Improving the accuracy of HES comorbidity codes by better documentation in surgical admission proforma

Background: Poor documentation in medical notes can affect the quality of the source document for coding which can lead to inaccurate coding. This study aimed to determine the accuracy of Hospital Episode Statistics (HES) data for comorbidities and to establish whether better documentation in admission clerking proforma can improve the accuracy of codes for comorbidities in general surgical patients.

Methods: A clinical audit was conducted to assess the accuracy, sensitivity, specificity, positive predictive value and negative predictive value of HES codes for comorbidities in general surgical patients before and after implementing better documentation in admission clerking proforma. The following comorbidities were included: hypertension, ischaemic heart disease, diabetes, asthma, chronic obstructive pulmonary disease, cerebrovascular disease, chronic kidney disease and hypercholesterolaemia. Medical notes were used as reference standard and a target standard of 98% was determined for the above measures.

Results: Overall, on the initial audit, HES codes had substandard accuracy (90.5%, kappa = 0.599), sensitivity (47.71%, 95% confidence interval 38.05–57.49%) and negative predictive value (89.60%, 95% confidence interval 86.73–92.03%). HES codes for comorbidities were 100% specific with positive predictive value of 100%. Implementing better documentation in the admission clerking proforma improved the accuracy (99.67%, kappa = 0.985), sensitivity (97.4%, 95% confidence interval 90.93–99.68%) and negative predictive value (99.62%, 95% confidence interval 98.63–99.95%) significantly from the baseline ($P<0.0001$).

Conclusions: Although HES codes can confidently predict the actual presence of the comorbidities, they have substandard accuracy and ability to rule out the presence of the comorbidities. Better documentation in clerking proforma can improve the accuracy and 'ruling out' ability of the HES codes. This can be achieved by improving knowledge and accountability of clinicians about documenting comorbidities.

Hospital Episode Statistics (HES; www.hscic.gov.uk/hes) is a data warehouse processing over 125 million admitted patient, outpatient, and accident and emergency records each year. It contains clinical, administrative, geographical and demographic information about an individual patient. The diagnostic, procedural and comorbidity data are coded using the *International Classification of Diseases* (10th revision) (ICD-10) (World Health Organization, 2010) and operations are coded using the *Office of Population Censuses and Surveys Surgical Operations and Procedures* (4th edition) (OPCS-4) (Health and Social Care Information Centre, 2014).

HES is commonly used by researchers. There have been concerns about the validity and accuracy of HES data for diagnoses (Patrick et al, 2013) and procedures (Macaulay et al, 1996). It has been argued that HES contains insufficient clinical detail to be used to monitor health service outcomes (Lee et al, 2002). However, accuracy rates of routinely collected data have improved in recent years (Burns et al, 2012).

Implementation of the generic medical record keeping standards, together with completion of information under the structure and content standards headings in admission and discharge proforma, helps to improve the efficiency of clinical coding (Royal College of Physicians, 2008). However, poor documentation in medical notes can affect the quality of the source document for coding which in turn can lead to inaccurate coding even when the coding practice is efficient.

The validity of HES data for comorbidities is not known. Recently, there has been an effort to increase coding accuracy of comorbidities. This study aimed to determine the accuracy of HES data for comorbidities and to establish whether better documentation in admission clerking proforma can improve the accuracy of codes for comorbidities in general surgical patients.

Methods

Upon gaining approval from the Clinical Governance Development Unit, a clinical audit was conducted in the general surgery department of a district general hospital. As this was an audit approval was not sought from the ethics committee. The audit loop was completed with two cycles. The baseline audit included randomly selected patients, using random number generator software, from a cohort of patients aged over 18 years admitted to the surgical assessment unit between 20 November 2014 and 1 January 2015.

For each patient, the comorbidity data were extracted from the clinical notes and compared with the corresponding data in the HES database to assess the accuracy of HES data. The clinicians in charge of clerking in the surgical assessment unit were educated about appropriate documentation of the comorbidities in the clerking proforma, and their performance was monitored daily by an on-call junior doctor at the end of each shift to identify inadequately completed proforma.

