National Comparative Audit of Lower Gastrointestinal Bleeding and the Use of Blood

Results from a National Audit

May 2016

Bowel Disease Research Foundation

NHS Blood and Transplant

This report has been endorsed by NHS Blood and Transplant, the Association of Coloproctology of Great Britain and Ireland, the British Society of Gastroenterology and the British Society of Interventional Radiology. The project has been funded by NHS Blood and Transplant and the Bowel Disease Research Foundation.

The Association of Coloproctology
of Great Britain and Ireland

Foreword

This Audit, funded by NHS Blood and Transplant and the Bowel Disease Research Foundation, represents a tremendous amount of hard work and has produced data of the utmost importance for the development of a safe and efficient lower GI bleeding service. On behalf of ACPGBI I should like to pay tribute to everyone who participated in this project especially those who are mentioned in the Acknowledgements and the List of Participating Sites across the UK. Although lower GI bleeding rarely presents as major haemorrhage it is clear that many hospitals are not adequately set up to provide safe acute haemorrhage control. In addition, it appears that many patients admitted with lower GI bleeding are not investigated but are often transfused inappropriately. The recommendations stemming from this audit are practical, sensible and potentially lifesaving, and are fully endorsed by the ACPGBI.

Professor Bob Steele

President ACPGBI

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Acknowledgements

This audit required a lot of effort from busy clinical teams and audit departments over a sustained period of time. We thank all hospitals that participated for their commitment, hard work and contribution to this important piece of work. We are extremely grateful to the clinical teams and especially junior doctors for their enormous contribution. For many this audit will have required numerous extra hours of unpaid work. A full list of participating hospitals can be found in Appendix 3.
We thank the Association of Coloproctology of Great Britain and Ireland for their continued support and valuable input and also extend our thanks to the hospitals that piloted the audit:

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Executive Summary

Lower gastrointestinal bleeding (LGIB) is a common indication for emergency hospitalisation and represents 20% of patients admitted with gastrointestinal bleeding (GIB)[1]. In comparison to upper gastrointestinal bleeding (UGIB) there are few data characterising its modern day epidemiology, interventions and outcomes and this is reflected by the lack of national guidelines. There are a range of investigations and treatments that can be used in LGIB from bedside diagnostic tests to more complex procedures that may not be available in all hospitals. It is not known whether access to investigation and treatment varies between hospitals and whether this affects patient outcome. GIB is a leading indication for transfusion[2] and LGIB alone accounts for 2.7% of all red cell transfusions in England[3]. The indication and appropriateness of these has not been described on a national scale. This nationwide audit describes characteristics, aetiology and management of patients admitted to a large number of UK hospitals with LGIB.

Data were collected from 143 hospitals across the United Kingdom, which includes 84% hospital trusts in England. 138 hospitals provided data on the provision of services for LGIB and 139 hospitals provided data on 2528 patients presenting with LGIB between 1st September and 1st December 2015.

Results

- Median age 74 (IQR 57-83) and 1319 (52.5%) were female.
- 1994/2521 (79.1%) patients had co-morbidities, most commonly hypertension 1003/2521(39.8%), diabetes 377/2521(15.0%) and chronic respiratory disease 298/2521(11.8%).
- 1075/2510 (42.8%) patients were receiving an oral anti-platelet or anticoagulant.
- Inpatients accounted for 185/2405 (7.3%) bleeds.
- Haemodynamic shock was infrequent, but more common in inpatients.
- 666/2493 (26.7%) patients received a red cell transfusion with 258/2493 (10.3%) requiring more than 4 units.
- 642/2481 (25.9%) had flexible sigmoidoscopy or colonoscopy whilst admitted and 54/2450 (2.2%) received endoscopic haemostasis.
- 507/2452 (20.7%) underwent computed tomography (CT) of the abdomen, 149/2452 (6.1%) CT angiography, 37/2467 (1.5%) mesenteric angiography and 19/2504 (0.8%) embolisation.
- 1213/2473 (49.0%) had no inpatient investigations to identify a source of bleeding.
- 6/2475 (0.2%) underwent laparotomy for bleeding and 26/2475 (1.1%) underwent transanal surgery for bleeding.
- 260/1993 (13.6%) were re-admitted within 28 days, 111/1993 (5.6%) due to further LGIB.
- Mortality at 30 days post presentation with LGIB was 85/2492 (3.4%).
- The most frequent discharge diagnoses were diverticular disease (668/2528, 27.1%), benign anorectal conditions (422/2528, 17.1%) and bleeding source unidentified (576/2528, 23.4%). Other diagnoses included colitis, angiodysplasia, cancer and polyps.

Organisation of Care

99/136 (72.8%) hospitals were able to provide 24/7 access to onsite lower GI endoscopy, and 72/136 (54.9%) reported 24/7 onsite or networked access to interventional radiology (IR). Of the 50 hospitals that provided onsite out of hours IR, only 19/50 (39%) met the minimum requirements to safely staff an out of hours rota.

Only 28/136 (20.6%) hospitals reported that elderly patients admitted with LGIB were routinely reviewed by Care of the Elderly physicians.133/138 (96.4%) hospitals provided guidelines for blood transfusion for patients with major haemorrhage but these were reported as not being readily available by case completers in 103/138 (74.6%) hospitals.

Cases of LGIB

Most patients did not meet the criteria for clinically significant bleeding (defined as bleeding associated with a systolic blood pressure <100mmHg, heart rate ≥ 100 and ≥1 unit red cell transfusion), but despite this 666/2493 (26.7%) received a red cell transfusion. Many patients were transfused at Hb thresholds above 70-80g/l and many were transfused to target Hb of more than 90-100g/l. A lot of these transfusions could be considered avoidable. Although most patients did not have significant transfusion requirements, 5% received large volume transfusions, but only 20% of these triggered a major haemorrhage protocol (MHP). Few patients received platelet transfusion or FFP, but based on platelet counts, clotting indices and the severity of bleeding most of these transfusions were avoidable.

Non-steroidal anti-inflammatory drugs (NSAIDs) are known to cause ulceration in the LGI tract but only 89/146 (61.0%) of patients presenting with LGIB had their NSAID withheld**.** Of the 10% LGIB patients taking warfarin, the vast majority did not receive appropriate PCC or vitamin K for the management of their bleeding, mostly receiving too little PCC or too much vitamin K.

Nearly half of the patients admitted with LGIB had no inpatient investigations to identify a source. 10/36 (27.8%) patients with clinically significant bleeding did not have the source of their bleeding investigated. Of those that did undergo investigation to identify a bleeding source, 22/33 (66.7%) investigations occurred more than 24 hours after admission or onset of clinically significant bleeding. 73/2178 (3.4%) patients who presented with rectal bleeding underwent rigid sigmoidoscopy or proctoscopy**.**

Very few patients required surgical control of bleeding, but frequently those that did, did not have appropriate pre-operative risk scoring. Despite this, all patients were managed by a senior surgeon and anaesthetist.

Conclusions

This is the first and largest audit of LGIB conducted in the UK and reports detailed evaluation of many components of care on an unprecedented scale. Presentation

with haemodynamic shock and major haemorrhage is very uncommon, in contrast to upper GI bleeding. Many patients are not investigated and the long-term impact of this requires further study. Most hospitals provide access to lower GI endoscopy, but only half had ready access to IR. Despite the small numbers of patients with shock, 25% patients receive a red cell transfusion. Many of these transfusions may be deemed inappropriate and represent a significant opportunity to reduce the burden of transfusion in this group of patients.

RECOMMENDATIONS

ORGANISATIONAL REQUIREMENTS

See chapter 7, the provision of endoscopy and interventional radiology.

1. All hospitals that routinely admit patients with LGIB should ensure they have provision for out of hours lower GI endoscopy and that an endoscopist rota is appropriately available (also recommended by NCEPOD).
2. A rigid sigmoidoscope or proctoscope should be available on acute admission units and performed in every patient presenting with LGIB. Admitting teams should be appropriately trained in its use and interpretation.
3. Hospitals should review the organisation of endoscopy lists to ensure the provision of urgent slots that can be used for patients with LGIB who do not need immediate investigation (also recommended by NCEPOD).
4. Hospitals have a duty of care to provide acute haemorrhage control. Those that do not provide on-site IR should liaise with their regional centre to establish an agreed formalised network (also recommended by NCEPOD), including details on the referral mechanism to a designated admitting team.
5. As stated by Royal College of Radiologists and the British Society of Interventional Radiology, a rota frequency of 1:6 should be used as the minimum number to safely staff an out of hours IR service (rising to 1:8 in units covering populations of more than 1 million) and networks should be used to facilitate this. A similar rota is required by allied health professionals to support this service.

MULTIDISCIPLINARY TEAMS

See chapter 5; patient demographics, and chapter 7; LGIB in the elderly.

6. Given the older age and high burden of co-morbid illness in patients with LGIB, hospitals that do not provide routine Care of the Elderly input for patients admitted under surgical teams should develop pathways that facilitate appropriate and timely access to elderly care (also recommended by NELA).

TRANSFUSION PRACTICE

See chapter 7; transfusion guidelines, and chapter 6; standards for red cell transfusion.

7. All hospitals should ensure they have an up to date guideline for blood transfusion in patients with major haemorrhage, that it is readily available in all admission units and that it is supported by training and regular drills involving both clinical and laboratory staff (also recommended by BCSH 2015).
8. Hospitals should examine their transfusion practice to ensure appropriate transfusion thresholds are being utilised (also recommended by BCSH 2015). Thresholds should be reviewed during admission as due to the intermittent nature of LGIB, a patient's needs may change.

OPTIMUM MANAGEMENT OF LGIB

See chapter 6; medicines management, the investigation of LGIB and surgery, and chapter 7; provision of guidelines for the management of gastrointestinal bleeding.

9. All hospitals should develop comprehensive local guidelines that cover both upper and lower GI bleeding (also recommended by NCEPOD). They should include the management of NSAIDs, warfarin, anti-platelet agents and other anticoagulant drugs. As 5% patients are re-admitted with further bleeding, re-bleeding plans should be included as a basic standard of care.

10. Patients who are shocked and requiring red cell transfusion should be prioritised and investigated urgently as an inpatient (also recommended by NICE and NCEPOD).
11. As the frequency of shock in LGIB is low, better risk stratification tools are required to enable the identification of the patients that will benefit from inpatient investigation and those that will not.
12. All patients undergoing major abdominal surgery for LGIB should have pre-operative risk assessment and discussion with level 2-3 care where appropriate (also recommended by NELA).
13. All emergency laparotomies for LGIB should be undertaken by a senior surgeon and senior anaesthetist (also recommended by NELA and ASGBI).

Definitions and Abbreviations

Term	Definition
Clinically significant bleeding	Bleeding associated with systolic blood pressure <100mmHg, heart rate ≥ 100 and ≥1 unit red cell transfusion
Lower gastrointestinal bleeding	Bleeding into the bowel distal to the ligament of Treitz
Major haemorrhage	Bleeding that triggers a Major Haemorrhage Protocol

Abbreviation	Definition
ACS	Acute coronary syndrome
APTT ratio	Activated partial thromboplastin time ratio
CTA	Computerised tomographic angiogram
EUA	Examination under anaesthesia
NOAC	Novel oral anticoagulant
FFP	Fresh frozen plasma
GI	Gastrointestinal
Hb	Haemoglobin
INR	International normalised ratio
IR	Interventional Radiology
IQR	Interquartile range
LGIB	Lower gastrointestinal bleeding
LOS	Length of Stay
LMWH	Low molecular weight heparin
NSAIDs	Non-steroidal anti-inflammatory drugs
OGD	Oesophagogastroduodenoscopy
UGIB	Upper gastrointestinal bleeding

Introduction

What is lower gastrointestinal bleeding?

Lower gastrointestinal bleeding (LGIB) accounts for up to 20% hospital admissions for gastrointestinal bleeding a year in the UK[1]. Traditionally it is defined as bleeding that arises distal to the ligament of Treitz. Developments in the diagnosis of bleeding from the small bowel has lead to the term mid-gastrointestinal bleeding (from the ligament of treitz to the ileocaecal valve) but due to the overlap of presenting features, for the purpose of this audit, LGIB includes small bowel as well as colonic and anorectal bleeding.

There is some evidence from Europe that the incidence of LGIB is increasing and that mortality rates may be comparable to upper gastrointestinal bleeding (UGIB)[4]. LGIB may present as trivial bleeding requiring no inpatient investigation or treatment, or as life threatening haemorrhage needing urgent intervention.

Unlike UGIB, there are a lack of large studies examining patient characteristics, clinical management and standards of care. The National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report into gastrointestinal bleeding[5] highlighted this deficiency and recommended further research into LGIB.

