     2861.59    R2       0.248    C       0.771
 Not died    11454    d.f.             41    Brier    0.158    Dxy     0.541
 Died         3996    Pr(> chi2) <0.0001                       gamma   0.543
max |deriv| 3e-08                                              tau-a   0.208


                    Coef    S.E.   Odds
Intercept           -5.8147 0.4162  0.0030
Severity=[0.05,0.1)  2.1699 0.4208  8.7570
Severity=[0.1,0.2)   0.8913 0.2924  2.4382
Severity=[0.2,0.3)   1.8169 0.2917  6.1529
Severity=[0.3,0.4)   2.4844 0.2897 11.9936
Sex=Female           0.1597 0.0412  1.1731
Age=[1,5)            0.5218 0.4386  1.6851
Age=[5,10)           0.5879 0.5158  1.8001
Age=[10,15)          0.7415 0.5943  2.0991
Age=[15,20)          0.9299 0.4896  2.5343
Age=[20,25)         -0.9187 1.0478  0.3990
Age=[25,30)          1.3257 0.4738  3.7649
Age=[30,35)          1.3265 0.4252  3.7677
Age=[35,40)          1.2854 0.3716  3.6162
Age=[40,45)          1.5455 0.3521  4.6902
Age=[45,50)          1.7688 0.3247  5.8637
Age=[50,55)          2.0349 0.3133  7.6518
Age=[55,60)          2.3179 0.3065 10.1538
Age=[60,65)          2.2765 0.3023  9.7426
Age=[65,70)          2.5355 0.3010 12.6227
Age=[70,75)          2.7067 0.2994 14.9793
Age=[75,80)          2.9422 0.2980 18.9570
Age=[80,85)          3.1589 0.2980 23.5442
Age=[85,90)          3.5656 0.2991 35.3592
Age=[90,95)          3.7721 0.3079 43.4733
Age=95+              3.9618 0.3513 52.5536
Comorbidity_1=1      0.4162 0.1056  1.5162
Comorbidity_2=1      0.5455 0.0793  1.7255
Comorbidity_3=1      0.6979 0.1147  2.0095
Comorbidity_4=1      0.5605 0.1206  1.7516
Comorbidity_9=1      1.6865 0.1692  5.4006
Comorbidity_13=1     0.4168 0.0730  1.5172
Comorbidity_14=1     0.6208 0.0714  1.8605
Comorbidity_16=1     0.6646 0.0900  1.9436
Month=2             -0.0547 0.0701  0.9467
Month=3             -0.1139 0.0700  0.8923
Month=4             -0.2144 0.0712  0.8070
Month=5             -0.1831 0.0700  0.8327
Month=6             -0.0628 0.0685  0.9391
Year=2008            0.0407 0.0611  1.0415
Year=2009           -0.1681 0.0601  0.8453
Year=2010           -0.1544 0.0587  0.8569
```

## [12] Cancer of esophagus

```
Logistic Regression Model

lrm(formula = Death ~ Age + Urgency + Comorbidity_1 + Comorbidity_6 +
    Comorbidity_16 + Source + Year, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs          10596    LR chi2     494.81    R2       0.120    C       0.736
 Not died     9913    d.f.            20    Brier    0.057    Dxy     0.472
 Died          683    Pr(> chi2) <0.0001                      gamma   0.483
max |deriv| 5e-10                                             tau-a   0.057


                    Coef    S.E.   Odds
Intercept           -4.2253 0.6084 0.0146
Age=[40,45)          0.3888 0.7364 1.4752
Age=[45,50)         -0.0038 0.6613 0.9962
Age=[50,55)          0.3166 0.6243 1.3724
Age=[55,60)          0.4985 0.6118 1.6463
Age=[60,65)          0.4594 0.6094 1.5831
Age=[65,70)          0.6087 0.6097 1.8380
Age=[70,75)          0.8128 0.6094 2.2543
Age=[75,80)          0.8378 0.6103 2.3114
Age=[80,85)          0.8157 0.6165 2.2607
Age=[85,90)          0.6231 0.6364 1.8646
Age=[90,95),95+      0.4671 0.7075 1.5954
Urgency=Not planned  1.5386 0.0853 4.6581
Comorbidity_1=1      0.6431 0.2631 1.9023
Comorbidity_6=1      0.7028 0.2270 2.0194
Comorbidity_16=1     0.6085 0.0832 1.8376
Source=Nursing home  0.3262 0.3985 1.3857
Source=Hospital      1.2425 0.3344 3.4643
Year=2008           -0.1405 0.1170 0.8689
Year=2009            0.0381 0.1136 1.0389
Year=2010           -0.1898 0.1188 0.8271
```

## [13] Cancer of stomach

```
Logistic Regression Model

lrm(formula = Death ~ Age + Urgency + Comorbidity_2 + Comorbidity_4 +
    Comorbidity_6 + Comorbidity_13 + Comorbidity_16 + Year, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs          14564    LR chi2     767.20    R2       0.152    C       0.784
 Not died    13795    d.f.            22    Brier    0.047    Dxy     0.568
 Died          769    Pr(> chi2) <0.0001                      gamma   0.578
max |deriv| 3e-12                                             tau-a   0.057


                    Coef    S.E.   Odds
Intercept           -3.8055 0.4808 0.0222
Age=[30,35)          0.8909 0.5897 2.4372
Age=[35,40)         -0.2861 0.6126 0.7512
Age=[40,45)         -0.8157 0.5807 0.4423
Age=[45,50)         -0.5658 0.5321 0.5679
Age=[50,55)         -0.7144 0.5116 0.4895
Age=[55,60)         -0.3627 0.4933 0.6958
Age=[60,65)         -0.1228 0.4850 0.8844
Age=[65,70)         -0.2150 0.4842 0.8065
Age=[70,75)          0.1791 0.4805 1.1961
Age=[75,80)          0.4773 0.4794 1.6117
Age=[80,85)          0.5723 0.4836 1.7724
Age=[85,90)          0.7345 0.4893 2.0844
Age=[90,95),95+      0.6706 0.5220 1.9555
Urgency=Not planned  1.5020 0.0811 4.4908
Comorbidity_2=1      1.0417 0.3090 2.8342
Comorbidity_4=1      1.0062 0.2785 2.7352
Comorbidity_6=1      0.5820 0.2162 1.7896
Comorbidity_13=1     1.2860 0.2786 3.6183
Comorbidity_16=1     0.6366 0.0788 1.8901
```

```
Year=2008             -0.2144 0.1097 0.8071
Year=2009             -0.2185 0.1083 0.8037
Year=2010             -0.1681 0.1082 0.8452
```

---

## [14] Cancer of colon

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_5 +
    Comorbidity_6 + Comorbidity_8 + Comorbidity_9 + Comorbidity_13 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          40199    LR chi2     2341.63    R2       0.168    C       0.790
 Not died    38096    d.f.             34    Brier    0.046    Dxy     0.581
 Died         2103    Pr(> chi2) <0.0001                       gamma   0.590
max |deriv| 2e-07                                              tau-a   0.058


                      Coef    S.E.   Odds
Intercept             -7.5603 1.1619  0.0005
Severity=[0.01,0.02)   1.5881 0.9528  4.8945
Severity=[0.02,0.05)   2.2052 0.5816  9.0718
Severity=[0.05,0.1)    2.4066 0.5812 11.0959
Sex=Female            -0.2013 0.0480  0.8177
Age=[30,35)            0.0310 1.2359  1.0315
Age=[35,40)            0.6770 1.0792  1.9680
Age=[40,45)            0.5125 1.0582  1.6694
Age=[45,50)            0.6720 1.0325  1.9581
Age=[50,55)            0.7734 1.0198  2.1671
Age=[55,60)            0.9554 1.0145  2.5996
Age=[60,65)            1.1367 1.0115  3.1165
Age=[65,70)            1.2761 1.0107  3.5825
Age=[70,75)            1.4677 1.0102  4.3394
Age=[75,80)            1.8594 1.0096  6.4196
Age=[80,85)            2.1753 1.0095  8.8053
Age=[85,90)            2.5338 1.0100 12.6013
Age=[90,95)            2.5632 1.0148 12.9772
Age=95+                3.2153 1.0411 24.9100
Urgency=Not planned    1.3046 0.0477  3.6861
Comorbidity_1=1        0.8599 0.1251  2.3629
Comorbidity_2=1        1.4013 0.1353  4.0604
Comorbidity_3=1        0.6850 0.2171  1.9837
Comorbidity_4=1        0.5864 0.1884  1.7975
Comorbidity_5=1        0.5874 0.2408  1.7993
Comorbidity_6=1        0.3358 0.1349  1.3991
Comorbidity_8=1        0.9974 0.4064  2.7111
Comorbidity_9=1        1.8051 0.3426  6.0808
Comorbidity_13=1       1.1656 0.1685  3.2080
Comorbidity_16=1       0.7209 0.0477  2.0563
Year=2008             -0.1321 0.0658  0.8763
Year=2009             -0.1595 0.0655  0.8526
Year=2010             -0.3437 0.0661  0.7091
Source=Nursing home    0.0295 0.2072  1.0299
Source=Hospital        1.1387 0.2706  3.1228
```

---

## [15] Cancer of rectum and anus

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_6 + Comorbidity_13 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          21207    LR chi2      855.49    R2       0.153    C       0.797
 Not died    20481    d.f.             27    Brier    0.031    Dxy     0.595
 Died          726    Pr(> chi2) <0.0001                       gamma   0.605
max |deriv| 4e-10                                              tau-a   0.039
```

```
                       Coef    S.E.   Odds
Intercept              -7.2687 1.2341  0.0007
Severity=[0.02,0.05)    1.8250 0.7136  6.2026
Severity=[0.05,0.1)     1.9482 0.7422  7.0163
Sex=Female             -0.2980 0.0827  0.7423
Age=[35,40)             0.7458 1.1647  2.1081
Age=[40,45)             0.0741 1.1258  1.0769
Age=[45,50)             0.8149 1.0447  2.2590
Age=[50,55)             0.8341 1.0287  2.3028
Age=[55,60)             1.0284 1.0183  2.7967
Age=[60,65)             1.0486 1.0137  2.8537
Age=[65,70)             1.2924 1.0125  3.6415
Age=[70,75)             1.7124 1.0100  5.5421
Age=[75,80)             1.9324 1.0096  6.9063
Age=[80,85)             2.4925 1.0097 12.0914
Age=[85,90)             2.3676 1.0133 10.6716
Age=[90,95),95+         2.3093 1.0342 10.0671
Urgency=Not planned     1.3935 0.0804  4.0289
Comorbidity_1=1         1.0960 0.2150  2.9922
Comorbidity_2=1         1.1398 0.2338  3.1260
Comorbidity_4=1         0.8480 0.2915  2.3351
Comorbidity_6=1         0.5477 0.2200  1.7292
Comorbidity_13=1        1.6871 0.2595  5.4036
Comorbidity_16=1        0.6184 0.0808  1.8559
Year=2008               0.0414 0.1062  1.0423
Year=2009              -0.2138 0.1116  0.8075
Year=2010              -0.3794 0.1133  0.6843
Source=Nursing home     0.0418 0.3387  1.0427
Source=Hospital         1.9594 0.3496  7.0948
```

---

## [17] Cancer of pancreas

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_4 + Comorbidity_6 + Comorbidity_13 + Comorbidity_16 +
    Year, data = data, y = TRUE, maxit = 100)

                        Model Likelihood     Discrimination    Rank Discrim.
                           Ratio Test           Indexes           Indexes

Obs          10774    LR chi2      572.72    R2       0.113    C       0.717
 Not died     9787    d.f.             22    Brier    0.078    Dxy     0.435
 Died          987    Pr(> chi2) <0.0001                       gamma   0.440
max |deriv| 1e-12                                              tau-a   0.072


                     Coef    S.E.   Odds
Intercept            -5.4598 0.7273 0.0043
Severity=[0.05,0.1)   1.1347 0.5890 3.1104
Severity=[0.1,0.2)    1.3741 0.5895 3.9515
Age=[40,45)           0.6552 0.5131 1.9256
Age=[45,50)           0.5707 0.4761 1.7695
Age=[50,55)           0.6849 0.4503 1.9837
Age=[55,60)           0.7982 0.4373 2.2216
Age=[60,65)           0.8160 0.4324 2.2614
Age=[65,70)           0.8927 0.4317 2.4417
Age=[70,75)           0.8837 0.4321 2.4197
Age=[75,80)           1.0206 0.4319 2.7747
Age=[80,85)           1.1839 0.4342 3.2670
Age=[85,90)           1.3633 0.4433 3.9092
Age=[90,95),95+       1.4856 0.4777 4.4175
Urgency=Not planned   1.0873 0.0745 2.9662
Comorbidity_1=1       1.0255 0.2118 2.7884
Comorbidity_4=1       1.3041 0.2616 3.6845
Comorbidity_6=1       0.9070 0.2073 2.4769
Comorbidity_13=1      1.6167 0.2779 5.0366
Comorbidity_16=1      0.7197 0.0708 2.0537
Year=2008            -0.0360 0.1002 0.9646
Year=2009            -0.0217 0.0993 0.9785
Year=2010            -0.0895 0.0983 0.9144
```

---

## [19] Cancer of bronchus; lung

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + SES + Month + Year + Source, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs          72238    LR chi2    7515.36    R2       0.231    C       0.817
 Not died    66440    d.f.            42    Brier    0.065    Dxy     0.635
 Died         5798    Pr(> chi2) <0.0001                      gamma   0.641
max |deriv| 1e-10                                             tau-a   0.094


                                        Coef    S.E.   Odds
Intercept                               -5.0053 0.7055 0.0067
Severity=[0.05,0.1)                      0.4959 0.3693 1.6419
Severity=[0.1,0.2)                       0.8340 0.3689 2.3026
Sex=Female                              -0.0832 0.0312 0.9202
Age=[30,35)                              0.4396 0.7482 1.5521
Age=[35,40)                              0.4386 0.6345 1.5505
Age=[40,45)                              0.5824 0.6123 1.7904
Age=[45,50)                              0.4240 0.6067 1.5280
Age=[50,55)                              0.4955 0.6041 1.6413
Age=[55,60)                              0.5798 0.6031 1.7857
Age=[60,65)                              0.6357 0.6027 1.8884
Age=[65,70)                              0.6615 0.6026 1.9378
Age=[70,75)                              0.8230 0.6025 2.2773
Age=[75,80)                              0.9749 0.6027 2.6509
Age=[80,85)                              1.2300 0.6036 3.4212
Age=[85,90)                              1.3662 0.6072 3.9206
Age=[90,95),95+                          1.5491 0.6305 4.7073
Urgency=Not planned                      2.1994 0.0349 9.0200
Comorbidity_1=1                          0.3464 0.0984 1.4139
Comorbidity_2=1                          0.8479 0.1061 2.3348
Comorbidity_3=1                          0.5148 0.1375 1.6732
Comorbidity_4=1                          0.6519 0.1286 1.9193
Comorbidity_6=1                          0.2060 0.0582 1.2287
Comorbidity_8=1                          0.9816 0.2839 2.6687
Comorbidity_9=1                          1.4812 0.3331 4.3984
Comorbidity_13=1                         1.0907 0.1293 2.9762
Comorbidity_14=1                         0.3331 0.0927 1.3953
Comorbidity_16=1                         0.4849 0.0305 1.6241
SES=Below average                       -0.0895 0.0428 0.9144
SES=Average                             -0.1345 0.0443 0.8741
SES=Above average                       -0.1203 0.0452 0.8867
SES=Highest                             -0.0280 0.0474 0.9724
Month=2                                 -0.1291 0.0507 0.8789
Month=3                                 -0.0684 0.0497 0.9339
Month=4                                 -0.2126 0.0506 0.8084
Month=5                                 -0.1383 0.0505 0.8709
Month=6                                 -0.1996 0.0512 0.8191
Year=2008                               -0.1228 0.0411 0.8845
Year=2009                               -0.2153 0.0414 0.8063
Year=2010                               -0.3226 0.0416 0.7242
Source=Nursing home                      0.1686 0.1770 1.1836
Source=General hospital                  1.0114 0.1814 2.7494
Source=Academic or topclinical hospital  0.9273 0.2705 2.5276
```

## [24] Cancer of breast

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_4 +
    Comorbidity_13 + Comorbidity_16 + Year, data = data, y = TRUE,
    maxit = 100)
```

```
                       Model Likelihood     Discrimination    Rank Discrim.
                          Ratio Test           Indexes           Indexes

Obs           57519    LR chi2    2408.78    R2       0.371    C       0.928
 Not died     56912    d.f.            22    Brier    0.009    Dxy     0.856
 Died           607    Pr(> chi2) <0.0001                      gamma   0.890
max |deriv| 2e-12                                              tau-a   0.018


                       Coef    S.E.    Odds
Intercept             -8.4670 1.0403  0.0002
Severity=[0.01,0.02)   0.9809 0.1366  2.6667
Severity=[0.02,0.05)   1.1723 0.4249  3.2293
Age=[30,35)            1.0696 1.1270  2.9142
Age=[35,40)            0.6571 1.0760  1.9292
Age=[40,45)            1.1991 1.0425  3.3170
Age=[45,50)            0.9755 1.0381  2.6524
Age=[50,55)            1.3067 1.0335  3.6941
Age=[55,60)            1.3422 1.0338  3.8274
Age=[60,65)            1.3807 1.0311  3.9778
Age=[65,70)            1.5058 1.0332  4.5079
Age=[70,75)            1.5042 1.0355  4.5005
Age=[75,80)            1.9013 1.0350  6.6945
Age=[80,85)            1.7647 1.0363  5.8397
Age=[85,90)            2.1679 1.0409  8.7397
Age=[90,95),95+        2.3594 1.0722 10.5851
Urgency=Not planned    3.4671 0.1020 32.0441
Comorbidity_4=1        1.2265 0.4311  3.4093
Comorbidity_13=1       1.4345 0.3843  4.1977
Comorbidity_16=1       1.4704 0.0983  4.3508
Year=2008             -0.1017 0.1228  0.9033
Year=2009             -0.0826 0.1232  0.9207
Year=2010             -0.4115 0.1289  0.6627
```

