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ERCP for bile duct stones across a national service, demonstrating a high requirement for repeat procedures


Affiliations below.

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This study was supported by Boston Scientific Corporation (http://dx.doi.org/10.13039/100008497), This study was supported in part by an unrestricte

Abstract:

Background - Bile duct stones (BDS) represent approximately 50% of the requirement for ERCP within most services. Significant variation in outcome rates for BDS clearance at ERCP has been reported, and endoscopy societies have set standards for expected clearance rates. The aim of this study was to analyse procedural outcome across a national service.

Methods - Using verified hospital episode statistics (HES) data for the National Health Service (NHS) in England, we analysed all patients having first ERCPs for BDS from 2015-17, and followed these patients for at least 2 years.

Results - In total 37,468 patients underwent a first ERCP for BDS, with 69.8% undergoing only one procedure. This figure of less than 70% of BDS cleared at first ERCP is below the Key Performance Indicators as set by the British Society of Gastroenterology (>75%) and the European Society of Gastrointestinal Endoscopy (>90%). Of 55,556 ERCPs done for BDS, 52.9% were repeat procedures, with 11,322 patients needing multiple procedures.

For hospitals performing significant numbers of ERCPs (more than 600 for BDS during the study period) patients undergoing repeat ERCPs for BDS ranged from 9% to 50%.

Conclusion - In this nationwide study the performance at clearing BDS at first ERCP is suboptimal, with high numbers of repeat procedures required. This may have a negative impact on both patient’s outcomes and experience, and increase pressure on endoscopy services. Apparent variation of outcome between acute hospital care providers requires further analysis.

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ERCP for bile duct stones across a national service, demonstrating a high requirement for repeat procedures.

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Introduction

Bile duct stones (BDS) are a common problem. The European Society of Gastrointestinal Endoscopy (ESGE) estimates that 10-15% of adults have gallbladder stones and up to 18% of these will have BDS [1]. Complications from BDS may include obstructive jaundice, biliary colic, infection (cholangitis or hepatic abscesses) or acute pancreatitis. Considering that more than 25% of patients with BDS will develop symptoms over time, BDS clearance is recommended by ESGE, irrespective of symptoms [1–4]. The management of BDS has 2 steps; clearance of stones from the biliary tree, and cholecystectomy (if not previously performed) to remove the pool of residual stones. The commonest method of clearing BDS is endoscopic retrograde cholangio-pancreatography (ERCP). BDS is the clinical indication for approximately 50% of the ERCPs performed in the UK [5,6].

Reported success of stone clearance at ERCP shows wide variation, ranging from 62.3% to > 96%[5] [7] [8]. Factors explaining these differences may include study design (e.g., inclusion of patients who had had previous ERCPs), prospective/retrospective data, specialist/non-specialist centre enrolment, and self-reported results. A 2007 UK wide prospective audit reported overall success rates for ERCP at 70.4% and a BDS complete clearance rate of 62.3% [5]. Procedural success at first ERCP was 71.9%, albeit this did not specifically report BDS clearance at first ERCP. A prospective Dutch registry study captured approximately 50% of all ERCPs done nationally over a 1 year period, with 4,388 (51.2%) of the 8,575 procedures performed for BDS. The success rate of these reported procedures was 85.2%, but included both first and repeat procedures. Of note, the success rate fell to 76% amongst those cases not submitted for analysis. [8] Using a self-reporting tool Cotton et al. reported on more than 18,000 ERCPs performed by 63 endoscopists in the US. Stone clearance rates were
extremely high (99% for stones < 10mm, 96% for stones > 10mm)[7]. However, the data was not based on intention to treat, and failure to adequately identify the ampulla was an exclusion criteria.

Expected standards for BDS clearance at ERCP have been set. The British Society of Gastroenterology's (BSG) 'ERCP - a way forward' position statement in 2014 [9] set a minimum standard of 75% BDS clearance rate at first ERCP within an individual’s, as well as a service’s, practice. An ‘aspirational target’ of 80% for BDS clearance was also set. These are ‘intention to treat’, so incorporate all procedural challenges (e.g., failed oesophageal intubation, selective biliary cannulation). The American Society of Gastrointestinal Endoscopy (ASGE) and European Society of Gastrointestinal Endoscopy (ESGE) have higher minimum expected level of BDS clearance. Both the ASGE and ESGE state that for stones less than 1cm more than 90% should be cleared at first ERCP. The ESGE state that this only includes those who have had successful biliary cannulation. [1,10].

