

## Descriptive Study Comparing Routine Hospital Administrative Data with the Vascular Society of Great Britain and Ireland's National Vascular Database

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**Objective.** To compare patient volume and outcomes in vascular surgery between an administrative data set (Hospital Episode Statistics) and a clinical database (National Vascular Database).

**Design.** Descriptive study.

**Methods.** Volume of cases determined by age, sex, year and procedure and in-hospital mortality by procedure for both datasets for patients undergoing either repair of abdominal aortic aneurysm, carotid endarterectomy or infrainguinal bypass over a three year period between 1st April 2001 and 31st March 2004.

**Results.** There were 32,242 admissions with a mention of the three selected vascular procedures within the administrative data set compared to 8462 within the clinical database. For NHS trusts common to both datasets, there were twice as many procedures (16,923) recorded within the administrative dataset compared to the clinical database. Patient characteristics were similar across both databases. Further analysis limiting the administrative data to records attributed to consultants known to contribute to the clinical database showed much closer agreement with only 11% more repairs of abdominal aortic aneurysm recorded within the administrative dataset compared to the National Vascular Database.

**Conclusions.** There are significant differences in total numbers between HES and the NVD. If the National Vascular Database is to become a credible source of information on activity and outcomes for vascular surgery, there is a clear need to increase the number of contributing surgeons and to increase the completeness of data submitted. Further analysis at individual record level is needed to identify other reasons for discrepancies which could help to enhance data quality, both within Hospital Episode Statistics and within the National Vascular Database.

**Keywords:** Vascular surgery; Performance monitoring; Casemix.

### Introduction

Increasing pressure for the public release of health outcomes, in light of high-profile cases like Bristol<sup>1</sup> and Shipman<sup>2,3</sup> in the UK has already led to some centre specific surgical outcome data being placed in the public domain.<sup>4,5</sup> Of chief concern is that the data for assessing outcomes, adjusted for case mix, should not be biased or incomplete.<sup>6</sup> Despite massive investments in technology, routinely collected

administrative data are regarded with suspicion by clinicians.<sup>7</sup> Many clinicians would argue that administrative data is unreliable and that data collected by themselves is more accurate. A number of multi-centre clinical databases have been developed in parallel with administrative systems, in part, to enable the analysis of risk adjusted outcomes.<sup>8</sup> The report from the public inquiry into deaths at a paediatric cardiac unit at Bristol<sup>1</sup> criticised this 'dual' system of collecting data in the health service as "wasteful and anachronistic". It also suggested that Hospital Episode Statistics, the administrative database available within England, should be supported as a major national resource and used to undertake monitoring of a range of healthcare outcomes.

The Vascular Society of Great Britain and Ireland (VSGBI) runs the National Vascular Database (NVD), which collects data from surgeons on a voluntary

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basis. The NVD commenced as a pilot study in 1998 and since then has collected data on index procedures, carotid endarterectomy, aortic aneurysm repair and infrainguinal bypass and a 4th index procedure, amputation, was added in 2005. The first NVD report was produced in 1999 and since then 3 further reports have been published, the most recent in 2004. Data are collected on each of the above procedures including details of the operation performed, the surgical and anaesthetic staff involved, patient history and risk factors, biochemical and haematological parameters, postoperative morbidity and in-hospital mortality. At the time of the 2004 report 259 surgeons in 99 hospitals were contributing data, and there were a total of 12,389 records on the database.<sup>9</sup>

The Hospital Episode Statistics (HES) database comprises data gathered locally through Patient Administration Systems (PAS) or Hospital Information Systems (HIS). It contains personal, medical and administrative details of all inpatient and day-case treatment delivered by NHS hospitals in England. Over 14 million HES records are now collected annually. The dataset includes date of birth, sex, admission methods, main diagnosis, up to 13 secondary diagnosis fields, twelve operation fields, length of stay, waiting times, ethnic group and method of discharge.

The aim of this study is to compare patient volume and outcomes, for the same time period, between the administrative data set (Hospital Episode Statistics) and the clinical database (National Vascular Database), to assess the degree of agreement between them, in order to inform the utility of a combined approach, using data from the two sources, in assessing data quality and ultimately in comparing and monitoring surgical outcomes at a trust and at national level.

## Methods

NVD records were extracted for patients who had undergone vascular procedures between 1st April 2001 and 31st March 2004 in England. Procedures are classified at the time of data entry. Records were extracted for people undergoing carotid endarterectomy, infrainguinal bypass and repair of abdominal aortic aneurysm.