The diagnosis and treatment of LGIB is complex. Diagnosis may be made via several modalities. Colonoscopy and flexible sigmoidoscopy provide direct visualisation of the colon and may offer an opportunity for endoscopic haemostasis such as clipping, thermocoagulation or adrenaline injection. Colonoscopy requires bowel preparation and may require sedation, so may not be suitable for all patients, especially in an emergent setting where adequate bowel preparation is challenging. Computed tomographic angiography (CTA) and mesenteric angiography may identify the site of bleeding but require active bleeding. 15% of patients presenting with LGIB are reported to have a source in the upper GI tract[6] and this proportion increases with major bleeding. Oesophagogastroduodenoscopy (OGD) also plays an important role in the investigation of patients with LGIB. Patients that have on-going bleeding despite a normal colonoscopy and OGD may have a source in the small bowel. Investigations such as push enteroscopy, capsule endoscopy and nuclear scintigraphy can be used in this group of patients.

Treatment options also include mesenteric embolisation and surgery, but most LGIB stops spontaneously. Determining which treatment modality to select is difficult, especially as embolisation and surgery are associated with significant risks. Embolisation relies on access to the mesenteric vasculature and depends on reducing blood flow to the bleeding segment of bowel without causing ischaemia. Emergency abdominal surgery is associated with significant morbidity and has a 30 day mortality rate of 15%[7].

Caring for the patient with LGIB also requires careful optimisation of co-morbid conditions including management of concomitant medication, which may have caused bleeding. There is evidence that anti-platelet medications, anti-coagulants and non-steroidal inflammatory drugs (NSAIDS) may increase the severity of bleeding[8] but their cessation needs to be balanced with the risk of cardiovascular events.

Why is this audit necessary?

Transfusion is an essential component in the management of LGIB. A large observational study conducted in England over a ten-year period identified gastrointestinal bleeding (upper and lower) as one of the largest single indications for transfusion of red cells[2]. Acute LGIB is reported to account for 2.7% of all red cells transfused in England[3]. With the increasing evidence of the negative effect of transfusion in UGIB[9], the use of blood in patients with LGIB requires further evaluation.

The proportion of patients undergoing investigation and emergency treatment for LGIB is not known. Whether these interventions are available and conducted appropriately warrants investigation.

This is the first nationwide audit focussing exclusively on LGIB. The results will be used to describe current practice and audit against existing guidelines.

What does this audit aim to achieve?

The overall aim of this audit is to characterise the clinical characteristics, management strategies and outcomes of patients with acute LGIB presenting to UK hospitals. Specific objectives include:

1. Description of the use of inpatient investigations (lower GI endoscopy, CT, interventional radiology, nuclear medicine and surgery) and their associated diagnostic yield.
2. Evaluation of therapeutic modalities (endoscopic haemostasis, embolisation and surgery) focussing on availability.
3. Quantification of blood product transfusion (red cell, platelets and fresh frozen plasma) in comparison to established national guidelines and protocols.
4. Description of the management and current treatment strategies for patients on long-term anticoagulants (including novel oral anticoagulants) who develop LGIB.
5. Identification of both institutional and patient specific risk factors for poor outcome.

What does this report include?

This report provides hospitals with their individual data in comparison to national results. The results are presented in two parts; (1) patient specific results and (2) organisation of care. Organisation of care includes the availability of endoscopy, interventional radiology, surgery, critical care and transfusion for LGIB. Patient specific data include the number of the patients managed appropriately according to pre-existing guidelines on risk assessment, endoscopy, transfusion and the management of anticoagulants.

Who are the principal stakeholders?

NHS Trusts in England, Wales, Scotland & Northern Ireland

Bowel Disease Research Foundation

NHS Blood and Transplant

Association of Coloproctology of Great Britain and Ireland

Methods

How were NHS Trusts and independent hospitals selected?

All 140 NHS Trusts in England that accept acute, adult admissions were invited to participate. Hospitals that focus on children or non-related specialities such as maternity hospitals or neurological units were not asked to participate. Eligible hospitals in Wales, Scotland and Northern Ireland were also invited. Independent hospitals were not invited to participate since GI bleeds are managed in the NHS.

How were Trusts recruited to the audit?

A letter, explaining the rationale and purpose of the audit, the proposed timescale and dataset to be collected was sent to the Chief Executive, Medical Director, Clinical Audit Manager/Audit Department and Consultant Haematologist with responsibility for transfusion in each eligible Trust in June 2015.

Transfusion Liaison Nurses and Hospital Liaison Managers were copied into all initial correspondence. Notices advertising the audit appeared in the regular Hospital Liaison mail out and on the National Comparative Audit of Blood Transfusion and the Association of Coloproctology and Bowel Disease Research Foundation web pages. The audit was publicised via a plenary lecture at the Digestive Disorders Federation conference in June 2015 and on social media (@LGIBaudit).

Trusts in Wales, Scotland and Northern Ireland were invited to participate via their respective Blood Services.

What is the nature and size of the case sample for this audit?

The cases

Hospitals were asked to identify all cases of LGIB as long as they resulted in an admission to hospital or developed whilst patients were already hospitalised for another reason. An admission was defined as an over-night stay or ≥24 hours in hospital. Patients did not need to have had a blood transfusion to be eligible. Case identifiers were asked to enrol consecutive cases, if they met the following criteria:

- Patients aged ≥ 16
- History of bright or dark blood per rectum, maroon coloured stool or blood mixed in with stool, clots per rectum or passage of melaena without haematemesis

Melaena without haematemesis was included so that cases of small bowel bleeding were not missed. It can sometimes be challenging to distinguish upper from lower GI sources of bleeding[5] so the criteria are deliberately broad. Details of patients who were admitted with the above presentations but were more likely to have an upper GI source were included but then excluded from the analyses specific to LGIB by the central audit team. These cases were defined and adjudicated as follows:

- Any patient who underwent OGD that identified an UGI source with stigmata of recent haemorrhage (proven UGIB)
- Any patient that presented with melaena and had abnormal findings at OGD, e.g. mild gastritis even if no stigmata of recent haemorrhage (probable UGIB)
- Any patient with isolated melaena and no OGD or other investigations confirming a LGIB (suspected UGIB)

Data were collected until discharge, inpatient death or until the patient had been admitted for more than 28 days.

Who collected the data?

The data were collected by a team consisting of an Audit Lead and Case Enterers.

The Audit Lead

The Audit Lead was responsible for ensuring that cases were rigorously identified and that the data were complete and accurate. Audit leads were predominantly Colorectal or General Surgical Consultants or Registrars.

Data entry

Once a case was identified, the audit lead nominated a junior doctor or representative from the hospital clinical audit department to collect and enter the full data. Those entering data were encouraged to discuss any clinical questions with the audit lead, but guidance notes were also provided, and support was available throughout the data collection period by e-mail and telephone, for both the case identifiers and the audit lead.

What was the data collection method?

This comparative audit involved collection of organisational and individual patient data.

Organisational data

This recorded the availability of services for the investigation and treatment of LGIB. Each hospital was asked to complete **one** copy of this.

Patient specific data

This recorded the clinical characteristics and outcomes of patients with acute LGIB. It included questions on clinical examination, the timing, use and results of endoscopy, radiology and surgery, the use, timing and volume of blood products and how patients on anti-coagulants were managed. The clinical details for each patient identified were entered on to an online questionnaire. No patient identifiers were collected and a password protected website was used to do this.

Questionnaire design

The questionnaires were piloted at ten potentially eligible sites in the UK. Each site was asked to review the questionnaires and record feasibility of data collection for each question via a standardised grading system.

Seven sites returned the organisational questionnaire pilot and all but two questions were answered as expected. The questions that were difficult to complete asked for a grading of the availability of guidelines. These were uniformly unanswered. On review it was decided that the data collected by these questions was non-essential and time-consuming. These questions were removed from the dataset.

Six hospitals were asked to identify and complete patient-specific questionnaires on five cases of LGIB. All mandatory questions were deemed feasible and accessible. The remainder of the questions were reviewed and clarified. No questions were

excluded. Wording and phrasing was amended for questions deemed ambiguous based upon the pilot exercise. Answers were reviewed to ensure data was interpretable and reproducible.

To establish a pattern of hospital admission locations for patients with LGIB, five hospitals (including a tertiary referral centre for interventional radiology and a small district general hospital) were asked to describe their referral pathways and pilot the process of case identification. Feedback on ease of case identification, time spent and suggestions for other locations was collected. A previous national audit of severe gastrointestinal haemorrhage demonstrated that unlike UGIB, which may present to a range of departments and specialities, LGIB presents to a more limited selection of locations[5], namely surgery, gastroenterology and general medicine wards. To maximise case ascertainment in this audit, Audit Leads were asked to have daily contact with surgical admission units and the surgical on-call team, daily contact with medical admission units and on-call team and visits to the gastroenterology wards three times per week.

What was the dataset collected for this audit?

See appendices 1 and 2

What were the data handling arrangements?

Data on service provision and organisation were entered on to an electronic survey or on to paper copies, which were then entered into a database. Patient specific cases were given a unique code to enable data entry without using any patient identifiers. Each participating hospital was given a unique login and password to ensure data integrity. No patient identifiers were collected.

Data analysis

Once all datasets were indicated as finished by the local site and checked for any missing data or incorrect entries, duplicates and cases of haematemesis were removed. Variations in spelling of drug names, abbreviations and treatments were standardised. Any answers with an 'other' option were re-recoded as one of the other fixed responses or compiled into a footnote. The discharge diagnosis was determined by using the following hierarchy: (1) diagnostic CT, endoscopy, examination under anaesthesia (EUA), laparoscopy or laparotomy, (2) diagnostic digital rectal examination, (3) diagnosis as documented in medical notes or discharge papers.

Data were collected on several baseline co-morbidities. To ensure standardised reporting we supplied hospitals with the following definitions:

- Hypertension: Requiring anti-hypertensive medication(s)
- Congestive Cardiac failure: On pharmacotherapy or clinical examination findings consistent with congestive heart failure
- Peripheral vascular disease: Intermittent claudication, gangrene, resection and replacement of lower limb arteries, blood vessel replaced by prosthesis, gangrene, aortic aneurysm
- Dementia: formally diagnosed
- Peptic ulcer disease requiring PPIs or H2 receptor antagonists
- Diabetes without end-organ damage: Include Type 1 and Type 2 diabetes

- Diabetes with end- organ damage: Renal, ophthalmic or neurological complications

Applying Audit Standards

Cases with missing data that corresponded to audit standards were included in the calculation of denominators. Site reports with local data were issued to sites that contributed 10 or more cases of LGIB once exclusions had been applied.

Audit Standards

What standards were used for the audit, and what is the evidence base for these standards?

The development of audit standards using existing guidelines is limited by the lack of national guidance. The most relevant guidelines that include LGIB are the Scottish Intercollegiate Guidelines Network (SIGN) guidelines[10]. As there is no NICE equivalent these were adopted where appropriate. The NCEPOD report on GI bleeding[5] also made recommendations on LGIB, and these were adopted where relevant. Where guidelines on specific aspects of the management of LGIB do not exist, British Society of Gastroenterology and NICE guidelines on the management of UGIB[11] were interchanged as the auditable standard, as appropriate. The British Committee for Standards in Haematology (BCSH)[12,13] and NICE guidelines on the use of red blood cells (RBCs), platelets and fresh frozen plasma[15] were used to develop standards for transfusion. Recommendations made by the Association of Surgeons of Great Britain and Ireland (ASGBI)[16] and the National Emergency Laparotomy Audit (NELA)[17] on peri-operative care were adopted where applicable. Recommendations on safe staffing were taken from the British Society of interventional Radiology (BSIR) statements[18]. In areas where no guidelines exist, expert opinion was sought.

