How does perception of the bowel cancer screening colonoscopy service differ between Screening and Non-Screening Colonoscopists and what are the differences in quality and productivity?

Hayley Jayne Heard

This thesis is submitted in fulfilment of the degree of Doctor of Health Studies (Professional Doctorate)

School of Social Science

Cardiff University

2022

Acknowledgements

I would like to express my sincere thanks to my supervisors Professor Adam Hedgecoe and Dr Honor Young, without whom I would not be submitting this thesis. I will always be grateful for their continuous advice and support throughout my Professional Doctorate journey.

I would also like to thank my family and friends for their continued support and promise I will not take on another big project for a while.

This study would not have been possible without the support of Lead Colonoscopists throughout Wales, and I am grateful to them for agreeing to participate and for providing me with data to analyse and colleagues to interview. I hope the findings of this research will feed into practice and support service improvement within endoscopy units in Wales.

Abstract

Introduction

Quality assurance and performance management of colonoscopy in Wales appears to be more robust within the screening programme than the non-screening service. It is uncertain if these processes lead to improved quality or productivity and if the assessment process for potential screening colonoscopists deters colonoscopists from applying.

Method

A mixed methods study comprising of analysis of individual colonoscopists, and endoscopy units' key performance indicator (KPI) data was conducted. KPI data from 6 of the 7 Welsh health boards was analysed and data used to develop interview guides for semi structured interviews. 10 Screening Colonoscopists, 10 Non-Screening Colonoscopists, 3 Specialist Screening Practitioners and 3 Endoscopy Unit Managers were interviewed to explore perceptions of quality and productivity of the screening and non- screening colonoscopy services and acceptability of assessment and accreditation processes.

Results

The study showed a statistically significant variation in polyp detection rate with Screening Colonoscopists achieving 62% and Non-Screening Colonoscopists a mean of 32% (p=.00). The rate of procedures undertaken without sedation was also statistically significant between the groups with Screening Colonoscopists performing more unsedated procedures (35% compared to 19% in Non-Screening Colonoscopists p=.005). All other KPI's analysed revealed no significant difference. Qualitative data suggested a strong perception of increased quality and productivity within the screening programme and although some interviewees considered the assessment process to be a deterrent to potential Screening Colonoscopists, it was considered necessary.

Conclusions

The screening colonoscopy service in Wales is perceived to be associated with higher quality and increased productivity compared to the non-screening colonoscopy service and there is some quantitative data to support this. The Screening Colonoscopist assessment process is considered necessary, although some improvements have been suggested including shorter timeframes and greater mentorship.

List of tables

List of figures

Chapter 2 Literature review

Contents

1: Introduction

This study has explored variation in quality and productivity between screening and non-screening colonoscopy services in Wales. It has also considered professional perspectives of quality and productivity within these services and explored professionals' views of the Screening Colonoscopist accreditation process.

A mixed methods design was used comprising of quantitative analysis of key performance indicator (KPI) data relating to the quality of individual colonoscopists performance at colonoscopy and of endoscopy units (where colonoscopy is undertaken) KPI data relating to productivity of the screening and non-screening colonoscopy services. Following on from the quantitative phase of the study and initial inspection of the data, semi structured interviews were undertaken to explore professional perspectives of quality and productivity and of the Screening Colonoscopist accreditation process.

Qualitative data were interrogated using thematic analysis and triangulated with quantitive data which had been subject to analysis with inferential statistical tests to ascertain statistical significance of variation between screening and non-screening colonoscopy services and colonoscopists. Analysis of both phases of the study allowed development of understanding to answer research questions detailed later in this chapter, which in turn allowed development of recommendations for further research and for policy makers.

Background

Bowel cancer, also known as colorectal cancer (CRC) is a major cause of morbidity and mortality in the UK. More than 40,000 people are diagnosed and more than 16,000 people die from the disease each year (CRUK 2019) in the

UK, making it the second leading cause of cancer death next to lung cancer (CRUK 2022). In Wales, each year more than 2,000 people are diagnosed with bowel cancer and around 1,000 people die from the disease.

Treatment for bowel cancer is much more effective and even curative if the disease is diagnosed early. Randomised controlled trials have demonstrated that mortality from bowel cancer can be significantly reduced by screening using faecal-occult blood testing (Towler et al. 1998). Bowel cancer screening programmes began rolling out across the UK in 2006 and started in Wales in October 2008. The programme works by identifying eligible people (men and women aged between 60 and 74 years of age) and sending them a bowel screening test kit in the post every two years for completion at home and return to the central screening laboratory. Completion involves applying a small sample of stool to the screening device and returning it in a hygienically sealed envelope for analysis. If laboratory analysis indicates a positive result (by the presence of haemoglobin in the stool), participants are contacted and asked to make an appointment to speak to a Specialist Screening Practitioner (SSP). The SSP will provide information about implications of the positive test, assess fitness for follow on tests (colonoscopy) and go through medication and bowel preparation for the colonoscopy, as well as the risks and benefits of the procedure.

If participants with a positive screening test result are fit and consent to colonoscopy as a follow up test, it is arranged in one of the 13 local assessment centres approved by Bowel Screening Wales (BSW) in each of the seven health boards in Wales. Colonoscopy examines the lining of the bowel from the inside using a flexible tube (colonoscope) with integral light and camera to allow identification of disease and removal of biopsy samples. Polyps (small, usually

benign growths that may develop into cancers) can be identified and removed from the bowel at colonoscopy thus preventing malignant transformation. High quality colonoscopy can identify cancer early before symptoms are present and prevent it developing by removing polyps.

Screening Colonoscopy in Wales is only undertaken on dedicated screening lists with no more than 4 patients on each. Although undertaken in all health boards in Wales, the screening service is centrally managed and separate to the non-screening colonoscopy service that manages referrals from primary and secondary care for patients with symptoms. The screening service operates a different service model to that of the non-screening service with robust pre-assessment and reduced list size. At the beginning of the programme concerns were raised about development of a two-tier service, with screening being associated with shorter waiting times and better quality assurance. Concerns were also raised about productivity with screening colonoscopy lists being seen as unproductive with only four patients on a list. Some suggested that more patients could be seen on a list. Given the current concerns with long waiting lists understanding and improving productivity is paramount.

Bowel screening aims to detect bowel cancer at an early stage before symptoms have developed, but colonoscopy is an invasive procedure and quality is paramount to the success of the screening programme and to the individual involved. Only colonoscopists accredited by BSW are able to perform procedures for the bowel screening programme in Wales.

To achieve accreditation colonoscopists must submit data for personal audit and scrutiny by the BSW colonoscopy panel, complete and pass a multiple-choice question examination and successfully complete an assessment process

that involves direct observation of procedural skill (DOPs), assessed independently by two screening assessors. The process in Wales is based on the English bowel cancer screening programme accreditation criteria (BCSP 2008), but with greater focus on therapeutic colonoscopy (colonoscopy where pathology is removed).

Following accreditation Screening Colonoscopists are subject to ongoing quality assurance by 6 monthly reviews of KPI data in line with the process used in England (BCSP 2011), although with slightly different standards. Outliers are notified and mentorship with Quality Assurance Advisors for BSW supports development of individual improvement plans. Some accredited Screening Colonoscopists have been stopped from screening in Wales because of consistent under performance. Although there are quality assurance processes in place for the non-screening service in Wales, anecdotal evidence from professional conversations suggest they are less robust.

The bowel screening programme in Wales is due to expand in 2022. An optimisation plan approved by the Welsh government involves improving the test which will reduce the threshold to offer people colonoscopy and expanding the age range to include people from the age of 50 years. This will significantly increase demand for colonoscopy, at a time when waiting lists are already much longer than they should be and more accredited Screening Colonoscopists will be needed.

Anecdotal evidence from professional conversation suggests the accreditation process may deter colonoscopists from applying to become Screening Colonoscopists for fear of failure and humiliation. At the beginning of the screening programme in Wales there was a significant failure rate (75% in 2008) for colonoscopists undergoing the assessment process to become

accredited Screening Colonoscopists and this may have impacted on other colonoscopists decisions to put themselves forward for assessment. The success rate is much higher now and there were 21 accredited Screening Colonoscopists in Wales at the time of this study, which is slightly less than in England per head of population (Ravindran et al. 2021).

The approach to generating additional screening colonoscopy capacity in Wales will be multi-faceted and include amending job plans of existing Screening Colonoscopists, but additional Screening Colonoscopists will be needed soon and BSW must consider the best way of supporting applications for assessment from potential Screening Colonoscopists. The current accreditation process is seen as lengthy and is relatively expensive, but it has always been considered necessary to ensure delivery of consistently high-quality colonoscopy. However, there does not appear to be evidence in the literature to support or refute improved quality of screening colonoscopy in Wales compared to the non-screening colonoscopy service, or to support the assumption that the Screening Colonoscopist accreditation process is responsible for any potential improvement in quality of the screening colonoscopy service in Wales.

The research aims

This study aims to consider if there is indeed variation in quality and productivity between screening and non-screening colonoscopy services in Wales and to explore professional perspectives of quality and productivity of both services and the Screening Colonoscopist accreditation process.

Using a mixed methods design, the study will consider quantitative key performance indicator data from individual colonoscopists to consider variation in quality and from endoscopy units to explore variation in

productivity KPI data. Semi structured interviews will generate qualitative data to explore professional perspectives of quality and productivity and also of the Screening Colonoscopists accreditation process.

Data from both quantitative and qualitative phases of the study will be triangulated in order to answer the following research questions:

1. Is there a difference in quality between screening and non-screening colonoscopy services in Wales?
2. Is there a perceived difference in quality between screening and non-screening colonoscopy services in Wales?
3. Is there a difference in productivity between the screening and non-screening colonoscopy services in Wales?
4. Is there a perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
5. How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

Research design

The mixed methods and critical realist paradigm used for this study allowed for exploration of professional perspectives and analysis of quantitative data which were triangulated to inform recommendations for policy makers and further research.

Quantitative phase

The quantitative phase of this study involved analysing key performance indicator (KPI) data for endoscopy units and individual colonoscopists provided

by Lead Colonoscopists. KPI data is routinely collected for individual colonoscopists as a requirement for accreditation by the Joint Advisory Group on Gastrointestinal Endoscopy (JAG).

To recognise the need for improved quality the JAG worked collaboratively with the British Society of Gastroenterology (BSG), and the Association of Coloproctology of Great Britain and Ireland (ACPGBI) to review existing and define new key performance indicators (KPI) for colonoscopy as detailed in chapter 2. These included:

- Caecal intubation rate (completion rate)
- Adenoma and polyp detection rate
- Rectal retroversion rate
- Colonoscopy withdrawal time
- Sedation rate
- Polyp retrieval rate
- Comfort score
- Perforation rate
- Post polypectomy bleed rate

Following discussion with Lead Colonoscopists in Wales it became apparent that much of this data would not be available for Welsh Colonoscopists and there was variation across the health boards in terms of availability of data. Although units are working towards improvement in data collection and the ability to upload data to the National Endoscopy Database (NED), it has not yet been consistently achieved across Wales.

It was therefore decided to focus on the following KPIs for the purpose of this study:

- Procedure numbers
- Polyp detection rate
- Withdrawal time
- Sedation and unsedated procedure rate
- Comfort score
- Completion rate

These KPIs were considered by the Lead Colonoscopists to be important determinants of quality and most likely to have complete data sets from Welsh health boards.

Having received data from each Lead Colonoscopist relating to those who consented to participate in the study, the anonymised data sets were analysed to identify statistical significance of variation and findings were used to shape interview guides for the semi structured interviews conducted for the qualitative phase of the study.

Qualitative phase

The qualitative phase of this study comprised of semi-structured interviews with professionals involved in delivering colonoscopy services in Wales. The same colonoscopists who had agreed for their data to be submitted for quantitative analysis participated in the semi structured interviews along with three Specialist Screening Practitioners and three Endoscopy Unit Managers.

Building on quantitative findings, semi-structured interviews were used to explore professional perspectives of quality and productivity and of the Screening Colonoscopist accreditation process. This approach proved to be

useful to enable understanding of the views of professionals involved in delivering colonoscopy services in Wales.

Anecdotal evidence from previous professional conversations had suggested that perception of the screening colonoscopy service may differ between Screening and Non-Screening Colonoscopists, particularly in relation to the assessment and accreditation process for Screening Colonoscopists. It had been said that implementation of the screening programme generated a two-tier service with selected and “elite” colonoscopists, rigorously monitored and standardised key performance and quality indicators for the screening programme and less rigorous processes for the symptomatic service.

From previous discussions with colonoscopists, it was clear that some professionals believed that the assessment and accreditation process for Screening Colonoscopists deterred colonoscopists from applying for fear of failing the assessment, particularly the direct observation of procedural skills (DOPs) or “driving test”. As the screening programme is due to expand and additional Screening Colonoscopists will be needed this was concerning and warranted further exploration.

Literature relating to Colonoscopists’ perceptions of the assessment process was found to be limited and this study will add valuable data to inform further research and policy makers.

Combined analysis

Key findings from both phases of the study were triangulated as described in chapter 3 to generate robust understanding of the data used to answer the research questions.

This study was conceived from anecdotal evidence suggesting that the screening colonoscopy service was of better quality than the non-screening service and that it was less productive. As described earlier, views had been expressed about the potential impact the Screening Colonoscopist accreditation model had on future applications which was concerning as more Screening Colonoscopists are needed to support expansion of the screening programme.

Whilst there is a place for anecdotal evidence in medicine according to Macnaughton, in Greenhalgh (1998), as students learn from more experienced clinicians, it can be dangerous to base decisions on a single clinician's previous experience (Greenhalgh 2019).

This study adds to the body of literature by providing both quantitative and qualitative evidence to support variation in quality and productivity between screening and non-screening colonoscopy services. It also explores views of the Screening Colonoscopists accreditation process from multi professional groups working within endoscopy services in Wales to provide collective qualitative data to inform future service development.

Overview of chapters

Chapter 2 provides a description of the processes used to select and review relevant literature. Focusing on empirical literature around the key areas of interest; quality and productivity of screening and non-screening colonoscopy and perceptions of the Screening Colonoscopist accreditation processes, it sets out the literature and concludes with what is and is not known about these topics in order to contextualise this study.

Chapter 3 outlines the research methodology used for this study and the merits of employing mixed methods. It begins by considering the research

questions and goes on to provide an overview of the epistemological and ontological position from which the study was approached. This chapter goes on to provide a detailed description of the methods used including data analysis and the plan for triangulation of results.

Chapters 4 and 5 present quantitative research findings. Chapter 4 explores individual colonoscopists key performance indicator (KPI) data and details statistical test results used to establish significance of variation. This chapter considers variation in quality between Screening and Non-Screening Colonoscopists KPI data. Chapter 5 outlines endoscopy unit KPI data relating to productivity and statistical tests used to determine variation between screening and non-screening colonoscopy services. Initial interpretation of findings is set out in these chapters and will be built upon in chapter 7.

Chapter 6 describes findings of the qualitative research phase of the study. Data from semi structured interviews are presented and perceptions of quality and productivity of screening and non-screening colonoscopy services explored. The chapter goes on to explore professional perceptions of the Screening Colonoscopist accreditation process which contributes to understanding the research questions. In line with the approach used in chapters 4 and 5, this chapter also outlines initial interpretation of findings for further exploration in chapter 7.

Chapter 7 details discussion around both quantitative and qualitative phases of the study and triangulates findings to answer the research questions. It builds on initial interpretation of findings set out in chapters 4,5 and 6, making links to the literature to understand how this study has addressed the research questions.

Chapter 8 provides an overall conclusion for the study and makes recommendations for further research and for policy makers.

2: Literature Review

Introduction

Following on from the rationale and background for this study set out in chapter 1, this chapter will provide a review of the literature relating to quality and productivity of screening and non-screening colonoscopy services and also to the acceptability of the Screening Colonoscopist assessment and accreditation process.

After setting out the review strategy and processes used, this chapter will consider the literature relating to the three main topics of interest: quality and productivity of screening and non-screening colonoscopy and acceptability of the Screening Colonoscopist accreditation process. It will conclude with what is known and unknown about these topics in order to contextualise the current study and make recommendations for further research.

Search strategy

Following an initial scoping exercise using Google Scholar, prominent textbooks and discussion with subject experts, this literature review carried out initially in 2017 was refreshed in 2020 and 2022. To ensure contemporaneous data the search dates were restricted to between 2008 and 2022 and limited to developed countries with English language publications.

A wide search strategy was adopted initially using the terms listed in table 2.1. to ensure all relevant studies were included. Electronic databases delivered relevant peer reviewed research publications which were filtered for review. Following discussion with Lead Colonoscopists, search terms relating to quality and productivity of colonoscopy were restricted to key performance indicators where data were readily available in Wales.

Table 2.1: Literature key search terms

Colonoscopy	Quality Assurance Key
Colonoscopist	performance indicators
Quality indicators	Productivity
Procedure numbers	Did not attend (DNA)
Adenoma detection rate	List utilisation
Polyp detection rate	Efficiency
Withdrawal time	Colorectal Cancer
Comfort score	Bowel screening
Sedation	Clinical competence
Completion rate	Competency Assessment
Caecal Intubation rate	Accreditation

The electronic literature search was undertaken in MEDLINE, CINAHL and Web of Science initially because of their widespread coverage of health care research. Terms were used in isolation and combination and searches were repeated in the journals GUT and Frontline Gastroenterology to minimise the risk of exclusion of relevant texts. Discussion with clinical experts identified additional publications and grey literature including conference abstracts and professional meeting papers.

Study selection

The search revealed 1,601 citations from the electronic databases and 160 publications through other sources such as references within research publications and in the grey literature. Having grouped papers initially according to date of publication, further stratification by quality of research

and applicability to the topic was undertaken. A methodical approach was taken to consider the year of publication, population, location, author, design, sample size and overall quality of the paper.

Having removed duplicates, 1,203 records were screened by title and abstract. Of these, 981 were not considered eligible for inclusion in this literature review, because, for example they related to a specific aspect of colonoscopy such as complex polypectomy rather than general quality and 222 full-text citations were retrieved for further evaluation. A tool for filtering the literature was developed as illustrated in table 2.2, based on a checklist for finding, appraising, and implementing evidence by Greenhalgh (2019). Key papers were checked with citation chain to ensure the most recent and relevant studies were included. Following critical appraisal of the publications 102 were included in the literature review.

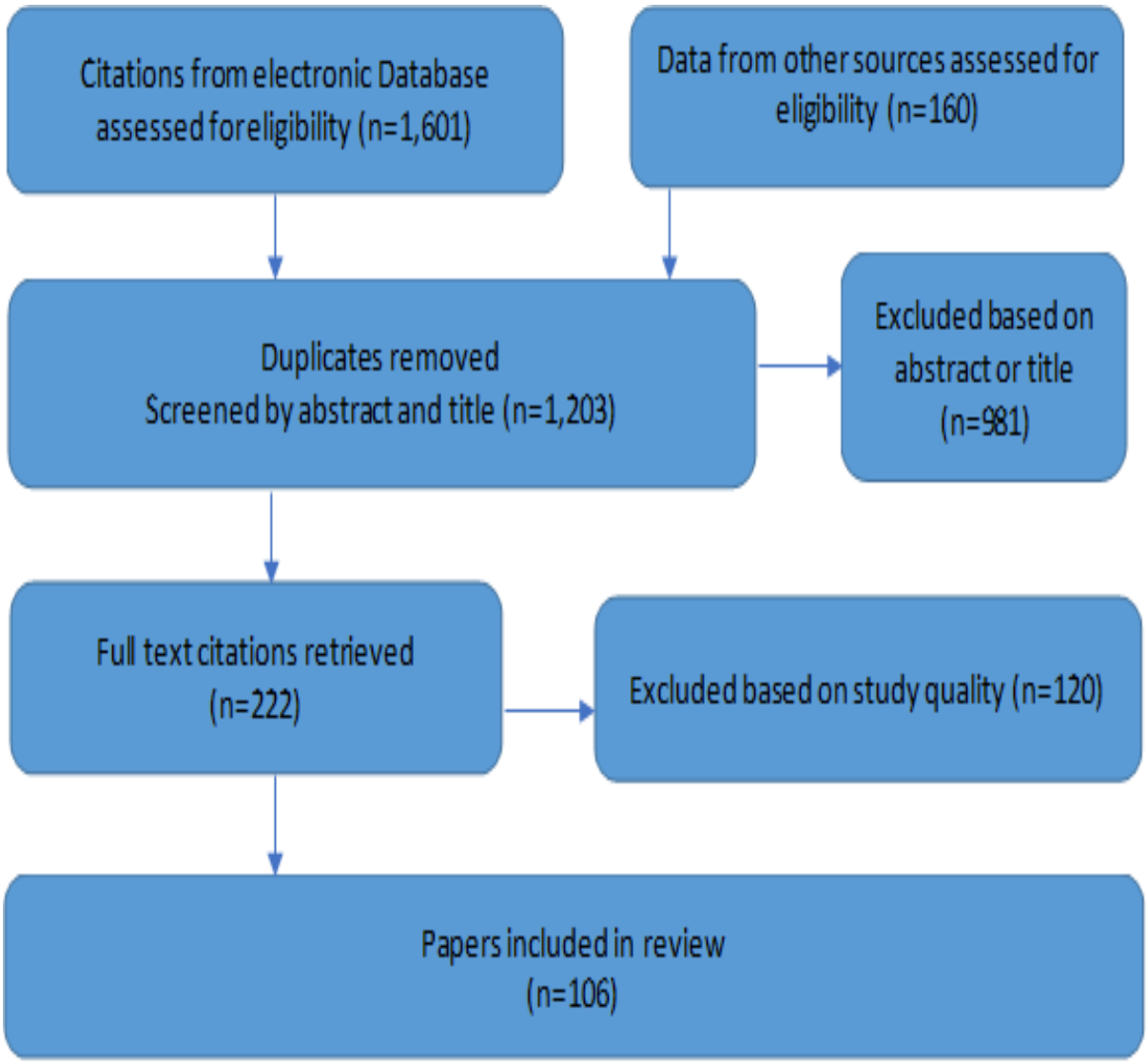
Most of the literature reviewed was quantitative in nature, although some qualitative studies were included. Most studies were conducted in the U.K., but some from other European countries and America were also included. Systematic reviews and meta-analyses were prioritised, but many cohort and case-controlled studies were included alongside randomised controlled studies where sample size was considered adequate. Included studies were not commercially funded and there was no evidence of publication bias.

Table 2.2: Review tool for filtering key literature

Criterion		Yes	No	Some	Notes
1	Is the study high level evidence?				
2	Is the subject matter relevant?				
3	Is the study primary research?				
4	Is it original research?				
5	Is the sample size appropriate?				
6	Is the study methodology appropriate for the research question?				
7	Is the study duration appropriate?				
8	Were recruitment methods appropriate?				
9	Were data collection methods appropriate?				
10	Were results interpreted appropriately?				

A robust approach was taken to searching and reviewing the literature to provide background evidence and to contextualise this study. The method used is outlined in figure 2.1

Figure 2.1. Diagram to illustrate literature search methodology



Articles were grouped according to the main area of interest and textbooks trawled for additional information. Although there was some overlap, the major topic areas of quality and productivity of colonoscopy and acceptability of the Screening Colonoscopy accreditation process were broadly well served as independent foci of research. Findings for each topic will be discussed along with literature on bowel cancer screening and emergent themes from the literature search.

Review findings

Since Dr Wolff developed the colonoscope in 1969 and realised its potential to diagnose and treat colorectal cancer there has been exponential increase in its use with over 700,000 colonoscopy procedures being undertaken in the UK each year (Ravindran et al. 2020) and around 72,000 of those in Wales per year (NEP 2021 unpublished data). With a goal of identifying and removing lesions or polyps before progression to cancer and diagnosing malignancy early when treatment is more effective, the drive for continuous improvement of colonoscopy has been strong.

Colonoscopy is used to diagnose and treat a variety of conditions, not only cancer, but the impact of an early diagnosis of bowel cancer is significant with 10% of patients surviving 5 years if their cancer is diagnosed at stage 4 compared to 90% if their cancer is diagnosed and treated at stage 1 (Ma et al. 2021; Alonso-Abreu et al. 2017; Castanon et al. 2022). Although equipment and supporting staff contribute to overall quality, effective colonoscopy relies largely on operator skill, and there is known to be considerable variation in the standard of colonoscopy performed across the UK and further afield (Mazurek et al. 2021; Robertson et al. 2015; and Burr et al. 2019).

Colonoscopy is an invasive procedure capable of causing harm, with potential complications including bowel perforation, bleeding, and adverse reactions to bowel cleansing medication. It is therefore vital that the procedure is performed to the best possible standard and patients are well prepared and informed of the risks.

Bowel cancer screening

Screening programmes are based on the balance of risk and benefit originally described by Wilson and Jungner (1968), so consistency of approach and

standardisation of quality are paramount in order for the screening test to be replicated at a population level (Dobrow et al. 2018). Screening patients are largely an asymptomatic population and are likely to approach the offer of colonoscopy from a different psychological perspective than patients with symptoms (Denters et al. 2015), emphasising the need for a consistently high-quality service.

A reduction in mortality associated with bowel cancer screening was demonstrated by randomised controlled trials two decades ago (Scholefield et al. 2002) and the National Screening Committee (UKNSC) recommended the use of biennial testing for bowel cancer by detecting blood in faeces in 2003. Bowel cancer screening was introduced in England between 2006 and 2009, in Scotland in 2007 and Wales in October 2008 with Northern Ireland following in 2012. The screening programmes aim to reduce mortality from bowel cancer in the group of people invited for screening by 15%. To do this they send their eligible population (currently men and women aged between 60 and 74 years of age in Wales) a faecal occult blood test kit to complete at home and return to the laboratory every 2 years. A newer, more sensitive test called the faecal immunochemical test (FIT) has more recently been introduced and operates in the same public facing way, although it is handled differently in the laboratory, being a largely automated test as opposed to the previous manually interpreted test.

Currently around 1.5% of people completing a test kit will have a positive result (BSW 2021) and will be offered further assessment with a Specialist Screening Practitioner and colonoscopy if considered fit enough for the procedure. Screening colonoscopy in Wales is only undertaken by accredited colonoscopists who satisfy certain quality markers as described below and

whose key performance indicators (KPIs) are regularly reviewed to ensure they perform to a consistently high standard. Similar KPIs for the non-screening colonoscopy service in the UK exist but appear to be monitored differently (JAG 2021).

Quality

Quality is defined as “the standard of how good something is when measured against similar things” or “general excellence”. (Oxford English Dictionary 2015). As mentioned previously, the British Society of Gastroenterology (BSG) states that colonoscopy should be delivered by endoscopists performing high quality procedures (Rees et al 2016). Although there is evidence to suggest the standard of colonoscopy in the UK has improved (Bowles et al. 2004; Gavin et al. 2013), variation remains, and “general excellence” does not appear to have been achieved. Increasing demand warrants strengthening the focus on quality assurance (Logan et al. 2012).

Quality within endoscopy services is multi-faceted. From the Colonoscopists’ perspective, it is about performing a complete procedure, identifying any existing pathology and removing polyps effectively. However, if the patient does not have a good experience i.e., if they found it too uncomfortable, painful, or embarrassing they will not come back again and that would affect the overall quality of service, especially for the screening programme that relies on uptake to balance the benefit versus harm of screening an asymptomatic population. Maintenance of high-quality standards in colonoscopy is essential to the success of national population-based screening programmes according to Rembacken (2012).

There is evidence to demonstrate the link between good quality colonoscopy, defined as that with high adenoma detection rates and careful inspection

measured by the time in which it takes to withdraw the scope (withdrawal time), disease identification and reduction in mortality (Kaminski 2010). Moreover, poor quality colonoscopy, defined in the same way is associated with complications and reduced effectiveness in disease prevention (Gavin et al 2012).

The quality of colonoscopy is largely operator dependant and key performance indicators (KPIs) have been defined by the JAG and BSG (JAG 2019 and 2021) for monitoring colonoscopists performance. With increasing levels of colonoscopy activity each year, there is pressure to ensure universal high-quality procedures are performed (Shine et al. 2020; Rees et al. 2016).

Data quality issues relating to key performance indicators are apparent from the literature. The European Colonoscopy Quality Investigation Group (Spada et al. 2021) described challenges with data quality and concluded this was an area in need of improvement. The National Endoscopy Database (NED) has been established to support and enable quality assurance in endoscopy across the UK (Lee et al. 2019) by standardising definitions, improving data quality and enabling comprehensive data collection, although not all units are currently uploading information including many in Wales.

Procedure numbers

There appears to be discrepancy in the literature as to the number of procedures colonoscopists need to undertake each year to develop and maintain competence. Horner (2011) concluded that endoscopists performing more than 100 colonoscopies per year achieve significantly better standards than those performing less, although Park (2013) found that trainees needed to achieve 275 procedures per year to achieve competency when measured by achieving 90% completion rates. Ward et al. (2014) suggested colonoscopists

need to complete more than 200 procedures per year to achieve competence and at least 100 per year to maintain it.

The JAG expects a minimum of 100 procedures to be undertaken per year and Bowel Screening Wales (BSW) require 150 procedures per year, at least 80 of which must be screening colonoscopies. These figures are supported by Neilson et al. (2021) who found that colonoscopists performing less than 100 procedures per year had significantly lower adenoma detection rates and recommended that the threshold of 100 procedures per year should be maintained as a minimum by all colonoscopists.

Other countries have similar standards, but, in Germany a minimum number of 200 procedures per year is required to maintain screening performance although Adler (2013) found there was no correlation between case volume and adenoma detection rate. Even so, strict compliance is enforced with careful monitoring of the central German performance register and non-specialists performing less than 200 procedures per year are reportedly prevented from undertaking colonoscopy.

Completion rates

Examination of the entire colon by colonoscopy is the gold standard investigation for colorectal cancer enabling direct assessment of the entire colonic mucosa (bowel lining), although visualization is rarely 100% (Bevan et al. 2018). Complete examination of the colon is essential to detect abnormalities (Brenner 2012) and completion rate is considered to be the key quality indicator to assess competence in colonoscopy (Ekkelenkamp et al. 2001), it was also considered the most frequently used quality indicator by Rex et al (2006). There were higher rates of missed cancers recorded when

procedures had been performed by colonoscopists with low completion rates (Baxter 2011) and when procedures were incomplete (Morris et al. 2012).

The JAG minimum standard for completion rate is 90% with an aspirational target of 95% and the standard expected of a Screening Colonoscopist in Wales without adjustment for occluding pathology is 90% (BSW 2020). Large studies have shown this to be achievable (Lee et al. 2012), although there appears to be considerable variation in rates as described by Shah (2007) and others. The U.K. national colonoscopy audit in 1999 described completion rates for colonoscopy, otherwise known as caecal intubation rates, as unacceptably low at 65.9% (Verma 2012). Despite recent improvement variation is persistent according to Neilson et al. (2020).

Accredited bowel Screening Colonoscopists have been shown to perform better with completion rates in excess of 97% compared to an average of 88% for Non-Screening Colonoscopists in England (Ahmed 2016) suggesting a significant performance gap when comparing Screening Colonoscopists to Non-Screening Colonoscopists. However, Patel et al. (2013) also described variation, within the Screening Colonoscopist group who have completed a structured accreditation process.

Ahmed et al. (2015) reported increased completion rates in screening patients compared to those referred to the symptomatic service but attributed this to patient factors rather than the colonoscopist. The difference between screening and symptomatic patients is complex with the potential for other factors to influence quality such as bowel preparation and pre assessment. Nagrath et al. (2011) reported colonoscopy completion rates of 90% or higher for all Screening Colonoscopists undertaking bowel-screening procedures. However, five of the Colonoscopists studied performed both screening and

non-screening colonoscopy and two of them had reduced completion rates when performing non-screening procedures, but not for screening patients. Case mix was similar, which supports Zorzi's (2015) conclusion that many factors can influence quality of colonoscopy including patient, centre and endoscopist characteristics.