HES records were extracted for patients who had undergone vascular procedures between 1st April 2001 and 31st March 2004. Procedures were identified by using the tabular list of the classification of surgical operations and procedures supplied by the Office of Population Censuses and Surveys, fourth revision (OPCS-4). The following OPCS4 codes were used:

Carotid endarterectomy (L29); infra-inguinal bypass (L582-L587, L592-L597); repair of abdominal aortic aneurysm (L183-6, L193-6, L203-6, L213-6). Abdominal aortic aneurysms were split into ruptured or unruptured. To account for the possibility of a patient's care being transferred between consultants during an admission for treatment of their arterial disease, finished consultant episodes were linked into spells to determine the numbers of cases and in-hospital deaths. Importantly, HES records only deaths in hospital, consequently patients who die elsewhere do not have their deaths included in HES.

The primary endpoint was in-hospital mortality, defined as death from all causes occurring during a patient's hospital stay.

The numbers of cases within each database by age, sex, year and procedure were compared for the 46 trusts common to both databases. Mortality by procedure group was also compared. For the NVD, mortality was based on records with a known outcome. To attempt to explain any discrepancy between HES and NVD in trusts common to both databases, the number of cases within HES recorded under consultants who also contribute data to the NVD was determined and compared with the total number of cases within the NVD.

Data was analysed within SPSS version 12.0. Differences in mortality between the two data sources were assessed using the Chi-Square test.

## Results

Between 1 April 2001 and 31 March 2004, 184 English NHS trusts within the HES database submitted data on 32,242 admissions with a mention of the three selected vascular procedures. For the same period the NVD recorded 8462 (Only 26% of HES) patients from the 53 Hospitals within 46 English trusts. For the same 46 NHS trusts, HES recorded twice as many (16,923) procedures.

The numbers of patients by age, sex, year and procedure group in trusts common to both databases are given for HES and NVD in [Table 1](#). Although proportions for each parameter appear similar between NVD and HES, they are significantly different ( $p < 0.05$ ). Annual figures are constant within HES (around 5600 per year). Within the NVD, there appears to be at least 20% more cases recorded in 2002/3 than in the preceding and following year. Death rates by procedure were slightly higher within HES for all procedures with mortality for all AAAs at 18% in HES and 15% in the NVD ([Table 2](#)).

**Table 1. Comparison of patient characteristics for HES and NVD for three years data (2001/2–2003/4)**

		HES		NVD
		All	46 trusts common to NVD	All
Group Total		32,242 (100%)	16,923 (100%)	8462 (100%)
Age	<45	264 (1%)	137 (1%)	150 (2%)
	45–49	361 (1%)	213 (1%)	114 (1%)
	50–54	924 (3%)	498 (3%)	259 (3%)
	55–59	1959 (6%)	1045 (6%)	498 (6%)
	60–64	3562 (11%)	1961 (12%)	899 (11%)
	65–69	5547 (17%)	2935 (17%)	1410 (17%)
	70–74	7169 (22%)	3721 (22%)	1827 (22%)
	75–79	7029 (22%)	3626 (21%)	1843 (22%)
	80–84	4080 (13%)	2093 (12%)	1102 (13%)
	85–89	1173 (4%)	603 (4%)	310 (4%)
90+	174 (1%)	91 (1%)	50 (1%)	
Sex	Unknown	0 (0%)	0 (0%)	128 (2%)
	Male	23,659 (73%)	12,290 (73%)	6096 (72%)
	Female	8583 (27%)	4633 (27%)	2238 (26%)
Year	2001/2	10,762 (33%)	5545 (33%)	2461 (29%)
	2002/3	10,698 (33%)	5677 (33%)	3299 (39%)
	2003/4	10,782 (33%)	5701 (34%)	2702 (32%)
Procedure	Infra-inguinal bypass	9661 (30%)	4887 (29%)	2102 (25%)
	Carotid endarterectomy	10,237 (32%)	5949 (35%)	3141 (37%)
	Unruptured AAA	8,975 (28%)	4388 (26%)	2393 (28%)
	Ruptured AAA	3369 (10%)	1699 (10%)	795 (9%)

For repair of abdominal aortic aneurysm, 11% more cases (3577) within HES were attributed to consultants who also contribute data to the NVD compared with the 3219 cases recorded within the NVD (Table 2). For carotid endarterectomy, the figure was 20% higher (3755) within HES than the 3141 cases recorded within

the NVD. For infra-inguinal bypass the figure was 54% higher (3240) within HES than the 2102 cases recorded within the NVD. Mortality was slightly lower within HES amongst the consultants contributing to the NVD compared to procedures carried out by other consultants but this difference was not statistically significant for any procedure ( $p > 0.05$ ). There was no significant difference between mortality in HES in consultants contributing to the NVD compared to the NVD figures.

