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RESEARCH ARTICLE

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Assessing national patterns and outcomes of pituitary surgery: is hospital administrative data good enough?

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ABSTRACT

Purpose: Patterns of surgical care, outcomes, and quality of care can be assessed using hospital administrative databases but this requires accurate and complete data. The aim of this study was to explore whether the quality of hospital administrative data was sufficient to assess pituitary surgery practice in England.

Methods: The study analysed Hospital Episode Statistics (HES) data from April 2013 to March 2018 on all adult patients undergoing pituitary surgery in England. A series of data quality indicators examined the attribution of cases to consultants, the coding of sellar and parasellar lesions, associated endocrine and visual disorders, and surgical procedures. Differences in data quality over time and between neurosurgical units were examined.

Results: A total of 5613 records describing pituitary procedures were identified. Overall, 97.3% had a diagnostic code for the tumour or lesion treated, with 29.7% ($n = 1669$) and 17.8% ($n = 1000$) describing endocrine and visual disorders, respectively. There was a significant reduction from the first to the fifth year in records that only contained a pituitary tumour code (63.7%–47.0%, $p < .001$). The use of procedure codes that attracted the highest tariff increased over time (66.4%–82.4%, $p < .001$). Patterns of coding varied widely between the 24 neurosurgical units.

Conclusion: The quality of HES data on pituitary surgery has improved over time but there is wide variation in the quality of data between neurosurgical units. Research studies and quality improvement programmes using these data need to check it is of sufficient quality to not invalidate their results.

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Data quality; hospital administrative data; clinical coding; pituitary; endoscopy; surgery

Introduction

Patterns of surgical care, outcomes, and quality of care can be assessed using hospital administrative data. Hospital Episode Statistics (HES) is the administrative database for National Health Service (NHS) hospitals in England[1] and has been used for various clinical research studies and national quality improvement initiatives, including in neurosurgical programmes.[2–4] Concerns have been expressed about the quality and accuracy of HES data,[5] although there are studies that have demonstrated improvements in data quality.[6] The accuracy with which pituitary surgery is recorded in HES is not known.

Pituitary surgery most commonly involves minimally invasive, trans-nasal surgical techniques for the excision of pituitary tumors. The use of pituitary surgical approaches has extended to other non-adenomatous sellar and parasellar tumors such as craniopharyngioma, Rathke's cysts, and meningiomas.[7] Pituitary tumors come to clinical attention in several ways. They may disturb the normally finely balanced endocrine system by impaired or excessive secretion of hormones. Secretory tumors present clinically as acromegaly, Cushing's disease and rarely, hyperthyroidism and hypergonadism.[8] Prolactinoma is the commonest secretory adenoma for which the mainstay of treatment is medical, although a small number require surgery.[9] Patients may also present acutely unwell with pituitary apoplexy due to acute bleeding in a tumor.[10] Pituitary tumours may present with neurological deficits due to mass effects on neural structures. Clinical features include visual field defects, ophthalmoplegia, headaches, and hypothalamic dysfunction.[11] Incidental pituitary adenomas are increasingly found when patients have cranial imaging for unrelated indications.[10]

Accurate coding of the clinical presentations within HES records may require the entry of several diagnostic codes that capture the complete clinical picture. Similarly, surgical procedures may require the entry of a combinations of codes. However, it is not known if all hospitals enter these data in sufficient detail or if the coding structures adequately reflect surgical approaches or developments in techniques. The aim of our study was to investigate the quality of HES data for pituitary surgery and to explore how it can be used in research, clinical audit, and service evaluation. The study explored the patterns of coding for patients having pituitary surgery in England's 24 adult

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neurosurgical units, including how the various clinical presentations and surgical procedures are recorded. Additional objectives were to compare coding patterns between neurosurgical units and examine changes over time.

