ABSTRACT

The HSMR tested

Type and impact of measurement errors in determining standardised mortality ratios

Background and aims of the study

The hospital standardised mortality ratio, the 'HSMR', has received attention in the Netherlands and abroad, as an indicator of the quality of care. The intention is that outcomes would enable comparisons on mortality ratios to be made between hospitals on a national level after statistical adjustment was made for the casemix. In addition to this, the indicator can also be used on the more detailed level of the diagnostic group within a hospital. This is called a standardised mortality ratio (SMR).

Various parties have an interest in applying the HSMR and the SMRs. SMRs have, for example, been used in Dutch hospitals for several years in order to monitor and improve the quality of care. The HSMR can also be used to increase transparency in health care by making the figures public. The Inspectorate and the media welcomed this development. Finally, it is hoped that the potential improvement in the quality of care and the greater transparency may benefit the patient.

The HSMR is an indicator that should reflect variations in quality of care. While a good indicator should be reliable and valid, demonstrating these properties for the HSMR is not easy. There are a number of factors that have nothing to do with quality of care, which could distort the validity of the HSMR. Firstly the data used to calculate the HSMR may be unreliable, incomplete or inconsistent. Secondly, there are factors or circumstances, different between hospitals, that may distort the HSMR-outcomes. This thesis describes the results of an investigation into these distorting factors. The questions we addressed are the following:

1. What factors could affect the validity and reliability of the HSMR?
2. What is the possible impact of these factors on the results of HSMR and SMRs?
3. And to what extent is the HSMR suitable as an indicator in support of improving the quality of care and allowing public disclosure?

Methods

Four different types of variations, which we call 'sources of distortion', have been analysed in order to answer the research questions.

1. ***Variation in the registration of admissions***, as collated in the national medical registration dataset (LMR). The study focused on three aspects of the coding process that are sensitive to errors or inconsistencies. These are: the principal diagnosis, secondary diagnoses and admission type. This involved the analysis of data from the LMR from six large non-university teaching hospitals (Santeon). Furthermore medical coders from these hospitals were interviewed. The study period covered the years 2003 to 2007.

2. ***Variation in the type of treatment for heart disease*** as determined by the 'Special Medical Procedures Act' (WBMV). The effect of carrying out open heart surgery and angioplasty treatment by twelve cardiac centres in the Netherlands has been examined. The impact upon the HSMR of these cardiac centres has been examined by calculating the HSMR with, and without carrying out these procedures and by comparing the results. The study period was 2004.

3. ***Variations in the casemix on the primary diagnostic level.*** The occurrence of variations in the casemix on the primary diagnostic level was analysed using the LMR of all Dutch hospitals over the years 2005 to 2009. It was investigated whether the HSMR corrected adequately for possible variations, by calculating the standardised mortality ratios for high risk and for low risk diagnostic subgroups and by comparing the outcomes.

4. ***Variations in the frequency of readmission.*** This study analysed whether the number of times on average that a patient was admitted, the 'readmission frequency', differed among six, large, non-university teaching hospitals. In addition we looked at the extent to which predicted mortality was associated with the readmission frequency. The Santeon study period covered the years 2003 to 2007. The impact that differences in readmission frequency have on the HSMR was calculated using nationwide data over the years 2005 to 2009.

Main findings

Registration

The principal diagnosis, secondary diagnoses and admission type showed variations in coding due to: the physician not (timely) delivering medical patient data at discharge; pressure on the time available to do the coding work, because of a limited number of coders; ambiguous diagnosis codes; ambiguous coding rules for coding admission-type and, to a limited degree, to mistakes in the coding. In most of the cases it turned out to be impossible to assess the impact upon the HSMR outcome by recalculation. The impact of the frequently used codes 799.8 and 799.9 ('diagnosis unknown') could however be estimated. For one of the six hospitals the HSMR increased by 22 HSMR points after correction and for another hospital it fell by 5 HSMR points. Variations observed in the percentage of emergency admissions coded, may have had a strong impact on the HSMR but this could not be quantified.

