

A retrospective analysis of the cost of hospitalizations for sickle cell disease with crisis in England, 2010/11

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ABSTRACT

Background Sickle cell disease (SCD) is an inherited blood disorder which may result in a broad range of complications including recurring and severe episodes of pain—sickle ‘crises’—which require frequent hospitalizations. We assessed the cost of hospitalizations associated with SCD with crisis in England.

Methods Hospital Episodes Statistics data for all hospital episodes in England between 2010 and 2011 recording Sickle Cell Anaemia with Crisis as primary diagnosis were used. The total cost of admissions and exceeded length of stay due to SCD were assessed using Healthcare Resource Groups tariffs. The impact of patients’ characteristics on SCD admissions costs and the likelihood of incurring extra bed days were also examined.

Results In 2010–11, England had 6077 admissions associated with SCD with crisis as primary diagnosis. The total cost for these admissions for commissioners was £18 798 255. The cost of admissions increases with age (children admissions costs 50% less than adults). Patients between 10 and 19 years old are more likely to stay longer in hospital compared with others.

Conclusion SCD represents a significant cost for commissioners and the NHS. Further work is required to assess how best to manage patients in the community, which could potentially lead to a reduction in hospital admissions and length of stay, and their associated costs.

Keywords chronic disease, costs, hospitalization, management and policy, public health, sickle cell

Introduction

Sickle cell disease (SCD) is an inherited blood disorder that dominantly affects people of African and Caribbean origin.¹ The disease is known for its painful episodes (also known as vaso-occlusive crisis or sickle crisis) which lead to a significant number of hospital admissions and readmissions each year.^{2–4} A recent study in England showed a 58% increase in the overall SCD admission rate between 2001 and 2010 using Hospital Episodes Statistics (HES) data for England.⁵

SCD is the fastest growing and most frequent inherited disorder in England; ~12 500 people are living with the condition⁶ and 240 000 have SCD trait.⁷ SCD may be less common than other known chronic diseases^{8–10} but its growth and high impact on hospital admissions poses a potential cost burden for the National Health Service, in the addition to the impact it has on patients and their families, particularly in areas with a high prevalence such as London.

With the exception of a recent National Institute of Clinical Excellence (NICE) report,¹¹ there is little data about the

overall cost of health-care utilization associated with SCD and hospital admissions in England. In contrast, several studies have been conducted in the USA where patients with SCD frequently attend emergency departments or are admitted as inpatients and account for the majority of health-care expenses associated with the disease.^{12–16} Expenditure associated with SCD can be used to raise awareness of the severity of this condition and to explore innovations in prevention or management of disease complications. Given this is the most common inherited disorder in the UK, data on costs associated

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with hospital admissions can provide information about the impact of SCD on the National Health Service (NHS) and be of value to health economists, policy-makers and commissioners. The aim of this study was to estimate the costs for commissioners associated with hospital admissions due to SCD in England.

Methods

HES provide data on all NHS hospital admissions, emergency department attendances and outpatient visits in England, including treatment performed in private hospitals but funded by the NHS. This study uses HES data on hospital admissions for the period from April 2010 to March 2011. HES data contain details on both the reason that patients are admitted to hospital (known as the 'primary diagnosis') and any other conditions they have, which are coded using ICD-10.¹ This analysis uses patients with a primary diagnosis of 'sickle cell anaemia with crisis' (D57.0).

As data regarding the cost and resource consumption for hospital admissions, including SCD admissions, were not available, we used the Healthcare Resource Groups (HRG) tariffs as a proxy to assess the cost for commissioners. HRGs form the basic currency for payment of NHS services by relying on an informed assumption that health-care costs are exclusively driven by diagnosis or procedure. The English HRG tariffs provide cost data for elective and non-elective hospital episodes and additional per diem cost for very long stays that exceed the so-called 'trim point', which marks the expected LOS for each HRG. Estimated costs are reported as a national schedule of reference costs and are also aggregated by hospital to provide the reference cost index.^{17,18}

Despite the tariffs, the real costs of SCD borne by the NHS appear not to be reflected; this is a first attempt to assess the cost of admissions due to SCD adopting the commissioners perspective. There are only three available HRG tariffs for SCD which are coded as:

- (1) PA47Z Sickle cell anaemia with crisis (for children admissions).
- (2) SA10D Sickle cell anaemia with complications (CC) (including SCD with crisis).
- (3) SA10F Sickle cell anaemia without complications (CC).

Because there are no specific tariffs for each ICD-10 code, we made certain assumptions which are consistent with those of

the NICE report.¹¹ The tariffs were linked only to primary diagnosis:

- (a) ICD-10 'Sickle cell anaemia with Crisis' (D57.0) is linked to HRG PA47Z 'Sickle cell anaemia with crisis' (age between 0 and 19 years);
- (b) ICD-10 'Sickle cell anaemia with Crisis' (D57.0) is linked to HRG SA10D 'Sickle cell anaemia with CC' for adult admissions (age >20 years);
- (c) ICD-10 'Sickle cell anaemia without crisis and other sickle cell disorders (D57.2–8) might be linked with HRG code SA10F 'Sickle cell anaemia without CC;

All other admissions, in which the SCD with crisis appeared in any other of the diagnoses, but not as a primary diagnosis, were excluded from our analysis. This will underestimate the cost of admissions linked to SCD, but we have adopted a conservative approach and not included extra costs that we are not certain have been appropriately coded for SCD. Both emergency and elective admissions have been analysed separately, as they have different tariffs, and to show the impact of emergency admissions due to SCD.

