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Is it time we split bowel preparation for all colonoscopies? Outcomes from a national survey of bowel preparation practice in the UK

Thomas Archer ,[1,2] Ahmad Reza Shirazi-Nejad,[1] Ammar Al-Rifaie,[1] Bernard M Corfe,[3] Stuart Riley,[1] Mo Thoufeeq[1]

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[1]Department of Gastroenterology, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK
[2]Molecular Gastroenterology Research Group, Department of Oncology & Metabolism, The University of Sheffield, Sheffield, UK
[3]Population and Health Science Institute, Newcastle University, Newcastle upon Tyne, UK

Correspondence to
Dr Thomas Archer;
thomas.archer@nhs.net

ABSTRACT

Introduction Adequate bowel preparation is a prerequisite for effective colonoscopy. Split bowel preparation results in optimal cleansing. This study assessed the bowel preparation regimes advised by endoscopy units across the UK, and correlated the differences with outcomes.

Methods Trusts in the UK were surveyed, with data requested between January 2018 and January 2019, including: the type and timing of preparation, pre-endoscopy diet, adequacy rates and polyp detection. Trusts were grouped according to the timing of bowel preparation. χ^2 test was used to assess for differences in bowel preparation adequacy.

Results Moviprep was the first line bowel preparation in 79% of trusts. Only 7% of trusts advised splitting bowel preparation for all procedures, however, 91% used split bowel preparation for afternoon procedures. Trusts that split preparation for all procedures had an inadequacy rate of 6.7%, compared with 8.5% (p<0.001) for those that split preparation for PM procedures alone and 9.5% (p<0.001) for those that provided day before preparation for all procedures. Morning procedures with day-before preparation had a higher rate of inadequate cleansing than afternoon procedures that received split preparation (7.7% vs 6.5 %, p<0.001). The polyp detection rate for procedures with adequate preparation was 37.1%, compared with 26.4% for those that were inadequate.

Conclusion Most trusts in the UK do not provide instructions optimising the timing of bowel preparation prior to colonoscopy. This correlated with an increased rate of inadequate cleansing. Splitting bowel preparation is likely to reduce the impacts of poor cleansing: missed lesions, repeat colonoscopies and significant costs.

Key messages

What is already known about this subject?

► Trials show that splitting bowel preparation leads to better quality cleansing. Shortening the interval between the last dose of bowel preparation and the colonoscopy leads to optimal preparation outcomes. Utilisation of split bowel preparation at National Health Service (NHS) Trusts, and the effect on bowel preparation, is less well characterised.

What are the new findings?

► Most NHS Trusts in the UK do not split bowel preparation for morning procedures, but do for afternoon procedures. Those trusts that split bowel preparation had higher rates of adequate preparation.

How might it impact on clinical practice in the foreseeable future?

► Nationwide adoption of morning split bowel preparation is likely to lead to improved rates of adequate bowel preparation. In turn this would result in fewer missed lesions, repeated procedures and significant cost savings.

INTRODUCTION

Colorectal cancer (CRC) is the fourth most common cause of cancer in the UK, with the second highest mortality.[1] Colonoscopy is the gold-standard investigation of the large bowel. Over 600 000 colonoscopies are performed in the UK each year. Polyps detected and removed at endoscopy reduce the subsequent risk of CRC.[2–6] Adequate colonic cleansing is integral to performing high quality endoscopy, but poor bowel preparation is common.[7] Inadequate bowel preparation is associated with missed polyps and cancers, prolonged and incomplete examinations and the need for repeat procedures.[8–11] Preparation for colonoscopy is achieved by patients completing a preprocedural regime, consisting of a restrictive diet and a purgative drink that clears the bowel.