---

### [29] Cancer of prostate

```
Logistic Regression Model

lrm(formula = Death ~ Age + Urgency + Comorbidity_1 + Comorbidity_2 +
    Comorbidity_13 + Comorbidity_16 + Year, data = data, y = TRUE,
    maxit = 100)
                        Model Likelihood     Discrimination    Rank Discrim.
                           Ratio Test           Indexes           Indexes

Obs           23081    LR chi2    1470.63    R2       0.280    C       0.889
 Not died     22457    d.f.            16    Brier    0.024    Dxy     0.779
 Died           624    Pr(> chi2) <0.0001                      gamma   0.793
max |deriv| 9e-13                                              tau-a   0.041


                      Coef    S.E.   Odds
Intercept            -6.3260 0.5154 0.0018
Age=[55,60)           0.6508 0.5609 1.9171
Age=[60,65)           1.0984 0.5240 2.9994
Age=[65,70)           1.0651 0.5192 2.9012
Age=[70,75)           1.4110 0.5152 4.0999
Age=[75,80)           1.3032 0.5172 3.6811
Age=[80,85)           1.7356 0.5161 5.6726
Age=[85,90)           1.5075 0.5289 4.5154
Age=[90,95),95+       1.9537 0.5550 7.0545
Urgency=Not planned   2.0650 0.1102 7.8850
Comorbidity_1=1       1.3522 0.2143 3.8659
Comorbidity_2=1       1.5235 0.2455 4.5882
Comorbidity_13=1      0.8151 0.2289 2.2594
Comorbidity_16=1      1.3355 0.1021 3.8020
Year=2008            -0.0596 0.1207 0.9422
Year=2009            -0.1258 0.1211 0.8818
Year=2010            -0.5073 0.1248 0.6021
```

---

### [32] Cancer of bladder

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_6 + Comorbidity_13 +
    Comorbidity_16 + SES + Year, data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.    
                         Ratio Test            Indexes          Indexes       

Obs         41505    LR chi2    1822.67    R2       0.295    C       0.892    
 Not died   40875    d.f.            27    Brier    0.013    Dxy     0.783    
 Died         630    Pr(> chi2) <0.0001                      gamma   0.814    
max |deriv| 2e-08                                            tau-a   0.023    


                                 Coef    S.E.   Odds   
Intercept                        -8.1335 0.6544  0.0003
Severity=[0.01,0.02)              1.2858 0.3195  3.6175
Severity=[0.02,0.05),[0.05,0.1)   1.7699 0.2666  5.8700
Age=[45,50)                       0.7200 0.7101  2.0544
Age=[50,55)                       1.0929 0.6375  2.9831
Age=[55,60)                       1.0413 0.6232  2.8329
Age=[60,65)                       1.2017 0.6101  3.3256
Age=[65,70)                       1.4639 0.6036  4.3227
Age=[70,75)                       1.3558 0.6032  3.8800
Age=[75,80)                       1.5600 0.6015  4.7590
Age=[80,85)                       1.6532 0.6028  5.2238
Age=[85,90)                       1.8764 0.6072  6.5299
Age=[90,95)                       1.8662 0.6477  6.4639
Age=95+                           2.0845 0.8678  8.0405
Urgency=Not planned               2.6082 0.0929 13.5742
Comorbidity_1=1                   0.9347 0.2442  2.5465
Comorbidity_2=1                   1.1302 0.3093  3.0963
Comorbidity_4=1                   1.1391 0.3387  3.1239
Comorbidity_6=1                   0.8181 0.2531  2.2663
Comorbidity_13=1                  1.2133 0.2159  3.3647
Comorbidity_16=1                  1.3895 0.0939  4.0127
SES=Below average                -0.0615 0.1285  0.9403
SES=Average                      -0.2850 0.1367  0.7520
SES=Above average                -0.0707 0.1363  0.9317
SES=Highest                       0.1615 0.1366  1.1752
Year=2008                        -0.1361 0.1207  0.8728
Year=2009                        -0.1586 0.1209  0.8533
Year=2010                        -0.4412 0.1230  0.6432
```

---

## [38] Non-Hodgkins lymphoma

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 + 
    Comorbidity_4 + Comorbidity_6 + Comorbidity_13 + Comorbidity_14 + 
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.    
                         Ratio Test            Indexes          Indexes       

Obs         20110    LR chi2    1373.45    R2       0.199    C       0.813    
 Not died   19086    d.f.            36    Brier    0.044    Dxy     0.627    
 Died        1024    Pr(> chi2) <0.0001                      gamma   0.636    
max |deriv| 6e-08                                            tau-a   0.061    


                                                Coef    S.E.   Odds   
Intercept                                       -6.8929 1.0556  0.0010
Severity=[0.01,0.02)                             0.6006 0.8040  1.8233
Severity=[0.02,0.05)                             0.5413 0.3013  1.7183
Severity=[0.05,0.1)                              1.0922 0.2876  2.9809
Severity=[0.1,0.2)                               2.2529 0.4593  9.5148
Severity=[0.4,1],[0.3,0.4),[0.2,0.3),Others      1.9253 0.5247  6.8569
Age=[5,10)                                      -0.2260 1.4288  0.7977
Age=[10,15)                                      0.1781 1.2396  1.1949
Age=[15,20)                                      0.1278 1.2402  1.1363
Age=[20,25)                                      1.5768 1.0979  4.8396
Age=[25,30)                                      0.7466 1.1728  2.1097
Age=[30,35)                                      0.2079 1.2405  1.2310
Age=[35,40)                                      1.4183 1.0623  4.1300
Age=[40,45)                                      1.7859 1.0396  5.9650
Age=[45,50)                                      1.4805 1.0367  4.3951
Age=[50,55)                                      1.7207 1.0279  5.5883
Age=[55,60)                                      1.7622 1.0244  5.8252
Age=[60,65)                                      1.9265 1.0208  6.8653
Age=[65,70)                                      2.0165 1.0211  7.5119
Age=[70,75)                                      2.3300 1.0201 10.2783
Age=[75,80)                                      2.5404 1.0197 12.6842
Age=[80,85)                                      2.6278 1.0211 13.8436
Age=[85,90)                                      2.8902 1.0239 17.9962
Age=[90,95),95+                                  3.1135 1.0467 22.4994
Urgency=Not planned                              1.7099 0.0741  5.5285
Comorbidity_2=1                                  1.3403 0.1857  3.8202
```

```
Comorbidity_4=1                            1.0911 0.2878  2.9774
Comorbidity_6=1                            0.9032 0.1898  2.4675
Comorbidity_13=1                           1.4218 0.2054  4.1446
Comorbidity_14=1                           0.7187 0.1546  2.0518
Comorbidity_16=1                           0.5726 0.1820  1.7728
Year=2008                                 -0.0905 0.0939  0.9134
Year=2009                                 -0.1361 0.0939  0.8728
Year=2010                                 -0.3378 0.0969  0.7134
Source=Nursing home                        0.2809 0.2551  1.3243
Source=General hospital                    0.8603 0.2651  2.3638
Source=Academic or topclinical hospital    2.0370 0.2971  7.6674
```

---

## [39] Leukemias

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_4 + Comorbidity_6 + Comorbidity_13 + Comorbidity_16 +
    Source + Year, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          19229    LR chi2    1863.03    R2       0.254    C       0.844
 Not died    18080    d.f.            37    Brier    0.049    Dxy     0.688
 Died         1149    Pr(> chi2) <0.0001                      gamma   0.693
max |deriv| 2e-06                                             tau-a   0.077


                                          Coef    S.E.   Odds
Intercept                                 -6.1932 1.1326  0.0020
Severity=[0.01,0.02)                       2.1290 1.0325  8.4064
Severity=[0.02,0.05)                       1.2193 1.0564  3.3848
Severity=[0.05,0.1)                        1.7567 1.0291  5.7932
Severity=[0.1,0.2)                         2.4483 1.0280 11.5685
Severity=[0.2,0.3)                         2.5974 1.0616 13.4292
Severity=[0.4,1],[0.3,0.4),Others         3.0645 1.1184 21.4243
Age=[1,5)                                 -2.2002 0.6021  0.1108
Age=[5,10)                                -3.9541 1.1049  0.0192
Age=[10,15)                               -1.5913 0.6228  0.2037
Age=[15,20)                               -1.2265 0.5894  0.2933
Age=[20,25)                               -0.9431 0.6242  0.3894
Age=[25,30)                                0.0113 0.5443  1.0113
Age=[30,35)                               -0.3627 0.5929  0.6958
Age=[35,40)                                0.0430 0.5293  1.0439
Age=[40,45)                                0.3523 0.5051  1.4224
Age=[45,50)                                0.2660 0.5045  1.3047
Age=[50,55)                                0.4480 0.4983  1.5652
Age=[55,60)                                0.7353 0.4855  2.0862
Age=[60,65)                                0.7339 0.4840  2.0832
Age=[65,70)                                1.0813 0.4826  2.9485
Age=[70,75)                                1.3492 0.4810  3.8543
Age=[75,80)                                1.5818 0.4817  4.8638
Age=[80,85)                                1.6705 0.4836  5.3148
Age=[85,90)                                1.7171 0.4928  5.5685
Age=[90,95),95+                            2.1442 0.5442  8.5349
Urgency=Not planned                        1.1989 0.0703  3.3164
Comorbidity_2=1                            1.0364 0.1776  2.8191
Comorbidity_4=1                            1.9257 0.2376  6.8602
Comorbidity_6=1                            0.5415 0.2213  1.7185
Comorbidity_13=1                           1.2177 0.2092  3.3793
Comorbidity_16=1                           1.1034 0.3088  3.0144
Source=Nursing home                       -0.2881 0.3142  0.7497
Source=General hospital                    0.9203 0.1993  2.5101
Source=Academic or topclinical hospital    0.8993 0.3197  2.4579
Year=2008                                 -0.0243 0.0923  0.9760
Year=2009                                  0.0082 0.0914  1.0082
Year=2010                                 -0.2048 0.0945  0.8148
```

---

## [42] Secondary malignancies

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_9 + Comorbidity_13 + Comorbidity_16 + SES + Year +
    Source, data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          67710    LR chi2    4549.91    R2       0.159    C       0.772
 Not died    62751    d.f.            42    Brier    0.063    Dxy     0.545
 Died         4959    Pr(> chi2) <0.0001                      gamma   0.550
max |deriv| 2e-09                                             tau-a   0.074


                                         Coef    S.E.   Odds
Intercept                                -6.3862 1.0316 0.0017
Severity=[0.01,0.02)                      0.4542 0.2345 1.5749
Severity=[0.02,0.05)                      1.0525 0.2136 2.8648
Severity=[0.05,0.1)                       1.4154 0.2004 4.1182
Severity=[0.1,0.2)                        1.5412 0.2040 4.6702
Age=[10,15)                               0.2944 1.4345 1.3423
Age=[15,20)                               0.0991 1.2381 1.1042
Age=[20,25)                              -0.9611 1.4267 0.3825
Age=[25,30)                               0.5160 1.0738 1.6753
Age=[30,35)                               1.3503 1.0283 3.8588
Age=[35,40)                               1.1929 1.0193 3.2965
Age=[40,45)                               1.0347 1.0163 2.8142
Age=[45,50)                               1.1740 1.0141 3.2350
Age=[50,55)                               1.2172 1.0132 3.3776
Age=[55,60)                               1.2951 1.0126 3.6513
Age=[60,65)                               1.3787 1.0122 3.9697
Age=[65,70)                               1.4501 1.0123 4.2634
Age=[70,75)                               1.5101 1.0123 4.5270
Age=[75,80)                               1.6283 1.0124 5.0952
Age=[80,85)                               1.9207 1.0126 6.8257
Age=[85,90)                               2.0198 1.0137 7.5370
Age=[90,95)                               2.0341 1.0202 7.6457
Age=95+                                   1.7249 1.0964 5.6120
Urgency=Not planned                       1.5744 0.0370 4.8278
Comorbidity_1=1                           0.5722 0.1209 1.7721
Comorbidity_2=1                           1.1937 0.1201 3.2994
Comorbidity_3=1                           0.6002 0.1803 1.8226
Comorbidity_4=1                           0.9933 0.1306 2.7001
Comorbidity_6=1                           0.3680 0.1020 1.4448
Comorbidity_9=1                           1.3809 0.2469 3.9783
Comorbidity_13=1                          1.0367 0.1236 2.8199
Comorbidity_16=1                          0.4934 0.0310 1.6379
SES=Below average                        -0.0939 0.0464 0.9103
SES=Average                              -0.1528 0.0478 0.8583
SES=Above average                        -0.1207 0.0473 0.8863
SES=Highest                              -0.1505 0.0494 0.8602
SES=Unknown                               0.1200 0.5388 1.1275
Year=2008                                 0.0123 0.0432 1.0123
Year=2009                                -0.1380 0.0439 0.8711
Year=2010                                -0.2172 0.0439 0.8047
Source=Nursing home                       0.2782 0.1496 1.3208
Source=General hospital                   0.3335 0.1697 1.3958
Source=Academic or topclinical hospital   0.5958 0.2232 1.8144
```

---

## [44] Neoplasms of unspecified nature or uncertain behavior

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_3 + Comorbidity_4 + Comorbidity_6 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + Year + Source, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          20895    LR chi2     697.13    R2       0.156    C       0.806
 Not died    20368    d.f.            37    Brier    0.023    Dxy     0.612
 Died          527    Pr(> chi2) <0.0001                      gamma   0.625
max |deriv| 9e-07                                             tau-a   0.030


                                         Coef    S.E.   Odds
Intercept                                -5.2707 0.6550 0.0051
Severity=[0.01,0.02)                      0.7763 0.2581 2.1735
Severity=[0.02,0.05)                      1.4757 0.2283 4.3740
Severity=[0.05,0.1),[0.1,0.2)             1.5613 0.2329 4.7648
Age=[1,5)                                -2.0339 1.1755 0.1308
Age=[5,10)                               -1.2263 0.9389 0.2934
Age=[10,15)                              -1.9844 1.1756 0.1375
Age=[15,20)                              -1.5833 1.1761 0.2053
Age=[20,25)                              -0.6467 0.7947 0.5238
Age=[25,30)                              -1.3400 0.9395 0.2619
```