The length of stay (LOS) for each admission was considered in the analysis to assess the cost due to hospitalizations that exceed the trim point of the HRG tariff. The trim point identifies the LOS covered by the tariff after which an extra daily payment is required for each specific HRG. The trim points vary according to the type of HRG and type of admission (emergency versus elective admission) and extra days carry an extra cost. For HRG PA47Z Sickle Cell Anaemia with Crisis, the trim point is 9 days for emergency admissions and 8 days for elective admissions; for HRG SA10D Sickle Cell Anaemia with CC, the trim point is 30 days both for emergency and elective admissions. Therefore, an LOS exceeding the trim point will increase the cost by £234 for each extra day for children admissions and £204 for adult admissions.

HRGs tariffs and extra LOS payments have been adjusted for the Market Forces Factor (MFF) to take into account of specific differences in the costs of providing services across providers.¹⁹ For example, admissions in Central London would typically be more expensive as labour and building costs are higher and this has been reflected applying a specific MFF to each provider.¹⁹

Analysis

The cost of admissions associated with SCD was measured as follows:

- (1) The total number of episodes with a primary diagnosis containing ICD-10 code 'Sickle cell anaemia with Crisis' (D57.0.) data was taken from HES with a distinction between emergency and elective admissions.

¹The ICD-10 is a system of coding created by the World Health Organization that notes various medical records including diseases, symptoms, abnormal findings and external causes of injury.

- (2) The total number of admissions for patients between 0 and 19 years has been multiplied by the correspondent HRG tariff PA47Z 'Sickle cell anaemia with crisis', respectively in emergency and elective admission, adjusted for MFF for each provider.
- (3) The total number of admissions for patients 20 years or older (adults) has been multiplied by the correspondent HRG tariff SA10D 'Sickle Cell Anaemia with CC' respectively in emergency and elective admission, adjusted for MFF for each provider.
- (4) The total cost of admissions for SCD is the sum of the total cost of admissions in emergency and elective for children and adults.

The cost of extra LOS for admissions associated with SCD has been assessed as follows:

- (1) For each episode presenting as primary diagnosis containing the ICD-10 code 'Sickle cell anaemia with Crisis' (D57.0.) the extra LOS has been assessed as the difference between the number of days spent in hospital (LOS) and the trim point from the HRG tariff.
- (2) The total number of days in hospital exceeding the trim point has been multiplied by the daily extra cost (£234 per day for children admissions and £204 for adults), adjusted for the MFF for each provider.
- (3) The total cost of extra LOS is the sum of the extra cost of LOS of emergency and elective admissions for adults and children admissions.

The analysis was carried out at a national level for England and the results are reported for England, London and English Primary Care Trusts (PCTs)².

A linear regression model was used to analyse the impact of age and gender on SCD cost. Here we have log transformed the costs and present our results as the percentage difference from the reference group. We analysed the data separately for London and the rest of the country to examine whether any associations differ between locations. We also used logistic regression to examine the association between age and gender on incurring extra bed days.

Results

In 2010–11, England had 6077 admissions associated with SCD with crisis as a primary diagnosis. The total cost for

these admissions was £18 798 255 of which £17 085 288 (91%) was for emergency admissions (Table 1). Adult admissions represent 84.5% of all admissions, representing a cost of £14 370 931 for emergency admissions. Children admissions represent 15.5% of total admissions, and the cost of emergency admissions was £2714 357.

In total, the LOS exceeded the trim point by 1144 days, for an extra cost of £294 697 (93.1% for emergency admissions) (Table 1). For emergency admissions, the extra LOS is 438 days for children and 624 days for adults, for an extra total cost of £274 104. Because the tariff for children has a shorter trim point compared with adults (9 days instead of 30 days) and an extra day costs more, long admissions for children represent a higher cost in terms of LOS.

Within England London had the highest number of admissions associated with SCD, with 4363 admissions for SCD crisis as primary diagnosis at a total cost of £14 223 139 of which £13 984 884 were for emergency admissions (89.9%) (Table 1). In line with the national data, adults represent 87.1% of total admissions and children account for 12.9%.

London accounts for 75.6% of all of England's costs for admissions associated with SCD and 80.8% of all of England's days beyond the trim point (extra days). In Table 2 we provide a summary for all PCTs in England, with the cost of admissions for SCD and the rate of admissions every 100 000 (Table 2).

There is a high variability in the number of admissions across PCTs in England. City and Hackney is the PCT with the highest number and the highest costs in 2010–11, followed by Haringey and Brent (Table 2). In these PCTs, the rates of SCD admissions are the highest in England, 347, 153 and 102 every 100 000, respectively. City and Hackney also had the highest costs associated with LOS beyond the trim point, followed by Redbridge and Westminster (Table 2). Outside London, Luton is the PCT with the highest rate of SCD admissions (39.41 every 100 000), followed by Nottingham (32.47), Manchester (20.01) and South Birmingham (20.10) (Table 2).

The regression models performed to check whether age and gender are significantly associated with SCD costs show that admissions in adults cost more than in children (Table 3). The total cost increases with age: admissions in age <9 and age 10–19 cost £1740 and £1686 ($P < 0.001$), less, respectively, compared with the age 20–29; admissions costs £65 more in the group age 30–49 compared with the age 20–29. There is no statistically significant difference in cost for patients over 50 years. Admissions were more costly for males than females, but the differences are not statistically significant. The results for London are similar to those for the rest of England.

²An NHS Primary Care Trust (PCT) was a type of NHS Trust, part of the NHS in England. PCTs were largely administrative bodies, responsible for commissioning primary, community and secondary health services from providers. Primary Care Trusts were abolished on 31 March 2013, but existed while this study was conducted.