ERCP carries risk, whether at index or subsequent procedure. Bodger et al showed a 30 day post-ERCP all-cause mortality rate of 5.3%, of which specific procedural complication codes were identified in 1.2% of deaths, representing 0.06% of ERCPs [6]. Other studies have shown all-cause mortality post ERCP ranging from 2 to 5.9% [5,6,11–14] with deaths directly related to the procedure ranging from 0.2 to 0.5% [15–17]. Definitive stone clearance at index ERCP is the optimal patient outcome. Long-term biliary stenting without stone clearance carries significant risk of adverse outcome [18,19], including a 40% rate of cholangitis, and up to a 15% biliary-related mortality [14].

Most studies of ERCP for the management of BDS have focussed on outcomes for index or single procedures. The objective of this study was to assess the burden of ERCPs for BDS disease across a national service, as well as to investigate the technical success of first ERCPs for BDS, and the consequent need for, and success of, additional procedures.

**Methods**

A retrospective analysis of National Health Services (NHS) hospitals in England, incorporating patients aged 18 years or over who were admitted between 01-April-2015 and 31-March-2019 was performed. Data were obtained from the Hospital Episode Statistics (HES) admitted patient care data set. This is an administrative data set that contains data on diagnoses and procedures as well as organizational characteristics and patient demographics for all NHS activity in England. An accredited clinical coder was recruited to support the identification of appropriate International Classification of Diseases 10th Revision (ICD-10) codes that classified a diagnosis of bile duct stones (table 1) as well as OPCS Classification of Interventions and Procedures (OPCS-4) to classify procedural codes to identified the performance of ERCP for BDS.

Patients were included for analysis if an appropriate diagnosis (ICD-10 code - table 1) and procedure (OPCS-4 code (Supplementary table 1) was included within HES, irrespective of diagnostic position. To identify the patient cohort, the pseudonymized patient identifiers attached to these episodes were selected.

To ensure that patients in the cohort were analysed from their first bile duct stone diagnosis, pseudonymized patient identifiers were also identified if they were recorded in HES data as having an ICD-10 code consistent with BDS for the time period 01-April-2013 to 31 March-2015). These patient identifiers were then excluded from the study cohort, providing a 2 year exclusion window prior to the start of the study period. Patients were also removed from the cohort if their first bile duct stone diagnosis was recorded after 01-April-2017. This ensured that all patients in the study cohort had a minimum of 2 years of follow up from their initial diagnosis.
With the finalised list of patient identifiers for the cohort, all episodes of care for these patients between 01-April-2015 and 31-March-2019 were then identified. Procedures were identified using the relevant OPCS-4 codes.

Distinct patients and spells were counted according to various criteria as above. To provide comparison between acute hospital care providers (NHS Trusts) control limits to indicate variation from the national mean were calculated. These limits were calculated at the 2 standard deviation (95%) and 3 standard deviation (99.8) level.

**Statistical Methods**

To enable comparison between hospital endoscopy services (acute hospital care providers in England) in the proportion of patients undergoing >1 ERCP, a funnel plot to illustrate variation from the national mean was used [20]. We calculated control limits at 2 standard deviations and 3 standard deviations from the mean. These control limits were then plotted (Figure 1) with a count of patients for each acute hospital care provider on the X axis (denominator for this indicator) and the proportion of those patients who underwent >1 ERCP procedures on the Y axis.

**Results**

Coded data from 154 acute hospital care providers in England was assessed and all possible codes for an ERCP performed for bile duct stones (BDS) was identified. In the years 2015/16 to 2018/19 183,503 ERCPs were performed. The number of ERCPs undertaken each year remained stable (table 2). In total 86,602 (47.2%) of the ERCPs in this 4 year period were undertaken for BDS. This figure includes all ERCPs performed for BDS over this time period, including those excluded from the final study cohort who had had an ERCP prior to 2015-16 financial year, and those who had a first ERCP for BDS after 2016-17 financial year (who were not then available for 2 years of follow up within study period). During the study recruitment period (2015/16 to 2016/17) 37,468 patients had an initial presentation with BDS and underwent at least one ERCP. During this study recruitment period 92,406 ERCPs were performed nationally and 41,654 (45.1%) of these were carried out for BDS. Figure 2 shows a flow chart of patient inception.