There appears to be a link between procedure numbers and completion rate according to Harewood (2005) with colonoscopists performing more than one hundred procedures per annum achieving a caecal intubation rate of 91.76%. This was reduced for colonoscopists performing less than one hundred procedures and variation between disciplines was observed with Gastroenterologists performing better than surgeons. Patel (2016) agreed and found a significant correlation between increased activity in the previous year and higher completion rates, although noted that there did not appear to be a link between higher completion rates and increased adenoma detection rate.

There appears to be discrepancy in the literature to link higher completion rates with adenoma detection rates (Lee et al. 2012).

Adenoma and polyp detection rates

The vast majority of colorectal cancers arise from premalignant polyps known as adenomas. The process of an adenoma mutating into a carcinoma (cancer) called the adenocarcinoma sequence takes many years (Fearon et al. 1990). Adenomas are common, occurring in a quarter to a half of all people aged between 60 and 74 years (Hassan et al. 2010), although only about 5% of the population will develop colorectal cancer during their lifetime. It appears that most colorectal cancers start life as a polyp, but not all polyps become a colorectal cancer. Colorectal cancer is a condition that lends itself to screening, as there are benefits in terms of improved outcomes by detecting the

condition at an early stage when treatment is likely to be more effective and identifying and removing adenomas and preventing malignant transformation.

Although adenoma detection rate (ADR) is considered to be one of the markers most commonly associated with high quality in colonoscopy (Rees et al. 2016), it involves correlating colonoscopy findings and pathology results to determine if polyps removed were indeed adenomas. Many health boards and endoscopy units are not able to access pathology results systematically for this purpose, making determination of ADR impossible (Zorron et al. 2020).

Polyp detection rate (PDR) is considered to be an acceptable surrogate marker if it can be shown to accurately reflect ADR according to Rajasekhar et al. (2012), although some feel there should be distinct targets for both ADR and PDR depending on the indication for colonoscopy (Boroff et al. 2017). Whilst Sandy et al (2020) agreed with others that PDR can be used as a surrogate measure for ADR, Neilson et al. (2021) suggest age should be considered alongside it to increase the accuracy of this prediction.

Robertson et al. (2015), stated that based upon current evidence, ADR is likely to be the single most important procedural quality metric, and services should develop mechanisms to reliably measure it. However, given the correlation between PDR and ADR, PDR can be used until systems are in place to reliably measure ADR (Williams et al. 2011).

For the purposes of this study PDR was considered the best available data to give an understanding of variation in detection of polyps between cohorts.

Long-term effects of polypectomy in terms of reduced mortality from colorectal cancer have been described (Zauber et al. 2012). Colonoscopists with higher adenoma detection rates have lower rates of interval cancer (Patel

2016) defined as colorectal cancer diagnosed within 60 months of a negative colonoscopy (Lee et al. 2017). Adenomas are detected, removed by polypectomy and retrieved at colonoscopy. Endoscopic polypectomy is effective in reducing colorectal cancer incidence and mortality (Zauber et al. 2012). Seghal (2017) agreed with other studies in that adenoma detection rate is a key quality indicator of colonoscopy with the strongest association to post-colonoscopy colorectal cancer or interval cancer. They went on to describe the likelihood of lower adenoma detection rates for Non-Screening Colonoscopists. Adler et al. (2013) found there was variation in polyp detection rates amongst Screening Colonoscopists, although average rates were higher than the average for Non-Screening Colonoscopists.

Some patients who have premalignant polyps detected at colonoscopy are more likely to develop further polyps or colorectal cancer (East et al. 2017) and surveillance colonoscopy is advisable. Surveillance aims to detect and resect metachronous premalignant polyps and to detect lesions not identified on the initial examination, thereby preventing cancer and reducing colorectal cancer mortality. Anderson et al. (2012) found statistically significant higher adenoma detection rates for surveillance colonoscopy compared to initial colonoscopy.

There is clear evidence that patients of higher adenoma detecting colonoscopists have lower post-colonoscopy colorectal cancer incidence and mortality rates (Corley et al. 2014). Low polyp detecting colonoscopists expose their patients to risk by not only leaving lesions in situ, but also by underestimating the need for surveillance as management is dependent on the number and size of adenomas removed (Mangus-Sanjuan et al. 2018).

High adenoma detection rates can only be achieved by a slow, meticulous inspection technique. Hilsden et al. (2015) concluded that along with adenoma

detection rate, average withdrawal time should be prioritised in quality assurance programmes.

Withdrawal times

Most mucosal inspection takes place during withdrawal of the colonoscope from the caecum (end of the bowel) to the rectum and there appears to be an association between polyp detection rate and colonoscopy withdrawal time (Overholt et al. 2010).

Colonoscopy withdrawal times greater than 6 minutes have been shown to increase adenoma detection rates, and it is therefore also assumed polyp detection rates (Lee et al. 2013), although improvement appears to be capped at 10 minutes, beyond which no additional pathology is identified (Lee 2011). There is however some discrepancy in the literature and El-Feki et al. (2016) did not find a significant effect of increased withdrawal time on ADR. Adler (2013) was not able to confirm correlation between increased withdrawal time and adenoma detection rate either, but many studies have including Barclay (2008) and Lee et al. (2011) who also found that increased colonoscopy withdrawal time may be associated with better technique.

Chawdhary and Muller (2018) stated that even the most experienced colonoscopists would miss adenomas if their withdrawal times were less than 6 minutes, after describing results of their study where 21% of the 138 colonoscopists included were found to have withdrawal times less than 6 minutes.

Two large studies have suggested that a minimum withdrawal time of 6 minutes in diagnostic colonoscopies is necessary to achieve adequate adenoma detection rates (Barclay et al. 2006; Simmons et al. 2006), with a threefold difference depending on the duration of withdrawal. These studies

also demonstrated that colonoscopists with withdrawal times of greater than 6 minutes not only had higher rates of adenoma detection, but they also detected more cancer and advanced lesions with increased risk of malignant transformation.

In the English Bowel Cancer Screening Programme (BCSP), longer mean withdrawal times were associated with better adenoma detection rates (Lee et al. 2013), although other influential factors were considered such as aspiration of liquid, careful examination behind folds (Rex 2000), position change, (Hewett et al. 2010), or advanced technology such as high-resolution scopes (East et al. 2008; DeMarco et al. 2010).

Comfort score

Colonoscopy should not be a painful experience. Comfort during colonoscopy is associated with greater patient satisfaction, acceptability, and improved compliance with repeat procedures according to Nicholas et al. (2012) and Ko et al. (2009). Ekkelenkamp et al. (2011) considered patient comfort to be a measure of colonoscopists' technique, although Mahmood (2018) suggests reasons for discomfort are multifaceted and include bowel preparation and patient factors such as visceral sensitivity or anxiety as well as operator technique.

As the colonoscopist becomes more experienced and skills improve, the comfort score in general is expected to improve and the JAG expect 90% of patients to experience little or no discomfort.

The National Colonoscopy Audit undertaken in 2011 (Gavin et al. 2013) found that 10% of patients experienced moderate or severe discomfort, but also recognised that measuring comfort is difficult with different scales being used and different interpretation. Mairead et al. (2017) agreed that comfort scores

of 4 or 5 (as a mark out of 5 when 0 is no discomfort and 5 is extreme discomfort) in fewer than 10% of patients should be achievable and suggested that units need a validated tool which enables scoring of patient's discomfort with the aim of less than 10% of patients experiencing moderate or severe discomfort (Rees et al. 2016).

The JAG expects comfort scores to be triangulated with nurses, patients and colonoscopist, although there appears to be practical difficulties in achieving this in some areas and many units rely on nurse reported comfort scores only. Whilst Rostom et al. (2013) supports the use of a nurse assessed patient comfort score as part of ongoing quality monitoring programmes, Rafferty et al. (2014) found that endoscopy nurses gave higher comfort scores (indicating more discomfort) than patients and endoscopists.

It is, however, clear from the literature that patient comfort is an indicator of procedure quality, but it must be interpreted in light of the type and amount of sedation used (Ekkelenkamp et al. 2011).

Sedation use

It appears that some studies found comfort scores were not affected by the use of sedation (Birdi 2015), while others found sedation use not only reduced patient discomfort but also improved the overall quality of colonoscopy (Baudet et al. 2019). The impact of sedation use on quality was supported by Zhao et al. (2020) who described increased completion rates with sedation use and Khan et al. (2020) who go further to suggest that sedation use is necessary to achieve current quality standards.

However, as well as the potential side effects from the drug Midazolam, which include life threatening breathing problems (Medline plus 2022) sedation has been associated with adverse events at colonoscopy. Zhao et al. (2020) linked

sedation use with increased risk of bowel perforation, as colonoscopists push harder to get through.

Although sedation related complications are relatively rare (Behrens et al. 2019), the British Society of Gastroenterology (BSG) guidelines (2003) suggest a maximum dose of 5mgs of Midazolam for colonoscopies performed under conscious sedation and with lower doses for the elderly. The JAG standards agree and state that no more than 2mgs of Midazolam should be given to patients aged 70 years and over.

Whilst the rate of unsedated procedures is not strictly considered by JAG to be a KPI, performing colonoscopy without sedation is considered by some to be safer (Takahashi et al. 2005), and the JAG suggest collecting this information to assist with interpretation of other results, for example if a colonoscopist is an outlier for comfort score results. It is however a KPI for Screening Colonoscopists with a standard of more than 15% of cases to be undertaken without sedation expected.

Quality assurance

Quality assurance (QA) is defined as the maintenance of a desired level of quality in a service or product (Oxford English Dictionary 2015). One of the QA pioneers, Henry Ford emphasised standardisation (Wood 2003) as the key to effective QA, with regular inspection to ensure faulty operations do not proceed for any length of time. A similar approach is taken in health care with measured performance allowing assessment of clinical practice. Porter and Lee (2013) stated that improvement in any field requires measuring results and wherever we see systematic measurement of results in health care we see improvement. However, others (Chinitz and Rodwin 2014) consider that

improvement has much more to do with organizational culture and how it makes use of metrics than with the quality measurements per se.

Muller (2018) considered metrics to be effective when they were embedded in a larger system, when measurement was undertaken by multi professional teams and when the measures were in keeping with professionals' sense of mission. Describing a successful quality improvement project Muller (2018) went on to explain it was effective because it was led by clinicians, enabled by real time data-based feedback and primarily focused on improving patient care which fundamentally motivated clinicians to change behaviours.

The quality metrics set by the JAG and the bowel screening programmes, are focused on improving outcomes for patients and form the basis of quality assurance within colonoscopy services across the UK. Although KPI's are broadly the same between the two services, anecdotal evidence from professional conversation suggests there is a significant difference in the way in which they are monitored, with quality assurance and performance management frameworks being more robust within the screening programme. The aim of quality assurance processes within both colonoscopy services is to provide data-based clinical feedback to drive improvement, as described by Muller (2018). Although it has been argued that the indictors that JAG requires serve to monitor technical performance rather than outcomes and do not assess the impact colonoscopy has on reduction in mortality from bowel cancer (Richter 2013).

Post colonoscopy colorectal cancer (PCCRC)

The World Endoscopy Organization (WEO) developed consensus statements on post-colonoscopy colorectal cancer (PCCRC) or interval cancer to standardise methods of analysis. It proposed an approach to investigating PCCRC detected

within four years of a negative colonoscopy. PCCRC suggests that a cancer or premalignant polyp may have been missed at colonoscopy (Anderson et al. 2020). The post colonoscopy colorectal cancer rate is an important indicator of the quality of colonoscopy, and it has been demonstrated that endoscopists with higher adenoma detection rates have lower post colonoscopy colorectal cancer rates (Kaminski et al. 2010; Corley et al. 2014; Robertson 2015).

Singh (2010) found that one in thirteen colorectal cancers may have arisen from a missed lesion, diagnosed after colonoscopy, with women more likely to have a cancer missed at colonoscopy than men, although it is unclear whether this is because of procedural difficulty, bowel preparation issues, or different tumour biology between men and women.

A nation-wide study in England demonstrated that post colonoscopy cancer, or interval cancer occurred at a rate of 8.6% (Morris et al. 2015), while the overall English bowel cancer screening Colonoscopists post colonoscopy colorectal cancer rate between 2006 and 2010 was 3.1%, less than half of the 7.3% seen in the symptomatic service reported by Derbyshire (2018). In 2019, Burr et al. concluded that there was wide variation in the rate of post colonoscopy colorectal cancer across the NHS in England and the lowest rates were seen in bowel cancer screeners.

In Canada, Inadomi (2010) undertook retrospective analysis of cancer registry data to discover that 7.9% of all bowel cancers had a colonoscopy performed between 6 and 36 months before the diagnosis, likely representing cancers that were missed at the primary colonoscopy. This supports the view that the cause of post colonoscopy colorectal cancer is a deficit in colonoscopy quality rather than accelerated tumour biology. Inadomi (2010) went on to describe the professional background of the colonoscopist as a significant predictor of

missed cancers despite adjustment for procedural volume. Even Non-Gastroenterologists who perform a high volume of procedures missed more cancers than Gastroenterologists did.

Anderson et al. (2020) appears to support the view that post colonoscopy colorectal cancer is related to colonoscopist skill as they concluded that 89% of them could be avoided with better surveillance colonoscopy. Although PCCRC is an important determinant of a quality colonoscopy service, data on PCCRC rates is not currently routinely collected in Wales and was therefore not included in this study.

Productivity-optimisation of current resource

Shenbagaraj et al. (2019) described increased pressures in endoscopy services across the UK following the JAG national audit in 2017 which focused on the impact of national U.K. targets on endoscopy units. Many services, including 42% of Welsh units, reported difficulty meeting national waiting time targets and were said to be “just about coping”.

The JAG repeated the census in 2019 which demonstrated a clear trend of increasing activity and even fewer services achieving waiting time targets than in the 2017 audit (Ravindran et al. (2021). Both audits took place before the Covid 19 pandemic which has significantly exacerbated the difficulties with long waiting times. On top of historical backlogs of patients waiting for procedures, there is now a Covid backlog.

The current demand for colonoscopy has resulted in efforts to try to increase the productivity of endoscopy units, to ensure optimisation of current resource. This includes demand and capacity planning, extended hours and longer shift patterns and general optimisation of current services. The JAG

recommends collecting data on productivity measures which is used to drive improvements and as minimum units are expected to monitor:

- The rate of unattended appointments including “did not attend” (DNA’s) and cancellations
- The overall utilisation of lists to include the number of fully booked lists and the rate of reinstated (backfilled) lists following cancellation
- Booked procedures versus achieved
- Start and finish times
- Room turnaround around times (interval between patients)

This data is poorly collected and much of it currently relies on snapshot audit. Data quality is paramount for any management decision and poor data quality can lead to poor patient outcomes as described by Ehsani-Moghaddam et al. (2019).

Data Quality

Quality of colonoscopy is known to vary as previously discussed. Initiatives to improve colonoscopy are based on data from local and national audit. The National Endoscopy Database (NED) has been established to automatically gather local data on endoscopy procedures which can be used for quality assurance, service intelligence and research on a national level (Lee et al. 2019). However, not all Welsh Health Boards are able to upload information to the NED yet. Until they can local systems should be in place to capture individual colonoscopist key performance indicator data and unit productivity measures.

Lund et al. (2019) found data quality to be high when studying colonoscopy performance indicators in Denmark, but that does not appear to be the case elsewhere. Lee et al. (2004) highlighted data quality issues on the bowel screening programme in England and it was also cited as a concern for some areas of the Scottish bowel screening programme by Quyn et al. (2018), although generally data collection was considered to be satisfactory in Scotland.

Did not attend appointments (DNA)

Last minute cancellations usually go unfilled and hinder the flow and productivity of a unit (Cardoso et al. 2019). The JAG expects to see the rate of DNAs for endoscopy units at less than 10%, but in 2017, Shenbagaraj et al. (2019) found that DNA rates greater than 10% were found in 16% of Welsh units. They also found a significant difference between DNA rates for the screening colonoscopy service and the non-screening service across the UK with the screening service having a much lower DNA rate.

Not attending colonoscopy is associated with a range of adverse health outcomes, including increased risk of advanced stage bowel cancer and death (Beshara et al. 2020; Corley et al. 2017; Lee et al. 2017) but there are many reasons people fail to attend colonoscopy appointments including social circumstances, education, and practicalities (Plumb et al. 2016). Kerrison, Travis et al. (2020) identified a range of psychological and social barriers to colonoscopy including sociocultural, practical, psychological, health-related, and COVID-related while Robison et al. (2019) identified how social relationships are likely to motivate individual health care decisions and the importance of social capital.

Denberg et al. (2005) found a significant number of patients failed to attend because of scheduling problems, but suggested improvements could be made with better communication with patients and improved management of booking and scheduling. However, a more recent review, attempted to synthesise the barriers and facilitators towards colonoscopy across multiple indications, including screening and non-screening services (Lim et al. 2021), and also identified gaps in healthcare systems which could be addressed to improve attendance rates for colonoscopy as previously raised by Denberg (2005).

Lim et al. (2021) concluded that alongside logistical and management concerns, there had been a shift in the last decade from patients' dependence on detailed information about procedures and a physician's emotional support towards concern over dignity preservation. Previous attempts to encourage participation in colonoscopy which relied on delivering information about the benefits in terms of early cancer detection seem less likely to be effective now according to Lim et al. (2021) as this information is readily available on social media.

Previous studies (Shenbagaraj et al. 2019) concluded that DNA rates are improved within the screening service and cite better preparation as the reason. Specialist Screening Practitioners (SSPs) undertake a thorough pre assessment with patients, so they know what to expect at the colonoscopy and how to take bowel cleansing medication. They have also built up a relationship with SSP's which supports their attendance at colonoscopy. Seoane et al. (2020) demonstrated through a randomised controlled trial, that telephone contact and a nurse administered educational intervention improved colonoscopy attendance in the non-screening colonoscopy setting.

Bidirectional communication was found to be the crucial point in reducing the non-attendance rate and an endoscopy nurse was considered the best person to conduct the educational intervention and to eliminate barriers that negatively influence the patient's attendance. Other interventions to improve DNA rates have proved successful, although there is room for further improvement. Stratmann et al. (2018) found that sending a personalised invitation letter to patients to follow up an invitation to colonoscopy also improved attendance and others have found text reminders support attendance (Baker 2015).

Scheduling errors can result in colonoscopy appointments being cancelled on the day. Partin et al. (2016) suggested that systems should be developed to enable self-scheduling for patients. He also suggested that systems need to be capable of identifying patients with significant pre-existing conditions who may not be suitable for colonoscopy and those with limited life expectancy. There appear to be many reasons why colonoscopy appointments are lost or cancelled on the day including poor bowel preparation, failure to stop contraindicated medications, and overbooking. Many of these issues could also be addressed with more robust pre assessment as demonstrated by Seoane et al. (2020).

List utilisation

Bryce et al. (2019) found that in their unit, on average 28.5 patients per month had procedures cancelled on the day due to poor bowel prep or inadequate fasting. This was reduced to 23.5 procedures following the introduction of nurse led pre-assessment. They went on to state that multiple small improvements in efficiency can achieve better utilisation of lists and have a significant impact on productivity. This was supported by Arora et al. (2021)

who improved list efficiency by implementing a four staged improvement plan comprising of nurse led consent, an in room briefing tool, addressing communication issues, and reviewing workforce rotas.

There appears to be a paucity in the literature to demonstrate the effect of measuring list utilisation rates, although there is evidence to suggest that multiple small improvements such as improving room turnaround times between patients are necessary to improve overall list efficiency (Day et al. 2015; Gladys-Oryhon et al. 2019).

Repeat colonoscopy

Whilst it may appear that the symptomatic service is more productive by putting additional patients on a list, anecdotal evidence from professional conversations suggests that there are fewer repeat procedures on the screening programme compared to the symptomatic service. Bhatti et al. (2021) found that 7.5% of colonoscopy procedures needed to be repeated. Whilst the majority of these were for further management of polyps a significant proportion (3%) were for poor bowel preparation and because patients had not stopped anti coagulation medication (2%). They concluded that whilst most of the repeat procedures for polypectomy were appropriate, many that were due to poor preparation were completely preventable.

Some would argue that repeat procedures for management of polypectomy are not always appropriate or necessary and may be associated with colonoscopist skill or time allowed for procedures. Ravindran et al. (2021) found that procedures undertaken by private insource companies[1] had lower

1 Health boards employ private insource companies to undertake colonoscopy lists to support waiting list reduction

sedation rates, but also lower adenoma detection and polyp detection rates. They also brought more patients back for repeat procedures.

Screening Colonoscopists assessment and accreditation

Prior to implementation of the screening programme in Wales in 2008, Colonoscopists, who had expressed an interest in undertaking screening procedures, were assessed according to the standard that had been agreed nationally and implemented by the English Bowel Cancer Screening Programme (BCSP 2007). Only 25% of applicants passed the assessment first time and although most went on to undertake training and passed on their second attempt, some failed three times and gave up. All colonoscopists were senior consultants undertaking colonoscopy for the non-screening service and continued to do so.

Screening Colonoscopists in the English NHS Bowel Cancer Screening Programme (BCSP) are predominantly surgeons, physicians or nurse endoscopists, although in Wales only surgeons and physicians undertake screening procedures. All are required to attain the same quality standards prior to commencing colonoscopy in the programme and undergo the same performance audits.

Lim et al. (2011) found that accredited bowel cancer screeners continue to perform at a consistently high standard, above the national target over time. The high standard expected of a bowel cancer screener prior to joining the programme may explain the consistent performance shown. These studies appear to support the accreditation process for screening Colonoscopists by demonstrating that all accredited colonoscopists perform to a consistent high standard irrespective of speciality.

Lee (2012) describes the English NHS Bowel Cancer Screening Programme (BCSP) as a service providing high quality colonoscopy as demonstrated by high completion rate (otherwise known as caecal intubation rate), adenoma detection rate, comfort scores and low adverse event rates. This quality is achieved by ensuring that BCSP colonoscopists are trained to a high standard and that these standards are maintained through ongoing quality assurance measures. While accreditation is mandatory for colonoscopists to undertake bowel cancer screening, this is not the case for non-screening colonoscopy and significant variation in clinical practice exists (Horner et al. 2011).

Whilst it is widely recognised that uniform quality standards lead to reduced risk and improved outcomes for patients. Kelly (2010) argues that it was not clear if the addition of a "driving test" was necessary to select Screening Colonoscopists. The assessment and accreditation processes are in place in most developed countries, but not all; for example, Scotland operate a different approach where colonoscopists are not dedicated to screening or non-screening procedures and referrals are made from the screening programme into secondary care and managed in the same ways as primary care referrals.

Although the assessment and accreditation processes have not been adopted by the Scottish bowel cancer-screening programme, colonoscopy quality is monitored. Results suggest slightly lower quality compared to England and Wales for some indicators such as polyp detection and cancer detection rates, although other indicators were comparable, and all were above the threshold set as minimum standards (Quyn et al. 2018).

As the bowel cancer-screening programme plans to expand in order to optimise public health benefit, additional Screening Colonoscopists will be

needed. There is some concern that screening may not be attractive to colonoscopists. An informal survey of gastroenterology trainees in the U.K. revealed only 4/52 had an interest in becoming accredited Screening Colonoscopists (Watson et al. 2011). In 2010, the British Society of Gastroenterology (BSG) assessed the gastroenterology workforce using a comprehensive online survey. With a response rate of 36%, 61.4% (156/254) said there was a moderate or large amount of exposure to the bowel cancer-screening programme in their region and just over 10% (27/254) had no exposure to the bowel cancer-screening programme. Over half (142/256) were aware of the application and assessment criteria to become Screening Colonoscopists and 64% expressed a moderate or high level of interest in becoming a Screening Colonoscopist. Trainees were asked what deterred them from becoming Screening Colonoscopists and the most common reason was time pressures (53.8%). However, some commented that the 'lack of training in advanced techniques' was also a concern (41.7%).

There appears to be limited qualitative data in the literature to explore perceptions of the Screening Colonoscopist assessment process, although the UK has one of the most rigorous accreditation processes in place for Screening Colonoscopists (Kelly 2010).

Conclusion

There is considerable evidence to link the quality of colonoscopy with improved patient outcomes and early detection of disease. The quality of colonoscopy is largely operator dependant and although there has been consistent improvement, there is evidence to suggest significant variation in key performance indicator values between colonoscopists.

The literature suggests the screening colonoscopy service employs more robust quality assurance and performance management processes. It is uncertain if this leads directly to improved quality or productivity, but there is evidence to suggest feeding back quality metrics supports service improvement.

Although collection of productivity metrics is recommended by the JAG the main body of literature relating to productivity of colonoscopy relates to nonattendance at colonoscopy (DNA). There appears to be a significant difference in the rate of patients failing to attend screening colonoscopy compared to non-screening colonoscopy.

There is some evidence to support the view that there is a difference in quality and productivity between the screening and non-screening colonoscopy services, although this evidence is not specific to Wales. It is not clear from the literature if the Screening Colonoscopist assessment process contributes to variation in quality and there appears to have been little research into professional views of the accreditation process.

This study will contribute to the body of evidence by providing quantitative and qualitative data on quality and productivity of colonoscopy services in Wales and perceptions of the accreditation process for Screening Colonoscopists. It will go on to make recommendations for further research and for policy makers which could potentially lead to tangible improvements for patients and professionals involved with colonoscopy services in Wales.

3: Methodology

Introduction

This chapter sets out the research methodology used for this study to understand variation in quality and productivity of screening and non-screening colonoscopy services and to explore professional perspectives of both services and the Screening Colonoscopists accreditation process.

It begins with the research questions, followed by an overview of the epistemological and ontological position from which the study was approached, then goes on to provide a detailed description of the methods used. After outlining analytical and ethical considerations including data analysis, triangulation and consent it will summarise the study methodology.

The study applied a mixed methods approach to answer the following research questions:

- Is there a difference in quality between screening and non-screening colonoscopy services in Wales?
- Is there a perceived difference in quality between screening and non-screening colonoscopy services in Wales?
- Is there a difference in productivity between the screening and non-screening colonoscopy services in Wales?
- Is there a perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
- How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

Methodological approach

The mixed methods and critical realist paradigm used for this study allowed for exploration of professional perspectives and analysis of quantitative data which were triangulated to inform recommendations for policy makers and further research.

Social science research has utilised mixed methods since its early days with examples as far back as 1845 when Frederick Engels studied the condition of the working class in England (Engels 1845), however a systematic methodological debate began in the 1970's. Through the 70's and 80's some continued to question if qualitative and quantitative paradigms could be combined, seeing mixed methods research as a third methodological paradigm, with questionable epistemological foundations (Teddlie and Tashakkori 2003; Johnson et al. 2017). Quantitative researchers taking a purist stance came from a positivist paradigm, believing that social research should be objective, making time and context free generalisations (Johnson and Onwuegbuzie 2004). Opposing views of the qualitative purists, favouring an interpretivist paradigm, suggested that time and context free generalisations were not possible, and social construction of the world needed to be understood (McEvoy and Richards 2006).

Mixed methods thinking, as described by Greene (2007) who saw it as "multiple ways of seeing and hearing", is visible in everyday life. Many television news broadcasts contain numerical information supported by narrative of people's experience. Whilst mixed methods thinking is interesting in day-to-day life, mixed methods research provides multiple ways of addressing a research problem as described by Creswell and Plano Clark (2017), who saw it as an accessible approach to enquiry. This is supported by

Johnson and Onwuegbuzie (2004) who present pragmatism is an attractive philosophical partner for mixed methods and state that the methodological pluralism of mixed methods research often results in superior research.

Although some say the "paradigm wars" are ongoing, (Howe 1988; Johnson and Onwuegbuzie 2004; Melosik 2021) there appears to be a more recent expansion of mixed methods research and growing rates of publications (Timans 2019). Although mixed methods, and particularly qualitative research, remains underrepresented in clinical journals according to Greenhalgh (2016).

It appears that methods used for medical studies have tended to reinforce traditional dichotomies between qualitative and quantitative methods, affirming conventional and linear approaches to research (Teddlie and Tashakkori 2009; Rycroft-Malone 2018). In contrast, this study used mixed methods and the ontological and epistemological principles of critical realism to implement a more responsive and dynamic mode of enquiry.

By adopting a view of reality as an open and complex system where other mechanisms and conditions exist and preserving a link between theory and method (Danermark et al. 2002) enquiry into quality, productivity and acceptability of screening and non-screening colonoscopy has been possible. This method proved to be an effective and flexible way of building knowledge and enhancing understanding.

Epistemological perspective

Analysis was undertaken from a critical realist perspective based on the work of Bhaskar (2008) and Sayer (2000). Baskar believed that, while reality was objective, empirical observation alone would not enable understanding of the social world. Generative mechanisms including the physical, biological, psychological, and social were considered to work together or against each

other to create the reality. Sayer (2000) argues that it is the fallibility of our knowledge that justifies the view that the world exists regardless of what we think of it.

A critical realist approach was particularly attractive for this study as it is primarily practice based research encompassing aspects of natural science and social science. Similar approaches have been described by Mingers (2004) and Venkatesh et al (2013) who highlighted the value of critical realism as an underlying framework for mixed methods studies. This research has been undertaken for practical reasons: to understand if the screening colonoscopy service in Wales is associated with improved quality and productivity compared to the non-screening colonoscopy service, and to explore professionals' perspectives of the Screening Colonoscopists accreditation process to determine if it deters colonoscopists from applying to become screeners. Findings will inform recommendations to policy makers and further research. It is recognised that many generative mechanisms, such as experience at colonoscopy and understanding of the screening colonoscopy service model are likely to have contributed to the conclusions of this study. The mechanisms underlying professional perspectives of colonoscopy services are complex and single method empirical study alone was considered to be limited. Danermark et al (2002) discussed the implications of a critical realist epistemology for social science research and highlighted how different methods convey knowledge about generative mechanisms. Since previous research into screening and non-screening colonoscopy has frequently relied on quantitative designs an alternative approach was considered appropriate to add to the body of understanding.

Furthermore, both traditional quantitive and qualitative research and the mixed methods approach used for this study share commonality in that both rely on empirical observation and measures to ensure validity (Johnson and Onwuegbuzie 2004). This was considered to facilitate effective combination of methods and the pluralistic approach taken was a pragmatic decision based on what was considered to be the optimal method to answer these particular research questions, an approach described by Johnson and Onwuegbuzie (2004). McEvoy and Richards (2006) concur that methods can be mixed when a common epistemological and ontological standpoint such as critical realism exists.

Ontological perspective

The philosophical position of critical realism offers an alternative to established paradigms of positivism and interpretivism (McEvoy and Richards 2003) it appears to be situated midway between the two, giving rise to a more nuanced version of realist ontology (Mingers 2001). Incorporating both epistemology and ontology, critical realism acknowledges that the world is real, and that knowledge production is fallible and theory dependant, but not theory determined (Fryer 2020). Fryer (2020) states that critical realism is the best theory of ontology and epistemology, not least because it reaches its conclusion through powerful retroductive reasoning. He goes on to say that the two main conclusions of critical realism are that the research should look for causal tendencies and that social science must consider agent and structure.

A three-level ontological stratification is said to exist within critical realism (Bhaskar 1978) which includes the real – an open system where all possible mechanisms reside – the actual – for what actually occurs – and the empirical,

consisting of knowledge that can be acquired through observation. Described by Mingers (2004) as overlapping domains of real, actual, and empirical, these causal mechanisms cannot be observed, but they can be inferred through a combination of empirical investigation and theory.

Critical realists are not interested in generalisable law, or merely to identify lived experiences of social actors, they seek to develop deeper understanding and levels of explanation (McEvoy and Richards 2006). Although critical realists argue that the choice of research methods should be dictated by the research questions, Olsen (2002) suggested that the most efficient approach in many cases will be a combination of qualitative and quantitative methods. Given the apparent gap in the literature of qualitative and mixed methods research relating to the area of interest for this study and the complexity of considering professional perspectives of the Screening Colonoscopists accreditation process, a mixed methods research study was chosen to explore the research questions set out at the beginning of this thesis.

Methods

To answer the research questions for this study, multiple data sources were required to produce a complete picture as described by Gilham (2000). A mixed methods design was chosen as previously described to enable collection and interpretation of relevant data. Although Bryman (2006) recognised that mixed methods research studies must transcend the limitations of both quantitative and qualitative methodologies, it was considered the most appropriate method to use for this study as the flexibility of design enabled follow up of emergent themes and investigation of complexities discovered during the quantitative and qualitative phases (Gilham 2000).