Organisation of Care

1. Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to on-site endoscopy, interventional radiology (on-site or covered by a formal network), on-site abdominal surgery, on-site critical care and anaesthesia[5]
2. Endoscopy lists should be organised to ensure GI bleeds are prioritised[5]
3. There should be a minimum of 6 interventional radiologists on an out of hours rota for hospitals with a catchment population of <1 million[18]
4. Routine daily input from Medicine for the Care of Older People should be available to patients aged ≥70 admitted under surgical teams[17,19]
5. A massive transfusion protocol should be in place, in all hospitals to provide compatible blood urgently for patients with major bleeding[20]
6. Local arrangements should be in place to provide compatible blood urgently for patients with major bleeding[12,20]
7. Guidelines on gastrointestinal bleeding should be readily available in all hospitals (developed from DoH guidance[20] and NCEPOD[5])

Patient Specific Data

1. All patients with lower GI bleeding should undergo digital rectal examination[10]
2. All patients with rectal bleeding should undergo proctoscopy or rigid sigmoidoscopy[10]
3. All patients admitted with LGIB should have a full blood count, coagulation screen and routine biochemistry (consensus opinion)
4. Continue low-dose aspirin for secondary prevention of vascular events in patients with lower gastrointestinal bleeding in whom haemostasis has been achieved or are considered to have stopped bleeding spontaneously (developed from NICE[11])
5. Stop other non-steroidal anti-inflammatory drugs (including cyclooxygenase-2 inhibitors) during the acute phase in patients presenting with lower gastrointestinal bleeding (developed from NICE[11])

6. Emergency anticoagulation reversal in major haemorrhage* should be with 25-50U/kg 4 factor PCC and 5mg vitamin K IV[13]
7. Reversal for non-clinically significant bleeding should be with 1-3mg IV vitamin K[13]
8. Use restrictive red blood cell transfusion thresholds (70 g/litre and a haemoglobin concentration target of 70–90 g/litre after transfusion) for patients who need red blood cell transfusions and who do not have major haemorrhage or acute coronary syndrome[15]
9. Offer platelet transfusion to patients with LGIB who have clinically significant bleeding and have a platelet count of less than 30 x 10^9/litre (developed from NICE[15])
10. Do not routinely give more than a single adult dose of platelets in a transfusion[15]
11. In LGIB offer fresh frozen plasma to patients who have either a international normalised ratio or activated partial thromboplastin ratio greater than 1.5 times normal (developed from NICE[11])
12. Use a dose of at least 15 ml/kg when giving FFP transfusions[15]
13. The cause and site of clinically significant lower gastrointestinal bleeding** should be determined following the early use (within 24 hours) of colonoscopy or flexible sigmoidoscopy or the use of computed tomography angiography or digital subtraction angiography (developed from SIGN[10])
14. Patients with LGIB with clinically significant bleeding** should have an OGD unless the cause has been established using another modality of investigation within 24 hours (developed from NICE[11])
15. When surgery is contemplated, a formal assessment of the risk of death and complications should be undertaken by a clinician and documented in the patient record[16,17]
16. Surgical procedures with a predicted mortality >10% should be conducted under the direct supervision of a consultant surgeon (CCT holder) and consultant anaesthetist unless the consultants are satisfied that the delegated staff have adequate competency, experience, manpower and are adequately free of competing responsibilities[16]
17. Localised segmental intestinal resection or subtotal colectomy is recommended for the management of colonic haemorrhage uncontrolled by other techniques[10]

*Major haemorrhage is defined as patients who triggered a Major Haemorrhage Protocol
** Clinically significant LGIB is defined as bleeding associated with systolic blood pressure <100mmHg, heart rate ≥ 100 and ≥1 unit red cell transfusion

Participation Results

Table 1: Submitted Data

Across the UK 174 hospitals were invited to participate, 143 provided results. This corresponds to 140 eligible NHS Trusts in England, of which 117 (84%) participated.

	N (%) Hospitals
Organisational and Patient Specific Data	134 (93.7%)
Organisational Data only	4 (2.8%)
Patient Specific Data only	5 (3.5%)

Principal Findings

Figure 1: Identified cases

143 hospitals identified 2781 potential cases of LGIB. 9 duplicates, 22 incomplete cases and 10 patients presenting with haematemesis were excluded. Patients that had an upper GI source identified on OGD (proven UGIB), or an OGD that was abnormal but with no stigmata of recent haemorrhage (probable UGIB) or presented solely with melaena but had no confirmatory OGD or other investigation (suspected UGIB) were also excluded.

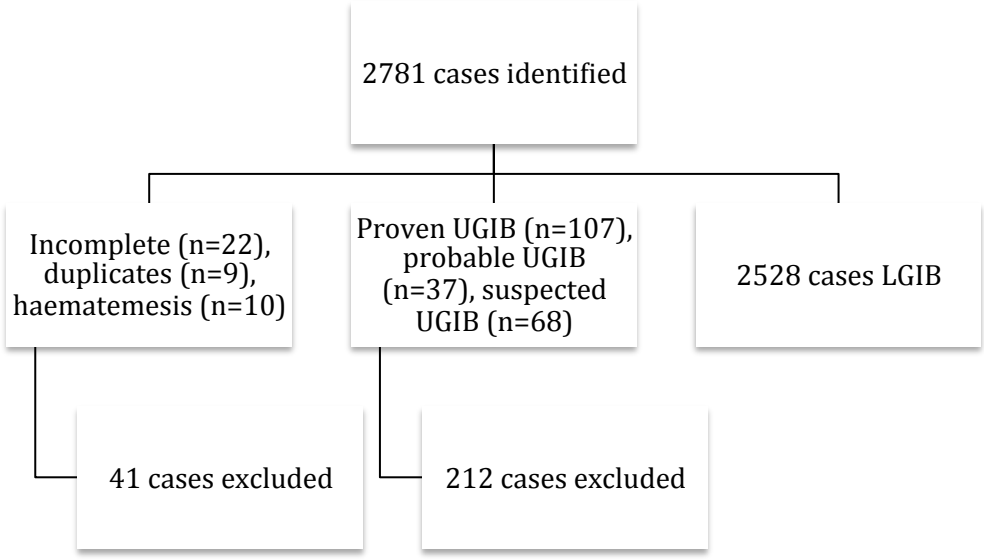

Table 2: Modes of presentation

	Patients (Total N = 2528) N (%)
Acute admission	2331 (92.2)
LGIB in an established inpatient	185 (7.3)
Other *	12 (0.5)

*Other; unable to characterise from data provided

LGIB that developed in established inpatients represented a very small proportion cases.

Table 3: Transfer Status

	All patients Total N = 2528 N (%)
Requiring transfer to another hospital	**56 (2.2)**
For ITU	0
For endoscopy	7 (0.3)
For surgical input	40 (1.6)
For radiology input (non interventional)	0
For interventional radiology input	6 (0.2)
Other	3 (0.1)
(Missing)	(11)

The number of patients requiring transfer to another hospital for management of LGIB was very small. The most frequent indication was for surgical input. A small number were transferred for IR input.

Table 4: Patient Demographics

	All patients Total N = 2528
Median Age (IQR)	74 (57-83)
Gender N (%)	
Male	1202 (47.5)
Female	1319 (52.5)
(Missing)	6
Co-morbidities N (%)	
Hypertension	1003 (39.7)
Myocardial infarction	285 (11.3)
Congestive cardiac failure	159 (6.3)
Diabetes	377 (15.0)
Stroke	217 (8.6)
Chronic respiratory disease	298 (11.8)
(Missing)	7
Medications N (%)	
Aspirin	584 (23.1)
Clopidogrel	235 (9.3)
Dual anti-platelet	75 (3.0)
Warfarin	270 (10.7)
NOACs (total)	131 (5.2)
Apixaban	*38 (1.5)*
Dabigatran	*16 (0.6)*
Rivaroxiban	*77 (3.0)*
(Missing)	18
NSAIDs	146 (5.8)
(Missing)	0
Haemodynamic Status* N (%)	
Normal	2004 (79.4)
Isolated tachycardia	388 (15.4)
Shock	58 (2.3)
(Missing)	75
Admitting Hb N (%)	
Hb ≤ 70 g/l	140 (5.6%)
Hb ≤ 80g/l	272 (10.8%)
Median Hb (IQR)	122 (100 -139)
(Missing)	14

*On admission or first set of observations after developing LGIB. Shock defined as HR≥100 and SBP<100mmHg.

LGIB patients were frequently elderly, with significant co-morbidities and many were taking antiplatelet and anticoagulant medications. Anaemia on presentation was uncommon and shock was infrequent.

Table 5: Inpatient investigations

	All patients **Total N = 2528** **N (%)**
Endoscopy	
Colonoscopy	99 (4.0)
Flexible sigmoidoscopy	543 (21.9)
Rigid sigmoidoscopy and proctoscopy	84 (3.4)
TOTAL	**726 (29.3)**
(missing data)	47
OGD	285 (11.5)
(missing data)	39
Capsule endoscopy	7 (0.2)
Enteroscopy	1 (0.1)
(missing data)	50
Radiology	
CT Abdomen/pelvis	507 (20.7)
CT Angiography	149 (6.1)
TOTAL	**656 (26.7)**
(missing data)	76
Interventional Radiology	
Mesenteric Angiography	37 (1.5)
(missing data)	61
Nuclear medicine	
Red cell scan	1 (0.04)
(missing data)	53
No inpatient investigation*	1213 (49.0)
(missing data)	55

* Inpatient investigation includes rigid sigmoidoscopy, proctoscopy, flexible sigmoidoscopy, colonoscopy, OGD, CT abdomen/pelvis, CTA, mesenteric angiography and red cell scanning

The most frequently used inpatient investigations were flexible sigmoidoscopy and CT Abdomen/pelvis. CTA was utilised in the minority of cases. The most important finding presented in this table is the large number of patients that did not undergo any inpatient investigations to identify the source of bleeding. Inpatient investigation may not be required in all patients as many patients are stable and most bleeding stops spontaneously. However a number of these patients that were not investigated did have significant bleeding; 210/1213 (17.3%) received a red cell transfusion, 60 (5.0%) requiring 4 or more units. Moreover, 126/1213 (10.4%) were re-admitted by 28 days, 59 (4.9%) of these due to further LGIB.

Table 6: Interventions for LGIB

	All patients **Total N = 2528** **N (%)**
Mesenteric embolisation (missing data)	19 (0.8) 24
Endoscopic haemostasis Missing data	54 (2.2) 78
Surgery Laparotomy for bleeding Transanal surgery for bleeding (missing)	 6 (0.2) 26 (1.1) 53
Transfusion Red cell transfusion *≥4 units* (Missing data) FFP (missing data) Platelets (missing data)	 666 (26.7) 258 (10.3) 35 56 (2.2) 38 44 (1.8) 38

A quarter of patients presenting with LGIB received a red cell transfusion, 10% receiving 4 or more units. FFP and platelets were used in a very small number of patients.

Mesenteric embolisation and endoscopic haemostasis were very infrequently used. The most frequently used methods of haemostasis were banding (n=13), argon laser (n=11) and clipping (n=9). 12/54 patients required 2 modalities and 3/54 required 3. Nearly 25% patients received flexible sigmoidoscopy or colonoscopy whilst admitted, but in the vast majority this did not lead to any treatment being delivered endoscopically.

Embolisation and surgery were both very rare. The number of cases requiring laparotomy for bleeding was six; one of these was for re-bleeding following embolisation.

Table 7: Cases requiring laparotomy for bleeding

Patient	Previous investigation	Source of bleeding	Procedure	Outcome
A	CTA – no blush	Rectal cancer	Anterior Resection	
B	CT Abdomen/pelvis	Angiodysplasia	Right hemicolectomy	
C	CTA - blush	Diverticular Bleed	Right hemicolectomy	
D	None	Suspected diverticular Bleed	Subtotal colectomy	Post-operative death
E	CTA- blush, MA-blush, embolised – further bleeding	NHL involving colon	Subtotal colectomy	Post-operative death
F	CTA - blush	Unknown	Laparotomy	Intra-operative death

Four of the patients who underwent laparotomy had a pre-operative CTA and 3 demonstrated extravasation of contrast. Only one went on to have angiography. Embolisation cannot entirely replace surgery, as some causes such as cancer will require operative management and some patients (as demonstrated) will re-bleed. However, employing embolisation may avoid surgery in some patients and can be used to stabilise patents pre-operatively to allow optimisation. One patient underwent CT abdomen/pelvis pre-operatively and one patient had no pre-operative investigations. 3/6 patients died during admission.

Table 8: Outcomes of LGIB

	All patients Total N = 2528 N (%)
Median length of stay (IQR)	3 (1-7)
Re-admitted within 28 days	
All	260 (13.6)
Due to LGIB	111 (4.6)
Unknown	535 (22.2)
In hospital mortality	85 (3.4)
Due to LGIB	4 (0.2)
Patients with ≥ 4 units red cells (n=258)	21 (8.2)
(Missing)	36

The median length of stay was 3 days (IQR 1-7). This was slightly shorter for patients that were not investigated as an inpatient (median 2, IQR1-4 days). Over 10% patients were re-admitted at 28 days, 5% due to further LGIB. In-hospital mortality was 3.4%; only 4 cases had LGIB listed as the primary cause of death.

Table 9: Discharge Diagnoses

	All patients **Total N = 2528** **N (%)**
Diverticular Disease	**668 (27.1)**
Colitis *Infective* *Ischaemic* *IBD* *Undetermined*	**346 (14.1)** 41 85 63 157
Malignancy *Colon* *Rectum* *Anal* *Other malignancy*[§]	**155 (6.3)** 62 71 9 13
Benign anorectal disorders *Haemorrhoids* *Solitary rectal ulcer* *Rectal prolapse* *Peri-anal abscess* *Anal fissure* *Fistula in ano* *Radiation proctitis* *Other Proctitis* *Constipation* *Other anorectal*[⌘]	**422 (17.1)** 305 16 12 8 18 3 25 6 13 16
Polyp(s)	**64 (2.6)**
Angiodysplasia	**25 (1.0)**
Post-endoscopy *Diagnostic (no intervention)* *Polypectomy* *TRUS and other biopsy* *Haemorrhoid banding* *EMR*	**77 (3.0)** 3 51 8 9 6
Post-operative*** *Colorectal resection* *Other abdominal surgery** *EUA rectum* *Haemorrhoidectomy* *HALO* *Prolapse surgery* *TEMS* *TAMIS*	**43 (1.7)** 12 7 4 11 4 1 3 1
Small bowel source[¢]	**16 (0.6)**
Drugs (presumed aetiology) *Anti-coagulant* *Anti-platelet* *DOAC* *NSAID* *Other***	**43** 21 4 10 4 4

Other[+]	**29 (1.2)**
Unknown	**576 (23.4)**
(Missing data)	67

[§]Other malignancy: Acute myeloid leukaemia, Non-hodgkins lymphoma, post-transplant lymphoproliferative disorder, bladder or gynaecological origin, neuroendocrine tumour, pancreatic, prostate, urothelial, disseminated intra-abdominal malignancy
[⌘]Other anorectal: skin tags, perianal haematoma, rectal varices, anorectal trauma
*Other abdominal surgery: reversal of Hartmann's, reversal of ileostomy
**Other drugs: laxatives, LMWH, mycophenolate mofetil, steroids
[¢]Small bowel source: Meckel's, small bowel ischaemia, intussusception, obstruction, small bowel tumour
[+]Other: chronic anastomotic ulcer, arterioenteric fistula, arteriovenous malformation, caecal varices, chronic anastomotic dehiscence, chronic perineal sinus, colon perforation, decompensated liver disease, endometriosis, stoma granulation tissue, hereditary haemorrhagic telangectasia, intussusception, large bowel obstruction, pouchitis, volvulus
***bleeding that developed following a surgical procedure, either during the same admission or requiring readmission

The most common aetiologies were diverticular, benign anorectal disorders and unknown. The unknown group contains 248 patients with non-diagnostic investigations and 328 patients that did undergo any inpatient investigations. Of these 328 patients 10/328 (3.0%) had been previously investigated for LGIB, 26/328 (7.9%) were deemed palliative and 14 (4.3%) died. Only one patient died who was not deemed palliative. 37/314 (11.8%) were re-admitted within 28 days.

