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## Evaluating stroke early supported discharge using cost-consequence analysis

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### ABSTRACT

**Purpose:** To evaluate different stroke early supported discharge (ESD) services in different geographical settings using cost-consequence analysis (CCA), which presents information about costs and outcomes in the form of a balance sheet. ESD is a multidisciplinary service intervention that facilitates discharge from hospital and includes delivery of stroke specialist rehabilitation at home.

**Materials and methods:** Data were collected from six purposively sampled services across the Midlands, East and North of England. All services, rural and urban, provided stroke rehabilitation to patients in their own homes. Cost data included direct and overhead costs of service provision and staff travel. Consequence data included service level adherence to an expert consensus regarding the specification of ESD service provision.

**Results:** We observed that the most rural services had the highest service cost per patient. The main costs associated with running each ESD service were staff costs. In terms of the consequences, there was a positive association between service costs per patient and greater adherence to meeting the evidence-based ESD service specification agreed by an expert panel.

**Conclusions:** This study found that rural services were associated with higher costs per patient, which in turn were associated with greater adherence to the expert consensus regarding ESD service specification. We suggest additional resources and costs are required in order for rural services to meet evidence-based criteria.

### ARTICLE HISTORY

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### KEYWORDS

Early supported discharge; stroke service delivery; health services research; cost-consequence analysis; evaluation; rurality

### ► IMPLICATIONS FOR REHABILITATION



- The main costs of an early supported discharge (ESD) service for stroke survivors were staff costs and these were positively associated with greater levels of rurality.
- Greater costs were associated with greater adherence to ESD core components, which has been previously found to enhance the effectiveness of ESD service provision.
- The cost-consequence analysis provides a descriptive summary for decision-makers about the costs of delivering ESD, suggesting additional resources and costs are required in order for rural services to meet evidence-based criteria.

## Introduction


There are around 100 000 new stroke cases and over a million people living with its consequences each year in the UK [1]. Stroke is one of the main causes of adult disability and there is strong research evidence that provision of stroke specialist rehabilitation enhances recovery [2]. In England, the recent National Health Service (NHS) Long Term Plan has made renewed recommendations for implementation of care models for stroke rehabilitation in practice with increased investment in community healthcare services [3]. Stroke early supported discharge (ESD) is a multidisciplinary service intervention that facilitates discharge

from hospital and delivery of stroke specialist rehabilitation at home [4]. ESD has been shown to lead to better patient outcomes, increased satisfaction with care and lower NHS costs compared with conventional care [5]. Based on cumulative evidence from clinical trials, stroke care guidelines in England and worldwide recommend the provision of ESD as part of an evidence-based stroke care pathway [6–11].

ESD is an intervention for adults who suffer a stroke that facilitates transfer of their rehabilitative care from an inpatient environment to a community setting. It enables patients to continue their rehabilitation therapy at home, with the same intensity and expertise that they would receive in hospital. ESD should be

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 Supplemental data for this article can be accessed [here](#).

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provided by a stroke specialist multidisciplinary team to patients with mild/moderate disability. Typically, the team consists of consultant physicians, nurses, physiotherapists, occupational therapists, speech and language therapists, clinical psychologists, rehabilitation assistants, and social workers visiting a patient from one to four times per day [12]. The service may not be suitable for stroke survivors with significant cognitive and functional impairments. The decision to offer ESD is made by the core multidisciplinary stroke team after discussion with the patient and their family or carer if applicable [6].

Prior to hospital discharge, a member of the ESD team may undertake a home visit (with the patient) or an environmental visit (without the patient) and if deemed appropriate, the service should begin within 24 h of discharge. The duration of ESD input depends on patient need although some services have a maximum length of input, e.g., 3 months, following which patients who need further rehabilitation are transferred to other community services [12]. ESD is a key intervention that is provided as part of the stroke care pathway, which incorporates prevention (including neurovascular services), acute care and early rehabilitation, community rehabilitation, long-term support with systematic follow-up and palliative care [8].

