The Second Patient Report of the National Emergency Laparotomy Audit (NELA): Overview of Hospital Episode Statistics (HES)

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Overview of Hospital Episode Statistics (HES)

The Hospital Episode Statistics (HES) database contains information about patients admitted to NHS hospitals in England since 1989, and collects data on more than 12 million hospital admissions each year. A unique patient identifier is used to link admissions by the same patient, enabling patterns of hospital care to be described prior to, during and after an index admission for emergency abdominal surgery (also referred to as emergency laparotomy).

Each HES record contains information about the time spent by a patient under the management of a consultant, and is referred to as an 'Episode'. This will represent a patient's entire hospital admission if they only spent time under one consultant/speciality, but patients who move between consultants/specialities during their hospital admission will have a record for each move. The entire period of time between admission and discharge is referred to as a 'Spell'. Each record contains fields that describe the combination of episodes within a spell, such as patient diagnosis (conditions), investigations/operations performed, the sequence of these events, and length of hospital stay.

The operative procedures (operations, radiological investigations etc) that a patient undergoes are described using the Office of Population Censuses and Surveys (OPCS) classification of procedures (Version 4). Currently up to 24 OPCS codes can be recorded in a record, with the first field (opertn_01) containing the most resource-intensive procedure. Subsequent fields contain secondary procedures, which may not be listed in date order. Procedure codes may be accompanied by codes describing the location and/or side of a procedure or other information about the operation.

A patient's medical conditions are captured using International Classification of Diseases (ICD-10) diagnosis codes, and currently up to twenty can be recorded. The first diagnosis field (diag_01) in a record holds the primary diagnosis for that episode. Other fields can be used to capture co-morbidities (other conditions the patient has) or complications (problems that have arisen during treatment), but in many cases, there is no simple way to distinguish between the two, e.g. a stroke could relate to a co-morbidity or complication.

Case ascertainment
The patients covered by NELA have surgery for many different problems, and can undergo a wide variety of surgical procedures. Their surgery may be performed as the primary operation within a hospital admission, or be a re-operation after another procedure (elective or emergency). Unlike other National Clinical Audits, where the expected number of cases can be defined using a small number of ICD-10 or OPCS codes, the number of problems or operations included in NELA means that a much larger combination of codes is required to identify eligible cases within HES.

In order to establish the expected number of emergency laparotomy cases at each hospital, we designed an algorithm (a system of rules) to find relevant patients in HES. The number of cases found nationally/at individual hospitals in HES was considered to be the expected number of cases, and used as the denominator to provide an indication of the proportion of expected cases submitted to NELA – the case ascertainment.

Creating the algorithm to identify procedures in HES that matched the NELA criteria
Our aim was to devise an algorithm consistent with the NELA inclusion criteria:

- Patients aged 18 years or over who had a major emergency abdominal procedure on the gastrointestinal (GI) tract (excluding trauma and transplant patients).
- Patients who had multiple procedures within the abdominal cavity during the same emergency theatre visit are included if one was an eligible major procedure on the GI tract (e.g. bowel resection).
- Patients who returned to theatre for an emergency laparotomy are included, even if the original operation was not eligible (e.g. an elective procedure).

We obtained an extract of HES data that included all admissions whose procedure fields contained an OPCS code related to abdominal surgery for patients discharged from English NHS hospitals over the six-year period between 1 April 2006 and 31 March 2012.

Overview of the algorithm

The algorithm follows a number of sequential steps -

1 Records were excluded if the operation fields did not contain any OPCS codes that corresponded to a potentially valid emergency laparotomy procedure.

2 The date and OPCS code(s) of the earliest surgical procedure(s) within an admission were found. This step ignored OPCS codes that identified diagnostic radiological procedures (e.g. CT scan), incidental procedures (e.g. catheter, central line and mechanical ventilation) and OPCS codes entered as qualifiers of the operation (anatomical site, side of operation, method of operation).