**Table 2. Mortality by procedure for HES and NVD for three years of data (2001/2–2003/4)**

	Infra-inguinal bypass	Carotid endarterectomy	Unruptured AAA	Ruptured AAA
<b>HES</b>				
All cases				
Cases	9661	10,237	8975	3369
Deaths	629	106	785	1570
Mortality	6.5%	1.0%	8.7%	46.6%
HES (46 trusts common to NVD)				
All cases				
Cases	4887	5949	4388	1699
Deaths	298	66	352	750
Mortality	6.1%	1.1%	8.0%	44.1%
Non NVD consultants				
Cases	1647	2194	1649	861
Deaths	122	24	148	388
Mortality	7.4%	1.1%	9.0%	45.1%
Consultants contributing to NVD				
Cases	3240	3755	2739	838
Deaths	176	42	204	362
Mortality	5.4%	1.1%	7.4%	43.2%
<b>NVD</b>				
All cases				
Cases	2102	3141	2393	795
Deaths	88	28	161	315
Mortality <sup>†</sup>	4.3%	1.0%	6.8%	40.4%

<sup>†</sup> Based on cases with known outcome.

### Discussion

We have shown that there are over four times as many vascular cases recorded within HES compared to the National Vascular Database. Part of this discrepancy can be explained by the fact that not all centres within England performing these index procedures are contributing to the NVD. However, if only the 46 trusts common to both datasets are compared, HES still records twice as many cases. Some of this difference can be explained by looking at consultant level data. It then becomes clear that not all consultants apparently performing the index procedures within a trust are contributing to the NVD. If only cases within HES where the consultant is known to be contributing to the NVD are used, then, at least for AAA, the NVD has nearly 90% of the numbers of HES cases. However, for the other two index procedures the difference is greater. We found no significant difference between

mortality in HES in consultants contributing to the NVD compared to the NVD figures which militates against biased reporting. Nevertheless, because of the voluntary nature of the National Vascular Database, underreporting or selective reporting of cases by contributing surgeons must be considered, and further work to validate both the HES and NVD data for individual surgeons and centres is required. As some surgeons started contributing to the NVD during the study period, the agreement between the number of cases in HES and the NVD should be closer in each successive year. The number of cases in HES increased year on year, but there were greater numbers in the NVD in 2002/3 compared to both the preceding and following year; the reason for this is not clear.

A further possible explanation for the discrepancy is that procedures within HES are being miscoded, either with regard to the procedure or the consultant responsible. This may certainly be true for at least some of the cases. The proportions of cases within each age group, by sex and by procedure were similar, suggesting that the cases were coming from a similar population. Concerns about the quality of HES data remain. Clinical coding is not subject to any regular external audit, and there is potential for inter-coder variation.<sup>10,11</sup> Although quality has improved greatly in recent years, HES data need careful interpretation.<sup>12</sup> A recent comparison of counts of episodes generated through HES and paper returns provided by each hospital trust suggests that the administrative database is capturing 98.9% of all activity.<sup>13</sup> The overall percentage of HES admissions with missing or invalid age, sex, admission method or length of stay was 3.4% in 1996/7 and 2.4% in 2003/4. A comparison between HES and the National Adult Cardiac Surgical Database carried out by the Society of Cardiothoracic Surgeons (SCTS) concluded that statistical correlation of counts of coronary artery bypass graft (CABG) procedures was good, although counts of operations were consistently lower within HES. This could have been due to a stricter definition of what constitutes an isolated CABG used for the HES analysis. It should also be noted that the Cardiac Database used a government funded database collector which is not currently available for the National Vascular Database. For more complex and newer procedures, the OPCS4 coding system used within HES to classify procedures may not be suitable, but a revision of the classification system is now available (OPCS4.3),<sup>14</sup> which may improve the recording of newer types of procedures.

Like many systems for hospital data, HES does not capture out-of-hospital deaths, and this is also true of the NVD. By linking spells together using a number of identifiers, we were able to capture most transfers to

other NHS hospitals, so only deaths following discharges home or to residential homes will be missed. This may account for the slightly higher number of deaths recorded within HES, as the NVD is not able to track patients in this way. Mortality for Infrainguinal bypass was significantly higher within HES overall compared to NVD, but this may reflect particular difficulties in coding for this procedure within HES. In a related issue, survival rates were found to be much higher within the Danish register compared to clinical trial data and this was thought to be due to loss to follow-up in the register.<sup>15</sup> In England, national death certificate data have been recently linked to hospital episode statistics providing date of death (including out of hospital death), which will allow more complete follow-up and longer-term outcomes to be monitored in the future.