There is a drive for cost-effective, evidence-based practice that seeks to ensure that limited health care resources are used to maximum benefit [13,14]. However, some of the more technical forms of economic evaluation (including cost-effectiveness, cost-utility, and cost-benefit analyses) have caused concern in relation to the lack of impact on the practice of service development [15–17]. The use of QALYs (quality-adjusted life years used in cost-utility analyses), a utility-based index measure of health benefit, presents particular interpretation problems in a policy-making context. Complex interventions, such as ESD, have multiple health- and non-health related outcomes, and it is not feasible or meaningful to combine costs and outcomes into a single measure, such as an incremental cost effectiveness ratio (ICER), as done in cost-effectiveness or cost-utility analysis.

As a result, cost-consequence analysis (CCA) is advocated, which presents information about costs and outcomes (clinical and other) in the form of a balance sheet [18]. Outcomes or consequences are shown in their natural units (some of which may be monetary), and costs and outcomes are not combined into a single measure. This economic evaluation approach is very versatile and practical [19]. CCA allows the decision-maker to determine whether the treatment or intervention or service is worth carrying out or commissioning [20]. The CCA approach helps to refine economic methods, identifying relevant costs and outcomes, and helps generate hypotheses for definitive cost-effectiveness studies. It provides a broad and rich source of economic information increasingly needed by NHS decision-makers [21].

Given cost implications are likely to be an important consideration with regard to successful adoption and implementation of interventions such as ESD, economic evaluation methods for complex interventions, such as ESD, should ideally consider the wider costs and benefits associated with the intervention [22]. Moreover, resources associated with delivery of a complex intervention are likely to equate to different costs in different places [23]. Given these issues, we undertook a CCA in which costs associated with different ESD service providers were considered in light of the geographical context in which they were operating and the service configurations that were achieved.

The evidence relating to cost implications of ESD is mixed, with previous studies reporting cost reductions, increases and no differences in comparison to treatment as usual [4,24]. There was

moderate evidence in a 2005 Cochrane systematic review that ESD services provided care at modestly lower total costs than usual care for stroke patients with mild or moderate disability. A caveat to this also concerns the heterogeneity of the rehabilitation service providers involved in randomised controlled trials, and the limited applicability of the results to more disabled patients [25]. A key investigation for the current paper is the degree of heterogeneity across different ESD services and their associated running costs operating in different geographical settings.

Saka et al. [26] contend the cost savings that can be generated by the reduction in the average hospital length of stay is partly offset by the increase in the ESD rehabilitation costs. However, the authors suggest the increase in costs remained within reasonable limits when compared with the increase in effectiveness. This effectiveness related to the effects of tailoring the rehabilitation programme to the patient's actual needs as observed and realised in their home environment as well as empowering the family and patient to take charge of their rehabilitation [27]. Furthermore, Brändal et al. [28] found that patients who received ESD experienced more satisfaction with rehabilitation after hospital discharge, less need for assistance with activities of daily living and less depression compared to patients that did not receive ESD. Although the same study found no differences between the ESD and non-ESD groups regarding pain or fatigue levels.

Despite the challenges of staff recruitment and greater geographical distances between healthcare providers, people living in predominantly rural areas in the UK have a two-year longer life expectancy and rate their wellbeing as slightly higher than those in predominantly urban areas [29]. However, it has been reported that the role of ESD services in more dispersed rural communities has not really been adequately addressed [4,30]. The purpose of this study was to investigate the costs and consequences of different stroke ESD services operating within different geographical settings. This paper presents an analysis of the costs, consequences, and their associations using data collected directly from different ESD services operating in different geographical locations from an urban-rural perspective.

## Materials and methods

### Sampling

Six stroke services offering ESD were included in the study. These services were purposively selected as part of a wider research study in which services were qualitatively evaluated. In the results section, we present characteristics of each service using information captured as part of the aforementioned qualitative evaluation. The data presented in this paper were collected through a questionnaire during the wider qualitative evaluation and we present more detail on the data capture process further below in this section. The purposive sampling frame was designed to compare different ESD service providers, operating in areas of differing levels of rurality [31]. The six services have been anonymised in this paper and are represented by the first six letters of the alphabet. The sites were labelled A–F with site A being the most urban through to site F being most rural.

