SUSQI PROJECT REPORT

Improving Endoscopy Pre-assessment at Barnsley Hospital: Strategies to reduce failed bowel preparation.

Date of Report: August 2026

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Background:

Healthcare contributes significantly to greenhouse gas emissions, resource consumption and waste generation. Endoscopy services are particularly resource intensive due to the energy required for procedure rooms, endoscope decontamination, consumables, patient travel and associated clinical activity. Improving the efficiency and effectiveness of endoscopy pathways therefore presents an important opportunity to improve patient care while reducing environmental impact.

Recent studies have demonstrated that gastrointestinal endoscopy generates substantial greenhouse gas emissions, energy consumption and waste, with patient travel, electricity use and endoscope reprocessing representing major contributors to the environmental footprint of endoscopy services.[1,2] Improving the efficiency and effectiveness of endoscopy pathways therefore presents an important opportunity to improve patient care while reducing environmental impact. Avoiding unnecessary or repeat procedures has been identified as one of the most effective approaches for reducing the environmental footprint of gastroenterology services.[3]

Adequate bowel preparation is recognised as a critical determinant of colonoscopy quality. Published evidence suggests that inadequate bowel preparation occurs in up to 25% of colonoscopies and is associated with prolonged procedure times, increased healthcare costs, repeat investigations and missed pathology.[4] International guidance recommends that endoscopy units routinely monitor bowel preparation quality and The Joint Advisory Group (JAG) Endoscopy Quality Standards require good quality bowel preparation in >90% of lower GI procedures. Split-dose bowel preparation regimens with Plenvu and enhanced preparation strategies for patients at increased risk of bowel preparation failure.[5,6],7

Like many other endoscopy departments, Barnsley Hospital endoscopy unit is a high patient throughput environment, performing an average of 362 colonoscopies a month in 2025/26. We examined the data from the first 4 months of 2026 which included 1558 colonoscopies, of which 11% (178) were combined procedures, that being an upper and lower GI endoscopy was performed during the same appointment. Between January and April 2026 there were 167 failed procedures due to inadequate bowel preparation, a failure rate of 11% for this reason alone. The rates of inadequate prep leading to procedure failure were 22.3%, for those undergoing combined procedures.

The Joint Advisory Group on GI Endoscopy (JAG) sets a UK benchmark of 10% for failed (unsuccessful or incomplete) procedures. Inadequate bowel prep is a key cause of incomplete procedures. Review of our failure rates due to poor prep indicates the department was not meeting this quality indicator.

Failed procedures frequently require repeat investigations, resulting in additional patient inconvenience, delayed diagnosis, increased pressure on waiting lists, duplication of staff time and avoidable use of healthcare resources. The financial cost of these failed procedures at Barnsley Hospital was just over £225,000 per month.

Delays between referral to diagnostic endoscopy have been shown to worsen colorectal cancer outcomes in patients with a positive FIT, particularly if those delays were significant 8. Additionally, the procedural risks to patients statistically increase with each procedure required to achieve a diagnostic test. Delayed diagnosis is associated with more time off work, increased presentations to healthcare and higher healthcare associated anxiety.

This project sought to understand the process of preparing for a colonoscopy from the patient and pathway perspective, to identify inefficiencies and to understand drivers behind inadequate bowel preparation. Reducing waste including avoidable repeat procedures offered an opportunity to improve patient experience, release capacity within the service, reduce healthcare costs and minimise the environmental impact associated with endoscopy procedures.[1,2,3,4]

Barnsley Hospital is well placed to address this challenge due to the engagement of a multidisciplinary team that includes clinical endoscopists, nursing staff, gastroenterology clinicians, quality improvement specialists and sustainability leads. The project also benefits from strong organisational support and previous departmental engagement in sustainability initiatives.

Aims:

To reduce the overall rate of failed colonoscopies due to inadequate bowel preparation at Barnsley Hospital from 11% to 5% by August 2026 through particular focus on pre-assessment processes.

Methods:

Understanding the Problem (Studying the system)

We mapped the outpatient lower GI endoscopy pathway to understand current processes, identify sources of waste and explore opportunities to improve sustainability. The existing endoscopy pathway was mapped prior to implementation of the interventions, with particular focus on patient journeys, administrative processes, bowel preparation provision and the causes of procedure failure. Hotspot analysis was performed on both the pre- and post-implementation pathways to identify key areas of environmental impact, resource consumption and operational inefficiency, and to assess the effect of the service changes.

Early project discussions identified two potential areas of focus:

1. Higher rates of failed procedures due to inadequate bowel prep in patients attending for colonoscopy.
2. Inefficient endoscopy preassessment pathways

We reviewed available audit data and explored factors contributing to inadequate bowel preparation including characteristics of the patient and the procedure and explored opportunities for prevention. This demonstrated that poor bowel preparation was a major contributor to failed procedures and highlighted combined procedures as a priority area for improvement.

Between January and April 2026, 167 procedures failed due to inadequate bowel preparation. Review of these cases showed a particularly high failure rate of 22% among patients undergoing combined upper and lower GI procedures compared with 9.5% for standalone colonoscopies.

At Barnsley Hospital endoscopy department, the Boston Bowel Preparation Score 9 is used to grade the cleanliness of the bowel during the procedure. The score is numerical from 0 to 9. Scores 0 to 4 are poor prep, 5 to 8 good prep and 9 is the best score of excellent prep. Inadequate bowel prep is defined as prep that is graded "poor", though in some cases with a Boston Score of 4, the objective of the test was achieved and the bowel prep was referred to as "suboptimal" only. These cases were not included as failed. Case review suggested that failure to complete bowel preparation as per the instructions was a contributory factor.

Changes Implemented
Current literature highlights the importance of patient education, personalised risk assessment and optimisation of bowel preparation in reducing procedure failure rates and improving colonoscopy quality. National and international guidance also supports the use of enhanced bowel preparation pathways and targeted interventions for patients at increased risk of inadequate bowel cleansing.

Discussions with neighbouring NHS trusts and review of established practice elsewhere identified face-to-face assessment and direct provision of bowel preparation as effective approaches to improving patient understanding, compliance and pathway efficiency. These examples helped inform the redesign of the local pathway and provided assurance regarding the feasibility of implementation.