For the 37,468 patients with an initial BDS presentation recruited during the 2 year period a total of 55,556 ERCPs were performed from recruitment to the end of 2018/19. In total 26,146 of the 37,468 patients recruited in this period had only 1 ERCP. This may suggest a BDS clearance rate at first ERCP of 69.8%.

11,322 patients underwent more than 1 ERCP, with a total of 29,410 ERCPs performed in this group. Over the whole study period 52.9% of ERCPs done for BDS in those who presented with an initial BDS in 2015/16 to 2016/17 were done as a repeat procedure. The breakdown of these results is shown on figures 3 and 4.
An assessment was made of the number of ERCPs performed per patient presenting with BDS according to acute hospital care providers in the NHS in England. (Figure 1. Applying BSG Key Performance Indicator (KPI) of a minimum stone clearance rate of 75% at first ERCP for stones. Figure 1 shows 32/154 (20.8%) of providers required more than 25% of their patients to have more than 1 ERCP.

Figure 1 shows the data for individual acute hospital care providers (within the NHS in England) demonstrating the number of patients undergoing ERCP for BDS during the study period against the percentage of patients requiring more than 1 ERCP for BDS. Each data point represents an acute hospital care provider.

Table 1 shows mean procedure count for each ICD-10 definition for bile duct stones. Patients with a diagnosis of bile duct stones and cholangitis needed the most ERCPs with 2.156 procedures per patient. Where as those with acute biliary pancreatitis needed the least ERCPS with 1.983 procedure per patient.

Discussion

Bile duct stones (BDS) remain a common clinical problem and a major indication for ERCP. Failure to clear stones at a first ERCP exposes patients to risks of further procedures, as well as risks linked to retained stones. The aim of this national population study was to capture every ERCP performed for BDS in England, and included 37,468 patients followed up for a minimum of 2 years. This provided an objective assessment of not only the success rate of clearing BDS within a national population, but the chronology of procedural success following the index ERCP.

The study showed that approximately 45,000 ERCPs were performed annually in England, with just under half of these for BDS. This data is similar to BSG (UK) audit data from 2006/2007 [6], and suggests that the electronically recorded Hospital Episode Statistics (HES) accurately captures complete data.

The success rate for BDS clearance at first ERCP (69.8%) does not meet the Key Performance Indicators (KPIs) set by the BSG (>75%) or ESGE (>90%). It is comparable to the overall success rate of first ERCP, for all indications, in England in 2004 (84% cannulation rate, 74% procedural success). Direct comparison for initial ERCP for BDS is not possible as this was not collected in the UK study [21]. In a more recent national Dutch study by Ekkelenkamp et al [8] 4388 of the total 8575 ERCPs were performed for BDS (51%), with an overall 85% stone clearance rate. However, only 59% of ERCPs were performed in patients with a native papilla (an indicator of ‘first ERCP’) and cannulation was achieved in 83% in this group. Again, direct comparison between this study and the Dutch study is not possible as the Dutch study did not collect the data on those who had first ERCP for BDS. The Dutch study did a data verification exercise. This involved randomly selecting 8 out of the 61 hospitals involved and verifying the data submitted to the study. For this group they looked at 20% of the submitted ERCPs. This was 281 ERCPs and all but 1 was submitted accurately. Second, from the same hospitals the ERCPs not submitted to the database were checked. This was a total of 441 ERCPs and was mainly procedures from participating endoscopists rather than those endoscopists who did not participate in the study. The success rate of the ERCPs not submitted was significantly lower than those recorded in the study (76.0% vs 85.8%; P<0.001)[8]. It seems probable that the
overall outcome for stone clearance for first ERCP in the Dutch population would be similar to that seen in this study. Moreover, in some studies data on ERCP outcome, including cannulation, is only recorded once identification of the papilla is achieved rather than based on intention to treat. In self-reported studies this risks significant data bias and may contribute to exceptionally high success rates of 97% for even the most difficult stones. [22].