Patient Specific Audit Results

Identified Cases

	National Cohort
Identified cases	2528

Clinical Examination and investigations

There are a range of tests and investigations that can be undertaken in the assessment of LGIB. The following standards assess the use of digital rectal examination (DRE), rigid sigmoidoscopy and proctoscopy.

Standard 1: All patients with lower GI bleeding should undergo digital rectal examination (SIGN 2008)

	National Cohort N=2528
Did the patient have a digital rectal examination? *Yes* *No* *Unknown*	 2191 (86.7%) 318 (12.6%) 19 (0.8%)
N (%) meeting Standard	2191 (86.7%)

12% of patients did not undergo this basic clinical investigation. Of the 2191 patients who received DRE, 1385/2191 (63.2%) had documented blood on PR, 99 (4.5%) melaena, 251 (11.5%) 'other' findings and 26 (1.2%) unknown. 556/2191 (25.4%) patients had a normal DRE. The 'other' findings included 131 cases of haemorrhoids, 40 rectal 'masses' and 23 benign anorectal conditions (peri-anal abscess, haematoma, prolapse, fissure, fistulae and warts).

Standard 2: All patients with rectal bleeding should undergo proctoscopy or rigid sigmoidoscopy (SIGN 2008)

	National Cohort N=2178
Total patients with rectal bleeding* *Proctoscopy* *Rigid sigmoidoscopy*	2178 (86.2%) 20 (0.9%) 60 (2.8%)
N (%) meeting Standard	73 (3.4%)**

*Rectal bleeding defined as bright or dark red blood PR or clots.
**7 patients had both; therefore the total number of patients meeting this standard is 73.

Proctoscopy and rigid sigmoidoscopy are standard bedside investigations that require minimal resources and training. They are vastly under-utilised. In the entire cohort, 2455 patients did not undergo proctoscopy or rigid sigmoidoscopy. Of these 2455 patients, 536 had inpatient flexible sigmoidoscopy. Readily identifiable

anorectal pathologies (anal cancer, anal fissures, haemorrhoids and rectal prolapse) were identified on 69/536 (12.9%) of these.

Laboratory Tests for LGIB

Standard 3: All patients admitted with LGIB should have a full blood count, coagulation screen and routine biochemistry (consensus opinion)

	National Cohort N=2528
Laboratory test*	
Full blood count	2499 (98.9%)
Coagulation Screen	2163 (85.6%)
Biochemistry	2483 (98.2%)
All 3 completed	2135 (84.5%)
Any 2 completed	358 (14.2%)
≤1 completed	35 (1.4%)
N (%) meeting Standard	2135 (84.5%)

*Missing data: 29 FBC, clotting 177, biochemistry 45 patients

Overall these were well performed and most patients had appropriate blood tests. The test most infrequently performed was a coagulation screen. The frequency of abnormal clotting in patients who did have a coagulation screen was 406/2163 (19.1%). Although it can be argued that a clotting screen is non-essential in some patients (minor bleeds or those with no risk factors for abnormal clotting), it is essential that patients who are taking anticoagulant medications are tested. Of 267/2528 (10.6%) patients taking oral anticoagulants (warfarin, acenocoumarol and phenindione), 19/267 (7.1%) did not have a coagulation screen.

Medicines Management

LGIB tends to be a disease of older patients, with multiple co-morbidities. The following standards examine the management of aspirin, NSAIDs and warfarin in LGIB.

Standard 4: Continue low-dose aspirin for secondary prevention of vascular events in patients with lower gastrointestinal bleeding in whom haemostasis has been achieved, or are considered to have stopped bleeding spontaneously (developed from NICE 2012)

	Total patients on aspirin in national cohort N=584
Bleeding stopped spontaneously	527 (90.2%)
-Aspirin continued or restarted	414 (78.6%)
-Aspirin stopped	91 (17.3%)
-Indeterminable	22 (4.2%)
Haemostasis achieved*	12 (2.1%)
-Aspirin continued or restarted	10 (83.3%)
-Aspirin stopped	1 (8.3%)
-Indeterminable	1 (8.3%)
N (%) meeting Standard	424 (78.7%)

*Haemostasis achieved defined as LGIB that was treated with endoscopic haemostasis or interventional radiology

584/2510 (23.2%) patients presenting with LGIB were taking aspirin. Decisions regarding the management of antiplatelet medications will therefore be a frequently encountered problem in LGIB. In 424/539 (78.7%) patients, aspirin was restarted and thus they were considered to have appropriate management of their aspirin.

Standard 5: Stop other non-steroidal anti-inflammatory drugs (including cyclooxygenase-2 inhibitors) during the acute phase in patients presenting with lower gastrointestinal bleeding (developed from NICE 2012)

	National Cohort N=2528
Patients on NSAID	146 (5.8%)
NSAID stopped	89 (61.0%)
N (%) meeting Standard	89 (61.0%)

In total 146/2528 (5.7%) patients were taking an NSAID, the most frequent being ibuprofen and naproxen. Although the number of patients who developed LGIB whilst

taking an NSAID is small, the management of these medications is important as NSAIDs can cause ulceration throughout the GI tract, including colonic lesions[21].

Standard 6: Emergency anticoagulation reversal in major haemorrhage* should be with 25-50U/kg 4 factor PCC and 5 vitamin K IV (BCSH 2013)

For the purpose of this audit, major haemorrhage is defined as LGIB that triggered a major haemorrhage protocol (MHP). Many hospitals include a range of vitamin K that may be given in the emergency reversal of warfarin. We have therefore accepted 5-10mg IV vitamin K as meeting this standard.

	National Cohort N=53*
Patients that triggered a MHP and were on warfarin: *All* *Received appropriate PCC* *Received appropriate Vitamin K*	 5 (0.2%) 3 (60.0%) 2 (40.0%)
N (%) meeting Standard	2 (40%)

*Missing data in 23 patients

The total number of patients in the entire cohort that triggered a MHP was 53/2528 (2.1%). Of these, 5 were taking warfarin. 1 had no data on reversal, 3 received appropriate PCC and 2 received appropriate vitamin K (see table below).

Patient	Source of Bleeding	Presenting INR	PCC	Vitamin K	Total RBC transfusion (u)	Meets Standard?
A	Aortocolonic fistula	1.8	Y	10mg IV	6	Y
B	Diverticular bleed	4	Y	N	4	N
C	Diverticular Bleed	1.2	Unknown	Unknown	Unknown	N
D	Source unknown	3.8	Y	10mg IV	7	Y
E	Source unknown	Unknown	N	None	3	N
N (%) meeting Standard						2/5 (40%)

Patients B and D had no inpatient investigations and were discharged after 4 and 6 days respectively. Patient E underwent a CT abdomen (not CTA) that did not identify the source of bleeding, but died due to metastatic cervical cancer 20 days later.

Although the number of patients triggering a MHP was very small, a number of patients did receive large volume red cell transfusions. 145/2493 (5.8%) patients received 4 or more units of red cells in a 24-hour period during admission, but only 31/145 (21.3%) triggered a MHP. The following table describes the use of blood products in patients that triggered a MHP and those that received large volume red cell transfusions (defined as receiving 4 or more units red cells in a 24 hour period) but did not trigger a MHP.

	Received ≥ 4 units RBC in 24 hours and did not trigger MHP N=114 N (%)	All patients that triggered a MHP N=53 N (%)
Median total volume of RBC transfusion (range)	4 (4-12)	4 (0-17)
Received FFP Median total units (range)	16 (14.0) 2 (1-7)	21 (39.6) 2.5 (1-6)
Received platelets Median total units (range)	10 (8.8) 1 (1-3)	12 (22.6) 1 (1-2)
Received cryoprecipitate	1 (0.9)	6 (11.3)
Mortality	11 (9.6)	3 (5.6)

Several of the patients who did not trigger a MHP despite requiring large volume red cell transfusions, were also transfused with other products. These patients may represent a group where a MHP should have been activated. Although patients that triggered a MHP were more likely to receive FFP, platelets and cryoprecipitate, FFP and platelets were only used in 39.6% and 22.6% patients respectively.

Standard 7: Reversal for non-clinically significant bleeding should be with 1-3mg IV vitamin K (BCSH 2013)

For the purpose of this audit, clinically significant bleeding is defined as LGIB associated with systolic blood pressure <100mmHg, heart rate ≥ 100 and ≥1 unit red cell transfusion.

This standard applies to patients that did not meet these criteria.

	National Cohort N=2528
Patients that were on Warfarin*:	
All	270 (10.7%)
Significant bleeding	6 (2.2%)
No significant bleeding	262 (97.0%)
*Received appropriate vitamin K**	20 (7.6%)
N (%) meeting Standard	20 (7.6%)[1]

*11 cases where warfarin status unknown

Warfarin was the most frequent oral anticoagulant, taken by 270/2510 (10.7%) patients. Most of these patients did not have clinically significant bleeding and most did not receive appropriate reversal of their warfarin. This was mostly due to patients being given too much vitamin K; only 20/262 (7.6%) received 1-3mg IV, in contrast to 38/262 (14.5%) who received 10mg IV. 60 patients were not taking warfarin but received vitamin K, 17 of which had normal clotting. The reason for the use of vitamin K in these patients was not clear and was probably inappropriate.

Red Cell Transfusion

Red cell transfusion is one of the most common interventions in LGIB, occurring in 666/2493 (26.7%) patients. The frequency of transfusion at each admitting haemoglobin threshold is described in the following table. 180/666 (27.0%) patients were transfused with an admitting Hb of >100g/l. Shock or tachycardia was found in less than 30% of patients transfused at each Hb threshold.

Admitting Hb	Total patients transfused at this threshold N	Normal admitting observations N (%)	Shocked* N (%)	Isolated tachycardia** N (%)	Missing Data N
Hb ≤ 70	139	106 (79.1)	12 (9.0)	16 (11.9)	5
Hb 71-80	122	88 (75.2)	9 (7.7)	20 (17.1)	5
Hb 81-90	115	82 (73.2)	5 (4.5)	25 (22.3)	3
Hb 91-100	100	78 (79.6)	2 (2.0	18 (18.4)	2
Hb 101-110	66	45(71.4)	3 (4.8)	15 (23.8)	3
Hb 111-120	50	36 (75.0)	1 (2.1)	11 (22.9)	2
Hb ≥ 121	74	53 (72.4)	4 (5.3)	17 (22.4)	0

*Shock defined as heart rate ≥100/minute and systolic blood pressure <100mmHg on admission, **isolated tachycardia defined as heart rate ≥100/minute.

Most patients admitted with LGIB do not have acute coronary syndrome and are not shocked so meet the criteria for restrictive blood transfusion.

Standard 8: Use restrictive red blood cell transfusion thresholds (70 g/litre and a haemoglobin concentration target of 70–90 g/litre after transfusion) for patients who need red blood cell transfusions and who do not have major haemorrhage or acute coronary syndrome (NICE 2015)

This standard is broken down into transfusion threshold (A) and target Hb (B).

Standard 8A Use restrictive red blood cell transfusion thresholds (70 g/litre) for patients who need red blood cell transfusions and who do not have major haemorrhage or acute coronary syndrome (NICE 2015)

	National Cohort Patients that received a red cell transfusion N=666
Patients meeting criteria for restrictive transfusion threshold:*	599 (89.9%)
-All transfusions were at ≤ 70g/l	117 (19.5%)
-At least one transfusion was at > 70g/l	438 (73.1%)
-All transfusions were at ≤ 80g/l	304 (50.8%)
-At least one transfusion was at > 80g/l	251 (41.9%)
N (%) meeting Standard	117 (19.5%)

* Defined as patients that do not have major haemorrhage (triggering MHP) or acute coronary syndrome
**missing data in 17 patients

Although the majority of patients meet the criteria for using restrictive transfusion thresholds, they are mostly not used. The indication for transfusion for many of these patients is not clear and could represent a group of patients where transfusion could be avoided.

