

# A cost analysis of elective hip revision arthroplasty versus periprosthetic hip fracture management in a district general hospital

Is financing adequate for these complex cases?

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In 2011, 8,639 revision hip arthroplasty procedures were recorded in the National Joint Registry.<sup>1</sup> Combining an increasing number of hip arthroplasty procedures with an ageing population is expected to lead to an increase in the burden of periprosthetic fractures requiring complex management.<sup>2</sup>

A major UK centre found that the typical cost of managing a periprosthetic fracture of the hip was £23,469, with the hospital recovering only £3,702 per patient in reimbursement.<sup>3</sup> Another major unit found that the mean cost of performing revision arthroplasty for aseptic loosening of the hip was £11,897, compared with £18,185 when managing a periprosthetic hip fracture with revision arthroplasty.<sup>4</sup> Estimated data based on the 2010–2011 'payment by results' (PbR) tariff and the hospital's specialist service 'top-up' suggested that the typical loss in this unit was a much smaller figure of £860 per case.

It has been suggested that further studies are required to confirm that there is a national problem with regard to inadequate reimbursement for revision hip arthroplasty.<sup>4</sup> The aim of our study was to establish whether the financial reimbursement is adequate at the district general hospital level for revision hip arthroplasty both in elective and trauma settings.

## METHODS

Consecutive patients who had sustained a periprosthetic fracture around a total hip replacement between 2010 and 2011 were compared with consecutive patients admitted for elective revision hip arthroplasty to manage aseptic loosening of their existing hip replacement during the same period. Data were collected with regard to patient age, length of stay and whether this was on the ward or on the high dependency unit. Periprosthetic fractures were classified according to the Vancouver system.<sup>5</sup> Operative management was recorded, including the theatre hours required and the implants used. Investigations were noted, encompassing all blood tests and radiological investigations. The cases were identified using the

logbooks of the two revision arthroplasty surgeons in the unit, who performed all the operations between them.

Inclusion criteria consisted of any case undergoing operative management for the periprosthetic group and any revision for aseptic loosening in the elective group. Exclusion criteria comprised any periprosthetic fracture managed non-operatively as well as any revisions not performed for aseptic loosening in the elective group.

Daily ward costs were calculated for the high dependency unit and the general ward as well as all commonly undertaken laboratory tests and radiological investigations (Table 1). The cost of a theatre hour was calculated by the finance department and included medical and non-medical staff costs, sterile services usage, maintenance and the use of expendable items. After reviewing each case individually with the coding department to determine the

**Table 1** Typical costs

Test	Cost
Full blood count	£3.30
Urea and electrolytes	£1.78
Liver function tests	£3.56
C-reactive protein	£0.89
ESR	£3.30
'Group and save'	£6.60
1 unit packed red cells	£124.85
Culture and sensitivity	£8.41
X-ray of the pelvis	£21.50
CT of the pelvis	£54.20
MRI of the hips	£155.90
Ward stay per day	£494.50
HDU stay per day	£1,194.60
1 theatre hour	£1,136

ESR = erythrocyte sedimentation rate; CT = computed tomography; MRI = magnetic resonance imaging; HDU = high dependency unit

**Table 2** Mean data for elective hip revision and periprosthetic fracture with 95% confidence intervals in brackets

	Elective hip revision	Periprosthetic fracture
Age	74.6 years (70.7–78.6 years)	78.9 years (76.1–81.7 years)
Length of stay	8 days (6.3–9.7 days)	34.7 days** (21.6–43.8 days)
Inpatient costs	£4,556 (£3,263–£4,992)	£17,233** (£10,917–£23,549)
Investigations	£276 (£176–391)	£316 (£220–£412)
Theatre costs	£5,074 (£4,263–5,540)	£3,347* (£2,707–£3,987)
Total costs	£13,110 (£11,198–£15,023)	£23,834* (£17,922–£29,745)
Gross reimbursement	£10,406 (£9,463–£11,349)	£9,764 (£8,184–£11,343)
<b>Net losses</b>	<b>£2,704 (£1,362–£4,046)</b>	<b>£14,070* (£8,526–£19,613)</b>

\* $p < 0.01$ , \*\* $p < 0.001$

Healthcare Resource Group codes allocated to each patient, the data on financial reimbursement could be confirmed. The total costs for each patient were subtracted from the reimbursement to calculate the net loss or profit.