The level of rurality measure was based on the Rural Urban Classification reported for the geographical area associated with the NHS Clinical Commissioning Group (CCG) who had procured each ESD service [32]. This Rural Urban Classification report was produced using data collected from the 2011 UK census whereby 43.7 million people (82.4% of the population) lived in urban areas (settlements of more than 10 000 people) in England. Although

only 9.3 million people lived in rural areas (17.6% of the population), i.e., in smaller towns (less than 10 000 people), villages, hamlets or isolated dwellings, rural areas made up 85% of the land area [32]. Regarding level of rurality, we classified CCGs based on the percentage of their population that lives in rural or “rural-related” areas, i.e., hub towns which are built-up areas (defined by Ordnance Survey) with a population of 10 000–30 000 that meet specific criteria relating to dwelling and business densities, suggesting the potential to serve the wider rural hinterland. Whereas, urban areas are the connected built up areas identified by Ordnance Survey mapping that have resident populations above 10 000 people [32]. Therefore, each CCG in England has a geographical area over which it operates to procure NHS services and this area has an associated level of rurality as a percentage of its population living in rural conditions which we have used to describe the rural–urban perspective of each service in this study. Where an ESD service included in this study was managed by multiple CCGs, then the weighted average level of rurality was calculated, based on the prevalence of stroke and transient ischaemic attack in that commissioning area (figures obtained from NHS Quality and Outcomes Framework) [33].

### Data capture

Data about staffing and adopted models of care were collected from each service leader (six in total) using a questionnaire designed by the authors ([Supplementary file](#)). The models of care questions were based on the 2015 Sentinel Stroke National Audit Programme (SSNAP) post-acute phase 2 audit [34]. The staffing questions asked about each team member’s role, whole-time equivalent (WTE) hours of work per week, grade, cost at middle of band and associated overhead costs for each team member. This information enabled the authors to calculate the number of staff within each service as well as the total staff cost. The number of patients admitted to the service over a 1-year period between 2018 and 2019 was also captured from the same questionnaire. The questionnaire asked about any other staff funded elsewhere that the patients had access to as well as all non-staff costs including travel, training, and equipment. Service specifications from each service were also collected to supplement the data and service description information was collected during the course of our wider qualitative evaluation of each service [31].

### Costs

Multidisciplinary team composition and workforce (WTE) information were used to calculate total staff costs. For each staff, we acquired the median annual salary for their given NHS banding and adjusted this for both overhead costs (i.e., pension and national insurance contributions) and fraction of WTE working (i.e., number of hours worked per week divided by full-time employed 37.5 h per week). These staff costs account for all the work conducted as a member of the ESD team which includes seeing patients, all associated administrative duties and supporting other members of the same team. Staff training (i.e., paid for courses and conferences), equipment (i.e., paid for printing, stationery, clinical equipment), and travel (based on annual mileage accumulated through visiting patients and car leasing) costs associated with delivery of rehabilitation were used to calculate total non-staff costs. For services A and B who provide both ESD and longer-term community rehabilitation, we present the breakdown of costs for the ESD portion of the service as well as the combined cost for the reader to appreciate the fraction dedicated to

the ESD portion. Using patient caseload information, direct costs per patient were calculated for the 2018–2019 time period. All costs presented in this study were retrieved directly from the six services.

### Consequences

The sole consequence in this paper was each service’s adherence to ESD core components using an ESD consensus score which we derived from an expert panel’s specification of ESD service provision [35]. The ESD consensus score has been previously developed using defined evidence-based core components of ESD as outlined in an international consensus document and evidence-based criteria utilised by the SSNAP in the UK [34,35]. This 17-item ESD consensus score was used to measure adoption of core components by each of the six ESD services, e.g., service composition (core service and others), staff training, service meetings, and service specificity. Each item was awarded a binary yes (1 point)/no (0 point) response in relation to each service meeting that particular criterion. This 17-item ESD consensus score was calculated, based on questionnaire data, for each of the six ESD services. Variability observed in ESD consensus scores was used to indicate different models of service delivery and whether these adhered to evidence-based core components.