Key Changes: Face to Face Pre Assessment and Patient Group Directive for Bowel Preparation
As part of a wider review of the lower gastrointestinal endoscopy pathway, the department identified several inefficiencies relating to bowel preparation provision and patient assessment. Historically, most patients underwent a telephone pre-assessment and were subsequently required to make a separate journey to the hospital pharmacy to collect their bowel preparation. This process created additional travel for patients, generated administrative workload across multiple departments, and contributed to issues with unused bowel preparation and wastage.

Pharmacy colleagues raised concerns regarding the increasing demands associated with supplying bowel preparation through the pharmacy service. The process was resource intensive and resulted in a significant amount of wasted bowel preparation when patients cancelled, did not attend appointments, or bowel preparation was issued but not collected. At the same time, pharmacy capacity was becoming increasingly constrained, creating a need to explore alternative models of distribution.

Agreement was reached to redesign the pathway to enable bowel preparation to be managed directly by the Endoscopy department. The proposed model involved the introduction of face-to-face pre-assessment clinics alongside a nurse-led patient group directive (PGD) to allow appropriately trained staff to assess patients and issue bowel preparation during the same appointment.

To support implementation, dedicated clinic space was identified within Medical Outpatients, allowing the establishment of face-to-face pre-assessment clinics. This provided an opportunity for a more comprehensive patient assessment than was possible through telephone consultations. Staff were able to review medical history, identify factors that may increase the risk of inadequate bowel preparation, assess patient understanding, and provide tailored advice and education regarding preparation instructions.

The PGD enabled nursing staff to supply bowel preparation directly at the point of assessment, inefficient use of the hospital pharmacy. This streamlined the patient pathway, reducing delays in obtaining bowel preparation and improved convenience for patients.

The face-to-face model was expected to improve patient understanding and compliance with bowel preparation instructions, particularly for patients with complex medical needs, language barriers, previous preparation failures or other factors associated with poor bowel preparation outcomes. The redesigned pathway therefore aimed not only to improve the patient experience but also to reduce

avoidable procedure failures, increase service efficiency and support the delivery of a more sustainable endoscopy service.

Secondary Changes: Digital Consent and Changes in Bowel Prep Regime
With the move to face-to-face pre-assessment, the department replaced paper consent forms with electronic consent processes. Following their pre-assessment appointment patients were sent digital information regards their endoscopy and bowel preparation. They were also sent a digital consent form offering them the opportunity to sign this ahead of the procedure, replacing the paper consent form that was posted to the patient as part of the previous, less efficient pathway. This built on previous successful digitalisation of patient information resources and was expected to further reduce paper use and remove printing and postal requirements.

The established PGD for bowel prep prioritised Plenvu split-dose (1.5L) bowel preparation over the previous first line bowel prep, Moviprep (3L). The change was driven by evidence from the CLEANSE study suggesting improved bowel preparation quality with Plenvu 7. It was anticipated that use of this lower volume prep would reduce procedure failures related to inadequate bowel cleansing. Plenvu also has a lower cost and carbon footprint,, though from patient feedback, a less tolerable taste.

Stakeholder Engagement
A wide range of stakeholders were identified and engaged throughout the project to ensure the proposed changes were practical, sustainable and supported across the organisation.

Within the Endoscopy department this included clinical endoscopists, nursing teams, pre-assessment staff and administrative teams. Clinical endoscopists were kept informed throughout implementation to ensure awareness of the revised bowel preparation pathways, new patient assessment processes and changes to bowel preparation regimens. Their feedback was valuable in identifying the impact of the interventions on procedure quality and service delivery.

The Quality Improvement (QI) Clinical Lead provided support throughout the project and facilitated participation in the Trust's *Give it a Go Week*, which provided an opportunity to showcase the improvements being introduced, raise awareness of the project and engage staff from across the organisation.

The Trust Sustainability Lead was engaged to support the sustainability aspects of the project and ensure that the environmental benefits of the pathway redesign, including reductions in patient travel, paper use and waste, could be recognised within wider Trust sustainability initiatives.

Close collaboration took place with the Pharmacy Care Group, including pharmacy managers and specialist pharmacy staff, to develop and implement the PGD. Their involvement was essential in supporting governance processes, staff training requirements and the transfer of bowel preparation provision from pharmacy services to the Endoscopy Unit.

The Medical Outpatients Team worked closely with the project team to identify and establish suitable clinic space for the introduction of face-to-face pre-assessment appointments. Service managers also played a key role in supporting pathway redesign, clinic scheduling and operational implementation.

Information Technology (IT) teams were engaged to facilitate the introduction of electronic consent through EIDO and to support updates to electronic care plans and associated documentation. This ensured that digital systems aligned with the redesigned pathway and supported the move towards a more paper-light service.

Stakeholder engagement was achieved through multidisciplinary meetings, service development discussions, informal feedback sessions, project presentations and participation in Trust improvement initiatives. This collaborative approach helped build support for the changes, identify potential

barriers to implementation and ensure that the redesigned pathway met the needs of patients, staff and the wider organisation.

Measurement:

Patient outcomes:

There are several risks associated with failed procedures. These include the direct risk to the patient of undergoing a colonoscopy. These risks are doubled when the patient has to undergo the procedure twice for the same outcome, a successful diagnostic procedure. Risks of an initial test being non-diagnostic is delays in diagnosis and increased anxiety for the patient or, potentially, worse clinical outcomes. In a resource constrained environment, the requirement for the service to accommodate repeat procedures has an effect on waiting lists and potentially the outcomes of the patients on that list, impacting their access to a diagnostic test.

We looked at process measures relating to the diagnostic endoscopy service at Barnsley Hospital and therefore commenting on patient outcomes related to diagnostic delay and repeated tests is outside this project's remit. However, improvements aimed at minimising diagnostic delay and repeated procedures could plausibly impact patient outcomes relating to issues above.

We have collected data relating to:

- Number and proportion of failed colonoscopies and combined procedures due to inadequate bowel prep
- Number of repeat endoscopy procedures required following failed bowel preparation.
- Number of patients redirected to alternative or no further investigation following a failed procedure.
- Time from referral to successful diagnostic procedure.
- Compliance with national endoscopy quality standards and local clinical protocols.

Environmental sustainability:

Carbon footprinting will be undertaken using a process-based inventory approach, supplemented by proxy measures where required. Measurement will focus on changes most likely to influence environmental impact.

We have estimated the carbon footprint difference in our patient pathway due to our interventions. This included:

- Bowel preparation
    - Number of patients receiving each bowel preparation regime.
    - Packaging weight and composition of Moviprep and Plenvu products.
    - Moviprep and Plenvu pharmaceutical ingredients
    - Waste generated from bowel preparation packaging.
- Digitialisation:
    - Number of consent forms completed electronically.
    - Reduction in paper consumption.
    - Reduction in postage associated with consent documentation.