The determinants of bowel preparation quality are multifactorial. Organisational factors such as the type of bowel preparation used, the timing of bowel preparation and pre-endoscopy diet may affect quality.[12–17] Bowel preparation is usually administered in multiple doses. In split bowel preparation part is given on the day prior, with the rest

given on the day of the procedure. Studies demonstrate that dose timing is pivotal to good bowel preparation, with 4–6 hours being the optimum interval from last dose.[18] As such, same day and split dose bowel preparation result in better bowel cleansing than day before preparation.[14 15 19 20] Although better bowel preparation is expected with split dosing, it requires patients to wake early to prepare for morning scheduled examinations. Despite evidence of its importance, a survey of endoscopy units in USA demonstrated that split bowel preparation is not the universal standard practice, with only 42% of units using it for all procedures.[21] The manufacturers' standard instructions for Moviprep and Klean prep do not recommend split bowel preparation for morning procedures (see online supplemental information). However, the variation in practice in the UK is unknown.

This study aimed to assess the variability of bowel preparation regimes employed within the UK, and correlate the different practices with adequacy of cleansing.

METHODS

Sampling

A list of Joint Advisory Group (JAG) accredited National Health Service (NHS) trusts and private healthcare providers was obtained from the JAG website (https://www.thejag.org.uk/Accreditedunits.aspx) in August 2019.

Design and data collection

A freedom of information request using a standard email (see online supplemental information) was sent to all NHS trusts with JAG accredited units in the UK. Relevant information regarding practice between 1 January 2018 and 1 January 2019 was requested and included details on; type of preparation, timing of preparation, pre-endoscopy diet and fasting. Sites were excluded from analysis if they did not provide the timing of the bowel preparation. Outcome data on quality of bowel preparation and polyp detection rate (PDR) were included in the enquiry. Quality of bowel preparation was requested as both an overall rate per site, and by session (morning, afternoon and evening). National guidelines recommend providing data in the format of excellent/good/fair/inadequate. Therefore, data were requested in this ordinal format. The delineation between grades is not defined and was dependent on observers. This ordinal scale was converted to a dichotomous outcome, of adequate (including grades of excellent, good and fair) or inadequate. As well as the total adequacy rates per trust, adequacy rates differentiated by scheduled appointment session (morning vs afternoon) were compared. Clarification of questions and responses was undertaken by one of the investigators (TA). Missing data were not approximated and were not included in the analysis. Data were exported to Microsoft Excel V.2008, Redmond, Washington.

Statistical analysis

Descriptive data were generated for variables including; type of bowel preparation, timing of regime, pre-endoscopy fasting and length of diet advised. The cohort was analysed as groups depending on these variations in practice. Cumulative rates of inadequate bowel preparation were calculated for each group. For timing of bowel preparation, units were grouped as: split preparation for both morning and afternoon procedures (SP-AM/PM group), split preparation for afternoon procedures alone with day before preparation for morning procedures (DB-AM/SP-PM group) and day before preparation for all procedures (DB-AM/PM group). The total rates of adequacy (inclusive of all procedures from the different sessions; morning, afternoon and where applicable evening) for these groups was compared. Subsequently, the rates differentiated by session were also compared. The correlation between covariants and quality of bowel preparation was compared using χ^2 tests and Pearson correlation coefficient, with a significant level set at p=0.05. Statistical analysis was performed using SPSS for Windows V.26, Armonk, New York, USA.

RESULTS

The survey was sent to 162 NHS Trusts and 21 private healthcare providers. It was returned by 127 NHS Trusts, of which 13 were excluded as timing of bowel preparation was not provided. A total of 114 trusts (70.4%) were included in the analysis (figure 1). No private providers supplied data. The most common first line bowel purgative was Moviprep, which was used first line at 88 (77.2%) trusts. Magnesium citrate/picosulphate was used first line at 22 (19.3%) trusts and Kleanprep at four (3.5%) trusts. Seventy-five trusts provided data on the rate of adequate preparation. Of these, 61 provided it in the ordinal scale of excellent/good/fair/inadequate. Ten provided it in three grades (good/fair/inadequate) and four provided it in a dichotomous scale.