Many patients have more than one transfusion episode (defined as consecutively transfused red cell units). 253 patients had 2 or more transfusion episodes and 35 had 4 or more. Transfusion data is therefore also presented by episode.

The mean transfusion threshold was consistent across the number of episodes (table below) and the most frequently used threshold was <80g/l.

Hb	Episode 1 N=626 (missing data =13)	Episode 2 N=253 (Missing data = 11)	Episode 3 N=85 (missing data = 9)	Episode 4 N= 35 (missing data = 3)	Total N=999 (missing data =36)
≤70	182	50	15	7	254
71-80	200	95	32	10	337
81-90	119	62	22	11	214
91-100	56	20	3	3	82
101-110	29	6	3	1	39
111-120	11	5	0	0	16
>120	16	3	1	0	20
Mean transfusion threshold	78.5g/l	79.7g/l	77.8g/l	77.3g/l	

In total 666 patients had 999 transfusion episodes. 877 (88.0%) of these episodes met the criteria for restrictive transfusion.

	National Cohort N=877 episodes
Episodes that met criteria for restrictive transfusion threshold	877 (88.0%)
-Number transfused at ≤ 70g/l	218 (24.9%)
-Number transfused at > 70g/l	613 (69.9%)
-Number transfused at ≤ 80g/l	519 (59.2%)
-Number transfused at > 80g/l	312 (35.6%)
N (%) meeting Standard	218 (24.9%)

*Episode data was missing in 45 patients

The majority of transfusion episodes correspond to patients where restrictive transfusion practice could be utilised. Only 218/877 (24.9%) episodes were appropriately transfused at a threshold of ≤ 70 g/l. If a threshold of ≤ 80 g/l is applied, the number of appropriate transfusions increases to 519/877 (59.2%) but there are still a significant number of episodes that could be deemed inappropriate. This presents an opportunity to improve patient blood management and reduce the demand on transfusion resources.

As well as employing a restrictive threshold when deciding to transfuse, over-transfusion can be reduced by using a restrictive target Hb. The Hb result after each transfusion can be used to guide the need for further red cells. NICE recommend a target of 70-90g/l after red cell transfusion.

Standard 8B: Use a haemoglobin concentration target of 70–90 g/litre after transfusion for patients who need red blood cell transfusions and who do not have major haemorrhage or acute coronary syndrome (NICE 2015)

	National Cohort Patients that received a red cell transfusion N=666
Transfused patients that meet the criteria for restrictive red cell transfusion*:	599 (89.9%)
Median number of units patients received (IQR)	3 (2-4)
At least one transfusion had a post-transfusion Hb < 70g/l	20 (3.3%)
*All transfusions had post-transfusion Hb 70-90g/l***	115 (19.2%)
At least one transfusion had a post-transfusion Hb > 90g/l	391 (65.3%)
At least one transfusion had a post-transfusion Hb>100g/l	231 (38.6%)
N (%) meeting Standard	115 (19.2%)

*Missing data in 17 patients

The median number of red cell units in transfusion was 3. Most patients were transfused to a threshold of more than 90g/l. The indication for this is not clear and may expose the patient to risks of over-transfusion.

This data is also presented by episode. The following table shows the target Hb by episode for the entire patient cohort (not just those suitable for restrictive red cell transfusion). Most patients were transfused to a Hb of 91-110g/l and received 2 units of red cells in a transfusion episode. Only 202/999 (20.2%) episodes were single unit transfusions. The mean post transfusion Hb was stable across the episodes.

Hb	Episode 1 N=626 (missing data =42)	Episode 2 N=253 (missing data =13)	Episode 3 N=85 (missing data = 10)	Episode 4 N=35 (missing data = 5)	Total N=999 (missing data = 70)
≤70	20	9	1	2	32
71-80	75	23	9	2	109
81-90	131	61	22	12	226
91-100	158	62	26	7	253
101-110	110	49	11	4	174
111-120	55	19	3	2	79
>120	35	17	3	1	56
Mean Hb threshold	96.9g/l	95.5g/l	93.4g/l	90.1g/l	

Restrictive transfusion thresholds have been applied to 877 episodes that meet these criteria.

	National Cohort patients that met criteria for restrictive transfusion N = 877
Red cell transfusion episodes: *Median number of units within an episode (IQR)* *Number with a post-transfusion Hb < 70g/l* *Number with a post-transfusion Hb 70-90g/l* *Number with a post-transfusion Hb > 90g/l* *Number with a post-transfusion Hb >100g/l*	 2 (2-2) 22 (2.5%) 287 (32.7%) 475 (54.2%) 261 (29.8%)
N (%) meeting Standard	287 (32.7%)

*Missing data in 93 episodes

877/999 (87.8%) episodes met the criteria for a restrictive target Hb threshold but the majority of these were transfused above 90g/l. 261/877 (29.8%) were transfused to a target of more than 100g/l. Again this represents an opportunity to reduce red cell transfusion in LGIB.

Although there were no specific questions on transfusion reactions in the audit tool, 4 transfusion complications were reported regardless. There was one report of 'transfusion associated haemolysis' and 3 reports of fluid overload and pulmonary oedema. These patients had received 4 units, 5 units, 12 units and 3 units of red cells respectively.

Platelet and FFP transfusion in LGIB

Although major haemorrhage was an infrequent event in LGIB, platelets and FFP were important interventions.

Standard 9: Offer platelet transfusion to patients with LGIB who have clinically significant bleeding and have a platelet count of less than 30 x 10^9/l (developed from NICE 2015)

	National Cohort N=2528
Patients that received a platelet transfusion	44 (1.7%)
Number with a platelet count < 30 and clinically significant bleeding	0
Number with a platelet count < 30 without clinically significant bleeding	7 (15.9%)
Number with a platelet count ≥ 30	36 (81.8%)
N (%) meeting Standard	0/44
Patients that did not receive a platelet transfusion*	2484
Number with a platelet count<30 and clinically significant bleeding	0
N (%) meeting Standard*	2456 (100%)

*1 patient had missing shock data, 27 patients had a missing platelet count so are excluded

In total 44 patients received a platelet transfusion, none had a platelet count of <30 and clinically significant bleeding. 36 patients received a platelet transfusion with a platelet count of ≥ 30. None of these had clinically significant bleeding. 10/36 were on aspirin, 9 were on clopidogrel and 4 were receiving dual anti-platelet therapy. The indication for platelets in the rest of these patients is not clear. As well as deciding whether to transfuse platelets or not, the dose of platelets is also important.

Standard 10: Do not routinely give more than a single adult dose of platelets in a transfusion (NICE 2015)

	National Cohort N=44
Median number of platelet doses transfused per patient (IQR)	1 (1-2)
Number who received at least one platelet transfusion of > 1 adult dose	6 (13.6%)
N (%) meeting Standard*	33 (75.0%)

*5 patients had no data on dose of platelets

Most patients received an appropriate dose of platelets. 6 patients received 2 or more doses of platelets in a transfusion. 4/6 of these were associated with large volume red cell transfusions (4-8 units) and 2/6 triggered a MHP. 2 were on dual anti-platelet therapy and one was taking aspirin. 1 required embolisation, 1 required subtotal colectomy and 2 died (1 due to AML and 1 ischaemic stroke). The cause of bleeding was 1 rectal cancer, 1 colitis and 4 unknown.

Standard 11: In LGIB offer fresh frozen plasma to patients who have either an international normalised ratio or activated partial thromboplastin ratio greater than 1.5 times normal (developed from NICE 2012)

	National National Cohort N=2528
Number of patients that received FFP*: *All* *INR or APTT > 1.5 times normal and received FFP***	 56 (2.2%) 15 (26.8%)
N (%) meeting Standard	15 (26.8%)

*Data on whether patient received FFP missing in 38 cases
**6 patients who received FFP had missing INR or APTT ratio

56/2490 (2.2%) patients received FFP during their admission, but only 15/56 (26.8%) had an INR>1.5. Of the 56 patients who received FFP, 36 were transfused with an INR or APTT ratio ≤ 1.2. Only 15/36 of these received FFP as part of a MHP. The use of FFP in the remaining 21/36 patients is unclear.

The following table describes patients that received FPP with a normal INR (≤ 1.2) comparing those that did and did not trigger a MHP.

	Received FFP and triggered a MHP N=15	Received FFP and did not trigger a MHP N=21
Received a red cell transfusion during admission	10	12
Clinically significant bleeding	1	1
Warfarin	1	3
Liver disease without cirrhosis	0	0
Liver disease with cirrhosis	0	0

FFP is standard prescription in a MHP. It is likely that the one patient with significant bleeding who received FFP in the non-MHP group was managed as part of a major bleeding pathway. 3 patients who did not trigger a MHP were taking warfarin, however FFP was not stated as a means of reversal for any of these patients. The

use of FFP in patients that had a normal clotting without clinically significant bleeding remains unclear.

Standard 12: Use a dose of at least 15 ml/kg when giving FFP transfusions (NICE 2015)

	National National Cohort N=56
Number of patients that received FFP: *Mean dose (range) ml/kg per patient** *Number of patients who received ≥ 15mg/kg for each transfusion*	 11.2 (3.6 - 28.2) 4 (7.1%)
N (%) meeting Standard	4 (7.1%)

*24 patients who received FFP had no data on their weight

Most patients who received FFP did not receive an appropriate dose for their weight. 28 patients had too little FFP in their initial transfusion for their weight. 6 of these patients weighed ≥90kg (full range 47-136kg). Of the 28/56 patients who were initially under-transfused, 3 required a further dose of FFP and 1 required 2 further doses.

The investigation of LGIB

Common investigations for LGIB include flexible sigmoidoscopy, colonoscopy, CTA and general protocol contrast CT (CT Abdomen/pelvis). Diagnostic yield may be affected by choice of investigation and also timing and severity of bleeding.

Standard 13: The cause and site of clinically significant lower gastrointestinal bleeding should be determined following the early use (within 24 hours) of colonoscopy or flexible sigmoidoscopy or the use of computed tomography angiography or digital subtraction angiography (developed from SIGN 2008)

	National National Cohort N=2528
Total number of patients with clinically significant bleeding	36 (1.4%)
Patients with clinically significant bleeding that did not undergo any inpatient endoscopy or radiology	14 (38.9%)
Patients with clinically significant bleeding who underwent:	
Colonoscopy or flexible sigmoidoscopy:	
- All	11 (30.6%)
- Within 24 hours	2 (5.6%)
CTA/CT Abdomen Pelvis	
- All	18 (50.0%)
-CTA	7 (19.4%)
-CTA within 24 hours	6 (16.7%)
MA	
- All	2 (5.6%)
- Within 24 hours	2 (5.6%)
N (%) meeting Standard*	9 (25.0%)

*One patient had 2 investigations within 24 hours

The proportion of patients presenting with LGIB that meet the criteria for clinically significant bleeding is very small. Despite this, a significant number are not investigated as an inpatient. Of the 14 that did not undergo inpatient endoscopy or radiology, 2 died and 3 were re-admitted within 28 days. Both patients who died were elderly with significant medical co-morbidities.

Of the patients with clinically significant bleeding that were investigated as an inpatient, the most frequently used investigations were CT Abdomen/pelvis and lower GI endoscopy. The most frequent investigation performed with 24 hours was CTA.

The majority of patients with clinically significant bleeding did not have the appropriate investigations performed at the appropriate time. Of the 7 patients who underwent CTA, extravasation of contrast was seen in one case, and this patient went on to have mesenteric embolisation. Of the patients that underwent colonoscopy or flexible sigmoidoscopy, none received endoscopic haemostasis.

The lack of risk stratification tools makes the identification of patients who would benefit from urgent investigation difficult. As the number of patients with LGIB and clinically significant bleeding is very small, we have applied the criteria for this standard to patents that received a red cell transfusion.

	National National Cohort N=2528
Total number of patients who received a red cell transfusion	666 (26.3%)
Patients with clinically significant bleeding that did not undergo any inpatient endoscopy or radiology	282 (42.3%)
Patients who received red cell transfusion who underwent:	
Colonoscopy or flexible sigmoidoscopy:	
- All	221 (33.2%)
- Within 24 hours	43 (6.5%)
CTA/CT Abdomen pelvis	259 (38.9%)
- All	124 (18.6%)
- CTA	70 (10.5%)
-CTA within 24 hours	
MA	
- All	38 (5.7%)
- Within 24 hours	17 (2.6%)
N (%) meeting Standard*	113 (17.0%)

*Investigation status missing in 11 patients who received red cells. 16 patients had more than one scan in 24 hours.

When using red cells as a marker of severity, 282/666 (42.3%) had no inpatient investigations. The most frequent investigation was CT or CTA, but only 10% of these occurred within 24 hours.