Materials and methods

Data

HES contains information on the type, timing and location of procedures, diagnoses, demographic data, and administrative data such as the responsible consultant and their background specialty. Admissions are categorised as either elective or non-elective (which includes emergency admissions and inter-hospital transfers). Procedures are coded using the classification from the UK Office of Population Censuses and Surveys (OPCS version 4) and diagnoses are coded using the International Classification of Diseases (ICD version 10). The most resource-intensive procedure in an episode of care is recorded as the primary procedure and there may be up to 23 secondary procedures. The primary diagnosis describes the main reason for the admission and up to 19 secondary diagnoses can be captured.

A 5-year period of HES data describing admissions to neurosurgery from 1st April 2013 to 31st March 2018 was searched for all pituitary procedures in patients aged 18 years or over. The HES extract was limited to the 24 NHS neurosurgical units that perform pituitary surgery. Pituitary surgery is classified in the OPCS codes using sixteen procedure codes in three categories. The categories included B01 – '*Excision of pituitary gland*', B02 – '*Destruction of pituitary gland*' and B04 – '*Other operations on pituitary gland*' (Table S2, supplementary material).

There are several surgical approaches to sellar and parasellar tumors including microscopic and endoscopic endonasal transsphenoidal surgery (mTSS and eTSS), and transcranial surgery (TCS). An eTSS surgical approach can be captured using several supplementary codes from OPCS category Y76 – '*Minimal access to other body cavity*' (Table S2, supplementary material). The National Clinical Coding Standards – which are produced by NHS Digital to provide guidance to Hospital Coders – specify that eTSS should be coded using the coding rule PCSB1: '*Pituitary excision with skull base reconstruction';* a sequence of supplementary codes that should directly follow the pituitary procedure code, which records an endoscopic skull base repair with mucosal flap (Table S2, supplementary material).[12] There are no other specific coding rules for pituitary surgery, and it is not known if hospitals use other supplementary codes to record mTSS and other technical aspects of the procedures. OPCS code B014 – '*Transcranial hypophysectomy'* is used to code for TCS.

Diagnostic codes for tumors and related clinical conditions for these pituitary procedures included codes for sellar and parasellar tumors, pituitary apoplexy, cerebrospinal fluid leak, endocrine disorders, and visual disturbance (Table S3, supplementary material).

Data quality indicators and analysis

A series of data quality indicators were developed to evaluate data completeness, patterns of procedure coding, and potential sources of error in clinical and administrative data fields. The data quality indicators are summarised in Table S1 (supplementary material).

Indicator 1 examined whether a patient had a neoplastic pituitary tumor or other sellar/parasellar lesion, plus any codes for endocrine disorders or visual disturbance. It was expected that each record would have at least one of these diagnostic codes in the 20 diagnostic fields; if none were found, the patient was assigned to a 'no codes' group. The proportion of diagnostic coding patterns over the study period, between elective and non-elective admissions, and between neurosurgical units were examined, and changes in the proportions of coding patterns were analyzed using Pearson χ^2 tests with a significance level of $\alpha = 0.05$.

Indicator 2 examined the proportions of pituitary operations recorded by procedure type (OPCS categories B01, B02, or B04) and examined differences between neurosurgical units and changes over time. NHS Hospitals are paid a tariff for each admission and several OPCS codes can be applied interchangeably to the excision of pituitary tumors; B041 attracts the highest tariff for mTSS and eTSS and should be used preferentially.[13]

Indicator 3 examined the recording of surgical technique. The proportion of procedures that recorded supplementary codes for eTSS and the proportion that adhered to the National Coding Standard PCSB1 for eTSS and skull base repair was determined. The remaining records were reviewed for additional codes that might be used by hospitals to record mTSS.

Indicator 4 focused on records where pituitary surgery was not the primary procedure. The types of primary procedures recorded were screened for other neurosurgical procedures or coding errors. Neurosurgical procedures were identified using the Neurosurgical National Audit Programme (NNAP) Coding Framework.[4]

Indicator 5 explored the attribution of procedures to consultants and their specialty. Records were checked against the specialist register of neurosurgeons to determine the number of records attributed to non-neurosurgeons.[4] The study reported the total and average number of procedures attributed to each consultant. The proportion of records not attributed to neurosurgery as the main specialty was determined.