- Patient travel: Our project saved a patient journey to collect bowel prep, but added a patient journey for pre-assessment (where bowel prep is not provided). Travel was therefore excluded as we assume patients would travel the same amount.

We estimated the carbon footprint ($kgCO_2e$) of a completed endoscopy procedure. Data was collected relating to:

- Procedure room energy use.
- Endoscope decontamination and reprocessing.
- Consumables and medications used during endoscopy procedures.
- Procedure-related waste streams.

Economic sustainability:
The project measured:

- Cost differences between combined procedures and repeated standalone procedures.
- Cost of failed procedures.
- Cost of repeat procedures.
- Cost of bowel preparation under previous and revised pathways.
- Staff resource utilisation associated with pre-assessment, pharmacy and repeat procedures.
- Potential financial benefits resulting from avoided repeat investigations and released clinical capacity.

Social sustainability:
Social sustainability outcomes were assessed through qualitative staff and patient surveys. To minimise survey fatigue and maximise response rates, the initial patient survey and the staff survey was incorporated into an existing endoscopy experience survey rather than distributed as a separate questionnaire. A separate patient survey following the implementation of our change was sent to those patients who had a failed test.

Patient Outcome measures

- Patient-reported experience of the endoscopy pathway.
- Patient understanding of bowel preparation instructions and confidence in completing preparation correctly.
- Experience of repeat investigations where procedures are unsuccessful.
- Issues associated with delays to diagnosis and repeat procedures.
- Patient engagement with and attitudes towards healthcare sustainability.

Staff Outcome measures:

- Staff views on the revised endoscopy pathway.
- Staff perceptions of workload associated with failed procedures and repeat investigations.
- Staff views on the sustainability benefits of the pathway changes.
- Staff confidence in supporting patients with bowel preparation and pre-assessment processes.
- Staff engagement with and attitudes towards healthcare sustainability.

Results:

We collected baseline data for our project from January to April 2026. Our project change, to one-stop face to face preassessment with nurse-led bowel prep delivery began on 4th May 2026. We collected change data from May to July 2026. We collected data on the patient, environmental, financial and social outcomes.

Patient and Population outcomes:
Following the implementation of our change inadequate bowel prep leading to procedure failure was reduced from 11% (167) to 7% (64) of colonoscopies. Failure rates for stand alone colonoscopies demonstrated the greatest reduction to 5% (44). This reduction brought the endoscopy failure rate below the benchmark of 10% set by JAG, demonstrating compliance with UK quality standards in endoscopy.

Following our change, thirty-four percent (22) of failed procedures were repeated. This translates to 2% of all colonoscopies performed during this time compared with 5% of colonoscopies in our baseline data. With 3 colonoscopies per list, this translates to 7 additional endoscopy sessions (2.4 sessions per month) to accommodate repeated procedures. Compared with 26 additional sessions (6.6 lists per month) required at baseline, this leads to 4.2 sessions a month released to facilitate procedures for other patients on the waiting list.

In those cases where the test was repeated, patients waited an additional 26 days on average (range 10-56) for a successful diagnostic test compared with 41 days (range 8-177) at baseline.

Environmental sustainability:
The carbon footprint of a colonoscopy performed at Barnsley Hospital is between 8.4 and 10.0 $kgCO_2e$ per procedure (see Appendix A). This includes the preassessment appointment, medication administration including bowel prep, procedure room environment, medical consumables, waste disposal and endoscope reprocessing. For our calculations we have used the lower value of 8.4 $kgCO_2e$ and have not included patient travel.

If using emissions of 8.4 $kgCO_2e$ per procedure, and monthly colonoscopies of 390 per month (1,558 colonoscopies in 4 months), then total emissions from 390 colonoscopies = 390*8.4 = 3,276 $kgCO_2e$ per month.

Table 1. Environmental impact pre and post intervention based on reducing the rate of failed colonoscopies

	Pre intervention	Post intervention
Number of procedures per month	390	390
Total emissions from procedures	3,276 $kgCO_2e$	3,276 $kgCO_2e$
Number of failures due to poor bowel prep	51 or 13%	21 or 5.5%
Emissions from failed procedures	51*8.4 = 428 $kgCO_2e$ /month	21*8.4 = 176 $kgCO_2e$ /month
Number of repeat procedures	5% of total procedures (20 patients)	2% of total (8 patients)
Emissions from repeat procedures	168 $kgCO_2e$	67.2 $kgCO_2e$

If reducing the failed colonoscopy rate by 30 procedures per month, then at 8.4 $kgCO_2e$ per procedure, this is a reduction of 252 $kgCO_2e$ per month or 3,024 $kgCO_2e$ per year.

Plenvu has an estimated carbon footprint of 0.15 $kgCO_2e$. The estimated carbon footprint of MoviPrep is 0.25 $kgCO_2e$. Change in the type of bowel prep used towards Plenvu was therefore associated with a reduction in the emissions associated with bowel prep with an average of 0.23 $kgCO_2e$ per procedure at baseline and 0.20 $kgCO_2e$ following the change.

Economic sustainability:
Financial cost data was sourced from the Finance Department at Barnsley hospital. They cost a stand alone colonoscopy at £578.91 and a combined procedure at £646.30 per procedure.

There were no additional costs associated with implementing our change as the area in Medical Outpatients already existed and was not being used by an alternative service. It was already equipped with furniture and non-medical consumables such as telephones and computers. Other required equipment was taken from the Endoscopy Department with nothing additional procured. Pre-assessment staff were already employed by the endoscopy department and no additional staff were hired to implement the change.

51 failed procedures (pre intervention) cost £29,524.41 per month; 21 failed procedures (post intervention) cost £12,157.11.

The financial cost of the additional 30 failed procedures per month (360 per year) at a financial cost of £578.91 (if they were all standalone procedures) which equated to £17,367 per month or £208,407 per year.

Table 2. Financial impact pre and post intervention based on reducing the rate of failed colonoscopies.

	Pre intervention	Post intervention
Number of procedures per month	390	390
Cost per procedure (£)(*)	£578.91	£578.91
Number of failures per month	51	21
Cost of failed procedures	51* £578.91 £29,524.41	21* £578.91 = £12,157.11
Financial savings per month		£17,367
Financial savings per year		£208,407

(* based on stand alone colonoscopy)

Social sustainability:
We performed an initial patient survey of all patients attending for a colonoscopy and a further survey, following implementation of our change, of all patients who had a failed procedure. We also performed a survey of endoscopy department staff.

