Mortality following emergency admission for fractured neck of femur at an English NHS Trust

Dr Rod Jones (ACMA, CGMA)
Statistical Advisor
Healthcare Analysis & Forecasting

hcaf_rod@yahoo.co.uk
01276 21061

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Aim

The aim of this study is to determine if decease following an emergency admission for a fractured neck of femur is higher than expected at the NHS Trust.

This report was commissioned due to the claim by the Dr Foster website that the age standardised mortality was 13% higher than the national average.

The conclusions in this report are the independent views of Healthcare Analysis & Forecasting.

1. Conclusions

1. Fractured neck of femur is a traumatic injury with a high incidence of ensuing complications and mortality
2. Approximately 1 in 10 patients die within 30 days of admission although this risk rises rapidly with age
3. Comparison of mortality between hospitals is not a direct measure of the quality of care since mortality is dependant on patient specific factors such as: exact type of the fracture, suitability for anaesthesia and associated co-morbidities such as respiratory infection, previous heart failure, dementia, malnutrition, alcoholism, etc.
4. Given the very small number of patients who actually die the claim for a real 13% higher mortality at the NHS Trust is not supported by statistical analysis.
5. The NHS Trust is within the expected range around the average in which 50% of hospitals will lie due to random variation in the condition of the arriving patients.

3. Introduction

Falls resulting in a fractured neck of femur are a significant cause of death[1]. The reason for the high mortality following a fractured neck of femur is partly to do with the relatively high average age of the patients and partly to do with the traumatic nature of this particular type of fracture and the associated major surgery required to correct the fracture.

The risk of a fall is significantly increased by a sedentary lifestyle (such as confinement in a nursing home or due to general ill health)[2].

Some 80% of UK admissions are for women and decease within one year has been reported to lie in the range of 20 to 35% of admissions[3] although for those over 85 years of age this risk has increased to 46% or higher (24% dying in hospital)[4]. In the UK some 73% of admissions are aged 69 and over[5], however, for the NHS Trust this

[1] Holden,J. et al (1998) British Journal of General Practice, 48 (432):1409-1412
[2] Galgali,G. et al (1998) New Zealand Medical Journal, 111(1058), 7-10
[3] Goldacre,M.J. et al (2002) British MedicaL Journal, 325
[4] Jennings,A.G. and de Boer,P. (1999) Injury, 30(3), 169-172.
[5] DOH data from HES (2001/02)

proportion varies from 78% to 86% (00/01 to 02/03), i.e. a significantly higher proportion of older persons.

The risk of mortality is higher for men although the risk of such a fracture and hence the number of admissions is lower due to the lower incidence of osteoporosis in men[6]. In the UK the proportion of male admissions averages 28% while for the NHS Trust this average varies from 19% to 26% (00/01 to 02/03), i.e. significantly fewer male admissions than national average.

Before launching into an analysis of the data it is always helpful to understand the nature of the problem. In this instance mortality is not a direct measure of the quality of care delivered by a hospital. This is due to the fact that the physical condition of the patient has an enormous influence on the outcome. Hence it would be a cause for concern if a relatively younger patient in good health and with an uncomplicated fracture were to die. On the other hand a patient with a history of alcoholism, hence malnutrition and poor kidney function would have a high expectation of mortality.

The point of relevance is that mortality statistics used within the UK (and the Dr Foster website) although having some adjustment for age do not take any other factors into account relating to the general state of the patient. Given that we are dealing with relatively small numbers the claim for a higher mortality rate needs to be understood in its correct context. Indeed we need to understand if the quoted figure of 13% higher mortality is merely a statistical artefact. In other words is the mortality in the range expected given the influence of patient condition on the final outcome?

To answer these questions we will explore the range of patient specific risk factors; look at the indicators of hospital performance which could contribute to the outcome and finally explore the limitations of the statistical methods used to report relative mortality rates.

4. Patient Specific Risk Factors

4.1.1. Type of Fracture

Risk of mortality is higher for trochanteric type fractures[7].

4.1.2. Bronchopneumonia

Surgery for fractured neck of femur on patients with bronchopneumonia results in only a 10% survival rate. Due to this enormous risk of decease it has been suggested that early surgical intervention should be denied[8].