Table 1 Costs for admissions and extra LOS associated with sickle cell anaemia with crisis (ICD-10 D57.0) in England and London, 2010–11

| <i>Admissions (England)</i> | <i>Emergency</i> | <i>Elective</i> | <i>Total admissions</i> |
|---|------------------|-----------------|-------------------------|
| D57.0 primary diagnosis admissions (total) | 5514 | 563 | 6077 |
| D57.0 primary diagnosis admissions (paediatrics) | 1462 | 154 | 1616 |
| D57.0 primary diagnosis admissions (adults) | 4052 | 409 | 4461 |
| HRG tariff PA47Z (to be adjusted by MFF) | £1534 | £1210 | |
| HRG tariff SA10D (to be adjusted by MFF) | £2959 | £2950 | |
| Total cost for admissions | £17 085 288 | £1 712 966 | £18 798 254 |
| Long stay trim point (days) for paediatric | 9 | 8 | |
| Long stay trim point (days) for adults | 30 | 30 | |
| Total days exceeding the trim point (paediatrics) | 438 | 7 | 445 |
| Total days exceeding the trim point (adults) | 624 | 75 | 699 |
| Per day long stay payment (for days exceeding trim point) paediatrics (£) | £234 | £234 | |
| Per day long stay payment (for days exceeding trim point) adults (£) | £204 | £204 | |
| Total cost for extra LOS | £274 104 | £20 592 | £294 697 |
| <i>Admissions (London)</i> | <i>Emergency</i> | <i>Elective</i> | <i>Total admissions</i> |
| D57.0 primary diagnosis admissions (total) | 3911 | 452 | 4363 |
| D57.0 primary diagnosis admissions (paediatrics) | 877 | 107 | 984 |
| D57.0 primary diagnosis admissions (adults) | 3034 | 345 | 3379 |
| Total cost for admission in London | £12 788 339 | £1 434 799 | £14 223 139 |
| Long stay trim point (days) for paediatric | 9 | 8 | |
| Long stay trim point (days) for adults | 30 | 30 | |
| Total days exceeding the trim point (paediatrics) | 246 | 5 | 251 |
| Total days exceeding the trim point (adults) | 586 | 75 | 661 |
| Total extra cost for extra LOS in London | £218 153 | £20 101 | £238 254 |

Source: our elaboration using HES data and HRG tariffs 2010–11.

The logistic regression to examine the association between age and gender on incurring extra bed days shows that patients 10–19 years old are much more likely to incur an extra bed days (an odds ratio of 8.3 with $P < 0.001$) compared with 20–29 years old. The results for other age groups and for gender do not show statistically significant differences (Table 4).

Discussions

What is already known on this topic

Studies that assess the cost of SCD are either primarily referring to children, not appropriately updated or have been conducted in the USA.^{12–15} Studies conducted in the USA show that patients with SCD who are frequently admitted as an emergency account for the majority of health-care expenses associated with the disease.¹⁶

NICE has assessed the costs (and potential savings) attributed to managing an adult SCD acute painful episode compared with their guidelines.¹¹ The costs (and savings) may

vary significantly depending on current practice and variation in local prevalence of SCD.

The same document provides an estimate for the cost of admission for ‘sickle cell anaemia with crisis’ in children and adults according to the National Schedule of Reference costs³ in 2010/11. According to the report, the approximate total cost to the NHS of these admissions and some day-case activity was ~£16.2 million, not including elective admissions (which is similar to our estimated costs £17 085 288). Moreover, the costs were not based on HES data and it is not clear if the period 2010–11 was starting in January or in April, with the financial year.

Better clinical management of SCD based on the NICE guidelines (health-care professionals training, pain management, administration of analgesia and patients monitoring) may positively impact on LOS.¹¹ However, the savings cannot be accurately estimated because the variation in current

³The national schedules of reference costs show the national average unit cost for each service for which costs were collected in 2010–11 reference costs.

Table 2 Costs for admissions and extra LOS associated with sickle cell anaemia with crisis (ICD-10 D57.0) in England PCTs 2010–11