### Analysis

We tabulated each service’s ESD core components to show how the consensus score was obtained. Descriptive statistics were used to quantify different characteristics across the six ESD services. Costs and consequences for all six services were then collated in a cost-consequence balance sheet. Services were ordered by percentage of rurality and total (including staff and travel) costs were presented in aggregate and on a per patient basis. Consequences were expressed as the total ESD consensus score obtained (out of 17). This measure was used as a consequence to indicate the level by which each service had adopted an evidence-based service model. Pearson’s product-moment pairwise linear correlations of the variables contained in the balance sheet were conducted to assist with understanding the associations observed and statistical significance was determined at the 5% level for the accompanying *p* values. Given the size of a team may be directly related to the cost of that team, the number of staff per service was added as a comparator variable in the correlation analysis to help appreciate any differences between aggregate costs and costs disaggregated by the number of patients seen by each service.

### Results

**Table 1** presents the multidisciplinary team compositions for the six services in terms of WTE units for all the main job types and grades. This information was collected as part of a wider qualitative evaluation [31]. Only two services had a stated manager as part of the team and the most rural service in this study was operating without either administrative support or a manager at the time of our data collection.

For ESD eligibility, the six services had broadly the same criterion set which included:

- a confirmed diagnosis of stroke;
- mild/moderate stroke severity;
- the ability to engage in rehabilitation;
- the ability to transfer by themselves or with one person;

**Table 1.** Multidisciplinary team composition by whole time equivalent units.

Discipline	A <sup>a</sup>	B <sup>a</sup>	C	D	E	F
OTs at grade 7	0.21 (0.83)	0.8 (1.6)	1	0.5	0.64	0.92
OTs at grade 6	0.24 (0.94)	0.9 (1.8)	1.8	1	1.4	6.71
OTs at grade 5	N/A (N/A)	N/A (N/A)	2	0.5	1	1
PTs at grade 7	0.16 (0.65)	0.8 (2.29)	0.81	0.6	0.64	2.64
PTs at grade 6	0.68 (2.71)	0.75 (1.5)	1.8	1	1.64	6.59
PTs at grade 5	N/A (N/A)	N/A (N/A)	2	1	1	6.49
SLTs at grade 7	0.15 (0.6)	0.32 (0.64)	N/A	N/A	0.6	0.8
SLTs at grade 6	0.13 (0.5)	N/A (N/A)	1	1	1	2.1
SLTs at grade 5	N/A (N/A)	0.2 (0.4)	0.6	0.5	N/A	1
APs at grade 4	0.91 (3.64)	0.5 (1)	N/A	N/A	2.6	7.8
RAs at grade 3	0.35 (1.39)	0.92 (1.84)	7.55	1.9	5.71	9.9
CSWs at grade 2	0.11 (0.43)	N/A (N/A)	N/A	0.05	N/A	N/A
Nurses	Access to	0.5 (1)	1.32	N/A	5.05	Access to
Psychologists	Access to	Access to (0.8)	Access to	0.1	1.6	N/A
Social workers	Access to	N/A (N/A)	N/A	0.1	N/A	Access to
Dieticians	0.25 (1)	N/A (N/A)	N/A	N/A	N/A	N/A
Administration	0.53 (2.12)	0.8 (1.6)	0.62	1	1	N/A
Manager	0.06 (0.23)	N/A (N/A)	N/A	1	N/A	N/A
Total	3.76 (15.03)	6.49 (14.47)	20.5	10	23.88	45.95
Patient caseload	183 (696)	312 (551)	440	268	509	874

OT: occupational therapist; PT: physiotherapist; SLT: speech and language therapist; AP: assistant practitioner; RA: rehabilitation assistant; CSW: clinical support worker.

<sup>a</sup>A and B teams offer both ESD and community rehabilitation so the parentheses include the combined situation for both teams.