The term ‘unsuccessful’ or ‘failed’ ERCP needs to be qualified. This definition, used in this study and in the previous UK audit by Williams et al [5], was applied where a repeat ERCP was required following an index procedure. However, this will include both patients who have failed cannulation (with an ongoing risk of worsening jaundice and cholangitis) and those in whom stone clearance was achieved, but in the setting of severe cholangitis and a profoundly septic patient a stent was placed to ensure optimal drainage. The former case would clinically represent a poor outcome, the latter a good outcome. The data in this study do not allow this clinical distinction to be reliably made, and both scenarios necessitate the patient requiring a further procedure. However, Table 1 shows that those patients with cholangitis did not undergo significantly more procedures than those without cholangitis. This suggests that a need to remove a biliary stent inserted as an ‘insurance’ in the setting of cholangitis was not an obvious factor in explaining an increase in overall repeat ERCPs. The reasons for failure to clear BDS are unclear but may relate to a range of factors, including endoscopist experience, unit volume and referral practice[23]. Individual endoscopist procedural outcome cannot be concluded from this study, although the introduction of the National Endoscopy Database (NED) within the NHS will make the monitoring of individual endoscopist’s activity and outcome simpler and more transparent. However, apparent significant variation was seen between acute hospital care providers (Figure 1). Figure 1 shows that a number of acute hospital care providers who performed significant numbers of ERCPs in patients with BDS (e.g., 600-700 patients during the study) required wide variation in need for repeat procedures (ranging from < 15% to > 50%). The reasons for this are unclear. An explanation might be referral differences, with one unit receiving a high proportion of perceived complex stone cases prior to index ERCP. Enhanced techniques for stone clearance, including endoscopic papillary large balloon dilatation (EPLBD) (sphincteroplasty) [24] and cholangioscopy with visually directed lithotripsy [25] may significantly improve the clearance of difficult stones. The use and availability of these techniques may have impacted on outcome. These are both recommended by ESGE[1]. It is possible, but not proven, that higher recall rates might also reflect an increased frequency of ‘stent and return’, with suboptimal attempts at definitive stone clearance at index ERCP. Whatever the explanation the headline data suggests different patient outcomes dependant on procedure location. Within the NHS the GIRFT (Getting It Right First Time) programme is aimed at systematically improving care by reducing unexplained variation and the need for repeat procedures. The data from this study suggests that renewed focus on the quality of ERCP for patients with BDS may be relevant. Many patients requiring more than one ERCP underwent multiple procedures, such that 52.7% of all ERCPs for BDS in this study were repeat procedures. Given the fact that approximately 50% of ERCPs within a service are for stones the data from this study would suggest that as a conservative estimate > 20% of all ERCPs performed within the NHS in England are repeat ERCPs for stones not definitively treated at a previous procedure. With a mean cost of £2,519 (circa €3,020) per ERCP (as per 2017/2018 NHS national tariff) this would represent a cost of more than £22.5 million (circa €27 million)). This potentially avoidable procedure burden also extends to endoscopy capacity and environmental cost related to consumables. The impact of repeat ERCP on patient experience has to our knowledge not been measured but must be assumed to be materially detrimental.
A number of predictors of failure of BDS clearance at ERCP are known, including stones above strictures, unfavourable stone to distal duct diameter, stone size >10mm, stone impaction, multiple stones, Mirrizzi syndrome and intrahepatic stones [26–28]. Over the timeframe of this study 3854 patients had 3 or more ERCPs for stones. It may be that early referral of cases to a specialist pancreaticobiliary multidisciplinary team would have provided additional therapeutic options. Certainly, there is a significant body of evidence that access to cholangioscopy increases the success rate of removal of bile duct stones. A recent large international multi centre analysis showed a 97% duct clearance rate using single operator cholangioscopy (SOC), with this achieved in a single session in 77% of patients[25]. In this paper 86% of patients undergoing SOC had had a previous failed procedure. Notwithstanding the caveat of retrospective cohort data this and other studies suggest that the availability of cholangioscopy within a managed geographical network for the management of complex stone would be expected to reduce the burden of repeat procedures.

A particular strength of this study is that it is a complete data set from a large national service over a 4 year period. The data was recorded by non-clinical coders not affiliated with a clinical team and there is no reliance on voluntary reporting. Therefore, there is likely to be minimal clinical or reporting bias in the outcome. Success in this study is measured objectively as no more ERCPs needed. Reporting bias might be an explanation for the different reported success in ERCP in the patient groups included and not included in the Ekkelenkamp study, as outlined above. In previous large studies, including that by Williams et al of a nationwide service, there was the option of individual endoscopists opting out of participation, which is not possible in this study[5,8].