This approach appears to be a relatively novel method of research for this area of clinical practice. Qualitative semi structured interviews were used to contextualise quantitative findings from key performance indicator data relating to quality and productivity of colonoscopy and to explore professional perceptions of the Screening Colonoscopist assessment process.

This study used an exploratory sequential mixed methods design (Creswell and Plano Clark 2011), which involved collecting quantitative data relating to productivity and quality of colonoscopy, undertaking initial analysis in advance of preparing interview guides and conducting semi structured interviews to gather qualitative data on both quality and productivity of colonoscopy, and also perceptions of the Screening Colonoscopists accreditation process.

Findings from each method were triangulated for interpretation of data relating to quality and productivity of colonoscopy. Qualitative data relating to perceptions of quality, productivity, and the Screening Colonoscopist accreditation process were analysed by thematic analysis.

Study design

As previously described, the design comprised of analysis of quantitative data relating to quality and productivity and qualitative data from semi structured interviews with professionals involved in delivering colonoscopy services. Interviews served to contextualise findings of the quantitative phase and to follow up on emergent themes whilst exploring professional perspectives of the Screening Colonoscopist accreditation process.

Quantitative phase

Lead Colonoscopists from each health board in Wales were identified and asked, initially verbally with a follow-up e-mail to nominate potential participants for the study who were sent information sheets and consent

forms by the Lead Colonoscopist. Inclusion criteria were discussed (appendix 3.1) and data request forms sent (appendix 3.2) to Lead Colonoscopists who compiled anonymised quality reports on individual colonoscopists key performance indicators (KPIs) for those who agreed to participate. Endoscopy unit data relating to productivity was also requested from the Lead Colonoscopists and returned via e-mail for analysis.

Study sample: colonoscopists

Twenty-four colonoscopists from 6 of the 7 health boards in Wales were asked and agreed to participate. The seventh health board was unable to do so because of a lack of electronic data. The endoscopy service in this health board was particularly low volume so exclusion was not considered a problem in terms of sample size. They were however able to participate in the qualitative phase of the study described later in this chapter.

Twelve of the twenty-one accredited Screening Colonoscopists in Wales were included in the study and twelve Non-Screening Colonoscopists were also recruited. Lead Colonoscopists were asked to nominate Screening Colonoscopists and Non-Screening Colonoscopists who had similar experience in terms of lifetime procedure numbers, usual case mix and annual colonoscopy activity. Matching the sample in this way was considered to be a robust mechanism to compare quality between the cohorts of colonoscopists. All participants of this phase of the study were medical doctors and all working at consultant grade.

It was recognised that there was a much larger pool of Non-Screening Colonoscopists available to choose from, as described in table 3.1, but for the purposes of this study where KPIs were being considered to compare quality of individual colonoscopists, equal sample sizes were considered adequate and

comparability in terms of experience was crucial. Variation in quality within each service was not included in this study.

Table 3.1. Health boards participating and total colonoscopists

University health board	*Screening Colonoscopists*	*Non-Screening Colonoscopists*	*Total number of colonoscopists in health board**	*Population health board catchment area*
Aneurin Bevan	*2*	*2*	*20*	*598,194*
Betsi Cadwaladr	*2*	*2*	*27*	*703,361*
Cardiff and Vale	*2*	*2*	*26*	*504,497*
Cwm Taf Morgannwg	*2*	*2*	*31*	*449,836*
Hywel Dda	*2*	*2*	*19*	*389,719*
Swansea Bay	*2*	*2*	*19*	*390,949*
Total	***12***	***12***	***142***	***3,036,556***

*Including Screening and Non-Screening Colonoscopists

Study sample: endoscopy units

There are 19 endoscopy units in Wales where colonoscopy is undertaken and 13 of them perform screening colonoscopy. Each health board was asked to participate by providing data related to endoscopy unit productivity via the Lead Colonoscopist. Data was aggregated to health board level by the Lead Colonoscopist in each health board. All agreed to participate, although recognised that availability of data was an issue.

Data request and collection: individual colonoscopists

As discussed in the previous chapter, the Joint Advisory Group on Gastrointestinal Endoscopy (JAG), the British Society of Gastroenterology (BSG), and the Association of Coloproctology of Great Britain and Ireland (ACPGBI) collectively defined key performance indicators for colonoscopists with minimum and aspirational targets attached to each. Bowel Screening Wales (BSW) also have performance targets, which are in line, but slightly stricter than the JAG targets as described in table 3.2. Following discussion with Lead Colonoscopists in Wales it became apparent that much of this data would not be available for Welsh colonoscopists and there was variation across the health boards in terms of availability of data. Although units are working towards improvement in data collection and the ability to upload data to the National Endoscopy Database (NED), it has not yet been consistently achieved across Wales. It was therefore decided to focus on the KPIs described in table 3.2 for the purpose of this study, as they were considered by the Lead Colonoscopists to be important determinants of quality and mostly likely to be well documented in Wales.

Table 3.2: JAG key performance indicators and aspirational targets

Performance indicator	Minimal standard (KPI)	Aspirational target	BSW target
Procedure numbers per year	100	150	150
Completion rate	90%	95%	90%
Polyp detection rate	15% Adenoma detection2	20% Adenoma detection	50%
Withdrawal time	6 minutes	10 minutes	7 minutes
Comfort score	<10% with moderate or severe discomfort	NA	<5% significant or extreme discomfort
Median Midazolam dose (Sedation)>70 years	≤2mgs	NA	≤2mgs
Median Midazolam dose (Sedation)<70 years	≤5mgs	NA	≤2mgs
% Un-sedated procedures	For interpretation of other results only		<15%

Following initial conversation with Lead Colonoscopists in each health board a data request form (appendix 3.2) was sent via e mail to clarify the data items required and follow-up phone calls were arranged for further clarity if required. There appeared to be variation in the methods used to collect data across health boards, with some able to download information directly from the National Endoscopy Database (NED) and others having to manually trawl through various spreadsheets kept locally to access the data requested. Lead Colonoscopists were asked to send the anonymised, coded data in whatever format they found convenient, as long as it was clear which were Screening and Non-Screening Colonoscopists. There was enthusiasm to participate, and data was sent promptly for most health boards after participants consent had been gained and entered onto an excel spreadsheet before developing an SPSS (IBM Corp 2020) codebook and database for analysis. Bowel Screening Wales

2 JAG sets standards for Adenoma detection rather than polyp detection but accept polyp detection rate as an estimate of ADR if validated as a marker on an individual level. This is in recognition of the difficulties of correlation with pathology data. A polyp detection rate of 40% is considered to equate to 15% ADR

(BSW) provided the 6 monthly individual colonoscopist KPI reports from the relevant timeframe.

Although not a primary aim of the research, an early intention was to consider variation in quality of colonoscopy services over time. Data were requested to represent two different time points; the most recent complete 12 months (2019-2020) and the earliest available complete 12 months of electronic data for the chosen KPIs for each of the colonoscopists recruited. The rationale for this was that the screening programme in Wales had been implemented in 2008 with a different service model and apparently more robust quality assurance processes than the non-screening programme. At the time of implementation of the programme critics cited this variation in service model as development of a two-tier service. The screening service continued with plans for implementation stating that this approach would serve to improve quality of both services over time. It transpired that this data was not available in sufficient quantity to analyse. Despite having similar experience in terms of lifetime procedure numbers, not all Screening Colonoscopists had been accredited long enough to hold historical KPI data within the screening programme and not all health boards were able to access historic data as electronic systems have changed and data not been retained.

Another early, secondary aim of the research was to explore potential variation in quality and productivity between screening and non-screening colonoscopy when performed by Screening Colonoscopists. Anecdotal evidence from background professional conversations prior to embarking on this study suggested that Screening Colonoscopists may behave differently when working on a screening list compared to a non-screening list. Various potential reasons were given for this, including the fact that they were aware

that their KPI data would be more heavily scrutinised by the bowel screening programme. This was an interesting line of enquiry and data was requested to be broken down by three cohorts:

- Screening Colonoscopists undertaking screening colonoscopy
- Screening Colonoscopists undertaking non-screening colonoscopy
- Non-Screening Colonoscopists undertaking non-screening procedures

Unfortunately, health boards were not able to differentiate between screening and non-screening activity. Data relating to Screening Colonoscopists undertaking screening procedures were obtained from BSW and data relating to all individual colonoscopists total colonoscopy activity were obtained from health boards, but data for Screening Colonoscopists undertaking non-screening colonoscopy only were not available. Data for Screening Colonoscopists total caseload contained information already accessed from BSW and was therefore not an independent cohort and not included in the final analysis beyond the descriptive and initial inferential statistical stage.

Having received data downloads from each Lead Colonoscopist relating to those who consented to participate in the study, the anonymised data sets were analysed during the quantitative phase of the study. Individual KPI's were compared across the cohorts to identify statistical significance of variation where it existed. Findings were used to shape interview guides for the qualitative semi-structured interviews.

Data request and collection: endoscopy units

Lead Colonoscopists and Bowel Screening Wales (BSW) were also asked to provide the following data relating to productivity of endoscopy units:

- The rate of appointments where patients did not attend (DNA)

- Cancellation rates
- The rate of planned versus actual procedures delivered
- The rate and reason of repeat procedures

Although the productive endoscopy unit is made up of many elements including effective workforce planning, optimal referral management, appropriate scheduling and many more (NHSIQ 2015), the data items requested were considered the minimum that should be available to support effective management of unit productivity in line with the JAG (2016) requirements. However, much of this data was unavailable electronically and only information on DNA rates was routinely collected by all health boards and BSW.

Qualitative phase

The qualitative phase of this study comprised of semi-structured interviews with professionals involved in delivering colonoscopy services in Wales. Building on initial interpretation of quantitative findings and anecdotal evidence from professional discussions, semi-structured interviews with relevant professionals were used to contextualise this data, examine professional perspectives and attempt to understand the world from their point of view (Kvale 1996).

Semi structured interviews allowed collection of open-ended data, taking an inductive approach, emergent themes were explored, and comparisons made as described by Saks and Allsop (2012) and Dejonckheere and Vaughn (2018). This approach proved to be a powerful tool to understand the thoughts, beliefs and experiences of professionals involved in delivering colonoscopy services in Wales.

Sample

The same colonoscopists whose data had been submitted for the quantitative phase of the study agreed to participate in the qualitative phase, with the addition of a representative from the seventh health board. To ensure a complete and rounded view, additional professional groups were identified for inclusion, based on the researcher's professional experience. Lead Colonoscopists provided names of the relevant professionals (Specialist Screening Practitioners and Endoscopy Unit Managers) to invite who were sent participant information sheets and consent forms by the researcher.

Specialist Screening Practitioners (SSPs) work only on the screening programme but are integral members of the endoscopy unit staffing team and were therefore thought to have valid views on the quality and productivity of colonoscopy for both services and an opinion of the assessment and accreditation process for Screening Colonoscopists. Three SSPs were interviewed, one from each region of Wales.

Endoscopy Unit Managers were also included on the same basis, with one being interviewed from each of the three regions in Wales. Endoscopy Unit Managers have operational responsibility for the entire unit and oversee screening and non-screening colonoscopy lists. Their inclusion in this study was considered important and valuable data was generated.

A total of 26 participants were interviewed, 3 Specialist Screening Practitioners, 3 Unit Managers, 10 Screening Colonoscopists and 10 Non-Screening Colonoscopists. Some professionals who had agreed to be interviewed were delayed in responding to the invitation and subsequent diary clashes meant that 4 of the colonoscopists whose data had been reviewed for the quantitative phase of the study were not included in the qualitative phase.

However, as all health boards and regions were represented and there was an equal sample of Screening and Non-Screening Colonoscopists, this was seen as providing good insight into professionals' concerns and views.

Data collection

Semi structured interviews were chosen because of the interest in individual professionals' perspectives and potential complexity of the topic, which was likely to generate large volumes of data. Although topics for discussion were considered and interview guides developed, based on the literature, anecdotal evidence and initial interpretation of quantitative findings, interviews were inductive to ensure participants were able to voice their perspective without being led. Topics of inclusion included perceptions of quality and productivity of screening and non-screening colonoscopy services and the Screening Colonoscopist accreditation process.

The interviews took place mainly in October 2021 and November 2021 with two slightly later in January 2022 because of participants' diary commitments. Potential interview questions were piloted with two individuals who were not involved in the study, one NHS manager and a nurse. Interview questions were amended slightly throughout the data collection phase to follow interesting points of view from previous interviews, although the broad themes remained the same.

Due to the Covid 19 pandemic and the need to work from home, interviews were undertaken virtually via Microsoft Teams with all professionals. Interviews lasted for between 30 and 45 minutes and were recorded and later transcribed verbatim prior to manual coding. Brief notes were also taken during the interview to capture key points.

Analysis plans

An analysis plan was drafted prior to collection of the data as recommended by Bryman (2016) and modified as the study progressed. Separate plans for quantitative and qualitative phases were developed and findings were triangulated to form conclusions in response to research questions.

Quantitative phase analysis plan

When data collection was complete, data were entered onto an excel spreadsheet to ensure consistency and assist further analysis prior to developing an IBM SPSS (IBM Corp 2020) codebook and database. Key variables were listed as the individual key performance indicators for the following cohorts:

- Screening Colonoscopists performing screening colonoscopy
- Screening colonoscopists performing total caseload
- Non-Screening Colonoscopists performing non-screening colonoscopy

Descriptive statistics including sample distribution as a measure of data quality, identification of missing data and outliers, frequencies, mean, median and range were used to summarise and visualise the entire dataset initially before breaking it down into the three cohorts above for further inferential analysis. The findings were compared to JAG minimum standards and the BSW standards.

Distribution of data was considered initially using a Shapiro Wilkes test (Shapiro and Wilk 1965) as the sample size was relatively small, but a Kolmogorov Smirnov test was also used as additional precaution along with skewness and kurtosis, providing comparison to Shapiro Wilkes in order to establish the distribution of the data for further analytical tests.

Distribution of data was considered by individual cohort, as this was the focus of further analysis and found to be relatively normally distributed prompting the use of parametric tests. Non-parametric tests were also used to cross reference.

Inferential statistics initially comprised of a one-way group analysis of variance (ANOVA) with post hoc Tukey test to establish variance between all three cohorts. The non-parametric equivalent, Kruskal Wallis was also undertaken for comparison. The cohort of Screening Colonoscopists undertaking their entire caseload was not an independent sample in that it contained both screening and non-screening cases, further analysis was therefore undertaken with two cohorts only: Screening Colonoscopists undertaken screening procedures and Non-Screening Colonoscopists undertaking non-screening procedures.

Multiple independent samples t-tests were undertaken to establish significance of variance between the groups. The non-parametric equivalent Mann Whitney-U was also conducted for comparison and Bonferroni correction applied because of the number of comparisons, in order to avoid spurious positive results.

Qualitative phase analysis plan

Upon completion of semi structured interviews recordings were transcribed verbatim and additional notes taken at interview included. Active reading and a six-step thematic analysis process were used as described by Braun and Clark (2006) comprising of:

1. Familiarisation
2. Coding
3. Generating themes

4. Reviewing themes
5. Defining themes
6. Writing up

This was an iterative process where data extracts were fitted into coherent themes and key quotations noted.

Triangulation

Triangulation is defined as the mixing of data so that diverse viewpoints cast light on a topic (Olsen 2004). The discipline of triangulation has emerged through interaction with qualitative and quantitative analysis and serves to bring these two modes of analysis together to shed light on a social research topic (Hughes et al. 2003). Greenhalgh (2019) states that the validity of qualitative research is greatly improved by the use of more than one method in combination, known as triangulation.

Triangulation can operate within or across research boundaries and was applied to this study to ascertain if the qualitative findings corroborated the quantitative data relating to quality and productivity. Key findings for each phase of the study were identified and triangulated.

As well as exploring perceptions of variation in quality and productivity, where findings were triangulated with the quantitative data, qualitative analysis then went on to explore professional perspectives of the Screening Colonoscopist accreditation process.

Ethical considerations

This study was conducted in line with the UK Research and Innovation policy on the governance of good research practice (2021). Ethical approval was granted by Cardiff University's School of Social Science Research Ethics Committee in October 2019 (approval number: SREC/3395).

Additional Research and Development approval was obtained from the National Health Service (NHS) for each health board in Wales, as colonoscopists from every health board were participating. NHS Ethics approval was not necessary as the study did not involve patients and all data related to professionals only which was anonymised.

Information sheets and consent forms were sent to all participants by the Lead Colonoscopist in advance of starting the study and an opportunity was given for informal discussion in advance of consent being given. Participants were informed of their right to withdraw at any time until the final thesis was written and that their data would be held confidentiality and made anonymous.

Data will be stored for five years on an encrypted NHS computer which is password protected and regularly backed up in line with General Data Protection Regulation 2018 (GDPR 2018) requirements.

Written consent forms were scanned and stored electronically with other study data. Consent was confirmed at the start of the semi structured interviews.

Researcher position

The researcher was known to all Lead Colonoscopists and most participants of this study as they previously occupied a senior management role within the bowel screening programme. FitzGerald (1995) described trust and understanding the interviewees situation as paramount to developing rapport and enabling honest sharing of experiences. Where there is a pre-existing relationship, rapport building is accelerated with no time wasted creating an environment in which the interviewee feels comfortable (McConnell-Henry et al. 2009). However, a pre-existing relationship could be detrimental if the

participant feels unable to be open for fear of reprisal, particularly in cases where the interviewer is more senior (Asselin 2003). The objectives of this study were made clear to participants and there was no obligation to participate.

Stronach et al. (2007) stated that the position of the researcher and awareness of its effect is important. A sensitivity to the researcher's personal, professional, cultural and social context was maintained through a reflexivity and methodological self-consciousness as described by Lynch (2000). Lynch (2000) also urges caution in the use of the term "reflexivity" stating that it implies epistemological advantage but is misunderstood with different meanings in different settings.

In this study however, the researcher was aware of potential bias and attempted to mitigate this by reinforcing the fact that interviews were anonymised and would not be shared. There were advantages to the researchers position in that participants were enthusiastic about being involved in the study and happy to engage with interviews. The researcher was given access to significant quantitative data which may have been difficult for other researchers to obtain without a pre -existing relationship with study participants.

Summary

This chapter has outlined the methodology used for the mixed methods approach to understanding variability in quality and productivity of screening and non-screening colonoscopy and exploring professional perspectives of the Screening Colonoscopist accreditation process. This was a pragmatic paradigm considered necessary to answer the research questions allowing exploration of the topics through quantitative and qualitative data.

The study involved analysing quantitative data to establish variance and significance of variance in quality and productivity between screening and non-screening colonoscopy. Semi structured interviews were undertaken with professionals involved in delivering screening and non-screening colonoscopy services across Wales and quantitative and qualitative data were triangulated to answer the research questions. Results of both phases of this study will be presented in the next chapter.

4 Results: Understanding variance in key performance indicators between Screening and Non-Screening Colonoscopists

Introduction

The aim of this chapter is to explore variance in key performance indicators (KPI's) between Screening and Non-Screening Colonoscopists. It will answer the following research question:

- Is there a significant difference in specific key performance indicator values between Screening and Non-Screening Colonoscopists?

This chapter begins by outlining demographic data to demonstrate representativeness of the sample and moves on to describe descriptive and inferential statistics to answer the research question.

Study sample

Colonoscopists

Twenty-four colonoscopists from 6 of the 7 health boards in Wales were recruited to participate in the quantitative phase of this study. As described in chapter 3 Powys Teaching Health board were unable to provide data for individual colonoscopists and were therefore not included in the quantitative phase of this study for individual colonoscopists, although they did supply some unit data (see chapter 5).

Twelve of the twenty-one accredited Screening Colonoscopists were identified randomly by health board Lead Colonoscopists for inclusion in this study. The number of Non-Screening Colonoscopists was matched to the screening sample with consideration given to lifetime procedure numbers and the nature of colonoscopy undertaken in order to provide a comparable Non-Screening Colonoscopist sample.

Data

Data were initially compared to the Joint Advisory Group on Gastrointestinal Endoscopy (JAG) standards and used to describe variance between the three initial cohorts of colonoscopist, those accredited to undertake screening colonoscopy (broken down into screening procedures only and their total caseload) and Non-Screening Colonoscopists, generally of comparable experience, but without screening accreditation.

Key performance indicators for individual colonoscopists

Following discussion with health board Lead Colonoscopists, one of whom had undertaken JAG assessments and was familiar with data collection processes in many of the health boards, a pragmatic decision was made to restrict the quantitative element of this study to analysis of eight key performance indicators (KPIs) as described in chapter 3.

Descriptive statistics

The following section describes each of the KPIs for the initial three different cohorts of colonoscopists:

- Screening Colonoscopists undertaking screening colonoscopy
- Screening Colonoscopists undertaking their total caseload
- Non-Screening Colonoscopists undertaking non-screening colonoscopy

Findings will be discussed as to whether they are in line with JAG minimum standards (KPIs) and how the groups compare to each other. Individual KPIs for each of the colonoscopist cohorts will be described and descriptive statistics reported. Sample size (n), median and mean are summarised in table 4.1. and range can be found in appendix 4.1. While there appeared to be differences in

many of the KPI values between the colonoscopist cohorts, further statistical tests were undertaken to establish whether these differences were statistically significant.

Table 4.1 Individual key performance indicator values- mean and median

Colonoscopist procedure		Procedure no.	Completion rate	Polyp detection	Comfort score	Withdrawal	Sedation >70	Sedation <70	No sedation
Screening Colonoscopist- screening procedures	Mean	152.93	94.16	61.63	19.14	9.35	1.87	1.87	35.39
	Median	133.00	94.95	63.97	20.17	9.00	1.90	1.90	35.55
	n	30	30	30	30	30	30	30	30
Screening Colonoscopist total procedures	Mean	231.00	93.08	52.46	8.34	15.76	1.59	1.88	28.7
	Median	197.00	93.10	55.47	4.57	14.90	1.70	2.00	38.20
	n	21	21	21	17	5	119	18	10
Non- Screening Colonoscopist- non-screening procedures	Mean	249.95	90.57	32.17	11.10	8.97	1.86	2.05	19.66
	Median	204.50	92.45	28.32	8.90	10.54	1.97	2.00	19.41
	n	22	22	22	15	4	18	18	10

*Range reported in appendix 4.1

Procedure numbers

The JAG expects all colonoscopists to undertake a total of 100 colonoscopy procedures per year as evidence suggests this is the number needed to maintain competence (Kong et al. 2013). Screening Colonoscopists are expected to achieve at least a total of 150 procedures per year, 80 of which must be screening colonoscopies. Data on procedure numbers appears well collected with no missing data in any of the cohorts. Colonoscopists in Wales perform a median of 175 procedures per year ranging from 42-708. One outlier who performed only 7 colonoscopies in one year was removed from analysis. Non-Screening Colonoscopists appear to perform slightly more colonoscopies than Screening Colonoscopists (SC Mean=231, NSC Mean=249) when considering the total data set.

Completion Rate

The consequences of an incomplete colonoscopy (otherwise known as caecal intubation) are missed diagnosis of cancer and other diseases and it can significantly affect patient outcomes (Brenner 2012). A colonoscopy is deemed to be complete when the entire length of the colon has been visualised and the caecum intubated i.e., when the scope passes into the terminal ileum, the distal part of the small bowel that intersects with the large bowel or colon (Rees 2016).

Completion rate is one of the most well-defined quality markers of colonoscopy (Kaminski 2017) and there was no missing data from the sample relating to this KPI. JAG expect colonoscopists to complete colonoscopy in at least 90% of cases, but the aspirational target is 95%. Screening Colonoscopists in the sample achieved a mean of 94% when undertaking screening procedures, slightly lower than the aspirational target of JAG, and slightly

lower again (93%) when considering their total caseload of procedures. Non-Screening Colonoscopists achieve a mean of 90%, only just satisfying the minimum standard expected by the JAG, so from these values, it appears that there is variation between Screening and Non-Screening Colonoscopists in relation to their rates of procedure completion.

Polyp detection rate

The JAG minimum standard relates to adenoma detection rather than polyp detection rate, as discussed in chapter 2. Adenomas account for around 10% of all colonic polyps (Calderwood 2016) and are a particular sort of polyp that are associated with progression to carcinoma (cancer). Adenoma detection rate (ADR) is the marker most commonly used to assure thorough examination of the colon. Lower adenoma detection rates are associated with higher rates missed cancers (Corley 2014; Rees et al. 2016) with JAG setting the minimum standard at 15%. Measuring ADR requires interrogation of pathology databases to obtain polyp histology, which is difficult for most units in Wales, because of the lack of joined up, electronic information technology systems.

Polyp detection rate (PDR) is often used as it is easier to obtain. JAG takes a position of ADR being the primary KPI, but PDR is acceptable where a ratio between an individual's ADR and PDR has been established and validated with a minimum value being set to ensure an ADR of 15%. This is broadly considered to be around 40% PDR (Francis et al. 2011).

The standard for polyp detection rate for screening colonoscopy in Wales is 50%. Data on this KPI is routinely collected and was valid in all cases for this study. With reference to the figures in Table 4.1, Screening Colonoscopists in the sample appear to perform extremely well in terms of polyp detection rate, exceeding the 40% standard recommended by the European Society of

Gastrointestinal Endoscopy Quality Improvement Initiative (ESGE 2017) and screening target for polyp detection with a mean of 62% when undertaking screening procedures and a mean of 52% for their complete caseload. Non-Screening Colonoscopists however failed to achieve the standard recommended by the European Society of Gastrointestinal Endoscopy Quality Improvement Initiative (2017) with a mean of 32%.

Withdrawal time

The time it takes a colonoscopist to withdraw the scope after reaching the caecum is a key performance indicator, as withdrawal is considered to be the critical time to assess for lesions (Lee et al. 2013). As discussed in chapter 2, withdrawal times longer than 6 minutes are associated with increased quality. There is a strong relationship between withdrawal times and polyp detection rates (Vavricka et al. 2016) with the rate of polyp detection significantly increasing with slower withdrawal times (greater than 6 minutes).

Data on this KPI has been routinely captured in screening cases since 2013, but this is not the case in the non-screening service and data on this KPI was only available in 40/73 (55%) cases. Although data were incomplete, the mean withdrawal time for each cohort exceeded the JAG minimum standard of 6 minutes and the screening standard, set at 1 minute longer. Screening Colonoscopists achieved a mean withdrawal time of 9.3 minutes when undertaking screening procedures and 15 minutes when doing their total caseload. It was lower for the Non-Screening Colonoscopists at 8.3 minutes.

Comfort score

Comfort is difficult to measure, but an attempt is made using a standardised scale, the Gloucester scale (Rafferty 2014) which relies on three measures of comfort, rated at the time of the procedure by the patient, the colonoscopist

and the nurse. Scores for comfort are given from 1-5 with 5 being severe discomfort, 1 being no discomfort at all and 2,3 and 4 being minimal, mild, and moderate respectively.

As discussed in chapter 2, JAG expect a consensus of scores agreed by all in the room and some units in Wales triangulate the scores given by the patient, nurse and endoscopist. However, this is not done consistently, and many units only record nurse reported comfort scores. It was therefore decided to focus only on nurse reported comfort scores for this study as this was the score most commonly available in units in Wales.

The rate at which nurses report moderate or extreme discomfort (scores 4 and 5 on the Gloucester scale) during procedures was recorded for this study and was expected to be less than 10% in line with JAG standards. Data was missing in 11/73 cases (15%).

The bowel screening programme uses a slightly different comfort score, but it also comprises of a scale of 5 with 1 being no discomfort, 5 being extreme discomfort and 2, 3 and 4 being mild, moderate, and significant discomfort respectively. For this study the rate of screening patients experiencing significant and extreme discomfort (4 and 5 on the BSW comfort score) were recorded and analysed.

Screening Colonoscopists undertaking screening procedures had a mean nurse rated comfort score of 19% which was lowered to 8% when considering their total caseload. This means that, on average, in 19% of the screening colonoscopy procedures they performed the nurse had scored patient comfort as 4 or 5 indicating that the patient was in significant or extreme discomfort. Non-Screening Colonoscopists undertaking non-screening procedures achieved

a comfort score of 11% which although lower than Screening Colonoscopists did not satisfy the JAG minimum standard.

Although these findings need further research and should be considered as a triangulated score with patient and colonoscopist rates in a future study, it appears that the minimum standard for comfort score is only achieved by Screening Colonoscopists when considering their entire workload rather than screening cases alone and not achieved at all by Non-Screening Colonoscopists.

Median Midazolam dose

Midazolam is a short acting sedative drug often used at colonoscopy. There is no standard dose for Midazolam, but the British Society of Gastroenterology (BSG) guidelines (2003) suggest a maximum dose of 5mgs with lower doses for the elderly. JAG standards state that no more than 2mgs of Midazolam should be given to patients aged 70 years and over and no more than 5 mgs to younger patients. Data in Wales was available in 66/73 (90%) cases for patients under the age of 70 and 68/73 (96%) in patients over the age of 70 years.

The eligible age for screening at the time of data collection was 60-74 years and the use of sedation was recorded for screening patients generally and not broken down by age. The same information was used for both under and over 70 years for the screening population.

The data collected for this study showed that Non-Screening Colonoscopists use slightly more sedation overall as described in table 4.2 but all mean sedation dosage rates comply with the JAG standards.

Table 4.2 Mean sedation dose used in patients over the age of 70 years and those aged 70 years or less.

Cohort	Midazolam ≥70	Midazolam<70
Screening Colonoscopists undertaking screening procedures	1.8mgs	1.8mgs
Screening Colonoscopists undertaking total procedures	1.5mgs	1.8mgs
Non-Screening Colonoscopists undertaking non-screening procedures	1.8mgs	2mgs

Rate of procedures undertaken without sedation

The JAG uses the rate of procedures undertaken without sedation to interpret results of other KPI's only and although they require this data to be collected, they do not consider it to be a KPI in its own right. For example, if a colonoscopist appears to be an outlier for comfort scores and their patients experience more significant discomfort the rate of unsedated procedures would be considered to understand if comfort could be improved by greater use of sedation. It is however a KPI for Screening Colonoscopists with more than 15% of cases undertaken without sedation expected. Data for the rate of un-sedated procedures was collected in 50/73 (68%) cases in this study.

Screening Colonoscopists undertaking screening colonoscopy perform un-sedated procedures on 35% of their patients, reducing to 28% when considering their entire caseload. Non-Screening Colonoscopists perform un-sedated procedures on 19% of their cases and all data satisfies the screening standard. Screening Colonoscopists undertake more procedures without sedation, but Non-Screening Colonoscopists also undertake more un-sedated procedures than the minimum number expected of a Screening Colonoscopist.

Summary of descriptive statistics for KPI data

In summary, descriptive inspection of the data revealed that, although KPI's are largely compliant with the JAG minimum standards there appears to be a greater percentage of patients who have undergone colonoscopy with the colonoscopists in this sample experiencing moderate or severe discomfort during colonoscopy as reported by nurses for the three cohorts of Colonoscopists. Although not triangulated with patient and colonoscopists comfort scores and there is evidence to support nurses reporting higher rates of discomfort compared to colonoscopists (Rafferty et al.2014) it is interesting to note that there appears to be more discomfort associated with colonoscopy in this sample of colonoscopists in Wales and slightly less sedation used by Screening Colonoscopists compared to Non-Screening Colonoscopists.

Non-Screening Colonoscopists appear to perform very slightly more colonoscopy than Screening Colonoscopists when considering their entire caseload, although the sample had been matched by experience.

Although mean completion rates appear to be slightly higher for Screening Colonoscopists, when median figures are considered, there is only a very slight increase for Screening Colonoscopists.

Polyp detection rate, however, is higher than the published minimum standards of 40% (ESGE 2017) with a polyp being detected at 50% of procedures on average across all cohorts.

Data quality of KPI data

KPI data for individual colonoscopists was recorded and aggregated into cohorts for analysis. Issues with data quality were identified during this study and will be discussed in this section. The lack of appropriate electronic systems hindered completeness of data collection and where there were information

technology systems in place, they often relied on manual data entry by busy clinical staff. Some systems had been updated, but historical data had been lost making it difficult to access KPI information from earlier timepoints with which to compare and assess any change over time.