The re-audit was undertaken to establish whether better documentation of

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comorbidities in admission clerking proforma had led to improvements in the accuracy of HES data. The re-audit included patients admitted to the surgical assessment unit between 1 April 2015 and 10 May 2015.

Outcome measures and standards

The outcome measures were accuracy, Cohen's kappa index value (as a more robust measure of agreement), sensitivity, specificity, positive predictive value and negative predictive value of HES codes for comorbidities. The ultimate target for data accuracy is 100%. However, to be realistic, considering the highest data accuracy recorded in the literature (Burns et al, 2012), 98% was determined as the target standard.

Comorbidities

The following comorbidities were considered: hypertension, ischaemic heart disease, diabetes, asthma, chronic obstructive pulmonary disease, cerebrovascular disease, chronic kidney disease and hypercholesterolaemia (*Table 1*). These were chosen as they are common comorbidities that are on the list of 25 chronic diseases to be coded.

Data collection

All parts of the clinical notes were searched for comorbidities independently by two authors (Shahab H, AN). Any discrepancies were resolved by discussion between the authors. An independent third author (JM) was consulted in the event of disagreement. The data from the medical notes were compared with the HES data for each individual patient. This involved obtaining identifiable data from the HES database based on the individual patient's allocated hospital number, and time and date of admission and discharge.

Implementation of better documentation

The action plans, which were implemented between 1 April 2015 and 10 May 2015, included:

Education

The clinicians in charge of clerking in the surgical assessment unit underwent two practical training sessions. The first session involved 1 hour of training about appropriate completion of the 'past medical history' and the 'comorbidities' sections of the clerking proforma. The second session involved 1 hour of training about effective use of available sources of information regarding patients' comorbidities such as electronic discharge summary letters, clinic letters and summary care records.

Monitoring

The performance of individual clinicians in completing the proforma was monitored daily by an on-call junior doctor at the end of each shift to identify inadequately completed proforma. The results were provided as feedback to the individual clinician for better compliance.