3 The algorithm classified the earliest procedures as eligible or ineligible according to a series of rules that combined criteria on whether the OPCS codes corresponded to an emergency laparotomy, the urgency of hospital admission and the primary diagnosis. As the time of operation is not captured in HES, it was assumed that all procedures that occurred on the same date were performed during the same theatre visit.

4 The algorithm then identified the next two valid emergency laparotomy OPCS codes occurring after the earliest operation date within the spell.

5 If the earliest surgical procedures within the spell contained an eligible procedure, it was classified as a primary emergency laparotomy. If the earliest surgical procedures were not eligible but the subsequent procedures were, the spell was classified as a re-operation emergency laparotomy. The spell was excluded if the sequence of procedures did not contain a valid procedure.

OPCS and ICD-10 code groupings

Valid OPCS codes were grouped into categories of emergency laparotomy based on the 'Main Procedure' field in the NELA dataset. Categories and rankings are described in the following tables.

Some patients undergo two or more procedures on the same date. In some situations, records have OPCS codes that both appear on the NELA procedure list, e.g. bowel resection and adhesiolysis; in others, an emergency laparotomy may be paired with a major procedure that is not within the scope of NELA, e.g. abdominal aortic aneurysm (AAA) repair and irrigation of peritoneal cavity. To determine whether records with combinations of operations should be included, we ranked the valid emergency laparotomy procedures by placing their OPCS codes into one of three tiers (A, B, C), according to the perceived severity of their insult to the patient. The ranked tiers are as follows:

- · A - procedures involving excision of all/part of an organ (stomach/bowel) or repair of a perforation.
- · B - procedures involving some form of bowel incision.
- · C - any other procedure in the emergency laparotomy OPCS code list, e.g. drainage, washout.

In most cases, all procedures within a category have the same rank, but this is not always the case. A fourth tier (D) was defined for procedure codes which were not included in the list of valid emergency laparotomy procedures, but could result in an emergency laparotomy, e.g. AAA repair.

The algorithm then allocated records with multiple emergency laparotomy procedures occurring on the same date as follows:

- Records that contained OPCS codes for tier A and tiers B and/or C were allocated to the tier A group, e.g. a record with OPCS codes for bowel resection, stoma formation and washout was grouped into the category for bowel resection (tier A).
- Records that contained OPCS codes for tiers B and C were allocated to the tier B group, e.g. a record with OPCS codes for stoma formation and washout was grouped into the stoma formation category (tier B).

The 'Indication for surgery' field in the NELA dataset was used as the starting point to form groups of ICD-10 codes that frequently appeared in the <diag_01> field of episodes containing valid emergency laparotomy OPCS codes (below).

The tier rankings were used to refine the eligibility criteria by distinguishing between three types of diagnostic category:

1 The first group corresponded to diagnoses that described operative episodes that were always eligible.

2 The second group of diagnoses defined records that would only be eligible when the earliest procedure was in the A/B group.

3 The third group of diagnoses defined records which would only be eligible as a re-operation (valid emergency laparotomy procedure occurring after an ineligible procedure).

Records with procedures for which the primary diagnosis was appendicitis or a gallbladder condition were ineligible except if the record contained an emergency laparotomy procedure in tier A, e.g. bowel resection.

Finally, records were labelled as eligible if they met the following criteria:

- Hernia repair OPCS code in combination with A and/or B tier procedure.
- Hernia diagnosis code in combination with A and/or B tier procedure.
- 'Clearance of pelvis' (OPCS code X14) in combination with A and/or B tier procedure.
- Obstruction diagnosis in combination with an A/B tier procedure or adhesiolysis.
- 'Other abdominal' tier D procedure code in combination with A and/or B tier procedure.

Records were labelled as ineligible if they met the following criteria:

- Ineligible diagnosis: ICD-10 codes for AAA/aortic dissection, liver conditions, ascites, pancreatic disease, ineligible cancers and ineligible peptic ulcer/hernia.
- 'Clearance of pelvis' (OPCS code X14) in combination with a C tier procedures.
- Hernia repair code with a C tier procedure.
- 'Other abdominal' tier D procedure with a C tier procedure.