For each numerical dataset, the mean and standard deviation was calculated. Comparative data from the periprosthetic fracture and elective groups were assessed using two-tailed, unpaired t-tests. A  $p$ -value of  $< 0.01$  was taken to indicate a significant difference.

## RESULTS

The 20 patients who sustained a periprosthetic fracture around a total hip replacement had a mean age of 78.9 years (range: 76.1–81.7 years) and a mean length of stay of 34.7 days (range: 7–112 days). The corresponding group of 20 patients admitted for elective revision hip replacement had a mean age of 74.6 years (range: 70.7–78.6 years) and a mean length of stay of 8 days (range: 3–19 days). Of the patients in the periprosthetic group, there were no Vancouver type A frac-

tures, six type B<sup>1</sup> fractures that underwent open reduction and internal fixation (ORIF), eight type B<sup>2</sup> fractures that underwent revision arthroplasty, two type B<sup>3</sup> fractures that underwent revision arthroplasty and four type C fractures, of which three underwent ORIF and one was managed non-operatively, with initial skin traction followed by conversion to a cast brace.

The total cost of managing the cohort of 20 patients who had sustained a periprosthetic fracture was £476,669, with £195,280 recovered in reimbursement from the primary care trust, equating to a net loss of £281,392, with a mean loss of £14,070 per patient treated. The biggest contributing factor to the total cost was the ward stay, which made up 69% of the overall costs with a mean of £16,501. The cost of the length of stay alone was greater than the financial reimbursement recovered. The mean financial reimbursement was £9,764 versus a mean cost per patient of £23,834.

In the cohort of patients undergoing elective single stage hip revision for aseptic loosening, the total cost was £262,208, with £208,122 recovered in reimbursement. This equated to a net loss of £54,086 and a mean loss per patient of £2,704. The mean overall cost per patient was £13,688 with a mean reimbursement of £10,393. When examining the breakdown of the expenditure in these cases, it can be seen that the cost of theatre time (£5,074 per case) was greater than the mean ward stay cost (£4,556).

Table 2 summarises the data and provides comparison between the two groups. The mean cost of managing a patient with a periprosthetic fracture was more than £10,000 greater than that of managing a patient undergoing elective hip revision, with the mean financial reimbursement similar in both groups. This has resulted in a large discrepancy between the two groups in terms of mean net losses: £2,704 in the elective group versus £14,070 in the periprosthetic group. By far the biggest discrepancy in costs between the two groups was for the length of stay, with the elective group having

a mean length of stay of 8 days, associated with a mean cost of £4,556, whereas the periprosthetic cohort had a mean length of stay of 34.7 days, associated with a mean cost of £16,501. This represents a cost that was 3.6 times greater for those with periprosthetic fractures.

## DISCUSSION

The mean cost of managing periprosthetic fractures in our unit was similar to that in Nottingham (£23,834 vs £23,469) but more than that in London (£18,185).<sup>3,4</sup> Two-thirds (69%) of the costs in our cohort were related to the inpatient stay, with a mean length of stay of 34.7 days. This was similar to Nottingham, where the length of stay made up 80% of their costs and their mean length

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of stay was 39 days. In London, Vanhegan *et al* found that their length of stay was shorter at 17.1 days, making up only 38% of their total costs when managing periprosthetic fractures.

Data from the Nottingham group pertained only to fractures but the London group also presented data relating to elective hip revision.<sup>4</sup> Their mean cost was £11,897 for elective cases, which is comparable with our data. However, their mean theatre cost was far lower than ours (£1,216 vs £5,074). Our theatre cost figure was based on all time in theatre, not just the operating time, and on an estimated hourly figure for running theatre of £1,136. Based on the quoted mean operating time in London, their hourly theatre cost was only £421, which we feel is likely to be a significant underestimate of the

true cost of running an adequately staffed orthopaedic theatre. If the same theatre and ward stay costs were applied across both datasets, the cost of performing an elective hip revision for aseptic loosening in our hospital would be less than that of a major London teaching hospital.