Feedback from our baseline patient survey of all patients attending for an endoscopy at BDGH indicated patients generally felt the pre-assessment process was informative with 97.6% (83) of respondents indicating that following their appointment they understood the bowel prep instructions and 97.3% (82) and 98% stating they were able to take the prep and fast as instructed respectively.

In contrast, our survey of preassessment staff demonstrated only 69% felt that patients attending for dual procedures understood the instructions they gave and commented that there is **"too much information to give".**

We surveyed patients who had a failed procedure following our change and got 10 responses (16% response rate). Eighty percent (8) said the pre-assessment bowel prep instructions were easy to follow and 90% (9) were able to fast as advised.

Over 97% of patients and 93% of staff we surveyed agreed that "it was important that the NHS ran efficiently minimising cost and waste, even if it is less convenient for me". Following that 90% of patients requiring a combined procedure stated they would prefer this to be at the same appointment. Reasons for this were reducing time off work and the number of journeys as well as reducing anxiety by getting everything over with at once **"It makes sense just to come once. I would be anxious having to come again after the first experience".**

When we asked staff the same question, 69% said they preferred when patients had combined procedures with many stating that they thought it was easier for the patient this way, **"resource efficiency and swifter for the patient".**

Patient-identified problems with combined procedures were around co-ordinating the different requirements for an upper and lower GI endoscopy such as consuming the bowel prep and fasting for long enough. One patient's feedback highlighted this: **"The first endoscopy booked was a combined procedure that failed because I could not take the second preparation at the right time. I was not therefore cleansed enough for the colonoscopy part to happen. The endoscopy took place as planned. The second appointment to do the colonoscopy split the 2 preparations over 12 hours and that was successfully managed".**

Staff problems around combined procedures highlighted increased failure rates of combined procedures and feeling it was overwhelming for the patient to have 2 procedures especially if they found the initial part of the procedure difficult **"Results are often poor needing repeated tests which is bad for the service"**

Staff were also asked about the process leading up to a failed procedure due to bowel prep. When asked what happens when the patient history or PR examination demonstrates bowel prep failure, 77% stated that the endoscopist would still perform an initial assessment of the bowel using an endoscope with 23% stating the procedure would be cancelled without using the endoscope at all. In contrast, our project data found that in 99.5% of failed procedures the endoscope was used.

Discussion:

Summary of findings

This SusQI project evaluated the introduction of a one-stop, face-to-face pre-assessment pathway in which trained nursing staff supplied bowel preparation under a PGD. The intervention was associated with a reduction in colonoscopies failing because of inadequate bowel preparation from 11% at baseline to 7% following implementation. Although the project did not fully achieve its target failure rate of 5%, this represents a clinically and operationally important improvement and brought the department in line with the JAG quality standards in endoscopy benchmark.

The greatest improvement occurred among patients undergoing standalone colonoscopy, for whom the failure rate fell from 9% to 5%. The reduction was smaller among patients undergoing combined upper and lower gastrointestinal endoscopy, from 22% to 19%. Combined procedures therefore remain an area of concern.

The proportion of failed procedures subsequently repeated fell from 47% to 34%. The combined reduction in failed procedures and percentage repeated meant the estimated number of additional endoscopy lists required for repeat procedures decreased from 6.6 to 2.4 per month, releasing approximately 4.2 lists of capacity each month. This resulted in a reduction in the average length of additional time patients who underwent a repeat procedure waited for a successful diagnostic investigation. It fell from 41 to 26 days, a reduction of 37%.

The project also delivered benefits across the four domains of sustainable healthcare:

- **Patient and population outcomes:** Fewer patients experienced an unsuccessful colonoscopy, repeat bowel preparation or repeat invasive investigation. The reduction in repeat activity released endoscopy capacity that may enable earlier investigation of other patients. For patients requiring a repeat procedure, the reduction in additional waiting time potentially reduced diagnostic delay and associated anxiety.
- **Environmental outcomes:** Reductions in failed and repeated procedures avoided emissions associated with clinical consumables, endoscope decontamination, waste disposal, medication and procedure-room energy use. Increased use of the lower-volume Plenvu regimen also reduced the estimated carbon footprint of bowel preparation. The project estimated a reduction of 3,024 $kgCO_2e$ per year relating to fewer failed procedures.
- **Financial outcomes:** The estimated combined saving from fewer failed procedures was £208,407 per year if sustained. This did not include staff time spent counselling patients, repeating pre-assessments and rescheduling procedures, or the opportunity value of the capacity released. The wider economic benefit may therefore be greater, although the reported figures represent avoided or released costs.
- **Social outcomes:** The redesigned pathway provided an opportunity for face-to-face education, assessment of individual risk and immediate provision of bowel preparation. Fewer failed procedures reduced the likelihood of patients having to take more time away from work or caring responsibilities, repeat an unpleasant preparation, travel again to hospital and experience continuing uncertainty while awaiting diagnosis. Staff and patients strongly

supported reducing waste, and most patients preferred combined procedures because these reduced visits, time away from work and anxiety.

Interpretation

The findings suggest that strengthening pre-assessment improves bowel preparation outcomes and reduces avoidable resource use. Face-to-face assessment allowed nurses to check patients' understanding, identify factors associated with preparation failure and tailor the explanation of preparation and fasting requirements. Supplying bowel preparation under the PGD during the same appointment also simplified the pathway and removed the risk of delay or non-collection from hospital pharmacy.

However, the observed improvement cannot be attributed solely to nurse-led provision under the PGD. Several changes occurred concurrently, including the move from telephone to face-to-face assessment, increased use of Plenvu, revised patient information, digital consent and changes to the timing and explanation of bowel preparation. This makes it difficult to understand which change had the greatest impact on improved outcomes. The improvement is best understood as the effect of a redesigned pre-assessment pathway and service rather than that of any single component.

The increase in Plenvu use occurred incrementally from the 4th March 2026 with 41% of colonoscopies using Plenvu in May increasing to 51 and then 55% in June and July respectively. We expect this value to continue to increase as the pre-assessment service becomes established and bowel prep prescriptions from other areas such as medical outpatients and surveillance endoscopies reduce.