Limitations of the algorithm:

Due to the nature of HES data, we had to make the following assumptions:

- That elective/emergency admissions are coded correctly.
- That multiple procedures listed on the same date occurred during the same visit to theatre.

- That the initial procedure during an emergency admission was performed as an emergency procedure.
- That subsequent procedures during any admission are emergency procedures and not planned follow-up procedures.
- Where multiple procedures with an equivalent ranking are listed on the same date, the one with the lowest operation number is the most important procedure.
- That the first ICD-10 code (diag_01) in the episode of care during which the first operation occurred is an accurate description of the reason for the patient undergoing an emergency laparotomy.

These assumptions may mean that our expected number of cases is not always correct. We plan to link the NELA patient data to inpatient HES data for the same time period. This will enable us to find out how accurate our method of finding emergency laparotomy cases in HES is, to make improvements where required, and to improve the accuracy of case ascertainment reporting.

Table 1
Procedure categories and groupings for the first operation

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
1. Peptic ulcer – suture or repair of perforation	G35	Operations on ulcer of stomach		A
	G52	Operations on ulcer of duodenum	except G523	A
2. Peptic ulcer oversew of bleed	G523	Oversew of blood vessel of duodenal ulcer		A
3. Gastric surgery – other	G01	Excision of oesophagus and stomach		A
	G27	Total excision of stomach		A
	G28	Partial excision of stomach		A
	G29	Open extirpation of lesion of stomach		A
	G36	Other repair of stomach		A
	G38	Other open operations on stomach		A
4. Small bowel resection	G49	Excision of duodenum		A
	G58	Excision of jejunum		A
	G69	Excision of ileum		A
5. Colectomy: left (including anterior resection)	H09	Excision of left hemicolon		A
	H10	Excision of sigmoid colon		A
	H33	Excision of rectum	except H335	A

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
6. Colectomy: right	H06	Extended excision of right hemicolon		A
	H07	Other excision of right hemicolon		A
	H08	Excision of transverse colon		A
7. Colectomy: subtotal	H11	Other excision of colon		A
	H29	Subtotal excision of colon		A
8. Colorectal resection (other)	H04	Total excision of colon and rectum		A
	H05	Total excision of colon		A
	H66	Therapeutic operations on ileoanal pouch		A
9. Hartmann's procedure	H335	Rectosigmoidectomy and closure of rectal stump and exteriori		A
20. Abdominal wall closure	T28	Other repair of anterior abdominal wall		C
22. Adhesiolysis	T412	Division of band of peritoneum		C
	T413	Freeing of adhesions of peritoneum		C
	T415	Freeing of extensive adhesions of peritoneum		C
23. Drainage of abscess/collection	T34	Open drainage of peritoneum		C

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
24. Exploratory/ relook laparotomy only	T30	Opening of abdomen		C
26. Intestinal bypass	G31	Connection of stomach to duodenum		B
	G32	Connection of stomach to transposed jejunum		B
	G33	Other connection of stomach to jejunum	except G334	B
	G51	Bypass of duodenum		B
	G61	Bypass of jejunum		B
	G71	Bypass of ileum		B
	G72	Other connection of ileum		B
	H13	Bypass of colon		B
28. Repair of intestinal perforation	G532	Closure of perforation of duodenum NEC		A
	G633	Closure of perforation of jejunum		A
	G784	Closure of perforation of ileum		A
30. Stoma formation	G601	Creation of jejunostomy		B
	G74	Creation of artificial opening into ileum		B
	H141	Tube caecostomy		B
	H151	Loop colostomy		B
	H152	End colostomy		B