```
Age=[30,35)                              -1.1408 0.8448 0.3196
Age=[35,40)                              -0.3716 0.7006 0.6896
Age=[40,45)                              -1.1479 0.7394 0.3173
Age=[45,50)                              -1.0982 0.7102 0.3335
Age=[50,55)                              -0.4776 0.6541 0.6203
Age=[55,60)                              -0.2987 0.6394 0.7418
Age=[60,65)                              -0.3359 0.6358 0.7147
Age=[65,70)                              -0.1069 0.6303 0.8986
Age=[70,75)                               0.0692 0.6256 1.0717
Age=[75,80)                               0.0802 0.6257 1.0835
Age=[80,85)                               0.3319 0.6246 1.3936
Age=[85,90)                               0.3588 0.6296 1.4316
Age=[90,95)                               0.5831 0.6488 1.7917
Age=95+                                   0.2394 0.8110 1.2705
Urgency=Not planned                       1.1633 0.0971 3.2004
Comorbidity_2=1                           1.5279 0.2126 4.6087
Comorbidity_3=1                           1.0007 0.3840 2.7203
Comorbidity_4=1                           1.1889 0.3114 3.2836
Comorbidity_6=1                           0.6623 0.2289 1.9392
Comorbidity_13=1                          0.7981 0.3003 2.2214
Comorbidity_14=1                          0.6353 0.2884 1.8876
Comorbidity_16=1                          0.7377 0.3195 2.0912
Year=2008                                -0.0822 0.1240 0.9211
Year=2009                                -0.0759 0.1242 0.9269
Year=2010                                -0.4615 0.1345 0.6304
Source=Nursing home                       0.7189 0.2770 2.0521
Source=General hospital                   0.7383 0.3282 2.0925
Source=Academic or topclinical hospital   1.2118 0.4838 3.3595
```

---

## [50] Diabetes mellitus with complications

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_6 + Comorbidity_9 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Year,
    data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          32495    LR chi2    1326.58    R2       0.217    C       0.856
 Not died    31812    d.f.            32    Brier    0.019    Dxy     0.713
 Died          683    Pr(> chi2) <0.0001                      gamma   0.723
max |deriv| 3e-08                                             tau-a   0.029


                     Coef    S.E.   Odds
Intercept            -8.1329 0.7225   0.0003
Severity=[0.01,0.02)  0.3185 0.2273   1.3751
Severity=[0.02,0.05)  1.0807 0.2252   2.9467
Severity=[0.05,0.1)   1.8534 0.3076   6.3817
Severity=[0.1,0.2)    2.6989 0.3488  14.8633
Sex=Female           -0.2319 0.0850   0.7931
Age=[25,30),[20,25)  -0.2040 1.2264   0.8155
Age=[30,35)           1.5810 0.9174   4.8597
Age=[35,40)           1.1814 0.9183   3.2589
Age=[40,45)           1.7442 0.8100   5.7215
Age=[45,50)           1.9345 0.7736   6.9209
Age=[50,55)           1.7378 0.7702   5.6851
Age=[55,60)           2.2016 0.7450   9.0399
Age=[60,65)           2.4126 0.7370  11.1635
Age=[65,70)           2.9602 0.7309  19.3015
Age=[70,75)           3.1092 0.7286  22.4032
Age=[75,80)           3.3744 0.7262  29.2056
Age=[80,85)           3.6750 0.7259  39.4496
Age=[85,90)           4.0116 0.7268  55.2370
Age=[90,95)           4.6351 0.7358 103.0372
Age=95+               4.6419 0.8130 103.7362
Urgency=Not planned   0.6697 0.1044   1.9536
Comorbidity_1=1       0.9953 0.1521   2.7055
Comorbidity_2=1       1.4962 0.1264   4.4645
Comorbidity_3=1       0.4731 0.1010   1.6049
Comorbidity_6=1       0.5808 0.1813   1.7874
Comorbidity_9=1       1.4831 0.3968   4.4068
Comorbidity_13=1      0.8700 0.1375   2.3868
Comorbidity_14=1      1.0800 0.2381   2.9446
Comorbidity_16=1      0.8913 0.2851   2.4382
Year=2008             0.0257 0.1094   1.0260
Year=2009            -0.2083 0.1151   0.8120
Year=2010            -0.4132 0.1185   0.6615
```

---

## [55] Fluid and electrolyte disorders

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_9 + Comorbidity_14 +
    Comorbidity_16 + SES + Month + Year, data = data, y = TRUE,
    maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          26922    LR chi2    1902.48    R2       0.221    C       0.828
 Not died    25697    d.f.            37    Brier    0.039    Dxy     0.657
 Died         1225    Pr(> chi2) <0.0001                      gamma   0.662
max |deriv| 4e-05                                             tau-a   0.057


                                                             Coef    S.E.   Odds
Intercept                                                  -7.3850 0.7333   0.0006
Severity=[0.02,0.05)                                       -0.2045 0.1784   0.8150
Severity=[0.05,0.1)                                         0.8078 0.1676   2.2430
Severity=[0.2,0.3)                                          2.7322 0.1880  15.3673
Sex=Female                                                 -0.3052 0.0643   0.7370
Age=[1,5)                                                   0.0394 0.9136   1.0402
Age=[25,30),[20,25),[15,20),[10,15),[5,10),[30,35)         -0.4733 1.2262   0.6229
Age=[35,40)                                                 2.3036 0.9215  10.0097
Age=[40,45)                                                 2.7693 0.8236  15.9478
Age=[45,50)                                                 2.5596 0.7959  12.9312
Age=[50,55)                                                 3.4999 0.7406  33.1124
Age=[55,60)                                                 3.2669 0.7354  26.2303
Age=[60,65)                                                 3.5901 0.7228  36.2392
Age=[65,70)                                                 3.7786 0.7203  43.7552
Age=[70,75)                                                 4.1647 0.7154  64.3732
Age=[75,80)                                                 4.3053 0.7131  74.0889
Age=[80,85)                                                 4.6532 0.7114 104.9251
Age=[85,90)                                                 4.8334 0.7116 125.6347
Age=[90,95)                                                 5.3038 0.7141 201.1045
Age=95+                                                     5.5324 0.7302 252.7615
Comorbidity_1=1                                             0.3821 0.1650   1.4654
Comorbidity_2=1                                             1.1126 0.1079   3.0422
Comorbidity_4=1                                             0.4950 0.1711   1.6405
Comorbidity_9=1                                             1.3357 0.2736   3.8026
Comorbidity_14=1                                            0.5939 0.1231   1.8110
Comorbidity_16=1                                            0.7198 0.1381   2.0540
SES=Below average                                          -0.1980 0.0934   0.8203
SES=Average                                                 0.1153 0.0898   1.1222
SES=Above average                                          -0.1233 0.0940   0.8840
SES=Highest                                                -0.2176 0.1014   0.8045
Month=2                                                    -0.2955 0.1020   0.7441
Month=3                                                    -0.2280 0.1026   0.7961
Month=4                                                    -0.4194 0.1043   0.6574
Month=5                                                    -0.2259 0.1063   0.7978
Month=6                                                    -0.1709 0.1027   0.8429
Year=2008                                                   0.0985 0.0839   1.1035
Year=2009                                                  -0.1932 0.0880   0.8243
Year=2010                                                  -0.2594 0.0899   0.7715
```

## [59] Deficiency and other anemia

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_2 +
    Comorbidity_4 + Comorbidity_13 + Comorbidity_14 + Comorbidity_16 +
    Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          45376    LR chi2     705.54    R2       0.114    C       0.783
 Not died    44749    d.f.            34    Brier    0.013    Dxy     0.565
 Died          627    Pr(> chi2) <0.0001                      gamma   0.588
max |deriv| 2e-07                                             tau-a   0.015
```

```
                                            Coef    S.E.   Odds
Intercept                                   -7.0147 0.6047 0.0009
Severity=[0.01,0.02)                         0.5682 0.1042 1.7651
Severity=[0.02,0.05),[0.1,0.2)               1.4782 0.1378 4.3851
Sex=Female                                  -0.2362 0.0841 0.7896
Age=[5,10)                                   0.3431 0.9214 1.4093
Age=[10,15)                                 -0.2470 1.1614 0.7811
Age=[15,20)                                 -0.1536 1.1615 0.8576
Age=[20,25)                                  0.5789 0.9201 1.7840
Age=[25,30)                                 -0.0837 1.1618 0.9197
Age=[30,35)                                  0.5618 0.9209 1.7538
Age=[35,40)                                  0.9835 0.7393 2.6737
Age=[40,45)                                 -0.1627 0.9207 0.8498
Age=[45,50)                                  0.2219 0.7393 1.2485
Age=[50,55)                                  1.1030 0.6459 3.0131
Age=[55,60)                                  1.2535 0.6246 3.5027
Age=[60,65)                                  1.0648 0.6167 2.9002
Age=[65,70)                                  1.2306 0.6073 3.4234
Age=[70,75)                                  1.2642 0.6031 3.5404
Age=[75,80)                                  1.4402 0.5978 4.2216
Age=[80,85)                                  1.6657 0.5961 5.2895
Age=[85,90)                                  2.0624 0.5959 7.8646
Age=[90,95)                                  1.9050 0.6087 6.7196
Age=95+                                      2.0357 0.6549 7.6575
Urgency=Not planned                          1.0946 0.1011 2.9881
Comorbidity_2=1                              1.5903 0.1212 4.9053
Comorbidity_4=1                              0.9738 0.2328 2.6480
Comorbidity_13=1                             0.6471 0.1473 1.9101
Comorbidity_14=1                             0.4964 0.1265 1.6428
Comorbidity_16=1                             0.8160 0.1549 2.2615
Year=2008                                   -0.0272 0.1109 0.9732
Year=2009                                   -0.3703 0.1176 0.6905
Year=2010                                   -0.4101 0.1154 0.6636
Source=Nursing home                          0.1282 0.2084 1.1368
Source=General hospital                      1.3774 0.4466 3.9646
Source=Academic or topclinical hospital      1.3077 0.7355 3.6978
```

---

## [85] Coma; stupor; and brain damage

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_5 + Comorbidity_6 + Comorbidity_14 + Year, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs           3983    LR chi2     784.98    R2       0.309    C       0.802
 Not died     3364    d.f.            28    Brier    0.099    Dxy     0.604
 Died          619    Pr(> chi2) <0.0001                      gamma   0.612
max |deriv| 3e-10                                             tau-a   0.159

                    Coef    S.E.   Odds
Intercept           -3.7609 0.4241  0.0233
Severity=[0.4,1]     3.0751 0.1354 21.6529
Age=[1,5)           -1.3959 0.7202  0.2476
Age=[5,10),[10,15)  -0.0475 0.6133  0.9536
Age=[15,20)         -1.0446 0.8341  0.3518
Age=[20,25)         -0.3565 0.7250  0.7001
Age=[25,30)         -0.8429 0.8545  0.4305
Age=[30,35)         -0.1586 0.6358  0.8534
Age=[35,40)          0.1810 0.5391  1.1984
Age=[40,45)         -0.0215 0.5411  0.9788
Age=[45,50)          0.0847 0.5028  1.0884
Age=[50,55)          0.4247 0.4615  1.5291
Age=[55,60)          0.5726 0.4553  1.7729
Age=[60,65)          0.8514 0.4268  2.3429
Age=[65,70)          0.9145 0.4355  2.4954
Age=[70,75)          1.2469 0.4196  3.4796
Age=[75,80)          1.2596 0.4144  3.5241
Age=[80,85)          1.3955 0.4126  4.0369
Age=[85,90)          1.5087 0.4169  4.5207
Age=[90,95)          1.7168 0.4389  5.5666
Age=95+              1.3935 0.5672  4.0291
Urgency=Not planned  0.5393 0.1633  1.7148
Comorbidity_2=1      0.9355 0.2376  2.5485
Comorbidity_5=1     -0.9878 0.3716  0.3724
Comorbidity_6=1      0.7119 0.2176  2.0378
Comorbidity_14=1     0.9682 0.2420  2.6332
Year=2008           -0.0622 0.1429  0.9397
Year=2009           -0.0398 0.1408  0.9610
Year=2010           -0.1786 0.1459  0.8365
```

## [96] Heart valve disorders

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_3 + Comorbidity_4 + Comorbidity_8 + Comorbidity_13 +
    Comorbidity_14 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          33780    LR chi2    1549.30    R2       0.158    C       0.789
 Not died    32442    d.f.            33    Brier    0.036    Dxy     0.579
 Died         1338    Pr(> chi2) <0.0001                      gamma   0.589
max |deriv| 3e-07                                             tau-a   0.044

                                         Coef    S.E.   Odds
Intercept                                -7.6962 1.0430  0.0005
Severity=[0.01,0.02)                      1.4408 1.0766  4.2240
Severity=[0.02,0.05)                      1.9714 0.3272  7.1807
Severity=[0.05,0.1)                       2.6289 0.3475 13.8583
Severity=[0.1,0.2)                        3.1603 0.3357 23.5777
Age=[15,20)                               1.0611 1.4366  2.8896
Age=[20,25)                               0.4471 1.4272  1.5638
Age=[25,30)                               0.3942 1.4234  1.4832
Age=[30,35)                              -0.1119 1.4283  0.8941
Age=[35,40)                               0.9761 1.0800  2.6541
Age=[40,45)                               0.7438 1.0787  2.1040
Age=[45,50)                              -0.2827 1.1276  0.7538
Age=[50,55)                               1.0644 1.0316  2.8991
Age=[55,60)                               0.9362 1.0261  2.5502
Age=[60,65)                               1.3346 1.0167  3.7985
Age=[65,70)                               1.6482 1.0142  5.1977
Age=[70,75)                               1.9856 1.0124  7.2833
Age=[75,80)                               2.1982 1.0117  9.0092
Age=[80,85)                               2.4947 1.0118 12.1177
Age=[85,90)                               2.7331 1.0132 15.3805
Age=[90,95),95+                           2.9352 1.0194 18.8251
Urgency=Not planned                       0.7319 0.0642  2.0791
Comorbidity_2=1                           0.9077 0.0788  2.4787
Comorbidity_3=1                           0.7341 0.1355  2.0835
Comorbidity_4=1                           1.0852 0.1397  2.9601
Comorbidity_8=1                           1.5804 0.3496  4.8569
Comorbidity_13=1                          1.1827 0.1167  3.2631
Comorbidity_14=1                          0.6084 0.2244  1.8374
Year=2008                                 0.0246 0.0827  1.0249
Year=2009                                -0.0759 0.0817  0.9269
Year=2010                                -0.3409 0.0860  0.7112
Source=Nursing home                       0.1912 0.2358  1.2107
Source=General hospital                   0.7569 0.0982  2.1318
Source=Academic or topclinical hospital   0.9266 0.1429  2.5259
```

## [100] Acute myocardial infarction

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_5 +
    Comorbidity_6 + Comorbidity_8 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + SES + Month + Year + Source, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          87847    LR chi2    5278.87    R2       0.152    C       0.766
 Not died    82076    d.f.            44    Brier    0.057    Dxy     0.533
 Died         5771    Pr(> chi2) <0.0001                      gamma   0.538
max |deriv| 5e-12                                             tau-a   0.065
```

```
                                           Coef    S.E.   Odds
Intercept                                  -3.7064 0.5258 0.0246
Severity=[0.05,0.1)                         1.1161 0.0586 3.0529
Severity=[0.1,0.2)                          1.4252 0.0578 4.1587
Age=[25,30)                                -0.6150 0.6926 0.5406
Age=[30,35)                                -1.0547 0.6200 0.3483
Age=[35,40)                                -1.1733 0.5538 0.3093
Age=[40,45)                                -1.2867 0.5362 0.2762
Age=[45,50)                                -1.0650 0.5272 0.3447
Age=[50,55)                                -1.1099 0.5253 0.3296
Age=[55,60)                                -0.8331 0.5234 0.4347
Age=[60,65)                                -0.5958 0.5222 0.5511
Age=[65,70)                                -0.3629 0.5219 0.6957
Age=[70,75)                                -0.0421 0.5213 0.9588
Age=[75,80)                                 0.2249 0.5210 1.2522
Age=[80,85)                                 0.6158 0.5208 1.8511
Age=[85,90)                                 0.8863 0.5212 2.4261
Age=[90,95)                                 1.2496 0.5231 3.4891
Age=95+                                     1.3370 0.5368 3.8075
Urgency=Not planned                         0.1870 0.0429 1.2056
Comorbidity_1=1                             0.2307 0.0491 1.2594
Comorbidity_2=1                             0.9382 0.0406 2.5555
Comorbidity_3=1                             0.3982 0.1085 1.4891
Comorbidity_4=1                             1.0620 0.0846 2.8923
Comorbidity_5=1                             0.4835 0.1574 1.6217
Comorbidity_6=1                             0.2382 0.0780 1.2689
Comorbidity_8=1                             0.6835 0.2815 1.9808
Comorbidity_13=1                            0.8986 0.0785 2.4561
Comorbidity_14=1                            0.5786 0.1240 1.7835
Comorbidity_16=1                            1.1015 0.1708 3.0086
SES=Below average                          -0.1360 0.0422 0.8729
SES=Average                                -0.1233 0.0433 0.8840
SES=Above average                          -0.1434 0.0433 0.8664
SES=Highest                                -0.1917 0.0466 0.8255
SES=Unknown                                 0.4109 0.3307 1.5081
Month=2                                     0.0163 0.0474 1.0164
Month=3                                    -0.1136 0.0495 0.8926
Month=4                                    -0.1327 0.0507 0.8758
Month=5                                    -0.0345 0.0485 0.9661
Month=6                                    -0.0207 0.0474 0.9795
Year=2008                                  -0.1715 0.0397 0.8424
Year=2009                                  -0.2991 0.0401 0.7415
Year=2010                                  -0.3452 0.0401 0.7080
Source=Nursing home                         0.0936 0.1037 1.0982
Source=General hospital                    -0.2330 0.0628 0.7921
Source=Academic or topclinical hospital    -0.3731 0.0821 0.6886
```

---

## [101] Coronary atherosclerosis and other heart disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_5 +
    Comorbidity_6 + Comorbidity_8 + Comorbidity_9 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + Year + Source, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs         228060    LR chi2    2651.81    R2       0.123    C       0.792
 Not died   226096    d.f.            34    Brier    0.008    Dxy     0.584
 Died         1964    Pr(> chi2) <0.0001                      gamma   0.622
max |deriv| 5e-11                                             tau-a   0.010


                                           Coef    S.E.    Odds
Intercept                                  -6.2405 1.0093  0.0019
Severity=[0.01,0.02)                        0.0595 0.0526  1.0613
Severity=[0.02,0.05)                        1.1293 0.1375  3.0936
Age=[30,35)                                -0.5406 1.4207  0.5824
Age=[35,40)                                -0.7108 1.1619  0.4913
Age=[40,45)                                -0.7958 1.0767  0.4512
Age=[45,50)                                -0.5870 1.0369  0.5560
Age=[50,55)                                -0.1230 1.0193  0.8842
Age=[55,60)                                -0.1175 1.0158  0.8891
Age=[60,65)                                 0.3658 1.0117  1.4416
Age=[65,70)                                 0.5746 1.0109  1.7764
Age=[70,75)                                 1.0134 1.0097  2.7549
Age=[75,80)                                 1.4457 1.0092  4.2447
Age=[80,85)                                 1.7900 1.0093  5.9894
Age=[85,90)                                 2.0481 1.0103  7.7532
Age=[90,95)                                 2.5103 1.0141 12.3092
```

```
Age=95+                                     3.0134 1.0370 20.3575
Urgency=Not planned                         0.5487 0.0549  1.7309
Comorbidity_1=1                             0.3033 0.0675  1.3544
Comorbidity_2=1                             1.5001 0.0718  4.4821
Comorbidity_3=1                             0.6968 0.1292  2.0074
Comorbidity_4=1                             1.0669 0.1220  2.9065
Comorbidity_5=1                             1.3735 0.2637  3.9490
Comorbidity_6=1                             0.6077 0.1012  1.8362
Comorbidity_8=1                             1.7956 0.2901  6.0231
Comorbidity_9=1                             1.7754 0.5724  5.9026
Comorbidity_13=1                            0.9040 0.1074  2.4696
Comorbidity_14=1                            1.0367 0.1777  2.8198
Comorbidity_16=1                            0.7075 0.2851  2.0289
Year=2008                                  -0.0890 0.0622  0.9148
Year=2009                                  -0.2443 0.0642  0.7832
Year=2010                                  -0.3875 0.0660  0.6787
Source=Nursing home                         0.4411 0.1744  1.5544
Source=General hospital                     0.8450 0.0752  2.3280
Source=Academic or topclinical hospital     0.6165 0.1130  1.8524
```