Completing the clerking proforma

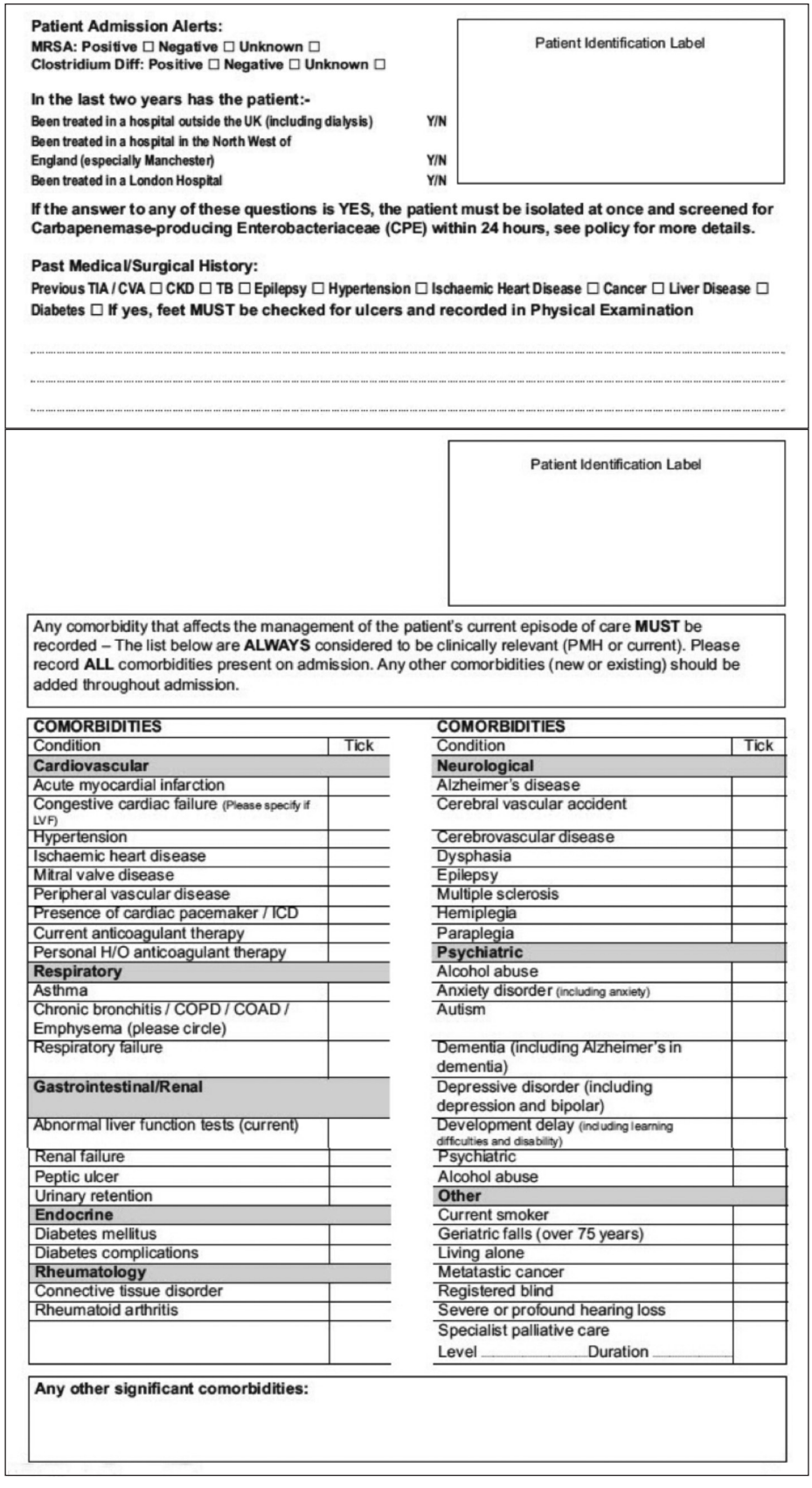
The admission clerking proforma were in paper format and were completed by junior doctors who had undergone the training sessions. While completing the proforma at initial clerking, the information about patients' comorbidities was obtained from the patients, electronic discharge summary letters, clinic letters and summary care records. The obtained data were written in the space provided in the 'past medical history' section of the proforma and the corresponding boxes in the 'comor-

Table 1. Diagnostic criteria for individual comorbidity

Chronic condition	Definition	
Chronic obstructive pulmonary disease	Doctor diagnosis of one of the following	Chronic obstructive pulmonary disease, emphysema
	Lung function test confirming chronic obstructive airway disease	
Asthma	Doctor diagnosis	
Chronic kidney disease	Doctor diagnosis of one of the following	Renal failure
		Nephritic syndrome
		Dialysis
		End stage renal disease
Diabetes	Doctor diagnosis of one of the following	Type 1 (insulin)
		Type 2 (non-insulin dependant)
		Type 3 (other types, e.g. malnutrition related)
	On following medications	Insulin, oral glycaemics, e.g. metformin, gliclazide
	Blood test	
Hypertension	Doctor diagnosis, 24-hour tape	
Hypercholesterolaemia	Doctor diagnosis, blood test	
Coronary heart disease	Doctor diagnosis of one of the following	Angina
		Myocardial infarction
		Congestive cardiac failure
		Left ventricular heart failure
		Cardiac arrest
	Has had any of the following surgery	Coronary artery angioplasty
		Coronary artery bypass
	On the following medication	Glyceryl trinitrate spray, other nitrates, ivabradine
	Coronary intervention (any)	
Cerebrovascular disease	Doctor diagnosis of one of the following	Transient ischaemic attack
		Stroke, amaurosis fugax

bidity' section of the proforma were ticked. The relevant sections of the admission clerking proforma which were used in this study are shown in *Figure 1*.

Figure 1. The relevant sections of the clerking proforma.



Patient Admission Alerts:
MRSA: Positive ☐ Negative ☐ Unknown ☐
Clostridium Diff: Positive ☐ Negative ☐ Unknown ☐

Patient Identification Label

In the last two years has the patient:-

Been treated in a hospital outside the UK (including dialysis)	Y/N
Been treated in a hospital in the North West of England (especially Manchester)	Y/N
Been treated in a London Hospital	Y/N

If the answer to any of these questions is YES, the patient must be isolated at once and screened for Carbapenemase-producing Enterobacteriaceae (CPE) within 24 hours, see policy for more details.