Bowel preparation regimes

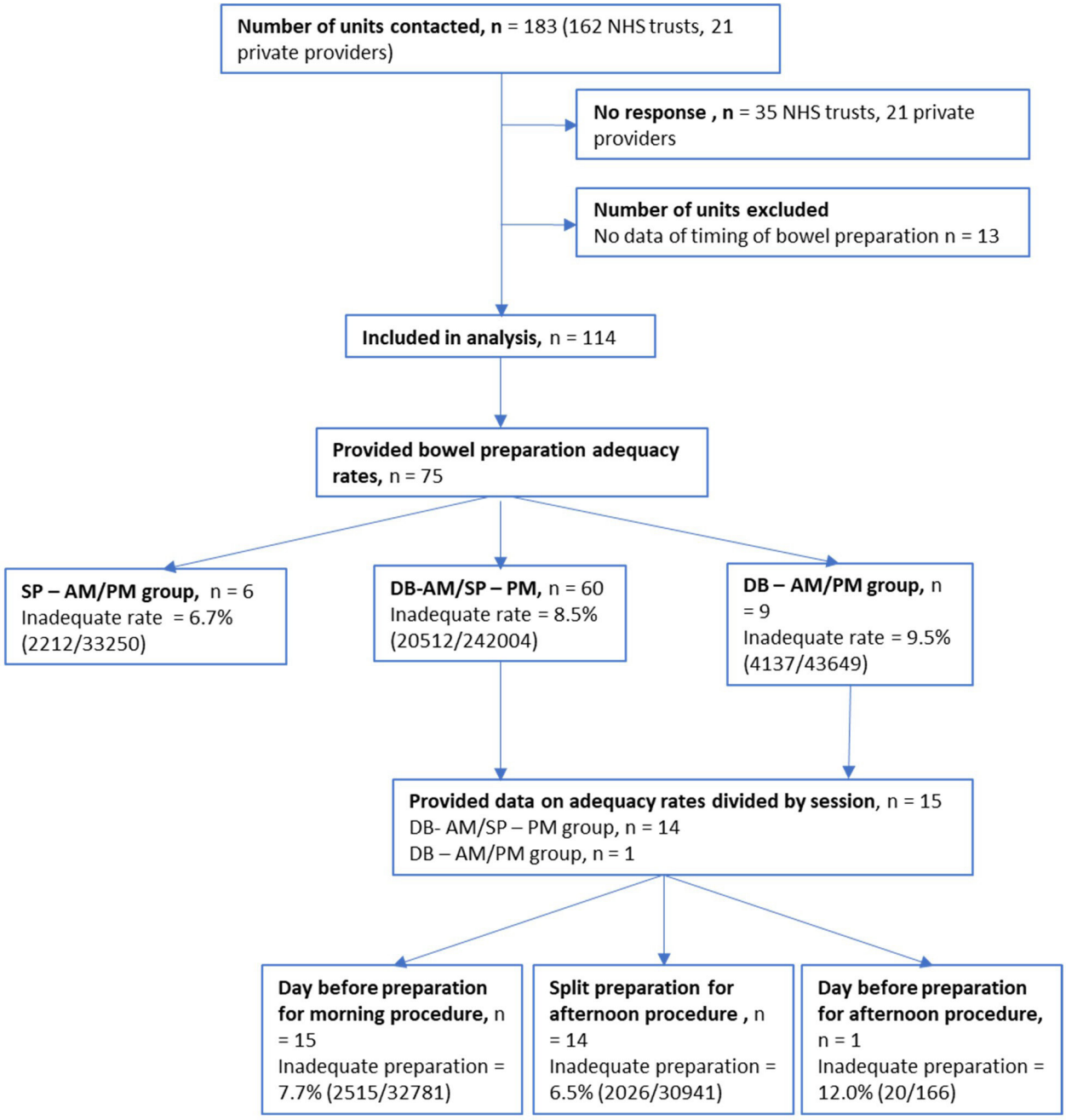
For morning procedures, day before bowel preparation was used by 106 (93.0%) and split bowel preparation was advised by the remaining eight (6.9%) trusts.

Conversely, for afternoon procedures split bowel preparation was utilised by 91.2% (101/114) of trusts, with a further two providing same day preparation. Day before preparation was advised by 10 (9.5%) trusts for afternoon procedures. One trust did not undertake afternoon procedures.