| SHA | Code | PCT | SCD adm./ 100 000 pop. ^a | Cost non-elective (A) (£) | Cost elective (B) (£) | Cost admiss. (A + B) (£) | Cost extra LOS (c) (£) | Total cost (A + B + C) (£) |
|-----------------------|-------|--------------------------|--|------------------------------|--------------------------|-----------------------------|---------------------------|-------------------------------|
| Q.30 North East | 5D7 | Newcastle | 6.89 | 36 195.98 | 1250.92 | 37 446.90 | | 37 446.90 |
| Q.30 North East | 5KM | Middlesbrough | 6.11 | 18 439.87 | 1241.50 | 19 681.37 | 240.09 | 19 921.46 |
| Q.30 North East | 5E1 | Stockton-on-Tees | 3.11 | 18 151.57 | | 18 151.57 | | 18 151.57 |
| Q.30 North East | 5KF | Gateshead | 1.54 | 7693.03 | | 7693.03 | 241.91 | 7934.94 |
| Q.30 North East | 5D8 | North Tyneside | 0.48 | 3059.07 | | 3059.07 | | 3059.07 |
| Q.30 North East | Total | | 1.45 | 83 539.52 | 2492.42 | 86 031.94 | 482.00 | 86 513.94 |
| Q.31 North West | 5NT | Manchester | 20.01 | 264 153.72 | 4 787.14 | 268 940.86 | 240.89 | 269 181.75 |
| Q.31 North West | TAP | Blackburn with Darwen | 5.93 | 27 478.61 | | 27 478.61 | | 27 478.61 |
| Q.31 North West | 5NQ | Heywood, Middleton R | 5.88 | 31 440.38 | | 31 440.38 | 738.27 | 32 178.65 |
| Q.31 North West | 5F5 | Salford | 4.68 | 17 895.42 | | 17 895.42 | | 17 895.42 |
| Q.31 North West | 5NL | Liverpool | 3.94 | 28 514.06 | 2515.16 | 31 029.22 | | 31 029.22 |
| Q.31 North West | 5JX | Bury | 2.74 | 10 981.34 | 3138.11 | 14 119.45 | | 14 119.45 |
| Q.31 North West | 5NG | Central Lancashire | 1.99 | 16 008.56 | | 16 008.56 | | 16 008.56 |
| Q.31 North West | 5HQ | Bolton | 1.88 | 11 156.80 | | 11 156.80 | 992.66 | 12 149.45 |
| Q.31 North West | 5J5 | Oldham | 1.79 | 6338.40 | 3111.88 | 9450.28 | | 9450.28 |
| Q.31 North West | 5F7 | Stockport | 1.4 | 6502.53 | | 6502.53 | | 6502.53 |
| Q.31 North West | 5J2 | Warrington | 1.01 | 6184.42 | | 6184.42 | | 6184.42 |
| Q.31 North West | 5NR | Trafford | 0.93 | 6620.55 | | 6620.55 | | 6620.55 |
| Q.31 North West | 5HG | Ashton, Leigh and Wigan | 0.66 | 3226.53 | | 3226.53 | | 3226.53 |
| Q.31 North West | 5NJ | Sefton | 0.37 | 3087.41 | | 3087.41 | | 3087.41 |
| Q.31 North West | 5NK | Wirral | 0.33 | 1594.32 | | 1594.32 | 1945.61 | 3539.93 |
| Q.31 North West | 5NF | North Lancashire T. | 0.3 | 3028.49 | | 3028.49 | | 3028.49 |
| Q.31 North West | 5NH | East Lancashire Teaching | 0.27 | 3053.18 | | 3053.18 | | 3053.18 |
| Q.31 North West | Total | | 2.74 | 447 264.72 | 13 552.29 | 460 817.01 | 3917.43 | 464 734.43 |
| Q.32 Yorkshire and H. | 5N1 | Leeds | 7.3 | 153 191.20 | 3119.09 | 156 310.29 | 1233.30 | 157 543.59 |
| Q.32 Yorkshire and H. | 5NY | Bradford & Airedale | 6.92 | 89 905.22 | 5590.79 | 95 496.01 | | 95 496.01 |
| Q.32 Yorkshire and H. | 5N2 | Kirklees | 4.94 | 61 715.86 | | 61 715.86 | | 61 715.86 |
| Q.32 Yorkshire and H. | 5N4 | Sheffield | 4.62 | 56 370.18 | 19 511.22 | 75 881.40 | | 75 881.40 |
| Q.32 Yorkshire and H. | 5NX | Hull Teaching | 4.08 | 30 279.89 | | 3090.16 | 3090.16 | 33 370.05 |
| Q.32 Yorkshire and H. | 5N5 | Doncaster | 2.02 | 18 349.76 | | 18 349.76 | | 18 349.76 |
| Q.32 Yorkshire and H. | 5J6 | Calderdale | 1.46 | 4799.20 | | 4799.20 | | 4799.20 |
| Q.32 Yorkshire and H. | 5H8 | Rotherham | 1.22 | 7670.81 | | 7670.81 | | 7670.81 |
| Q.32 Yorkshire and H. | 5N3 | Wakefield District | 0.88 | 3208.70 | 1265.49 | 4474.19 | | 4474.19 |
| Q.32 Yorkshire and H. | 5JE | Barnsley | 0.84 | 3043.71 | 3043.71 | 6087.42 | | 6087.42 |
| Q.32 Yorkshire and H. | TAN | North East Lincolnshire | 0.61 | 1565.62 | | 1565.62 | | 1565.62 |
| Q.32 Yorkshire and H. | 5NV | North Yorkshire and York | 0.38 | 9118.57 | | 9118.57 | | 9118.57 |
| Q.32 Yorkshire and H | Total | | 3.25 | 439 218.72 | 32 530.30 | 444 559.29 | 4323.46 | 476 072.48 |
| Q.33 East Midlands | 5EM | Nottingham City | 32.47 | 283 754.21 | 8092.28 | 291 846.49 | | 291 846.49 |
| Q.33 East Midlands | 5N7 | Derby City | 5.64 | 28 385.27 | 3077.73 | 31 463.00 | | 31 463.00 |
| Q.33 East Midlands | 5PA | Leicestershire County R | 3.16 | 38 297.65 | | 38 297.65 | 1965.77 | 40 263.42 |
| Q.33 East Midlands | 5PC | Leicester City | 2.71 | 221 819.63 | 3107.22 | 224 926.85 | 8108.81 | 233 035.66 |
| Q.33 East Midlands | 5N9 | Lincolnshire Teaching | 0.69 | 10 679.28 | | 10 679.28 | 237.54 | 10 916.83 |
| Q.33 East Midlands | 5N6 | Derbyshire County | 0.57 | 7705.67 | 1255.50 | 8961.17 | | 8961.17 |
| Q.33 East Midlands | 5N8 | Nottinghamshire C.T | 0.15 | 3070.27 | | 3070.27 | | 3070.27 |
| Q.33 East Midlands | Total | | 5.25 | 593 711.98 | 15 532.73 | 609 244.71 | 10 312.12 | 619 556.84 |
| Q.34 West Midlands | 5M1 | South Birmingham | 20.1 | 190 790.53 | 4345.80 | 195 136.34 | 491.42 | 195 627.76 |
| Q.34 West Midlands | 5PG | Birmingham East and N. | 10.73 | 104 037.47 | 1257.54 | 105 295.01 | 243.19 | 105 538.21 |
| Q.34 West Midlands | 5PF | Sandwell | 10.39 | 68 804.28 | 1270.55 | 70 074.82 | 491.42 | 70 566.24 |