Past Medical/Surgical History:
Previous TIA / CVA ☐ CKD ☐ TB ☐ Epilepsy ☐ Hypertension ☐ Ischaemic Heart Disease ☐ Cancer ☐ Liver Disease ☐ Diabetes ☐ If yes, feet MUST be checked for ulcers and recorded in Physical Examination

Patient Identification Label

Any comorbidity that affects the management of the patient's current episode of care **MUST** be recorded – The list below are **ALWAYS** considered to be clinically relevant (PMH or current). Please record **ALL** comorbidities present on admission. Any other comorbidities (new or existing) should be added throughout admission.

COMORBIDITIES	
Condition	Tick
Cardiovascular	
Acute myocardial infarction	
Congestive cardiac failure (Please specify if LVF)	
Hypertension	
Ischaemic heart disease	
Mitral valve disease	
Peripheral vascular disease	
Presence of cardiac pacemaker / ICD	
Current anticoagulant therapy	
Personal H/O anticoagulant therapy	
Respiratory	
Asthma	
Chronic bronchitis / COPD / COAD / Emphysema (please circle)	
Respiratory failure	
Gastrointestinal/Renal	
Abnormal liver function tests (current)	
Renal failure	
Peptic ulcer	
Urinary retention	
Endocrine	
Diabetes mellitus	
Diabetes complications	
Rheumatology	
Connective tissue disorder	
Rheumatoid arthritis	

COMORBIDITIES	
Condition	Tick
Neurological	
Alzheimer's disease	
Cerebral vascular accident	
Cerebrovascular disease	
Dysphasia	
Epilepsy	
Multiple sclerosis	
Hemiplegia	
Paraplegia	
Psychiatric	
Alcohol abuse	
Anxiety disorder (including anxiety)	
Autism	
Dementia (including Alzheimer's in dementia)	
Depressive disorder (including depression and bipolar)	
Development delay (including learning difficulties and disability)	
Psychiatric	
Alcohol abuse	
Other	
Current smoker	
Geriatric falls (over 75 years)	
Living alone	
Metatastic cancer	
Registered blind	
Severe or profound hearing loss	
Specialist palliative care Level ____ Duration ____	

Any other significant comorbidities:

Sustaining the improved documentation

In order to maintain better documentation of comorbidities, the aforementioned training sessions will take place for all new rotating clinicians at the start of their rotation. Moreover, the comorbidity section of the clerking proforma will be checked for completion by the nursing staff in the surgical assessment unit for each admission and incomplete proforma will be referred back to the individual clinician. The performance of each clinician in completing each section of the clerking proforma is checked daily by the on-call junior doctor at the end of each shift.

Data analysis

A systematic review of studies investigating the accuracy of hospital episode data from different countries showed median diagnostic accuracy of 80% (Burns et al, 2012). Considering the target accuracy, a 20% improvement was predicted. Therefore it was estimated that a minimum number of 150 patients (75 for the baseline audit and 75 for the re-audit) would be required to achieve 80% power (α=0.05) to detect 20% difference between two groups.

Individual patients were used as the unit of analysis. Patients' notes, known as the 'gold standard' reference (Burns et al, 2012), were used as the reference standard to calculate the outcomes. Therefore, a false negative was defined when a comorbidity was present in the medical notes but absent in the HES database. A false positive was defined when a comorbidity was absent in the medical notes but present in the HES database. Accuracy was calculated as the sum of the true positive and negatives divided by the sum of both true and false positives and negatives. The difference in the outcomes between the baseline and re-audit was analysed by the Pearson chi square test. The 95% confidence level was used to indicate statistical significance.

Results

Between 20 November 2014 and 1 January 2015, 994 adult general surgical patients admitted to the surgical assessment unit were identified, of which 75 were selected for the baseline audit. Another 75 of 856 adult patients admitted to the surgical

assessment unit between 1 April 2015 and 10 May 2015 were selected for the re-audit.