Variation in the indicator values of NHS neurosurgical units was examined using funnel plots.[14] In these plots, two funnel limits were used that indicate the ranges within which 95.0% (representing a difference of two standard deviations from the national rate) or 99.8% (representing a difference of three standard deviations) would be expected to fall if the variation was due only to random error. The control limits were calculated using the 'exact' binomial method. Data analysis was performed using Stata, Version 15 (StataCorp LP, College Station, TX) and Microsoft Excel, Microsoft Office 365 Version 2201 (Microsoft Corporation, Redmond, WA, USA).

Results

Between April 2013 and March 2018, a total of 5613 pituitary procedures were identified, of which 89.7% ($n = 5{,}034$) were elective and 10.3% ($n = 579$) were non-elective. The annual number of procedures was stable over the 5-year period.

For Indicator 1 that assessed whether records contained a relevant diagnostic code, only 2.7% of records did not describe the target of the procedure (Table 1). Pituitary adenomas (D352 – benign, D443 – uncertain, C751 – malignant) comprised 85.7% ($n = 4808/5613$) of all pathology.

Table 2 shows the different patterns of diagnostic codes that were found in HES. Overall, 29.7% ($n = 1669/5613$) of cases recorded endocrine disorders and 17.8% ($n = 1000/5613$) visual disturbance. In cases of pituitary adenoma, 28.7%

Table 1. Types of pituitary tumors, other sellar and parasellar tumors, or surgical indications treated by trans-sphenoidal surgery

ICD-10 diagnostic codes recorded	Number of cases	Proportion (%)
D35.2 – Benign neoplasm: Pituitary gland	4683	83.4
E23.6 – Other disorders of pituitary gland incl. Rathke's cyst	265	4.7
D35.3, C75.2, D44.4 – Benign, malignant, or uncertain neoplasm of the craniopharyngeal duct.	258	4.6
D44.3 – Neoplasm of uncertain or unknown behavior: pituitary gland	86	1.5
C75.1 – Malignant neoplasm: Pituitary gland	39	0.7
G93.0 – Cerebral cysts	12	0.2
Other sellar/parasellar tumor or indications for surgery (Table S2)	116	2.1
Not recorded	154	2.7
Total	5613	100

ICD-10: International classification of diseases, version 10.

Table 2. Diagnostic coding patterns grouped by type of lesion and clinical diagnoses.

Coding pattern	Number of procedures	Proportion (%)
Pituitary tumor		
Tumor code only	3071	54.7
+endocrine disorder	1312	23.4
+visual disturbance	776	13.8
+endocrine disorder and visual disturbance	184	3.3
Total	5343	95.2
Other sellar/parasellar tumor or indications for surgery		
Tumor code/surgical indication only	58	1.0
+endocrine disorder	31	0.6
+visual disturbance	22	0.4
+endocrine disorder and visual disturbance	5	0.1
Total	116	2.1
No tumor/other indication		
+endocrine disorder	128	2.3
+visual disturbance ± endocrine disorder	13	0.1
Total	141	2.5
No codes recorded	13	0.2
Total	5613	100

($n = 1380/4808$) recorded endocrine disorders and 17.6% ($n = 844/4808$) visual disturbance.

Between April 2013 and March 2018, there was a reduction from 63.7% to 47.0% ($p < .001$) in the proportion of records that only contained a pituitary tumor (or other lesion) code and no data on endocrine disorders or visual disturbance (Figure 1). There was an annual increase in the proportion of records containing codes for either endocrine disorders, visual disturbance, or both. There was a wide variation in the proportion of records at each neurosurgical unit that contained a pituitary tumor (or other lesions) code alone (Figure 2) and this variation was not associated with the volume of procedures performed. The coding patterns for each unit are shown in Figure S1 (supplementary material).