The study has limitations. The data is dependent on coding recorded by non-medical personnel, based on clinician-derived medical reports and so may be subject to coding error or poor documentation. However HES data has been found to be >90% accurate when used as a research tool.[29] Campbell et al showed that routinely collected data sets (including HES) were more accurate in coding for procedures, such as ERCP, than diagnosis, with a procedural accuracy rate of 97% [30].

Data from HES including diagnoses has been found to be reliable with accuracy consistently above 70% for diagnosis and frequently over 90% [30–32]. A systematic review found an overall accuracy rate for operations and procedures of 69.5% in England and Wales and 98% in Scottish studies[30]. The same review showed a diagnostic coding accuracy rate of 91% in England and Wales and 82% in Scotland.

Whilst in clinical practice a proportion of patients undergoing ERCP for suspected bile duct stones will have an alternative diagnosis, the ICD codes are generated after the patient episode so increasing the confidence that the recorded ERCPs were performed for BDS. A limitation of our study is an assumption that for those having only one ERCP, this ERCP resulted in successful BDS clearance. Included in this may have been patients who were lost to follow up, refused/were advised against further procedures, or died. This might suggest that the true stone clearance rate after a single ERCP is lower than the 69.8% reported in this study. Similarly, the exclusion of patients who had undergone an ERCP in the two years prior to the study may have failed to exclude some who had had a first ERCP before 2013 (e.g., having previously been lost to follow up). Another limitation is that HES data does not capture ERCPs done in non-NHS, private, facilities. It does capture private ERCPs done in NHS facilities. However no more than 1% of all ERCPs in England are performed in the private sector and so it is unlikely these will influence the data.
Conclusion

This population-wide study of hospital data suggests that overall bile duct stone clearance at ERCP falls below expected national and international standards. Significant variation between providers exists in the proportion of patients requiring repeat ERCPs after an initial procedure, and nationally more than 50% of all ERCPs for bile duct stones are repeat procedures. Approaches to reduce the need for repeat procedures, including stratification according to predicted case complexity, network-based delivery and the availability of advanced techniques for difficult stones, including cholangioscopy, may improve patient experience and the burden on ERCP capacity and health costs.