## [103] Pulmonary heart disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          26062    LR chi2    1221.96    R2       0.145    C       0.780
 Not died    24839    d.f.            34    Brier    0.042    Dxy     0.561
 Died         1223    Pr(> chi2) <0.0001                      gamma   0.570
max |deriv| 6e-06                                             tau-a   0.050


                                           Coef    S.E.   Odds
Intercept                                  -2.8444 0.3523 0.0582
Severity=[0.05,0.1)                         0.5833 0.1051 1.7919
Severity=[0.1,0.2)                          1.6009 0.2933 4.9574
Severity=[0.2,0.3)                          1.2845 0.1624 3.6130
Age=[10,15),[1,5),[5,10)                   -0.4443 0.5377 0.6413
Age=[15,20)                                -1.2449 0.5592 0.2880
Age=[20,25)                                -2.6322 0.7848 0.0719
Age=[25,30)                                -2.5721 0.6682 0.0764
Age=[30,35)                                -2.2717 0.5619 0.1031
Age=[35,40)                                -1.6541 0.4304 0.1913
Age=[40,45)                                -1.8408 0.4140 0.1587
Age=[45,50)                                -1.4799 0.3758 0.2277
Age=[50,55)                                -1.1650 0.3651 0.3119
Age=[55,60)                                -1.1044 0.3596 0.3314
Age=[60,65)                                -0.8227 0.3509 0.4393
Age=[65,70)                                -0.6262 0.3479 0.5346
Age=[70,75)                                -0.5721 0.3454 0.5643
Age=[75,80)                                -0.2769 0.3439 0.7582
Age=[80,85)                                 0.1186 0.3450 1.1259
Age=[85,90)                                 0.5772 0.3481 1.7811
Age=[90,95)                                 0.9065 0.3688 2.4757
Age=95+                                     0.5902 0.5083 1.8043
Urgency=Not planned                         0.2445 0.0895 1.2770
Comorbidity_1=1                             1.0007 0.1585 2.7201
Comorbidity_2=1                             1.0201 0.1039 2.7735
Comorbidity_4=1                             1.3929 0.1913 4.0265
Comorbidity_13=1                            0.6205 0.1829 1.8598
Comorbidity_14=1                            0.4808 0.1167 1.6174
Comorbidity_16=1                            1.1185 0.1202 3.0604
Year=2008                                  -0.2019 0.0883 0.8172
Year=2009                                  -0.1511 0.0848 0.8598
Year=2010                                  -0.4155 0.0864 0.6600
Source=Nursing home                         0.3387 0.1951 1.4032
Source=General hospital                     1.2835 0.1937 3.6091
Source=Academic or topclinical hospital     1.0120 0.3196 2.7512
```

## [106] Cardiac dysrhythmias

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_2 +
    Comorbidity_3 + Comorbidity_4 + Comorbidity_5 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_10 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + SES + Month + Year + Source, data = data,
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          180951    LR chi2    3020.23    R2       0.166    C       0.846
 Not died  179272    d.f.            49    Brier    0.009    Dxy     0.692
 Died          1679    Pr(> chi2) <0.0001                      gamma   0.722
max |deriv| 2e-07                                             tau-a   0.013


                                        Coef    S.E.   Odds
Intercept                               -7.3962 1.0087  0.0006
Severity=[0.01,0.02)                     1.0840 0.2778  2.9564
Severity=[0.02,0.05)                     1.5671 0.0519  4.7929
Sex=Female                              -0.2252 0.0524  0.7983
Age=[1,5),[5,10)                         0.4312 1.4174  1.5392
Age=[10,15)                              0.3126 1.4170  1.3669
Age=[15,20)                              0.6118 1.1571  1.8437
Age=[20,25)                              0.6290 1.1205  1.8757
Age=[25,30)                              0.7509 1.0979  2.1189
Age=[30,35)                              0.4886 1.0977  1.6301
Age=[35,40)                              0.1910 1.0823  1.2104
Age=[40,45)                              1.1054 1.0247  3.0204
Age=[45,50)                              0.7631 1.0238  2.1448
Age=[50,55)                              1.1061 1.0138  3.0225
Age=[55,60)                              1.2172 1.0095  3.3776
Age=[60,65)                              1.1753 1.0077  3.2391
Age=[65,70)                              1.4640 1.0062  4.3233
Age=[70,75)                              1.8297 1.0048  6.2318
Age=[75,80)                              2.0874 1.0043  8.0639
Age=[80,85)                              2.6442 1.0039 14.0725
Age=[85,90)                              3.1582 1.0041 23.5287
Age=[90,95)                              3.4299 1.0072 30.8737
Age=95+                                  3.7506 1.0218 42.5458
Urgency=Not planned                      0.6803 0.0727  1.9744
Comorbidity_2=1                          1.1462 0.0747  3.1461
Comorbidity_3=1                          0.6658 0.2017  1.9460
Comorbidity_4=1                          1.2453 0.1408  3.4739
Comorbidity_5=1                          0.9552 0.2403  2.5991
Comorbidity_6=1                          0.8012 0.1083  2.2281
Comorbidity_8=1                          2.0733 0.4156  7.9509
Comorbidity_10=1                         0.3104 0.1114  1.3639
Comorbidity_13=1                         1.1719 0.1282  3.2282
Comorbidity_14=1                         1.2870 0.1771  3.6220
Comorbidity_16=1                         1.5438 0.2184  4.6823
SES=Below average                       -0.1041 0.0723  0.9012
SES=Average                             -0.1910 0.0750  0.8261
SES=Above average                       -0.2864 0.0776  0.7510
SES=Highest                             -0.4489 0.0845  0.6384
SES=Unknown                              0.4684 0.7221  1.5974
Month=2                                 -0.0635 0.0835  0.9384
Month=3                                 -0.2281 0.0874  0.7960
Month=4                                 -0.2922 0.0888  0.7466
Month=5                                 -0.2453 0.0865  0.7824
Month=6                                 -0.0872 0.0829  0.9165
Year=2008                                0.0028 0.0710  1.0028
Year=2009                               -0.1905 0.0719  0.8266
Year=2010                               -0.3448 0.0725  0.7084
Source=Nursing home                      0.3616 0.1648  1.4356
Source=General hospital                  0.3689 0.1950  1.4462
Source=Academic or topclinical hospital  0.5058 0.2804  1.6583
```

## [107] Cardiac arrest and ventricular fibrillation

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_3 + Comorbidity_4 + Comorbidity_6 + Comorbidity_10 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Year +
    Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          8251    LR chi2    1909.21    R2       0.276    C       0.768
 Not died    4485    d.f.            32    Brier    0.195    Dxy     0.535
 Died        3766    Pr(> chi2) <0.0001                      gamma   0.538
max |deriv| 3e-09                                            tau-a   0.266


                                        Coef    S.E.   Odds
Intercept                               -3.5859 0.5572  0.0277
Severity=[0.2,0.3)                       2.5149 0.4600 12.3656
Severity=[0.4,1]                         3.9150 0.4599 50.1493
Age=[20,25),[15,20)                     -1.3107 0.4022  0.2696
Age=[25,30)                             -1.1180 0.4328  0.3269
Age=[30,35)                             -0.5938 0.3889  0.5522
Age=[35,40)                             -0.7437 0.3642  0.4753
Age=[40,45)                             -0.7299 0.3407  0.4819
Age=[45,50)                             -0.7726 0.3284  0.4618
Age=[50,55)                             -0.6429 0.3220  0.5258
Age=[55,60)                             -0.6909 0.3197  0.5011
Age=[60,65)                             -0.4165 0.3169  0.6593
Age=[65,70)                             -0.3936 0.3166  0.6746
Age=[70,75)                             -0.2717 0.3157  0.7621
Age=[75,80)                             -0.0520 0.3154  0.9494
Age=[80,85)                              0.3234 0.3181  1.3818
Age=[85,90)                              0.4304 0.3259  1.5379
Age=[90,95),95+                          0.6234 0.3715  1.8653
Urgency=Not planned                      0.9077 0.0759  2.4787
Comorbidity_1=1                         -0.3323 0.0657  0.7172
Comorbidity_3=1                          0.4190 0.2137  1.5204
Comorbidity_4=1                          0.5731 0.1778  1.7738
Comorbidity_6=1                          0.5274 0.1382  1.6945
Comorbidity_10=1                         0.3102 0.1194  1.3638
Comorbidity_13=1                         0.5437 0.1677  1.7223
Comorbidity_14=1                         0.5995 0.2356  1.8212
Comorbidity_16=1                         0.6408 0.3240  1.8980
Year=2008                               -0.1472 0.0736  0.8631
Year=2009                               -0.4031 0.0715  0.6682
Year=2010                               -0.3637 0.0724  0.6951
Source=Nursing home                      0.2395 0.2710  1.2706
Source=General hospital                 -0.9842 0.1282  0.3737
Source=Academic or topclinical hospital -0.5248 0.1798  0.5916
```

## [108] Congestive heart failure; nonhypertensive

```
Logistic Regression Model

lrm(formula = Death ~ Sex + Age + Urgency + Comorbidity_1 + Comorbidity_3 +
    Comorbidity_4 + Comorbidity_5 + Comorbidity_6 + Comorbidity_7 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Month + Year + Source, data = data, y = TRUE,
    maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs         99716    LR chi2    3039.92    R2       0.060    C       0.657
 Not died   88856    d.f.            41    Brier    0.094    Dxy     0.314
 Died       10860    Pr(> chi2) <0.0001                      gamma   0.318
max |deriv| 2e-07                                            tau-a   0.061


                                        Coef    S.E.   Odds
Intercept                               -2.5329 0.4282 0.0794
Sex=Female                              -0.1347 0.0216 0.8740
Age=[1,5),[5,10),[10,15),[15,20)         0.2718 0.5835 1.3123
Age=[20,25)                             -0.0621 0.6752 0.9398
```

```
Age=[25,30)                                  -1.3340 0.8326 0.2634
Age=[30,35)                                  -0.5454 0.5466 0.5796
Age=[35,40)                                  -0.7335 0.5065 0.4802
Age=[40,45)                                  -0.5977 0.4646 0.5501
Age=[45,50)                                  -0.9095 0.4534 0.4027
Age=[50,55)                                  -0.8710 0.4419 0.4185
Age=[55,60)                                  -0.5984 0.4336 0.5497
Age=[60,65)                                  -0.4301 0.4300 0.6504
Age=[65,70)                                  -0.2256 0.4286 0.7981
Age=[70,75)                                  -0.1307 0.4279 0.8775
Age=[75,80)                                   0.1976 0.4272 1.2185
Age=[80,85)                                   0.4211 0.4271 1.5236
Age=[85,90)                                   0.6504 0.4271 1.9163
Age=[90,95)                                   0.8453 0.4278 2.3286
Age=95+                                       1.0363 0.4317 2.8189
Urgency=Not planned                           0.3396 0.0320 1.4043
Comorbidity_1=1                               0.1359 0.0331 1.1456
Comorbidity_3=1                               0.3196 0.0766 1.3766
Comorbidity_4=1                               0.8593 0.0619 2.3615
Comorbidity_5=1                               0.3658 0.0873 1.4416
Comorbidity_6=1                               0.2573 0.0347 1.2934
Comorbidity_7=1                               0.2456 0.1341 1.2784
Comorbidity_8=1                               1.0850 0.2062 2.9596
Comorbidity_9=1                               1.1125 0.1789 3.0419
Comorbidity_13=1                              0.7675 0.0344 2.1544
Comorbidity_14=1                              0.5379 0.0708 1.7124
Comorbidity_16=1                              0.5968 0.1013 1.8163
Month=2                                      -0.1299 0.0337 0.8782
Month=3                                      -0.1983 0.0353 0.8201
Month=4                                      -0.2034 0.0369 0.8160
Month=5                                      -0.1888 0.0348 0.8279
Month=6                                      -0.1056 0.0335 0.8997
Year=2008                                    -0.0268 0.0293 0.9735
Year=2009                                    -0.0897 0.0291 0.9142
Year=2010                                    -0.2532 0.0296 0.7763
Source=Nursing home                           0.1074 0.0558 1.1134
Source=General hospital                       0.5662 0.0843 1.7615
Source=Academic or topclinical hospital       0.1758 0.1307 1.1922
```

---

## [109] Acute cerebrovascular disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_6 + Comorbidity_8 +
    Comorbidity_12 + Comorbidity_13 + Comorbidity_14 + Comorbidity_16 +
    Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          95070    LR chi2    10687.19    R2       0.191    C       0.761
 Not died    81658    d.f.             39    Brier    0.105    Dxy     0.522
 Died        13412    Pr(> chi2) <0.0001                       gamma   0.525
max |deriv| 5e-11                                              tau-a   0.126


                                             Coef    S.E.   Odds
Intercept                                    -4.1325 0.4272  0.0160
Severity=[0.1,0.2)                            0.0854 0.0277  1.0892
Severity=[0.2,0.3)                            1.6596 0.0408  5.2570
Severity=[0.3,0.4)                            1.8758 0.0241  6.5259
Age=[1,5)                                     0.0117 0.7365  1.0118
Age=[5,10)                                   -0.1982 0.6730  0.8202
Age=[10,15)                                   0.0205 0.6350  1.0207
Age=[15,20)                                   0.2465 0.5323  1.2795
Age=[20,25)                                   0.2215 0.5167  1.2479
Age=[25,30)                                   0.2084 0.4929  1.2318
Age=[30,35)                                   0.1731 0.4684  1.1890
Age=[35,40)                                   0.3300 0.4447  1.3910
Age=[40,45)                                   0.5950 0.4342  1.8129
Age=[45,50)                                   0.7202 0.4306  2.0549
Age=[50,55)                                   0.8225 0.4295  2.2763
Age=[55,60)                                   0.8507 0.4285  2.3414
Age=[60,65)                                   0.9861 0.4278  2.6809
Age=[65,70)                                   1.1766 0.4274  3.2434
Age=[70,75)                                   1.3696 0.4270  3.9339
Age=[75,80)                                   1.5748 0.4267  4.8299
Age=[80,85)                                   1.9256 0.4266  6.8590
Age=[85,90)                                   2.1573 0.4268  8.6479
Age=[90,95)                                   2.5610 0.4279 12.9488
Age=95+                                       2.8281 0.4343 16.9132
Urgency=Not planned                           0.2582 0.0345  1.2946
```

```
Comorbidity_1=1                            0.5488 0.0615  1.7312
Comorbidity_2=1                            1.4159 0.0664  4.1200
Comorbidity_3=1                            0.2295 0.1044  1.2580
Comorbidity_6=1                            0.5797 0.0655  1.7854
Comorbidity_8=1                            0.7225 0.2439  2.0596
Comorbidity_12=1                          -0.1189 0.0464  0.8879
Comorbidity_13=1                           0.6576 0.0973  1.9301
Comorbidity_14=1                           0.8609 0.0759  2.3652
Comorbidity_16=1                           0.8012 0.0932  2.2281
Year=2008                                 -0.0651 0.0282  0.9370
Year=2009                                 -0.1418 0.0281  0.8678
Year=2010                                 -0.2448 0.0284  0.7829
Source=Nursing home                        0.0166 0.0613  1.0167
Source=General hospital                   -0.3568 0.0616  0.6999
Source=Academic or topclinical hospital -0.4305 0.0874  0.6502
```