**Table 2.** Configuration of ESD consensus score measure.

	A <sup>a</sup>	B <sup>a</sup>	C	D	E	F
Core team members meeting or exceeding recommended WTE level per 100 stroke patients						
Doctors $\geq 0.1$	0	0	0	0	0	0
Nurses $\geq 0.4$	0	0	0	0	1	0
Occupational therapists $\geq 1$	0	0	1	0	0	0
Physiotherapists $\geq 1$	0	0	1	0	0	1
Speech and language therapists $\geq 0.3$	0	0	1	1	1	1
Access to other team members						
Clinical psychologists	1	1	1	1	1	0
Social workers	1	1	0	1	0	1
Rehabilitation assistants	1	1	1	1	1	1
Training opportunities						
Nurses	0	0	1	0	1	0
Therapists	1	1	1	1	1	1
Rehabilitation assistants	1	1	1	1	1	1
MDT meetings						
Weekly meetings	1	1	1	1	1	1
Core team attend	0	0	1	0	0	0
ESD member attends acute meeting	0	1	0	1	1	1
Service						
Stroke specific	1	1	1	1	1	1
Median waiting time between referral and ESD $\leq 1$ day	0	1	1	1	1	1
Weekly service $> 5$ days	0	1	0	0	1	1
Total ESD consensus score	7	10	12	10	12	11

WTE: whole time equivalent; MDT: multidisciplinary team.

<sup>a</sup>A and B teams offer both ESD and community rehabilitation.

- the ability to be safe in between visits;
- being resident in the service's catchment area;
- being registered with a GP in the service's catchment area.

Table 2 shows the 17-item ESD consensus score for each of the six ESD services and represents the level of adherence to the core components of ESD service delivery. The information presented indicates that no two services were configured in the same way even if they achieved the same consensus score thereby underlining the variability in models of service delivery. Also, the two services that provided both ESD and community rehabilitation did not meet or exceed the recommended WTE level of core staff per 100 patients.

Table 3 provides an overview of the six services involved in this study. Services varied in terms of percentage of rurality of their location, in line with our purposive sampling strategy. There were also differences in patient caseload and number of staff. We also noted some variability in their ESD consensus scores, which indicated different levels of adherence to an evidence-based service model. Furthermore, the total WTE units for each service appeared to increase as the patient caseload increases but on closer inspection the two stated hybrid services (i.e., services A and B) see approximately double the number of patients per WTE unit than the ESD-only services. It is important to note that the hybrid services in this study operated in the most urban areas so were situated in more densely populated areas than the more rural ESD-only services in this study [32].

As can be seen from Tables 2 and 3, the variation in service models is considerable. Table 4 presents the monetary costs associated with providing these service models accompanied by the main consequence described in this paper, i.e., each service's ESD consensus score. The table is presented as a cost-consequence balance sheet. The services with the highest overall costs were located in the most rural areas. The largest element of any ESD service costs was pay. As the level of rurality increased, the travel cost on a per patient basis also increased.

The pairwise linear correlation matrix is presented in Table 5. This analysis indicated that higher costs per patient (overall, staff, and travel costs considered separately) were significantly and positively associated with ESD services in areas of higher rurality as well as higher ESD consensus scores. Aggregate costs (not on a per patient basis) were not associated with ESD consensus scores. In contrast, aggregate overall and staff service-level costs were significantly and positively associated with the number of staff in each service, i.e., size of team but not on a per patient basis. This contrast showcases how per patient costs relate to adherence to evidence-based core components of ESD service delivery whereas aggregate costs relate to the size of the team.

## Discussion

This study has used CCA to evaluate six purposively sampled stroke ESD services in different geographical settings and

**Table 3.** Description of ESD services.

ESD service	Location: % of rurality	Patient caseload (2018–2019)	No. of staff	Total WTE units	ESD consensus score
A <sup>a</sup>	0	183 (696)	28 (28)	3.76 (15.03)	7
B <sup>a</sup>	5	312 (551)	11 (19)	6.49 (14.47)	10
C	34	440	24	20.5	12
D	50	268	13	10	10
E	66	509	28	23.88	12
F	71	874	50	45.95	11

<sup>a</sup>A and B services offered both ESD and community rehabilitation so the parentheses include the combined figures for the whole service.