**Supplementary Table 1. Grouped OPCS-4 procedure codes**

<table>
<thead>
<tr>
<th>ERCP:</th>
</tr>
</thead>
<tbody>
<tr>
<td>J381 Endoscopic sphincterotomy of sphincter of oddi and removal of calculus HFQ</td>
</tr>
<tr>
<td>J382 Endoscopic sphincterotomy of sphincter of oddi and insertion of tubal prosthesis into bile duct</td>
</tr>
<tr>
<td>J388 Other specified endoscopic incision of sphincter of oddi</td>
</tr>
<tr>
<td>J389 Unspecified endoscopic incision of sphincter of oddi</td>
</tr>
<tr>
<td>J391 Endoscopic sphincterotomy of accessory ampulla of vater</td>
</tr>
<tr>
<td>J398 Other specified other therapeutic endoscopic operations on ampulla of vater</td>
</tr>
<tr>
<td>J399 Unspecified other therapeutic endoscopic operations on ampulla of vater</td>
</tr>
<tr>
<td>J401 Endoscopic retrograde insertion of tubal prosthesis into both hepatic ducts</td>
</tr>
<tr>
<td>J402 Endoscopic retrograde insertion of tubal prosthesis into bile duct NEC</td>
</tr>
<tr>
<td>J403 Endoscopic retrograde renewal of tubal prosthesis in bile duct NEC</td>
</tr>
<tr>
<td>J404 Endoscopic retrograde removal of tubal prosthesis from bile duct</td>
</tr>
<tr>
<td>J405 Endoscopic retrograde insertion of expanding covered metal stent into bile duct</td>
</tr>
<tr>
<td>J406 Endoscopic retrograde insertion of expanding metal stent into bile duct NEC</td>
</tr>
<tr>
<td>J407 Endoscopic retrograde renewal of expanding metal stent in bile duct</td>
</tr>
<tr>
<td>J408 Other specified endoscopic retrograde placement of prosthesis in bile duct</td>
</tr>
<tr>
<td>J409 Unspecified endoscopic retrograde placement of prosthesis in bile duct</td>
</tr>
<tr>
<td>J411 Endoscopic retrograde extraction of calculus from bile duct</td>
</tr>
<tr>
<td>J412 Endoscopic dilation of bile duct NEC</td>
</tr>
<tr>
<td>J413 Endoscopic retrograde lithotripsy of calculus of bile duct</td>
</tr>
<tr>
<td>J414 Endoscopic retrograde photodynamic laser therapy of lesion of bile duct</td>
</tr>
<tr>
<td>J418 Other specified other therapeutic endoscopic retrograde operations on bile duct</td>
</tr>
<tr>
<td>J419 Unspecified other therapeutic endoscopic retrograde operations on bile duct</td>
</tr>
<tr>
<td>J421 Endoscopic retrograde insertion of tubal prosthesis into pancreatic duct</td>
</tr>
<tr>
<td>J422 Endoscopic retrograde renewal of tubal prosthesis in pancreatic duct</td>
</tr>
<tr>
<td>J423 Endoscopic retrograde removal of calculus from pancreatic duct</td>
</tr>
<tr>
<td>J424 Endoscopic retrograde drainage of lesion of pancreas</td>
</tr>
<tr>
<td>J425 Endoscopic retrograde dilation of pancreatic duct</td>
</tr>
<tr>
<td>J428 Other specified therapeutic endoscopic retrograde operations on pancreatic duct</td>
</tr>
<tr>
<td>J429 Unspecified therapeutic endoscopic retrograde operations on pancreatic duct</td>
</tr>
<tr>
<td>J431 Endoscopic retrograde cholangiopancreatography and biopsy of lesion of ampulla of vater</td>
</tr>
<tr>
<td>J432 Endoscopic retrograde cholangiopancreatography and biopsy of lesion of biliary or pancreatic system NEC</td>
</tr>
<tr>
<td>J433 Endoscopic retrograde cholangiopancreatography and collection of bile</td>
</tr>
<tr>
<td>J438 Other specified diagnostic endoscopic retrograde examination of bile duct and pancreatic duct</td>
</tr>
<tr>
<td>J439 Unspecified diagnostic endoscopic retrograde examination of bile duct and pancreatic duct</td>
</tr>
<tr>
<td>J441 Endoscopic retrograde cholangiography and biopsy of lesion of bile duct</td>
</tr>
<tr>
<td>J448 Other specified diagnostic endoscopic retrograde examination of bile duct</td>
</tr>
<tr>
<td>J449 Unspecified diagnostic endoscopic retrograde examination of bile duct</td>
</tr>
<tr>
<td>J451 Endoscopic retrograde pancreatography and biopsy of lesion of pancreas</td>
</tr>
<tr>
<td>J452 Endoscopic retrograde pancreatography and collection of pancreatic juice</td>
</tr>
<tr>
<td>J453 Endoscopic retrograde pancreatography through accessory ampulla of vater</td>
</tr>
<tr>
<td>J458 Other specified diagnostic endoscopic retrograde examination of pancreatic duct</td>
</tr>
<tr>
<td>J459 Unspecified diagnostic endoscopic retrograde examination of pancreatic duct</td>
</tr>
</tbody>
</table>
Diagnostic ERCP:
J431 Endoscopic retrograde cholangiopancreatography and biopsy of lesion of ampulla of vater
J432 Endoscopic retrograde cholangiopancreatography and biopsy of lesion of biliary or pancreatic system NEC
J433 Endoscopic retrograde cholangiopancreatography and collection of bile
J438 Other specified diagnostic endoscopic retrograde examination of bile duct and pancreatic duct
J439 Unspecified diagnostic endoscopic retrograde examination of bile duct and pancreatic duct
J441 Endoscopic retrograde cholangiography and biopsy of lesion of bile duct
J448 Other specified diagnostic endoscopic retrograde examination of bile duct
J449 Unspecified diagnostic endoscopic retrograde examination of bile duct
J451 Endoscopic retrograde pancreatography and biopsy of lesion of pancreas
J452 Endoscopic retrograde pancreatography and collection of pancreatic juice
J458 Other specified diagnostic endoscopic retrograde examination of pancreatic duct
J459 Unspecified diagnostic endoscopic retrograde examination of pancreatic duct