Continued

Table 2 Continued

| SHA | Code | PCT | SCD adm./ 100 000 pop. ^a | Cost non-elective (A) (£) | Cost elective (B) (£) | Cost adm. (A + B) (£) | Cost extra LOS (C) (£) | Total cost (A + B + C) (£) |
|----------------------|-------|-------------------------|--|------------------------------|--------------------------|--------------------------|---------------------------|-------------------------------|
| Q.34 West Midlands | 5MX | Heart of Birmingham T | 5.4 | 262 470.11 | 9225.77 | 271 695.88 | 3931.35 | 275 627.23 |
| Q.34 West Midlands | 5M3 | Walsall Teaching | 4.76 | 33 876.12 | | 33 876.12 | | 33 876.12 |
| Q.34 West Midlands | 5PE | Dudley PCT | 4.29 | 22 268.98 | 1270.55 | 23 539.52 | | 23 539.52 |
| Q.34 West Midlands | 5MK | Telford and Wrekin | 4.29 | 13 759.16 | 3020.50 | 16 779.66 | | 16 779.66 |
| Q.34 West Midlands | 5MD | Coventry Teaching | 3.57 | 37 170.42 | 1270.55 | 38 440.97 | | 38 440.97 |
| Q.34 West Midlands | 5PJ | Stoke on Trent | 3.44 | 25 741.22 | | 25 741.22 | | 25 741.22 |
| Q.34 West Midlands | 5PL | Worcestershire | 1.45 | 14 133.78 | 1257.54 | 15 391.32 | | 15 391.32 |
| Q.34 West Midlands | 5QW | Solihull | 1.42 | 7819.73 | | 7819.73 | | 7819.73 |
| Q.34 West Midlands | 5MV | Wolverhampton City | 1.24 | 9316.41 | | 9316.41 | | 9316.41 |
| Q.34 West Midlands | 5PH | North Staffordshire | 0.97 | 3133.15 | | 3133.15 | | 3133.15 |
| Q.34 West Midlands | 5M2 | Shropshire County | 0.69 | 6041.01 | | 6041.01 | | 6041.01 |
| Q.34 West Midlands | 5PK | South Staffordshire | 0.5 | 6271.39 | | 6271.39 | | 6271.39 |
| Q.34 West Midlands | Total | | 6.14 | 805 633.76 | 22 918.80 | 828 552.55 | 5157.38 | 833 709.94 |
| Q.35 East of England | 5GC | Luton | 39.41 | 203 152.33 | 3332.28 | 206 484.61 | | 206 484.61 |
| Q.35 East of England | 5QV | Hertfordshire | 8.92 | 263 068.06 | 55 312.47 | 318 380.53 | 1211.88 | 319 592.41 |
| Q.35 East of England | 5PY | South West Essex | 3.56 | 41 255.26 | 8715.70 | 49 970.96 | | 49 970.96 |
| Q.35 East of England | 5PV | West Essex | 3.32 | 26 353.86 | | 26 353.86 | | 26 353.86 |
| Q.35 East of England | 5P2 | Bedfordshire | 3.29 | 31 726.42 | 10 217.96 | 41 944.38 | 1317.60 | 43 261.98 |
| Q.35 East of England | 5PT | Suffolk | 2.72 | 30 894.60 | 1260.39 | 32 154.99 | 1306.27 | 33 461.26 |
| Q.35 East of England | 5PX | Mid Essex | 2.42 | 25 239.97 | | 25 239.97 | | 25 239.97 |
| Q.35 East of England | 5PP | Cambridgeshire | 1.98 | 32 019.07 | 3908.06 | 35 927.13 | | 35 927.13 |
| Q.35 East of England | 5PR | Great Yarmouth and W | 0.44 | | 1218.32 | 1218.32 | | 1218.32 |
| Q.35 East of England | 5PW | North East Essex | 0.3 | 3082.23 | | 3082.23 | | 3082.23 |
| Q.35 East of England | 5P1 | South East Essex | 0.3 | 9672.14 | | 9672.14 | | 9672.14 |
| Q.35 East of England | 5PQ | Norfolk | 0.26 | 4764.59 | | 4764.59 | | 4764.59 |
| Q.35 East of England | Total | | 4.42 | 671 228.53 | 83 965.18 | 755 193.71 | 3835.75 | 759 029.46 |
| Q.36 London | 5C3 | City and Hackney Teach. | 346.67 | 2 263 929.38 | 534 160.71 | 2 798 090.08 | 63 582.41 | 2 861 672.49 |
| Q.36 London | 5C9 | Haringey Teaching PCT | 153.38 | 1 203 689.40 | 42 598.08 | 1 246 287.48 | 5895.77 | 1 252 183.26 |
| Q.36 London | 5K5 | Brent Teaching | 102.71 | 816 513.50 | 12 279.81 | 828 793.31 | 14 464.82 | 843 258.13 |
| Q.36 London | 5LF | Lewisham | 92.44 | 667 443.96 | 57 368.46 | 724 812.42 | 13 694.84 | 738 507.26 |
| Q.36 London | 5LD | Lambeth | 78.54 | 701 592.68 | 67 198.84 | 768 791.52 | 10 316.11 | 779 107.63 |
| Q.36 London | 5K9 | Croydon | 77.91 | 745 439.97 | 19 714.91 | 765 154.88 | 9894.25 | 775 049.14 |
| Q.36 London | 5A8 | Greenwich Teaching | 70.42 | 419 118.03 | 26 249.18 | 445 367.22 | | 445 367.22 |
| Q.36 London | 5C2 | Barking and Dagenham | 68.56 | 364 400.50 | 64 994.92 | 429 395.42 | 8953.02 | 438 348.44 |
| Q.36 London | 5C1 | Enfield | 68.49 | 592 207.17 | 29 422.94 | 621 630.11 | | 621 630.11 |
| Q.36 London | 5NA | Redbridge | 67.95 | 602 773.58 | 32 508.31 | 635 281.89 | 23 964.23 | 659 246.12 |
| Q.36 London | 5C5 | Newham | 62.55 | 498 489.48 | 51 103.68 | 549 593.16 | 10 189.18 | 559 782.34 |
| Q.36 London | 5LE | Southwark | 60.62 | 461 880.46 | 61 307.34 | 523 187.80 | | 523 187.80 |
| Q.36 London | 5NC | Waltham Forest | 51.25 | 315 550.09 | 97 761.35 | 413 311.44 | 5391.55 | 418 702.99 |
| Q.36 London | 5H1 | Hammersmith and Fulh. | 48.24 | 238 238.83 | | 238 238.83 | 4193.96 | 242 432.79 |
| Q.36 London | 5LG | Wandsworth | 35.78 | 309 506.58 | 35 640.86 | 345 147.45 | 17 807.38 | 362 954.83 |
| Q.36 London | 5HX | Ealing | 34.82 | 303 962.39 | 20 635.42 | 324 597.81 | 2557.92 | 327 155.73 |
| Q.36 London | 5LA | Kensington and Chelsea | 34.38 | 193 403.20 | 34 192.20 | 227 595.40 | 532.01 | 228 127.41 |
| Q.36 London | 5K6 | Harrow | 33.19 | 196 649.77 | 3700.03 | 200 349.81 | | 200 349.81 |
| Q.36 London | 5LC | Westminster | 32.25 | 263 911.91 | 23 190.68 | 287 102.59 | 19 475.12 | 306 577.70 |
| Q.36 London | 5K8 | Islington | 31.8 | 165 137.17 | 50 453.93 | 215 591.10 | 14 279.81 | 229 870.91 |
| Q.36 London | TAK | Bexley Care Trust | 30.65 | 163 582.69 | 14 821.25 | 178 403.94 | 570.66 | 178 974.61 |
| Q.36 London | 5M7 | Sutton and Merton | 28.74 | 252 620.20 | 57 982.86 | 310 603.05 | 2548.21 | 313 151.26 |