The baseline audit

The overall accuracy of HES codes for all the comorbidities was below the 98% standard (overall accuracy = 90.5%, kappa = 0.599) (*Tables 2* and *3*). When calculated for any of the comorbidities, the accuracy was still substandard: 86.67% (kappa = 0.693) for hypertension, 94.67% (kappa = 0.687) for ischaemic heart disease, 96% (kappa = 0.865) for diabetes, 90.67% (kappa = 0.494) for asthma, 96% (kappa = 0.802) for chronic obstructive pulmonary disease, 89.33% (kappa = 0.302) for cerebrovascular disease, 94.67% (kappa = 0.479) for chronic kidney disease and 76% (kappa = 0.14) for hypercholesterolaemia.

Moreover, the sensitivity of HES codes was also below the standard: 47.71% for all the comorbidities (overall), 64.29% for hypertension, 55.56% for ischaemic heart disease, 80% for diabetes, 36.36% for asthma, 70% for chronic obstructive pulmonary disease, 20% for cerebrovascular disease, 33.33% for chronic kidney disease and 10% for hypercholesterolaemia.

HES codes were 100% specific for any of the comorbidities with a positive predictive value of 100%. Unlike the positive predictive value, the negative predictive value of HES codes was substandard: 89.60% for all comorbidities (overall), 82.46% for hypertension, 94.29% for ischaemic heart disease, 95.24% for diabetes, 90.14% for asthma, 95.59% for chronic obstructive pulmonary disease, 89.04% for cerebrovascular disease, 94.52% for chronic kidney disease and 75.34% for hypercholesterolaemia.

Table 2. Accuracy and Cohen's kappa index of HES codes for comorbidities

		Baseline	Re-audit	Improvement	*P* value†
Accuracy	Hypertension	86.67% (76.97–92.97)	100%	13.33%	0.0011
	Ischaemic heart disease	94.67% (86.67–98.31)	100%	5.33%	0.0426
	Diabetes	96% (88.42–99.10)	100%	4%	0.0802
	Asthma	90.67% (81.69–95.68)	100%	9.33%	0.0067
	COPD	96% (88.42–99.10)	100%	4%	0.0802
	Cerebrovascular disease	89.33% (80.10–94.74)	98.67% (92.13–>99.99)	9.34%	0.0161
	Hypercholesterolaemia	76% (65.14–84.33)	98.67% (92.13–>99.99)	22.67%	< 0.0001
	Chronic kidney disease	94.67% (86.67–98.31)	100%	5.53%	0.0426
	Overall	90.5% (87.88–92.61)	99.67% (98.71–>99.99)	9.17%	<0.0001
Cohen's kappa index	Hypertension	0.693 (0.524–0.862)	1	0.307	<0.0001
	Ischaemic heart disease	0.687 (0.404–0.971)	1	0.313	<0.0001
	Diabetes	0.865 (0.716–1.000)	1	0.135	<0.0001
	Asthma	0.494 (0.186–0.802)	1	0.506	<0.0001
	COPD	0.802 (0.586–1.000)	1	0.198	<0.0001
	Cerebrovascular disease	0.302 (-0.025–0.630)	0.94 (0.823–1.000)	0.638	<0.0001
	Hypercholesterolaemia	0.14 (-0.037–0.317)	0.902 (0.712–1.000)	0.762	<0.0001
	Chronic kidney disease	0.479 (0.055–0.903)	1	0.521	<0.0001
	Overall	0.599 (0.508–0.690)	0.985 (0.964–1.000)	0.386	<0.0001

† Pearson chi square test was used for comparison of proportions. Confidence level in brackets is 95%. COPD = chronic obstructive pulmonary disease; HES = Hospital Episode Statistics.

The re-audit

The overall accuracy of HES codes for comorbidities improved to 99.67% (kappa = 0.985) which was significantly different from the baseline audit ($P<0.0001$) (*Tables 2* and *3*). The accuracy of HES codes for any comorbidity improved to more than the 98% standard: 100% (kappa = 1) for ischaemic heart disease, 100% (kappa = 1) for diabetes, 100% (kappa = 1) for asthma, 100% (kappa = 1) for chronic obstructive pulmonary disease, 98.67%% (kappa = 0.940) for cerebrovascular disease, 100% (kappa = 1) for chronic kidney disease and 98.67% (kappa = 0.902) for hypercholesterolaemia.