Missing data

Analysis of the total data set revealed procedure numbers, completion rate and polyp detection rate, which have historically been collected routinely for all colonoscopists in Wales were well recorded for individual colonoscopists in each cohort with no missing data (n=73). Withdrawal rate is a more recent requirement of the JAG and was missing in 47% of cases. The proportion of cases undertaken without sedation was missing in 32% of cases in this study.

Data quality is a limiting factor of this study as although most data were available, some data were missing for 5 of the 8 KPI's as described in appendix 4.1.

Distribution of the complete data set

The normal distribution of data is an underlying assumption of parametric testing (Field 2013). Assessment of normality was considered essential for this study to ascertain the type of statistical tests needed to answer the research questions. The sample size for this study was relatively small (n=73) and the normality of data for each KPI was therefore considered initially using the Shapiro- Wilks test (Laerd 2016) as this test was considered to be more powerful in detecting non-normality in a small sample. Kolmogorov Smirnov tests, typically used for larger samples, were also used as an additional precaution to examine the normality of distribution of the KPI data to provide a comparison to the Shapiro-Wilks, ensuring the distribution of data had been accurately assessed for all cohorts (Peat and Barton 2005).

Considering distribution of the KPI data for the entire data set using Shapiro-Wilks and Kolmogorov Smirnov tests (Laerd 2016), almost all tests were statistically significant suggesting that data (apart from non-sedation rate) were mainly non-normally distributed as described in table 4.3. Measures of skewness and kurtosis however were close to zero indicating relatively normal distribution, although these may have been affected by the small sample size. Visual assessment of distribution of data for the entire dataset using histogram shows non-normally distributed data for most KPI's as illustrated in appendix 4.2.

Table 4.3 Assessment of normal distribution for individual colonoscopists key performance indicators

KPI	Skewness	Kurtosis	Kolmogorov Smirnov (KS)	KS Sig P	Shapiro Wilkes (SW)	SW Sig P
Procedure number	.279	.552	.128	.004	.905	.000
Completion rate	.279	.552	.124	.007	.883	.000
Polyp detection rate	.279	.552	.126	.006	.938	.001
Comfort	.302	.595	.170	.000	.909	.000
Sedation <70	.295	.582	.171	.000	.915	.000
Sedation >70	.291	.574	.260	.000	.854	.000
No Sedation	.337	.662	.122	.059	.961	.094
Withdrawal time	.374	.662	.154	.019	.945	.051

Distribution of data for individual cohorts of colonoscopist

Data for this study were to be used in individual cohorts of colonoscopist to assess variation between the groups. Normality of distribution of data was therefore considered by individual cohort.

When the data were split into cohorts, the distribution looked very different and the pattern of normality of the distribution of the data swayed to a picture of a relatively normal distribution as illustrated in table 4.4. Most tests for normal distribution were not significant, suggesting that KPI's demonstrated a normal distribution for most cohorts of colonoscopist.

Table 4.4 Distribution of data by cohort

KPI	Kolmogorov Smirnov Significance- P value	Shapiro Wilkes Significance- P value	Normality
Procedure number			
Screening Colonoscopist -screening procedures	.019	.002	Non-normal
Screening Colonoscopist - total procedures	.200	.077	Normal
Non-Screening Colonoscopist- non-screening procedures	.074	.012	KS Normal/SW Non-normal
Completion rate			
Screening Colonoscopist -screening procedures	.119	.135	Normal
Screening Colonoscopist - total procedures	.200	.477	Normal
Non-Screening Colonoscopists- non-screening procedures	.113	.007	KS Normal/SW Non-normal
Polyp detection rate			
Screening Colonoscopist -screening procedures	.024	.117	KS Non-normal/SW Normal
Screening Colonoscopist - total procedures	.200	.216	Normal
Non-Screening Colonoscopists- non-screening procedures	.064	.014	KS Normal/SW Non-normal
Comfort			
Screening Colonoscopist -screening procedures	.066	.126	Normal
Screening Colonoscopist - total procedures	.002	.000	Non-normal
Non-Screening Colonoscopists- non-screening procedures	.007	.003	Non-normal
Sedation<70			
Screening Colonoscopist -screening procedures	.001	.036	Non-normal
Screening Colonoscopist - total procedures	.000	.000	Non-normal
Non-Screening Colonoscopists- non-screening procedures	.000	.000	Non-normal
Sedation >70			
Screening Colonoscopist -screening procedures	.001	.036	Non-normal
Screening Colonoscopist - total procedures	.052	.011	KS Borderline/SW Non-normal
Non-Screening Colonoscopists- non-screening procedures	.006	.062	KS Non-normal/SW Normal
No sedation			
Screening Colonoscopist -screening procedures	.200	.568	Normal
Screening Colonoscopist - total procedures	.006	.057	KS Non-normal/SW Borderline

Non-Screening Colonoscopists- non-screening procedures	.185	.068	Normal
Withdrawal time			
Screening Colonoscopist -screening procedures	.002	.012	Non-normal
Screening Colonoscopist - total procedures	.200	.849	Normal
Non-Screening Colonoscopists- non-screening procedures	Missing	.172	Normal
Key: Normal  Discrepant  Non-normal 			

Data distribution for individual KPIs were considered for each cohort as described below. The overall picture of data distribution was used to determine the type of inferential statistical tests to be used.

Procedure numbers

Based on the results of both Kolmogorov Smirnov and Shapiro-Wilks statistical tests, data on procedure numbers was normally distributed for Screening Colonoscopists undertaking their entire caseload, but non-normally distributed when considering only screening cases. There was discrepancy between the statistical tests for Non-Screening Colonoscopists undertaking non-screening procedures with the Kolmogorov Smirnov reporting normal distribution for procedure numbers and Shapiro-Wilks non-normal.

Completion rate

Completion rate data was normally distributed for Screening Colonoscopists entirely and for Non-Screening Colonoscopists using the Kolmogorov Smirnov test, but the Shapiro-Wilks test reports non-normal distribution for completion rates for Non- Screening Colonoscopists undertaking non-screening procedures.

Polyp detection rate

Data on polyp detection rates were normally distributed for all cohorts apart from Screening Colonoscopists undertaking screening procedures when using the Kolmogorov Smirnov test and for Non-Screening Colonoscopists undertaking non-screening procedures when using the Shapiro-Wilks test.

Comfort

Comfort score data was normally distributed for Screening Colonoscopists undertaking screening procedures, but non-normally distributed for both other groups as assessed by the Kolmogorov Smirnov and Shapiro-Wilks statistical tests.

Sedation

Data on the use of sedation was non-normally distributed for all cohorts apart from Non-Screening Colonoscopists undertaking non-screening procedures as assessed by the Shapiro-Wilks test. When considering the rate of procedures undertaken without sedation data was normally distributed for Screening Colonoscopists undertaking screening procedures and for Non-Screening Colonoscopists undertaking non-screening procedures assessed by both the Kolmogorov Smirnov and Shapiro-Wilks statistical tests. There was discrepancy in the distribution pattern for Screening Colonoscopists undertaking their total caseload without the use of sedation as the Kolmogorov Smirnov test showed non-normally distributed data with a borderline result for the Shapiro-Wilks test.

Withdrawal time

Withdrawal time data was normally distributed for Screening Colonoscopists undertaking their total caseload and for Non-Screening Colonoscopists undertaking non-screening procedures, but non-normally distributed for Screening Colonoscopists undertaking screening procedures when assessed by both the Kolmogorov Smirnov and Shapiro-Wilks statistical tests.

Summary of distribution of data by individual cohorts of colonoscopist

As the majority (16/24, 64%) of data items demonstrated normal or borderline distribution by at least one test, parametric tests were selected to conduct inferential comparisons to address the research questions. Non-parametric equivalent tests were also undertaken to explore the research questions, to provide a comparison with the parametric tests and ensure potential deviations from the normal distribution did not impact results overall. The results of these tests are provided in appendix 4.3.

Initial inferential statistics

To answer the research question and ascertain if there was a significant difference in specific key performance indicator values between Screening and Non-Screening Colonoscopists, inferential statistical tests were used on mean KPI data obtained from Lead Colonoscopists in 6 of the 7 health boards in Wales. Although descriptive statistics had identified some differences in KPI values between the cohorts, further, inferential statistical tests were needed to assess if the differences were statistically significant.

A multivariate analysis of variance (MANOVA) test was considered for initial investigation but requires complete case analysis and was unsuitable because of the proportion of missing data. A one-way between group analysis of variance (ANOVA) was conducted with post-hoc Tukey test to establish whether there were significant differences between the three groups as described in Table 4.5. The non-parametric equivalent test, Kruskal Wallis is described in appendix 4.3.

Table 4.5 ANOVA comparison between all three cohorts of colonoscopists

KPI	F	Confidence intervals (95% for Mean)	ANOVA significance
Procedure numbers	1.180	1.7-2.1	.479
Completion rate	3.69	1.7-2.1	.073
PDR	33.02	45.9-54.16	<.001*
Comfort	7.73	1.1-1.6	<.001*
Withdrawal	14.85	1.1-1.6	<.001*
Sedation >70	2.95	1.6-2.0	.060
Sedation<70	2.82	1.6-2.0	.067
No sedation	Not reported	1.4-1.8	Not reported

**Statistically significant result*

ANOVA results for all three cohorts of colonoscopist for each key performance indicator

ANOVA results comparing all three cohorts of colonoscopist, and procedure type showed a statistically significant difference between groups in:

- Comfort scores
- Withdrawal times
- Polyp detection rate

Results for all other KPI's were not statistically significantly different.

Results of the Kruskal Wallis test (described in appendix 4.3) aligned with comfort scores, withdrawal time and polyp detection rates being statistically significantly different. The Kruskal Wallis test also identified sedation use under the age of seventy as significant and the rate of procedures undertaken without sedation as borderline statistically significant.

Given the similarity in analysis of these results, the remainder of this section will focus on the findings of parametric tests. It will go on to examine and discus results of the ANOVA analysis for each of the KPIs found to have statistically significant variation between groups in more detail and consider results in relation to the JAG standards.

Comfort score

As described in the descriptive statistics section, comfort scores appear to be outside what JAG would expect to see when considering the whole data set of three cohorts. The JAG standard is that 10% or fewer patients should experience significant or extreme discomfort at colonoscopy.

This study revealed that 19% of screening patients experienced moderate or significant discomfort (rated 4 or 5 on the comfort scale) and 11% of non-screening patients at procedures undertaken by Non-Screening Colonoscopists. Only Screening Colonoscopists when considering their total caseload were compliant with JAG standards as 8% of their patients experience significant or severe discomfort.

ANOVA analysis determined statistically significant variation between groups ($p<.001$). Tukey's post hoc test demonstrated that the variation was significant between Screening Colonoscopists performing screening colonoscopy and Screening Colonoscopists performing their total caseload ($p=.002$) and also between Screening Colonoscopists undertaking screening procedures compared to Non-Screening Colonoscopists performing non-screening colonoscopy ($p=.030$). There was no significant difference between Screening Colonoscopists undertaking their total caseload and Non-Screening Colonoscopists performing non-screening colonoscopy as illustrated in table 4.5.

Withdrawal time

When considering the entire data set and all three cohorts, withdrawal time exceeded the JAG and screening minimum standards of 6 and 7 minutes in each cohort. Non-Screening Colonoscopists achieved the lowest mean score of 8.3 minutes but were still considerably better than the JAG minimum standards. Although there was missing data for this KPI and the sample size was small (n=39), Screening Colonoscopists appeared to perform differently when undertaking screening procedures with a mean withdrawal time of 9.3 minutes compared to 15 minutes when considering data from their total caseload.

ANOVA analysis revealed statistically significant variation between groups (p=<.001). A post hoc Tukey test demonstrated significant variation between Screening Colonoscopists undertaking screening procedures and Screening Colonoscopists undertaking their total caseload and between Screening Colonoscopists performing their total caseload and Non-Screening Colonoscopists. There was no significant variation between Screening Colonoscopists performing screening colonoscopy and Non-Screening Colonoscopists, as shown in table 4.6.

Polyp detection rate

As described earlier, the polyp detection rate for Non-Screening Colonoscopists was below the minimum standard expected by JAG at 32%. Screening Colonoscopists performed better with detection rates of 52% when considering their total caseload and 62% when undertaking screening procedures as previously described. Polyp detection rates for Screening Colonoscopists were much higher than for Non-Screening Colonoscopists and

when considering their rates when undertaking screening procedures only were nearly double that of the Non-Screening Colonoscopists.

ANOVA analysis revealed statistically significant variation between groups and the post hoc Tukey test demonstrated that variation between each of the groups was statistically significant as illustrated in table 4.6.

Table 4.6 Post hoc Tukey test results

Colonoscopist/procedure type		Comfort scores Sig.	Withdrawal time Sig.	Polyp detection rate Sig.
Screening Colonoscopist- screening procedures	Screening Colonoscopist- total procedures	.002	<.001	.029
	Non-Screening Colonoscopist- non-screening procedures	.030	.954	<.001
Screening Colonoscopist- total procedures	Screening Colonoscopist- screening procedures	.002	<.001	.029
	Non-Screening Colonoscopist- non-screening procedures	.703	.001	<.001
Non-Screening Colonoscopist- non-screening procedures	Screening Colonoscopist- screening procedures	.030	.954	<.001
	Screening Colonoscopist- total procedures	.703	.001	<.001

Summary of ANOVA results for comparison of key performance indicators between groups including all three cohorts of colonoscopist and procedure type

This section considered results of the one-way ANOVA (and Kruskal Wallis tests) conducted to determine if KPI values varied significantly between the three initial groups of colonoscopist and procedure type. Findings suggest there was statistically significant variation between the groups for KPI's relating to comfort scores, withdrawal times and polyp detection rate.

These results provide a comparison of how KPI values vary for each colonoscopist, considering their caseload and type of procedure. However, whilst the findings were interesting, it was recognised that the three cohorts were not entirely independent. As discussed in chapter 3, as it was not possible to source data on Screening Colonoscopists undertaking non-screening procedures in isolation, only as part of their full caseload, which contained duplicate data on screening procedures, already provided by Bowel Screening Wales.

Consequently, further analysis, beyond this initial inferential stage will focus on answering the research questions by examining variation in KPIs between the two independent groups of colonoscopist:

- Screening Colonoscopists undertaking screening procedures
- Non-Screening Colonoscopists undertaking non-screening procedures

Further inferential statistics on independent groups

Although the ANOVA analysis demonstrated statistically significant variation between the three cohorts of colonoscopist and procedure type for some KPIs, further analysis is necessary with the independent groups only as described earlier in order to answer the following research question:

- Is there a significant difference in specific key performance indicator values between Screening and Non-Screening Colonoscopists?

The research question was considered, and appropriate statistical tests chosen for analysis of the data. This section describes results of inferential statistical tests used to answer the research question. An independent samples t-test was used to assess each KPI and identify whether there was statistically significant variance between the two colonoscopist groups. Outcome of Levene's test for equality of variances was assessed and results reported according to its significance as illustrated in Table 4.7. Given the slight divergences when establishing normality of distribution of the data, the non-parametric equivalent of the t-test, the Mann Whitney-U test, was also conducted and reported in appendix 4.4.

Given the number of key performance indicators analysed (n=8) and to minimise the risk of error, a Bonferroni correction was applied. Therefore, the new significance level of p=.006 was employed to reduce the incidence of a false positive result (Bland and Altman 1995) as shown in Table 4.7. A Bonferroni correction with the same significance level was also applied to the non- parametric equivalent Mann Whitney U test as described in appendix 4.4

Table 4.7 t-test results following application of Levene's test for equality of variances and Bonferroni correction

KPI	t-test statistic	t- test significance	Confidence interval 95%	Bonferroni significance P=.006
Procedure numbers	2.85	.006	-1.37 to - .226	Yes- borderline
Completion rate	2.47	.017	.124 to 1.25	No
PDR	9.53	.000	1.91 to 3.42	Yes
Comfort	2.57	.014	.167 to 1.45	No
Withdrawal	.159	.883	-.891 to 1.197	No
Sedation >70	-.303	.764	-.657 to .494	No
Sedation<70	-2.41	.020	-1.318 to -.113	No
No sedation	2.98	.005	.327 to 1.84	Yes

Considering results of the parametric t-test after applying the Bonferroni correction, there was a borderline statistically significant difference between the colonoscopists groups for procedure numbers. Variation between groups for the rate of procedures undertaken without sedation and polyp detection rate were clearly statistically significant.

Without the Bonferroni correction, when the significance level would be set to p=.05, completion rate, comfort scores and sedation use in patients under the age of 70 years would also have been significant.

However, there was some discrepancy between the parametric and the non-parametric tests relating to the use of sedation following application of the Bonferroni correction as described in appendix 4.5. Variation in sedation use in younger people (aged <70 years) was statistically significant between the groups and the rate of procedures undertaken without sedation was not according to results of the Mann Whitney U test following Bonferroni correction.

As data for sedation use in patients under the age of 70 years was non-normally distributed, non-parametric tests are appropriate. This KPI should be considered as having statistically significant variation between groups.

Data for the rate of procedures undertaken without sedation was partially normally distributed, but only for Screening Colonoscopists undertaking their total caseload when assessed by the Kolmogorov Smirnov test. Shapiro-Wilks was of borderline significance and data relating to both other cohorts for this KPI was normally distributed suggesting parametric tests would be appropriate, and variation between groups considered statistically significant.

Significant results

This section will further explore KPI's with statistically significant variation between the two independent groups of colonoscopist and procedure type following analysis with the parametric independent samples t-test, the non-parametric equivalent (Mann-Whitney U test) and application of Bonferroni correction.

Procedure numbers

Procedure numbers were calculated as a total number with the mean for each cohort established for comparison. There was no missing data for this KPI (n=51). It was noted that the mean total number of procedures undertaken by Screening Colonoscopists was comparable to the mean number of non-screening procedures undertaken by Non-Screening Colonoscopists. However, when comparing screening procedures only, undertaken by Screening Colonoscopists to non-screening procedures undertaken by Non-Screening Colonoscopists there was a statistically significant difference in procedures numbers undertaken.

Screening Colonoscopists undertaking only screening colonoscopies performed significantly less procedures (mean=152.93, sd=95.52) than Non-Screening Colonoscopists (mean=249.95, sd=149.35). The magnitude of difference was significant (p=.006) with 95% confidence interval [-1.37 to - .226].

This was to be expected as screening procedures only account for 8-10% of total colonoscopy activity (BSW 2018) in units across Wales and this is a similar picture across England (Logan 2012).

Polyp detection rate

Polyp detection rate was well documented with no missing data across either cohort (n=73). The proportion of procedures undertaken where one or more polyps had been detected was captured for individual colonoscopists and mean scores were considered in cohorts as described above to identify statistically significant variation between the two independent groups.

Screening Colonoscopists undertaking only screening procedures detected significantly more polyps (mean=61.63, sd=10.40) than Non-Screening Colonoscopists (mean=32.17, sd= 11.79). The extent of difference was significant ($p<.001$) with 95% confidence interval [1.91 to 3.42].

Polyp detection rate is a significant determinant of quality. Higher polyp detection rates are associated with reduced risk of interval cancer or missed lesions (Corley et al.2014). As discussed in chapter 2, these findings support evidence in the literature where Screening Colonoscopists have been found to detect more polyps than Non-Screening Colonoscopists (Adler 2013).

Rate of procedures undertaken without sedation

The rate of procedures undertaken without sedation was recorded for individual colonoscopists and means were considered for each of the previously described independent cohorts. Although there were some missing data for this KPI (n=34), results indicated a statistically significant difference in the rate at which procedures were undertaken without sedation ($p= .005$).

Screening Colonoscopists undertook significantly more screening procedures without sedation (mean=35.39 sd=13.89) than non-Screening Colonoscopists perform unsedated non-screening procedures (mean=19.66, sd=15.99).

Whilst this is not considered to be a KPI in its own right, as discussed in chapter 2, the JAG recommends collection of data on the rates of procedures undertaken without sedation to assist with interpretation of other KPI's such as comfort scores. There is evidence to link sedation use with complications (Zhao et al.2020) and it could therefore be considered a good thing to use less sedation.

Although there is discrepancy in the literature about the effect of sedation on comfort scores, it is possible that procedures may be more comfortable if sedation is used. The comfort scores in this sample of colonoscopists from health boards in Wales, although not statistically significantly different between groups are higher than the JAG standards indicating patients experience more discomfort at colonoscopy than they should.

Sedation use in patients under the age of 70 years

Sedation use in patients under the age of 70 years was fairly well documented with some missing data (9.6% missing) across the cohorts (n=66). The amount of sedation used in this age range of people (although screening patients are by default aged between 60 and 74 years and not broken down into age bands) varied between 1mg and 2.7mgs of Midazolam.

Screening Colonoscopists undertaking only screening procedures used the less sedation (mean=1.87mgs, sd=.319), than Non- Screening Colonoscopists (mean=2.05mgs, sd= .328). The extent of difference when analysed with the Mann-Whitney U test was significant (p=.001) with 95% confidence interval [1.91 to 3.42].

Benefits and risks of sedation use have been documented (Zhao 2020; Baudet 2019), but as with any drug, and in line with pharmaceutical principles, the

minimum needed to achieve its desired effect should be administered (Holford 2018). Although there is statistically significant variation between groups in the amount of sedation used, all groups use less than the maximum dose recommended by JAG.

Summary of findings of inferential statistics on individual Colonoscopists KPI's

To summarise, this chapter described data collected for the quantitative phase of this study relating to individual colonoscopists key performance indicators in order to answer the research question:

- Is there a significant difference in specific key performance indicator values between screening and non-screening Colonoscopists?

Demographic data relating to the sample were initially presented followed by descriptive statistics and results of initial inferential statistical tests undertaken on the three cohorts of colonoscopist and procedure type (Screening Colonoscopists undertaking screening procedures, Screening Colonoscopists undertaking their total caseload and Non-Screening Colonoscopists undertaking non-screening colonoscopy).

Results of further inferential statistical tests were then presented to assess variation and significance of difference between the two independent cohorts of colonoscopist and procedure type (Screening Colonoscopists undertaking screening procedures and Non-Screening Colonoscopists undertaking non-screening colonoscopy).

Statistically significant variation between the two independent groups was identified in relation to four of the KPI's:

- Procedure numbers
- Unsedated procedure rate

- Sedation use in patients under 70 years of age
- Polyp detection rate.

Procedure numbers can be explained by the relatively low concentration of screening colonoscopies undertaken in Wales compared to non-screening colonoscopy. Screening Colonoscopy accounts of around 10% of colonoscopy activity across Wales (as it does elsewhere in the UK) and when considering their total caseload, Screening Colonoscopists actually perform slightly less than the Non-Screening Colonoscopists, although this difference is not significant as discussed earlier.

The rate at which procedures are undertaken without sedation was not collected by all units (n=34). The JAG does not count the unsedated procedure rate as a KPI in its own right but suggest collection to assist with interpretation of other KPI results such as comfort scores. Screening Colonoscopists undertook significantly more screening procedures without sedation than Non-Screening Colonoscopists. There is evidence to suggest that colonoscopists who use less sedation have better techniques (Rodney et al.1993), although there is also discrepancy in the literature with Khan et al. (2020) stating that sedation is necessary to ensure compliance with completion rates and adenoma detection rate targets.

When sedation is used pharmaceutical principles suggest the minimum dose should be used to induce the desired effect and the BSG guidance suggests that no more than 5mgs of Midazolam should be given and less in older patients. Although there was a statistically significant variation detected between the two independent cohorts (with Screening Colonoscopists using less sedation) when analysed with Mann-Whitney U test, both cohorts of

colonoscopists used sedation doses within the standard quoted for national guidance with a range of between 1mg and 2.7mgs.

The most significant and important finding of the quantitative aspect of this study was a clear, statistically significant difference in polyp detection rates between Screening Colonoscopists undertaking screening procedures and Non-Screening Colonoscopists undertaking non-screening procedures.

Screening Colonoscopists detected at least one polyp at 62% of their procedures, almost twice as often as Non-Screening Colonoscopists who detected a polyp at 32% of procedures they performed.

Although other factors such as service model and pre assessment may contribute to these findings, polyp detection rate is a significant marker of the quality of colonoscopy (Corley et al.2014). These findings support published literature and demonstrate an increase in quality of screening colonoscopy compared to non-screening colonoscopy in relation to polyp detection.

5 Results: Understanding variance in productivity markers between screening and non-screening colonoscopy services

Introduction

The aim of this chapter is to explore variance in productivity key performance indicators (KPI's) between screening and non-screening colonoscopy services. It will answer the following research question:

- Is there a difference in productivity between screening and non-screening colonoscopy services?

Building on the previous chapter relating to individual colonoscopists performance data, this chapter will outline the data available from colonoscopy units to answer the research question relating to productivity. It will move on to describe descriptive and inferential statistical tests undertaken to establish significance of variation in productivity KPIs between the screening and non-screening colonoscopy services.

Productivity

To achieve Joint Advisory Group on Gastrointestinal Endoscopy (JAG) accreditation, endoscopy units are expected to collect and analyse productivity data and demonstrate measures taken to improve results. These include list utilisation, start and finish time audits and data on the rate of patients who do not attend (DNA) their appointments.

Data was requested for planned and actual procedure numbers, cancellations, DNAs and the rate and reason for repeat procedures from all health boards in Wales and from Bowel Screening Wales.

Study sample

Health boards

As described in chapter 3, there are 19 endoscopy units in Wales across the seven health boards. Lead Colonoscopists in each health board agreed to participate in this study by providing productivity KPI data relating to endoscopy units.

Data access

Although all health boards were happy to participate, limited electronic and easily accessible information was available as illustrated in Table 5.1.

The data items requested were considered the minimum that should be available to support effective management of unit productivity in line with the JAG (2016) requirements. However, much of this data was unavailable electronically and only information on the rate of unattended appointments, where patients did not attend (DNA rates) was routinely collected by all health boards and Bowel Screening Wales (BSW).

Some very limited data on planned and delivered lists were available in one health board, but it was not possible to distinguish between screening and non-screening cases. BSW collect this data for screening lists delivered in all health boards, but the lack of comparable information from health boards on non-screening lists made it impossible to compare between the two services for this KPI.

No other data relating to the productivity KPIs were available for inclusion in this study.

Table 5.1 Availability of unit productivity data within each health board in Wales

University health board	Did not attend	Cancellation	Actual vs planned procedures	Rate and reason of repeat procedure
Aneurin Bevan	√	X	X	X
Betsi Cadwaladr	√	X	X	X
Cardiff and Vale	√	X	X	X
Cwm Taf Morgannwg	√	X	X	X
Hywel Dda	√	√	√	X
Swansea Bay	√	X	X	X
Powys Teaching	√	X	X	X
BSW	√	X	√	X
Sample Size	N=7	N=1	N=2	N=0

The data requested was largely unavailable electronically as previously described. Some health board representatives said they audit productivity occasionally, but this was a manual exercise and not consistently undertaken. One example given of a manual audit when nursing staff log start and finish times for colonoscopy lists to ascertain late starts and early finishes as a way of improving timeliness and productivity.

Some Lead Colonoscopists said they could access some of the data requested, but it would take many hours of manual work trawling through different systems and documentation which they did not have time to support.

Bowel Screening Wales were able to supply data on DNAs for screening colonoscopy appointments between 2019 and 2020, which was broken down by health board. This data was also available for the non-screening colonoscopy service in each of the health boards in Wales.

Bowel Screening Wales were also able to supply data on the number of planned screening procedures and of screening procedures that were attended for the complete calendar year of 2019-2020. However, comparator data was limited as although this data was available for non-screening procedures in Hywel Dda University Health Board it was not collected by any other health board. Also, the data Hywel Dda University Health Board supplied on planned and delivered procedures was for total procedure numbers undertaken in their units and included screening colonoscopy so was not an independent sample.

No information was available from any health board or BSW for productivity KPIs from an earlier time point, and no other data related to productivity was available at all.

Descriptive Statistics

This section describes the productivity KPI data available for analysis and compares it to JAG standards. Information on DNA rates to support analysis of variation between groups (screening colonoscopy services and non-screening colonoscopy services) will be described including mean, median and range.

In addition, rates of planned and delivered screening colonoscopy procedures were compared between the screening service in each health board (provided by BSW) and the total service (including screening and non-screening) in Hywel Dda University Health Board, as although not an independent sample, and very small in size, this was the only data available to include non-screening rates of delivered procedures in Wales.

Did not attend (DNA)

To ascertain if there is a difference in productivity between screening and non-screening colonoscopy services, DNA rates for each health board and for each type of service (screening and non-screening) were considered.

Considering the total data set including all health boards and BSW, the mean percentage rate for patients not attending their planed colonoscopy appointments (DNA) is 4.8%. Breaking this data down into individual service cohorts, the rates are median 1.26% (mean= 2.19%) of DNAs for the screening service and a median of 7.3% (mean= 7.42%) for the non-screening service as described in table 6.2. Both services are within the national standard of 10% set by the JAG.

Table 5.2 Rates of patients not attending for colonoscopy appointments in screening and non-screening services.

University health board	DNA % screening	DNA % non-screening
Aneurin Bevan	0.75	2.97
Betsi Cadwaladr	1.26	7.30
Cardiff and Vale	9.82	8.50
Cwm Taf Morgannwg	1.43	2.80
Hywel Dda	0.20	13.62
Swansea Bay	0.00	4.00
Powys Teaching Health Board	1.89	12.76
Range	0-9.82	2.80-13.62
Mean	2.19	7.42
Median	1.26	7.3

Planned and actual procedures

Colonoscopy lists can be cancelled by the service for many internal reasons including managerial changes, lack of staff or equipment. The actual versus planned procedure rate gives an overall understanding of the utilisation of lists and some indication of productivity. BSW collect data on planned and delivered lists and achieved a 93% delivery rate for 2019/20 as described in table 6.3.

As described earlier in this chapter, comparable data was not available for Health boards, although Hywel Dda University Health board were able to supply data on total planned and delivered procedures, which included screening and non-screening and gave an overarching delivery rate of 69.3%.

Table 5.3 Rates of planned versus delivered colonoscopy lists in screening and non-screening services.

University health board	% Booked screening procedures attended	% Booked total procedures attended
Aneurin Bevan	93.8	Not available
Betsi Cadwaladr	93.4	Not available
Cardiff and Vale	94.2	Not available
Cwm Taf Morgannwg	96.8	Not available
Hywel Dda	96.3	69.3
Swansea Bay	86.0	Not available
Powys Teaching Health Board	90.8	Not available
Range	86.0-96.8	NA
Mean	93.04	NA

Distribution of data

Although the size of the data set was very small, Kolmogorov Smirnov and Shapiro- Wilks tests revealed normally distributed data for DNA rates in the screening service, but non-normally distributed DNA data for the non-screening service as described in appendix 5.1.

As there was no clarity on normality of distribution for the entire sample, non-parametric tests were selected to use on DNA data only. Further analysis of the KPI relating to planned and actual procedures was not possible because of the reported data quality issues.

Summary of descriptive statistics for KPI data

In summary, descriptive inspection of the small data set available for productivity KPIs revealed that, there appears to be differences in DNA rates between screening and non-screening services with more patients failing to attend non-screening appointments.

There may also be a difference in the proportion of procedures delivered from those booked between the groups based on the data from one Health Board. Although it appears that more booked screening procedures are delivered than non-screening, it is very difficult to draw conclusions from this data as cohorts are not independent and data comes from only one Health Board.

The next section will focus on inferential statistics examining DNA rates only and aims to establish if the observed difference in DNA rates between colonoscopy services is statistically significant.

Inferential statistics

To answer the research question and ascertain if there was a statistically significant difference in productivity KPIs between screening and non-screening colonoscopy services, inferential statistical tests were used on median DNA rates obtained from health board leads. Although descriptive statistics had identified a difference in DNA rates between the cohorts, further, inferential statistical tests were needed to assess the statistical significance of this difference.