4.1.4. Suitability for Anaesthesia

The operation to repair a fractured neck of femur is major surgery with prolonged exposure to anaesthesia. Using the American Society of Anaesthetists (ASA) scoring

[6] Kazar,G. et al (1997) Orvosi Hetilap, 138(50), 3173-3177
[7] Kazar,G. et al (1997) Orvosi Hetilap, 138(50), 3173-3177
[8] Ryder,S.A. et al (2001) Injury, 32(4), 295-297

system (1 = fit for anaesthesia through to 5 = totally unfit) one study showed that patients with an ASA score of 4 or 5 had only a 10% chance of survival. It was considered that early surgical intervention should be denied to such patients[9]. Another study looking at one and three year mortality showed a 1.7-times higher risk for ASA 3,4 or 5 patients[10].

4.1.4. Previous Heart Failure

A previous heart failure increases the risk of decease following surgery however on its own it was not deemed to be sufficient to warrant the withholding of surgery[11].

4.1.5. Nutritional Status

Patients classified as being malnourished are twice as likely to die within one year after admission to hospital for any reason[12]. A similar risk has been identified for patients with chronic body mass depletion (malnutrition or other causes)[13]. This risk also applies to patients admitted for fractured neck of femur[14].

4.1.6. Physical Activity

Physical activity is known to reduce the likelihood of all cause mortality[15]. The lack of physical activity is a causative factor in the increased risk of fractured neck of femur[16].

4.1.7. Mental State

Patients with senile dementia were reported to have 3-times higher mortality at four months or one year after surgery for fractured neck of femur. Patients with senile dementia also had a higher risk of being far less mobile after the operation. For this group of patients the less invasive method of internal fixation is recommended rather than hemiarthroplasty[17]. However, patients with a prior cerebrovascular accident did not appear to have a higher risk of decease (except that they tended to have an ASA rating of 3 or 4)[18].

4.1.8. Secondary Infection by Salmonella

The fact that a patient has had a fall of sufficient violence to cause a fractured neck of femur and the resulting internal trauma caused by the fractured bones is sufficient to increase the risk of Salmonella infection with consequent multi-organ failure[19].

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[9] Ryder,S.A. et al (2001) Injury, 32(4), 295-297
[10] Hamlet,W.P. et al (1997) American Journal of Orthopaedics, 26(9), 621-627.
[11] Ryder,S.A. et al (2001) Injury, 32(4), 295-297
[12] Persson,M.D. et al (2002) Journal of the American Geriatrics Society, 50(12): 1996-2002.
[13] Liu,L. et al (2002) Journals of Gerontology Series A, 57(11), M741-746
[14] Ryder,S.A. et al (2001) Injury, 32(4), 295-297
[15] Crespo,C.J. et al (2002) Annals of Epidemiology, 12(8), 543-552.
[16] Galgali,G. et al (1998) New Zealand Medical Journal, 111(1058), 7-10
[17] vanDortmont,L.M. et al (2000) Injury, 31(5), 327-331
[18] Youm,T. et al (2000) Journal of Orthopaedic Trauma, 14(5), 329-334
[19] Mofredj,A. et al (2001) Intensive Care Medicine, 27(5), 950-951

4.1.9. Pulmonary Fat Embolism

Some patients are at risk of death due to the onset of fat embolism in the lungs and kidneys leading to hypouresis, pulmonary edema & hypoxia and cardiac arrest[20].

4.1.10. Patients with Cancer

Patients with significantly advanced malignancy had poor outcomes following surgery and should not automatically be referred for surgery[21].

4.1.11. Alcoholism, Drug Addiction & Smoking

Patients suffering from alcoholism, drug addictions or long term smoking all have a higher risk of decease.

5. Hospital Specific Risk & Quality Factors

While the risk of decease may be a possible gross indicator of 'quality' the two measures, namely, risk of decease and quality of care should perhaps be considered as separate elements to the full picture.

5.1. Hospital Factors Increasing the Risk of Decease

5.1.1. Delay to Surgical Intervention

There is clear evidence to show that survival is improved for those patients receiving surgical intervention on the day of admission compared to those receiving intervention on the second day[22]. The risk of decease was reported to be 1.7-times higher[23] in one study and 4.5-times higher in another[24].

The delay experienced by a patient before surgery is made up from two components:

- **Suitability for immediate surgery**

Section 4 has already detailed a number of instances where medical opinion is that immediate surgery should be withheld until the patient is fit enough.