Special medical procedures

In the treatment of heart disease, variation occurs as a consequence of a division of the Dutch hospitals into either cardiac, or non-cardiac, centres. Cardiac centres perform special medical procedures that non-cardiac centres are not allowed to perform. Because the HSMR-model does not adjust for medical procedures, the treatment of heart disease turns out to be a source of variation. The analysis showed that angioplasty is associated with a decrease of HSMR and open heart surgery is associated with an increase of HSMR. The combined effect of omitting both types of treatment in the calculation, showed the HSMR to change within a range from -4.7 to 5.3%.

Casemix on the primary diagnostic level

The casemix on the primary diagnostic level (ICD-9) varies substantially for virtually all diagnostic groups involved in the calculation of the HSMR. The HSMR calculation, used in the Netherlands in 2010, does not adequately adjust for these variations. When comparing the original and newly calculated standardised mortality ratios, relative shifts occur ranging from -63% to 202% of the original SMR values, respectively, and from -6.7% to 4.3% of the original HSMR values. The standard deviations of the frequency distributions of these shifts amount to 14.6% for the SMRs, respectively to 2.0% for the HSMRs.

Readmissions

Differences in the readmission frequency turned out to be a source of variation. It may occur that one hospital admits the 'same patient', in terms of casemix variables, more frequently than another hospital would do under similar circumstances. Variation in the readmission frequency appears to be associated with a variation in predicted death and consequently with variation in standardised mortality ratios. The standardised mortality ratio for frequently admitted patients in general turned out to be significantly lower than the standardised mortality ratio for non-frequently admitted patients. Since admission frequencies vary substantially between hospitals, this may favour hospitals with relatively many frequently admitted patients.

Combination of effects

Based on our findings we calculated a new HSMR by adjusting for the factors mentioned above, with the exception of variation in registration. We calculated and compared two variants. One variant was nearly identical to the 2010 HSMR-model while the other included additional adjustment for the three factors mentioned. This resulted in an indication of the 'signal-to-distortion-ratio' of the (H)SMR while including the impact of random noise.
On the SMR level this ratio equalled approximately 1, indicating that the signal (distribution of all SMRs) and the distortion had a comparable level. On the HSMR level the ratio equalled approximately 2. If all the other known sources of distortion were to be quantified and counted, then these ratios would most likely turn out to be lower (worse).

General discussion and recommendations

The HSMR is the result of a sophisticated statistical calculation. There is no other such indicator of the quality of care on the hospital level and on the diagnostic group level in the Netherlands. However the signalling function it should perform is still immersed in a multitude of distorting factors. The current signal-to-distortion-ratio of the HSMR is unacceptably low. Sceptics may therefore consider it a useless tool. Other parties, who believe in the potential of the instrument, think that the HSMR should be utilised. Both would benefit from a HSMR free of distortion.

Improving the instrument

Improvements can be made to the HSMR instrument. A distinction can be made between cardiac centres and non-cardiac centres for heart diseases. By using an enhanced classification of risk categories improvements are possible in the adjustment for casemix differences on the primary diagnostic level. The HSMR can be adjusted for readmission frequency if a unique patient identification is available in the registration of the hospitals. By counting each co-morbidity no more than once and by excluding the primary diagnosis from the calculation, the method of calculating the charlsonindex can be improved.

Using the HSMR for quality improvement in hospitals

If the improvements suggested above in calculating the HSMR are not yet implemented, then we would recommend taking into account the possible occurrence of distorting effects. It is also important to maintain an adequate, unambiguous and complete registration of admissions (LMR).

Further investigation of the type and impact of measurement errors

Sources of distortion not investigated in this study deserve to be analysed and quantified on the national level. In particular we would highlight the following: the impact of palliative care; the 'constant risk fallacy'; death immediately after entering the emergency room of the hospital; death within 30 days after discharge; and the quality of the admission registration nationwide.

Public disclosure of the HSMR

If the HSMR can be clearly and demonstrably linked to the quality of care in hospitals, then there would be no technical arguments against disclosure. However, this thesis has shown that the HSMR, according to the Dutch 2010 model, is distorted by numerous sources of uncorrected variation. There is a fair chance that various good and safe hospitals could still score an unduly high HSMR in which case disclosure is undesirable. Only after improvement of the HSMR instrument, by applying among other things, the findings of this thesis, can the quality of the instrument be sufficiently guaranteed so as not prohibit disclosure. It is recommended that the publication also includes an indication of the residual level of distortion, expressed as a 'signal-to-distortion-ratio', including the level of random noise determined by confidence intervals.