Among non-elective admissions, a larger proportion of patients had a pituitary tumor (or other lesion) code associated with visual disturbance compared to elective admissions (28.7% vs 11.7, $p < .001$). Differences between the other coding patterns were small (Table S4, supplementary material).

Indicator 2 showed that procedure codes B012 – '*Trans-sphenoidal hypophysectomy*' and B041 – '*Excision of lesion of pituitary gland*' were used in 92.2% of procedures overall. B041 attracts a higher tariff when used for eTSS and mTSS and its use increased from 66.4% to 82.4% ($p < .001$) of all procedures (Figure 3). There was wide variation between units with some recording over 90% of procedures as B041 and several less than 20%, with two recording under 10% (Figure 4). As with diagnostic coding, there was no association with the volume of procedures performed. Only 10 procedures were TCS (B014 – '*Transcranial hypophysectomy*'). The pattern of procedure coding in each unit is shown in Figure S2 (supplementary material).

Indicator 3 analyzed the recording of surgical technique. Supplementary codes describing eTSS were found in 76.9% of records, overall and this increased from 69.8% to 80.5% over the study period ($p < .001$). Only 6.1% ($n = 343/5613$) of all procedures were coded in accordance with the National Clinical Coding Standards rule PCSB1 for eTSS with skull base repair. There was no significant change in this proportion over time.

Indicator 4 found that pituitary procedures were not the primary (most resource-dependent) procedure in only 51 records (0.9%). The primary procedures were mostly other surgical approaches to lesions of the brain. Only a small number of records contained errors, such as a diagnostic procedure as the primary procedure instead of pituitary surgery.

Attribution of procedures to consultants and their background specialty were examined by Indicator 5. Most cases (98.1%, $n = 5508/5613$) were attributed to neurosurgery as the main specialty. Ear, Nose, and Throat (ENT) surgery was the main specialty in 1.1% ($n = 62/5613$) of records and 0.8% ($n = 43/5613$) of records were attributed to various other specialties. Data for the responsible consultant was not available for 2013–14. From 2014–18 (4 years), 4483 procedures were attributed to 156 different consultants. One hundred consultants were attributed five or less procedures and most had only one. Of these, 32 were not neurosurgeons. The mean number of procedures performed by consultants with more than five cases was 80.3 (SD 77.5) – approximately 20 per annum.

Discussion

Hospital administrative data is commonly used to measure surgical outcomes and evaluate the practice of hospitals or surgeons.[3,4]

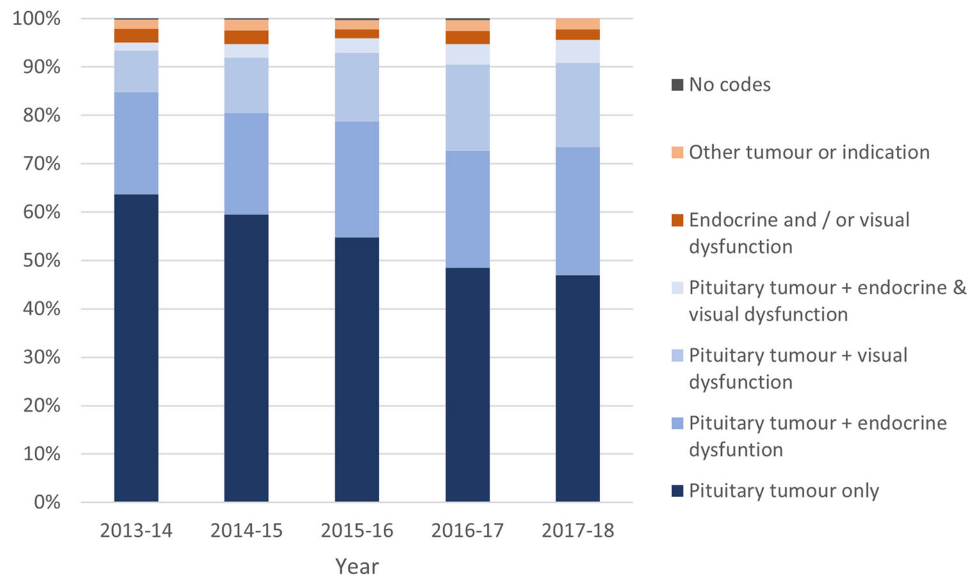

Figure 1. Changes in diagnostic coding patterns for pituitary surgery over five years ($p < .001$).