---

## [114] Peripheral and visceral atherosclerosis

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_7 + Comorbidity_8 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          40469    LR chi2    5102.20    R2       0.383    C       0.904
 Not died    38625    d.f.            36    Brier    0.033    Dxy     0.808
 Died         1844    Pr(> chi2) <0.0001                      gamma   0.816
max |deriv| 6e-10                                             tau-a   0.070


                                         Coef    S.E.   Odds
Intercept                               -7.9235 1.0433  0.0004
Severity=[0.02,0.05)                     0.7247 0.1892  2.0641
Severity=[0.05,0.1)                      1.1257 0.2103  3.0824
Severity=[0.1,0.2)                       2.1013 0.2008  8.1767
Severity=[0.4,1]                         3.3844 0.1985 29.4991
Age=[20,25),[25,30)                      0.5017 1.2575  1.6515
Age=[30,35)                              0.9503 1.1873  2.5865
Age=[35,40)                              0.4533 1.2555  1.5734
Age=[40,45)                              1.4475 1.0738  4.2526
Age=[45,50)                              1.9446 1.0470  6.9908
Age=[50,55)                              1.6367 1.0436  5.1380
Age=[55,60)                              2.0504 1.0346  7.7706
Age=[60,65)                              2.4920 1.0300 12.0859
Age=[65,70)                              2.3520 1.0298 10.5064
Age=[70,75)                              2.6910 1.0284 14.7463
Age=[75,80)                              3.0396 1.0277 20.8966
Age=[80,85)                              3.4209 1.0277 30.5978
Age=[85,90)                              3.6314 1.0286 37.7667
Age=[90,95)                              4.0644 1.0324 58.2323
Age=95+                                  4.5401 1.0570 93.6977
Urgency=Not planned                      1.4712 0.0696  4.3543
Comorbidity_1=1                          0.8207 0.1257  2.2720
Comorbidity_2=1                          1.2332 0.1291  3.4323
Comorbidity_3=1                          0.5794 0.0797  1.7850
Comorbidity_4=1                          0.6850 0.1772  1.9838
Comorbidity_6=1                          0.4792 0.1331  1.6148
Comorbidity_7=1                          0.7939 0.3155  2.2119
Comorbidity_8=1                          1.7910 0.3202  5.9956
Comorbidity_13=1                         1.1627 0.1283  3.1986
Comorbidity_14=1                         0.8940 0.2039  2.4449
Comorbidity_16=1                         1.1402 0.2718  3.1273
Year=2008                               -0.1368 0.0784  0.8722
Year=2009                               -0.1996 0.0782  0.8191
Year=2010                               -0.4468 0.0796  0.6396
Source=Nursing home                      0.1240 0.1760  1.1321
Source=General hospital                  1.4268 0.2237  4.1653
Source=Academic or topclinical hospital  1.4226 0.3234  4.1477
```

---

## [115] Aortic; peripheral; and visceral artery aneurysms

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_5 + Comorbidity_6 +
    Comorbidity_13 + Comorbidity_16 + Year, data = data, y = TRUE,
    maxit = 100)
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          26282    LR chi2    6082.05    R2       0.411    C       0.881
 Not died    23359    d.f.            30    Brier    0.068    Dxy     0.761
 Died         2923    Pr(> chi2) <0.0001                      gamma   0.766
max |deriv| 1e-08                                             tau-a   0.151


                      Coef    S.E.   Odds
Intercept             -6.1035 1.0770   0.0022
Severity=[0.01,0.02)   1.3597 1.0237   3.8949
Severity=[0.02,0.05)   2.3966 1.0174  10.9856
Severity=[0.05,0.1)    2.5561 1.0112  12.8861
Severity=[0.1,0.2)     3.5988 1.0124  36.5540
Severity=[0.4,1]       4.7242 1.0112 112.6402
Sex=Female             0.2297 0.0547   1.2582
Age=[30,35)           -0.3860 0.6195   0.6798
Age=[35,40)           -1.1664 0.6119   0.3115
Age=[40,45)           -0.8564 0.5070   0.4247
Age=[45,50)           -1.2193 0.4873   0.2954
Age=[50,55)           -0.6816 0.4312   0.5058
Age=[55,60)           -0.4400 0.4111   0.6440
Age=[60,65)           -0.7482 0.4043   0.4732
Age=[65,70)           -0.4520 0.4003   0.6364
Age=[70,75)           -0.1720 0.3979   0.8420
Age=[75,80)            0.3031 0.3968   1.3540
Age=[80,85)            0.7586 0.3976   2.1354
Age=[85,90)            1.2786 0.4010   3.5916
Age=[90,95),95+        2.3983 0.4237  11.0050
Urgency=Not planned    1.2637 0.0590   3.5384
Comorbidity_1=1        0.4815 0.1052   1.6185
Comorbidity_2=1        0.6768 0.1619   1.9675
Comorbidity_4=1        0.5790 0.1454   1.7842
Comorbidity_5=1        0.9637 0.3678   2.6213
Comorbidity_6=1        0.3133 0.1083   1.3680
Comorbidity_13=1       0.6173 0.1321   1.8539
Comorbidity_16=1       1.3081 0.2834   3.6992
Year=2008             -0.1562 0.0661   0.8554
Year=2009             -0.2209 0.0670   0.8018
Year=2010             -0.3686 0.0682   0.6917
```

## [116] Aortic and peripheral arterial embolism or thrombosis

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Year,
    data = data, y = TRUE, maxit = 100)
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          28569    LR chi2    1753.51    R2       0.278    C       0.886
 Not died    27825    d.f.            27    Brier    0.023    Dxy     0.773
 Died          744    Pr(> chi2) <0.0001                      gamma   0.783
max |deriv| 1e-11                                             tau-a   0.039


                      Coef    S.E.   Odds
Intercept             -7.3045 0.5258  0.0007
Severity=[0.02,0.05)   0.1279 0.1267  1.1364
Severity=[0.05,0.1)    1.8493 0.1659  6.3553
Severity=[0.1,0.2)     1.7841 0.2411  5.9540
Sex=Female             0.3152 0.0838  1.3706
Age=[45,50)            0.9486 0.6194  2.5820
Age=[50,55)            1.0324 0.5668  2.8079
```

```
Age=[55,60)           1.1752 0.5492  3.2387
Age=[60,65)           1.6850 0.5261  5.3923
Age=[65,70)           1.9318 0.5218  6.9021
Age=[70,75)           2.2496 0.5166  9.4837
Age=[75,80)           2.4866 0.5159 12.0198
Age=[80,85)           2.9222 0.5144 18.5827
Age=[85,90)           3.3097 0.5158 27.3767
Age=[90,95)           3.4024 0.5283 30.0374
Age=95+               3.7604 0.5853 42.9660
Urgency=Not planned   1.7668 0.0894  5.8522
Comorbidity_1=1       0.5942 0.1656  1.8115
Comorbidity_2=1       1.5596 0.1594  4.7571
Comorbidity_3=1       0.6651 0.0975  1.9447
Comorbidity_4=1       0.9803 0.1924  2.6654
Comorbidity_6=1       0.7846 0.1640  2.1916
Comorbidity_13=1      1.6576 0.1882  5.2467
Comorbidity_14=1      0.8593 0.2578  2.3615
Comorbidity_16=1      1.3629 0.2894  3.9076
Year=2008            -0.0942 0.1132  0.9101
Year=2009            -0.2894 0.1156  0.7487
Year=2010            -0.4022 0.1136  0.6689
```

---

## [117] Other circulatory disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_2 +
    Comorbidity_3 + Comorbidity_4 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs           21765    LR chi2    1006.45    R2       0.213    C       0.851
 Not died     21207    d.f.            35    Brier    0.023    Dxy     0.702
 Died           558    Pr(> chi2) <0.0001                      gamma   0.712
max |deriv| 2e-07                                              tau-a   0.035


                                          Coef    S.E.   Odds
Intercept                                -5.0228 0.5437  0.0066
Severity=[0.01,0.02)                      0.6896 0.2112  1.9928
Severity=[0.02,0.05)                      1.9109 0.1918  6.7593
Severity=[0.05,0.1)                       1.8779 0.1750  6.5399
Severity=[0.1,0.2),[0.3,0.4)              3.3941 0.2516 29.7878
Sex=Female                               -0.2487 0.0930  0.7798
Age=[1,5),[5,10)                         -1.8926 1.1290  0.1507
Age=[10,15)                              -0.9089 1.1369  0.4029
Age=[15,20),[20,25)                      -2.4830 1.1283  0.0835
Age=[25,30),[30,35)                      -2.8381 1.1277  0.0585
Age=[35,40)                              -1.0842 0.6868  0.3382
Age=[40,45)                              -0.7727 0.6172  0.4618
Age=[45,50)                              -2.1453 0.7221  0.1170
Age=[50,55)                              -0.9533 0.5766  0.3855
Age=[55,60)                              -1.5067 0.5931  0.2216
Age=[60,65)                              -0.7051 0.5468  0.4941
Age=[65,70)                              -0.4630 0.5397  0.6294
Age=[70,75)                              -0.3087 0.5337  0.7344
Age=[75,80)                               0.0570 0.5284  1.0587
Age=[80,85)                               0.2815 0.5282  1.3251
Age=[85,90)                               0.8506 0.5288  2.3411
Age=[90,95)                               0.6428 0.5558  1.9018
Age=95+                                   1.0918 0.6510  2.9795
Urgency=Not planned                       0.5010 0.1150  1.6504
Comorbidity_2=1                           1.3694 0.1796  3.9328
Comorbidity_3=1                           0.7127 0.1881  2.0395
Comorbidity_4=1                           0.7002 0.2700  2.0142
Comorbidity_13=1                          0.8741 0.1612  2.3966
Comorbidity_14=1                          0.6572 0.2599  1.9293
Comorbidity_16=1                          1.5536 0.3167  4.7284
Year=2008                                -0.1397 0.1250  0.8696
Year=2009                                -0.1939 0.1241  0.8238
Year=2010                                -0.5286 0.1315  0.5894
Source=Nursing home                       0.4582 0.2302  1.5812
Source=General hospital                   1.3122 0.2431  3.7143
Source=Academic or topclinical hospital   1.0237 0.4517  2.7835
```

---

## [122] Pneumonia (except that caused by tuberculosis or sexually transmitted diseases)

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_5 +
    Comorbidity_6 + Comorbidity_8 + Comorbidity_9 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + Month + Year + Source,
    data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs          118913    LR chi2     9845.29    R2       0.175    C       0.775
 Not died    108233    d.f.             47    Brier    0.075    Dxy     0.551
 Died         10680    Pr(> chi2) <0.0001                       gamma   0.554
max |deriv| 1e-11                                                tau-a   0.090


                                           Coef    S.E.   Odds
Intercept                                 -6.5118 0.3882  0.0015
Severity=[0.02,0.05),[0.01,0.02)           0.6884 0.3617  1.9906
Severity=[0.05,0.1)                        1.5002 0.3467  4.4825
Severity=[0.1,0.2)                         1.9973 0.3493  7.3693
Severity=[0.2,0.3),[0.3,0.4)               2.8484 0.4361 17.2606
Sex=Female                                -0.1386 0.0221  0.8706
Age=[1,5)                                 -0.8136 0.3769  0.4433
Age=[5,10)                                -0.1068 0.4092  0.8987
Age=[10,15)                                0.6629 0.4342  1.9405
Age=[15,20)                                1.6434 0.3427  5.1727
Age=[20,25)                                1.0752 0.3740  2.9305
Age=[25,30)                                0.8308 0.3737  2.2951
Age=[30,35)                                0.6268 0.3638  1.8716
Age=[35,40)                                0.9170 0.3198  2.5017
Age=[40,45)                                1.2324 0.3041  3.4293
Age=[45,50)                                1.6194 0.2926  5.0498
Age=[50,55)                                2.0217 0.2852  7.5515
Age=[55,60)                                2.0762 0.2822  7.9741
Age=[60,65)                                2.2106 0.2802  9.1216
Age=[65,70)                                2.4400 0.2791 11.4736
Age=[70,75)                                2.6880 0.2783 14.7022
Age=[75,80)                                3.0286 0.2776 20.6677
Age=[80,85)                                3.3291 0.2774 27.9122
Age=[85,90)                                3.6178 0.2776 37.2572
Age=[90,95)                                3.9046 0.2789 49.6325
Age=95+                                    4.0270 0.2859 56.0940
Comorbidity_1=1                            0.5409 0.0520  1.7175
Comorbidity_2=1                            0.6761 0.0324  1.9661
Comorbidity_3=1                            0.5350 0.0876  1.7074
Comorbidity_4=1                            0.8220 0.0624  2.2750
Comorbidity_5=1                            0.4574 0.0690  1.5800
Comorbidity_6=1                           -0.2520 0.0276  0.7773
Comorbidity_8=1                            0.6223 0.1898  1.8632
Comorbidity_9=1                            1.6827 0.1551  5.3798
Comorbidity_13=1                           0.5500 0.0498  1.7333
Comorbidity_14=1                           0.7026 0.0405  2.0190
Comorbidity_16=1                           0.8512 0.0533  2.3425
Month=2                                   -0.1653 0.0338  0.8477
Month=3                                   -0.1960 0.0362  0.8220
Month=4                                   -0.0816 0.0380  0.9216
Month=5                                   -0.1472 0.0360  0.8631
Month=6                                   -0.0757 0.0333  0.9271
Year=2008                                 -0.0375 0.0304  0.9632
Year=2009                                 -0.1091 0.0303  0.8967
Year=2010                                 -0.2260 0.0307  0.7977
Source=Nursing home                        0.2392 0.0533  1.2702
Source=General hospital                    0.5206 0.0864  1.6830
Source=Academic or topclinical hospital    0.3079 0.1586  1.3606
```

## [127] Chronic obstructive pulmonary disease and bronchiectasis

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_6 + Comorbidity_8 +
    Comorbidity_9 + Comorbidity_13 + Comorbidity_14 + Comorbidity_16 +
    Month + Year + Source, data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          76096    LR chi2    2155.70    R2       0.085    C       0.711
 Not died    72300    d.f.            38    Brier    0.046    Dxy     0.421
 Died         3796    Pr(> chi2) <0.0001                      gamma   0.429
max |deriv| 4e-09                                             tau-a   0.040


                                          Coef    S.E.   Odds
Intercept                                 -8.3064 1.0183  0.0002
Severity=[0.01,0.02)                       0.2454 0.5013  1.2781
Severity=[0.02,0.05)                       0.7915 0.2838  2.2067
Severity=[0.05,0.1)                        1.6093 0.2174  4.9991
Age=[30,35)                                1.3240 1.4174  3.7584
Age=[35,40)                                2.4497 1.0719 11.5844
Age=[40,45)                                2.3859 1.0329 10.8684
Age=[45,50)                                1.8390 1.0234  6.2900
Age=[50,55)                                2.3641 1.0090 10.6349
Age=[55,60)                                2.7623 1.0051 15.8357
Age=[60,65)                                3.0636 1.0035 21.4050
Age=[65,70)                                3.2679 1.0029 26.2565
Age=[70,75)                                3.4760 1.0025 32.3290
Age=[75,80)                                3.6756 1.0023 39.4711
Age=[80,85)                                3.8762 1.0024 48.2418
Age=[85,90)                                4.0665 1.0030 58.3509
Age=[90,95)                                4.2028 1.0067 66.8735
Age=95+                                    4.4623 1.0331 86.6853
Urgency=Not planned                        0.6928 0.0585  1.9992
Comorbidity_1=1                            0.4671 0.0891  1.5954
Comorbidity_2=1                            0.8664 0.0498  2.3782
Comorbidity_4=1                            0.7130 0.1367  2.0401
Comorbidity_6=1                            0.3251 0.0822  1.3842
Comorbidity_8=1                            1.5305 0.3478  4.6205
Comorbidity_9=1                            1.3141 0.3680  3.7213
Comorbidity_13=1                           0.8439 0.1047  2.3254
Comorbidity_14=1                           0.5371 0.1047  1.7110
Comorbidity_16=1                           0.7932 0.1413  2.2105
Month=2                                   -0.2436 0.0534  0.7838
Month=3                                   -0.2854 0.0569  0.7517
Month=4                                   -0.3115 0.0609  0.7323
Month=5                                   -0.4146 0.0580  0.6606
Month=6                                   -0.1363 0.0516  0.8726
Year=2008                                 -0.2000 0.0467  0.8187
Year=2009                                 -0.2718 0.0470  0.7620
Year=2010                                 -0.4590 0.0482  0.6319
Source=Nursing home                        0.2962 0.0994  1.3447
Source=General hospital                    0.8615 0.1502  2.3667
Source=Academic or topclinical hospital    0.5012 0.2936  1.6508
```