The increase in Plenvu use from 18% to 50% on average may have contributed to the reduction in failures because its lower volume may improve completion for some patients.

The limited improvement in combined procedures is important. These patients must reconcile the timing of split-dose bowel preparation with fasting requirements for upper gastrointestinal endoscopy. This creates more complex instructions and may shorten or disrupt the interval between the final preparation dose and colonoscopy. However, combined procedures make up only 11% of colonoscopies performed, indicating that although failure rates in this group are higher, any improvements here will have a lower impact on the overall failure rate.

Qualitative feedback supported this interpretation: staff described the amount of information as potentially overwhelming, and one patient reported being unable to take the second dose at the required time. Combined procedures remained efficient and were preferred by most patients, but they require a specifically designed preparation schedule rather than simply applying the instructions used for standalone colonoscopy.

The project also identified a possible discrepancy between reported practice and observed activity. Although 23% of staff believed that a procedure would be cancelled without insertion when inadequate preparation was apparent from the history or rectal examination, an endoscope was used in 99.5% of failed cases. In some patients, an initial examination will be clinically justified because the true quality of preparation cannot be established without endoscopic assessment. Nevertheless, clearer criteria for proceeding, abandoning or postponing a procedure could potentially avoid some resource use where severe preparation failure is already evident.

The reduction in repeat procedures reflects both fewer failures and reduced proportion of failed procedures that were repeated. Not all failed procedures require repetition: the appropriate response depends on the original indication, findings, patient fitness, likelihood of benefit and availability of alternative investigations. A lower repeat proportion is not necessarily an improvement unless decisions are clinically appropriate and patients remain adequately investigated.

Barriers and challenges

Implementation required coordination across Endoscopy, Pharmacy, Gastroenterology, Medical Outpatients, IT, quality improvement and sustainability teams. Development and approval of the PGD required governance input, medicines-management oversight, staff training and competency assessment. Although no additional staff or equipment were required, suitable clinic space had to be identified and the service reorganised around face-to-face appointments.

Staff had to become familiar with several new processes simultaneously, including a new bowel preparation regimen, different dose timings, electronic consent and revised patient information. This created a risk of inconsistent advice during the transition. Regular communication, competency-based training and opportunities for staff feedback were important in establishing the pathway.

The continuing high failure rate among combined procedures despite the wider improvement demonstrated that the complexity of coordinating bowel preparation and fasting requirements was not fully resolved by face-to-face education alone. This finding indicates a need for further intervention to improve outcomes for this group.

Face-to-face assessment may also create accessibility barriers. Although it allows richer communication, it may be less convenient for patients who live far from the hospital, work, have caring responsibilities or have mobility difficulties. Patient feedback indicated that many felt positive about telephone preassessment prior to the change. In this project, the face-to-face visit replaced the journey previously required to collect bowel preparation, so travel was assumed to be broadly unchanged. A flexible model, retaining remote assessment for selected low-risk patients, may be more equitable.

Digital consent and electronic information reduce paper and postage but may disadvantage patients who lack internet access, digital skills, suitable devices or confidence using electronic systems. Accessible printed information, interpretation services and non-digital consent routes should remain available.

Whilst the redesigned pathway delivered several benefits, implementation led to several simultaneous changes, including the introduction of face-to-face pre-assessment clinics, a new bowel preparation regimen, digital consent and revised patient information processes. Staff reported requiring time to become familiar with the new processes, particularly the revised bowel preparation instructions and timing requirements for different appointment schedules. These findings reinforced the importance of ongoing education, regular communication and opportunities for staff feedback when implementing complex pathway changes.

Risks

Whenever a change takes place, it may not be of benefit to all patients. It is clear, with regards to endoscopy preparation, there is no one-size-fits-all approach. Plenvu may be less acceptable to some patients because of its taste, whereas others prefer it due to the lower volume. Patients should receive practical advice about administration, and an alternative preparation should remain available when clinically indicated or where previous tolerability has been poor. Face to face pre-assessment aims to address these risks offering a more personalised and patient-centred approach to bowel prep.

Moving to digital consent, as with much of the patient-facing NHS digitalisation, risks excluding those who have lower digital literacy or limited access to electronic devices. Our experience is that this remains an important minority of patients accessing our service but alternative consent forms must remain available.

Limitations

One of the main limitations of our project were that several interventions were introduced together, including face-to-face pre-assessment, nurse-led supply under a PGD, increased use of Plenvu, and

electronic consent. It is consequently not possible to determine the contribution of each component to the improved outcomes.

Patient feedback following implementation was obtained only from patients whose procedure failed. There were ten responses, representing a 16% response rate, which introduces substantial non-response and selection bias. These results may not represent the experience of all patients using the redesigned pathway. The baseline and post-intervention patient surveys also sampled different populations, limiting direct comparison.

The estimated carbon footprint relied partly on process-based calculations and proxy data where exact values were unavailable. The emission values are therefore representative rather than absolute. Similarly, the financial results represent estimated avoided costs and released capacity rather than confirmed reductions in expenditure due to the complex nature of costing a healthcare system within the NHS.

Learning During the Project

The project took place during a period of significant service development within the Endoscopy department. Several improvements, including enhanced pre-assessment processes, revised bowel preparation pathways, nurse-led provision of bowel preparation through a PGD, and the introduction of digital consent, were implemented during the project period. While these initiatives reflected the department's ongoing commitment to improving patient experience, service efficiency and sustainability we learned that implementing so many changes at once also presented challenges. These were in the data interpretation and the experience of pre-endoscopy staff who struggled with the extent of new information. In future we will aim to make changes in a more step-wise manner.

We also found the issue of combined procedures interesting. Combined procedures are commonly referred to as the most efficient and sustainable option for patients requiring both an upper and lower endoscopy. They are also favoured by the majority of patients and, to a lesser extent, staff. However, our project found that one in 5 of these procedures fail due to inadequate bowel prep, impacting outcomes for the patient, environment and service. It has made us as a team want to understand more about the reasons these tests fail and allowed us to appreciate assumptions made with regards sustainability and efficiency if the processes and outcomes aren’t studied in detail.

On a practical note, as a team we have learnt the time commitment required to undertake a complex project such as this one and have appreciated the support from our senior staff in this regard. In future we would encourage more colleagues to be more involved as a bigger team would have helped distribute the workload and would have brought diversity of ideas to the meetings.