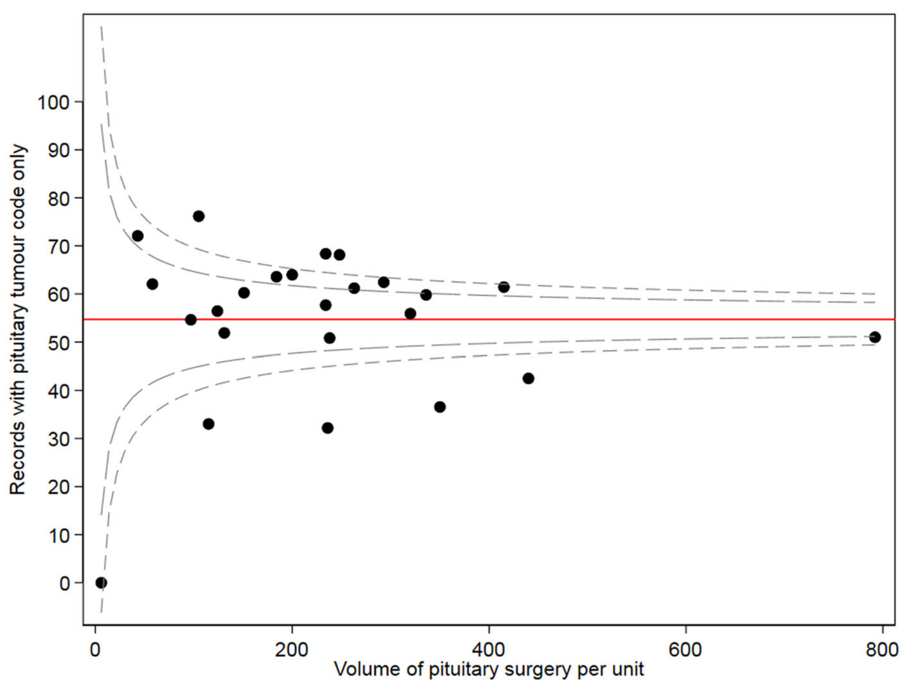

Figure 2. Funnel plot showing the proportion of records that contain a pituitary tumor code and no codes for an associated diagnosis against the volume of procedures performed in each neurosurgical unit in England. The inner and outer control limits are 2 and 3 SDs from the mean, respectively.

These assessments rely on accurate data, and the investigation of data quality is an important step when developing quality indicators and outcome measures.[15]

Studies on pituitary surgery using administrative data can be limited by a lack of granularity and missing data.[16,17] In this evaluation, we found the quality of HES data on conditions associated with pituitary tumors has improved significantly between April 2013 and March 2018, as had the recording of procedure codes. Over 97% of records contained a diagnostic code for the pituitary tumor or lesion being treated, as described by Indicator 1. Pituitary adenomas comprised 85.7% of all cases and the other 14.3% were non-adenomatous sellar or parasellar tumors, CSF leaks or pituitary apoplexy. The availability of information on the types of pathology treated, with a high level of data completeness, means that HES data could be used to describe the epidemiology of surgical practice, variation in treatment patterns across the country and provide information for service configuration in the context of low-volume and ultra-low volume surgery for sellar and parasellar pathology. The proportion of non-adenomatous tumors in this study is similar to a large radiological series of sellar and parasellar mass lesions (18% non-adenomatous lesions)[18] although less than a large surgical series (25% non-adenomatous lesions).[19] This suggests that HES contains reasonably reliable information on surgical pathology.