Continued

Table 2 Continued

| SHA | Code | PCT | SCD adm./ 100 000 pop. ^a | Cost non-elective (A) (£) | Cost elective (B) (£) | Cost admiss. (A + B) (£) | Cost extra LOS (C) (£) | Total cost (A + B + C) (£) |
|-----------------------|-------|--------------------------|--|------------------------------|--------------------------|-----------------------------|---------------------------|-------------------------------|
| Q.36 London | 5A9 | Barnet | 23.06 | 230 222.55 | 12 512.72 | 242 735.27 | 2977.07 | 245 712.35 |
| Q.36 London | 5K7 | Camden | 18.2 | 132 341.63 | 28 954.52 | 161 296.15 | 6676.22 | 167 972.36 |
| Q.36 London | 5A7 | Bromley | 17 | 112 356.40 | 15 740.26 | 128 096.66 | 290.3 | 128 386.95 |
| Q.36 London | 5A5 | Kingston | 14.89 | 65 249.58 | 7280.35 | 72 529.93 | | 72 529.93 |
| Q.36 London | 5AT | Hillingdon | 14.02 | 89 094.73 | | 89 094.73 | | 89 094.73 |
| Q.36 London | 5A4 | Havering | 10.94 | 92 387.46 | 1437.84 | 93 825.30 | | 93 825.30 |
| Q.36 London | 5C4 | Tower Hamlets | 8.9 | 69 996.30 | 7816.12 | 77 812.42 | | 77 812.42 |
| Q.36 London | 5HY | Hounslow | 5.06 | 36 578.71 | 3670.89 | 40 249.60 | | 40 249.60 |
| Q.36 London | 5M6 | Richmond and Twicken. | 0.53 | 1918.17 | | 1918.17 | | 1918.17 |
| Q.36 London | Total | | 55.28 | 12 570 186 | 1 414 698 | 13 984 884 | 238 254 | 1 422 313 |
| Q.37 South East Coast | 5LQ | Brighton and Hove City | 11.73 | 91 234.47 | 6851.82 | 98 086.29 | | 98 086.29 |
| Q.37 South East Coast | 5L3 | Medway | 9.93 | 62 161.74 | 1333.59 | 63 495.33 | | 63 495.33 |
| Q.37 South East Coast | 5P9 | West Kent | 5.69 | 71 170.18 | 4035.28 | 75 205.46 | 580.59 | 75 786.05 |
| Q.37 South East Coast | 5P6 | West Sussex | 2.36 | 47 060.35 | 7816.12 | 54 876.47 | 251.55 | 55 128.02 |
| Q.37 South East Coast | 5P5 | Surrey | 2.35 | 88 227.56 | | 8227.56 | | 88 227.56 |
| Q.37 South East Coast | 5P8 | Hastings and Rother | 1.71 | 7808.30 | | 7808.30 | | 7808.30 |
| Q.37 South East Coast | 5P7 | East Sussex Downs W. | 0.6 | 3214.69 | | 3214.69 | | 3214.69 |
| Q.37 South East Coast | 5QA | Eastern and Coastal Kent | 0.54 | 50 565.20 | 6932.11 | 57 497.31 | | 57 497.31 |
| Q.37 South East Coa. | Total | | 3.81 | 421 442.49 | 26 968.92 | 368 411.41 | 832.14 | 449 243.55 |
| Q.38 South Central | 5L1 | Southampton City | 9.71 | 66 712.88 | 6326.39 | 73 039.27 | | 73 039.27 |
| Q.38 South Central | 5QF | Berkshire West | 6.85 | 94 427.94 | | 94 427.94 | 1082.14 | 95 510.08 |
| Q.38 South Central | 5QE | Oxfordshire | 4.73 | 67 009.44 | 8047.49 | 75 056.93 | | 75 056.93 |
| Q.38 South Central | 5QD | Buckinghamshire | 3.72 | 49 435.48 | 7051.63 | 56 487.11 | | 56 487.11 |
| Q.38 South Central | 5FE | Portsmouth City Teaching | 3.27 | 20 859.09 | | 20 859.09 | | 20 859.09 |
| Q.38 South Central | 5QG | Berkshire East | 1.98 | 19 666.46 | 3196.18 | 22 862.64 | | 22 862.64 |
| Q.38 South Central | 5QT | Isle of Wight NHS | 0.7 | 3075.99 | | 3075.99 | | 3075.99 |
| Q.38 South Central | 5QC | Hampshire | 0.47 | 14 625.91 | | 14 625.91 | 2800.32 | 17 426.23 |
| Q.38 South Central | 5CQ | Milton Keynes | 0.41 | 3279.96 | | 3279.96 | | 3279.96 |
| Q.38 South Central | Total | | 3.11 | 339 093.15 | 24 621.69 | 363 714.84 | 3882.46 | 367 597.30 |
| Q.39 South West | 5QJ | Bristol | 17.02 | 180 505.09 | 33 917.74 | 214 422.84 | 8768.54 | 223 191.38 |
| Q.39 South West | 5FL | Bath and North East Som. | 7.36 | 36 330.77 | 9567.15 | 45 897.92 | | 45 897.92 |
| Q.39 South West | 5F1 | Plymouth Teaching | 4.44 | 20 585.88 | 2608.15 | 23 194.02 | 4306.24 | 27 500.27 |
| Q.39 South West | 5QH | Gloucestershire | 2.85 | 38 148.60 | 3189.05 | 41 337.65 | 10 624.99 | 51 962.64 |
| Q.39 South West | 5A3 | South Gloucestershire | 2.34 | 15 945.25 | 1304.07 | 17 249.32 | | 17 249.32 |
| Q.39 South West | 5QQ | Devon | 0.53 | 12 038.89 | | 12 038.89 | | 12 038.89 |
| Q.39 South West | 5K3 | Swindon | 0.48 | 1594.40 | | 1594.40 | | 1594.40 |
| Q.39 South West | 5M8 | North Somerset | 0.47 | 3189.05 | | 3189.05 | | 3189.05 |
| Q.39 South West | 5QK | Wiltshire | 0.22 | 1589.00 | | 1589.00 | | 1589.00 |
| Q.39 South West | Total | | 2.52 | 309 926.93 | 50 586.16 | 360 513.09 | 23 699.77 | 384 212.87 |