Throughout our project data quality and utility was a constant issue. We found audit department data uninterpretable despite taking time to discuss the project aims and the audit department staff being willing to support us. We moved to collecting our own data via the endoscopy management system but found this to be unreliable and missed out a large proportion of our target population when the automated filters applied. Eventually we trawled the raw endoscopy data ourselves. This was laborious and meant this aspect of the project took much longer than we anticipated. This has demonstrated the importance of accurate record keeping and careful interrogation of available information.

Transferability and next steps

The principles of this intervention are relevant to other NHS endoscopy units, particularly services with high rates of inadequate bowel preparation, fragmented pre-assessment pathways, substantial pharmacy workload or frequent repeat procedures. The model may also be useful in other diagnostic pathways in which inadequate preparation leads to cancellation or repetition, such as radiological or day case surgical procedures.

The priority for our department is to continue to address the issue of failed and repeated procedures. We recognise this as having the biggest impact on the environmental impact of our service. One area we hope to address is ways to further improve outcomes in combined procedures. Our next change cycle could test the impact of tools to improve patient understanding and compliance such as simplified appointment-specific instructions, or a reminder text message shortly before the procedure. This could include a departmental review of the timing of combined procedures to facilitate the best outcomes for bowel preparation compliance.

We would also like to implement changes targeting waste identified during this project. This includes rationalising the administration of Senna tablets to the necessary 14 tablets rather than a packet of 60 per procedure, moving to a filtration system for procedural water use rather than single use bottled sterile water and addressing the quantity of wasted sedation due to vial sizes.

Conclusions:

Introducing a one-stop, face-to-face pre-assessment pathway with nurse-led provision of bowel preparation under a PGD was associated with a reduction in colonoscopy failure due to inadequate preparation from 11% to 7%. The intervention reduced failure rates and repeat procedures, released approximately 4.2 endoscopy sessions each month and shortened the additional wait for a successful investigation by 37%. It generated projected environmental and financial benefits of 3024 kgCO2e and £208,407 per year respectively. It also reduced the inconvenience, anxiety and repeated preparation experienced by patients.

The project demonstrates that telephone or virtual appointments are not always the key to the best environmental outcomes. In this case, a streamlined pre-assessment service with a face-to-face appointment benefitted patient care, increased service capacity and improved financial and environmental sustainability. Our target of 5% was not reached despite several changes being made.

Simultaneous changes create challenges in understanding the impact of the different changes, however, it is clear that combined procedures, while offering efficiency in many other ways, continued to have a high failure rate. Deeper understanding of the challenges to adequate bowel prep in patients having combined procedures could offer valuable insights into national endoscopy services, particularly as combined procedures are cited as a key Green Endoscopy initiative in the BSG, JAG and CSH combined consensus on Green Endoscopy 10.

Continued measurement and refinement of the processes for combined procedures are therefore required. If the observed benefits are sustained, the pathway provides a practical model that could be adapted and evaluated across other NHS endoscopy services.

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Critical success factors
Please select **one or two** of the below factors that you believe were most essential to ensure the success of your project changes.

People	Process	Resources	Context
☐ Patient involvement and/or appropriate information for patients - to raise awareness and understanding of intervention ☐ Staff engagement ☐ MDT / Cross-department communication ☐ Skills and capability of staff X **Team/service agreement that there is a problem and changes are suitable to trial (Knowledge and understanding of the issue)** ☐ Support from senior organisational or system leaders	☐ clear guidance / evidence / policy to support the intervention. ☐ Incentivisation of the strategy – e.g., QOF in general practice ☐ systematic and coordinated approach ☐ clear, measurable targets ☐ long-term strategy for sustaining and embedding change developed in planning phase ☐ integrating the intervention into the natural workflow, team functions, technology systems, and incentive structures of the team/service/organisation	X **Dedicated time** ☐ QI training / information resources and organisation process / support ☐ Infrastructure capable of providing teams with information, data and equipment needed ☐ Research / evidence of change successfully implemented elsewhere ☐ Financial investment	☐ aims aligned with wider service, organisational or system goals. ☐ Links to patient benefits / clinical outcomes ☐ Links to staff benefits ☐ 'Permission' given through the organisational context, capacity and positive change culture.

Appendix A

Two actions

1. Changing how patients received bowel prep

Previous model: Patients received prescriptions and collected bowel prep from pharmacy.
New model: Bowel prep supplied directly during pre-assessment under a Patient Group Direction (PGD).
2. The service has moved from:

- Previous standard - Moviprep
- New standard PLENVU

Measurements

Methodology

A cradle-to-grave carbon footprint analysis was used to estimate the items greenhouse gas (GHG) emissions. Data was provided on the equipment used to deliver perform a colonoscopy and were carbon footprinted using a process-based carbon footprint analysis. Items were weighed by the team and materials identified.

Data was obtained from previous studies by the Centre for Sustainable Healthcare and other references. Where data was not available, calculations were made based on the weight and material of the product. Material weights were converted into GHG emissions using emission conversion factors taken from the Department of Energy Security and Net Zero (DESNZ)'s Greenhouse Gas Reporting Conversion Factors 2026 database, ICE V4.0 database and primary research papers and LCAs. The analysis included GHG emissions associated with primary materials, production, and disposal.

Materials

Material emissions are calculated by the weight of the material, emission factor of the material and number of items.

*Total emissions = weight of material * material emission factor*

Transport

For patient travel, emissions are calculated by distance of a patient journey and the emission factor for the mode of transport. If mode of transport isn't known, emissions from an average petrol car are used.

*Total emissions = distance of journey * emission factor*

The emissions factor for an average petrol car is 0.3339 $kgCO_2e$ per mile.

Waste

Waste emissions are calculated by amount of waste (tonnes) and the UK emission factor of average emissions by waste stream

*Total emissions = volume of waste * waste stream emission factor*

The emission factor for clinical waste is 1074 $kgCO_2e$.

Activity data

The yearly activity data showed 883 / 4,935 lower GI endoscopies failed in a 12-month period (2024-2025) - 17.9%.

Results

Table 1 describe the steps in performing a colonoscopy procedure from patient arrival to departure and the equipment used at each step. In addition, emissions from the bowel prep, energy used by the procedure room and waste disposal.

Table 1. Stages of colonoscopy with activity and consumables and equipment used for each.