Indicator 1 also explored records for information on associated diagnoses. Endocrine disorders were recorded in 29.7% of

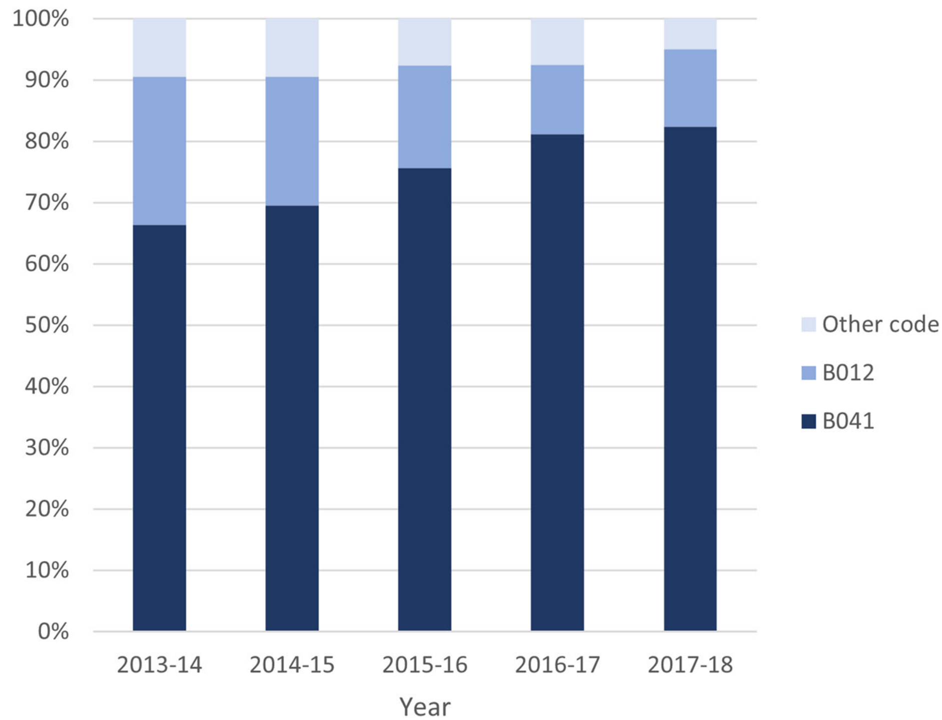

Figure 3. Changes in the use of procedure codes for pituitary surgery over 5 years ($p < .001$). B041 attracts a higher tariff than B012 for trans-sphenoidal excision of pituitary tumor.