**Table 4.** Cost-consequence balance sheet.

ESD team	A <sup>a</sup>		B <sup>a</sup>		C		D		E		F	
% rurality	0		5		34		50		66		71	
Costs	Total	Per patient	Total	Per patient	Total	Per patient	Total	Per patient	Total	Per patient	Total	Per patient
Overall (£)	108 777 (446 679)	594 (641)	258 333 (688 261)	827 (1249)	700 424	1591	383 844	1432	856 725	1683	1 679 273	1921
Staff (£)	106 849 (427 397)	583 (614)	243 040 (660 638)	778 (1198)	666 185	1514	356 144	1328	820 334	1611	1 558 385	1783
Travel (£)	1333 (13 331)	7 (19)	12 180 (22 000)	39 (39)	32 799	74	20 000	74	40 569	79	70 932	81
Consequences												
ESD consensus score	7		10		12		10		12		11	

<sup>a</sup>A and B teams offer both ESD and community rehabilitation so the parentheses include the combined situation for both teams.

**Table 5.** Pairwise linear correlation analysis<sup>a</sup>.

Measure	% rurality	No. of staff	ESD consensus score
% rurality	<i>R</i> ( <i>p</i> Value)		
No. of staff	0.53 (0.28)	<i>R</i> ( <i>p</i> Value)	
ESD consensus score	0.70 (0.12)	0.14 (0.79)	<i>R</i> ( <i>p</i> Value)
Overall cost per patient	0.95 (0.00)	0.53 (0.28)	0.83 (0.04)
Staff cost per patient	0.94 (0.00)	0.53 (0.28)	0.84 (0.04)
Travel cost per patient	0.90 (0.02)	0.26 (0.62)	0.89 (0.02)
Overall cost	0.81 (0.05)	0.84 (0.04)	0.59 (0.22)
Staff cost	0.82 (0.05)	0.83 (0.04)	0.60 (0.21)
Travel cost	0.86 (0.03)	0.78 (0.07)	0.67 (0.14)

<sup>a</sup>Only the ESD costs for teams A and B + ESD staff numbers for team B were used in the pairwise linear correlation analysis.

investigate operational costs and adherence to identified evidence-based core components of service delivery (consequences). Evidence of variability in terms of service configurations was found, as measured by level of adherence to evidence-based core components quantified by an ESD consensus score. No two services were the same in terms of ESD consensus score, size of team (number of staff and patients), level of rurality of the area in which they were based, and overall, staff and travel costs. Findings showed that higher ESD service costs per patient were significantly associated with the level of rurality in which the ESD service operated. This suggests that additional resource and associated costs were required by rural services in this study to meet evidence-based standards (and appropriate staff to patient ratios).

It is known that healthcare service provision in rural areas is more costly than in urban areas for a similar level of service provision [36,37]. Higher costs have been attributed to difficulties in staff recruitment and retention, higher travel costs and non-productive staff time when travelling as well as difficulties in realising economies of scale while adequately serving sparsely populated areas [37].

In this study, the consequence of higher service costs on a per patient basis was association with greater adherence to evidence-based core components, as measured by our ESD consensus score. One important aspect of the ESD consensus score was to determine if a service meets the recommended WTE level of core staff per 100 patients [38]. Hence, services that met the recommended number of staff per patients, were awarded a higher ESD consensus score.

We found it was the lower WTE amount of core staff per 100 patients within the most urban service that contributed to this service having the lowest ESD consensus score. Furthermore, our correlation analysis showed a significant positive association between service costs per patient and the ESD consensus score. This implies that resourcing a service that adheres to the core components of ESD service delivery requires costs to be appreciated on a per patient basis so that recommended staff to patient ratios are met. Our previous findings would suggest that further consequences of these additional cost implications may relate to additional patient benefit via the ESD service's ability to deliver a more responsive and intensive service [38].