The overall sensitivity improved from 47.71% to 97.4% which was just under the 98% target. The sensitivity of HES codes for hypertension, ischaemic heart disease, diabetes, asthma, chronic obstructive pulmonary disease and chronic kidney disease improved to 100%. The sensitivity of codes for cerebrovascular disease and hypercholesterolaemia improved significantly from baseline by 70% and 73.33% respectively, but did not reach the 98% standard. HES codes for all the comorbidities remained 100% specific with positive predictive value of 100%. Moreover, the negative predictive value for all the comorbidities met the 98% standard.

Discussion

The baseline audit of 75 general surgical patients showed that HES codes can confidently predict the actual presence of comorbidities; however, they have substandard accuracy and ability to rule out the presence of the comorbidities. Improving the documentation of comorbidities in the admission clerking proforma resulted in significant improvements in accuracy, sensitivity and negative predictive value of HES codes for comorbidities.

The accuracy of HES codes for comorbidities has been investigated by different studies. Inaccurate coding of comorbidities and complications in patients undergoing primary total knee arthroplasty has been reported by Mont et al (2002). On the other hand, Januel et al (2011) demonstrated that the accuracy and reliability of comorbidity codes has improved since the introduction of ICD-10 administrative

data. Powell et al (2001) showed that comorbidities were underreported in administrative data based on hospital discharge codes in patients with heart disease (median false negative rate of 49.5% and false positive rate of less than 1.5%).

The baseline accuracy in the current study was consistent with the accuracy reported by other studies (Burns et al,

Table 3. Sensitivity, specificity, positive predictive value and negative predictive value of HES codes for comorbidities

		Baseline	Re-audit	Improvement	*P* value†
Sensitivity	Hypertension	64.29% (44.07–81.36)	100% (83.16–100)	35.71%	0.0027
	Ischaemic heart disease	55.56% (21.20–86.30)	100% (69.15–100)	44.44%	0.0177
	Diabetes	80% (51.91–95.67)	100% (66.37–100)	20%	0.1515
	Asthma	36.36% (10.93–69.21)	100% (69.15–100)	63.64%	0.0020
	COPD	70% (34.75–93.33)	100% (59.04–100)	30%	0.1103
	Cerebrovascular disease	20% (2.52–55.61)	90% (55.50–99.75)	70%	0.0017
	Hypercholesterolaemia	10% (1.23–31.70)	83.33% (35.88–99.58)	73.33%	0.0004
	Chronic kidney disease	33.33% (4.33–77.72)	100% (47.82–100)	66.77%	0.0221
	Overall	47.71% (38.05–57.49)	97.4% (90.93–99.68%)	49.69%	<0.0001
Specificity	Hypertension	100% (92.45–100)	100% (93.51–100)	0%	–
	Ischaemic heart disease	100% (94.56–100)	100% (94.48–100)	0%	–
	Diabetes	100% (94.04–100)	100% (94.56–100)	0%	–
	Asthma	100% (94.40–100)	100% (94.48–100)	0%	–
	COPD	100% (94.48–100)	100% (94.72–100)	0%	–
	Cerebrovascular disease	100% (94.48–100)	100% (94.48–100)	0%	–
	Hypercholesterolaemia	100% (93.51–100)	100% (94.79–100)	0%	–
	Chronic kidney disease	100% (94.79–100)	100% (94.87–100)	0%	–
	Overall	100% (99.25–100)	100% (99.30–100)	0%	–
Positive predictive value	Hypertension	100% (81.47–100)	100% (83.16–100)	0%	–
	Ischaemic heart disease	100% (47.82–100)	100% (69.15–100)	0%	–
	Diabetes	100% (73.54–100)	100% (66.37–100)	0%	–
	Asthma	100% (39.76–100)	100% (69.15–100)	0%	–
	COPD	100% (59.04–100)	100% (59.04–100)	0%	–
	Cerebrovascular disease	100% (15.81–100)	100% (66.37–100)	0%	–
	Hypercholesterolaemia	100% (15.81–100)	100% (47.82–100)	0%	–
	Chronic kidney disease	100% (15.81–100)	100% (47.82–100)	0%	–
	Overall	100% (93.15– 100)	100% (95.20–100)	0%	–
Negative predictive value	Hypertension	82.46% (70.09–91.25)	100% (93.51–100)	17.54%	0.0011
	Ischaemic heart disease	94.29% (86.01–98.42)	100% (94.48–100)	5.52%	0.0504
	Diabetes	95.24% (86.71–99.01)	100% (94.56–100)	4.76%	0.0728
	Asthma	90.14% (80.74–95.94)	100% (94.48–100)	9.86%	0.0471
	COPD	95.59% (87.64–99.08)	100% (94.72–100)	4.41%	0.0799
	Cerebrovascular disease	89.04% (79.54–95.15)	98.48% (91.84–99.96)	9.44%	0.0239
	Hypercholesterolaemia	75.34% (63.86–84.68)	98.57% (92.30–99.96)	23.23%	<0.0001
	Chronic kidney disease	94.52% (86.56–98.49)	100% (94.87–100)	5.48%	0.0470
	Overall	89.60% (86.73–92.03)	99.62% (98.63–99.95)	10.02%	<0.0001