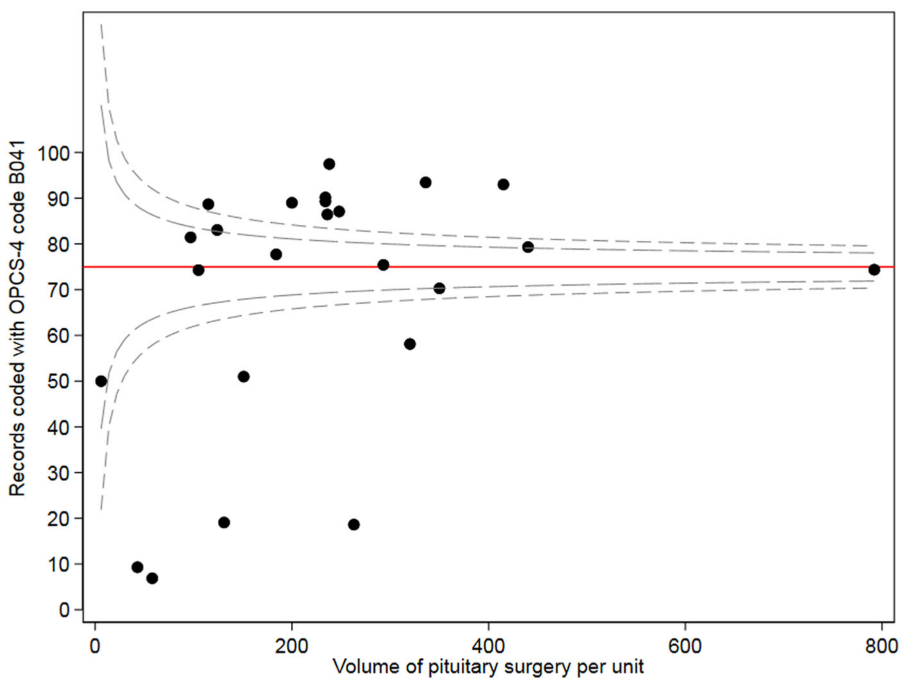

Figure 4. Funnel plot showing the proportion of records that use OPCS-4 code B041 to record pituitary surgery against the volume of procedures performed in each neurosurgical unit in England. The inner and outer control limits are 2 and 3 SDs from the mean, respectively.

all cases and in 28.7% of pituitary adenomas, with an increase in the reporting of this information between April 2013 and March 2018. Observational studies using administrative data from other countries have reported similar proportions of cases recording endocrine disorders; studies from Australia, Japan, and Finland reported functioning adenoma rates of 23.7%, 33.1%, and 44%, respectively.[20–22] In addition, the results of a recent UK multi-centre, prospective study on TSS reported a functioning adenoma rate of 32%. This suggests that HES data is nearing data completeness with respect to the reporting of endocrine disorders.

Visual disturbance is probably poorly reported in HES. Overall, 17.8% of all records reported it and although this proportion increased over the study period, it is a significantly lower figure than in clinical studies.[23] Moreover, it would not be possible to determine from HES if a patient had pre-operative visual disturbance and a new or worse postoperative deficit. Therefore, HES is not likely to be useful for deriving outcomes related to the visual disturbance for pituitary surgery.

There are clinical scenarios in which additional diagnostic information may not appear in HES; these include surgery for incidental pituitary tumors, serial tumor growth, tumor recurrence, or other tumor effects such as hypothalamic disorders.[8,24–26] In some instances, appropriate diagnostic codes do not exist or are not easily identified within ICD-10.

Indicators 2, 3, and 4 examined several aspects of procedure coding. Pituitary surgery was readily identified in HES across the 24 neurosurgical units. OPCS codes B041 (*'excision of lesion of pituitary gland'*) and B012 (*'trans-sphenoidal hypophysectomy'*) can be used interchangeably for both eTSS and mTSS, although B041 attracts a much higher tariff for the same operation.[27,28] The increased use of B041 over the study period means that more operations attracted the higher tariff, but the wide variation in coding practices between units suggests that some units are losing out financially.

Evaluation of the coding of technical aspects of the surgical approaches demonstrated some limitations of the OPCS codes for pituitary surgery. The use of supplementary codes to describe eTSS has increased with time, which is likely to reflect improved recording of these codes but could also be due to increasing uptake of endoscopic surgery. Several studies have reported increasing use of eTSS over mTSS and TCS,[20,21,29] although the relative outcomes of the approaches are yet to be fully established.[30] In the absence of codes specific to mTSS, it is not possible to confidently determine the precise prevalence of each technique, although at least 76.9% of pituitary surgery in England was eTSS.

Only 6.1% of records contained the specific series of codes outlined in national guidance on clinical coding for eTSS with skull base repair using a mucosal flap. The recent Delphi consensus paper on eTSS for pituitary adenomas described the numerous variations in approach, technique, and materials used.[31] Given the heterogeneity in the approach to skull base repair, the coding rule might only be applicable in limited circumstances, and it may be challenging for clinical coders to interpret when to apply the rule. HES data would not be helpful for evaluating surgical practice with respect to these technical aspects.