Stage	**Activity**	**Carbon Footprint Sources**	**Included in the carbon footprint**
1. Patient and staff travel to unit	Via Car/ Walking/ Bus	Time/ Fuel	Proxy values included
2. Arrives on Endoscopy Unit	Books in at reception	Computer/ Pen/ Paper/ digital infrastructure	No
3. Sits in waiting area		TV on in waiting area	No
4. Admission nurse calls patient into admission room	Goes into another room	Pen Wrist label Stickers BP machine Thermometer Paper notes Disinfectant wipe Digital infrastructure	Yes, for disposable equipment
5. Change room	Attends changing area to wait for procedure	Disposable shorts given Reusable gown Plastic basket for belongings givens given	Yes, for disposable equipment
6. Taken to procedure room	Another member of staff takes patient to procedure room	Sticker used	No
7. In procedure room	Questions asked/ introductions given Cannula Inserted	Digital infrastructure/ PC/ IPADS/ Gloves/ cannula pack/ torniquet/ wipe/flush 0.9% NaCl/ sharps bin used/ Linen on trolley/ Conti pad.	Yes, for disposable equipment
8. Patient lays on a trolley	On a trolley with clean linen and conti sheet	Linen use Conti sheet	No
9. Sats and Heart rate checked for baseline	Sats probe on finger Scope guide placed in front of patient	Sats probe Disinfectant wipe post procedure used	Yes, for disinfectant wipe
10. Endoscopist Performs PR Exam	With patients consent	Lubricant Gauze Cardboard tray Gloves x3	Yes
11. Sedation administered	Into Cannula and flushed twice	0.9% NaCl flush Fentanyl vial Midazolam Vial	Yes
12. 02 Administered	Via nasal Cannula	Nasal cannula Extension line for 0_2 0_2 (wall mounted)	Yes, for disposable equipment

13. Scope checked	Endoscopist performs scope checks for safety	Water CO_2 Suction tubing attached to the scope Water flushing tubing	Yes, for disposable equipment
14. Procedure Starts	Photos taken Water used to insufflate bowel Numerous dry wipes used for torque steering	Bottled water Wipes Infacol	Yes
15. Entonox used	Inhales Entonox from canister	Mouthpiece (plastic) Entonox cannister	Yes
16. Biopsies taken	Biopsies taken in bowel	Biopsy forceps Histology pot Paper request Report to attach to request Stickers Pen Use Staff takes samples to labs	Yes, for disposable equipment
17. Procedure Completes	End of test usually within 1 hour.	Disinfectant wipes Reprocessing of scope Report on paper using digital infrastructure	Yes, for disinfectant wipes
18. Patient taken to Discharge	Discharged home	Trolley cleaned with disinfectant Report printed and given Travel time for patient Fuel costs	Yes, for disinfectant wipes Travel already included from (1)

The consumable equipment to be included in the carbon footprint is separated out and displayed in Table 2. This includes the number of items used and the emission factor per item.

Table 2. Inventory for consumable equipment, emissions factors per item for raw materials and manufacturing, and the carbon footprint for the consumable equipment used.

	Consumable equipment used	**Number of items used**	**Carbon emission factor per item ($kgCO_2e$ /item use)**	**Carbon emissions for items used ($kgCO_2e$)**
Admission room	Clinell wipe *1	1	0.021	0.021
Procedure room	Nonsterile glove (single)	2	0.026	0.052
	Cannula	1	0.046	0.046
	Disposable torniquet	1	0.074	0.074
	10ml saline flush	1	0.047	0.047

	Syringe (10 ml)	1	0.024	0.024
Change room	Disposable shorts (*)	1	0.278	0.278
PR	Lubricating jelly	1	0.030	0.030
	Gauze (individual piece)	1	0.034	0.034
	Cardboard tray (**)	1	0.006	0.006
	Nonsterile glove (single)	3	0.026	0.078
Sedation	10ml saline flush	1	0.047	0.047
O2 administered	Nasal cannula and oxygen tubing (75cm)	1	0.184	0.184

(* estimated weight 50g, material Nonwoven polypropylene)
(** estimated weight 5g)
Emissions for all consumable items used (raw materials, production) is 0.921 $kgCO_2e$.

Patient travel
*Total emissions = distance of journey * emission factor*
Average distance patient travels one way is 8.7 miles; return journey is 17.4 miles (HOTT tool, 2018)
The emissions factor for an average petrol car is 0.3339 $kgCO_2e$ per mile.

Emissions per hospital visits = 17.4*0.3339 = 5.81 $kgCO_2e$ per patient visit.

Energy use
The dimensions of the procedure room were measured as 4.45m * 4.68m. Total floor space is 20.83m^2. Using ERIC data for Barnsley Hospital, total electricity consumed per year was 8,272,800 kWh and natural gas was 38,294,828 kWh with a gross internal floor space of 76,669 m^2. Energy used per m^2 is shown in Table 3.

Table 3. Energy (electricity and gas) used per m^2 for the hospital and procedure room per year.

	kWh per m^2 internal floor area	Emissions Factor ($kgCO_2e$ /kWh)	Emissions per m^2 internal floor space ($kgCO_2e$ per m^2)	Per 20.83m^2procedure room per year ($kgCO_2e$)
Electricity consumption (kWh)	107.9	0.14395 (*)	15.53	323.5
Natural gas consumption (kWh)	499.5	0.2355 (**)	117.61	2449.8
Total				2773.3

(* Electricity UK including Transmission and distribution (DESNZ 2026))
(** Natural gas including Well to Tank (DESNZ 2026))
If the procedure room is only used for colonoscopies and 4,935 procedures are carried out annually, emissions are 0.562 $kgCO_2e$ per procedure.

Other rooms may be used for the colonoscopy, and other procedures may be undertaken in the procedure room.

Water use
The literature states an average of 782mls water is used per colonoscopy. Unpublished LCA data by Dr Knott is 2.52 $kgCO_2e$ per 1L though the figure quoted in the literature is 0.58 $kgCO_2e$.
Emissions range from 0.454 $kgCO_2e$ to 1.97 $kgCO_2e$ per procedure.

Waste
*Total emissions = volume of waste * waste stream emission factor*

The emission factor for clinical waste is 1074 $kgCO_2e$.
Assuming all consumable items (with an approximate weight of 264g) are disposed of via clinical waste or sharps, emissions from waste are 0.2837 $kgCO_2e$ per procedure.

Medication for sedation
The medication used for sedation is:

- 5ml vial Midazolam 5mg/5ml 35.95 gCO2e per vial (0.036 $kgCO_2e$).
- 2ml vial Fentanyl 100mcg/2ml is 25.28gCO2e per vial (0.025 $kgCO_2e$).