The Mann Whitney U test was conducted to establish variance between DNA rates in the screening and non-screening services as this does not require normally distributed data and is able to accommodate small data sets. Results identified a statistically significant variation between the groups (u=5.000 and

p=.037.) with DNA rates being higher in the screening colonoscopy service meaning that more patients fail to attend.

Summary of findings of inferential statistics on productivity key performance indicators

To summarise, this chapter described data collected for the quantitative phase of this study relating to productivity key performance indicators (KPIs) for colonoscopy services in Wales in order to answer the research question:

- Is there a difference in productivity between screening and non-screening colonoscopy services?

Demographic data on the sample was presented followed by descriptive statistics and inferential statistical test results to assess variation and statistical significance of differences between the screening and non-screening colonoscopy services in relation to productivity KPIs.

The most important discovery was the lack of available data to completely answer the research questions. Productivity data was limited to the rate of patients who did not attend their colonoscopy appointment (DNA) and minimal information from BSW and one health board about planned and delivered activity.

However, from the information available it was possible to determine that there was a statistically significant difference in DNA rates between the screening and non-screening services. Screening patients are significantly less likely to fail to attend a colonoscopy appointment than patients of the non-screening service (2.19% screening DNA rate compared to 7.42% non-screening DNA rate).

There are many potential reasons for this described in the literature including poor scheduling (Denberg et al. 2005). Improved rates for the screening service may be due to better preparation and Pre-assessment of screening patients (Shenbagaraj et al. 2019) and improved communication (Seoane et al.2020).

Although both services were within the national expected standard set by the JAG of 10%, with increasing pressures for reducing waiting times for colonoscopy this needs to be addressed (Shenbagaraj et al. 2019).

Inferential analysis was not possible because of a lack of independent data, but there appears to be a difference in the rate of planned versus delivered procedures between the two services. The screening service delivered 93.5% of procedures planned between 2019 and 2020 and the total service including screening and non-screening procedures in one health board 69.3%, although this must be interpreted with caution. This finding is merely observational and descriptive as these are not independent samples and numbers were too low to statistically analyse.

Insufficient quantitative data were available to fully answer the research questions relating to productivity and further research is necessary.

6 Results: understanding variance in perceptions of the screening and non-screening colonoscopy services and of the Screening Colonoscopist accreditation process

Introduction

The aim of this chapter is to explore perceptions of the screening and non-screening colonoscopy services and the Screening Colonoscopist accreditation process amongst professionals working within endoscopy services in Wales. This will include:

- Screening Colonoscopists
- Non-Screening Colonoscopists
- Endoscopy Unit Managers
- Specialist Screening Practitioners.

Information gained will contribute to understanding the following research questions:

- Is there a perceived difference in quality between screening and non-screening colonoscopy services in Wales?
- Is there a perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
- How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

This chapter will begin by outlining responses to generic topics discussed at semi structured interviews conducted with professionals working within endoscopy units in Wales over a 3-month period in 2021/22. Interviews were undertaken after quantitative data from work package 1 had been interpreted

with the qualitative phase building on findings from the quantitative phase of this study.

Qualitative data will be presented in response to the research questions and contextualised from the perspective of critical realism and thematic analysis as described by Bhaskar (2008) and Braun and Clark (2006).

The chapter will explore participants views on variation of quality and productivity between the screening and non-screening colonoscopy services and perceptions of the Screening Colonoscopist assessment and process. It will investigate emerging themes and help to contextualise findings of the quantitative phase of this study.

Study Sample

Twenty-six interviews were undertaken in total comprising of 10 Screening Colonoscopists, 10 Non-Screening Colonoscopists, 3 Specialist Screening Practitioners (SSP) and 3 Endoscopy Unit Managers as described in table 7.1. Colonoscopists from all health boards in Wales participated and one Endoscopy Unit Manager and Specialist Screening Practitioner from each region.

Table 6.1. Interview participants and representative health boards

University Health Board and Region	Screening Colonoscopists	Non-Screening Colonoscopists	Specialist Screening Practitioner	Endoscopy Unit Manager
Southeast Wales				
Aneurin Bevan	1	1	0	1
Cardiff and Vale	2	2	1	0
Cwm Taf Morgannwg	2	2	0	0
Powys Teaching Health Board	1	1	0	0
Southwest Wales				
Hywel Dda	1	2	1	1
Swansea Bay	1	1	0	0
North Wales				
Betsi Cadwaladr	2	1	1	1
Total	10	10	3	3

Semi structured interview questions

A pre-determined and non-prescriptive topic guide was developed (appendix 6.1), with the flexibility to explore emerging themes and topics of interest as the interviews progressed. Following a literature review and consideration of the quantitative data, interview topics were identified, and loose questions formed to guide participants to offer their perspectives on the topics of interest. After the initial piloting and amendment of the interview guide further revisions were made after interviews to follow up on emergent themes at subsequent interviews.

The interview guide comprised of the following themes: quality and productivity of screening and non-screening colonoscopy services and acceptability of the Screening Colonoscopist assessment process.

Semi structured interviews allowed collection of open-ended data to explore professionals' perspectives and to attempt to understand the world from the interviewee's perspective. As described by DeJonckheere and Vaughn (2019), semi structured interviews require a relational focus with active engagement and practice. Participants were put at ease initially and asked broad general questions at first to explore their views, before moving on to probe into the specific areas of interest.

Data analysis

Considering notes taken at interview and transcripts detailing responses to questions and further discussion, data generated were analysed initially by breaking information down into themes and then manually coding as described by Braun and Clark (2006). This involved repeated reading of the transcripts, whilst actively suppressing any presumptions about the data.

Codes were organised into overarching themes and sub-themes and data extracts reviewed and allocated into coherent sections, ensuring representation of complete dataset. This was an iterative process and alterations were made accordingly (Braun & Clarke, 2006), before defining the themes.

Themes

Whilst exploring the main topics of quality and productivity relating to colonoscopy services and acceptability of the Screening Colonoscopist accreditation process, themes emerged as outlined in table 6.2

Table 6.2 topics and emergent themes following semi-structured interviews

Quality Elite colonoscopists Preparation Quality assurance	Productivity Patients that fail to attend (DNA) Repeat procedures Cancelled or incomplete procedures
Service Structure Scheduling and list size Service pressure Pre assessment and follow up	Accreditation Importance Preparation for assessment Barriers to application

Quality

What was clear from talking to participants was that all Screening Colonoscopists felt that there was a significant difference in quality between the screening and non-screening colonoscopy services with screening being higher quality. When asked what they thought about quality of colonoscopy services and if they felt there was a difference between the screening and non-screening colonoscopy service, one Screening Colonoscopist said:

"I regret to say that there is a big difference in quality between the two services and we can prove that because I look at KPI data for all our colonoscopists every 6 months. It is quite obvious….all the quality indicators are better for the screeners …"

This view was echoed by all other Screening Colonoscopists with another saying:

"Yeah, I think there is a significant difference……. the quality of the screening service is much better and more consistent……. there's also more awareness of everything and more evaluation……"

Most Non-Screening Colonoscopists (all, except one) were equally adamant that the quality of the screening colonoscopy service was better, and one said:

"Yes, in my mind there is no doubt, screening is a better-quality service…. patients on a screening list have more attention…and there's much more scrutiny of the screening service……."

Although discussions were overwhelmingly in favour of the screening service being of higher quality than the non-screening service, one Non-Screening Colonoscopist felt that:

"The two (services) are too different to compare…. the main difference is the volume of work….and the difference in the amount of therapy you come across ……Non-Screening Colonoscopists rule out disease whereas Screening Colonoscopists remove polyps and prevent it…they are two very different things…".

Although the Specialist Screening Practitioners (SSP) interviewed work solely on the screening colonoscopy service, they had perceptions of the non-screening service from working alongside colleagues who covered both screening and non-screening colonoscopy services. These perceptions were clearly aligned to other interviewees, feeling that the screening service was of better quality than the non-screening colonoscopy service. One Specialist Screening Practitioner said:

"I only work in the screening service, but the endoscopy unit staff highlighted to me at the beginning of the screening programme that bowel screening is gold standard. I didn't know any difference, but the unit staff tell me there's a great deal of difference and screening is much better with tighter protocols and the patients are better prepared…. a better service altogether, I think…"

Unit managers have a strategic view across both services and are responsible for operational management of the entire endoscopy unit where screening and non-screening colonoscopy takes place. All three unit managers interviewed felt that the screening service was better quality than the non-screening service. One unit manager said:

"***Yes, yes, there is a big difference. I feel it starts in the preparation of the patient…. Bowel screening has always been the gold standard and we're trying to follow that…. it's a double standard, a standard that the non-screening service should look to strive towards, but in the current climate it's a pipedream…"***

All apart from one interviewee felt that the screening colonoscopy service was "gold standard", and of better quality than the non-screening colonoscopy service. Many commented that there was a "two tier" service and that the non-screening colonoscopy service should be improved to align with the screening service.

The main reasons given for perceived improved quality of the screening programme were:

- More experienced and higher standard colonoscopists
- Better preparation of patients
- Better quality assurance processes

Each of these sub- themes of quality will be explored in the following section.

Elite colonoscopists

Bowel Screening Colonoscopists are seen as the "elite" amongst colonoscopists according to all Screening Colonoscopists interviewed, half of the Non-

Screening Colonoscopists interviewed and all participant SSPs and Unit Managers.

One Specialist Screening Practitioner said:

"There's more confidence in Screening Colonoscopists you know…. they're the top dog kind of thing, you know you're working with the boss……and everything has to be right for screening……."

One Non-Screening Colonoscopist commented that:

"***The entry point to become a Screening Colonoscopist is different to the entry point for Non-Screening Colonoscopists and by and large you will find the most experienced and capable colonoscopists do screening……. they are sort of "Head of Department" if you like…."***

Another shared that view and said:

"As a Non-Screening Colonoscopist there's definitely that feeling that Screening Colonoscopists are sort of top of their game, sort of elites…my perception is that they probably do better quality procedures than the Non-Screening Colonoscopists…"

Although one Non-screening Colonoscopist felt that Screening Colonoscopists were not intrinsically better and said:

"We need to be careful about making assumptions about quality based on whether or not a colonoscopist has put themselves through an assessment. It's a voluntary process and Screening Colonoscopists are a self-selected bunch of people."

However, all Screening Colonoscopists interviewed, and most other interviewees felt that performance of Screening Colonoscopists was better than Non-Screening Colonoscopists. One Screening Colonoscopist said:

"I attend MDT *(multi-disciplinary team)* ***meetings here, I mean, we come across procedures done by Screening Colonoscopists and Non-Screening Colonoscopists, and there's always a difference. Completion rates for the Screening Colonoscopists are always above 90% and for the Non-Screening Colonoscopists, they're not- that's the first thing……."***

There seemed to be a widely held belief by all groups of staff interviewed that Screening Colonoscopists do more procedures than Non-Screening Colonoscopists and it was felt that this may account for their improved performance and quality. One Screening Colonoscopist said:

"***Of course, the screeners do more colonoscopy and that is part of it…they're better because they do more…. we have some colonoscopists working in the non-screening service here doing less than 50 a year…they shouldn't be doing colonoscopy..."***

One Non-Screening Colonoscopist added to this, by commenting that they felt Screening Colonoscopists probably improve their skills by continuing to screen:

"***My assumption is that people who do bowel cancer screening are probably doing a lot more colonoscopy than people who aren't, and I think that probably means that even if they aren't better colonoscopists at the time of entry into the programme, they probably become better by virtue of the fact they are doing more…although it has to be said that they are pretty good colonoscopists in the first place to get into screening."***

A comment made by one Screening Colonoscopist supported this as they said:

"In the years that I have been a screener my skills have improved massively…. I'm a different colonoscopist now…before I started screening, I was a fairly basic colonoscopist, I hadn't done much therapeutic work, I was probably fairly ropey, but every screening list you find pathology and you get lots of practise removing it…. It's really benefitted me, I'm really so much better than I was".

Although most participants felt that Screening Colonoscopists were more accomplished colonoscopists, it was also acknowledged by some (mainly Non-Screening Colonoscopists) that there were Non-Screening Colonoscopists of comparable skill to Screening Colonoscopists who are not accredited to undertake bowel screening procedures for various reasons including the lack of time in their job plans.

One Non-Screening Colonoscopist stated that:

"I think there are some good high-quality people who have chosen not to do screening…. some people who don't do screening colonoscopy are more than capable of it in terms of quality…"

Another Non-Screening Colonoscopist stated that:

"There are plenty of very competent and very skilled colonoscopists in the non-screening group"

It seemed most interviewees were of the impression that whilst Screening Colonoscopists perform to a consistently high standard, there was significant variation in quality amongst Non-Screening Colonoscopists. One Non-Screening Colonoscopist said:

"So, as a group, of Non-Screening Colonoscopists, there are some that are just as good as Screening Colonoscopists, or nearly as good, but there are also those who are quite a way below their standard too..."

One of the Specialist Screening Practitioners went further to say:

"I think you're lucky if you land a particular consultant for the symptomatic *(non-screening)* ***service……it's lucky if they land a Screening Colonoscopist on a non-screening list, they will be sure of a good quality colonoscopy and that's not always the case on a non-screening colonoscopy list…".***

Screening Colonoscopists also appeared to be aware of greater variation in quality amongst Non-Screening Colonoscopists which concerned them, and one said:

"it's worrying, there are some colonoscopists working in the non-screening programme who really shouldn't be doing colonoscopy at all, their numbers are really low and their KPI data is poor, but there's pressure to keep activity levels up to manage waiting times…".

Preparation

The quality of pre-procedure assessment and preparation for screening patients was considered to be far superior to the non- screening colonoscopy service by all interview participants. One Unit Manager said that pre assessment was one of the main reasons the screening service was seen as Gold Standard and:

"*Obviously, the time they* *(Specialist Screening Practitioners who undertake pre procedure assessment on screening patients)* ***get with the patients is, you know, phenomenal……not an option at all for the non-***

screening service. So, they *(screening patients)* ***are prepared better because they've had more time, more energy sort of put into getting them to the procedure, the best prep, stopping medication if required …. It's a big difference from the non-screening service."***

All interview participants felt that patients arriving for screening colonoscopy were better prepared than those attending for non-screening procedures, and this seemed to be very important. One Non-Screening Colonoscopist stated that:

"Good preparation is equally as important as the procedure itself. If the patients not prepared, your colonoscopy isn't going to be as good. Specialist Screening Practitioners make a massive difference to the quality of the procedure…both in terms of information, which reduces anxiety and better adherence to bowel cleansing medications".

Pre-procedure assessment by Specialist Screening Practitioners was cited as the reason for optimal preparation of screening patients by all interview participants. During the hour-long Pre-assessment appointment patients are told about bowel preparation medication and any necessary changes to their own regular medication.

The relationship they build with the Specialist Screening Practitioners and the information they gain at the pre assessment appointment results in far fewer patients failing to arrive for their appointments according to most interviewees. One Unit Manager said:

"There's a very marked difference…screening have a really robust pre assessment which gives patients more information……. they've talked through everything and knew exactly what's happening…I think patients

appreciate the one-to-one information rather than just getting a leaflet in the post……there's practically no DNAs on a screening list unless it's an absolute emergency and it's a big problem with the non-screening service".

Also, fewer screening procedures are cancelled because patients have failed to stop their regular contraindicated medications such as anti-coagulants or not taken the bowel cleansing medication properly according to many participants. One Non-Screening Colonoscopist said:

I'd say the biggest difference is the preparation, the quality of prep on a screening list is great…. We often have patients turning up having taken only half their bowel preparation medication, or not having stopped their anti-coagulants on a non-screening list and we can't complete the procedure. This doesn't happen on a screening list as the SSPs go through everything with them beforehand…Everyone who comes in for bowel screening knows why they are there, they're ready and they expect it…. you know this is a massive difference to the non-screening service.

The rate of complete colonoscopy procedures on the screening service is higher than the non-screening service according to many interviewees. One Screening Colonoscopist said:

"We often have to stop procedures on the non-screening service because patients are too uncomfortable. This doesn't happen on a screening list, and we hardly use any sedation with them…. It's just that screening patients are better prepared, they know what to expect and that it is going to be uncomfortable. Patients on the non-screening service… don't know what to expect, it's kind of hearsay, they've had a chat with friends and families about these procedures and they have no inkling about how uncomfortable or painful it can be …".

They went on to say:

"Procedures are often incomplete on the non-screening service because of non-compliance with the prep *(bowel cleansing medication)* ***and we have to bring them back for another procedure. They may be on codeine*** *(a painkiller that causes constipation)* ***or just not drunk enough water or completed the course of prep, but whatever we often fail to complete a non-screening colonoscopy, and this very rarely happens on a screening list…".***

However, although the benefits of a "screening style" pre assessment process appear clear, there are other factors to consider. Participants of the screening service are by default aged between 60 and 74 years of age and will have passed an assessment of fitness for colonoscopy prior to the procedure. Non-screening patients can be any age and are often frailer than those of the screening service and potentially less likely to be fully compliant with bowel preparation medication according to a few interviewees. One Screening Colonoscopist said:

"So, if you think about it the people coming through the screening programme are in the best possible age range to scope…. they're around 60-74 years old, worldly wise, but not too infirm type group of people. They are much better than the young people who are sometimes more histrionic and the older ones who are co morbid so they're a different group to those coming through the non-screening service….".

Many non-screening services have now introduced pre assessment, but this is apparently not as robust as the screening process according to some participants and there appears to be variation across Wales. Most non-screening colonoscopy services do not pre assess all patients routinely but

apparently prioritise those known to have pre-existing medical conditions or complications.

The attention and individualised care screening patients receive was seen as contentious by some interviewees who commented that it was inequitable as patients of the non-screening service received a lesser quality service. One Unit Manager stated that:

"It's a double standard in a way…..patients with symptoms *(on non-screening service)* ***could have pathology and need more time spending with them before and after the procedure to explain things and what could be found, but they don't get it……There is a feeling from some of my colleagues that screening has introduced a two tier service and everyone should be given the same standard of care……it's not fair that screening is prioritised in the unit…….".***

Quality assurance

There also appears to be widespread belief that the quality assurance processes in place for the screening programme are more rigorous than the non-screening service with ongoing robust assessment of Key Performance Indicator (KPI) data. One Screening Colonoscopist said:

"Well, it's like chalk and cheese isn't it……I'm the lead colonoscopist in my health board and I am trying to give colonoscopists *(on the non-screening service)* ***their KPI data regularly now, I started in January this year and I'm flagging where there is poor performance and giving them tips on how to improve. It's difficult though, it hasn't happened before and I don't think anyone had any idea we had KPIs, especially the surgeons, who don't seem interested. The screening service is a complete contrast, they are very strict and rigid with the way they manage performance. I'm quite***

comfortable with that now, but it was very intimidating when I first started…".

This view of significant difference in quality assurance measures is shared by many interviewees with one Non-Screening Colonoscopist saying:

"We do have our KPIs looked at here, and there's this user meeting where results are supposed to be discussed, but it doesn't always happen……. The screening service is uniform across Wales, but there's variation with the non-screening service. There is some sort of quality control here (on non-screening service)**, but it's not as robust as screening and its variable…"**

Quality assurance processes on the non-screening service were said to be informal, sporadic and variable by some interviewees. One Non-Screening Colonoscopist said:

"I do look up my own KPI data when I can, but I know my colleagues don't…. I think the lead colonoscopist for the health board looks at them sometimes too, but I think its variable, I've never heard from them, I don't think it's a regular thing, quite informal...I've heard the screening programme is much stricter".

One Screening Colonoscopist compared the two services and said:

"In the non-screening service QA is supposed to be six monthly via the Endoscopy User Group, the chair basically looks at your KPI data and sends an anonymised report to you asking you to reflect on the data, but it's a very informal thing, nobody is penalised for it, you know, it's pretty much like….just improve on it and you know some people will and some people

won't. The bowel screening data is much more detailed and regular, it's managed properly".

Although it was said by most interviewed that the quality assurance processes for the screening service were better than the non-screening service, there was a negative connotation to views expressed by some Non-Screening Colonoscopists with terms such as "rigid", "severe" and "heavily scrutinised" being used to describe the process of reviewing KPI data for the screening service. One Non-Screening Colonoscopist said:

"Yes, there is a big difference *(in quality assurance)* ***…. I think the scrutiny in the bowel screening programme is much much more, much more severe, higher, compared to the symptomatic*** *(non-screening)* ***service, yes definitely….".***

Screening Colonoscopists appeared to view the quality assurance processes of the screening service as robust, but positive. Many of them commented that it was helpful to get their data and see how they were performing. One Screening Colonoscopist said:

"We get our own data, but you can also see how you compare to others. The whole process is supportive and constructive feedback is given if its needed, it's very significantly different, better than the non-screening service".

Another went on to say:

"That's one of the attractions of screening, it is quite hard, and it puts a little pressure on you as well as things are being highly monitored and audited, but it is also quite satisfying to be provided with that data, it keeps us on our toes".

One Screening Colonoscopist commented about their own behaviour being different when working between the services saying:

"You are more careful with everything on a screening list because you know everything is being looked at, polyp detection rate, withdrawal and everything, there's no question, because you're aware all the KPIs are looked at properly. They are looked at on the non-screening service, but not as often and nothing ever happens with them".

Another Screening Colonoscopist commented that the robust manner in which the screening service manages quality assurance is part of the reason why the screening service is considered to be better quality and said:

"It may have something to do with the Hawthorne effect as we know we are being watched?"

To summarise, the majority (all apart from 1) of those interviewed felt that the quality of the screening service was far better than the non-screening service with the screening service being seen as "Gold Standard". Reasons given for this view include more experienced "elite" colonoscopists, better preparation and improved quality assurance processes.

Colonoscopists in the screening service were generally seen as "top of their game" and the heads of department, although some interviewees acknowledged that there were also some good colonoscopists working in the non-screening programme. Screening Colonoscopists were seen to be operating with consistently high quality, whilst quality amongst Non-Screening Colonoscopists was considered to be very variable.

Pre procedure preparation was considered to be very important, and all interviewees felt that this was much better on the screening service, largely

because of the work of the Specialist Screening Practitioners who undertake robust pre- assessment. Pre assessment in the non-screening programme was said to be variable, and far less robust than the screening service. Effective pre assessment, according to the participants results in better prepared and less anxious patients, who stop routine medication when indicated and complete the course of bowel cleansing medication meaning that the quality of the procedure itself is improved.

Quality assurance processes were considered to be like “Chalk and cheese” between the services. The screening service was considered to be far more robust in its approach to quality assurance. It was acknowledged that KPI data is monitored more regularly and there is feedback when its needed. Some health boards review KPI data for the non-screening service, but it was said to be variable and usually reliant on individuals’ reflection and motivation to improve. Whilst Non-Screening Colonoscopists considered the approach to quality assurance taken by the screening service to be “severe”, “rigid” or “heavily scrutinised,” Screening Colonoscopists found it helpful, and reassuring saying it keeps them on their toes and drives improvement where it’s needed.

In summary, the screening colonoscopy service was considered to be of higher quality compared to the non-screening service, although, this was considered to be contentious with some interviewees describing a two-tier service. Many interviewees stated that the non-screening service should strive to achieve the standards of the screening service.

Productivity

This section will explore interviewees perceptions of productivity in the different services. According to participants of these interviews, productivity is a topic of conversation in endoscopy units currently as they are required to

optimise the current service to address capacity gaps. This appeared to be a topic many interviewees had previously given consideration. The main themes that emerged from interviews were related to unattended appointments (DNA), cancelled or incomplete procedures and repeat procedures.

Patients that do not attend (DNA)

Most interviewees said that the number of patients who fail to attend colonoscopy appointments was significantly higher on the non-screening service. One Unit Manager said:

"I can't remember the last time we had a DNA on a screening list, it hardly ever happens, I think it's because they've spoken to the S.S.P……. they understand the importance of turning up and taking the prep…… it's like they have a personal relationship with the S.S.P…..they have confidence in them. We get loads of DNAs on a non-screening list, you always expect at least one on every list".

Interviewees from each other professional group agreed and one Non-Screening Colonoscopist said:

"We always struggle with DNAs, despite the nurses ringing them up, they still don't come. I would say it's at least 10% of patients that don't turn up to their procedure on a symptomatic *(non-screening)* ***list. It's a problem, especially now when waiting lists are so long, we can't afford to lose slots...".***

Screening Colonoscopists gave very similar views and one said:

"Gosh, DNAs, I really don't remember when we last had one on a screening list. On the normal *(non-screening)* ***service we get them all the time, there are always a few people that don't turn up every day, in a multi roomed unit***

that's a lot of people…it's a massive difference between the services, it needs looking at……".

Cancelled or incomplete procedures

Cancelled procedures were also reported to be a problem for the non-screening service by many interviewees. There were many reasons given for cancellations, but the ones mentioned most during these interviews were the procedures that were cancelled because the patients were either not prepared properly or had not stopped taking contraindicated medication prior to the procedure day.

One Non-Screening Colonoscopist said:

"We get people turning up on a non-screening list all the time, they haven't read the book, they have no idea what they've come for…. They sign the consent form, get into the room and you know, they're screaming before you start because they have no idea what they are there for…it's really difficult to calm them down and you usually need to reschedule...".

The reason for improved productivity on the screening service was widely believed to be better preparation of patients, particularly because of the Specialist Screening Practitioners (S.S.P.s) pre assessment work. One Screening Colonoscopist said:

"Screening patients are always well prepared, they know what to expect, they've sorted their medication and taken the prep *(bowel cleansing medication),* ***you're good to go. Non-screening patients often have no idea what they've turned up for, there are regularly issues with medication and even if the prep is good enough to do the colonoscopy, you're always worried that you have missed something because its often not as good as it should***

be. We end up bringing lots of people back for another procedure……. it's not fair on them, they need to take more prep".

Inappropriate referrals are apparently also an issue for the non-screening service. One Non-Screening Colonoscopist said:

"We lose some slots because of inappropriate referrals too which isn't an issue for the screening programme. On a screening list you know everyone has had a positive screening test and definitely need a colonoscopy. For the others *(non-screening list)****, you get GPs referring in and I've had quite a few patients that I don't feel need a colonoscopy, but they haven't been filtered out at vetting. It's a really tricky one….you have a patient in front of you who has taken bowel prep for days and is expecting a colonoscopy that they may not need…. I don't think we should put them through an invasive procedure unless they really need it, so I sometimes don't do it and write back to the GP……of course that slot is lost then though."***

There appears to be a general feeling that too many procedures are fitted into non-screening lists and that although less procedures are performed on a screening list, they may actually be more productive. Non-screening lists often over run and sometimes patients at the end cannot have procedures undertaken or need to return for a subsequent procedure if they need polyps removed.

Repeat procedures

The number of repeat procedures was said to be greater on the non-screening service by many participants, because of time and colonoscopist skills. One Screening Colonoscopist said:

"If you have a rammed list in the non-screening service world, which they always are, multiple colons, and OGD's *(Oesophagogastroduodenoscopy- an upper GI tract endoscopy procedure)****……people will have to come back for pathology to be removed that you could have taken out if you had a bit more time in the first place".***

Another Screening Colonoscopist said:

"We can usually take out very small polyps on a non-screening list, but there isn't time to do anything significant, they have to come back, I would say about 10-20% of patients come back for therapy……it also depends on who's doing the initial procedure. Some Non-Screening Colonoscopists don't do much therapy, so even if they have time, they don't remove the polyp…they bring the patient back on a list with a different, usually Screening Colonoscopist".

This means subjecting patients to repeat bowel preparation medication, potentially increasing their risk of cardiovascular complications by stopping anti-coagulation medication for a second time and another invasive colonoscopy procedure according to many interviewees.

Patients on a screening list would nearly always have polyps removed at the time of the initial procedure according to most participants at interview, although sometimes there are so many polyps, or a very complex lesion and a second procedure is necessary. One Screening Colonoscopist said:

"I commonly overrun on my screening lists……. I actually do all my screening lists in the morning now and if I overrun a bit its ok its only into lunchtime and I've sorted my patients out and I've done more polyps. You find so many polyps on a screening list……If you have lots of polyps to

remove on the first 2 patients what do you do for number 3 and 4? It's hard, we always try to remove everything we find at the first procedure, but it's not always possible".

Repeat procedures are a particular issue when non-screening lists are undertaken by private insourcing companies[3] according to many interviewees, as they rarely remove polyps and patients are brought back for another procedure. According to participants, the screening service do not apparently allow insourcing of lists by private companies. One Screening Colonoscopist said:

The insourcing teams are regularly not removing polyps that they should and it's a criticism that not only I have…….they see polyps less than 2 cm in size, but don't remove them and the patients have to come back for another procedure……. I think they are so rushed, but it's not helpful having so many repeat procedures….".

To summarise, productivity on a screening list was said to be improved compared to the non-screening service by most interviewees. Despite having less patients on a list, it appears the screening service is likely to be more productive as fewer patients need to return for repeat procedures, fewer fail to attend their appointments and when they are arrived, they are better prepared, having taken their bowel cleansing medication correctly and stopped their usual medication where necessary so fewer procedures are cancelled on the day.

[3] *Many health boards employ private companies to undertake lists at weekends to address waiting time challenges*

Service structure

The bowel screening service has been set up completely differently to the non-screening service according to many participants. This section will explore interviewees perceptions of the structure of both services and the difference between them. Themes that emerged included scheduling and list size, service pressure, pre assessment and follow up.

Scheduling and list size

Four screening colonoscopies are undertaken on every screening list, but under normal circumstances, before the COVID-19 pandemic there would, apparently be 5 or 6 colonoscopies on non-screening lists, often mixed with additional upper gastrointestinal procedures. This was cited as a problem by many interview participants with one Non-Screening Colonoscopist saying:

"I think the management of lists is my biggest bugbear……..a screening list has greater control over numbers and I know that there's more therapy on those lists, but it often feels a gross inequity that I'm in one room hammering my way through 6 colonoscopies , while in the next room, on the screening list, they've got much more control over that, they've only got 4 patients, better kit, more senior staff and things like that….".

Management of scheduling and booking appeared to be a particular concern with one Screening Colonoscopist saying:

"We book to a standard template for screening, it's always been the same and it works well……we seem to have lost the plot with booking in the non-screening service, it's really gone pear shaped I'm afraid. The booking is random, patients can't get through to the booking clerk, because she's so busy. Phone lines are constantly engaged, it's frustrating for patients. It's chaos……it needs to be managed better.".

On top of already overly full lists, Non-Screening Colonoscopists often have to fit in an emergency procedure which apparently rarely happens on a screening list as that session would be protected. One Non-Screening Colonoscopist said:

"Screening is encapsulated, it's a completely different service, managed differently and run by different people…it's protected".

Most of the Non-Screening Colonoscopists interviewed said that their lists were too full and that they often needed to rush through the last procedure and sometimes cancel those at the end of the list. Most of the Screening Colonoscopists said that the screening lists were "about right" in terms of numbers, although some said they often over run because of the amount of pathology they find, and this is apparently worse since the screening programme started using the new Faecal Immunochemical Test (FIT). One Screening Colonoscopist said:

"I have almost never finished my bowel screening list ahead of time, there's always pathology, especially since we started using FIT…….".

The perception of most interviewees seemed to be that the non-screening service booked too many patients onto a list, although it was widely acknowledged that the volume of patients waiting for procedures meant that lists were not likely to be reduced. One Unit Manager said:

"I think we would all like to book less patients onto a non-screening list……I know procedures are rushed and many people have to come back for a second procedure, but there's always that push back that we need to be taking people off the waiting list and there are just so many people waiting….with the symptomatic workload coming in we just can't afford to do less on a list".

Another unit manager agreed with this and went on to say:

"I've noticed that patients seem to be less comfortable on a non-screening list……. the colonoscopist may be pushing a little bit quicker to get the procedure done…….it makes it more uncomfortable and they're more likely to miss something…….. with screening they have the luxury of time….".

The pandemic has apparently brought about temporary changes to the way in which colonoscopy is performed. The non-screening colonoscopy service now generally operates with fewer patients on a list and more pre assessment is done by telephone, which is similar to the way in which the screening service has always operated. This is a short-term measure according to some interviewees and non-screening lists are to be over booked again very shortly.