Standard 14: Patients with LGIB with clinically significant bleeding should have an OGD unless the cause has been established using another modality of investigation within 24 hours (developed from NICE 2012)

	National Cohort N=2528
Total number of patients with clinically significant bleeding	36 (1.4%)
Patients who underwent colonoscopy, sigmoidoscopy or proctoscopy**	12 (33.3%)
-*Source of bleeding identified*	4 (11.1%)
Patients who underwent CT/ CTA	
-*All*	15 (41.7%)
-*Source of bleeding identified*	5 (13.9%)
Patients with non-diagnostic endoscopy or CT/CTA	
-*All*	9 (25.0%)
-*underwent OGD*	4 (11.1%)
-*within 24 hours*	3 (8.3%)
Patients who did not undergo lower GI endoscopy or CT/CTA	
-*All*	12 (33.3%)
-*underwent OGD*	2 (5.6%)
-*within 24 hours*	1 (2.8%)
N (%) meeting Standard	4 (19.0%)

*2 patients with data on OGD missing, 1 unknown endoscopy or CT status, 3 patients underwent CT/CTA and lower GI endoscopy.

Of the 36 patients with clinically significant bleeding, 4 had the source diagnosed on lower GI endoscopy and 5 were diagnosed on CT or CTA. 9 patients had non-diagnostic lower GI endoscopy, CT, CTA or both. Of these only 3 underwent OGD within 24 hours. 12/36 patients with clinically significant bleeding did not undergo lower GI endoscopy or CT/CTA. Only two of these underwent OGD, one within 24 hours.

Some patients presenting with LGIB will have a source in the upper GI tract, particularly those with massive haematochezia. In this group of LGIB with clinically significant bleeding only 19% underwent urgent OGD. Those that did not represent a group at risk of missed potential diagnosis.

Again as the frequency of clinically significant bleeding was so low, we have applied this standard to patients that received a red cell transfusion.

	National Cohort N=2528
Total number of patients who received a red cell transfusion	666 (26.3%)
Patients who underwent colonoscopy, sigmoidoscopy or proctoscopy *-All* *-Source of bleeding identified*	244 (36.6%) 118 (17.7%)
Patients who underwent CT/ CTA *-All* *-Source of bleeding identified*	203 (30.5%) 87 (13.1%)
Patients with non-diagnostic endoscopy or CT/CTA *-All* *-underwent OGD* *-within 24 hours*	157 (23.6%) 72 (10.8%) 24 (3.6%)
Patients who did not undergo lower GI endoscopy or CT/CTA *-All* *-underwent OGD* *-within 24 hours*	259 (38.9%) 45 (6.8%) 20 (3.0%)
N (%) meeting Standard	44 (10.6%)

When applied to patients that received a red cell transfusion, a similar trend is seen. 17.7% patients had the source of bleeding diagnosed at lower GI endoscopy, and 13.1% diagnosed at CT or CTA. Of the patients that had non-diagnostic investigations, only 10.8% had an OGD, a third of these being undertaken within 24 hours.

259 (38.9%) patients did not undergo lower GI endoscopy, CT or CTA despite receiving a red cell transfusion. Of these 45/259 (17.3%) underwent OGD, half of which were performed urgently.

Surgery

Most patients presenting with LGIB do not require surgical management, but those that do can be challenging cases with high risk of morbidity and mortality.

In this audit, 117/2528 (4.6%) patients underwent surgery. Although all of these patients presented with the symptoms of LGIB, arrest of haemorrhage was the main indication for surgery in only a minority of cases. Only 6 patients required laparotomy for uncontrollable LGIB. Intra-operative findings included 2 diverticular bleeds, 1 bleeding rectal cancer, 1 angiodysplasia, 1 NHL involving the colon and 1 negative laparotomy. The latter patient died on-table.

In total there were 48 resections, including 12 for colorectal cancer, 15 for colitis and 4 for ischaemic bowel. As the numbers are very small, we present only national data.

Standard 15: When surgery is contemplated, a formal assessment of the risk of death and complications should be undertaken by a clinician and documented in the patient record (adapted from ASGBI 2012 and NELA 2015)

	National
Total number of patients who underwent colorectal resection*	48
Number that had a surgical risk score	11 (22.9%)
Unknown	6
N (%) meeting Standard	11 (22.9%)

* Including one negative laparotomy

Less than a quarter of the patients who underwent colorectal resection had a documented risk score. 9/11 used P-POSSUM scoring. The average predicted morbidity was 63.6% (range 21-95%) and mortality 15.0% (range 2.5-30%). These cases represent an unwell group of patients with complex peri-operative needs.

Standard 16: Surgical procedures with a predicted mortality >10% should be conducted under the direct supervision of a consultant surgeon (CCT holder) and consultant anaesthetist unless the consultants are satisfied that the delegated staff have adequate competency, experience, manpower and are adequately free of competing responsibilities (ASGBI 2012)

Nationally, 3 patients who underwent colorectal resection had a predicted mortality of >10%. 2 were performed by a Consultant Surgeon and 1 was performed by Registrar who was supervised by a Consultant. 2 patients were anaesthetised by a consultant Anaesthetist and one by an Associate Specialist. All patients met this standard.

Standard 17: Localised segmental intestinal resection or subtotal colectomy is recommended for the management of colonic haemorrhage uncontrolled by other techniques (SIGN 2008)

Five patients underwent resection for colonic haemorrhage. Previous interventions included 4 CTA and 1 had attempted embolisation. As the numbers are so small, we present only national data.

Patient	Source of Bleeding	Procedure	Meets Standard?
A	Rectal cancer	Anterior Resection	Y
B	Angiodysplasia	Right hemicolectomy	Y
C	Diverticular Bleed	Right hemicolectomy	Y
D*	Diverticular Bleed	Subtotal colectomy	N
E**	NHL involving colon	Subtotal colectomy	N
N (%) meeting Standard			3/5 (60%)

*Patient D had no investigations before surgery and died shortly afterwards. The cause of bleeding is yet to be confirmed.

**Patient E underwent embolisation but developed recurrent bleeding the following day that required surgical management. This patient died 11 days after surgery.

Two patients who underwent subtotal colectomy died. The three that survived to discharge were admitted for 24, 28, 21 days respectively, one developed a hospital acquired UTI post-operatively and 1 was re-admitted within 28 days.

Summary of Key Findings

- Less than 5% of patients who presented with rectal bleeding underwent rigid sigmoidoscopy or proctoscopy
- NSAIDs are known to cause ulceration in the LGI tract but only 60% of patients presenting with LGIB had their NSAID withheld
- 10% patients with LGIB were taking warfarin. The vast majority did not receive appropriate PCC or vitamin K in the management of their bleeding.
- Most patients did not meet the criteria for clinically significant bleeding, but despite this over 25% received a red cell transfusion. Many patients were transfused liberally, at Hb thresholds above 70-80g/l and many had a target Hb of >90-100g/l. Many of these transfusions were avoidable.
- Single unit transfusions represented 20% of transfusions; most patients received two units. Wider adoption of single unit transfusions in stable patients may reduce the volume of red cell units required.
- Although most patients did not have significant transfusion needs, 5% required large volume transfusions, but only 20% of these triggered a MHP. A MHP has been shown to improve outcomes in bleeding by ensuring appropriate product ratios are provided urgently. This represents a key opportunity to improve practice.
- Very small numbers of patients received platelet transfusion or FFP, but based on platelet counts, clotting and the severity of bleeding many of these could have been avoided.
- The majority of patients underwent no inpatient investigation to identify the bleeding source. Nearly a third of patients that had clinically significant bleeding did not have the source of their bleeding investigated. Of those that did undergo investigation, many waited more than 24 hours.
- Very few patients required surgical control of bleeding. Patients that did require surgery mostly did not have appropriate pre-operative risk scoring, but despite this, all patients were managed by an appropriately senior surgeon and anaesthetist.

Organisational Data Results

138 hospitals provided data on the organisation of services for LGIB. Of these 2 (1.4%) indicated that they did not routinely admit LGIB (a tertiary centre for oncology and a heart and lung specialist hospital). These hospitals were therefore excluded from any standards that apply to routine LGIB admissions.

Audit Standard 1: Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to on-site endoscopy, interventional radiology (on-site or covered by a formal network), on-site abdominal surgery, on-site critical care and anaesthesia (NCEPOD 2015)

For the purpose of assessment, this standard has been broken down into four care domains; (1) endoscopy, (2) interventional radiology, (3) abdominal surgery and (4) critical care and anaesthesia.

1. Endoscopy

Audit Standard 1: Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to on-site endoscopy.

24/7 access to endosccopy was investigated both in hours (defined as 9am-5pm Monday to Friday) and out of hours (defined as 5.01pm-8.59am Monday to Friday and throughout the weekend). These were examined separately.

	National Audit N= 136* n (%)
Does your hospital provide in-hours colonoscopy or flexible sigmoidoscopy for lower GI bleeding? *Yes* *No* *Unknown*	 134 (98.5) 2 (1.5) 0
Does your hospital provide out-of-hours colonoscopy or flexible sigmoidoscopy for lower GI bleeding? *Yes* *No* *Unknown*	 99 (72.8) 37 (27.2) 0
N (%) meeting Standard	99 (72.8)

*Hospitals that do not routinely admit LGIB are not included in this standard

Of the 136 sites that routinely admit LGIB, 134/136 (98.5%) stated that they provide in-hours colonoscopy and flexible sigmoidoscopy. This reduced to 99/136 (72.8%) in the out of hours period. In total only 99/136 (72.8%) hospitals are able to provide 24/7 access ton-site lower GI endoscopy for LGIB.

Hospitals that did not provide 24/7 access to lower GI endoscopy were asked to report how they would manage patients who may require this service, particularly in the out of hours setting. Only one reported that they had an agreed referral protocol to another hospital. 8/136 (5.9%) reported ad hoc arrangements and 5/136 (3.7%) reported no arrangements at all. 19/136 (14.0%) did not answer. Four reported 'other arrangements', including a service limited to mornings at the weekend and a lower GI

endoscopy service that was only available in emergency theatre, depending on the speciality of the on-call surgeon.

Of the 37/136 hospitals that do not provide out of hours lower GI endoscopy, 19 reported that they did have an endoscopist rota. Several reported that the rota is only for upper GI bleeding endoscopy. Many reported that although they have an endoscopist rota, there is no rota for endoscopy nurses.

The 99/136 hospitals that do provide out of hours lower GI endoscopy for LGIB were asked to report the competency of up to 8 of their endoscopists at providing haemostatic therapy. 82/99 hospitals reported that all of the endoscopists on their rota were proficient at haemostatic therapy during colonoscopy or flexible sigmoidoscopy. It is essential that all endoscopists providing an emergency service for LGIB are fully competent at therapeutic as well as diagnostic lower GI endoscopy.

Audit Standard 2: Endoscopy lists should be organised to ensure that GI bleeds are prioritised (NCEPOD 2015)

	National Audit N= 136* n (%)
Are there Monday-Friday defined emergency endoscopy slots that can be used for flexible sigmoidoscopy or colonoscopy for lower GI bleeding? *Yes* *No* *Unknown*	 77 (56.6) 59 (43.4) 0
N (%) meeting Standard	77 (56.6)

*Hospitals that do not routinely admit LGIB are not included in this standard

77/136 (56.6%) hospitals reported that they had defined emergency slots which could be used to provide lower GI endoscopy for LGIB. There is evidence in upper GI bleeding that urgent access to OGD improves care and reduces length of stay. LGIB is less likely to warrant urgent inpatient colonoscopy or flexible sigmoidoscopy but those that do will benefit from prioritisation of endoscopy for bleeding. The availability of daily emergency endoscopy slots for emergency bleeding will reduce waiting times for these procedures, which has both financial and logistical benefits.

2. Interventional Radiology (IR)

Relevant audit standard: Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to interventional radiology (on-site or covered by a formal network (NCEPOD 2015)

Centralisation has meant that many hospitals may have had their IR serves moved to an external site. Given the associated costs and experience required to provide this service many hospitals cover out of hours services with a network, and rely on referrals to another hospital to access these treatments. Data was collected on referral pathways and on-site provision.

	National Audit N= 136* n (%)
What are the arrangements for in-hours[∞] interventional radiology for lower GI bleeding?	
On-site service	73 (53.7)
Agreed referral protocol to another hospital	19 (14.0)
Ad hoc arrangements	34 (25.0)
No arrangements in place	8 (5.9)
Other	2 (1.5)
N (%) meeting Standard	92 (67.6%)
What are the arrangements for out-of-hours[§] IR for lower GI bleeding?	
On-site service	50 (36.8)
Agreed referral protocol to another hospital	22 (16.2)
Ad hoc arrangements	44 (32.4)
No arrangements in place	17 (12.5)
Other	3 (2.2)
N (%) meeting Standard	72 (54.9)

*Hospitals that do not routinely admit LGIB are not included in this standard

The provision of IR is divided into [∞]in hours (9am-5pm Monday to Friday) and [§] out of hours (5.01pm-8.59am Monday to Friday and throughout the weekend).

All hospitals provided data on the provision of IR. 73/136 (53.7%) hospitals reported that they provided on-site in-hours IR but this reduced to 50/136 (36.8%) in the out of hours setting. This represents a significant discrepancy between in and out of hours availability of this service. It might be expected that the difference is accounted for by an increase in the use of agreed referral protocols out of hours, but this was not the case. The biggest increases were seen in 'ad hoc arrangements' and 'no arrangements'. Ad hoc arrangements were reported by 34/136 (25.0%) hospitals and this increased to 44/136 (32.4%) out of hours.