Data taken from MCF Formulary (https://formulary.yewmaker.com/)

In total, emissions are 0.061 $kgCO_2e$ per patient from IV medication for sedation.

Medication for bowel prep
Senna is given for 7 days prior to the procedure with either Movicol or Plenvu taken the night before.

The carbon footprint of Senna is not available. The only stimulant laxative which has a carbon footprint reported in Medicine Carbon Footprint (MCF) Dataset - Products | Zenodo is Bisacodyl with a footprint of 2.66 gCO_2e per tablet. A box of 60 would have a footprint of 159.6 gCO_2e (0.16 $kgCO_2e$) compared to 14 tablets having a footprint of 37 gCO_2e (0.037 $kgCO_2e$). Emissions per patient 0.160 $kgCO_2e$ for a pre procedure course of stimulant laxatives.

Movicol and Plenvu
Neither Movicol nor Plenvu have carbon footprints per patient dose. However, data from Carbon footprint assessment and sensitivity analysis of diagnostic colonoscopy - PubMed suggest 360 gCO2e from sedation, bowel prep and CO2 insufflation. Given IV sedation has been calculated above as 61g, and estimations based on volume of medication from data sheets (Plenvu powder for oral solution - Summary of Product Characteristics (SmPC) - (emc) | 8578, and MOVIPREP, powder for oral solution - Summary of Product Characteristics (SmPC) - (emc) | 289) estimates for Plenvu are 0.15 $kgCO_2e$ per bowel-prep course and 0.25 $kgCO_2e$ for a Movicol bowel-prep course.

Summary

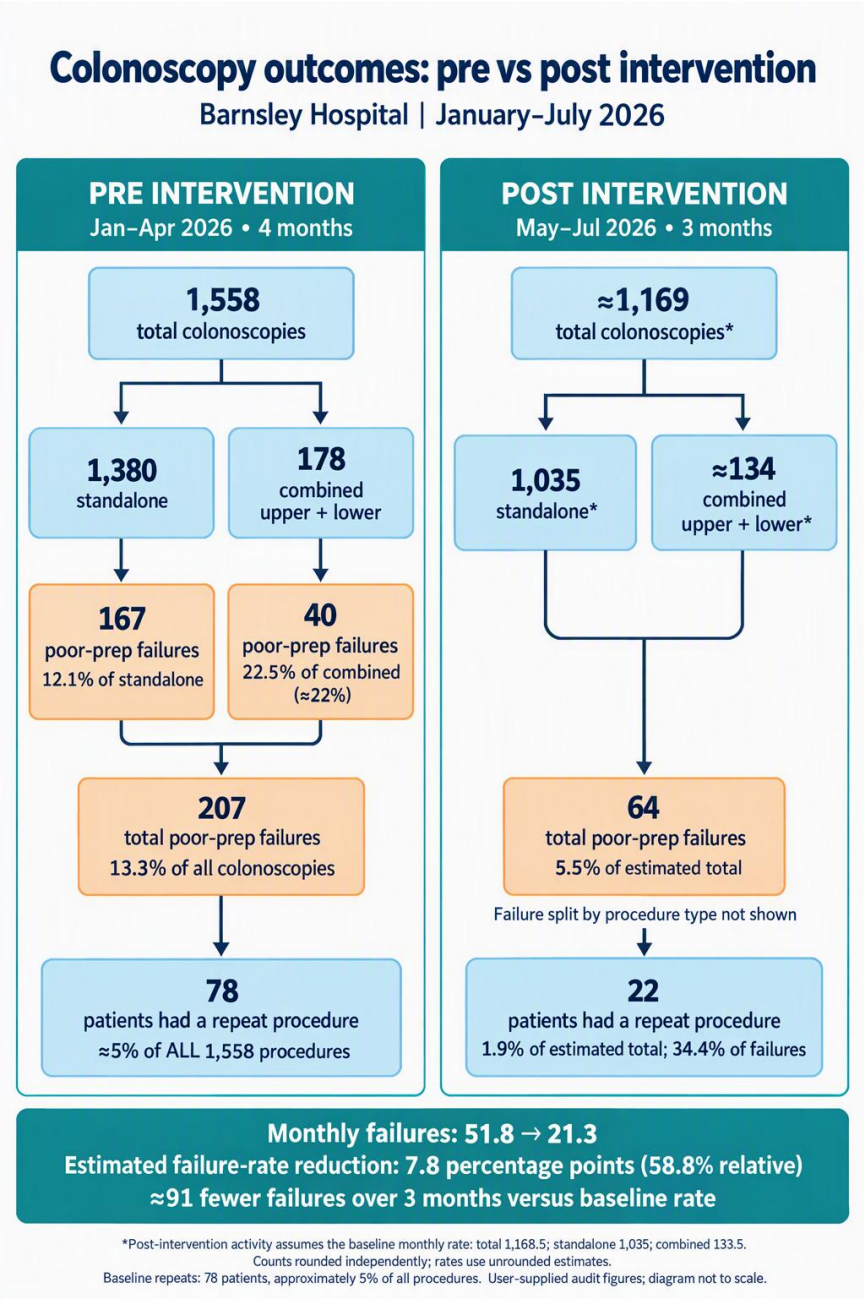
Emissions per patient visit are

- all consumable items used (raw materials, production) is 0.921 kgCO2e.
- patient travel is 5.81 kgCO2e.
- waste is 0.2837 kgCO2e.
- for IV medication are 0.061 kgCO2e.
- from energy use are 0.562 kgCO2e.
- for water used range from 0.454 kgCO2eto 1.97 kgCO2e.

- for bowel prep are 0.160 kgCO2efor senna, 0.15 kgCO_2efor Plenvu and 0.25 kgCO_2e for Movicol.

Total emissions per procedure ranges from 8.4 kgCO_2e for Plenvu and lower range for water to 10.0 kgCO_2e for Movicol and higher range for water.

Appendix B: Pre- and post-intervention procedure outcomes



Repeat figures: Between January and April 2026, 78 patients had a repeat procedure, equivalent to approximately 5% of all 1,558 procedures. Between May and July, 22 patients had a repeat procedure.

Data reconciliation: The diagram uses the supplied 167 standalone failures plus 40 combined-procedure failures, giving 207 baseline failures rather than the 167 total stated elsewhere in the report. Post-intervention activity is estimated at the same monthly rate as baseline; rates use 1,168.5 estimated procedures. The report's failure totals and associated calculations still require reconciliation.