Service pressure

Many interviewees felt that non-screening lists were more stressful and poorly managed with pressure to finish on time and move on to the next list. One Non-Screening Colonoscopist said:

"We try to treat everyone the same, but we end up with the list grossly over running, we like to remove pathology, but it adds to the stress, when you're starting your last case on the list, and it's already gone 5 o'clock. I suppose then the quality diminishes because your focus has changed and yeah, you're a bit knackered. It's very stressful, there's a lot of pressure".

Another Non-Screening Colonoscopist appeared to agree, saying:

"Screening lists are conducted in a different manner to a normal colonoscopy list……. there's no such thing as a normal colonoscopy list really, they're mixed lists here with upper GI procedures which in itself brings a certain pressure. You might have 5 colonoscopies and a couple of upper GI

procedures to juggle. There are time pressures to finish the list and I think there will be a tendency to rush and finish faster..."

Many interviewees reported managerial pressure to over book lists with one Screening Colonoscopist saying:

"The scheduling for the non-screening service is ridiculous and when we question it, we are just told we can't afford to lose slots...the waiting lists are so long…. we report them to the Welsh Government…there is a lot of pressure to increase activity".

A Non-Screening Colonoscopist made a similar comment:

"I mean, I think management of the non-screening lists, is the most annoying thing……. screening seem to have more control……. they have more staff and better equipment and just seem to be much more organised altogether".

Although it was widely recognised as a better service model, the screening service was also subject to criticism. It was seen by some participants (all non-screening Colonoscopists) as having disproportionate attention and prioritisation from managers and as having redirected resource from the non-screening service. One Unit Manager said:

"We've tried to adopt the bowel screening philosophy or structure, but obviously with the logistics, and you know, you go to your management team and say, oh we need a permanent pre assessment team, you try to justify, saying it will reduce DNAs and repeat procedures and have long term benefits, but it doesn't hit home……

They went on to elaborate on their perception of the two-tier service saying:

"I know when it comes to cancelling lists in our department, if it was a choice between cancelling a bowel screening list or a symptomatic list, it would always be a non-screening list, because the pressure that comes from the bowel screening programme to comply with waiting time standards and it comes with money…….it goes against the grain for me…….non-screening patients are just as important and have been waiting longer.".

There appeared to be a perception from all groups of staff interviewed, that there was generally more pressure on the non-screening service. Poor management and numbers on the lists were cited most often as the cause along with poor preparation of patients, which was seen to be a result of ineffective pre-assessment of non-screening patients.

Preassessment and follow up

The merits of effective pre assessment discussed by participants have been described above. The screening service appears to have been set up to accommodate an hour long pre assessment telephone call for each patient and this remains the service model today. This is apparently not the case for the non-screening service where generally only those with known pre-existing conditions are pre assessed and this is undertaken by questionnaire or telephone call, with some health boards bringing patients into clinic. It appears to be variable in the symptomatic service and generally not as effective according to many interviewees. One Unit Manager said:

"We would love to replicate the screening model and do better pre-assessment, but it's impossible, for one thing the numbers involved would make it very difficult, but we've been fighting for pre-assessment staff for years and it just not happening, it's not seen as a priority…. screening patients get a much better service……it's a much better service".

Other interviewees commented that the bowel screening service was established from scratch and is "fit for purpose", but the general endoscopy service has evolved over many years in hospitals and been subject to underinvestment for decades. One Screening Colonoscopist said:

"We all know what we would like to do……we would like our non-screening patients to have the same standard of service that the screening patients get with better pre assessment and everything else, but the service is just not geared up that way……. We have always struggled to get any sort of investment into endoscopy….we've been asking for preassessment staff for years…….the screening service was set up to accommodate this from the beginning…….they have a telephone helpline and there are SSPs...by the time we get to see them they have already spoken to the SSP's and others within the programme, they know what to expect and we rarely get people coming through that are not suitable or under prepared".

Some interviewees commented that the follow up of patients was also seen as superior on the screening service as Specialist Screening Practitioners contact patients following their procedure to check for any complications and clarify understanding of findings. This does not happen on the non-screening service but was seen as good practice by many interview participants. One Unit Manger said:

"Screening patients get a much better service after the procedure as well. The SSP speaks to them on the day, but she also rings them the next day to check they're ok and again with the histology……non-screening patients don't get any of that……they get an outpatient appointment to discuss any histology, but otherwise nothing."

Some interviewees said that histology results were available quicker for screening patients than they are for non-screening patients, adding to the criticism about development of a two-tier service. One Unit Manager said:

"Screening patients just get a better service all round……. they even get their histology results quicker……..they're usually available in a week, whereas we're working on 5 to 6 weeks or more for the non-screening patients at the moment…….and they get that personal phone call saying, these are your results and this is what they mean….".

In summary, many interviewees felt that the screening service had been set up appropriately and was "fit for purpose", offering a better service for patients because of the way in which it had been established. Particular benefits were the built in pre assessment time, strict compliance with patient numbers on a list, ring fenced funding and clearly defined and monitored timeliness standards for pre assessment, procedure, follow up and results.

The non-screening service appeared to be overburdened with more patients on a list having different procedures with less time and the expectation that emergency cases will be fitted in on top. Many interviewees described service pressure and a stressful working environment.

Accreditation of Screening Colonoscopists

To become a Screening Colonoscopist, colonoscopists must pass an assessment and become accredited by Bowel Screening Wales (BSW). The assessment involves initial scrutiny of KPI data and previous colonoscopy reports, a multi choice question examination and direct observation of procedural skill. It is a lengthy and costly process and had previously, anecdotally been cited as the reason that many colonoscopists chose not to undertake screening.

As the bowel screening programme is due to expand over the next few years, more Screening Colonoscopists will be needed, and it was therefore considered important to understand if the assessment process plays a part in people's reluctance to come forward for assessment.

In this section the views of interview participants will be explored in relation to the assessment process and accreditation of Screening Colonoscopists. A variety of views were captured which appears to highlight a particular variance between the professional groups interviewed. General themes that emerged however, included the importance of the accreditation process, preparation for assessment and barriers which include time to undertake screening lists and fear of failing the assessment. Suggestions for improvement were also given and are described at the end of this section.

Importance

Most interviewees felt that the assessment process was important, and some said it was essential. One Screening Colonoscopist said:

"Accreditation and quality assurance is phenomenally important for patient safety….and to optimise the workforce skills……I'm a massive believer in it. Some people don't like having their data looked at and then being named and looked at for what they're doing, but you know, a lot of that should be completely expected, for what we do to patients, we should be expecting to be looked at to make sure we meet the standard. Actually, if society knew we weren't doing that generally, I don't think they would be very happy……I've seen a couple of people come through the screening accreditation process and it's a very fair process, it's really fair and really supportive".

This view was shared by all Screening Colonoscopists with another saying:

"The assessment process is essential and for me, I think it was pretty spot on, just the right amount of pressure that you felt you had to work for it …….it was stressful on the assessment day…. but I thought it was the right balance and the preparation beforehand was excellent……. ongoing updates and refreshers were brilliant, that's been really, really helpful".

Non-Screening Colonoscopists appeared to agree that some sort of standardisation of quality was necessary for screening colonoscopists, but there was less certainty of the benefits of the current standard and assessment process with one Non-Screening Colonoscopist saying:

I think you have to have a certain standard, there's no doubt……. it's just how high that bar is set.".

Another Non-Screening Colonoscopist felt that standards should actually be higher and the same for both services, but had concerns about the current assessment process saying:

"***We need to set higher standards, and everyone should meet them, Screeners and Non-Screening Colonoscopists……if you don't meet the standards, you shouldn't scope…… I've had 20 years of post-grad stuff and don't want to go back to that……I don't think the exam is necessary…. just make the target excellence and make everyone meet that……. that's my harsh view".***

It appears that the widespread belief from all cohorts of interviewees was that standardised quality, and the assessment of skills and knowledge was important prior to undertaking screening colonoscopy.

Views on the current assessment process that assures colonoscopists knowledge and skills were more varied with Screening Colonoscopists being

mainly supportive of the current approach and Non-Screening Colonoscopists being more critical.

Preparation for assessment

It was acknowledged by many interviewees that there was a lot of work involved in preparing for assessment and some felt this could be a barrier to application. One Non-Screening Colonoscopist said:

"I saw a colleague go through this…. he spent evenings and evenings, hours and hours getting his data together to apply…….realistically most of us don't have time to do this in work time, it's in your own free time…you need to be willing to give up a lot of your free time to do screening..".

This was echoed by many Non-Screening Colonoscopists with another saying:

"You're asking for people to do quite a lot of work in terms of collecting their data and analysing it……I think there is too much emphasis on process rather than outcome……. I'm sure there would be other ways of doing it to ensure you have the right people doing screening without making it too much of an ordeal for everyone."

Screening Colonoscopists also recognised the amount of preparation work needed for assessment with one saying:

"It was a lot of work, I had to print of 100 reports or something……it takes a lot of time……. this should be easier now with data from NED *(National Endoscopy Database).*

Unit Managers said they did not know much about the assessment process but had just heard it was hard and they wondered if it put people off applying. Specialist Screening Practitioners took a similar stance, but one said:

I think it's a lot of work and I think it has put some people off…….it seems there's quite a rigmarole to get through and I'm sure it's put people off applying".

Many interviewees questioned if there could be a more streamlined way of collecting data to support the assessment process, but there appeared to be a general understanding that the data was necessary.

Barriers to becoming a screening colonoscopist

Some barriers relating to the assessment process have been described, but many people said that the main barrier is colonoscopists' time. Many interviewees said they would have to give up something else in their job plan to accommodate screening and all their work is necessary. It seems screening is generally seen as a significant commitment with one Non-Screening Colonoscopist saying:

"People are just too busy doing other things……. where are they going to fit it in? I'm sure there are some that are worried about the scrutiny that comes with screening, but mostly I think people just have too much on……. they would have to pick this up as additional activity really as they won't be able to drop anything.... that's extra screening colonoscopy lists".

Another Non-Screening Colonoscopist said:

"You know, becoming a Screening Colonoscopist doesn't feel like a huge privilege, it feels like a lot of work for no significant reward. You know there's plenty of opportunities to do extra sessions…. there's no shortage of extra paid work for doctors".

Other Non-Screening Colonoscopists shared this view with one saying:

"There's no great incentive for me to jump through all the hoops to become a Screening Colonoscopist…. I have other fish to fry if you like".

Some interviewees said screening is just too much "hassle" and they already have too much on their plate to commit time to this.

Many interviewees reported knowing Non-Screening Colonoscopists who qualify for assessment to become screening Colonoscopists and yet have decided not to do so. Whilst the main reason appeared to be time as described earlier, some said the fear of failing the assessment and intimidation played a part. One Non-Screening Colonoscopist said:

"We know of people who have applied and been declined, it's a humiliating process to go through. I think to put yourself forward and be told that you're not up to scratch, I think that is not something people want to do".

This was a recurring theme amongst Non-Screening Colonoscopists with another saying:

"It's certainly quite an intimidating process and there is the perception that you know you are very exposed, all of your activities very closely monitored, that there is that greater feedback even after accreditation. I guess it's that sort of self-doubt, you know, am I the right person to do this? Am I going to expose myself as not being very good? I can only speak personally, but it certainly makes me hesitant".

Screening Colonoscopists, who have by default been through the process, acknowledged that it can be intimidating, and one said:

"It's a stressful thing, it probably puts some people off, but all exams are stressful, and I think it was as good as it could be. It's probably a bit more

stressful being observed by peers, but I remember it being fairly clear cut as to what was expected, there seemed good information, it's like all medical exams you go through".

Some people commented that it was likely to be better for younger colonoscopists who had recently completed training compared to those who had been practising 10 years or more. One Screening Colonoscopist said:

"***The assessment process is quite intimidating…….from my point of view it was ok as I'm a young consultant, just come through the training programme….it's easy for me to adapt to that situation, because throughout your training you're assessed and stuff, but I can see why it would be difficult for older consultants who are not used to being watched…..I think the fear of failure would be quite intimidating."***

In addition to the described barriers there appeared to be a feeling from some interviewees that the screening programme was a "closed shop" and an "elite club" that was hard to break in to, although some reported recent improvements and greater inclusivity.

In summary the accreditation process for Screening Colonoscopists was seen as necessary, albeit intimidating for some and longwinded. Some suggestions for improvement to the current process in order to generate additional Screening Colonoscopists were given by a number of interviewees including:

- Improved mentorship for potential and accredited Screening Colonoscopists
- Reduction in the requirements for therapeutic experience prior to accreditation, this was considered to come with screening practice and effective mentorship

- Workshop sessions to raise awareness of screening pathways, including the network multi-disciplinary team
- Improved post accreditation training
- Improved peer support and training sessions to include case studies and training for the entire team
- Access to observed lists including visits to other units to observe and undertake lists
- Electronic data collection prior to assessment
- A communication strategy and active recruitment campaign for potential Screening Colonoscopists
- In depth training modules in lesion recognition
- Normalisation of screening and access to upskill training

Many Screening Colonoscopists commented that they felt there should be greater support for accredited colonoscopists in terms of interaction between screeners and Bowel Screening Wales with more educational events and facilitated peer support where challenges can be shared, and positive experiences and case studies shared.

Conclusion

In this chapter perceptions of quality and productivity amongst Screening and Non-Screening Colonoscopists have been explored, as well as Specialist Screening Practitioners and Unit Mangers. We have also considered views on the accreditation process for Screening Colonoscopists to answer the following research questions:

- Is there a perceived difference in quality between screening and non-screening colonoscopy services in Wales?

- Is there a perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
- How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

In response to the first research question relating to quality, it appears that the screening colonoscopy service is, in the views of my interviewees, associated with increased quality. All apart from one participant interviewed believed there to be a difference in quality between the screening and non-screening services with the screening service being seen as better. Reasons cited for the enhanced quality of the screening service included, “Elite” colonoscopists, an improved service structure, robust pre assessment, and superior quality assurance processes.

In terms of productivity, there appears to be some consensus to the view that the screening colonoscopy service is associated with increased productivity compared to the non-screening service. Many interviewees considered this to be the case because far fewer patients fail to attend screening appointments compared to non-screening patients. Also, there was a view from many interviewees that fewer screening colonoscopy procedures need to be repeated as patients are better prepared for their initial colonoscopy.

The Screening Colonoscopist assessment and accreditation process appeared to be viewed differently by Screening Colonoscopists and Non-Screening Colonoscopists, with Unit Managers and Specialist Screening Practitioners generally feeling that they we not familiar enough with the process to comment. It was acknowledged that more Screening Colonoscopists will be needed and there are Colonoscopists in Wales who satisfy the entry level

criteria but choose not to go for assessment. Reasons cited for this included lack of time in their job plan and having to give something else up to accommodate screening.

Although in the main, the assessment process is seen as necessary, some participants (mainly Non-Screening Colonoscopists) felt that it may put people off applying to become Screening Colonoscopists, as it was seen as lengthy starting with an onerous collection of data prior to application. Fear of failure and humiliation were also factors, and it was felt that many people would apparently not be happy with the level of scrutiny placed on them by the screening programme, both during assessment and after. Screening Colonoscopists view of the assessment process was generally more positive than Non-Screening Colonoscopists, although some suggestions for improvement were given including streamlining data collection, greater mentorship, and peer support.

7 Discussion

Introduction

The background to this study lies in anecdotal evidence suggesting that screening colonoscopy was associated with better quality than non-screening colonoscopy and was less productive because fewer procedures were undertaken on screening colonoscopy lists. Professional conversations have suggested that the accreditation process to become a Screening Colonoscopist may put people off applying.

This study considered quantitative key performance indicator (KPI) data and qualitative data obtained from semi structured interviews with professionals working in both screening and non-screening colonoscopy services. Potential variation and perceptions of difference in quality and productivity between screening and non-screening colonoscopy services were explored along with professionals' views of the Screening Colonoscopist accreditation process.

The aim of this chapter is to build on initial interpretation of data described in results chapters 4, 5 and 6, and to reflect on the findings of both quantitative and qualitative research phases. Findings will be linked to the literature described in chapter 2 to understand how this study has addressed the following research questions:

- Is there a difference in quality between screening and non-screening colonoscopy services in Wales?
- Is there a perceived difference in quality between screening and non-screening colonoscopy services in Wales?
- Is there a difference in productivity between the screening and non-screening colonoscopy services in Wales?

- Is there a perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
- How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

The chapter will be structured around the main research topics: quality and productivity of screening and non-screening colonoscopy services and acceptability of the Screening Colonoscopist accreditation process. Each section will consider both quantitative and qualitative data, how they support or refute each other and how this links to published literature to understand and respond to the research questions. It will end with a reflection on the research methodology, including strengths, and limitations of the study before drawing conclusions in order to make recommendations for further research and for policy makers in the next chapter.

Understanding variance in quality

As discussed previously, the British Society of Gastroenterology (BSG) stated that colonoscopy should be delivered by endoscopists performing high quality procedures (Rees et al. 2016) and worked collaboratively with the JAG (Joint Advisory Group on GI Endoscopy) and ACPGBI (Association of Coloproctology of Great Britain and Ireland) to define key performance indicators (KPIs) with which to monitor quality.

Data was not available for all KPIs in Wales, and it was therefore decided to focus on the following for the purpose of this study:

- Procedure numbers
- Polyp detection rate

- Withdrawal time
- Sedation and unsedated procedure rate
- Comfort score
- Completion rate

Discussion of quantitative and qualitative data analysis relating to quality

The approach to data collection was variable across the health boards with some having the requested KPI values available immediately and others having to access different reports to pull it together with various levels of support from electronic systems. There was, however, a universal willingness to support this study and one Lead Colonoscopist spent 8 hours of their weekend off pulling data together in their unit to complete the request for information. This study was seen as important and likely to generate useful information to shape the future service model. When approached to request participation, many Lead Colonoscopists were of the opinion that we need more Screening Colonoscopists for the future and were particularly keen that we should explore barriers to recruitment and modes of improvement.

Data came in different formats and was collated onto a spreadsheet and later into the IBM Statistical Package for Social Science (SPSS) for analysis.

Understanding individual colonoscopist key performance indicator data

There is some evidence to suggest that Screening Colonoscopists perform better quality colonoscopy with Derbyshire et al. (2018) quoting missed cancer rates of 3.1% for Screening Colonoscopists in England, compared to 7.3% for the Non-Screening Colonoscopists. Data in Wales relating to missed cancers have not yet been analysed, but the following section describes other key performance indicators and makes comparison between the Screening and Non-Screening Colonoscopist cohorts.

Most professionals interviewed for this study felt that Screening Colonoscopists were better colonoscopists than those working for the non-screening service. It was, however also recognised that there were some very good colonoscopists in the non-screening service, but variation in skills and experience in this cohort was considered extreme whereas Screening Colonoscopists work to high quality uniform standards. Ahmed et al. (2015) supports this, stating that Screening and Non-Screening colonoscopists differ in their performance indicators and pathology detection. Naumann et al. (2021) found that even though the quality of screening colonoscopy in England was high at the start of the programme, there has been consistent improvement over the last 13 years. Although the national colonoscopy audits in 2017 and 2019 (Shenbagaraj 2019; Ravindran 2021) indicate general improvement in quality of the key performance indicators listed below, the baseline appears to have been higher historically for Screening Colonoscopists (Adler 2013).

Procedure numbers

There is discrepancy in the literature about the exact procedure numbers that need to be achieved to develop and maintain competence, but as previously described, JAG expect a minimum of 100 procedures to be undertaken per year and BSW (Bowel Screening Wales) require 150 procedures per year.

As a whole, colonoscopists in Wales perform a mean of 240 procedures per year, with Non- Screening Colonoscopists appearing to perform slightly more colonoscopies than Screening Colonoscopists (a mean of 249 compared to 231) when considering the total sample data set, although the difference is not statistically significant. Given that all Colonoscopists involved in this study were senior doctors with comparable lifetime experience of colonoscopy, the

number of procedures undertaken each year by those involved in this study appears to be in line with expected quality standards.

Screening colonoscopy accounts for 8-10% of all colonoscopy activity in Wales (BSW 2020), it is therefore not possible to compare the number of screening procedures undertaken by Screening Colonoscopists to the total number of procedures undertaken by Non-Screening Colonoscopists. Comparing Screening Colonoscopists and the Non-Screening Colonoscopists selected for this study, procedure numbers when performing their total caseloads in each health board in Wales (apart from the individual health board that was unable to supply data) were very similar.

Shilun et al. (2017) suggest that colonoscopy skill improves with practice and the more you do the better you are. This view was expressed by many interviewees who commented that Screening Colonoscopists were better because they do more colonoscopy than those working on the non-screening service, although this view was not supported by quantitative data analysed for this study. There was an assumption that Screening Colonoscopists do a lot more colonoscopy than Non-Screening Colonoscopists, but again data analysed for this study suggests that is not the case, although individuals were invited to participate because of comparable experience. If an average procedure number was taken from a wider pool of Non-Screening Colonoscopist it is possibly that Screening Colonoscopists would perform more than the average Non-Screening Colonoscopist, but for this study, Non-Screening Colonoscopists performed very similar numbers of colonoscopy to the Screening Colonoscopists.

Completion Rate

As previously described, the JAG minimum standard for completion rate is 90% with an aspirational target of 95% and the standard expected of a Screening Colonoscopist in Wales without adjustment for occluding pathology is 90% (BSW 2020).

This study identified slight variation in completion rates between the Screening and Non-Screening Colonoscopists included, with the Non-Screening Colonoscopists only just achieving the minimum of 90% on average and Screening Colonoscopists achieving an average of 94% when undertaking screening procedures and 93% for their total caseload. This variation was not statistically significant according to ANOVA comparison of the total dataset and all cohorts achieved the minimum expected standard.

Given that this study included only a small proportion of the total pool of Non-Screening Colonoscopists, and those considered to be of comparable experience to Screening Colonoscopists, it is possible that a comparison involving greater numbers of Non-Screening Colonoscopists and those with differing experience would show greater variation.

It appears there is a perception that Screening Colonoscopists have a higher completion rate than Non-Screening Colonoscopists, with some interviewees commenting on significant differences noted at MDT (multi-disciplinary team) meetings or on review by Lead Colonoscopists. This view was not supported by quantitative data collected for this study, but as described earlier it is likely that the sample of Non-Screening Colonoscopists included in this study were not typical of the average pool of Non-Screening Colonoscopists.

Polyp detection rate (PDR)

As discussed in chapter 2, there is some debate over whether PDR can be used as a surrogate marker for ADR, although generally it is considered to be acceptable with a standard of 40% PDR being representative of 15% ADR (Kiminski 2017). Bowel Screening Wales set slightly higher standards and expect 50% PDR for Screening Colonoscopists.

The Screening Colonoscopists in Wales involved in this study appear to perform extremely well in terms of detecting polyps, exceeding the 50% screening target with a mean of 62% when undertaking screening procedures and a mean of 52% for their complete caseload. Non- Screening Colonoscopists failed to achieve this standard, with a mean of 32%. Data published by BSW in 2021 (BSW annual statistical report 2021) described an even higher polyp detection rate for Screening Colonoscopists in Wales at 74%.

Inferential statistics demonstrated that the variation between the two independent cohorts (Screening Colonoscopists undertaking screening colonoscopy and Non-Screening Colonoscopists performing non-screening procedures) of colonoscopists was statistically significant with Screening Colonoscopists achieving higher polyp detection rates than Non-Screening Colonoscopists.

The only data available for Screening Colonoscopists performing non-screening procedures was in combination with their screening cases and was therefore not an independent sample and could not be analysed. However, it is interesting to note that the performance of Screening Colonoscopists appears to be worse at 52% PDR when considering their entire caseload including screening and non-screening colonoscopy, although it is still higher than Non-Screening Colonoscopists. This may add weight to the views of Non-Screening

Colonoscopists at interview that Screening Colonoscopists find more polyps because they have more time to look. When working on a non-screening list where less time is allowed, their polyp detection rate falls.

Equally, it could be related to patient population; as noted by Adler (2013), screening patients have more polyps than non-screening patients and that may account for an increased detection rate for Screening Colonoscopists as a cohort. Screening patients are also from within a defined age range (60-74 years) and polyps are known to develop with age (Silva et al. 2014). However, a large UK study (Sehgal et al. 2016) also found there to be a significant difference in ADR and PDR between Screening and Non-Screening Colonoscopists and included results from procedures undertaken on patients within the screening age range only for each cohort, thus mitigating the potential effects of age on polyp development.

Given that we know from the literature that PDR is an effective measure of quality, it might be concluded that Screening Colonoscopists perform higher quality procedures compared to the Non-Screening Colonoscopists included in this study.

This was supported at interview with a popular perception being that Screening Colonoscopists had higher polyp detection rates, which has been shown to be associated with lower rates of missed cancers (Corley et al. 2014). Some interviewees thought this was because Screening Colonoscopists had longer to do the procedure and the longer you spend looking for something the more you will find. However, Rajasekhar (2012) also described significant variation in polyp detection rates, supporting interviewees perception and quantitative findings of this study.

There was consensus in the perception that more polyps were found in screening patients compared to those of the non-screening service and some interviewees felt this may explain the perceived higher polyp detection rate of Screening Colonoscopists, although Adler (2013) found that polyp detection rate was more closely linked to individual colonoscopist factors rather than population or case volume.

It appears that perceptions at interview of Screening Colonoscopists achieving higher polyp detection rate are supported by the analysis of quantitative data for this study which showed a statistically significant variation.

Withdrawal time

As discussed earlier, there is some discrepancy in the literature relating to withdrawal time for colonoscopy, but generally it is considered that withdrawal times greater than 6 minutes are associated with improved quality in terms of adenoma detection rates. JAG set the minimum standard at 6 minutes and BSW 7 minutes.

There was some missing data for this study related to withdrawal times as a KPI (n=39) as not all health boards collect this information, but the data available showed that each cohort surpassed the minimum recommended standard for JAG and BSW.

Non-Screening Colonoscopists take an average of 8.3 minutes to withdraw the scope whilst Screening Colonoscopists take 9.3 minutes when undertaking screening procedures and 15 minutes for their total caseload. Although the cohort with Screening Colonoscopists undertaking their entire caseload is not an independent sample, initial analysis with ANOVA described a statistically significant result. This is an interesting observation because it implies that non-screening procedures, when undertaken by Screening Colonoscopists take

longer, refuting claims by many colonoscopists who described the non-screening colonoscopy lists as over booked and rushed.

Further inferential analysis between the two independent groups demonstrated that the difference in withdrawal times between Screening Colonoscopists undertaking screening colonoscopy and Non-Screening Colonoscopists undertaking non-screening procedures was not statistically significantly different.

Comfort score

The JAG set a standard of no more than 10% of patients experiencing moderate or severe discomfort and expect comfort scores to be recorded as a triangulation of patient, nurse and endoscopist scores, as described previously. However, this study considers only nurse reported comfort scores, as triangulation appears to be inconsistent across Wales.

The percentage of procedures where the nurse scored 4 or 5 (indicating moderate or severe discomfort) on the comfort scale were recorded and compared. Although the BSW scale was slightly different they both comprised of a 5-point Likert scale with 5 being extreme or severe discomfort and were therefore considered suitable for comparison. The National Colonoscopy Audit (Gavin et al. 2013) found that 10% of patients experienced moderate or severe discomfort, but also recognised that measuring comfort is difficult with different scales being used and different interpretation.

In Wales, endoscopy units tend to use a modified Gloucester scale (Ball et al. 2015) which scores comfort on five levels, no discomfort, minimal, mild, moderate or severe discomfort and it appears that patients on screening colonoscopy lists experience greater degrees of discomfort than they should according to JAG standards with nurses scoring 4 or 5 on the comfort scale for

19% of procedures indicating that 19% of patients experience moderate or severe discomfort. This figure falls to 8% for Screening Colonoscopists when considering their total caseload, which includes screening and non- screening cases.

Non-Screening Colonoscopists also appear to perform more uncomfortable procedures than the JAG would expect with 11% of their patients experiencing moderate or severe discomfort. There was a statistically significant difference between the three cohorts related to comfort scores analysed by both ANOVA and Krusckal Wallis tests, but further inferential tests carried out on the two independent cohorts only, Screening Colonoscopists undertaking screening colonoscopy and Non-Screening Colonoscopists performing non-screening colonoscopy found the difference between the two cohorts was not statistically significant.

Although it has been shown that nurses tend to give higher comfort scores, indicating more discomfort (Rafferty et al 2014) these results are concerning as they appear to indicate that patients in Wales on screening and non-screening lists experience more discomfort than they should. Further research is necessary to consider triangulated scores from nurses, endoscopists and patients as well as other patient rated outcome measures to give a more accurate picture of patient comfort.

Comfort was mentioned at interview with some interviewees commenting that Screening Colonoscopists perform more comfortable procedures as Non-Screening Colonoscopists are more rushed and tend to push harder. It was also said that Non-Screening Colonoscopists use more sedation than Screening Colonoscopists. Findings of Ekkelenkamp et al. (2011) would seem to support this in a study that linked better quality colonoscopy with less sedation use,

finding that colonoscopists who used less sedation performed procedures with less discomfort, higher polyp detection rates and higher completion rates. Quantitative data analysed for this study found more procedures were undertaken without sedation by Screening Colonoscopists, but comfort scores were not significantly different.

Sedation use

It appears that some studies found comfort scores were not affected by the use of sedation (Birdi 2015), while others found sedation use not only reduced patient discomfort but also improved the overall quality of colonoscopy (Baudet, et al. 2019). The impact on quality was supported by Zhao et al. (2020) who described increased completion rates with sedation use and Khan et al. (2020) who go further to suggest that sedation use is necessary to achieve current quality standards.

However, as well as the potential side effects from the drug Midazolam, which include life threatening breathing problems (Medline plus 2022) it has been associated with adverse events at colonoscopy. Zhao et al. (2020) linked sedation use with increased risk of bowel perforation.

Although sedation related complications are relatively rare (Behrens et al 2019), the British Society of Gastroenterology (BSG) guidelines (2003) suggest a maximum dose of 5mgs of Midazolam for colonoscopies performed under conscious sedation and with lower doses for the elderly. The JAG standards agree and state that no more than 2mgs of Midazolam should be given to patients aged 70 years and over.

The bowel screening programme in Wales monitor sedation use, but do not break it down by age as their eligible population is restricted to those between the ages of 60 and 74 years. For the purpose of this study the same

information on sedation use in the screening population was used to compare that used for the non-screening cohort aged under and over 70 years.

All mean sedation doses collected for this study were within the expected range as described by JAG and BSG, although Non-Screening Colonoscopists used slightly more sedation in younger people. The variance in sedation use in people aged 70 or less between Screening and Non-Screening Colonoscopists was found to be statistically significant when analysed using ANOVA with the three cohorts, (Screening Colonoscopists undertaking screening procedures, Screening Colonoscopists performing their total caseload and Non-Screening Colonoscopists performing non-screening procedures).

Further analysis with the two independent cohorts (Screening Colonoscopists performing screening colonoscopy and Non-Screening Colonoscopists) using an independent samples t- test did not show a statistically significant difference between rates of sedation use in people aged 70 or younger.

The rate of procedures undertaken without sedation, however, was significantly different between the two groups when analysed with an independent samples t-test, with more screening colonoscopy being undertaken without sedation compared to non-screening colonoscopy.

Whilst the rate of unsedated procedures is not strictly considered to be a KPI, performing colonoscopy without sedation is considered by some to be safer (Takahashi et al. 2005), and the JAG suggest collecting this information to assist with interpretation of other results. It is however a KPI for Screening Colonoscopists with a standard of more than 15% of cases to be undertaken without sedation expected. This study demonstrated that Screening Colonoscopists exceed the BSW standard with 35% of their screening cases being performed without sedation and, although Non-Screening

Colonoscopists perform less unsedated procedures than Screening Colonoscopists, they also achieve the standard by undertaking 19% of procedures unsedated.

Summary of findings relating to individual colonoscopists KPI data

Findings of the quantitative phase of this study relating to individual colonoscopists KPI values showed statistically significant variation between groups for polyp detection rate and the rate of procedures undertaken without sedation. These findings were supported by qualitative data with many professionals interviewed commenting on increased polyp detection rate amongst Screening Colonoscopists and their minimal use of sedation.