When asked about 'other' and 'ad hoc' arrangements entailed, several hospitals reported that angiography depended on the availability of a small number of radiologists (1 or 2) and that if none was available patients would be transferred elsewhere, although there was no formalised pathway for this. One reported that they

did have an agreed referral pathway for IR but this was only for trauma patients. There was no equivalent for LGIB.

No arrangements were reported by 8/136 (5.9%) hospitals in hours, but this increased to 17/136 (12.5%) in the out of hours setting.

It appears that several hospitals with on-site services in hours, reverted to informal or no arrangements in the out of hours setting. This inconsistency in the provision of IR may represent a significant deviation in treatment options available for LGIB purely as a result of timing of symptoms. Given that embolisation is mostly utilised in unstable, severe bleeds, the absence of a planned referral pathway in many of these hospitals is a standard for which quality can be improved.

Audit Standard 3: There should be a minimum of 6 interventional radiologists on the rota (BSIR provision statement)

This standard is relevant to hospitals that provide out-of-hours on-site interventional radiology (n=50). The remaining 86 hospitals were asked not to complete this question. 47/50 hospitals responded.

	National Audit N=50 n (%)
How many interventional radiologists are on the rota that can provide embolisation for lower GI bleeding? *Hospitals with < 6* *Hospitals with ≥ 6* *No data*	 28 19 3
N (%) meeting Standard	19 (39%)

The BSIR and RCR have made recommendations stating that the minimum number of interventional radiologists required to safely staff an out of hours rota is 6. Of the 50 hospitals that provided on-site out of hours IR, only 19/50 (39%) hospitals had 6 or more interventional radiologists on their rota. The median number of radiologists on a rota was 5 (range 1-9).

The networking of hospitals to provide out of hours embolisation across a number of sites, may mean that large geographical areas are covered by a small number of radiologists. 45 hospitals provided data on the size of their networks. 27/50 (54%) hospitals provided out of hours IR to external sites. 7/50 hospitals provided this service for 3 or more other hospitals, 2/50 provided it for ten or more. For hospitals serving large populations (defined as >1 million people) the BSIR/RCR have recommended that the minimum number of interventional radiologists on a rota is 8.

Provision of out of hours interventional radiology also relies on the availability of specially trained radiology nurses. Of the 50 hospitals that provided on-site out of hours IR, 29/50 reported having an out of hours rota for IR nurses and radiographers and 3/50 reported having no rota. 18/50 hospitals did not provide data on this. The discrepancy between the out of hours availability of radiologists and their support staff means that the former may be working in isolation on some of the most unstable patients.

3. Surgery and Critical Care and Anaesthesia

Relevant audit standard: Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to on-site endoscopy, interventional radiology (on-site or covered by a formal network), on-site abdominal surgery, on-site critical care and anaesthesia (NCEPOD 2015)

Provision of Abdominal Surgery

	National Audit N= 136* n (%)
What are the arrangements for in-hours emergency abdominal surgery for lower GI bleeding? *On-site service* *Agreed referral protocol to another hospital* *Ad hoc arrangements* *No arrangements in place*	 136 (100%) 0 0 0
N (%) meeting Standard	136 (100%)
What are the arrangements for out-of-hours emergency abdominal surgery for lower GI bleeding? *On-site service* *Agreed referral protocol to another hospital* *Ad hoc arrangements* *No arrangements in place*	 136 (100%) 0 0 0
N (%) meeting Standard	136 (100%)

*Hospitals that do not routinely admit LGIB are not included in this standard

All hospitals that routinely admitted LGIB provided in and out of hours on-site abdominal surgery.

With the advances in endoscopic and radiological therapies for LGIB, surgery is rarely indicated. Ready access is still essential for those patients with unavoidable surgically managed pathologies (such as bleeding colonic tumours or colitis) or to treat complications that may arise from alternative forms of treatment.

Provision of Critical Care (Level 3)

	National Audit N= 136* n (%)
Does your hospital have any Critical Care on-site? *Yes* *No*	 135 (99.2) 1 (0.8)
N (%) meeting Standard	135 (99.2)

*Hospitals that do not routinely admit LGIB are not included in this standard

All hospital but one hospital reported providing level 3 care. This hospital is in the remote and rural setting and did report providing high dependency care (level 2).

Some patients may develop LGIB whilst hospitalised for another reason. By definition these patients will have other medical co-morbidities and may have complex care requirements. Continued access to high dependency and critical care is essential.

Summary of All Domains

Audit Standard 1: Patients with any acute GI bleed should only be admitted to hospitals with 24/7 access to on-site endoscopy, interventional radiology (on-site or covered by a formal network), on-site abdominal surgery, on-site critical care and anaesthesia (NCEPOD 2015)

	National Audit N= 136* n (%)
N hospitals meeting all standards for:	
4 domains	59 (43.3)
3 domains	52 (37.7)
2 domains	24 (17.4)
≤ 1 domains	1 (0.7)

*Hospitals that do not routinely admit LGIB are not included in this standard

In the previous sections the data have been presented by each domain (endoscopy, IR, abdominal surgery and critical care and anaesthesia) but here the data is combined. To fully meet this standard, all hospitals that routinely admit LGIB must have on-site endoscopy, abdominal surgery and critical care and on-site or an agreed referral protocol for IR. Only 59 (43.3%) hospitals meet this standard.

4. LGIB in the Elderly

Audit standard 4: Routine daily input from Medicine for the Care of Older People should be available to patients aged ≥ 70 admitted under surgical teams (adapted from NCEPOD 2012 and NELA 2015)

	National Audit N= 136* n (%)
Are elderly patients admitted under the care of surgical teams routinely reviewed by a Care of the Elderly doctor (or equivalent)? *Yes* *No* *Unknown*	 28 (20.6) 108 (79.4) 0
N (%) meeting Standard	28 (20.6)

*Hospitals that do not routinely admit LGIB are not included in this standard

All hospitals were asked which teams usually accepted LGIB and all reported that the majority of patients would be referred to general surgery.

The involvement of care of the elderly specialists has become standard practice in orthopaedics and increasingly in acute surgical admissions. However only 28/136 (20.6%) hospitals reported that elderly patients admitted with LGIB were reviewed by Care of the Elderly doctors. LGIB tends to be a disease of the older person and there is evidence that patients with medical co-morbidities have worse outcomes. This therefore represents an area with significant potential for improvement.

5. Transfusion

Audit standard 5: A massive transfusion protocol should be readily available in all hospitals (developed from Department of Health guidance)

This standard applies to all hospitals that participated in the audit; regardless of whether they routinely admit patients with LGIB (n=138). Readily available is defined as provided on the hospital intranet AND displayed on the wall in admission units. Sites were asked to inspect their emergency department and acute admissions units or equivalent.

	National Audit N= 138 n (%)
Does your hospital have separate written guidelines for blood transfusion in patients with major haemorrhage? *Yes* *No* *Unknown*	 133 (96.4) 5 (3.6) 0
N (%) meeting Standard	133 (97.8)
How are these guidelines made available? *Provided on hospital intranet* *Displayed on wall in admissions units* *Both* *Other*	 132 (95.6) 36 (26.1) 35 (25.4) 8 (5.8)
N (%) meeting Standard	35 (25.4)

Of the 138 hospitals that provided data on the provision of guidelines for the transfusion management of major haemorrhage, 5/138 (3.6%) reported that they did not have this guidance.

A massive transfusion protocol serves not just as a guideline for the volume and timing of blood products but also provides a standardised format of communication between clinical teams and transfusion laboratories. In 2010 the National Patient Safety Agency released a rapid response report recommending that 'the hospital transfusion committee reviews the local protocols and practices for requesting and obtaining blood in an emergency (including out of hours), ensuring that they include all the actions required by clinical teams, laboratories and support services, e.g. portering and transport staff/drivers and any specific actions pertinent to sites without an on-site transfusion laboratory'. Whilst it is surprising that five hospitals report no guidance despite the previous directive, this may reflect the clinicians' awareness as opposed to a true lack of provision. This remains a concern however, as this clinician may be the decision maker managing the patient at the time of massive haemorrhage.

The majority of hospitals reported that the massive transfusion protocol was available on their intranet. Only 36/138 (26.1%) hospitals reported that their massive transfusion protocol was displayed in admitting wards. To meet the standard, the protocol must be available online and displayed in admission units. Only 35/138 (25.4%) met this standard. It is essential that this protocol is readily accessible in the acute, clinical setting.

Audit standard 6: Local arrangements should be in place to provide compatible blood urgently for patients with major bleeding (BCSH 2015 and DoH guidance 2010)

	National Audit N= 138 n (%)
Are on-call transfusion laboratory staff on site at all times*? *Yes* *No* *Unknown*	 137(99.2) 1 0
N (%) meeting Standard	137 (99.2)

*24 hours/day, seven days/week

Delays in the provision of blood products may be as a result of clinician behaviour or transfusion laboratory availability. All but one site reported on-call transfusion laboratory staff were available 24/7. The one site without this was in a remote and rural setting with specific procedures tailored to their island location.

6. Guidelines

Audit standard 7: Guidelines on gastrointestinal bleeding should be readily available in all hospitals (developed from DoH guidance and NCEPOD 2015 recommendations)

Readily available is defined as provided on the hospital intranet AND displayed on the wall in admission units. Sites were asked to inspect their emergency department and acute admissions units or equivalent.

	National Audit N= 138 n (%)
Does your hospital have written guidelines for the management of GI bleeding? *Yes* *No* *Unknown*	 100 (72.5) 34 (24.6) 4 (2.9)
N (%) meeting Standard	100 (72.5)
How are these guidelines made available? *Provided on hospital intranet* *Displayed on wall in admissions units* *Both* *Other* *Unknown*	 90 (65.2) 20 (14.5) 19 (13.8) 10 (7.2) 4 (2.9
N (%) meeting Standard	19 (13.8)

100/138 (72.5%) hospitals reported providing written guidelines on the management of GI bleeding. The 2015 NCEPOD report into upper and lower GI bleeding recommended that 'care pathways for all GI bleeds should include, as a minimum, risk assessment, escalation of care, transfusion documentation, core procedural documentation, network arrangements and re-bleed plans. The pathway needs to be clearly documented.' There is detailed guidance provided by NICE on the management of upper GI bleeding which may form the basis of developing GI bleed guidelines.

A much smaller number of hospitals reported that these guidelines included LGIB. As LGIB is not covered by a NICE guideline or other national body this is more difficult. As it is often difficult to distinguish lower from upper GI bleeding at presentation it would be appropriate to develop a comprehensive guideline that covers both.

When asked how readily available these guidelines were, most hospitals reported that they were available on the hospital intranet but much fewer were displayed on the walls of admission units. Only 19/138 (13.8%) hospitals met the criteria for availability.

Summary of Key Findings

- Only 99/136 (72.8%) hospitals were able to provide 24/7 access to on-site lower GI endoscopy for LGIB.
- 42/136 (30.8%) hospitals had no formal arrangements in hours for the provision of IR and 61/136 (44.9%) hospitals had no formal arrangements out of hours (either on-site or via an agreed referral pathway).
- Of the 50 hospitals that provided on-site out of hours IR, only 19/50 (39%) met the minimum requirements stated by the BSIR and RCR to safely staff an out of hours rota.
- All hospitals provided on-site abdominal surgery and 135/136 (99%) provided level 3 critical care
- Only 49/136 (43.3%) hospitals met the standards for all four care domains (endoscopy, IR, surgery and critical care)
- Only 28/136 (20.6%) hospitals reported that elderly patients admitted with LGIB were routinely reviewed by Care of the Elderly doctors.
- 133/138 (96.4) hospitals provided guidelines for blood transfusion for patients with major haemorrhage but these were not readily available in 103/138 (74.6%) hospitals.

Discussion

This is the first audit of LGIB conducted in the UK and reports detailed evaluation of many components of care in an unprecedented number. As research into LGIB is lacking, the data on investigations, surgery and mortality are novel in the UK but are also of relevance internationally. Hospitals were invited to participate based on routine admission of LGIB as opposed to size or location. The cases were unselected and consecutive and are an accurate reflection of those presenting to UK hospitals. The results are therefore widely applicable.