---

## [129] Aspiration pneumonitis; food/vomitus

```
Logistic Regression Model

lrm(formula = Death ~ Sex + Age + Comorbidity_1 + Comorbidity_2 +
    Comorbidity_6 + Comorbidity_12 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs           4518    LR chi2     389.86    R2       0.120    C       0.681
 Not died     3306    d.f.            28    Brier    0.180    Dxy     0.362
 Died         1212    Pr(> chi2) <0.0001                      gamma   0.365
max |deriv| 4e-06                                             tau-a   0.142


                    Coef    S.E.   Odds
Intercept           -3.0670 0.3938 0.0466
Sex=Female           0.1503 0.0745 1.1622
Age=[5,10)           0.3967 0.6465 1.4870
Age=[10,15)         -0.2623 0.8179 0.7693
Age=[15,20),[20,25)  1.1142 0.5042 3.0472
Age=[25,30),[30,35)  1.3356 0.4844 3.8024
Age=[35,40)          0.7518 0.5802 2.1209
Age=[40,45)          0.7608 0.5371 2.1399
Age=[45,50)          0.9144 0.4709 2.4953
Age=[50,55)          1.6652 0.4377 5.2869
Age=[55,60)          1.7896 0.4157 5.9873
Age=[60,65)          1.3748 0.4146 3.9543
Age=[65,70)          1.8899 0.4076 6.6187
Age=[70,75)          2.0635 0.4004 7.8737
Age=[75,80)          2.0417 0.3989 7.7038
```

```
Age=[80,85)          2.3017 0.3962  9.9908
Age=[85,90)          2.5724 0.3981 13.0966
Age=[90,95)          2.7593 0.4105 15.7894
Age=95+              2.5572 0.4758 12.8998
Comorbidity_1=1      0.7343 0.2152  2.0839
Comorbidity_2=1      0.5302 0.1516  1.6993
Comorbidity_6=1     -0.3256 0.1391  0.7221
Comorbidity_12=1    -0.6502 0.2932  0.5219
Comorbidity_13=1     0.4739 0.2021  1.6063
Comorbidity_14=1     0.5915 0.1686  1.8067
Comorbidity_16=1     1.0020 0.2300  2.7238
Year=2008            0.0621 0.1020  1.0641
Year=2009           -0.0430 0.1009  0.9579
Year=2010           -0.2206 0.1012  0.8020
```

---

## [130] Pleurisy; pneumothorax; pulmonary collapse

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_6 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          22683    LR chi2    1278.15    R2       0.196    C       0.827
 Not died    21801    d.f.            32    Brier    0.035    Dxy     0.653
 Died          882    Pr(> chi2) <0.0001                      gamma   0.661
max |deriv| 4e-07                                             tau-a   0.049


                                        Coef    S.E.   Odds
Intercept                               -5.5103 0.7340  0.0040
Severity=[0.02,0.05)                     0.1999 0.1771  1.2213
Severity=[0.05,0.1)                      0.4968 0.1040  1.6435
Severity=[0.1,0.2)                       1.7244 0.2307  5.6092
Age=[15,20),[10,15),[5,10)              -2.6025 1.2327  0.0741
Age=[20,25)                             -1.5479 0.9245  0.2127
Age=[25,30),[30,35)                     -3.0967 1.2328  0.0452
Age=[35,40)                             -0.8855 0.8767  0.4125
Age=[40,45)                             -0.1783 0.7935  0.8367
Age=[45,50)                              0.2894 0.7589  1.3356
Age=[50,55)                              0.5025 0.7436  1.6528
Age=[55,60)                              0.8785 0.7337  2.4073
Age=[60,65)                              0.8313 0.7298  2.2963
Age=[65,70)                              1.3121 0.7257  3.7138
Age=[70,75)                              1.1953 0.7260  3.3046
Age=[75,80)                              1.6055 0.7235  4.9803
Age=[80,85)                              2.0051 0.7231  7.4272
Age=[85,90)                              2.2177 0.7251  9.1865
Age=[90,95)                              2.4110 0.7348 11.1453
Age=95+                                  1.7735 0.8379  5.8913
Urgency=Not planned                      0.8393 0.0950  2.3148
Comorbidity_2=1                          0.5481 0.1381  1.7300
Comorbidity_6=1                          0.6408 0.1133  1.8980
Comorbidity_9=1                          0.8677 0.3143  2.3814
Comorbidity_13=1                         1.1991 0.1754  3.3172
Comorbidity_14=1                         0.6233 0.1124  1.8651
Comorbidity_16=1                         0.8778 0.1248  2.4056
Year=2008                               -0.0145 0.1018  0.9856
Year=2009                                0.0175 0.0992  1.0176
Year=2010                               -0.3843 0.1059  0.6809
Source=Nursing home                      0.4442 0.2203  1.5592
Source=General hospital                  0.7208 0.2320  2.0561
Source=Academic or topclinical hospital  0.9272 0.3462  2.5275
```

---

## [133] Other lower respiratory disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_2 +
    Comorbidity_4 + Comorbidity_6 + Comorbidity_9 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + SES + Month + Year + Source,
    data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          97754    LR chi2     7525.23    R2       0.249    C       0.860
 Not died    93578    d.f.             50    Brier    0.037    Dxy     0.720
 Died         4176    Pr(> chi2) <0.0001                       gamma   0.725
max |deriv| 9e-11                                              tau-a   0.059


                                                Coef    S.E.   Odds
Intercept                                       -9.3531 0.3706  0.0001
Severity=[0.01,0.02)                             2.2781 0.4474  9.7583
Severity=[0.02,0.05)                             2.0077 0.2240  7.4460
Severity=[0.05,0.1)                              3.0814 0.2202 21.7883
Severity=[0.1,0.2)                               4.1377 0.2257 62.6590
Severity=[0.4,1],[0.3,0.4),[0.2,0.3),Others      3.1941 0.6348 24.3877
Sex=Female                                      -0.1788 0.0346  0.8362
Age=[1,5)                                       -0.2195 0.4423  0.8029
Age=[5,10)                                       1.1566 0.4790  3.1792
Age=[10,15)                                      1.2458 0.5370  3.4759
Age=[15,20)                                      1.4739 0.4610  4.3663
Age=[20,25)                                      0.6581 0.5353  1.9311
Age=[25,30)                                      1.3478 0.4036  3.8489
Age=[30,35)                                      0.6108 0.4435  1.8419
Age=[35,40)                                      0.9257 0.3677  2.5237
Age=[40,45)                                      1.2044 0.3386  3.3347
Age=[45,50)                                      1.4393 0.3182  4.2178
Age=[50,55)                                      1.7770 0.3069  5.9122
Age=[55,60)                                      2.2394 0.2992  9.3878
Age=[60,65)                                      2.3384 0.2969 10.3649
Age=[65,70)                                      2.5590 0.2956 12.9225
Age=[70,75)                                      2.8252 0.2940 16.8651
Age=[75,80)                                      2.9921 0.2934 19.9266
Age=[80,85)                                      3.2354 0.2934 25.4162
Age=[85,90)                                      3.4058 0.2946 30.1399
Age=[90,95)                                      3.7600 0.2999 42.9473
Age=95+                                          3.9319 0.3248 51.0039
Urgency=Not planned                              1.4923 0.0537  4.4473
Comorbidity_2=1                                  0.6147 0.0557  1.8492
Comorbidity_4=1                                  0.5975 0.1241  1.8176
Comorbidity_6=1                                  0.2777 0.0431  1.3201
Comorbidity_9=1                                  1.6591 0.2609  5.2546
Comorbidity_13=1                                 0.5571 0.0900  1.7456
Comorbidity_14=1                                 0.9922 0.0644  2.6971
Comorbidity_16=1                                 0.8918 0.0777  2.4396
SES=Below average                               -0.1226 0.0499  0.8846
SES=Average                                     -0.1549 0.0506  0.8565
SES=Above average                               -0.0985 0.0511  0.9062
SES=Highest                                     -0.1306 0.0544  0.8776
SES=Unknown                                      0.7336 0.4117  2.0827
Month=2                                         -0.1112 0.0542  0.8948
Month=3                                         -0.2240 0.0571  0.7993
Month=4                                         -0.2647 0.0598  0.7675
Month=5                                         -0.2220 0.0575  0.8009
Month=6                                         -0.1126 0.0540  0.8935
Year=2008                                       -0.0724 0.0472  0.9302
Year=2009                                       -0.2467 0.0477  0.7814
Year=2010                                       -0.4074 0.0485  0.6654
Source=Nursing home                              0.3416 0.1087  1.4071
Source=General hospital                          1.2888 0.1224  3.6283
Source=Academic or topclinical hospital          1.3690 0.2006  3.9313
```

---

## [145] Intestinal obstruction without hernia

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Comorbidity_1 + Comorbidity_2 +
    Comorbidity_4 + Comorbidity_5 + Comorbidity_6 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + Year, data = data, y = TRUE,
    maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          32213    LR chi2     2904.14    R2       0.234    C       0.833
 Not died    30243    d.f.             29    Brier    0.051    Dxy     0.667
 Died         1970    Pr(> chi2) <0.0001                       gamma   0.674
max |deriv| 3e-09                                              tau-a   0.077
```

```
                       Coef    S.E.   Odds
Intercept              -8.0206 1.0456   0.0003
Severity=[0.01,0.02)   -1.2093 0.4156   0.2984
Severity=[0.02,0.05)   -0.3764 0.6131   0.6863
Severity=[0.05,0.1)     0.6829 0.4027   1.9795
Age=[25,30)             2.8645 1.1237  17.5409
Age=[30,35)             1.9337 1.2300   6.9153
Age=[35,40)             2.4873 1.1004  12.0288
Age=[40,45)             2.6132 1.0596  13.6423
Age=[45,50)             3.2021 1.0279  24.5835
Age=[50,55)             3.4836 1.0182  32.5778
Age=[55,60)             3.5036 1.0154  33.2357
Age=[60,65)             3.8282 1.0112  45.9817
Age=[65,70)             4.2400 1.0093  69.4046
Age=[70,75)             4.3799 1.0085  79.8310
Age=[75,80)             4.8917 1.0073 133.1734
Age=[80,85)             5.3701 1.0069 214.8823
Age=[85,90)             5.8764 1.0069 356.5187
Age=[90,95)             6.1582 1.0088 472.5856
Age=95+                 6.4484 1.0187 631.6829
Comorbidity_1=1         0.4436 0.1615   1.5583
Comorbidity_2=1         1.2235 0.1439   3.3990
Comorbidity_4=1         0.9571 0.1714   2.6042
Comorbidity_5=1         0.5333 0.1945   1.7046
Comorbidity_6=1         0.8162 0.1171   2.2620
Comorbidity_13=1        1.0551 0.1452   2.8724
Comorbidity_14=1        0.5234 0.0861   1.6878
Comorbidity_16=1        0.8568 0.0861   2.3557
Year=2008               0.0630 0.0700   1.0651
Year=2009              -0.0608 0.0715   0.9410
Year=2010              -0.1695 0.0704   0.8440
```

---

## [146] Diverticulosis and diverticulitis

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_6 + Comorbidity_7 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Month +
    Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          32658    LR chi2    1270.10    R2       0.218    C       0.856
 Not died    32019    d.f.            33    Brier    0.018    Dxy     0.711
 Died          639    Pr(> chi2) <0.0001                      gamma   0.725
max |deriv| 2e-05                                             tau-a   0.027


                       Coef    S.E.   Odds
Intercept              -8.9623 1.0157   0.0001
Severity=[0.02,0.05)    1.4395 0.1167   4.2186
Severity=[0.05,0.1)     2.4834 0.4230  11.9815
Age=[40,45)             0.6301 1.2254   1.8778
Age=[45,50)             1.0166 1.1187   2.7637
Age=[50,55)             1.8020 1.0463   6.0619
Age=[55,60)             1.6187 1.0497   5.0464
Age=[60,65)             2.6945 1.0169  14.7974
Age=[65,70)             2.8841 1.0170  17.8870
Age=[70,75)             3.4964 1.0085  32.9967
Age=[75,80)             4.2098 1.0047  67.3431
Age=[80,85)             4.3933 1.0048  80.9038
Age=[85,90)             4.8972 1.0055 133.9130
Age=[90,95)             4.9796 1.0160 145.4217
Age=95+                 5.2904 1.0637 198.4156
Urgency=Not planned     0.5510 0.1122   1.7351
Comorbidity_1=1         1.0746 0.2068   2.9287
Comorbidity_2=1         1.7056 0.1811   5.5048
Comorbidity_4=1         0.6300 0.2912   1.8776
Comorbidity_6=1         0.6345 0.2003   1.8861
Comorbidity_7=1         1.0486 0.3654   2.8537
Comorbidity_13=1        1.3944 0.1943   4.0324
Comorbidity_14=1        1.1439 0.2353   3.1391
Comorbidity_16=1        1.8243 0.2794   6.1986
Month=2                 0.0662 0.1378   1.0685
Month=3                -0.2834 0.1459   0.7533
Month=4                -0.3217 0.1478   0.7249
Month=5                -0.1822 0.1442   0.8334
Month=6                -0.2454 0.1485   0.7824
Year=2008               0.0210 0.1148   1.0213
Year=2009              -0.2005 0.1178   0.8183
Year=2010              -0.4757 0.1226   0.6215
```

```
Source=Nursing home   0.5456 0.2319   1.7257
Source=Hospital       1.3137 0.3822   3.7199
```

---

## [149] Biliary tract disease

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + SES + Year + Source, data = data, y = TRUE,
    maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs         122765    LR chi2     2586.23    R2       0.279    C       0.911
 Not died   121978    d.f.             40    Brier    0.006    Dxy     0.823
 Died          787    Pr(> chi2) <0.0001                       gamma   0.856
max |deriv| 1e-09                                              tau-a   0.010


                                            Coef    S.E.   Odds
Intercept                                   -5.3514 0.7778  0.0047
Severity=[0.01,0.02)                         0.8404 0.0994  2.3172
Severity=[0.02,0.05)                         1.1960 0.1021  3.3069
Severity=[0.05,0.1)                          2.8246 0.4099 16.8538
Severity=[0.1,0.2)                           2.7308 0.2751 15.3450
Age=[1,5),[20,25),[15,20),[10,15),[5,10)    -3.4277 1.2613  0.0325
Age=[25,30),[35,40),[30,35)                 -4.2101 1.0448  0.0148
Age=[40,45)                                 -2.8686 0.9172  0.0568
Age=[45,50)                                 -2.0891 0.8314  0.1238
Age=[50,55)                                 -1.6030 0.8060  0.2013
Age=[55,60)                                 -1.4658 0.7962  0.2309
Age=[60,65)                                 -1.3168 0.7894  0.2680
Age=[65,70)                                 -0.9471 0.7840  0.3879
Age=[70,75)                                 -0.3598 0.7767  0.6978
Age=[75,80)                                  0.0212 0.7740  1.0214
Age=[80,85)                                  0.6565 0.7724  1.9281
Age=[85,90)                                  1.0090 0.7728  2.7429
Age=[90,95)                                  1.2607 0.7785  3.5279
Age=95+                                      1.6437 0.8057  5.1745
Urgency=Not planned                          0.6420 0.0946  1.9004
Comorbidity_1=1                              1.0112 0.1732  2.7489
Comorbidity_2=1                              1.7653 0.1510  5.8436
Comorbidity_3=1                              0.7254 0.2915  2.0656
Comorbidity_4=1                              1.0579 0.2341  2.8803
Comorbidity_6=1                              0.4991 0.1800  1.6472
Comorbidity_8=1                              1.3699 0.4146  3.9351
Comorbidity_9=1                              2.2299 0.2952  9.2990
Comorbidity_13=1                             1.9235 0.1707  6.8452
Comorbidity_14=1                             0.5772 0.1767  1.7811
Comorbidity_16=1                             1.4259 0.2050  4.1614
SES=Below average                           -0.0918 0.1115  0.9123
SES=Average                                  0.0256 0.1093  1.0259
SES=Above average                           -0.1967 0.1160  0.8214
SES=Highest                                 -0.3456 0.1296  0.7078
SES=Unknown                                  0.4258 1.0267  1.5309
Year=2008                                    0.0063 0.1040  1.0063
Year=2009                                   -0.1836 0.1061  0.8323
Year=2010                                   -0.4786 0.1099  0.6196
Source=Nursing home                          0.5433 0.1890  1.7217
Source=General hospital                      0.5616 0.3659  1.7535
Source=Academic or topclinical hospital     -0.0322 1.0176  0.9683
```

---

## [150] Liver disease; alcohol-related

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Urgency + Comorbidity_2 + Comorbidity_9 +
    Comorbidity_13 + Year, data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes           Indexes

Obs          4848    LR chi2      326.84    R2       0.121    C       0.708
 Not died    4221    d.f.              9    Brier    0.105    Dxy     0.415
 Died         627    Pr(> chi2) <0.0001                       gamma   0.446
max |deriv| 2e-05                                             tau-a   0.094


                     Coef    S.E.   Odds
Intercept            -5.1347 1.0227 0.0059
Severity=[0.05,0.1)   1.1198 1.0287 3.0641
Severity=[0.1,0.2)    2.2384 1.0146 9.3785
Urgency=Not planned   1.1730 0.1199 3.2315
Comorbidity_2=1       1.3757 0.3105 3.9580
Comorbidity_9=1       1.0301 0.0976 2.8015
Comorbidity_13=1      1.3079 0.2178 3.6985
Year=2008            -0.0461 0.1269 0.9550
Year=2009            -0.0930 0.1282 0.9112
Year=2010            -0.2956 0.1301 0.7441
```