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
	G334	Open reduction of intussusception of gastroenterostomy		B
	G602	Refashioning of jejunostomy		B
	G603	Closure of jejunostomy		B
	G608	Other specified artificial opening into jejunum		B
	G609	Unspecified artificial opening into jejunum		B
	G733	Resection of ileostomy		B
	G75	Attention to artificial opening into ileum		B
	H142	Refashioning of caecostomy		B
31. Stoma revision	H143	Closure of caecostomy		B
	H148	Other specified exteriorisation of caecum		B
	H149	Unspecified exteriorisation of caecum		B
	H153	Refashioning of colostomy		B
	H154	Closure of colostomy		B
	H155	Dilation of colostomy		B
	H156	Reduction of prolapse of colostomy		B
	H158	Other specified other exteriorisation of colon		B
	H159	Unspecified other exteriorisation of colon		B
32. Washout only	T463	Irrigation of peritoneal cavity		C

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
99. Other	G531	Open biopsy of lesion of duodenum		B
	G533	Open removal of foreign body from duodenum		B
	G535	Incision of duodenum NEC		B
	G536	Correction of malrotation of duodenum		B
	G538	Other specified open operations on duodenum		B
	G539	Unspecified open operations on duodenum		B
	G631	Open biopsy of lesion of jejunum		B
	G632	Incision of jejunum		B
	G638	Other specified open operations on jejunum		B
	G639	Unspecified open operations on jejunum		B
	G701	Excision of meckel's diverticulum		B
	G702	Excision of lesion of ileum NEC		B
	G703	Open destruction of lesion of ileum		B

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
99. Other	G708	Other specified open extirpation of lesion of ileum		B
	G709	Unspecified open extirpation of lesion of ileum		B
	G731	Revision of anastomosis of ileum		B
	G732	Closure of anastomosis of ileum		B
	G734	Resection of ileo-colic anastomosis		B
	G738	Other specified attention to connection of ileum		B
	G739	Unspecified attention to connection of ileum		B
	G76	Intra-abdominal manipulation of ileum		B
	G781	Open biopsy of lesion of ileum		B
	G782	Strictureplasty of ileum		B
	G783	Removal of foreign body from ileum		B
	G785	Exclusion of segment of ileum		B
	G788	Other specified other open operations on ileum		B
	G789	Unspecified open operations on ileum		B

Procedure category from NELA dataset	OPCS code	OPCS description	Comment	Operation group
99. Other	H12	Extirpation of lesion of colon		B
	H16	Incision of colon		B
	H17	Intra-abdominal manipulation of colon		B
	H19	Other open operations on colon		B
	T36	Operations on omentum		C
	T411	Open biopsy of lesion of peritoneum NEC		C
	T414	Open removal of foreign body from peritoneum		C
	T418	Other specified open operations on peritoneum		C
	T419	Unspecified open operations on peritoneum		C

Table 2
Diagnostic categories   - (a) Admission with these diagnoses in the operative episode are eligible

CEU diagnosis group	ICD-10 code	Description
Infection	A04	Other bacterial intestinal infections
	A183	Tuberculosis of intestines, peritoneum and mesenteric glands
	A41	Other septicaemia
Gastric Cancer	C16	Malignant neoplasm of stomach
Bowel Cancer	C17	Malignant neoplasm of small intestine
	C18	Malignant neoplasm of colon
	C19	Malignant neoplasm of rectosigmoid junction
	C20	Malignant neoplasm of rectum
	C260	Malignant neoplasm of intestinal tract, part unspecified
	C268	Malignant neoplasm, overlapping lesion of digestive system
	C269	Malignant neoplasm of ill-defined sites within digestive system
Other Cancer	C48	Malignant neoplasm of retroperitoneum and peritoneum
	C56	Malignant neoplasm of ovary
	C76	Malignant neoplasm of other and ill-defined sites
	C77	Secondary and unspecified malignant neoplasm of lymph nodes
	C78	Secondary malignant neoplasm of respiratory and digestive organs
	C80	Malignant neoplasm without specification of site
	C81	Hodgkin's disease