In 2015 NCEPOD conducted a national enquiry into patients treated for GI bleeding (upper and lower) that received 4 or more units of blood[5]. They identified the following key findings:

- 32% hospitals admitting GI bleed patients did not have a 24/7 endoscopy service
- 73% hospitals could not provide 24/7 embolisation of GI bleeding onsite
- Blood product use was inappropriate in 20% cases
- The anatomical site of bleeding was identified in 47% of LGIB
- 30% patients with LGIB had a colonoscopy or flexible sigmoidoscopy
- 24% patients died overall, the mortality rate of LGIB was comparable to that of the patients who died with non-variceal UGIB (20.2% and 21.5% respectively)

These findings were based on a study population of 618 severe GI bleeds, only 138 were LGIB. Data were collected between January and April 2013. In September to December 2015, looking at over 2500 unselected cases of LGIB, we have found that:

- 27% hospitals admitting LGIB did not have 24/7 access to colonoscopy or flexible sigmoidoscopy
- 73% hospitals did not provide 24/7 embolisation of LGIB onsite
- 70% red cell transfusions could be deemed inappropriate in relation to Hb threshold or target
- 49% LGIB had no inpatient investigations to identify the bleeding source
- 26% patients had a colonoscopy or flexible sigmoidoscopy
- In-hospital mortality in patients who received $\geq$ 4 units red cells was 8.2% (overall mortality was 3.4%)

In the 2 years between these two reports, the availability of endoscopy and embolisation is unchanged. The use of flexible sigmoidoscopy and colonoscopy is also consistent. Approximately half of patients admitted had no inpatient investigations. Other studies have shown that 42%-46.5%[22,23] patients admitted with LGIB are discharged without investigation. Endoscopy and radiology require considerable resources and will not be necessary in all patients presenting with LGIB. The inclusion criteria for this audit were deliberately broad and will have captured 'trivial' bleeds so the lack of inpatient investigation in some patients may be justified. Identifying which patients will benefit from investigation is difficult, and outcome data from those not investigated is lacking. Further research into the long-term outcomes of these patients is required.

Very small numbers of patients received endoscopic haemostasis or embolisation. Whether this is due to the apparent lack of availability of interventional radiology and endoscopy requires further study. The number of patients requiring surgical control of bleeding was very small.

In this audit in-hospital mortality was 3.4% of all patients and 8.2% of those that received 4 or more red cell transfusions. This is lower than previously quoted figures; 3.9-8.8%[22,24], and 20.2% in patients who received 4 or more red cell transfusions in the NCEPOD report[5].

The median length of stay was 3 days. As nearly half of patients were not investigated and only very small numbers received treatment it raises the question of why these patients are being kept in hospital. Given the advanced age of many of these patients this may be due to social care requirements.

In this audit 26.7% patients received a red cell transfusion. Previous studies have reported that red cell transfusion is used in 20.9%[22] of all patients admitted with LGIB, rising to 40%[25] in patients requiring colonoscopy. That most of the patients in this audit who received red cells did not have clinically significant bleeding is a novel finding and may suggest that the inappropriate use of transfusion is a bigger problem than previously thought.

Although most patients did not have significant transfusion needs, 5% required large volume transfusions (4 or more units red cells), but only 20% of these triggered a MHP. Although nearly all hospitals had a MHP, they were not 'readily available' in 25% hospitals. A MHP aims to ensure that appropriate product ratios are provided urgently. In trauma, balanced transfusions (RBC and other products) improve survival[26]. It is essential that all hospitals provide written guidance on major haemorrhage and that this is easily accessible to surgical teams.

Appropriate guidance on the management of anti-platelet agents and anti-coagulants is also important. Although there is evidence that anti-platelets are associated with re-bleeding[27], this must be balanced with the risk of cardiovascular complications in patients that have these drugs withheld. There is some evidence that continuing aspirin in patients with LGIB reduces the risk of serious cardiovascular events and death[28]. This is discussed in detail in the NICE guidance on UGIB and many of the principles are applicable to LGIB.

LGIB patients represent a varied and complex group of patients with the potential for significant improvements in care. Writing a comprehensive guideline for LGIB must be a priority. This has been limited by the lack of data on patient characteristics, interventions and outcomes. This audit provides a contemporary report of LGIB patients and also the facilities available for their treatment. We hope it will provide a useful base to start developing best practice guidance.

There are several limitations to this audit. The volume of data collected represents a large body of work and although the cases are mostly very complete, it is inevitable that some cases will have been missed. The identification of cases relied on daily case capture, sustained over two months. An audit of UGIB that used similar case capture methods identified 85% cases when compared to HES data[29]. This comparison is very difficult to do in LGIB as there are no comprehensive codes in the ICD-10 classification.

Case ascertainment and data collection were prospective, but relied on accurate record keeping in patients' notes and electronic records which may be unreliable. As cases were completed, they were appraised by the project group to ensure completeness and accuracy. Missing data were repeatedly chased to maximise completeness.

A password-protected website was created to collect data, with each site having its own page that only it could access. This caused a problem for the majority of hospitals, as their IT systems did not support the webpage. This should be considered in all future audits that rely on electronic data collection, especially as the gap between commercial and NHS software is expanding and may not be anticipated by companies that provide specialised software of this type.

Comparison to Upper GI Bleeding

UGIB and LGIB are often grouped as one entity, so comparison of the two in terms of patient characteristics and outcomes is useful for several reasons. It can be difficult to distinguish upper from lower sources clinically[5] and many of the resources used for diagnosis and treatment are similar. Despite this, in the UK most UGIB is managed by gastroenterologists and LGIB by general surgeons. In May 2015 the NCEPOD report into GI bleeding stated that 'the traditional separation of upper and lower GI bleeding in hospitals should stop. All acute hospitals should have a lead clinician who is responsible for local integrated care pathways for both upper and lower GI bleeding'[5]. We therefore present our findings in comparison to similar data for UGIB.

The UGIB data is from the 2007 NHSBT and the British Society of Gastroenterology audit of UGIB[30]. The methodology of this audit was very similar, capturing 6750 patients presenting with UGIB to UK hospitals between 1st May to 30th June 2007.

	2007 Audit UGIB[30] N= 6750 N (%)	2015 Audit LGIB N = 2528 N (%)
Median age (IQR)	68 (49-81)	74 (57-83)
Male sex (%)	4009 (59)	1209 (48)
Co-morbidities	3389 (50)	1994 (79)
Medications		
Aspirin	1874 (28)	584 (23.1)
Warfarin	473 (7.0)	270 (10.7)
Inpatients bleeds	1107 (16.4)	185 (7.3)
Shock	929 (13.8)	58 (2.3)
Red cell transfusion	2922 (43)	666 (26.7)
Inpatient endoscopy (*OGD for UGIB, Flexible sigmoidoscopy or colonoscopy for LGIB)*	5004 (74)	642 (25.9)
Interventional Radiology*	84 (1.2)	37 (1.5)
Laparotomy for bleeding	104 (1.5)	6 (0.4)
Median LOS (IQR)	5 (2-12)	3 (1-7)
In-hospital mortality	675 (10)	85 (3.4)

*Mesenteric angiography ± embolisation, transjugular intrahepatic porto-systemic shunt

The data from these two audits show that in comparison to UGIB, patients presenting with LGIB are older, a higher proportion have co-morbidities and equivalent numbers are receiving antiplatelet or anticoagulant medications. Despite this, fewer patients are shocked and a smaller proportion require blood transfusion. Similar proportions receive interventional radiology procedures, but the number of patients requiring

laparotomy for bleeding is smaller. Fewer patients are investigated as an inpatient and the median length of stay is shorter. In-hospital mortality is less frequent in LGIB than UGIB.

Action Points

Further research examining the outcomes of angiography and embolisation is required, particularly looking at outcomes in comparison to other interventions. A national audit of visceral bleeding outcomes or a national registry of patients treated by interventional radiology could provide data for this purpose.

The relevant national societies should collaborate to produce guidelines for the management of LGIB.

There should be increased communication between surgical teams, transfusion practitioners and haematologists with responsibility for transfusion to ensure both are kept up to date with developments in surgical and transfusion practice. We suggest discussion of all patients with gastrointestinal bleeding who trigger a MHP at monthly morbidity and mortality meetings.

Conclusions

This is the first audit of LGIB conducted in the UK and includes detailed evaluation of many components of care including endoscopy, interventional radiology and transfusion in an unprecedented number. The infrequency of shock and major haemorrhage is an important novel finding especially in the context of high levels of blood transfusion. We hope that sites will examine their transfusion practice in relation to these findings and tailor their transfusion strategy accordingly.

Many patients are not investigated for the source of bleeding and the long-term impact of this requires further study. The numbers of patients receiving endoscopic or interventional radiology treatment are very low, but it is not clear whether this is due to limited availability or because it is not needed. If the latter, there may be an opportunity to increase the outpatient or ambulatory care of these patients. The lack of robust risk scoring methods may hamper this and should be addressed as a priority.

LGIB patients can be complex to manage and present a diagnostic challenge. We hope that this audit provides the basis for further work that improves the care, experiences and outcomes of these patients.

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The Royal Marsden NHS Foundation Trust	Sue Alexander	Dr R Vuononvirta	Dr R Vuononvirta
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The Shrewsbury and Telford Hospital NHS Trust	Mr V Vidyasankar	Dr Thomas Allman	
The Whittington Hospital NHS Trust	Mr A Oshowo	Dr Dilan Patel	Sue Ellis
University Hospital of South Manchester NHS Foundation Trust	Mr A Sharma	Mr Taher Fatayer, Dr Zainab Sherazi, Dr Sarah-Lindsay Jones	Jacqueline Serevitch
University Hospital Southampton NHS Foundation Trust	Mr J Knight	Dr F Howse, Dr B van Herwijnen, Dr M Rawashdeh	Sharon Garrigos
University Hospitals Birmingham NHS Foundation Trust	Surgeon Commander Catherine Doran	Dr J Hodgetts	
University Hospitals Bristol NHS Foundation Trust	Mr J Shabbir	Mr M Al Ardah	Stuart Metcalfe
University Hospitals Coventry and Warwickshire NHS Trust	Mr P McCullough	Dr Charlotte ElSayed, Dr Matthew Cooke, Dr Celine Wei-Te Ting, Janine Beddow Modern Matron	Tanuja Patel
University Hospitals of Leicester NHS Trust	Mr A Miller		
University Hospitals of Morecambe Bay NHS Foundation Trust participating as Furness General Hospital and the Royal Lancaster Infirmary	Miss Panna Patel (Furness General Hospital)	Mr Stergios Tezas, Dr James Wheeler, Mr Amit Choudhury	Lynne Kaighan
	Miss C Bronder (Royal Lancaster Infirmary)	Dr J Roy, Dr S Mehmood, Dr A Lindsay	Neil McDonald
Walsall Healthcare NHS Trust	Miss S Addison		
Warrington & Halton Hospitals NHS Foundation Trust	Mr Mark Tighe		
West Suffolk NHS Foundation Trust	Mr J Alberts and Miss S H Rossi	Dr James McTaggart, Dr Lauren Deacon, Dr Andrew Mason	
Weston Area Health NHS Trust	Mr N Chandratreya	Dr. James Fullick, Dr. Frances Wensley, Dr. Elizabeth Shermon, Dr. Afra Gangi, Mr Jamal Ghadhar	

Wirral University Teaching Hospital NHS Foundation Trust	Mr D Smith	Mr M Elshaieb, Ms Y Goh, Ms C Tamura	
Worcestershire Acute Hospitals NHS Trust	Mrs D Nicol	Dr J Ng, Mr George Elshetwy	Diane Lynch
Wye Valley NHS Trust participating as Hereford County Hospital	Mr Dayo Adeyemo		Val Bailey Julie Preece
Yeovil District Hospital NHS Foundation Trust	Mr N Francis	Dr Diane Wright	
York Teaching Hospital NHS Foundation Trust participating as York Hospital and Scarborough Hospital	Mr Nick Woodcock (York Hospital)	Nala Sivarajasingham, Kazim Abbas, Konstantinos Lasithiotakis, Konstantinos Polyzois	Sheila Vass
	Ms Clare McNaught (Scarborough Hospital)	Dr Tevin Browne	

SCOTLAND

Gilbert Bain Hospital, Shetland	Dr K Lalla	Dr Charlotte Nicholl, Dr Anna Datta	
Glasgow Royal Infirmary	Mr F Maxwell	Dr Elaine Yeap and Dr Edel Quinn	
Ninewells Hospital	Miss C Carden	Mr G Muthukumarasamy, Miss Z Vujovic	
Queen Elizabeth University Hospital Glasgow	Mr G Nicholson	Matthew Corr, Nicholas Bradley, Matthew Schembri, Elizabeth Day, Chris Ray	
The Royal Alexandra Hospital Paisley	Miss E Wright		
Western General, Edinburgh	Mr Hugh M Paterson	Dr Nichola Robertson, Dr Clare Connelly, Dr Klaas Schuur	

WALES

Morriston Hospital Swansea	Professor Dean Harris and Mr Eyas Qasem	Dr Jenny Frederina Wong , Dr Niamh Osheil, Dr Tariq Yasin, Dr Felix Gregory	
Neville Hall	Miss Kathryn Boyce		
Royal Gwent	Mr G Williams	Dr G Carr, Dr H Jayamanne	

University Hospital Llandough	Mr M Davies	Miss Sophie Tate, Dr Emma Keelaher, Dr Yao Zong Tay	
University Hospital of Wales Cardiff			

NORTHERN IRELAND

Ulster Hospital Dundonald	Mr K Mulholland	Dr Colin McIlmunn, Dr Jennifer McInerney	Sharon Thompson
South West Acute Hospital	Ms Alison McCoubrey	Dr Isman Jidaal and Dr Aseel Sleiwah	Annette McCullagh
Daisy Hill and Craigavon Hospitals	Mr D McKay		Raymond Haffey
Belfast Health and Social Care Trust	Mr L Convie		