^aThe rate is given by the number of admissions in emergency and elective over the number of population in the PCT for 2011.

(2) Source of population at PCT level: NHS 2011. <https://www.gov.uk/government/publications/exposition-book-2011-2012>.

practice and lack of baseline data in several areas make it difficult to assess the cost impact of implementing the guideline.¹¹

One study assessing the views of patients with SCD showed that patients and carers often bypass their general practitioner for acute problems and attend directly at accident

and emergency (A&E) suggesting better primary care interventions could reduce emergency admissions.^{20,21} One study looked at 145 general practices in the East Midlands and showed that as the proportion of patients able to consult their primary care physician increased, emergency admission rates decreased.²²

Table 3 Regression of total costs of admission on age and sex at national level and London level only

| | <i>National</i> | | | <i>London</i> | | |
|------------|--------------------------------|---|----------------|--------------------------------|---|----------------|
| | <i>Geometric mean cost (£)</i> | <i>Comparison (as % of reference group costs)</i> | <i>P value</i> | <i>Geometric mean cost (£)</i> | <i>Comparison (as % of reference group costs)</i> | <i>P value</i> |
| Age | | | | | | |
| <1 | 1758 | 50.26 | <0.001 | 1828 | 50.27 | <0.001 |
| 1–9 | 1732 | 49.53 | <0.001 | 1804 | 49.61 | <0.001 |
| 10–19 | 1812 | 51.83 | <0.001 | 1881 | 51.71 | <0.001 |
| 20–29 | 3499 | Ref. | Ref. | 3636 | Ref. | Ref. |
| 30–39 | 3564 | 101.87 | <0.001 | 3640 | 100.11 | <0.001 |
| 40–49 | 3565 | 101.94 | <0.001 | 3638 | 100.03 | <0.001 |
| 50+ | 3535 | 101.10 | 0.194 | 3622 | 99.55 | 0.605 |
| Sex | | | | | | |
| Men | 3021 | Ref. | Ref. | 3182 | Ref. | Ref. |
| Women | 2854 | 99.59 | 0.195 | 3052 | 100.36 | 0.278 |

Source: our elaboration.

Table 4 Logistic regression of the association between age and gender on incurring extra bed days at national level and London level

| | <i>National</i> | | | <i>London</i> | | |
|------------|-----------------------------|-------------------|----------------|-----------------------------|-------------------|----------------|
| | <i>% Staying extra days</i> | <i>Odds ratio</i> | <i>P value</i> | <i>% Staying extra days</i> | <i>Odds ratio</i> | <i>P value</i> |
| Age | | | | | | |
| <1 | 0 | — | — | 0 | — | — |
| 1–9 | 1.31 | 1.26 | 0.576 | 0.82 | 0.54 | 0.316 |
| 10–19 | 8.08 | 8.38 | <0.001 | 8.1 | 5.65 | <0.001 |
| 20–29 | 1.04 | Ref. | Ref. | 1.47 | Ref. | Ref. |
| 30–39 | 1.11 | 1.07 | 0.834 | 1.26 | 0.84 | 0.616 |
| 40–49 | 0.93 | 0.90 | 0.8 | 0.85 | 0.56 | 0.24 |
| 50+ | 1.27 | 1.22 | 0.745 | 1.7 | 1.09 | 0.895 |
| Sex | | | | | | |
| Men | 1.98 | Ref. | Ref. | 1.78 | Ref. | Ref. |
| Women | 2.47 | 1.00 | 0.985 | 2.73 | 1.35 | 0.162 |

Source: our elaboration.