ERCP with stents:
J382 Endoscopic sphincterotomy of sphincter of Oddi and insertion of tubal prosthesis into bile duct
J401 Endoscopic retrograde insertion of tubal prosthesis into both hepatic ducts
J402 Endoscopic retrograde insertion of tubal prosthesis into bile duct NEC
J405 Endoscopic retrograde insertion of expanding covered metal stent into bile duct
J406 Endoscopic retrograde insertion of expanding metal stent into bile duct NEC

ERCP with Definitive Clearance:
J38.1 Endoscopic sphincterotomy of sphincter of Oddi and removal of calculus HFQ
J38.8 Other specified endoscopic incision of sphincter of Oddi
J38.9 Unspecified endoscopic incision of sphincter of Oddi
J39.1 Endoscopic sphincterotomy of accessory ampulla of Vater
J39.8 Other specified other therapeutic endoscopic operations on ampulla of Vater
J39.9 Unspecified other therapeutic endoscopic operations on ampulla of Vater
J41.1 Endoscopic retrograde extraction of calculus from bile duct
J41.2 Endoscopic dilation of bile duct NEC
J41.3 Endoscopic retrograde lithotripsy of calculus of bile duct
J41.4 Endoscopic retrograde photodynamic laser therapy of lesion of bile duct
J41.8 Other specified other therapeutic endoscopic retrograde operations on bile duct
J41.9 Unspecified other therapeutic endoscopic retrograde operations on bile duct
J42.1 Endoscopic retrograde insertion of tubal prosthesis into pancreatic duct
J42.2 Endoscopic retrograde renewal of tubal prosthesis in pancreatic duct
J42.3 Endoscopic retrograde removal of calculus from pancreatic duct
J42.4 Endoscopic retrograde drainage of lesion of pancreas
J42.5 Endoscopic retrograde dilation of pancreatic duct
J42.8 Other specified therapeutic endoscopic retrograde operations on pancreatic duct
J42.9 Unspecified therapeutic endoscopic retrograde operations on pancreatic duct
Table 1. ICD-10 Codes for patients at first diagnosis and the mean number of ERCP procedures performed

<table>
<thead>
<tr>
<th>ICD-10 Code</th>
<th>Description</th>
<th>Count of patients</th>
<th>% of patients</th>
<th>Mean count of ERCP procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>K803</td>
<td>Calculus of bile duct with cholangitis</td>
<td>6,210</td>
<td>16.57</td>
<td>2.156231186</td>
</tr>
<tr>
<td>K804</td>
<td>Calculus of bile duct with cholecystitis</td>
<td>4,085</td>
<td>10.90</td>
<td>2.044383436</td>
</tr>
<tr>
<td>K805</td>
<td>Calculus of bile duct without cholangitis or cholecystitis</td>
<td>23,130</td>
<td>61.73</td>
<td>2.100905197</td>
</tr>
<tr>
<td>K851</td>
<td>Biliary acute pancreatitis</td>
<td>4,043</td>
<td>10.79</td>
<td>1.983352601</td>
</tr>
</tbody>
</table>
Table 2. ERCPs performed in England NHS by year, according to HES data and OPSC 4.6 procedural codes.

<table>
<thead>
<tr>
<th>Financial Year</th>
<th>Number of ERCPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015/16</td>
<td>45824</td>
</tr>
<tr>
<td>2016/17</td>
<td>46241</td>
</tr>
<tr>
<td>2017/18</td>
<td>45326</td>
</tr>
<tr>
<td>2018/19</td>
<td>46112</td>
</tr>
<tr>
<td>Total</td>
<td>183503</td>
</tr>
</tbody>
</table>
Figure 1: Individual acute hospital care provider data demonstrating the number of patients in 2015-2019 undergoing ERCP for bile duct stones against the percentage of patients requiring more than 1 ERCP. Source: HES APC 2015/16-2018/19.

The straight line is the mean with 2 and 3 standard deviations from the mean displayed.
Figure 2 – Flow chart of cohort inception
Figure 3. Number of patients undergoing specific number of ERCPs 2015-2019, after first presentation with BDS in 2015-17.
Figure 4. Total number of initial and repeat ERCPs 2015-2019, after first presentation with BDS in 2015-17.