- **Size of the department**

Patients arriving with fractured neck of femur can arrive outside normal working hours and over the weekend. Their treatment usually requires a dedicated theatre (and associated dedicated theatre staff) to avoid cancellation of the normal non-emergency surgery. The immediate availability of an anaesthetist is also required. Smaller departments are not able to offer this level of service and hence will experience a delay to surgery particularly when a patient is admitted over the weekend.

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[20] Mori,K. et al (1999) Japanese Journal of Anaesthesiology, 48(4), 416-418
[21] McNamara,P. et al (1997) Age & Ageing, 26(6), 471-474
[22] Smektala,R. et al (2000) Zentralblatt fur Chirurgie, 125(9), 744-749
[23] Beringer,T.R. et al (1996) Ulster Medical Journal, 65 (1), 32-38
[24] Hamlet, W.P. et al (1997) American Journal of Orthopaedics, 26(9), 621-627

Hence analysis of data from German hospitals showed that the larger departments able to specialise in trauma had a delay before operation which was on average 0.5 to 0.7 days shorter than the smaller departments.

International benchmarks are not readily available, however, in 1989 the Royal Victoria Hospital (Belfast) was reporting that 57% of patients received surgery on the day of admission[25]. Of all the factors this is the one most likely to be behind a persistent higher mortality rate at particular NHS sites.

The NHS Trust delivers Orthopaedic services from two hospital sites, namely, A and B. Volume of admissions per annum is around 200 at A with slightly more at B.
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5.1.2. Treatment for blood clotting

The risk of fatal pulmonary embolism following surgery for fractured neck of femur is known to be relatively high. One study showed that treatment with heparin reduced the risk of death but that the risk of embolism extended well beyond discharge from hospital[26]. Another study showed that aspirin had the potential to prevent 4 fatal pulmonary emboli per 1,000 patients; however, this was balanced against an increased risk of aspirin-induced bleeding requiring post operative transfusion (6 per 1,000 patients)[27].

5.1.3. Preparation of the cement used to fix the bones

The following is one example of a recent development in medical technology which may make a significant impact on future hospital practice. In this German study the authors postulated that the high level of circulatory and pulmonary problems following repair of fractured neck of femur may be due to air embolism during polymerisation of the methylmethacrylate used to cement the bones. To prevent this they proposed that the cement should be mixed under vacuum. In a small trial with 72 patients (36 in each group) the group with cement mixed under vacuum had a 6-times reduction in the incidence of pulmonary embolism and a 4-times reduction in complications from poor arterial oxygenation. Mortality was reduced from 13.8% in the group with normal mixing of cement down to 2.8% where cement was mixed under vacuum[28].

The above finding needs to be validated by further studies; however, it does demonstrate how a breakthrough in practice can lead to a dramatic reduction in mortality.

5.2. Hospital Factors Leading to Quality of Care

Our knowledge of the factors leading to higher quality of care is developing over time. Hence it has taken many years of controlled trials to establish which factors lead

[25] Beringer,T.R. et al (1996) Ulster Medical Journal, 65(1), 32-38
[26] Frostick,S.P. (2000) Haemostasis, 30 Suppl 2, 82-87
[27] Anon (2000) Lancet, 355(9212), 1295-1302
[28] Leidinger,W. et al (2002) Unfallchirung, 105(8), 675-679

to a high 'quality'of care. This is because as many of the patient specific factors as possible need to be ruled out to establish the true cause of the outcome.

5.2.1. Choice of Procedure

There are three possible interventions for fractured neck of femur, namely, internal fixation, uncemented hemiarthroplasty or cemented total hip arthroplasty gives the best outcomes.

In this respect one study of nearly 300 over 65 year olds over a period of 13 years showed no statistical difference in mortality between the three procedures, however, in terms of the need for longer-term revisional surgery, complications or patient mobility and discomfort total hip arthroplasty gave the best results (in spite of higher earlier complications, increased blood loss and longer time for surgery)[29]. This general conclusion has been supported by other recent studies and reviews[30,31,32,33]. One review has suggested that internal fixation is a cause for higher longer-term mortality[34]

5.2.2. Post-operative Rehabilitation

For the surviving patients the 'quality' of the post operative rehabilitation is probably the most influential aspect of a return to a normal quality of life (walking ability and associated painfulness)[35].