---

## [151] Other liver diseases

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_2 +
    Comorbidity_4 + Comorbidity_9 + Comorbidity_13 + Comorbidity_16 +
    Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes           Indexes

Obs         16369    LR chi2     1387.36    R2       0.201    C       0.795
 Not died   15193    d.f.             37    Brier    0.059    Dxy     0.590
 Died        1176    Pr(> chi2) <0.0001                       gamma   0.596
max |deriv| 7e-08                                             tau-a   0.079


                                         Coef    S.E.   Odds
Intercept                                -4.2659 0.5955  0.0140
Severity=[0.01,0.02)                      0.2109 0.7455  1.2348
Severity=[0.02,0.05)                      0.6237 0.4566  1.8658
Severity=[0.05,0.1)                       1.7474 0.5604  5.7399
Severity=[0.1,0.2)                        1.9616 0.4554  7.1107
Severity=[0.2,0.3)                        3.2119 0.4800 24.8260
Severity=[0.4,1]                          4.4325 0.4902 84.1401
Age=[1,5)                                -0.0998 0.5418  0.9050
Age=[5,10)                               -1.1532 0.7098  0.3156
Age=[10,15)                              -1.6459 0.8479  0.1928
Age=[15,20)                              -2.1138 0.8289  0.1208
Age=[20,25)                              -1.8023 0.8271  0.1649
Age=[25,30)                              -2.1444 0.8169  0.1171
Age=[30,35)                              -1.6687 0.6071  0.1885
Age=[35,40)                              -1.3230 0.5104  0.2663
Age=[40,45)                              -0.7510 0.4358  0.4719
Age=[45,50)                              -0.7360 0.4149  0.4790
Age=[50,55)                              -0.2939 0.4012  0.7453
Age=[55,60)                              -0.2953 0.3978  0.7443
Age=[60,65)                              -0.3547 0.3971  0.7014
Age=[65,70)                              -0.3069 0.3973  0.7358
Age=[70,75)                               0.0170 0.3971  1.0172
Age=[75,80)                               0.2036 0.3978  1.2258
Age=[80,85)                               0.4372 0.4007  1.5484
Age=[85,90)                               0.5298 0.4086  1.6986
Age=[90,95),95+                           1.0931 0.4347  2.9834
Urgency=Not planned                       0.7522 0.0757  2.1217
Comorbidity_2=1                           0.6488 0.1661  1.9133
Comorbidity_4=1                           0.7580 0.2711  2.1341
Comorbidity_9=1                           0.3020 0.0809  1.3526
Comorbidity_13=1                          1.1108 0.1441  3.0367
Comorbidity_16=1                          1.1118 0.1280  3.0400
Year=2008                                -0.1286 0.0902  0.8793
Year=2009                                -0.3046 0.0924  0.7374
Year=2010                                -0.3740 0.0919  0.6880
Source=Nursing home                       0.0256 0.2106  1.0260
Source=General hospital                   1.1031 0.2029  3.0135
Source=Academic or topclinical hospital   0.4482 0.3305  1.5655
```

---

## [153] Gastrointestinal hemorrhage

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_9 + Comorbidity_13 + Comorbidity_14 + Comorbidity_16 +
    SES + Month + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          33657    LR chi2    1631.72    R2       0.160    C       0.791
 Not died    32232    d.f.            46    Brier    0.038    Dxy     0.582
 Died         1425    Pr(> chi2) <0.0001                      gamma   0.589
max |deriv| 7e-06                                             tau-a   0.047


                                         Coef    S.E.   Odds
Intercept                                -7.8188 1.0310   0.0004
Severity=[0.02,0.05)                      0.1306 0.2330   1.1395
Severity=[0.05,0.1)                       0.7368 0.2292   2.0892
Severity=[0.1,0.2)                        1.3841 0.2746   3.9913
Severity=[0.2,0.3)                        2.5750 0.3653  13.1308
Severity=[0.3,0.4),[0.4,1]                3.2540 0.3205  25.8945
Sex=Female                               -0.2226 0.0593   0.8005
Age=[30,35)                               2.6339 1.1205  13.9281
Age=[35,40)                               1.4591 1.2281   4.3021
Age=[40,45)                               2.6182 1.0630  13.7115
Age=[45,50)                               2.9230 1.0329  18.5967
Age=[50,55)                               3.5574 1.0145  35.0726
Age=[55,60)                               3.4578 1.0115  31.7471
Age=[60,65)                               3.6209 1.0073  37.3709
Age=[65,70)                               3.8699 1.0059  47.9357
Age=[70,75)                               3.8926 1.0049  49.0406
Age=[75,80)                               4.1255 1.0036  61.9013
Age=[80,85)                               4.5036 1.0029  90.3389
Age=[85,90)                               4.8874 1.0029 132.6089
Age=[90,95)                               5.0853 1.0054 161.6286
Age=95+                                   5.2872 1.0173 197.7834
Urgency=Not planned                       0.3792 0.0985   1.4612
Comorbidity_1=1                           0.4713 0.1332   1.6020
Comorbidity_2=1                           1.5892 0.1137   4.9001
Comorbidity_3=1                           0.4584 0.2030   1.5815
Comorbidity_4=1                           0.7309 0.1742   2.0769
Comorbidity_6=1                           0.6617 0.1342   1.9381
Comorbidity_9=1                           1.3174 0.1418   3.7339
Comorbidity_13=1                          0.9533 0.1263   2.5942
Comorbidity_14=1                          1.1364 0.1067   3.1154
Comorbidity_16=1                          0.8890 0.1351   2.4328
SES=Below average                        -0.1895 0.0838   0.8274
SES=Average                              -0.2508 0.0855   0.7782
SES=Above average                        -0.2361 0.0853   0.7897
SES=Highest                              -0.1427 0.0899   0.8670
SES=Unknown                               0.7903 0.6199   2.2041
Month=2                                  -0.1559 0.0919   0.8556
Month=3                                  -0.3755 0.0979   0.6870
Month=4                                  -0.3069 0.0974   0.7358
Month=5                                  -0.2353 0.0945   0.7903
Month=6                                  -0.2490 0.0940   0.7796
Year=2008                                -0.1860 0.0776   0.8303
Year=2009                                -0.2497 0.0778   0.7790
Year=2010                                -0.5583 0.0819   0.5722
Source=Nursing home                       0.2169 0.1418   1.2422
Source=General hospital                   0.9667 0.2515   2.6293
Source=Academic or topclinical hospital   0.5158 0.5311   1.6749
```

---

## [155] Other gastrointestinal disorders

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_5 + Comorbidity_9 +
    Comorbidity_13 + Comorbidity_14 + Comorbidity_16 + Year,
    data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          45745    LR chi2    2599.41    R2       0.344    C       0.904
 Not died    44950    d.f.            33    Brier    0.014    Dxy     0.807
 Died          795    Pr(> chi2) <0.0001                      gamma   0.823
max |deriv| 3e-08                                             tau-a   0.028


                           Coef    S.E.   Odds
Intercept                  -6.3745 0.5139  0.0017
Severity=[0.01,0.02)        0.9682 0.1779  2.6333
Severity=[0.02,0.05)        1.1226 0.1068  3.0729
Severity=[0.05,0.1)         1.7665 0.5332  5.8502
Severity=[0.1,0.2)          2.6882 0.3315 14.7051
Severity=[0.2,0.3)          3.5400 0.1016 34.4658
Age=[1,5)                  -0.4791 0.7669  0.6193
Age=[5,10),[15,20),[10,15)  -2.6720 1.1197  0.0691
Age=[20,25),[30,35),[25,30) -2.7556 1.1224  0.0636
Age=[35,40)                -1.3265 0.8712  0.2654
Age=[40,45)                 0.0212 0.5801  1.0214
Age=[45,50)                 0.3087 0.5605  1.3616
Age=[50,55)                -0.0466 0.5584  0.9545
Age=[55,60)                 0.3029 0.5365  1.3538
Age=[60,65)                 0.5077 0.5281  1.6614
Age=[65,70)                 0.9353 0.5210  2.5479
Age=[70,75)                 1.2611 0.5159  3.5292
Age=[75,80)                 1.4771 0.5134  4.3804
Age=[80,85)                 1.9228 0.5116  6.8401
Age=[85,90)                 2.3093 0.5137 10.0673
Age=[90,95)                 2.3622 0.5316 10.6142
Age=95+                     2.9088 0.5925 18.3346
Urgency=Not planned         0.5975 0.0975  1.8176
Comorbidity_1=1             0.5990 0.2277  1.8204
Comorbidity_2=1             1.3344 0.2189  3.7979
Comorbidity_4=1             1.1140 0.2220  3.0467
Comorbidity_5=1             0.7186 0.3097  2.0516
Comorbidity_9=1             1.9233 0.4881  6.8438
Comorbidity_13=1            0.7511 0.2483  2.1194
Comorbidity_14=1            0.5945 0.1271  1.8121
Comorbidity_16=1            1.0006 0.1392  2.7199
Year=2008                  -0.1699 0.1098  0.8437
Year=2009                  -0.3495 0.1136  0.7050
Year=2010                  -0.4373 0.1128  0.6458
```

---

## [157] Acute and unspecified renal failure

```
Logistic Regression Model

lrm(formula = Death ~ Age + Urgency + Comorbidity_2 + Comorbidity_3 +
    Comorbidity_9 + Comorbidity_14 + Comorbidity_16 + Month +
    Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs           9766    LR chi2     734.06    R2       0.150    C       0.747
 Not died     8772    d.f.            34    Brier    0.083    Dxy     0.494
 Died          994    Pr(> chi2) <0.0001                      gamma   0.498
max |deriv| 4e-06                                             tau-a   0.090


                                     Coef    S.E.   Odds
Intercept                            -2.9867 0.5447 0.0505
Age=[1,5),[5,10),[10,15),[15,20)     -2.3762 1.1365 0.0929
Age=[20,25)                          -1.7814 1.1398 0.1684
Age=[25,30)                          -1.7275 1.1391 0.1777
Age=[30,35)                          -1.3388 0.8912 0.2622
Age=[35,40)                          -0.7452 0.6763 0.4747
Age=[40,45)                          -0.1452 0.6127 0.8648
Age=[45,50)                          -0.8727 0.6341 0.4178
Age=[50,55)                          -0.7742 0.5967 0.4611
Age=[55,60)                          -0.5656 0.5720 0.5680
Age=[60,65)                           0.0045 0.5521 1.0045
Age=[65,70)                          -0.2420 0.5526 0.7850
Age=[70,75)                           0.1571 0.5445 1.1701
Age=[75,80)                           0.4103 0.5413 1.5073
Age=[80,85)                           0.8435 0.5410 2.3245
Age=[85,90)                           1.3399 0.5423 3.8188
Age=[90,95)                           1.4336 0.5522 4.1937
Age=95+                               2.0518 0.5989 7.7820
Urgency=Not planned                   0.5795 0.0912 1.7852
Comorbidity_2=1                       1.0964 0.1051 2.9934
```

```
Comorbidity_3=1                            0.6503 0.2034 1.9162
Comorbidity_9=1                            1.3212 0.3457 3.7481
Comorbidity_14=1                           0.3194 0.1333 1.3763
Comorbidity_16=1                           0.9899 0.1667 2.6910
Month=2                                   -0.1669 0.1197 0.8463
Month=3                                   -0.1618 0.1173 0.8506
Month=4                                   -0.4297 0.1241 0.6507
Month=5                                   -0.3160 0.1230 0.7291
Month=6                                    0.0719 0.1133 1.0745
Year=2008                                 -0.0434 0.1042 0.9576
Year=2009                                 -0.0589 0.1016 0.9428
Year=2010                                 -0.2939 0.1014 0.7454
Source=Nursing home                       -0.0507 0.1941 0.9506
Source=General hospital                    0.9171 0.1740 2.5020
Source=Academic or topclinical hospital -0.1554 0.6070 0.8561
```

---

## [158] Chronic renal failure

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_6 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test            Indexes          Indexes

Obs          18683    LR chi2     1342.31    R2       0.247    C       0.853
 Not died    17956    d.f.             32    Brier    0.033    Dxy     0.707
 Died          727    Pr(> chi2) <0.0001                       gamma   0.715
max |deriv| 5e-06                                              tau-a   0.053


                                          Coef    S.E.   Odds
Intercept                                 -6.9818 1.0256  0.0009
Severity=[0.02,0.05)                       0.4500 0.1792  1.5683
Sex=Female                                 0.1833 0.0821  1.2012
Age=[10,15)                                0.7640 1.4243  2.1469
Age=[15,20)                                0.7500 1.2360  2.1170
Age=[20,25)                                0.2329 1.4214  1.2623
Age=[25,30)                                0.0078 1.4212  1.0079
Age=[30,35)                                0.9935 1.1629  2.7006
Age=[35,40)                               -0.5752 1.4206  0.5626
Age=[40,45)                                0.6925 1.1033  1.9987
Age=[45,50)                                1.4633 1.0458  4.3202
Age=[50,55)                                1.4597 1.0368  4.3047
Age=[55,60)                                1.5143 1.0284  4.5463
Age=[60,65)                                1.9968 1.0172  7.3657
Age=[65,70)                                2.0775 1.0167  7.9846
Age=[70,75)                                2.4038 1.0135 11.0649
Age=[75,80)                                2.6454 1.0114 14.0887
Age=[80,85)                                3.1471 1.0107 23.2692
Age=[85,90)                                3.5957 1.0126 36.4418
Age=[90,95),95+                            3.5021 1.0272 33.1844
Urgency=Not planned                        1.6891 0.0922  5.4145
Comorbidity_1=1                            0.6961 0.1730  2.0060
Comorbidity_2=1                            0.7568 0.1289  2.1314
Comorbidity_3=1                            0.7918 0.2003  2.2073
Comorbidity_6=1                            0.4472 0.1879  1.5639
Comorbidity_14=1                           0.6468 0.2217  1.9094
Comorbidity_16=1                           1.1070 0.2996  3.0252
Year=2008                                  0.0754 0.1089  1.0783
Year=2009                                 -0.2917 0.1193  0.7470
Year=2010                                 -0.2909 0.1157  0.7476
Source=Nursing home                        0.4416 0.2531  1.5552
Source=General hospital                    1.0193 0.2446  2.7712
Source=Academic or topclinical hospital  2.0716 0.4074  7.9378
```

---

## [159] Urinary tract infections

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Source + Year, data = data, y = TRUE, maxit = 100)
```

```
                       Model Likelihood     Discrimination    Rank Discrim.
                          Ratio Test           Indexes           Indexes

Obs          62266    LR chi2     2389.36    R2       0.185    C       0.835
 Not died    60764    d.f.             36    Brier    0.022    Dxy     0.669
 Died         1502    Pr(> chi2) <0.0001                       gamma   0.679
max |deriv| 9e-06                                              tau-a   0.032