Interviewees also said that Screening Colonoscopists perform more colonoscopy and their completion rates are higher, but quantitative data analysis did not reveal significant variation between the groups for these ley performance indicators.

Quality Assurance

Although KPI's are broadly the same for both services there appears to be a significant difference in the way in which they are monitored. All interviewees felt the Quality Assurance (QA) processes of the screening service were much more robust, with some saying they were managed properly, detailed, and regular. Conversely the non-screening service employ a QA process that was seen as informal, variable, and inconsistent according to many interviewees of this study.

Interestingly the Screening Colonoscopists, whilst stating that the QA processes in the screening service were strict and kept them on their toes, appeared to welcome this approach saying it was reassuring and helpful. Non-

Screening Colonoscopists, however believed it to be rigid, severe, or heavily scrutinized.

Service structure

There was widespread consensus at interview that the service model implemented for the screening programme with list numbers restricted to 4 patients, was a better model. Although many interviewees stated that the non-screening service should learn lessons from this and align, many also said that it would not be possible to replicate the screening service model on the non-screening service because of the volume of patients referred.

Pre- assessment

Alongside reduced list size, preassessment was considered to be the most significant benefit for the screening service model. Almost all interviewees commented on the robust nature of pre assessment and the way in which it supported better quality and more appropriate colonoscopy. Rothnie et al. (2014) found that effective pre assessment improved the quality of bowel preparation for patients undergoing colonoscopy.

There also appears to be a different perception of screening lists between the groups with Non-Screening Colonoscopists painting a picture of a calm, organised and relaxed list. Although they recognised that there was more pathology detected, the screening lists were seen as having the luxury of time, additional staff, a more experienced team, and better equipment. Screening Colonoscopists however, had a slightly different view, saying the screening lists were busy lists, with lots more pathology to manage and although they recognised the staff reserved for screening lists were more experienced and there was an extra nurse (Specialist Screening Practitioner) this was considered necessary because of the complex nature of this work. It was interesting to

note that perceptions at interview were that Screening Colonoscopists perform more colonoscopy, although this was not supported by quantitative data. Despite this, Non-Screening Colonoscopists were considered to be the ones who were busier with more cases per list and generally working under pressure with the screening lists being perceived by Non-Screening Colonoscopist as calm and unrushed.

Summary of findings relating to quality

The screening colonoscopy service was generally considered to be of higher quality compared to the non-screening service, because of colonoscopist skill and expertise, QA processes and the service structure. There was some quantitative evidence to support this with increased polyp detection rates and more rational use of sedation for Screening Colonoscopists, but other key performance indicators did not show significant variation.

Understanding variance in productivity

Productivity in colonoscopy relates to the relationship between input and output, usually referring to numbers of patients seen in a given time frame. From discussion with professionals in the field, it appears that productivity is currently a topic of conversation in endoscopy units as they are required to optimise the current service to address capacity gaps at the same time as improving and maintaining a quality service. Some of the quality improvements in colonoscopy such as increased withdrawal time increase the time taken to perform a colonoscopy. This, together with the backlog of patients waiting for procedures after the Covid 19 pandemic and previous underinvestment in endoscopy services mean productivity is paramount in today's colonoscopy services. Bryce et al. (2019) found that multiple small improvements in efficiency such as on turnaround times and procedural

preparation could achieve significant impact on productivity, although sustainability of these improvements was noted as difficult to assess in the short term.

Discussion of quantitative and qualitative data relating to productivity

Productivity of individual colonoscopists is not monitored in endoscopy services in Wales. Indeed, although JAG expect endoscopy units to collect productivity data and have systems in place to use the information to drive improvements, most units in Wales struggle to do so. Hampered by the lack of joined up electronic systems, much data on productivity relies on manual snapshot audits relating to the unit as a whole rather than individual colonoscopists.

Data for this study was limited to the rate at which patients do not attend colonoscopy appointments (DNA) and very limited information on planned and actual procedures for both services.

Did not attend

Many patients fail to attend appointments and much needed capacity is lost (GIRFT 2021). The rate of unattended appointments, known as DNAs (did not attend) is monitored and has an enormous impact on the quality of endoscopy services causing significant administrative burden, extended waiting times and increased costs. Tools have been developed to support improvement (NHS England and NHS Improvement 2021) which involve developing an understanding of the cause of DNA's and implementing mitigation such as improved pre assessment and better communication.

This study found variation between the screening and non-screening services in relation to DNA rates with the non-screening colonoscopy service having 7.4% of patients failing to attend compared to 2.2% on the screening service.

When analysed using a Mann Whitney U test, this variation was found to be statistically significant.

Non- attendance at colonoscopy appointments has been a significant issue for decades (Adams et al. 2004) and presents a real challenge to the service and risk to patients as diagnoses are further delayed. Both services in Wales appear to have higher rates of DNA's than the UK national average which has been quoted at 3.48% for non-screening colonoscopy and 1.3% for screening colonoscopy by JAG (Ravindran et al 2021). The JAG figures are based on self-reported audit data from 68% of endoscopy units in the UK and are less than the national expected standard set by JAG of less than 10%.

Causes of non-attendance are multi factorial and some may be avoidable. Several studies have shown benefit in sending text reminders (Baker et al. 2015), but this service is not available in all health boards in Wales and is not widely used for the colonoscopy service.

Although screening colonoscopy DNA rates are better than the non-screening service in Wales, in the current climate of long waiting times, any lost colonoscopy appointment is significant, and improvement must be made. Denberg et al. (2005) suggests this can be improved by better communication and improvement in the quality of colonoscopy management and scheduling mechanisms.

The DNA rate appears to be a longstanding issue that all professionals interviewed were aware of. All interviewees said that the non-screening service had a significant issue with people failing to attend their colonoscopy appointment, commenting that it happened every day, but this was not considered to be a problem for the screening service. Some interviewees said they could not remember the last time a patient failed to attend a screening

colonoscopy appointment. Although Plumb et al. (2016) described many patient factors associated with non-attendance, reasons for the perceived improved screening service DNA rates given by interviewees of this study were mainly centred on Pre-assessment. Many people said that patients were better informed, they knew what to expect and had built up a relationship with the Specialist Screening Practitioner, making them more likely to attend. This view appears to be supported by the literature and Shenbagaraj et al. (2019) also commented on lower DNA rates for the screening programme citing robust Pre-assessment as the cause.

Many interviewees said that the non-screening service would be more productive if they invested in effective pre- assessment.

Planned versus actual activity

The Getting it Right First Time (GIRFT) report (2021) discusses ways of optimising capacity and managing demand for endoscopy services in an attempt to achieve balance and strengthen management to optimise current services. Many recommendations are given to improve quality and productivity including suggestions to optimise workforce, make effective use of clinical time and improve pre-assessment processes. A major focus of the GIRFT report (2021) was on making better use of current services which includes ensuring all planned activity is delivered.

Planned versus delivered activity is an indicator which endoscopy units should report to achieve JAG accreditation, it supports effective and high-quality management of units, but this data appears to be very poorly collected in Wales.

Bowel Screening Wales collect data on planned versus delivered activity to ascertain list utilisation. The derived list utilisation rate for BSW was said to be

93% for 2019-2020, meaning that 93% of the lists planned actually go ahead. Unfortunately, it was not possible to compare this with the non-screening service, as the only health board that was able to collect this data at all was not able to break it down into screening and non-screening. The list utilisation rate for all endoscopy services in that one health board was 69% which appears significantly different to the screening programme, but as the data set was so small and cohorts not independent further analysis was not possible. The quantitative phase of this study has not been able to determine if list utilisation is better for the screening service than the non-screening service, although findings suggest it may be and further research is necessary.

Repeat procedures

Effective pre- assessment was also said to result in patients being better prepared from a medical perspective. Examples were given of patients arriving at non-screening colonoscopy lists without having stopped their anti-coagulation medication meaning a therapeutic procedure could not be performed. This would apparently not happen on a screening list as the Specialist Screening Practitioner would have gone through medication beforehand and given advice on necessary changes. Bowel cleansing medication would also be taken properly on a screening list apparently with fewer sub- optimal or incomplete procedures as a result. This is supported by Ahmed et al. (2016) who described increased completion rates amongst Screening Colonoscopists.

Most interviewees felt that there were fewer repeat procedures on the screening service, although there was no quantitative data available to support or refute this perception.

Cancelled procedures

Some interviewees said that screening lists are prioritised over non-screening lists, and this was seen as contentious by a few interviewees, mainly Non-Screening Colonoscopists and Unit Managers. One interviewee said that if their unit had to cancel a list, it would not be a screening list. Screening was said to be perceived as more important by some managers and although some interviewees made reference to increased pathology detection, many also said it was unfair that screening patients received a far better service than the non-screening service. Ravindran et al. (2021) found that the rate of cancelled procedures was much lower on the screening service, but there was no data available to confirm or refute this in Wales.

Summary of findings relating to productivity

To summarise, productivity on a screening list was said to be better than the non-screening service by most interviewees. Despite having less patients on a list, it appears the screening service is likely to be more productive as fewer patients need to return for repeat procedures, fewer fail to attend their appointments and when they arrive, they are better prepared, having taken their bowel cleansing medication correctly and stopped their usual medication when necessary, so fewer procedures are cancelled on the day.

Although there is some evidence in the literature to support these perceptions, there was limited quantitative data available for this study. Findings did, however, identify a statistically significant difference in DNA rates between the two services with the screening colonoscopy service having a much lower rate of patients failing to attend colonoscopy appointments than the non-screening service.

Understanding perceptions of the Screening Colonoscopists accreditation process

Interviewees generally thought the assessment and accreditation process for Screening Colonoscopists was necessary, although some felt it was unnecessarily lengthy. The fact that it is considered necessary is in keeping with the European Society of Gastrointestinal Endoscopy position statement on quality in screening colonoscopy (2012). Three main themes emerged during interviews and will be explored in this section.

Importance

There was a difference in perception between the groups with Screening Colonoscopists saying the accreditation process was important and whilst acknowledging it as challenging, generally felt it was supportive and a positive experience. Non-Screening Colonoscopists (who have not gone through accreditation) appeared to perceive the assessment process to be unduly harsh and critical with a significant administrative burden in advance. Specialist Screening Practitioners and Unit Managers said they were not familiar with the process, but they had heard it was hard and lengthy with a lot of documentation to collect prior to assessment.

Although there appears to be multiple papers describing the quality standards of screening colonoscopists (BCSA 2011) and others confirming improved performance (Lim et al. 2011), there seems to be a paucity of qualitative research into professional perspectives of the accreditation process. This further supports Greenhalgh's (2016) view that there is underrepresentation of qualitative research in clinical journals.

Preparation for assessment

Data collection to support application for accreditation appeared to be a particular concern for many interviewees, which apparently was not helped by

the lack of electronic systems and processes. Some interviewees commented on the amount of information that was needed to apply for accreditation and said that this would need to be done in their own time as there was no time within their current job plans. This concern appeared to be shared by all professional groups interviewed.

Barriers to application

Although in the main, the assessment process was seen as necessary, some participants (mainly Non-Screening Colonoscopists) felt that it may put people off applying to become Screening Colonoscopists, as it was seen as a lengthy process starting with an onerous collection of data prior to application. Fear of failure and humiliation were also factors, and it was felt (mainly by Non-Screening Colonoscopists) that many people would apparently not be happy with the level of scrutiny placed on them by the screening programme, both during assessment and after. The main barrier though appeared to be time in their job plans and the need to give something up to accommodate screening.

This coupled with the fact that assessment is a lengthy process which needs commitment, and the ongoing level of scrutiny were considered barriers to application for assessment and accreditation.

The Screening Colonoscopist assessment and accreditation process appeared to be viewed differently by Screening Colonoscopists and Non-Screening Colonoscopists. Screening Colonoscopists view of the assessment process was generally more positive than Non-Screening Colonoscopists, although some suggestions for improvement were given including streamlining data collection, greater mentorship, and peer support. Unit Managers and Specialist Screening Practitioners generally felt that they we not familiar enough with the process to comment.

It was acknowledged that more Screening Colonoscopists will be needed and there are colonoscopists in Wales who satisfy the entry level criteria but choose not to go for assessment. Reasons cited for this included lack of time in their job plan and having to give something else up to accommodate screening.

Summary of findings relating to perceptions of Screening Colonoscopist accreditation process

The assessment and accreditation process for Screening Colonoscopists were generally seen as important and necessary, although also lengthy and long winded. It appears that some improvement could be made to the administrative and data collection processes, but the basic principle of examination and observation of procedural skill was considered sound. However, there are examples from elsewhere in the UK where accreditation has been streamlined that appear to be well received (Lloyd et al. 2021).

The barriers to becoming a Screening Colonoscopist appeared to be more to do with other work pressures and time commitments rather than the assessment process itself, although some Non-Screening Colonoscopists felt that this may also be putting people off applying.

It appears that assessment and accreditation is viewed differently by Non-Screening Colonoscopists, who have not gone through the process themselves. Perhaps more positive and proactive communication from people who have completed assessment, and from BSW to clarify the process and what to expect and also the support and benefits available would help in reducing the barriers and encouraging other colonoscopists to put themselves forward for assessment.

Conclusions and implications

Data gathered during the quantitative and qualitative phases of this study have been collated to answer the following research questions:

1. Is there a difference or perceived difference in quality between screening and non-screening colonoscopy services in Wales?
2. Is there a difference or perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?
3. How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

This section will draw data together to consider each question in turn and make recommendations for further research and for policy makers for elaboration in the next chapter.

Is there a difference or perceived difference in quality between screening and non-screening colonoscopy services in Wales?

The majority of those interviewed for this study believed the screening service was of higher quality than the non-screening service. Reasons given for this included the use of “elite” colonoscopists, better service structure, better quality assurance processes and robust pre assessment of patients.

In terms of KPI data to support this view there is a very clear and statistically significant difference in polyp detection rate with Screening Colonoscopists detecting more polyps. This may be partly due to the fact that much of their workload is with screening patients who have more polyps, although even when their total caseload is considered their rates appear higher. Rees et al. (2016) considered adenoma detection rate to be the marker most commonly

associated with high quality colonoscopy. With polyp detection rate (PDR) being an accepted surrogate marker for Adenoma detection rate, the higher PDR rate amongst Screening Colonoscopists in Wales appears to represent higher quality procedures being undertaken by Screening Colonoscopists from the perspective of polyp detection.

Completion rate and other key performance indicators did not appear to be significantly different, although Screening Colonoscopists appear to use less sedation and perform more unsedated procedures.

In response to the research question posed it appears that there is a strong perception that screening colonoscopy is of higher quality than non-screening colonoscopy and there are some key performance data to support this view.

Is there a difference or perceived difference in productivity between the screening and non-screening colonoscopy services in Wales?

Productivity is a broad term encompassing many aspects of endoscopy services. In terms of whether the screening service is more productive than the non-screening service there is a perception amongst interviewee participants, that it is, although this was mainly related to the rate of patients failing to attend appointments. Productivity would be reduced if colonoscopy appointments were lost by patients failing to attend so this perception appears to be sound. There is clear quantitative evidence to support this view with a statistically significant difference between the screening and non-screening services in terms of DNA rate with the screening rate being less than one third of the non-screening service.

There was consensus that the pre-assessment process adopted by the screening service were the source of improved productivity as patients were

better prepared and less likely to cancel an appointment or fail to attend. All interviewees considered the assessment process in the screening service to be superior to that of the non-screening service.

Other aspects of productivity were not tested though because of a lack of data, so in response to this research question perhaps it may be fair to say there is a perception of increased productivity within the screening colonoscopy service. This is supported by quantitative data to demonstrate a statistically significant decrease in the number of patients failing to attend a screening appointment compared to a non-screening appointment, but other markers of productivity have not been tested.

How is the assessment process for Screening Colonoscopists in Wales perceived by Screening Colonoscopists, Non-Screening Colonoscopists and other endoscopy unit staff?

The Screening Colonoscopist assessment process appears to be viewed differently by Screening and Non-Screening Colonoscopists. Whilst the majority viewed the process as important and necessary, although lengthy, Non-Screening Colonoscopists considered it to be harsh, strict, rigid, and heavily scrutinized. They felt people would be deterred from applying because of fear of failure and humiliation. They also felt some colonoscopists would not be happy with the ongoing level of scrutiny the screening programme utilises.

Screening Colonoscopist however recognised the assessment process as stressful, but felt it was fair, supportive, and well executed. They were reassured by the ongoing quality assurance processes within the screening programme and commented on feeling well supported. Other professional groups interviewed were unfamiliar with the assessment process but had heard it was hard and long winded.

It seems the assessment process itself may put some people off applying, with the main issues relating to the manual data collection necessary prior to application and the time it takes to go through the process. A more significant barrier appeared to be lack of time in job plans to undertake screening.

It appears that the assessment process is viewed as positive by those that have been through it, although some recommendations for improvement were noted including facilitating electronic data collection, shorter timeframes between application and assessment and greater mentorship and training opportunities. Those that had not been through the process and had minimal knowledge of the detail or available support given to progress had a different view.

In response to the research question, perceptions of the Screening Colonoscopists assessment process were mixed, although most interviewees saw it as necessary. It appears some improvement is needed to the enabling processes of assessment and accreditation. Communication appears to be lacking and the screening colonoscopists perspective and a realistic description of the process and support mechanisms in place for applicants should be proactively communicated to potential Screening Colonoscopists.

Reflections on research design

A key strength of this study was the mixed methods design enabling consideration of any variation in quality and productivity between screening and non-screening colonoscopy services as well as professional perceptions of the Screening Colonoscopist accreditation process. Flyvbjerg (2006) suggested that good social science should employ a mix of qualitative and quantitative methods to effectively answer the research question. Greenhalgh et al. (2016)

described a paucity of qualitative research in clinical journals, which does not appear to have been addressed.

The literature identified that quality and productivity have been the focus of endoscopy services for many years (Gavin et al 2013), but there is little evidence to suggest significant comparison between the screening and non-screening services, particularly in Wales and professional perspectives on accreditation of Screening Colonoscopists did not appear to have been considered.

Sampling of staff was undertaken through a pragmatic approach with reliance on the Lead Colonoscopist to identify appropriate participants. Although criteria for inclusion were given, the Lead Colonoscopist may have included colonoscopists who would show their health board in a positive light. However, quantitative analysis of key performance indicator data enabled comparison of quality between colonoscopists working in screening and non-screening services in Wales. Although availability and quality of data relating to productivity were limiting factors, it has been possible to consider variation in the rate of patients failing to attend colonoscopy appointments for both services.

Qualitative analysis of semi structured professional interviews provided an opportunity to explore perceptions of quality, productivity and of the accreditation process for Screening Colonoscopists to derive a rounded view on the topics of interest.

The use of thematic analysis provided a practical application framework and a robust, rigorous, and transparent approach to analysing qualitative data to facilitate deeper understanding.

Critical realism proved useful for understanding the reality of both services, providing a common epistemological and ontological standpoint which facilitated the mixing of data gathered during quantitative and qualitative phases of this study. This allowed in-depth insight and greater understanding of variation between the services and perceptions of the accreditation process for Screening Colonoscopists.

The study was limited by availability of data and busy clinicians juggling post pandemic workloads. On reflection, if data had been more readily available it would have been better to have included more Non-Screening Colonoscopists and to have limited KPI data to procedures carried out on people within the age range for screening, thus removing any population bias.

Study strengths, challenges, and limitations

Strengths

This study involved all health boards in Wales, although one health board was not able to provide data for the quantitative phase. Although much has been written about quality of colonoscopy, there is a paucity of Welsh data, which this study sought to address as well as the lack of qualitative information on professional perspectives of the screening and non-screening services and the assessment and accreditation process for Screening Colonoscopists.

The study involved gathering both quantitative and qualitative data and triangulating it to develop recommendations for further research and for policy makers. This research has been undertaken with the population who are likely to benefit from its outputs (professionals involved in delivering colonoscopy services in Wales) and the researcher was known to most of them. National organisations in Wales including the Welsh Association for Gastroenterology (WAGE), who represent professionals in the field, along with the National

Endoscopy Programme (NEP) and Bowel Screening Wales (BSW) are well positioned to act on findings of this research on behalf of their members.

The study utilised a reasonably sized sample from different professional backgrounds and there was enthusiasm to participate. Enthusiasm came from the perspective of wanting to make a difference to colonoscopy services in Wales and this study was seen as capable of generating data to support this.

Challenges

Data quality and completeness was the biggest challenge with a surprising lack of data on productivity measures from all health boards in Wales and historic individual colonoscopist KPI data. Availability of electronic data appears to be a daily challenge to professionals in Wales with some Lead Colonoscopists going to great lengths to draw data together from different systems to support this study. Whilst this is a limitation for the analysis of this study, it is a significant point of learning for services in Wales and evidence of direction for future improvement.

Research questions were revised to reflect availability of data in relation to productivity and also to historic data which was not available for all colonoscopists. The original intention was to explore any change in quality and productivity over time to see if implementation of the screening programme had made a difference to both services, but this was not possible.

It was also originally intended to study variation between Screening Colonoscopists performing non-screening colonoscopy and Screening Colonoscopists performing screening colonoscopy as anecdotal evidence from professional conversations suggested they behave differently depending on which service list they were performing. This was not possible as no health

board in Wales was able to separate complete activity into screening and non-screening cases.

Limitations

The study was limited by availability of data as described. For example, exploration of variance in productivity was limited to the rate at which patients do not attend (DNA) colonoscopy appointments, and although interesting it is difficult to draw conclusions on variance in productivity between the different services from this narrow perspective.

Although sample size was considered adequate to assess variation in quality and productivity between screening and non-screening colonoscopy services, it is noted that a small sample of the total pool of Non-Screening Colonoscopists were included, and those that were had deliberately been targeted because of their comparable experience to the Screening Colonoscopists. It was therefore not possible to assess the extent to which variation in quality of individual colonoscopists exists within the non-screening colonoscopy service generally.

Implications for future research and policy makers

Areas for future research and implications for policy makers will be discussed in more detail in the next chapter but include further exploration of data quality issues, quality and productivity measures for both individual colonoscopists and endoscopy units and suggestions for improvement to the Screening Colonoscopist assessment and accreditation process.

Conclusion

In this chapter findings of this mixed research methods study have been considered and research questions explored relating to quality and

productivity of screening and non-screening colonoscopy services and perceptions of the accreditation process for Screening Colonoscopists.

It has been established that there is some evidence to suggest the screening colonoscopy service is associated with better quality and improved productivity than the non-screening colonoscopy service and perceptions of the Screening Colonoscopist assessment and accreditation process are broadly positive although some areas for improvement have been noted.

8 Conclusion

This thesis has documented findings of a mixed methods research study which considered variation in quality and productivity between screening and non-screening colonoscopy services in Wales. The study also explored professional perspectives of quality and productivity and the Screening Colonoscopist accreditation process.

As discussed in chapter 7, it has been established that there is some evidence to suggest that the screening colonoscopy service is associated with increased quality and productivity compared to the non-screening colonoscopy service and perceptions of the Screening Colonoscopist accreditation process are broadly positive.

This chapter will build on discussion in chapter 7 and present summarised conclusions focused on the initial topics of interest; quality, productivity, and accreditation of Screening Colonoscopists. Data quality will be included as an emergent finding and the chapter will conclude by outlining the contribution this study has made to the evidence based and making recommendations for further research and for policy makers and managers.

Quality

The screening colonoscopy service in Wales was perceived to be of higher quality than the non-screening colonoscopy service. Reasons given included the use of “elite” colonoscopists, a better service model, more robust pre-assessment and a more rigorous approach to quality assurance.

There is some quantitative evidence to support this perception with polyp detection rates being statistically significantly increased for Screening Colonoscopists along with the rate of procedures undertaken without sedation

and sedation dosage used in younger patients. There was a perception that Screening Colonoscopists identify more polyps because they have more time to look and because they do more procedures. Neither of these assumptions were supported by the quantitative data.

All other KPIs relating to quality were not significantly different and comfort scores for all groups indicated increased levels of discomfort compared to the JAG national standard.

Productivity

The screening colonoscopy service in Wales is perceived to be more productive than the non-screening colonoscopy service. This perception was based mainly on the fact that fewer patients do not attend (DNA) screening colonoscopy appointments than non-screening colonoscopy appointments. This was supported by quantitative data with a statistically significant variation between services.

However, no other data related to productivity was available apart from one health board's collection of information relating to planned and delivered procedures which was not broken down by service type. This was also available from Bowel Screening Wales for screening lists across Wales, but with no comparator data it was not possible to establish significance.

Robust pre assessment was cited as the reason for decreased DNAs in the screening programme, although it was also recognised that it would not be possible to replicate this for the non-screening service due to the volume of patients referred.

Screening Colonoscopist accreditation

There were differing views of the Screening Colonoscopist assessment process between groups. Whilst most interviewees felt the accreditation process was necessary and important, many felt it was long winded with onerous expectations of data collection prior to assessment. Those that had gone through the accreditation process (Screening Colonoscopists) however, considered it to be robust, but fair and supportive. Many Non-Screening Colonoscopists had a different view and felt the accreditation process was overly critical, strict, and harsh, although mainly agreed that it was important.

Some interviewees felt that the accreditation process and ongoing scrutiny of KPI data may put some people off becoming a Screening Colonoscopist, but the main barriers appear to be time commitment and job plans.

Data quality

The study was limited by a surprising lack of data relating to key performance indicators for quality and productivity that should be collected by endoscopy services according to the JAG.

The study protocol had been amended to include a limited number of KPIs which were said to be well documented in Wales, but 5 of the 8 KPIs related to quality still had some data missing. Data relating to productivity was particularly poorly collected and, as discussed previously was only available consistently for the rate at which patients do not attend (DNA) colonoscopy appointments.

Availability of electronic data appears to be a daily challenge to professionals in Wales with some Lead Colonoscopists going to great lengths to draw data together from different systems to support this study.

Muller (2018) states that lower-level performers can take steps to improve measured performance but improving productivity in endoscopy units in Wales would appear to be difficult without these most basic measurements in place.

Contribution to evidence base

This study has contributed to the evidence base in that there is now qualitative and quantitative evidence to support significant variation in quality between screening and non-screening colonoscopy services in Wales. Screening colonoscopy is perceived to be of higher quality and there is statistically significant increased polyp detection rate amongst Screening Colonoscopists in Wales compared to Non-Screening Colonoscopists.

There is also now clear evidence to support statistically significant increased productivity of the screening colonoscopy service in Wales relating to the DNA rate and this was supported by qualitative data.

Professional perspectives on accreditation of Screening Colonoscopists do not appear to have been considered previously and this study has provided insight into benefits and concerns with suggestions for improvement.

A significant contribution of this study is to highlight the issues with data quality and provision of routine electronic performance and quality assurance data.

Implications for future research

Further research is recommended into variation in quality between screening and non-screening colonoscopists in Wales using a bigger sample size of Non-Screening Colonoscopists. The age range of patients whose procedure data is included in the KPI reports should be restricted to match that of the screening service. This would remove any population bias and enable a better

understanding of the true comparison between individual colonoscopists KPI data.

Colonoscopists for this study were matched by experience and therefore Non-Screening Colonoscopists were not truly representative of the wider pool of Non-Screening Colonoscopists. Anecdotal evidence from professional conversations suggests there are some Non-Screening Colonoscopists in Wales who perform very few procedures and whose KPI values are of poor quality. It is likely that further research with this protocol would describe even greater variation in quality between the two services.

Further research into variation in productivity would be useful to inform service development.

Implications for policy makers and managers

Challenges with data collection processes in Wales need to be addressed to enable routine collection of quality assurance and performance data.

In addition to improvement in electronic data collection systems, administrative processes supporting the Screening Colonoscopist accreditation process needs to be streamlined to reduce timescales between application and accreditation.

Communication about the benefits of becoming a Screening Colonoscopist should be improved and include processes in place to support Screening Colonoscopists and accounts from newly accredited Screening Colonoscopists.

References

Adams, L.A., Pawlik, J., Forbes, G.M. 2004. Nonattendance at outpatient endoscopy. *Endoscopy*; 36: 402– 404.

Adler, A., Wegscheider, K., Lieberman, D., Aminalai, A., Aschenbeck, J., Drossel, R., Mayr, M., Mrob, M., Scheel, M., Schro¨der, A., Gerber, K., Stange, G., Roll, S., Gauger, U., Wiedenmann, B., Altenhofen, L., Rosch, T. 2013. Factors determining the quality of screening colonoscopy: a prospective study on adenoma detection rates, from 12 134 examinations *Gut*;62:236–241. doi:10.1136/gutjnl-2011-300167

Ahmed, S., Naumann, D., Karandikar, S. 2015. Are there differences in screening vs. non-screening colonoscopy? PTH-342. Gut ;64:A559.

Ahmed S, Naumann DN, Karandikar S. 2016Differences in screening vs non-screening colonoscopy: scope for improvement? *Colorectal Dis.* Sep;18(9):903-9. doi: 10.1111/codi.13291.

Alonso-Abreu I, Alarcón-Fernández O, Gimeno-García AZ, Romero-García R, Carrillo-Palau M, Nicolás-Pérez D, Jiménez A, Quintero E. 2017. Early Colonoscopy Improves the Outcome of Patients With Symptomatic Colorectal Cancer. Dis Colon Rectum. Aug;60(8):837-844.

Anderson, J. et al. 2012. Adenoma detection rates in screening versus surveillance colonoscopies: Data from the new hampshire colonoscopy registry acg colorectal cancer prevention award. *American Journal of Gastroenterology*;107 (Suppl): S804-S805.

Anderson, R., Burr, N.E., Valori, R. 2020. Causes of Post-Colonoscopy Colorectal Cancers Based on World Endoscopy Organization System of Analysis. *Gastroenterology*. Apr;158(5):1287-1299.e2.

Arora,K.S., Chehkuan, T, Marelli,T., 2021. Improving endoscopy turnaround time and list efficiency through implementation of a multi-faceted improvement plan. *Gut*; London Vol. 70, Iss. Suppl 4, (Nov 2021): A192-A192. DOI:10.1136/gutjnl-2021-BSG.358.

Asselin, M. E. 2003. Insider research: Issues to consider when doing qualitative research in your own setting. *Journal for Nurses in Staff Development*, 19, 99–103. PTH-43

Baker, D.W., Brown, T., Goldman, S.N., Liss, D.T., Kollar, S., Balsley, K., Lee, J.Y., Buchanan, D.R. 2015. Two-year follow-up of the effectiveness of a multifaceted intervention to improve adherence to annual colorectal cancer screening in community health centers. *Cancer Causes Control*. Nov;26(11):1685-90. doi: 10.1007/s10552-015-0650-0. Epub Sep 4. PMID: 26337733.

Ball, A.J., Rees, C.J., Corfe, B.M., Riley, S.A. 2015. Sedation practice and comfort during colonoscopy: lessons learnt from a national screening programme. *Eur J Gastroenterol Hepatol*. Jun;27(6):741-6. doi: 10.1097/MEG.0000000000000360. PMID: 25874595.

Barclay, R.L., Vicari, J.J., Greenlaw, R.L. 2008. Effect of a time-dependent colonoscopic withdrawal protocol on adenoma detection during screening colonoscopy. *Clin Gastroenterol Hepatol*;6:1091–8

Barclay, R.L., Vicari, J.J., Doughty, A.S., et al. 2006. Colonoscopic withdrawal times and adenoma detection during screening colonoscopy. *N Engl J Med*;355:2533e41.

Baudet, J.S., Armando, A.J. 2019. Effect of conscious sedation with midazolam and fentanyl on the overall quality of colonoscopy: a prospective and

randomized study. *Revista Espanola de Enfermadades Digestivas* , vol. 111, no. 7, July pp. 507+.

Baxter, N.N., Sutradhar, R., Forbes, S.S., et al. 2011. Analysis of administrative data finds endoscopist quality measures associated with postcolonoscopy colorectal cancer. *Gastroenterology*;140:65–72.

BCSP 2011 Bowel cancer screening: guidelines for colonoscopy. At: https:// www.gov.uk/government/publications/bowel-cancer-screening-colonosocpy-quality-assurance.Bowel cancer screening: guidelines for colonoscopy - GOV.UK (www.gov.uk)

BCSP 2007. NHS Bowel Cancer Screening Programmes Accreditation of Screening Colonoscopists Implementation Guide No.3 Version 3 18 May

BCSP 2008. NHS Bowel Cancer Screening Programme. Accreditation of Screening Colonoscopists. BCSP Implementation Guide No 3 (Version5).