Finally, when comparing these two datasets, the expenditure on implants was higher in our group (£3,798 vs £2,298.) It is difficult to be certain of the correct explanation for this but it may be related to surgeon implant preference, the price negotiated with the implant manufacturers or a difference in the complexity of the case mix.

Our mean loss per case in the elective group was £2,704. The largest contributors to the total costs were theatre time (£5,074), length of ward stay (£4,556) and implant costs (£3,798). If the current system of reimbursement remains unchanged, breaking even would require a significant reduction in the length of stay. Based on our estimated ward cost, the length of stay would have to be reduced by a mean of 5.5 days per patient to break even. This would bring the target length of stay down to 2.5 days, which we believe represents an unrealistic figure for these complex cases.

Our mean reimbursement of £9,764 in the periprosthetic group falls a long way short of recovering the mean total cost per patient of £23,834. By far the largest contributor to this cost was the ward stay (£17,223). Using the same calculation as for the elective cohort, the length of stay would have to be reduced by a mean of 28.5 days to a target of 6.2 days to break even. This is also an unrealistic target, with these patients being elderly, often having multiple co-morbidities, and sometimes requiring considerable medical workup and optimisation prior to undergoing surgery.

The huge losses from the management of periprosthetic hip fractures in Nottingham provided a clear insight into the problems found in the reimbursement of complex cases using the PbR system.<sup>3</sup> Our data have again highlighted this problem and shown

that it also applies to elective cases. Our mean reimbursement for elective hip revision surgery is similar to that found in London. However, they also expected to receive an additional top-up of 30%, based on the fact that their hospital was providing an additional specialist service by performing revision arthroplasty. This top-up is only provided in certain revision situations and is therefore not likely to be applicable to many of these cases.

Our hospital does not receive a specialist service top-up and either has to accept that a loss is inevitable when managing these cases or has to consider referring them to a tertiary centre. The current PbR system of reimbursement creates this dilemma for hospitals, which, although intended to create competition and drive down costs, may be to the detriment of patient care. It can be seen from the literature that tertiary centres are not compensated adequately for these cases and, consequently, may not wish to accept cases requiring revision hip arthroplasty. With many orthopaedic departments now having grown to a size where there is a high degree of local subspecialisation, it may not be true to regard revision arthroplasty as a tertiary-level service requiring an extra top-up and more appropriate for the basic level of reimbursement to be raised to a suitable level.

Similar financial problems have been found with cases of pelvic trauma, resulting in pressure to prioritise simpler cases.<sup>6</sup> However, these centres have now managed to negotiate remuneration separately to PbR, helping to ensure that the more difficult cases can now be undertaken without financial penalty. The PbR exclusions are usually for the treatment of conditions for which fewer than 1 in 50 hospitals would be able to provide a service.<sup>7</sup> In orthopaedics, examples of these would be bone tumours, limb reconstruction with Ilizarov frames and peripheral nerve surgery. In terms of revision arthroplasty, the PbR exclusions are for 'third and greater revisions of prosthetic joint replacement'<sup>7</sup> and it is therefore a relatively unusual situation in which an additional specialist service top-up would be paid in these cases.

Vanhegan *et al* extrapolated their estimated loss per case of £860 across the 7,852 revision cases performed in England and Wales in 2010 to suggest an anticipated £6.75 million overall loss to hospitals.<sup>4</sup> Their figure of £860 per case may be an underestimate given the surprisingly low ward and theatre costs in their study. Based on the data we have presented, the total loss per year to hospitals in England and Wales may well be four times as much or greater.

## CONCLUSIONS

Although limited by the relatively small size of this study, our findings show that the financial reimbursement for these difficult cases appears inadequate in a typical district general hospital and this problem is not isolated to just one region of this country. We hope that an accumulation of such financial data will help to strengthen the argument for greater financial reimbursement for hospitals managing these complex cases.

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