CEU diagnosis group	ICD-10 code	Description
Other Cancer	C82	Follicular [nodular] non-Hodgkin's lymphoma
	C83	Diffuse non-Hodgkin's lymphoma
	C85	Other and unspecified types of non-Hodgkin's lymphoma
	D37	Neoplasm of uncertain or unknown behaviour of oral cavity and digestive organs
	D48	Neoplasm of uncertain or unknown behaviour of other and unspecified sites
Peptic ulcer	K25	Gastric ulcer
	K26	Duodenal ulcer
	K27	Peptic ulcer, site unspecified
	K28	Gastrojejunal ulcer
Hernia	K400	Bilateral inguinal hernia with obstruction without gangrene
	K401	Bilateral inguinal hernia, with gangrene
	K403	Unilateral or unspecified inguinal hernia with obstruct without gangrene
	K404	Unilateral or unspecified inguinal hernia, with gangrene
	K410	Bilateral femoral hernia, with obstruction, without gangrene
	K411	Bilateral femoral hernia, with gangrene
	K413	Unilateral or unspecified femoral hernia with obstruct without gangrene
	K414	Unilateral or unspecified femoral hernia, with gangrene
	K420	Umbilical hernia with obstruction, without gangrene
	K421	Umbilical hernia with gangrene

CEU diagnosis group	ICD-10 code	Description
Hernia	K430	Ventral hernia with obstruction, without gangrene
	K431	Ventral hernia with gangrene
	K450	Other specified abdominal hernia with obstruct without gangrene
	K451	Other specified abdominal hernia with gangrene
	K460	Unspecified abdominal hernia with obstruction without gangrene
	K461	Unspecified abdominal hernia with gangrene
Crohn's disease	K50	Crohn's disease [regional enteritis]
Ulcerative colitis	K51	Ulcerative colitis
Bowel ischaemia	K55	Vascular disorders of intestine
Volvulus	K562	Volvulus
CEU Diagnosis Group	ICD-10 code	Description
Adhesions	K565	Intestinal adhesions [bands] with obstruction
	K660	Peritoneal adhesions
	N736	Female pelvic peritoneal adhesions
	N994	Postprocedural pelvic peritoneal adhesions
Other obstruction	K560	Paralytic ileus
	K561	Intussusception
	K563	Gallstone ileus
	K564	Other impaction of intestine
	K566	Other and unspecified intestinal obstruction
	K567	Ileus, unspecified
	K59	Other functional intestinal disorders

CEU diagnosis group	ICD-10 code	Description
Other obstruction	T18	Foreign body in alimentary tract
Peritonitis	K63	Other diseases of intestine
	K65	Peritonitis
	K661	Haemoperitoneum
	K668	Other specified disorders of peritoneum
	K669	Disorder of peritoneum, unspecified
Haemorrhage	K92	Other diseases of digestive system
	R58	Haemorrhage, not elsewhere classified
Complications	K91	Postprocedural disorders of digestive system NEC
	T81	Complications of procedures, not elsewhere classified
	T85	Complications of other internal prosthetic devices implants and grafts
Diverticulitis	K57	Diverticular disease of intestine
Miscellaneous	D12	Benign neoplasm of colon, rectum, anus and anal canal
	D17	Benign lipomatous neoplasm
	D20	Benign neoplasm soft tissues of retroperitoneum and peritoneum
	K31	Other diseases of stomach and duodenum
	K52	Other noninfective gastroenteritis and colitis
	K62	Other diseases of anus and rectum
	N321	Vesicointestinal fistula
	N822	Fistula of vagina to small intestine
	N823	Fistula of vagina to large intestine
	N824	Other female intestinal-genital tract fistulae

CEU diagnosis group	ICD-10 code	Description
Miscellaneous	Q43	Other congenital malformations of intestine
	R10	Abdominal and pelvic pain
	R19	Other symptoms and signs involving digestive system and abdomen
	Z43	Attention to artificial openings

Table 3
Diagnostic categories – (b) Admissions with these diagnoses in the operative episode are eligible when the first procedure is in the A/B group