The attribution of procedures to individual surgeons was examined by Indicator 5. The attribution of cases in HES may be inaccurate,[32] and this becomes more complicated when more than one consultant was involved in a procedure. One hundred surgeons had less than five attributed pituitary procedures and about a third of these were not neurosurgeons. Evaluating surgeon-level performance when the majority of surgeons have low procedure numbers – and when there are errors in case attribution – will not produce statistically valid outcomes.[33] Moreover, quality of care depends not only on the surgeon but the wider clinical team and processes of the institution.[34,35] As such, unit-level figures are likely to be more reliable for quality assurance programmes using HES data.[32]

Supporting improvements in data quality

The quality of pituitary surgery data in HES has improved at a national level over time but there were significant variations in data quality between neurosurgical units. Inherent variability in the prevalence of associated diagnoses and variation in treatment paradigms between units would be expected, but this is unlikely to account for the variation observed. Some units were simply better than others at coding this information. This may arise due to differences in local coding practices, such as the extent of clinician involvement in coding and the employment of specialty-specific or general clinical coders.[36] Inter-provider variability in the quality of coding is recognised as a confounder in the evaluation of outcomes based on HES data.[37]

Improvements in coding quality can be supported by clinicians engaging with coding processes[38] and there are several incentives for surgeons to take an active interest. As described, the findings of audit and research will be more reliable if based on good quality data, helping to identify clinically important trends or outcomes. Clear documentation of the surgical pathology and any endocrine disorders or visual disturbance either on the operation note or discharge documents is likely to improve the recording of this information. There are also significant financial benefits to be gained from coding procedures appropriately. The results of this study suggest that there needs to be more awareness of the importance of coding practices to support good-quality data and ensure appropriate remuneration for neurosurgical services.

Data quality issues can be addressed at a national level. Hospital Coders use nationally distributed guidance and may develop expertise in certain areas. The codes and the guidance are developed by NHS Digital's Case-mix Service. Where there is a need to develop new coding strategies this is done with a clinical expert from the specialist area working with the Case-mix Service.

Limitations

This study was an internal evaluation of data patterns and completeness in HES. This study was limited by the fact that tumor-associated conditions cannot be distinguished from unrelated comorbidity or postoperative complications in HES. This is a potential source of over-estimation of endocrine disorders and visual disturbance rates. This study did not report on secretory adenoma subtypes because estimates could have been inaccurate due to missing data. Histology information is not included in HES and estimations about the incidence of pituitary pathology relies on it having been coded accurately using ICD-10 codes, based on information in the hospital clinical records.

Conclusions

This study examined the quality of the diagnostic, procedure, and administrative coding of pituitary surgery in English HES data. The quality of data on conditions associated with pituitary tumors improved significantly between April 2013 and March 2018. The recording of procedure codes and surgical technique codes have also improved. However, there is wide variation in the quality of data between neurosurgical units in the NHS in England. Greater awareness of the importance of data quality is needed to improve the reliability of research studies and quality improvement programmes, and to ensure appropriate remuneration of neurosurgical units. Further research should focus on evaluating the use of HES data to develop quality indicators for pituitary surgery. The data may be useful for assessing outcomes from surgery on tumor sub-types and volume-outcome relationships.[30,39]

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Author contributions

AW contributed to study conception, design, data acquisition, data analysis, data interpretation, writing – draft preparation and revision. DC contributed to study conception, design, data acquisition, data interpretation, writing – revision. PH contributed to data interpretation, writing – revision. RM contributed to data interpretation, writing – revision. NP contributed to design, data interpretation, writing – revision. All authors read and approved the final manuscript.

Ethical approval

The study is exempt from UK National Research Ethics Service (NRES) approval because it involved the analysis of an existing data set of anonymized data for service evaluation. HES data were made available by NHS Digital (Copyright 2022, re-used with the permission of NHS Digital. All rights reserved). Approvals for the use of anonymized HES data were obtained as part of the standard NHS Digital data access process.

Disclosure statement

The authors have no competing interests to report that are relevant to the content of this article.

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Data availability statement

No additional data are available.

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