A study conducted in London has shown that overnight admissions decreased as a result of better pain management, use of analgesia, transfusions, community support and improved education at home.^{23–26} Moving treatments from hospital to community or ambulatory setting could contribute to avoid patients being admitted to hospital to be treated, with savings in terms of resources. Elective transfusions for example are an essential treatment in SCD and can now be provided in ambulatory setting instead of admitting the patients in hospital to receive the treatment.^{23–25} There is

evidence that admissions are increasing as an effect of readmissions of patients with SCD and that effective discharge planning with a link between hospitals, primary and community care might help prevent readmissions.^{22,27}

What this study adds

This study is the first in England to use HES data to assess the cost of admissions for SCD, applying the HRGs tariffs to those admissions presenting SCD as primary diagnosis only.

We adopted a conservative approach to ensure the costs are linked to SCD with crisis to provide an accurate estimate of the costs for hospitalization linked to SCD.

According to a report published by the Audit Commission, clinical coding errors continue to affect Healthcare Resource Coding (HRG) assignment in England.²⁰ Nevertheless, this study relies on good quality coding (in 2009 primary diagnoses codes were validated as accurate the 87% of the time).²⁰

Limitations of this study

The analysis underestimates the real costs of admissions associated with SCD, as it takes into account only the cases of SCD with crisis as primary diagnosis, but there are many episodes in which SCD appears as a secondary, tertiary or further underlying diagnosis. Even if the main cause of admission is not an SCD crisis, the disease's underlying characteristics may have predisposed the patient to be admitted to hospital or increased the risk of comorbidity or complications.

In our study, the admissions having SCD with crisis as a primary diagnosis represent 92.5% of all the admissions for SCD with crisis (including also secondary, third, fourth and fifth diagnosis) and so almost 7.5% of admissions are not included here. Assuming we can apply the same HRG tariffs for the excluded admissions (those after the primary diagnosis), the total cost for admissions linked to SCD with crisis will increase to £20 376 822, a difference of £1 578 567.

The other 13 589 admissions are linked to SCD without crisis (ICD-10 codes D57.1–8) as primary or further diagnosis, but the cost for these admissions has not been taken into account in this study. It is very difficult to estimate the cost of these admissions without knowing the HRG tariff applied when the patient is discharged. However, the primary diagnosis of these admissions is mainly for SCD without complications, anaemia, respiratory infections and asthma. Considered that 25% of these admissions are in emergency, the cost of admissions for SCD is even higher. Further research can help gain a more detailed estimate of the costs borne by the NHS and also for unaccounted expenditures such as those spent by patients and their families to treat and manage this condition at home or for other sectors, providing a closer estimate of the entire societal cost.

Finally, we used the episode as unit of analysis instead of spells or continuous inpatient stay as we excluded from the analysis patients who have been transferred. We are aware that this might have an impact on excess payments for extra LOS and might underestimate or overestimate the cost for some providers. However, it would have been difficult to attribute in a reliable way the cost of extra LOS to each Trust. We therefore decided to adopt a conservative approach.

Conclusions

According to our study, in 2010–11, the cost of emergency admissions in England due to SCD was £17.1 million which compares with the £16.2 million estimated in the NICE report.¹¹ In this study we did not take into account all of the day-case activities or admissions that have SCD with crisis as a secondary, tertiary or further diagnosis which explains the cost discrepancy between our study and the NICE report.

London accounts for 75.7% of all of England's costs for admissions associated with SCD.

The results show that emergency admissions represent 90.9% of the entire admissions cost. Shifting the balance of care from A&E to primary care is possible²⁸ and better clinical management of patients with SCD may positively impact emergency admissions.

Management of SCD needs to take a more modern approach.²⁹ Proper management is essential in reducing crises and episodes that require hospital admissions. In order to provide effective and safe care, primary care physicians, community nurse specialists and community paediatricians should have a better awareness of warning symptoms and signs which require assessment in hospital.³⁰

This study shows that patients 10–19 years old are much more likely to incur extra bed days and that the cost of an extra day for them is higher than for adults. Therefore, a better management of SCD in children to prevent hospital admissions or at least reduce the LOS could be cost saving.

A recent study emphasizes the need for 'a preventative and comprehensive model of care in addition to care management'.³¹ Adults with SCD need coordinated care led by a primary care physician in coordination with a provider experienced in SCD. Patients and parents of children affected by SCD should also have a good awareness of symptoms and when and how to seek help.³²

Recently, SCD has achieved specialized commissioning status but the current specifications focus mainly on provision of acute care.³³ Links between primary care and community care could be improved through proper discharge planning, multi-disciplinary teams and better communication with primary care.³⁴ The 'community hub model' was first introduced by the Sickle Cell Society's Comprehensive Care Project and in contrast shows that the patients and patient groups prioritize social determinants of health. The model advocates a patient-centred approach where an integrated sickle care pathway encompassing all public health-care needs are addressed specifically mental, social (employment and schooling), acute and primary. This in turn may increase user satisfaction and could assist in reducing unnecessary admissions to hospitals.^{34–36}

Further research which better understands hospital utilization of patients with SCD could also explain allocation of health-care costs due to SCD. HRG tariffs could also be revisited to link disease severity with scalable HRGs which could give a clearer picture as to whom the majority of the SCD patients consuming resources are.

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Conflict of interest

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