Within the NVD for the time period covered in this analysis, there were no records missing age, but 3.3% of records were missing data on whether the patient was discharged alive or dead. More detailed information specific to each index procedure is less well recorded, with for example 26% of records on aneurysms missing information on whether they are ruptured or not. Where the ruptured status of an aneurysm is not recorded, it is inferred from the mode of admission. Differences observed within these groups between HES and the NVD should therefore be interpreted with caution. A similar comparison of data from the Norwegian national vascular registry with a national administrative database found under-reporting of patients operated on for carotid artery stenosis as well as under-reporting of early deaths within their registry.<sup>16</sup>

## Conclusions

Comparison between HES and the NVD shows similar patient demographics for the procedures of aortic aneurysm surgery, carotid endarterectomy and infrainguinal bypass. Mortality rates following surgery in these groups are similar although slightly lower in the NVD. However there are other significant differences in terms of total numbers between HES and the NVD. The NVD is voluntary and as such could be missing as many as 75% of vascular procedures, although some of this difference could be due to miscoding in relation to procedure within HES.

If the NVD is to become a credible source of information on activity and outcomes for vascular surgery, there is a clear need to increase the number of contributing surgeons and to improve the completeness and quality of data submitted. Further analysis at

individual record level to identify other reasons for discrepancies could help to enhance data quality, both within HES and within the NVD. Further collaboration in combining HES and NVD data may be beneficial in improving data accuracy of surgical outcomes following major arterial surgery. With over 100 multicentre clinical databases in the UK alone<sup>8</sup> there is scope for utilising our methods in other specialties, and in other countries where dual systems of reporting exist.

### Competing Interest Statement

PA is employed within the Dr Foster Unit at Imperial. The Dr Foster Unit at Imperial College London is funded by a grant from Dr Foster Ltd (an independent health service research organisation) TL, SB, DP and SA on behalf of the Audit and Research Committee of the Vascular Society of Great Britain and Ireland.

### Contributors

PA, SA and DP were involved in the original research question. DP, PA and SB carried out the data extracts. PA carried out the analysis. PA and TL drafted the paper. All investigators contributed comments on drafts.

### References

- 1 The Bristol Royal Infirmary Inquiry. Learning from Bristol: the report of the public inquiry into children's heart surgery at the Bristol Royal Infirmary 1984–1995. Available from: <http://www.bristol-inquiry.org.uk/>
- 2 BAKER R. Harold Shipman's clinical practice. 1974–1998. London: Stationery Office; 2001.
- 3 AYLIN P, BEST NG, BOTTLE A, MARSHALL C. Following Shipman: a pilot system for monitoring mortality rates in primary care. *The Lancet* 2003;**362**:485–491.
- 4 BRIDGEWATER B, GRAYSON A, JACKSON M, BROOKS N, GROTTI G, KEENAN D *et al*. Surgeon specific mortality in adult cardiac surgery: comparison between crude and risk stratified data. *BMJ* 2003;**327**(7405):13–17.
- 5 Healthcare Commission (2006). Heart surgery in Great Britain. Available at: <http://heartsurgery.healthcarecommission.org.uk/>.
- 6 FINE L, KEOGH B, CRETIN S, ORLANDO M, GOULD M. How to evaluate and improve the quality and credibility of an outcomes database: validation and feedback study on the UK Cardiac Surgery Experience. *BMJ* 2003;**326**:25–28, 2.
- 7 MCKEE M, DIXON J, CHENET L. Making routine data adequate to support clinical audit. *BMJ* 1994;**309**:1246–1247.
- 8 BLACK N, BARKER M, PAYNE M. Cross sectional survey of multicentre clinical databases in the United Kingdom. *BMJ* 2004;**328**:1478.
- 9 The Vascular Society of Great Britain and Ireland. Fourth National Vascular Database Report 2004. Henley-upon-Thames: Dendrite clinical systems; 2005.
- 10 WALSH K, HARRISON N, RENSHAW M. Comparison of the quality of patient data collected by hospital and departmental computer systems. *Health Trends* 1993;**25**(3):105–108.
- 11 DIXON J, SANDERSON C, ELLIOTT P, WALLS P, JONES J, PETTICREW M. Assessment of the reproducibility of clinical coding in routinely collected hospital activity data: a study of two hospitals. *J Pub Health Med* 1998;**20**(1):63–69.
- 12 HANSELL A, BOTTLE A, SHURLOCK L, AYLIN P. Accessing and using hospital activity data. *J Pub Health Med* 2001;**21**(3):51–56.
- 13 HES Data Quality Indicator (DQI) reports for 2003–04. Available from: <http://www.hesonline.nhs.uk/>
- 14 OPCS4.3 Intervention Classification. Available at: <http://www.connectingforhealth.nhs.uk/interventionclassification/>
- 15 JENSEN LP, NIELSON OM, SCHROEDER TV. The importance of complete follow-up for results after femoro-infrapopliteal vascular surgery. *Eur J Vasc Endovasc Surg* 1996;**12**:28–286.
- 16 DAHL T, RUDJORD K, MYHRE HO. Data quality of surgery for carotid artery stenosis. Are the national Vascular Registries Reliable. *Eur J Vasc Endovasc Surg* 2006;**31**:381–385.

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