Evening endoscopy lists were performed at 17 (14.9%) trusts. Split bowel preparation was recommended by nine (52.9%) trusts. The remaining eight (47.1%) trusts advised same day preparation (figure 2).

Pre-endoscopy diet and fasting

A low-residue diet (LRD) was recommended by 102/114 (88.6%) trusts, 9 trusts did not recommend a specific diet and 3 did not provide details on the diet advised.



n = number of trusts, **SP – AM/PM group =** Bowel preparation timing split for all procedures, **DB – AM/SP – PM group =** Bowel preparation split for afternoon procedures with day before timing for morning procedures, **DB – AM/PM group =** Bowel preparation with day before timing for all procedures

Figure 1 Study flow chart. NHS, National Health Service.

Of those that recommended an LRD, the length of diet varied considerably. An LRD was recommended for 2 days by 37/102 (36.3%) trusts, 3 days by 36/102 (35.3%) Trusts, 1 day by 20/102 (19.6%) trusts. A more prolonged LRD was recommended by a small proportion of Trusts as their standard instructions. A 5-day LRD was recommended by five (4.9%) trusts and one (1.0%) trust recommended 7 days of LRD prior to colonoscopy (see figure 3). Three trusts did not provide the length of LRD recommended to patients.

Recommendations on fasting time prior to colonoscopy was provided by 40 trusts. For morning appointments, the median time was 23.5 hours, (range of 16–35.5 hours) and an IQR of 4.5. For afternoon appointments, the median was 23.5 hours (range of 21.5–31) and an IQR of 1.

Timing of bowel preparation and adequacy of cleansing

A total of 75 trusts provided bowel preparation adequacy data. Overall, the bowel preparation was graded as inadequate in 8.4% of procedures. Of the 75 units, 6 split

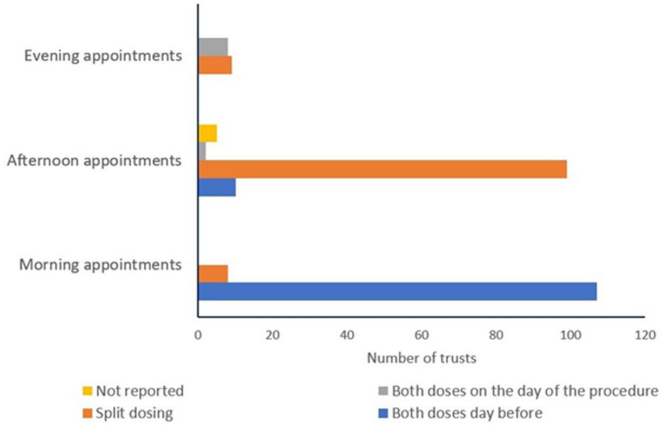


Figure 2 Schedule of bowel preparation with respect to colonoscopy appointment time.

bowel preparation for both morning and afternoon procedures, the SP-AM/PM group, 60 advised day before bowel preparation for morning procedures and split bowel preparation for afternoon procedures, the DB-AM/SP-PM group and 9 advised day before preparation for all procedures, the DB-AM/PM group. The rate of inadequate bowel preparation was 6.7% (2212/33250) for the SP-AM/PM group, compared with 8.5% (20512/242004) in the DB-AM/SP-PM group (OR=0.8, 95% CI 0.765 to 0.832, p<0.0001) and 9.5% (4137/43649) in the DB-AM/PM group (OR=0.68, 95% CI 0.645 to 0.718, p<0.0001).

Adequacy of cleansing differentiated by session

Fourteen trusts from the DB-AM/SP-PM group provided adequacy rates differentiated by session. Within the DB-AM/SP-PM group all procedures performed in the morning session received day before preparation, whereas for the afternoon session they received split bowel preparation. The rate of inadequate preparation for afternoon procedures that received split bowel preparation was 6.5% (2026/30941), compared with 7.7% (2515/32781) for morning procedures that received day before bowel preparation (OR=0.7885, 95% CI 0.7421 to 0.8379, p<0.001). One trust from the DB-AM/PM group provided adequacy rates differentiated by session. Conversely, at this trust fewer morning procedures were inadequate than afternoon procedures (7.4% vs 12.0%).