† Pearson chi square test was used for comparison of proportions. Confidence level in brackets is 95%. COPD = chronic obstructive pulmonary disease; HES = Hospital Episode Statistics.

2012). The authors believe that substandard baseline accuracy in their study was mainly the result of poor documentation of comorbidities in admission proforma. This is reflected by the significant improvement in the accuracy when better documentation was implemented. Coding was performed by the same coders in the baseline and re-audit, so the authors do not believe that errors from coders contributed to substandard accuracy in the baseline audit. Considering that coders can only use documentation that complies with coding regulations, incomplete or inadequate provider documentation can lead to coding errors which may explain substandard accuracy, sensitivity and negative predictive value in the baseline audit. The same clerking proforma were used in the baseline and re-audit; therefore, lack of training and accountability of clinicians in documenting comorbidities may be the possible explanation for poor documentations in the baseline audit.

The baseline sensitivity of HES codes for comorbidities in this study was comparable with the findings of others (Januel et al, 2011). The improvement in sensitivity as a result of better documentation was conspicuous in this study. When completing the clerking proforma, exploring the available data resources for comorbidities would help to reduce the risk of missed cases or false negatives. This may explain the improved sensitivity in this study. Consistent with these findings, low false positive rates in comorbidity codes have also been reported by others (Powell et al, 2001). The current results suggest that sources of false positives in coding such as miscoding, and inappropriate use of presence-on-admission are being appropriately avoided by coders leading to specific codes with high positive predictive value.

The current study has some limitations. It only considered the eight most common comorbidities; other comorbidities were not included. The study was conducted in a single district general hospital and the results of baseline accuracy may be variable in different hospitals (Hajibandeh et al, 2015). Although two independent authors extracted data on comorbidities from the medical notes, there is always the possibility of measurement error.

Conclusions

Although HES codes can confidently predict the actual presence of the comorbidities, they have substandard accuracy and ability to rule out the presence of the comorbidities. Appropriate documentation of comorbidities in clerking proforma can improve accuracy and 'ruling out' ability of HES codes for comorbidities. Better documentation of comorbidities in clerking proforma can be achieved by improving the knowledge and accountability of clinicians in documenting them. Introducing educational packages for junior doctors during the induction process may facilitate their training. **BJHM**

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LEARNING POINTS

- Hospital Episode Statistics (HES) codes can confidently predict the actual presence of the comorbidities.
- HES codes have substandard accuracy and ability to rule out the presence of the comorbidities.
- Better documentation in clerking proforma can improve the accuracy and 'ruling out' ability of the HES codes.
- Better documentation can be achieved by improving knowledge and accountability of clinicians about documenting comorbidities.