CEU diagnosis group	ICD-10 code	Description
Ineligible Cancers	C21	Malignant neoplasm of anus and anal canal
	C22	Malignant neoplasm of liver and intrahepatic bile ducts
	C23	Malignant neoplasm of gallbladder
	C24	Malignant neoplasm of other and unspecified parts biliary tract
	C25	Malignant neoplasm of pancreas
	C261	Malignant neoplasm of spleen
	C51	Malignant neoplasm of vulva
	C52	Malignant neoplasm of vagina
	C53	Malignant neoplasm of cervix uteri
	C54	Malignant neoplasm of corpus uteri
	C55	Malignant neoplasm of uterus, part unspecified
	C57	Malignant neoplasm of other and unspecified female genital organs
	C60	Malignant neoplasm of penis
	C61	Malignant neoplasm of prostate
	C62	Malignant neoplasm of testis
	C64	Malignant neoplasm of kidney, except renal pelvis
	C65	Malignant neoplasm of renal pelvis
	C66	Malignant neoplasm of ureter
	C67	Malignant neoplasm of bladder

CEU diagnosis group	ICD-10 code	Description
Ineligible Cancers	C68	Malignant neoplasm of other and unspecified urinary organs
	D30	Benign neoplasm of urinary organs
	D41	Neoplasm of uncertain or unknown behaviour of urinary organs
	D73	Diseases of spleen
Ascites	R18	Ascites
Gynaecological/ Obstetric	Nx	All remaining 'N' codes
	O	All codes
Ineligible Hernias	K402	Bilateral inguinal hernia, without obstruction or gangrene
	K409	Unilateral or unspecified inguinal hernia without obstruction or gangrene
	K412	Bilateral femoral hernia, without obstruction or gangrene
	K419	Unilateral or unspecified femoral hernia without obstruction or gangrene
	K429	Umbilical hernia without obstruction or gangrene
	K439	Ventral hernia without obstruction or gangrene
	K458	Other specified abdominal hernia without obstruction or gangrene
	K469	Unspecified abdominal hernia without obstruction or gangrene
Not classified	All remaining codes not mentioned above	

Table 4
Diagnostic categories – (c) Admissions with these diagnoses in the operative episode are eligible only as a re-operation to an ineligible procedure

CEU diagnosis group	ICD-10 code	Description
Oesophageal disease	C15	Malignant neoplasm of oesophagus
	D00	Carcinoma in situ of oral cavity, oesophagus and stomach
	D13	Benign neoplasm of other and ill-defined parts of digestive system
	I85	Oesophageal varices
	I982	Oesophageal varices in diseases classified elsewhere
	K20	Oesophagitis
	K21	Gastro-oesophageal reflux disease
	K22	Other diseases of oesophagus
	K23	Disorders of oesophagus in diseases classified elsewhere
	Q39	Congenital malformations of oesophagus
	T28	Burn and corrosion of other internal organs
AAA/Aortic dissection	I71	Aortic aneurysm and dissection
	I72	Other aneurysm
	I790	Aneurysm of aorta in diseases classified elsewhere
Pancreatic disease	K85	Acute pancreatitis
	K86	Other diseases of pancreas
Liver conditions	K70	Alcoholic liver disease
	K71	Toxic liver disease
	K72	Hepatic failure, not elsewhere classified

CEU diagnosis group	ICD-10 code	Description
Liver conditions	K73	Chronic hepatitis, not elsewhere classified
	K74	Fibrosis and cirrhosis of liver
	K75	Other inflammatory liver diseases
	K76	Other diseases of liver
	K77	Liver disorders in diseases classified elsewhere
	R16	Hepatomegaly and splenomegaly, not elsewhere classified
	R17	Unspecified jaundice
Renal disease	N0	All codes
	N1	All codes
	N2	All codes
	N3	All codes
	N990	Postprocedural renal failure
	N991	Postprocedural urethral stricture
	N995	Malfunction of external stoma of urinary tract
	N998	Other postprocedural disorders of genitourinary system
	N999	Postprocedural disorder of genitourinary system, unspecified
Male	N4	All codes
	N5	All codes
Trauma	S	All codes