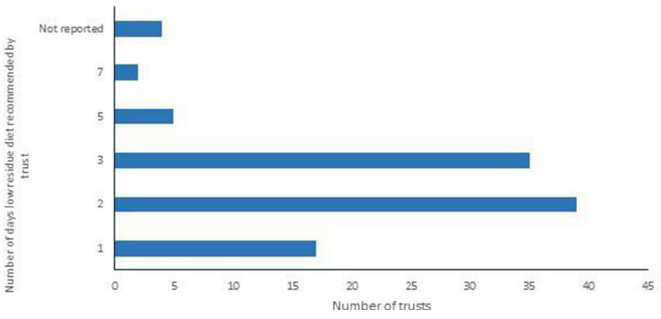


Figure 3 The number of trusts recommending each duration of pre-endoscopy diet.

PDR and quality of bowel preparation

The PDR along with the quality of bowel preparation was provided by 19 trusts, with a combined total of 73 908 procedures. The PDR for adequate bowel preparation was 37.7%, whereas for inadequate bowel preparation it was 25.9% (OR 1.734, 95% CI 1.628 to 1.846, p<0.0001).

Length of diet, fast and bowel preparation adequacy

The rate of adequacy of bowel preparation as well as the period of fasting prior to endoscopy was provided by 24 trusts. No correlation was demonstrated between the duration of the fast prior to colonoscopy and the rate of inadequate bowel preparation (Pearson correlation=−0.1870, 95% CI −0.549 to 0.234, p=0.381).

Sixty-seven trusts provided data on the adequacy of bowel preparation as well as the length of LRD prior to endoscopy. No correlation was demonstrated between the rate of inadequate bowel preparation and the length of LRD (Pearson correlation=0.055, 95% CI=-0.188 to 0.291, p=0.659).

DISCUSSION

This is the first national survey of bowel preparation in the UK. It demonstrates considerable variation between trusts, and indicates the possible effect of these differences on bowel cleansing. Almost all trusts in the UK split bowel preparation for afternoon procedures, however, only 7% split preparation for morning examinations. A significant difference in the adequacy of cleansing was seen when these variations in practice were compared. The overall adequacy rate was greater in trusts that used split bowel preparation for all procedures compared with trusts that did not. Furthermore, in trusts that both split as well as recommended day before preparation, those receiving split dosing had a lower rate of inadequate cleansing than those receiving day before preparation. This indicates the superiority of splitting bowel preparation.

Prior studies demonstrate that splitting bowel preparation leads to improved bowel cleansing.[18 20] Meta-analyses have compared the difference between split bowel preparation and day before preparation. Bucci *et al* demonstrated an inadequacy rate of 15% with split preparation and 37% with non-split preparation, with a relative risk reduction of 59%. This was a finding echoed in a meta-analysis by Martel *et al* who found that split bowel preparation provided superior cleansing to day before preparation, with an OR of adequate cleansing of 2.51 (95% CI 1.46 to 4.63).[14] The time from final dose of bowel preparation to procedure is referred to as the run-way time. The longer the run-way time, the higher the rate of inadequate preparation. Siddiqui *et al* found that for each hour over a 5-hour run-way time, there was a 10% decrease in the number of patients with good or excellent bowel preparation.[18] Our study was primarily designed to assess variation in national practice. The design is not optimal to prove association between split bowel preparation

and improved bowel cleansing, however, its great benefit is already known. The correlation seen also supports this prior finding. Trusts that employed universal splitting of bowel preparation had higher rates of adequate cleansing with a relative risk reduction of 21% compared with units that used day before preparation for morning appointments. Moreover, the shortest consistent runway time, seen in the afternoon procedure in the DB-AM/SP-PM group, had an inadequacy rate of 6.5%. As the runway time extended the rate of inadequately prepared procedures also increased. Day before preparation for morning procedures and afternoon procedures had a minimum runway time of 11 hours and 14 hours, respectively, with corresponding inadequacy rates of 7.7% and 12.0%.