6. Measuring Increased Risk

6.1. Death in Hospital

Death within hospital could be considered to be a valid measure of the risk of decease. However the medical literature is quite clear regarding the fact that the risk of decease is elevated for any patient undergoing surgery for fractured neck of femur with increased levels of in-hospital and ex-hospital 1, 3 & 5 year mortality, i.e. mortality must be measured at an identical point in time to give comparable results.

Decease while in hospital is therefore not an equally comparable measure for the simple reason that the time spent in hospital depends greatly on the supporting infrastructure around a hospital. Hence some hospitals discharge patients very early for convalescence in a nearby community hospital or with a supporting hospital-at-home scheme. Those hospitals with supporting infrastructure will therefore have correspondingly lower numbers of deceases. As a general comment the NHS Trust does not have access to early discharge schemes for its orthopaedic patients and would therefore be expected to have a higher number of in-hospital deaths due to the simple fact that the patients stay for a longer period of time.

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[29] Kumar,K.J. & Marsh, G (2000) Injury, 31(10), 793-797
[30] Khan,R.J. et al (2002) Injury, 33(1),13-17
[31] Rogmark,C. et al (2002) Acta Orthopaedica Scandinavica, 73(6), 605-610
[32] Cree,M. et al (2002) Canadian Journal of Surgery, 45(4), 248-254.
[33] Broos,P.L. (1999) Acta Chirurgica Belgica, 99(4), 190-194
[34] Hudson,J.I. et al. (1998) Clinical Orthopaedics & Related Research, 1998 March (348), 59-66
[35] Kazar,G. et al. (1997) Orvosi Hetilap, 138(5), 3173-3177

6.1. Death within 30 Days of Admission

The choice of death (from all causes) within 30 days of admission used within the UK appears to be a somewhat arbitrary cut off point, however, the main aim is to introduce an element of consistency in order to compare like with like. The inclusion of death from all causes has been defended in a recent study on the grounds that mention of a previous fractured neck of femur is often omitted from the death certificate[36].

Hence the UK measure of death within 30 days is as good a measure as any other of the in-hospital and short-term ex-hospital deaths. Given the short timescale between admission and the 30 day cut off point the inclusion of deaths from all causes appears to be justified.

5.2. Is a one year snap-shot a good choice for such an indicator?

Practice within the UK as promoted by the DOH appears to be out of line with international studies on mortality following any hospital intervention. It would seem that the pressure for short-term measures via hospital star ratings has confused many of the issues.

International practice tends to recognise the need for higher volumes of data and hence studies within a single hospital or between groups of hospitals are usually an aggregate of 6 or more years of data[37,38]. The study by Jarman et al (1999)[39] of deaths from all causes in English hospitals used three years data across 183 hospitals – a very large data set indeed. This latter study indicated that the most significant factor in all deaths within hospital was the number of doctors per 100 beds and the number of GP's per head of population. This explains why the Dr Foster website gives information on the number of doctors per 100 beds as a measure of 'quality'.

The next figure gives data for all English hospital Trusts for death following a fractured hip. The age and sex standardised rates have been calculated on two successive years. It is immediately apparent that in most instances the score from one year to the next is controlled by random variation rather than an genuine measure of 'quality'.

In this respect one Trust had a score of 18,897 per 100,000 deaths per admission in 1998/99 (the highest in the UK) yet in the following year had a score of only 3,893 (the lowest in the UK)! Such massive variation is simply not possible – rather it is an artefact of the method used to score and hence rank hospitals.

The random variation caused by the patient specific risk factors in what are small number events is overwhelming the attempt to make any meaningful measure of 'quality'.