This study does suffer from some limitations. A major limitation is the small sample size. There were 136 ESD services in operation in England in 2015 but only data from six services (4%) were used in this study. Hence, our findings are suggestive and the associations reported would benefit from being tested in a larger sample, including further exploration of different ESD and community stroke rehabilitation models [39]. In addition, the range of ESD consensus score presented in this paper, i.e., 7–12 within a range of 0–17, is rather narrow and there may be services with scores outside of this range in England which we have not captured and analysed here. That said, the variety of services purposively sampled in this study cover a representative range of possible ESD services available in England [34] thereby providing generalisable findings which should be of interest to many ESD services in England not included in our study. We also acknowledge our implied associations are based on correlation analysis and therefore these insights may not necessarily represent causation. Another limitation pertains to our use of CCA. This CCA provides a snapshot in time which suffers from being unable to capture all the consequences, especially indirect effects arising from ESD service provision, as well as failing to capture consequences that occur at other points in time. One specific consequence not captured by this study are any patient outcomes or carer's burden as an output of ESD service provision. This limitation hinders decision-makers who may still encounter difficulties in drawing unambiguous conclusions for service delivery [18]. Also, this study does not take into account the time spent travelling by staff as opposed to seeing patients which means we could not compute the service cost on a per patient visit basis which

would be of interest to ESD services and commissioners of ESD services.

The evidence relating to the cost implications of ESD is mixed, with previous studies reporting reductions, increases and no differences in comparison to treatment as usual [4,24]. Teng et al. [27] postulate that any reductions in hospital length of stay associated with ESD translate into negligible cost savings, as freed up beds are then used by other patients. From this perspective, the authors suggest ESD can be viewed as an additional cost. In this paper, we have looked at the cost of providing ESD across six services and presented evidence to show how this cost differs across level of rurality, size of team and adherence to ESD core components of service delivery. Rural services were more costly but they also resourced higher amounts of staffing on a per patient basis which ensured they deliver an evidence-based service. A policy implication of this would be that additional resources and costs may be required in order for rural services to meet evidence-based criteria. We also recommend evaluating these observed cost differences across rural and urban services from a patient outcome perspective.

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### Disclosure statement

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### References

- [1] Patel A, Berdunov V, Quayyum Z, et al. Estimated societal costs of stroke in the UK based on a discrete event simulation. *Age Ageing*. 2020;49(2):270–276.
- [2] Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. *The Lancet*. 2011;377(9778):1693–1702.
- [3] NHS England. The NHS long term plan. London: NHS England; 2019.
- [4] Langhorne P, Baylan S, Early Supported Discharge Trialists. Early supported discharge services for people with acute stroke. *Cochrane Database Syst Rev*. 2017;2017(7):CD000443.
- [5] Fearon P, Langhorne P, Early Supported Discharge Trialists. Services for reducing duration of hospital care for acute stroke patients. *Cochrane Database Syst Rev*. 2012;12(9):CD000443.
- [6] National Institute for Health and Care Excellence. Stroke rehabilitation in adults: NICE clinical guidelines CG162. London: National Institute for Health and Clinical Excellence; 2013.
- [7] Stroke Foundation. Clinical guidelines for stroke management. Australia: Stroke Foundation Melbourne; 2017.
- [8] Bowen A, James M, Young G, editors. Royal College of Physicians 2016 National Clinical Guideline for Stroke. London: RCP; 2016.
- [9] European Stroke Organisation Executive Committee, ESO Writing Committee. Guidelines for management of ischaemic stroke and transient ischaemic attack. *Cerebrovasc Dis*. 2008;25(5):457–507.
- [10] Hebert D, Lindsay MP, McIntyre A, et al. Canadian stroke best practice recommendations: stroke rehabilitation practice guidelines, update 2015. *Int J Stroke*. 2016;11(4):459–484.
- [11] Adeoye O, Nyström KV, Yavagal DR, et al. Recommendations for the establishment of stroke systems of care: a 2019 update: a policy statement from the American Stroke Association. *Stroke*. 2019;50(7):e187–e210.
- [12] Rodgers H, Price C. Stroke unit care, inpatient rehabilitation and early supported discharge. *Clin Med*. 2017;17(2):173–177.
- [13] Drummond MF, Sculpher MJ, Claxton K, et al. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2015.
- [14] Drummond M. Economic analysis alongside clinical trials: problems and potential. *J Rheumatol*. 1995;22(7):1403–1407.
- [15] Donaldson C, Currie G, Mitton C. Cost effectiveness analysis in health care: contraindications. *BMJ*. 2002;325(7369):891–894.
- [16] Coast J, Hensher M, Mulligan J-A, et al. Conceptual and practical difficulties with the economic evaluation of health services developments. *J Health Serv Res Policy*. 2000;5(1):42–48.
- [17] Byford S, Sefton T. First aid: lessons from health economics for economic evaluation in social welfare [health and social care discussion paper]. London: London School of Economics; 2002.
- [18] Gage H, Kaye J, Owen C, et al. Evaluating rehabilitation using cost-consequences analysis: an example in Parkinson's disease. *Clin Rehabil*. 2006;20(3):232–238.
- [19] Coast J. Is economic evaluation in touch with society's health values? *BMJ*. 2004;329(7476):1233–1236.
- [20] Advisors O. Community engagement – approaches to improve health and reduce health inequalities. Cost consequence analysis. *Health Economics*. Vol. 3. London: National Institute for Health and Care Excellence (NICE); 2016.
- [21] Hunter R, Shearer J. Cost-consequences analysis—an under-used method of economic evaluation. London: National Institute for Health Research; 2014.
- [22] Craig LE, Wu O, Bernhardt J, et al. Approaches to economic evaluations of stroke rehabilitation. *Int J Stroke*. 2014;9(1):88–100.
- [23] Anderson R, Hardwick R. Realism and resources: towards more explanatory economic evaluation. *Evaluation*. 2016;22(3):323–341.
- [24] Neale S, Leach K, Steinfors S, et al. Costs and length of stay associated with early supported discharge for moderate