The benefit afforded in adequacy rates due to split dosing over day before preparation was lower than expected. However, the overall rate of inadequate preparation in this survey was also much lower than anticipated, with previous studies demonstrating as many as 25% of procedures having poor preparation.[7 22] The categorical grading scale used in this survey, and currently recommended for routine practice, may be an explanation for this discrepancy.[23] It has an inferior interobserver reliability and has a poorer correlation with missed lesions compared with segmental grading scales, such as the Boston Bowel Preparation Scale or the Ottawa Bowel Preparation Scale.[24] Routine use of these segmental scales would provide a more accurate and reliable assessment of bowel preparation quality. It is likely that a proportion of procedures with suboptimal preparation were graded as adequate using this categorical scale. The preferential use of a segmental grading scale would likely improve the sensitivity to suboptimal preparation.

Both adequate bowel preparation and PDR are indicators for quality colonoscopy. There is an inverse relationship between PDR and subsequent CRC.[2 11 25] Sulz *et al* conducted a meta-analysis of 27 studies, including 246 340 colonoscopies, and found that both small and advanced polyps were less commonly diagnosed when poor bowel preparation was present.[26] This was a finding echoed in our study, with the overall polyp detection being significantly lower in procedures that had inadequate bowel preparation.

Only 7% of trusts within the UK offered split bowel preparation for all procedures. Ton *et al*, performing a survey of units in the USA, found that split bowel preparation was not universally used, with 42% of units advising it for all procedures.[21] Anecdotally, there is resistance to recommending split bowel preparation for all, since it requires patients with morning procedures waking early, potentially interrupting their sleep. However, Unger *et al* demonstrated that most patients would be willing to wake up to take split bowel preparation.[27] Furthermore, Radaelli *et al* found that when given the choice, most patients chose split, over day before, dosing.[28] Moviprep continues to have an effect several hours after completion, which could affect sleep if taken at 20:00 hours, as most day before protocols advise. Radaelli *et al* demonstrated that split bowel preparation actually led to a significantly better quality of sleep than day before dosing.[28]

An LRD was recommended by almost all trusts. Previous studies have demonstrated that it is as effective as a clear liquid diet, but better tolerated by patients.[29] A more prolonged LRD is often used in 'difficult-to-prep' patients, with studies demonstrating that regimes containing a prolonged LRD obtain a superior cleanse.[30 31] A correlation with an increasing length of LRD and the proportion of adequate procedures was not seen in this study. This is in line with trials conducted by Gimeno-García *et al* and Taveira *et al*, who did not demonstrate an improvement in bowel preparation with a 3-day LRD, compared with a 1-day LRD.[16 32]

There are limited data assessing the optimal time patients should fast prior to their colonoscopy. Melicharkova *et al* demonstrated that having a breakfast the day prior to colonoscopy did not affect the rate of inadequate preparation, over a complete fast the day prior to a colonoscopy.[33] An even shorter fast of 14 hours was used in a study by Aoun *et al*, with no reduction in the proportion of adequate bowel preparation.[34] In this survey, the range of fast was considerable, from 16 hours to 35.5 hours, with no clear benefit demonstrated with an increased fast. Further research of the effect of varying lengths of fasting is warranted.

These data were sourced from a survey and therefore has the limitations of this form of data acquisition. There are many patient factors that impact on bowel preparation quality, including patient comorbidities, medications and adherence.[7 22] Collection of data on individual factors is not feasible on such a large scale. Although these may act as confounders, on a large cohort, such as in this study, it is likely that individual variables would tend towards becoming even between the groups, and institutional differences between the trusts would likely have a more significant effect. Not all sites were able to provide data for all queries. However, the response rates were still relatively high and adequacy rates were provided for over 300 000 colonoscopies, approximately half of the national annual total.[35] The high proportion of units represented gives a clear indication of the practice on a national scale, which can aid in guiding policy and future planning. In view of the limitations, these data cannot act as proof on its own, but it is consistent with, and further evidence in support of, prior data that split bowel preparation is superior.[19 20] However, these data clearly represents that most trusts do not split bowel preparation for all their patients, representing a significant opportunity to improve, both in terms of patient care as well as significant savings for the NHS. The actual difference in adequacy may be more pronounced than seen in this study. In view of the aforementioned limitations the design of this study is not optimal to demonstrate this difference, and the actual clinical effect of split bowel preparation may be more significant.