                                              Coef    S.E.   Odds
Intercept                                   -10.1253 1.0084   0.0000
Severity=[0.01,0.02)                          0.8349 0.4075   2.3047
Severity=[0.02,0.05),[0.05,0.1)               1.1997 0.1297   3.3192
Sex=Female                                   -0.1790 0.0551   0.8361
Age=[20,25)                                   1.8810 1.4147   6.5602
Age=[25,30)                                   2.0553 1.4148   7.8096
Age=[30,35)                                   3.0739 1.1553  21.6272
Age=[35,40)                                   3.3583 1.0961  28.7407
Age=[40,45)                                   3.3343 1.0808  28.0596
Age=[45,50)                                   3.5514 1.0495  34.8612
Age=[50,55)                                   3.9512 1.0268  51.9971
Age=[55,60)                                   4.0326 1.0179  56.4097
Age=[60,65)                                   3.9299 1.0143  50.9043
Age=[65,70)                                   4.2636 1.0088  71.0628
Age=[70,75)                                   4.7235 1.0046 112.5579
Age=[75,80)                                   5.0107 1.0030 150.0084
Age=[80,85)                                   5.2971 1.0025 199.7640
Age=[85,90)                                   5.7757 1.0023 322.3611
Age=[90,95)                                   6.0344 1.0039 417.5690
Age=95+                                       6.2069 1.0144 496.1813
Urgency=Not planned                           0.5440 0.1006   1.7228
Comorbidity_1=1                               0.9155 0.1149   2.4980
Comorbidity_2=1                               1.1347 0.0914   3.1102
Comorbidity_3=1                               0.6653 0.1926   1.9451
Comorbidity_4=1                               1.0304 0.1210   2.8021
Comorbidity_6=1                               0.4519 0.1187   1.5713
Comorbidity_8=1                               1.3927 0.3623   4.0256
Comorbidity_9=1                               1.3318 0.3554   3.7879
Comorbidity_13=1                              0.5588 0.1021   1.7486
Comorbidity_14=1                              0.4226 0.1190   1.5259
Comorbidity_16=1                              0.9842 0.1428   2.6758
Source=Nursing home                           0.2531 0.1055   1.2880
Source=General hospital                       1.1480 0.2726   3.1520
Source=Academic or topclinical hospital       0.9896 0.4503   2.6901
Year=2008                                    -0.0101 0.0796   0.9900
Year=2009                                    -0.0500 0.0782   0.9513
Year=2010                                    -0.2482 0.0779   0.7802
```

---

## [226] Fracture of neck of femur (hip)

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Month + Year, data = data, y = TRUE, maxit = 100)

                       Model Likelihood     Discrimination    Rank Discrim.
                          Ratio Test           Indexes           Indexes

Obs          66420    LR chi2     3492.10    R2       0.166    C       0.786
 Not died    63409    d.f.             32    Brier    0.040    Dxy     0.572
 Died         3011    Pr(> chi2) <0.0001                       gamma   0.580
max |deriv| 1e-05                                              tau-a   0.050


                      Coef    S.E.   Odds
Intercept            -7.3917 1.0054   0.0006
Severity=[0.05,0.1)   0.2189 0.0492   1.2447
Sex=Female           -0.7478 0.0414   0.4734
Age=[45,50)           2.2882 1.1020   9.8567
Age=[50,55)           2.2729 1.0702   9.7074
Age=[55,60)           2.7126 1.0318  15.0684
Age=[60,65)           3.2479 1.0141  25.7362
Age=[65,70)           3.1716 1.0131  23.8461
Age=[70,75)           3.6440 1.0055  38.2436
Age=[75,80)           4.1891 1.0024  65.9639
Age=[80,85)           4.6337 1.0015 102.8965
Age=[85,90)           4.9711 1.0013 144.1864
Age=[90,95)           5.4392 1.0016 230.2587
Age=95+               5.7455 1.0033 312.7888
Urgency=Not planned   0.2387 0.0953   1.2696
Comorbidity_1=1       1.0150 0.0889   2.7593
```

```
Comorbidity_2=1       2.1340 0.0728   8.4490
Comorbidity_3=1       0.7659 0.1740   2.1510
Comorbidity_4=1       0.8641 0.1020   2.3728
Comorbidity_6=1       0.6461 0.0888   1.9081
Comorbidity_8=1       1.6486 0.2456   5.1999
Comorbidity_9=1       2.5630 0.3126  12.9751
Comorbidity_13=1      1.5928 0.1155   4.9176
Comorbidity_14=1      0.8318 0.1481   2.2976
Comorbidity_16=1      0.9802 0.1973   2.6650
Month=2              -0.1974 0.0676   0.8209
Month=3              -0.2011 0.0680   0.8178
Month=4              -0.1328 0.0676   0.8756
Month=5              -0.1756 0.0668   0.8390
Month=6              -0.0471 0.0636   0.9540
Year=2008            -0.0544 0.0536   0.9471
Year=2009            -0.2169 0.0548   0.8050
Year=2010            -0.5380 0.0573   0.5839
```

---

## [233] Intracranial injury

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_4 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          56990    LR chi2     5600.54    R2       0.417    C       0.935
 Not died    55405    d.f.             42    Brier    0.021    Dxy     0.870
 Died         1585    Pr(> chi2) <0.0001                       gamma   0.876
max |deriv| 1e-08                                              tau-a   0.047


                                        Coef    S.E.   Odds
Intercept                               -8.0341 0.7364    0.0003
Severity=[0.01,0.02)                     1.6277 0.1306    5.0922
Severity=[0.02,0.05)                     2.2573 0.1330    9.5569
Severity=[0.05,0.1)                      3.1945 0.1336   24.3981
Severity=[0.1,0.2)                       3.5130 0.1137   33.5472
Severity=[0.2,0.3)                       4.1471 0.1385   63.2522
Severity=[0.3,0.4)                       4.5231 0.2207   92.1204
Severity=[0.4,1]                         7.0081 0.1652 1105.5649
Severity=0                               4.7861 0.1624  119.8323
Sex=Female                              -0.3621 0.0633    0.6962
Age=[1,5)                                0.7456 0.8340    2.1078
Age=[5,10)                               1.2136 0.8247    3.3655
Age=[10,15)                              2.0045 0.7710    7.4222
Age=[15,20)                              2.4060 0.7416   11.0895
Age=[20,25)                              2.4868 0.7428   12.0233
Age=[25,30)                              1.7738 0.7661    5.8931
Age=[30,35)                              2.5031 0.7535   12.2200
Age=[35,40)                              2.6606 0.7465   14.3048
Age=[40,45)                              2.4482 0.7484   11.5679
Age=[45,50)                              2.5146 0.7422   12.3616
Age=[50,55)                              2.8194 0.7393   16.7664
Age=[55,60)                              2.7746 0.7367   16.0321
Age=[60,65)                              3.0860 0.7341   21.8884
Age=[65,70)                              3.0542 0.7341   21.2049
Age=[70,75)                              3.3848 0.7316   29.5127
Age=[75,80)                              3.6530 0.7301   38.5904
Age=[80,85)                              3.9173 0.7292   50.2620
Age=[85,90)                              4.2673 0.7299   71.3283
Age=[90,95)                              4.5828 0.7354   97.7830
Age=95+                                  5.0412 0.7621  154.6524
Urgency=Not planned                     -0.4506 0.0911    0.6372
Comorbidity_1=1                          0.6271 0.2040    1.8722
Comorbidity_2=1                          1.3434 0.2262    3.8319
Comorbidity_4=1                          0.6301 0.1596    1.8778
Comorbidity_13=1                         0.9450 0.2962    2.5728
Comorbidity_14=1                         0.8254 0.2908    2.2828
Comorbidity_16=1                         1.1337 0.3500    3.1071
Year=2008                               -0.2232 0.0865    0.7999
Year=2009                               -0.2023 0.0816    0.8168
Year=2010                               -0.4546 0.0836    0.6347
Source=Nursing home                      0.0866 0.1718    1.0904
Source=General hospital                 -0.5173 0.1499    0.5961
Source=Academic or topclinical hospital -0.5430 0.2039    0.5810
```

---

## [237] Complication of device; implant or graft

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Sex + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_5 +
    Comorbidity_6 + Comorbidity_7 + Comorbidity_9 + Comorbidity_13 +
    Comorbidity_14 + Comorbidity_16 + Month + Year + Source,
    data = data, y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.
                         Ratio Test           Indexes           Indexes

Obs          74632    LR chi2    1715.88    R2       0.178    C       0.844
 Not died    73682    d.f.            45    Brier    0.012    Dxy     0.689
 Died          950    Pr(> chi2) <0.0001                      gamma   0.709
max |deriv| 2e-07                                             tau-a   0.017


                                          Coef    S.E.   Odds
Intercept                                -7.9141 1.0097  0.0004
Severity=[0.01,0.02)                      0.4210 0.1012  1.5235
Severity=[0.02,0.05)                      1.4096 0.0889  4.0943
Severity=[0.05,0.1)                       1.8975 0.2995  6.6691
Sex=Female                               -0.2683 0.0704  0.7647
Age=[10,15)                               1.0115 1.4175  2.7497
Age=[15,20)                               0.4179 1.4170  1.5188
Age=[20,25)                               1.3385 1.1580  3.8133
Age=[25,30)                              -0.0023 1.4179  0.9977
Age=[30,35)                               0.9442 1.1575  2.5709
Age=[35,40)                               1.7193 1.0473  5.5804
Age=[40,45)                               0.9682 1.0720  2.6331
Age=[45,50)                               1.0295 1.0513  2.7997
Age=[50,55)                               1.4607 1.0261  4.3089
Age=[55,60)                               2.0144 1.0124  7.4965
Age=[60,65)                               2.1546 1.0096  8.6245
Age=[65,70)                               2.2907 1.0080  9.8823
Age=[70,75)                               2.6526 1.0059 14.1905
Age=[75,80)                               2.8316 1.0051 16.9720
Age=[80,85)                               3.1472 1.0054 23.2716
Age=[85,90)                               3.7085 1.0062 40.7906
Age=[90,95)                               3.8100 1.0157 45.1508
Age=95+                                   4.1950 1.0554 66.3533
Urgency=Not planned                       0.9107 0.0753  2.4860
Comorbidity_1=1                           0.5531 0.1543  1.7386
Comorbidity_2=1                           1.9494 0.1409  7.0243
Comorbidity_3=1                           0.7989 0.1477  2.2230
Comorbidity_4=1                           1.2137 0.1925  3.3658
Comorbidity_5=1                           1.1787 0.2666  3.2502
Comorbidity_6=1                           0.7130 0.1653  2.0400
Comorbidity_7=1                           1.0771 0.3094  2.9363
Comorbidity_9=1                           1.9534 0.4526  7.0529
Comorbidity_13=1                          0.7280 0.1150  2.0710
Comorbidity_14=1                          0.8223 0.1625  2.2757
Comorbidity_16=1                          0.7797 0.2165  2.1808
Month=2                                  -0.1816 0.1139  0.8340
Month=3                                  -0.2485 0.1153  0.7799
Month=4                                  -0.3529 0.1195  0.7027
Month=5                                  -0.1542 0.1128  0.8571
Month=6                                  -0.0800 0.1111  0.9232
Year=2008                                -0.0917 0.0945  0.9124
Year=2009                                -0.1830 0.0938  0.8328
Year=2010                                -0.4447 0.0969  0.6410
Source=Nursing home                       0.2445 0.1629  1.2769
Source=General hospital                   1.1775 0.1728  3.2464
Source=Academic or topclinical hospital   0.8903 0.3392  2.4358
```

## [238] Complications of surgical procedures or medical care

```
Logistic Regression Model

lrm(formula = Death ~ Severity + Age + Urgency + Comorbidity_1 +
    Comorbidity_2 + Comorbidity_3 + Comorbidity_4 + Comorbidity_6 +
    Comorbidity_8 + Comorbidity_9 + Comorbidity_13 + Comorbidity_14 +
    Comorbidity_16 + Year + Source, data = data, y = TRUE, maxit = 100)
```

```
                      Model Likelihood     Discrimination    Rank Discrim.    
                         Ratio Test            Indexes          Indexes       
Obs          67041    LR chi2    2326.66    R2       0.221    C       0.865    
 Not died    65936    d.f.            42    Brier    0.015    Dxy     0.730    
 Died         1105    Pr(> chi2) <0.0001                      gamma   0.744    
max |deriv| 3e-06                                             tau-a   0.024    

                                        Coef    S.E.   Odds   
Intercept                               -5.0392 0.4160  0.0065
Severity=[0.01,0.02)                     0.6626 0.1028  1.9398
Severity=[0.02,0.05)                     1.2869 0.1062  3.6215
Severity=[0.05,0.1)                      1.4967 0.1358  4.4669
Severity=[0.1,0.2)                       3.7568 0.2093 42.8115
Severity=[0.2,0.3)                       3.3312 0.2454 27.9720
Age=[1,5)                               -2.8471 1.0788  0.0580
Age=[5,10)                              -2.7967 1.1008  0.0610
Age=[10,15)                             -1.9691 0.8238  0.1396
Age=[15,20)                             -2.4283 0.8172  0.0882
Age=[20,25)                             -2.2914 0.7093  0.1011
Age=[25,30)                             -2.3287 0.7042  0.0974
Age=[30,35)                             -2.0557 0.6012  0.1280
Age=[35,40)                             -2.4264 0.6012  0.0884
Age=[40,45)                             -1.4783 0.4759  0.2280
Age=[45,50)                             -1.6723 0.4687  0.1878
Age=[50,55)                             -1.1544 0.4341  0.3152
Age=[55,60)                             -0.7885 0.4205  0.4545
Age=[60,65)                             -0.6709 0.4132  0.5113
Age=[65,70)                             -0.3296 0.4099  0.7192
Age=[70,75)                              0.0561 0.4064  1.0578
Age=[75,80)                              0.5754 0.4039  1.7779
Age=[80,85)                              0.7654 0.4059  2.1498
Age=[85,90)                              0.9300 0.4133  2.5346
Age=[90,95)                              1.6944 0.4308  5.4433
Age=95+                                  1.7075 0.5404  5.5153
Urgency=Not planned                      0.2356 0.0719  1.2657
Comorbidity_1=1                          0.6465 0.1512  1.9089
Comorbidity_2=1                          1.4064 0.1682  4.0811
Comorbidity_3=1                          0.6613 0.1494  1.9374
Comorbidity_4=1                          1.1087 0.1919  3.0303
Comorbidity_6=1                          0.5531 0.1527  1.7386
Comorbidity_8=1                          1.5861 0.3674  4.8848
Comorbidity_9=1                          2.5063 0.3220 12.2589
Comorbidity_13=1                         1.2336 0.1508  3.4335
Comorbidity_14=1                         0.9991 0.1182  2.7159
Comorbidity_16=1                         0.7932 0.1450  2.2105
Year=2008                               -0.0157 0.0903  0.9844
Year=2009                               -0.1809 0.0902  0.8345
Year=2010                               -0.4187 0.0926  0.6579
Source=Nursing home                      0.5574 0.1481  1.7462
Source=General hospital                  1.5373 0.1115  4.6519
Source=Academic or topclinical hospital  1.3791 0.1759  3.9713
```

---

## [249] Shock

```
Logistic Regression Model

lrm(formula = Death ~ Age + Comorbidity_1 + Comorbidity_2 + Comorbidity_6 + 
    Comorbidity_9 + Comorbidity_14 + Comorbidity_16 + Year, data = data, 
    y = TRUE, maxit = 100)

                      Model Likelihood     Discrimination    Rank Discrim.    
                         Ratio Test            Indexes          Indexes       
Obs           2912    LR chi2     518.69    R2       0.218    C       0.731    
 Not died     1445    d.f.            22    Brier    0.209    Dxy     0.461    
 Died         1467    Pr(> chi2) <0.0001                      gamma   0.467    
max |deriv| 8e-07                                             tau-a   0.231    

                                Coef    S.E.   Odds   
Intercept                       -2.4358 0.4306  0.0875
Age=[15,20),[20,25)             -0.2431 0.6705  0.7842
Age=[35,40),[30,35),[25,30)      0.8034 0.5113  2.2331
Age=[40,45)                      0.9943 0.5314  2.7029
Age=[45,50)                      1.6562 0.4806  5.2394
Age=[50,55)                      1.6977 0.4637  5.4614
Age=[55,60)                      1.9443 0.4536  6.9884
Age=[60,65)                      2.0661 0.4425  7.8937
Age=[65,70)                      2.3129 0.4440 10.1033
Age=[70,75)                      2.3959 0.4407 10.9781
Age=[75,80)                      2.8460 0.4359 17.2183
```

| | | | |
|---|---|---|---|
| Age=[80,85) | 3.0678 | 0.4386 | 21.4939 |
| Age=[85,90) | 3.1624 | 0.4414 | 23.6267 |
| Age=[90,95),95+ | 3.6896 | 0.4798 | 40.0303 |
| Comorbidity_1=1 | 0.5771 | 0.1384 | 1.7809 |
| Comorbidity_2=1 | 0.4081 | 0.1423 | 1.5040 |
| Comorbidity_6=1 | 0.5718 | 0.1942 | 1.7715 |
| Comorbidity_9=1 | 1.2922 | 0.3063 | 3.6407 |
| Comorbidity_14=1 | 0.7579 | 0.1807 | 2.1339 |
| Comorbidity_16=1 | 1.4925 | 0.2783 | 4.4483 |
| Year=2008 | -0.1128 | 0.1169 | 0.8933 |
| Year=2009 | -0.2473 | 0.1165 | 0.7809 |
| Year=2010 | -0.4073 | 0.1175 | 0.6655 |