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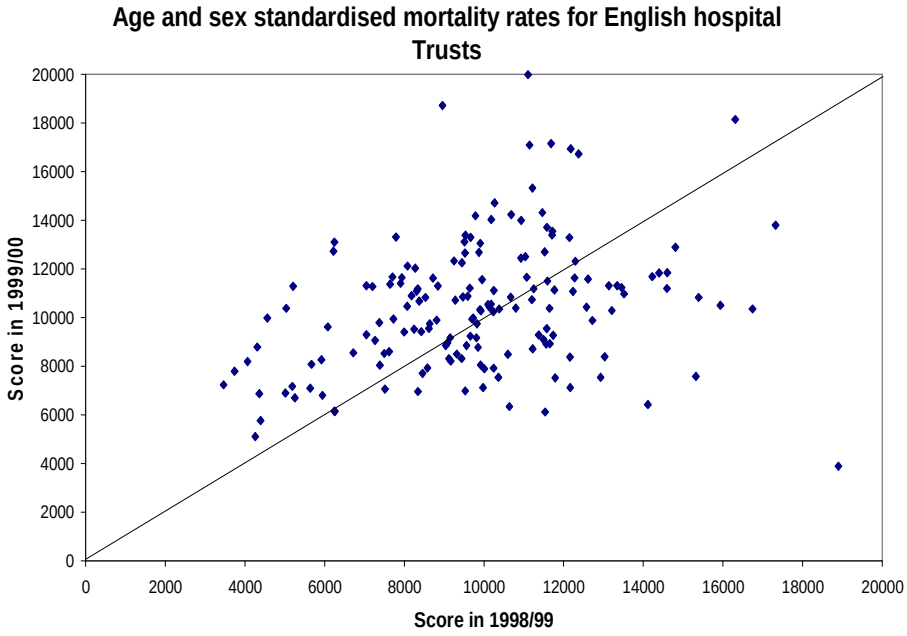
[36] Goldacre,M.J. et al (2002) British Medica Journal, 325 (7369), 868-869
[37] Broos,P.L. (1999) Acta Chirurgica Belgica, 99(4), 190-194
[38] Smektala,R. et al (1999) Chirurg., 70(11), 1330-1338
[39] Jarman,B. et al (1999) British Medical Journal, 318, 1515-1520



5.3. Is a league table approach helpful?

A league table approach is one where hospitals are ranked from so-called best to worst. This is similar to that used on the Dr Foster website. Hence at first sight a score of 113 for mortality from fractured neck of femur at the NHS Trust would lead to the conclusion that any patient had a 13% higher risk of decease at this hospital Trust.

Fortunately this is not the case and a recent publication in the British Medical Journal has suggested that an approach based on Industrial Control Charts gives a much more reliable indication of the relative risk of decease[40]. This approach gives proper recognition to the role of random variation due to the multitude of patient specific risk factors.

A similar approach will be employed to demonstrate that the NHS Trust has a normal level of decease from fractured neck of femur.

Age and Sex Standardised Mortality Rates

Due to the fact that the patient specific factors discussed above are not routinely recorded for every patient in the data used by the Department of Health the minimum level of adjustment is therefore made to account for the effect of the age and sex of the patient – since these pieces of information about the patient are standard data items.

While this may seem a relatively unambiguous way of achieving some degree of standardisation there are still pitfalls for the unwary. These pitfalls arise from the use of what are called standard 5 year age bands up to the age of 85 and a final age band for those over 85 years. Given that the risk of decease is far greater for anyone above this age the use of a single age band is extremely unsatisfactory. Even the use of 5

[40] Adab,P et al (2002) British Medical Journal, 324, 95-98

year age bands can be questioned on the grounds that a couple of patients more than average at the upper end of the age band could be sufficient to skew the results. The availability of Pentium processors in even the most basic desktop computer means that single year standardisation should be the basic method.

5.5. Is the National Average a Valid Benchmark?

The comparison between a single hospital and the national average assumes that the national average is a reliable benchmark.

However data for fractured hip shows that the so-called national average varied from 9,898 deaths per 100,000 admissions in one year to 10,331 the next, i.e. the national average is itself showing considerable movement.

As can be seen even the so-called national average is itself uncertain. This is because the risk of decease is influenced by the multitude of patient specific risk factors. Even at a national level the volume of patients is still too small to even out the random fluctuation caused by such patient specific factors.

Hence it should be obvious that if the national average is uncertain then the calculation of a standardised mortality rate for a single hospital will be an even less certain indicator of ‘quality’.

How do we account for random variation?

Given the fact that data for UK hospitals is not adjusted for the patient specific risk factors how do we discern if one hospital with an age and sex standardised mortality rate of 87 is any different from another hospital with a rate of 113.

After all, as a potential patient we are looking for real assurance that the local hospital is at least as good as the national average. We can also certainly do without the unnecessary doubt cast over the relative performance of our local hospital should a score of 113 prove to measure little more than a score of 87, i.e. a measure of random variation rather than any real ‘quality’ factors.

Dr Rod Jones provides consultancy and analysis for healthcare organisations. He can be contacted at hcaf_rod@yahoo.co.uk