Colonoscopy is a limited resource and the demand outstrips the supply.[35] Efficiency and productivity gains could be made readily, and at negligible additional cost, through optimising bowel cleansing protocols to reduce poor quality preparation. Timing of preparation is a significant, yet often overlooked, factor that plays a crucial role in determining adequacy of bowel preparation, with split bowel preparation consistently delivering better outcomes.[14 20 36 37] Recent ESGE guidelines recommended that all colonoscopic procedures should be undertaken using split bowel preparation.[38] This single change in practice could lead to a universal improvement in bowel preparation quality. Although not all colonoscopy examinations that are judged to be inadequately prepared will be repeated, extrapolation of this data could lead to, not only significant quality improvements to be gained, but very considerable cost savings to be made. This is particularly important as endoscopy units plan to restore services during and following the COVID-19 pandemic.[39] Since most trusts did not split bowel preparation for all procedures, this presents a significant opportunity for widespread improvement in practice.

Twitter Thomas Archer @Dr_tom-archer

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ORCID iD

Thomas Archer http://orcid.org/0000-0002-0330-5585

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1. What is the first line bowel preparation laxative that is offered to patients undergoing colonoscopy?
2. Do you offer any alternative bowel preparation laxatives for patients undergoing colonoscopy?
3. How many patients received each bowel preparation laxative between 1st January 2018- 1st January 2019?
4. What were the number of patients receiving each bowel preparation laxative who had inadequate bowel preparation between 1st January 2018- 1st January 2019?
5. Are patients undergoing colonoscopy advised to take the bowel preparation at a single time or split over two different times?
6. During the period of 1st January 2018- 1st January 2019, what times were patients advised to consume the bowel preparation for a morning colonoscopy appointment?
7. During the period of 1st January 2018- 1st January 2019, what times were patients advised to consume the bowel preparation for an afternoon colonoscopy appointment?
8. During the period of 1st January 2018- 1st January 2019, what times were patients advised to consume the bowel preparation for an evening colonoscopy appointment?
9. Are patient's advised to consume a particular diet prior to their colonoscopy? If so what diet are they advised to consume? How many days are they advised to consume it for?
10. Do any of your patients attend a specific pre assessment clinic after they are referred for colonoscopy, but before they attend on the day of their endoscopy to receive more detailed endoscopy information? What is the criteria for referral to this pre assessment clinic?
11. How many patients are seen in this pre assessment clinic between 1st January 2018- 1st January 2019?
12. How many colonoscopies did you perform in the last year (1st January 2018- 1st January 2019)
13. During the period of 1st January 2018- 1st January 2019:
14. How many patients were documented as having excellent bowel preparation?
15. What was the polyp detection rate in patient with excellent bowel preparation?
16. How many patients were documented as having good bowel preparation?
17. What was the polyp detection rate in patient with good bowel preparation?
18. How many patients were documented as having fair bowel preparation?
19. What was the polyp detection rate in patient with fair bowel preparation?
20. How many patients were documented as having inadequate bowel preparation?
21. What was the polyp detection rate in patient with inadequate bowel preparation?
22. How many patients had a morning appointment during the period of 1st January 2018- 1st January 2019?
23. How many patients who had a morning appointment during the period of 1st January 2018- 1st January 2019 had inadequate bowel prep?
24. How many patients had an afternoon appointment during the period of 1st January 2018- 1st January 2019?
25. How many patients who had an afternoon appointment during the period of 1st January 2018- 1st January 2019 had inadequate bowel prep?
26. How many patients had an evening appointment during the period of 1st January 2018- 1st January 2019?
27. How many patients who had an evening appointment during the period of 1st January 2018- 1st January 2019 had inadequate bowel prep?
28. If a patient has a repeat colonoscopy due to inadequate bowel preparation, do you have a specific bowel preparation regime for those patients? If so what is it?