- and severe stroke survivors. *J Stroke Cerebrovasc Dis.* 2020; 29(8):104996.
- [25] Brady BK, McGahan L, Skidmore B. Systematic review of economic evidence on stroke rehabilitation services. *Int J Technol Assess Health Care.* 2005;21(1):15–21.
- [26] Saka O, Serra V, Samyshkin Y, et al. Cost-effectiveness of stroke unit care followed by early supported discharge. *Stroke.* 2009;40(1):24–29.
- [27] Teng J, Mayo NE, Latimer E, et al. Costs and caregiver consequences of early supported discharge for stroke patients. *Stroke.* 2003;34(2):528–536.
- [28] Bråndal A, Eriksson M, Glader E-L, et al. Effect of early supported discharge after stroke on patient reported outcome based on the Swedish Riksstroke Registry. *BMC Neurol.* 2019;19(1):40.
- [29] Collingwood J. The UK National Health Service: a rural versus urban perspective; 2020 [cited 2021 Apr 30]. Available from: <https://sma.org/the-uk-national-health-service/>
- [30] Brewer L, Williams D. A review of early supported discharge after stroke. *Rev Clin Gerontol.* 2010;20(4):327–337.
- [31] Fisher R, Chouliara N, Byrne A, et al. What is the impact of large-scale implementation of stroke early supported discharge? A mixed methods realist evaluation study protocol. *Implement Sci.* 2019;14(1):61.
- [32] Office for National Statistics. Rural/urban classification. London: Office for National Statistics; 2011.
- [33] NHS Digital. Quality and outcomes framework (QOF); 2015–16. Leeds: Health and Social Care Information Centre; 2016.
- [34] Royal College of Physicians, Care Quality Improvement Department on behalf of the Intercollegiate Stroke Working Party. Sentinel Stroke National Audit Programme (SSNAP). Post-acute organisational audit; phase 2: organisational audit of post-acute stroke service providers. London: Royal College of Physicians; 2015.
- [35] Fisher RJ, Gaynor C, Kerr M, et al. A consensus on stroke: early supported discharge. *Stroke.* 2011;42(5):1392–1397.
- [36] OECD. Strategies to improve rural service delivery, OECD rural policy reviews. Paris: OECD Publishing; 2010.
- [37] Palmer B, Appleby J, Spencer J. Rural health care: a rapid review of the impact of rurality on the costs of delivering health care. London: Nuffield Trust; 2019.
- [38] Fisher RJ, Byrne A, Chouliara N, et al. Effectiveness of stroke early supported discharge: analysis from a National Stroke Registry. *Circ Cardiovasc Qual Outcomes.* 2020;13(8):e006395.
- [39] Party ISW. Sentinel Stroke National Audit Programme (SSNAP). London: Royal College of Physicians; 2015.