BCSP 2011. NHS Bowel Cancer Screening Programme. Quality Assurance Guidelines for Colonoscopy. NHS BCSP Publication No.6, 2011.

Behrens, A., Kreuzmayr, A., Manner, H. et al. 2019. Acute sedation-associated complications in GI endoscopy (ProSed 2 Study): results from the prospective multicentre electronic registry of sedation-associated complications. *Gut* ;68:445-452.

Beshara, M. Ahoroni, D. Comanester, A. Vilkin, D. Boltin, I. Dotan, Y. Niv, A.D. C ohen, Z. Levi. 2020. Association between time to colonoscopy after a positive guaiac fecal test result and risk of colorectal cancer and advanced stage disease at diagnosis. 146, pp. 1532-1540

K Bhatti, H Yousef, M Aung. 2021.Repeat Colonoscopy: Incidence, Etiology, And Suggestions for Improvement, *British Journal of Surgery*, Volume 108, Issue Supplement_6, September.

Bhaskar, R. 1975. A Realist Theory of Science, Leeds, UK: Leeds Books. Bhaskar, R. 1978. The Possibility of Naturalism, Sussex, UK: Harvester Press. Bhaskar, R. 1989. Reclaiming reality, London: Verso.

Birdi, S., Stasinos, I., Muller, A. 2015. Colonoscopy procedures with and without sedation and pain scores. PWE-441. Gut ;64:A403-A404.

Bland, J.M., Altman, D.G. 1995. Multiple significance tests: The Bonferroni method. BMJ;310(6973):170.

Boroff, E.S., Disbrow, M., Crowell, M.D., Ramirez, F.C. 2017. Adenoma and Polyp Detection Rates in Colonoscopy according to Indication. *Gastroenterol Res Pract*.;2017:7207595. doi:10.1155/2017/7207595.

BSW 2020 Title: Bowel Screening Wales Annual Statistical Report 2018-19 Date: This report published 13 February 2020 ISBN: 978-1-78986-110-5 AVAILABLE ON https://phw.nhs.wales/services-and-teams/screening/bowel-screening/information-resources/programme-reports/bsw-annual-statistical-reports/bsw-annual-statistical-report-2018-19/ ACCESSED 1-6-22.

Bowles C., Leicester, R., Romaya, C., et al. 2004. A prospective study of colonoscopy practice in the UK today: are we adequately prepared for national colorectal cancer screening tomorrow? *Gut;* 53:277–83. 8

Braun, V., Clarke, V.2006. Using thematic analysis in psychology. Qualitative Research in Psychology3 (2):77-101

Brenner, H., Chang-Claude, J., Seiler, C.M., et al. 2012. Interval cancers after negative colonoscopy: population-based case-control study. *Gut*;61:1576–82.

British Society of Gastroenterology (BSG) guidelines (2003- sedation

Bryce, K., Tai, C.K., Murray, S. et al.2019. Should we all be looking for Marginal Gains in Endoscopy Efficiency? *Gut* ;68:A231. PTU-080.

Bryman, A. (2006b). Mixed methods. London: Sage Publications

BSW 2018- Inquiry into Endoscopy Services- BSW Submission to the Health Social Care and Sports Committee inquiry into endoscopy services 29th November 2018 E07 Inquiry into Endoscopy Services https://busnes.senedd.cymru/documents/s81023/E07

BSW October 2021 Annual statistical report Title: Bowel Screening Wales Annual Statistical Report 2019-20 Date: This report published October 2021 ISBN: 978-1-78986-154-459

Burr NE, Derbyshire E, Taylor J, Whalley S, Subramanian V, Finan PJ, Rutter MD, Valori R, Morris EJA. 2019.Variation in post-colonoscopy colorectal cancer across colonoscopy providers in English National Health Service: population based cohort study.BMJ. Nov 13;367:l6090. doi: 10.1136/bmj.l6090

Calderwood, A.H., Lasser, K.E., Roy, H.K. 2016. Colon adenoma features and their impact on risk of future advanced adenomas and colorectal cancer. *World J Gastrointest Oncol*. Dec 15. 8(12):826-34.

Cardoso R, Niedermaier T, Chen C, Hoffmeister M, Brenner H 2019. Colonoscopy and sigmoidoscopy use among the average-risk population for colorectal cancer: a systematic review and trend analysis. Cancer Prev Res (Phila) 12:617–630

Castanon A, Parmar D, Massat N, Sasieni P, Duffy SW.
J Natl Cancer Inst. 2022 May 16:djac100. doi: 10.1093/jnci/djac10

Chawdhary, F.R., Muller, F. 2018. A missed opportunity? colonoscopy withdrawal times in a large DGH. PTH-045.*Gut* ;67:A34-A35.

Chinitz,D., Rodwin, V. 2014. What Passes and Fails as Health Policy and Management. *J Health Polit Policy Law* 1 October; 39 (5): 1113–1126.

Corley, D.A., Jensen, C.D., Marks, A.R., et al. 2014. Adenoma detection rate and risk of colorectal cancer and death. *N Eng J Med*; 370:1298–306.

D.A. Corley, C.D. Jensen, V.P. Quinn, C.A. Doubeni, A.G. Zauber, J.K. Lee, J.E. Sc hottinger, A.R. Marks, W.K. Zhao, *et al.* 2017. Association between time to colonoscopy after a positive fecal test result and risk of colorectal cancer and cancer stage at diagnosis 317, pp. 1631-1641

Creswell, J. W. and Plano Clark, V.L. 2017. *Conducting Mixed Methods Research* 3rd ed. Los Angeles: Sage publications

Creswell, J.W. and Plano Clark, V.L. (2011) Designing and Conducting Mixed Methods Research. 2nd Edition, Sage Publications, Los Angeles.

CRUK 2022 www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/bowel-cancer- ACCESSED 30-6-22

Danermark, B., Ekstrom, M., Jakobsen, L., and Karlsson, J. C. 2002. Explaining Society: Critical Realism in the Social Sciences, London: Routledge.

Day LW, Belson D. 2015. Studying and Incorporating Efficiency into Gastrointestinal Endoscopy Centers. Gastroenterol Res Pract. 2015;2015:764153.

DeJonckheere, M., Vaughn, L.M. 2019. Semistructured interviewing in primary care research: a balance of relationship and rigour. *Family Medicine and Community Health* ;7:e000057

Del Vecchio Blanco, G., Dwairi, R., Giannelli, M., Palmieri, G., Formica, V., Portarena, I., Grasso, E., Di Iorio, L., Benassi, M., Giudice, E.A., Nardecchia, A., Rossi, P., Roselli, M., Sica, G., Monteleone, G., Paoluzi, O.A. 2021. Clinical care pathway program versus open-access system: a study on appropriateness, quality, and efficiency in the delivery of colonoscopy in the colorectal cancer. *Intern Emerg Med*. Aug;16(5):1197-1206.

DeMarco, D.C., Odstrcil, E., Lara, L.F. et al. 2010. Impact of experience with a retrograde-viewingdeviceon adenoma detection rates and withdrawal times during colonoscopy: the Third Eye Retroscope study group. Gastrointest Endosc; 71: 542–550.

Denberg, T.D., Melhado, T.V., Coombes, J.M., et al. 2005. Predictors of nonadherence to screening colonoscopy. *J Gen Intern Med*.20(11):989-995. doi:10.1111/j.1525-1497.2005.00164.

Denters MJ, Deutekom M, Essink-Bot ML, Bossuyt PM, Fockens P, Dekker E. 2015. Assessing knowledge and attitudes towards screening among users of Faecal Immunochemical Test (FIT). Health Expect. Oct;18(5):839-49. doi: 10.1111/hex.12056

Derbyshire, E., Nickerson, C., Wright, S., et al. 2018. Post colonoscopy colorectal cancer in the english national health service bowel cancer screening programme. ADTH-04. *Gut* ;67:A9.

Dobrow MJ, Hagens V, Chafe R, Sullivan T, Rabeneck L. 2018. Consolidated principles for screening based on a systematic review and consensus process. *CMAJ*.;190(14):E422-E429. doi:10.1503/cmaj.171154

East, J.E., Stavrindis, M., Thomas-Gibson, S. et al. 2008. A comparative study of standard vs high definition colonoscopy for adenoma and hyperplastic polyp detection with optimized withdrawal technique. Aliment Pharmacol Ther; 28: 768–776.

East, J.E., Atkin, W.S., Bateman, A.C. et al. 2017. British Society of Gastroenterology position statement on serrated polyps in the colon and rectum. *Gut*;66:1181–96.

Ehsani-Moghaddam B, Martin K, Queenan JA. 2021. Data quality in healthcare: A report of practical experience with the Canadian Primary Care Sentinel Surveillance Network data. *Health Information Management Journal*.;50(1-2):88-92. doi:10.1177/1833358319887743

Ekkelenkamp, V.E., Shaw, I., Valori, R., et al. 2011.Comfort scores in colonoscopy performance. *Gut*;60:A44-A45.

El-Feki, M., Wilson, R., Hopper, A., et al.2016. Colonoscopy Withdrawal Time in Non-Screening Colonoscopies. 6 Minutes or Not? PTU-027. *Gut*;65:A65-A66.

Engels, F. 1845 *The Condition of the Working Class in England.* Leipzig: Otto Wigand.

European Society of Gastrointestinal Endoscopy position statement on quality in screening colonoscopy (2012)

Fearon, E.R., Vogelstein, B. 1990. A genetic model for colorectal tumorigenesis. Cell;61:759–67.

Ferlay, J., Parkin, D.M., Stelliarova-Foucher, E. 2010. Estimates of cancer incidence and mortality in Europe in 2008. *Eur J Cancer*; 46:765e81.

Field, A. 2013. Discovering Statistics Using IBM SPSS Statistics SAGE: London page 881

FitzGerald, M. 1995. The experience of chronic illness in rural Australia. Armidale: The University of New England.

Flyvbjerg, B. 2006. Five misunderstandings about case-study research. *Qualitative Inquiry*, 12(2), 219-245.

Francis, D.L., Rodriguez-Correa, D.T., Buchner, A. et al. 2011. Application of a conversion factor to estimate the adenoma detection rate from the polyp detection rate. *Gastrointest Endosc* 73: 493 – 497.

Fryer, T, 2020. A short guide to ontology and epistemology: why everyone should be a critical realist. Available at: http://tfryercom.files.wordpress.com/2020/10/cr_shortguide_201029.pdf

Gavin, D. et al. 2012. The national colonoscopy audit: A nationwide assessment of the quality and safety of colonoscopy in the UK. *Gut*;61 (July): A3

Gavin D., Valori, R., Anderson, J.T., et al. 2013. The National Colonoscopy Audit: a nationwide assessment of the quality and safety of colonoscopy in the UK. *Gut;* 62:242–9.

GDPR, 2018. Guide to the General Data Protection Regulation. [online] GOV.UK. Available at: <https://www.gov.uk/government/publications/guide-to-the-general-data-protection-regulation> [Accessed 27 June 2022].

Gillham, B. 2000. Case study research methods. London: Bloomsbury Publishing.

GIRFT. Oates, B. 2021. www.GettingItRightFirstTime.co.uk-www.gettingitrightfirsttime.co.uk/wp-content/uploads/2021/10/Gastroenterology-Oct21v.pdf - March:accessed 2-6-22.

Gladys-Oryhon, Jordan, Umar, Shifa, Cole, Rita, et al. 2019. Increasing Endoscopy Unit Efficiency: It's Time to Take Control: 547. *Am J Gastroenterol.*

Greene, J. C. 2007. Mixed methods in social inquiry. San Fransisco, CA: Jossey-Bass.

Greenhalgh, T., Annandale, E., *et al*. 2016. An open letter to The BMJ editors on qualitative research. *BMJ* Feb 10;352.

Greehalgh, T. 2019. How to read a paper, the basics of evidence based medicine and healthcare. Wiley Blackwell: Oxford.

Harewood, G.C. 2005.Relationship of Colonoscopy Completion Rates and Endoscopist Features. *Dig Dis Sci* **50,** 47–51. https://doi.org/10.1007/s10620-005-1276-y

Hilsden, R.J. et al. 2015. The association of colonoscopy quality indicators with the detection of screen-relevant lesions, adverse events, and postcolonoscopy cancers in an asymptomatic Canadian colorectal cancer screening population. *Gastrointestinal Endoscopy*;82 (5): 887-894.

Holford, N. 2018. Pharmacodynamic principles and target concentration intervention. *Transl Clin Pharmacol*. Dec;26(4):150-154.

Hughes, J. A., Sharrock, W. W., & Martin, P. J. 2003. Understanding classical sociology: Marx, Weber, Durkheim. London, Thousand Oaks, Calif.: Sage Publications.

Jang,H. 2017. Training in Endoscopy: Colonoscopy. *Clinical Endoscopy* 10.5946/ce.2017.077, 50, 4, (322-327).

IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp

Inadomi, J. 2010. Editorial: Interval cancers after colonoscopy: the importance of training. *American Journal of Gastroenterology*;105 (12): 2597-2598.

JAG 2021. accreditation programme Guide to meeting the quality and safety standards For UK services. (2021) https://www.thejag.org.uk/CMS/UploadedDocuments/Scheme/Scheme5/Guidance/191107%20-%20guidance%20-%20JAG%20quality%20and%20safety%201.0%20final.pdf

Johnson, R. and Onwuegbuzie, A. 2004. Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational researcher*. 33. 14. 10.3102/0013189X033007014.

Johnson, R. B., de Waal, C., Stefurak, T. and Hildebrand, D. L. 2017. Understanding the philosophical positions of classical and neo pragmatists for mixed methods research. *Cologne Journal of Sociology and Social Psychology*.69(S2), 63–86.

Kaminski, M.F., Thomas-Gibson, S., Bugajski, M., Bretthauer, M., Rees, C.J., Dekker, E., Hoff, G., Jover, R., Suchanek, S., Ferlitsch, M., et al. 2017. Performance measures for lower gastrointestinal endoscopy: A European Society of Gastrointestinal Endoscopy (ESGE) quality improvement initiative. *United Eur. Gastroenterol*. 5:309–334. doi: 10.1177/2050640617700014.

Kaminski, M.F., Regula, J, Kraszewska, E., et al. 2010. Quality indicators for colonoscopy and the risk of interval cancer. N Engl J Med;362:17951803.

Kelly, N.M. et al. 2010. Is the "driving test" a robust quality indicator of colonoscopy performance? A review of the test practicing endoscopists in england are required to pass prior to performing screening colonoscopy as part of the NHS bowel cancer screening program. *Gastroenterology*;138 (5 SUPPL.#1): S326-S327.

Kerrison, R.S. Sheik-Mohamud,
D. E. McBride, K.L. Whitaker, C. Rees, S. Duffy, *et al.* 2021.
Patient barriers and facilitators of colonoscopy use: a rapid systematic review and thematic synthesis of the qualitative literature
Prev Med, 145, Article 106413

Khan, F., Hur, C., Lebwohl, B. et al. 2020. Unsedated Colonoscopy: Impact on Quality Indicators. *Dig Dis Sci* 65, 3116–3122 At: https://doi-org.abc.cardiff.ac.uk/10.1007/s10620-020-06491-0

Kaminski, M.F. , Thomas-Gibson, S. , Bugajski, M. et al. 2017. Performance measures for lower gastrointestinal endoscopy: a European Society of gastrointestinal endoscopy (ESGE) quality improvement initiative. *Endoscopy*; 49:378–97.doi:10.1055/s-0043-103411

H.H. Ko, H. Zhang, J.J. Telford, *et al.* 2009. Factors influencing patient satisfaction when undergoing endoscopic procedures. Gastrointest Endosc, 69, pp. 883-891

Kong, C., Young, A.N., Benson, K., et al. 2013. What is the Number Required to Maintain Competency? – a Retrospective Audit. *Gut* ;62:A21 OC-048 Colonoscopy.

Kvale S . *Interviews.* Thousand Oaks*:* SAGE Publications*,* 1996.

Laerd Statistics. Lund Research Ltd 2022. Testing for Normality using SPSS Statistics. Available from: http://www.statistics.laerd.com. ACCESSED 30-6-22.

Laerd Statistics 2016. One-way ANOVA using Stata. Retrieved from https://statistics.laerd.com

Lee, R.H., Tang, R.S., Muthusamy, V.R., et al. 2011. Quality of colonoscopy withdrawal technique and variability in adenoma detection rates. *Gastrointest Endosc*;74:128–34.

Lee T., Rutter, M., Blanks, R. et al. 2012. Colonoscopy quality measures: experience from the NHS Bowel Cancer Screening Programme. *Gut*; 61:1050-1057.

Lee, T.J.W., Blanks, R.G., Rees, C.J. on behalf of Northern Region Endoscopy Group (NREG), et al. 2011.Colonoscopy withdrawal time and adenoma detection rate in screening colonoscopy: the optimum average withdrawal time is 10 min. *Gut*;60:A44.

Lee, T.J., Blanks, R.G., Rees, C.J. et al. 2013. Longer mean colonoscopy withdrawal time is associated with increased adenoma detection: evidence from the Bowel Cancer Screening Programme in England. Endoscopy; 45: 20 – 26.

Lee, T., Siau, K., Esmaily, S., Docherty, J., Stebbing, J., Brookes, M., Broughton, R., Rogers, P., Dunckley, P., Rutter, M. Development of a national automated endoscopy database: The United Kingdom National Endoscopy Database (NED), *United European Gastroenterology Journal*, 10.1177/2050640619841539, 7, 6, (798-806).

Lee, Y.M., Huh, K.C. 2017. Clinical and biological features of interval colorectal cancer. *Clin. Endoscop*. 2017;50(3):254-260.

K.T. Lim, C.H. Ng, G.M. Decruz, T.Z. Lim, K. Devi, K.-K. Tan, *et al.* 2021. Barriers and facilitators towards colonoscopy: a qualitative systematic review Eur J Cancer Prev: J Eur Cancer Prev Organ, 30 (3), pp. 232-238.

Llyod, K., Kinsella, C., Haslam, N., et al. 2021. Accelerated accreditation for bowel cancer screening colonoscopist in cheshire and Merseyside. PTU-84. *Gut*;70:A209.

Logan, R.F.A., Patnick, J., Nickerson, C., et al. 2012. Outcomes of the Bowel Cancer Screening Programme (BCSP) in England after the first 1 million tests. *Gut;*61: 1439–46.

Lund M, Erichsen R, Valori R, Møller Jensen T, Helle Njor S, Laurberg S, Andersen B; 2019. Central Denmark Region's "Quality of Colonoscopies" group†. Data quality and colonoscopy performance indicators in the prevalent round of a FIT-based colorectal cancer screening program. *Scand J Gastroenterol*. 2019 Apr;54(4):471-477.

Lynch, M. 2000. Against Reflexivity as an Academic Virtue and Source of Privileged Knowledge. *Theory, Culture & Society*.;17(3):26-54. doi:10.1177/02632760022051202

Wang, Y, Wang, M, Wu, H-X, Xu, R-H. Advancing to the era of cancer immunotherapy. *Cancer Commun*. 2021; 41: 803– 829. https://doi.org/10.1002/cac2.12178

Macnaughton, in Greenhalgh 1998

Mahmood, T. 2018. Colonoscopy Comfort Scores Agreement between Endoscopy Nurses and the Endoscopists: Should the Patients Instead Award the Score?. *J Gastroint Dis*: JGID-101. DOI: 10.29011/JGID-101. 000001.

Mc Nally, M., Omorogbe, J.A., Cretu, I. 2017. A Review of Patient Comfort Scores at Colonoscopy in a Regional Irish Endoscopy Unit. Tu1026. *Gastrointestinal Endoscopy*,Volume 85, Issue 5, Supplement.

Mangas- Sanjuan, C., Zapater, P., Cubiella, J., et al. 2018. Importance of endoscopist quality metrics for findings at surveillance colonoscopy: the detection- surveillance paradox. *United European Gastroenterol* J;6:622–9.

Mazurek M, Murray A, Heitman SJ, Ruan Y, Antoniou SA, Boyne D, Murthy S, Baxter NN, Datta I, Shorr R, Ma C, Swain MG, Hilsden RJ, Brenner DR, Forbes N. 2021.Association Between Endoscopist Specialty and Colonoscopy Quality: A Systematic Review and Meta-analysis.Clin Gastroenterol Hepatol. Aug 25:S1542-3565(21)00909-5. doi: 10.1016/j.cgh.2021.08.029. Online ahead of print.

McConnell-Henry,T., James, A., Chapman, Y., Francis, K. 2010. Researching with people you know: Issues in interviewing, *Contemporary Nurse*, 34:1, 2-9.

McEvoy, P. & Richards, D. (2006). A critical realist rationale for using a combination of quantitative and qualitative methods. Journal of Research in Nursing, 11(1), 66-78.

MEDLINE PLUS 2022. Midazolam- sedation- accessed 1.6.22 https://medlineplus.gov/druginfo/meds/a609014.html

Melosik, Z. 2021. There Is No End of Paradigms War in Social Sciences: A Meta-Analytical Approach, Przegląd Badań Edukacyjnych (Educational *Studies Review)*, 1(32), pp. 193–203. doi: 10.12775/PBE.2021.011.

Mingers, J. 2004. “Real-izing Information Systems: Critical Realism as an Underpinning Philosophy for Information Systems,” Information and Organization (14:2), pp. 87-103.

Mingers, J. 2001. “Combining IS Research Methods: Towards a Pluralist Methodology,” Information Systems Research (12:3), pp. 240-259.

Shiha,M.G., Al-Rifaie, A.,Thoufeeq, M. 2021. Impact of the National Endoscopy Database (NED) on colonoscopy withdrawal time: a tertiary centre experience, *BMJ Open Gastroenterology*, 10.1136/bmjgast-2021-000699, **8**, 1.

Morris, E.J.A., Whitehouse, L.E., Farrell, T, et al. 2012. A restrospective observational study examining the characteristics and outcomes of tumours diagnosed within and without of the English NHS Bowel Cancer Screening Programme. *Br J Cancer*;107:757–64.

Morris, E.J., Rutter, M.D., Finan, P.J., Thomas, J.D., Valori ,R. 2015. Post-colonoscopy colorectal cancer (PCCRC) rates vary considerably depending on the method used to calculate them: a retrospective observational population-based study of PCCRC in the English national health service. Gut;64:1248-1256.

Nagrath, N., Phull, P. 2011. Does colonoscopists' performance vary between bowel screening and patients with symptoms - A comparison of colonoscopy completion rates. *Gut*;60 (April): A199.

Neilson, L., East, J., Rajasekhar, P., et al. 2017. Sustained change in colonoscopy practice 3 years after introduction of quality in colonoscopy (qic) bundle. AODTU-003. *Gut* ;66:A46.

Neilson LJ, East JE, Rajasekhar PT, Bassett P, Dunn S, Bevan R, Paremal S, Esmaily S, Rees CJ. 2020. Sustained colonoscopy quality improvement using a simple intervention bundle. Endoscopy. Apr;52(4):285-292. doi: 10.1055/a-1098-2101

Neilson, L.J., Dew, R., Hampton, J.S*., et a.l*2021*.* Does polyp detection rate accurately reflect adenoma detection rate? *Gut* 2021;70**:**A68

Neilson, L.J., Dew, R., Hampton, J.S., et al. 2021. Low colonoscopy numbers correlate with poor quality colonoscopy: time to implement national standards. P54.*Gut* ;70: A68-A69.

NHS England and NHS Improvement 2021: Quality, Service Improvement and Redesign Tools: Reducing did not attends. Online library of Quality, Service Improvement and Redesign tools -www.england.nhs.uk/wp-content/uploads/2021/12/qsir-reducing-dnas.pdf- accessed 2-6-22.

NHSIQ. 2015. The productive endoscopy unit: building teams for safer care-toolkit: NHS Improving Quality - Publication date: March 2015 - Review date: March 2017 https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2020/06/toolkit.pdf

J. Sint Nicolaas, V. de Jonge, I.J. Korfage, *et al.* 2012. Benchmarking patient experiences in colonoscopy using the Global Rating Scale Endoscopy, 44 , pp. 462-472

Olsen, W. 2004. Triangulation in Social Research: Qualitative and Quantitative Methods Can Really Be Mixed, in Developments in Sociology Vol. 20, ed. M. Holborn, London: Macmillan.

Overholt BF, Brooks-Belli L, Grace M, *et al.* 2010. Withdrawal times and associated factors in colonoscopy: a quality assurance multicenter assessment. J Clin gastroenterol ;**44**:e806.

Oxford English Dictionary 2015. 3 ed Oxford: University Press

Park, H.J., Hong, J.H., Kim, H.S., et al. 2013. Predictive factors affecting cecal intubation failure in colonoscopy trainees. *BMC Med Educ*;13:5.

Pasquarella, C., Kaplan, B., Mahajan, L., Lamparyk, K., Kay, M. 2019. A Single-center Review of Pediatric Colonoscopy Quality Indicators, *Journal of Pediatric Gastroenterology & Nutrition. 1*0.1097/MPG.0000000000002239, 68, 5, (648-654), (2019).

Patel, K., Thomas-Gibson, S., Faiz, O. et al. 2013. An Evaluation of Screening Colonoscopists' Performance After a Structured Accreditation Process .PWE-048. *Gut* ;62:A149-A150.

Patel, K et al. 2016. An evaluation of screening colonoscopists performance after a structures accreditation process. Gut;65(suppl 1) PWE-048.

Peat, J., Barton, B. 2005. Medical Statistics: A guide to data analysis and critical appraisal. Blackwell Publishing: BMJ Books

Peerally, M.F., Mohanan, V., Verma, A., et al. 2021. Playing Hide and Seek: Qualitative research and Gastroenterology. PTU-85. *Gu*t ;70:A209-A210.

Plumb,A. Ghanouni, A., Rainbow, S. 2016. Patient factors associated with non-attendance at colonoscopy after a positive screening faecal occult blood test. https://doi-org.abc.cardiff.ac.uk/10.1177/0969141316645629 Volume: 24 issue: 1, page(s): 12-19.

Porter, M. Lee, T. 2013. The strategy that will fix health care Harvard Business Review October 2013 pp50-70 esp. 56

Quyn et al. Scottish Bowel Screening Programme colonoscopy quality – scope for improvement? *Colorectal Disease* 2018 (20) 277 – 285.

Rafferty, H., Hutchinson, J., Ansari, S., et al. 2014. Comfort Scoring For Endoscopic Procedures: Who Is Right – The Endoscopist, The Nurse Or The Patient? Gut ;63:A139-A140. PWE-040.

Rafferty, H., Hutchinson, J., Ansari, S., et al. 2014. Comfort Scoring For Endoscopic Procedures: Who Is Right – The Endoscopist, The Nurse Or The Patient? PWE-040. *Gut* ;63:A139-A140

Rajasekhar, P.T., Lee, T.J., Rutter, M.D., et al. 2012. Using a 'conversion factor' to estimate adenoma detection rate. *Endoscopy*; 61(Suppl 3):A371.

Rajasekhar,P., Rees, C., Rutter, M., Hungin, P. 2014- CITED AS 12 IN TEXT?. Developing a clinical research network: The Northern Region Endoscopy Group experience, Clinical Medicine, 10.7861/*clinmedicine*.14-2-107, 14, 2, (107-112).

Rajasekhar, P.T., Rutter, M.D., Bramble, M.G., et al. 2012. Achieving high quality colonoscopy: using graphical representation to measure performance and reset standards. *Colorectal Dis*; 14:1538–45.

Ravindran, S., Bassett, P., Shaw, T. et al. 2020. National census of UK endoscopy services in 2019. Frontline Gastroenterology Epub ahead of print: doi:10.1136/ flgastro—101538. ACCESSED 30-6-22.

Ravindran, S., Bassett, P., Shaw, T., et al. 2021. National census of UK endoscopy services in 2019. *Frontline Gastroenterology* ;12:451-460.

Ravindran, S., Shaw, T., Broughton, R., et al. 2021. The JAG survey of UK endoscopy services: results from the 2019 census. P70.*Gut* ;70:A76.

Rees CJ, Bevan R. 2014. The National Health Service Bowel Cancer Screening Program: the early years. Expert Rev Gastroenterol Hepatol. Jul;7(5):421-37. doi: 10.1586/17474124.2013.811045. PMID: 23899282.

Rees,C., Thomas- Gibson, S., Rutter, M., Baragwanath,P.,Pullan, R., Feeney,M., Haslam, N. 2016. UK key performance indicators and quality assurance standards for colonoscopy, *Gut*, 10.1136/gutjnl-2016-312044, 65, 12, (1923-1929).

Rees, C., Koo, S., Anderson, J., McAlindon, M., Veitch, A., Morris, A.J., Bhandari, P., East, J., Webster, G., Oppong, K.W., Penman, I. 2018. British society of gastroenterology Endoscopy Quality Improvement Programme (EQIP): overview and progress, *Frontline Gastroenterology*, 10.1136/flgastro-2018-101073, **10**, 2, (148-153), (2019).

Rees, C.J., Thomas- Gibson, S., Rutter, M.D. 2016. on behalf of: the British Society of Gastroenterology, the Joint Advisory Group on GI Endoscopy, the Association of Coloproctology of Great Britain and Ireland UK key performance indicators and quality assurance standards for colonoscopy *Gut* ;65:1923-1929.

Rees, C., Thomas-Gibson, S., Bourke, M., Rex, D., Fockens, P., Kaminski, M., Haslam, N., Walls, M. 2018. Managing underperformance in endoscopy: a pragmatic approach, *Gastrointestinal Endoscopy*, 10.1016/j.gie.2018.06.029, 88, 4, (737-744.e1).

Rees, C., Bevan, R., Zimmermann-Fraedrich, K., Rutter, M., Rex, D., Dekker, E., Ponchon, T., Bretthauer, M., Regula, J., Saunders, B.,Hassan, C., Bourke, M., Rösch, T. 2016. Expert opinions and scientific evidence for colonoscopy key performance indicators, *Gut,* 10.1136/gutjnl-2016-312043, 65, 12, (2045-2060).

Rembacken, B., Hassan, C., Riemann, J.F., Chilton, A., Rutter, M., Dumonceau, J.M., Omar, M., Ponchon, T. 2012. Quality in screening colonoscopy: position statement of the European Society of Gastrointestinal Endoscopy (ESGE). Endoscopy. Oct;44(10):957-68. doi: 10.1055/s-0032-1325686.

Rex, D.K., Bond, J.H., Winawer, S., et al. 2000. Quality in the technical performance of colonoscopy and the continuous quality improvement process

for colonoscopy: recommendations of the U.S. Multi-Society Task Force on Colorectal Cancer. *Am J. Gastroenterol;*97:1296–308.

Rex, D.K., Petrini, J.L., Baron, T.H. et al. 2006. Quality indicators for colonoscopy. *Am J Gastroenterol*; 101:873–85

Richter, J. 2013. Colonoscopy quality improvement: practice to public health, Gastrointestinal Endoscopy, Volume 78, Issue 6, Pages 919-924,

Robertson, D.J., Kaminski, M.F., Bretthauer, M. 2015. Effectiveness, training and quality assurance of colonoscopy screening for colorectal cancer. *Gut* ;64:982-990.

Robison et al 2019. How social capital influences medical choices: a study of colonoscopy decisionmaking *APPLIED ECONOMICS*, VOL. 52, NO. 24, 2544–2555 https://doi.org/10.1080/00036846.2019.1693020

Rodney, W.M., Dabov, G., Orientale, E., Reeves, W.P. 1993. Sedation associated with a more complete colonoscopy. *J Fam Pract*. ;36:394–400.

Rothnie, A., Padmanabhan, H., Higgins, A., et al. 2014. Is Face-to-face Pre-assessment Prior To Colonoscopy Useful? *Gut*;63:A135-A136 PWE-031.

Rutter, M.D., East, J., Rees, C.J. et al. 2020.British Society of Gastroenterology/Association of Coloproctology of Great Britain and Ireland/Public Health England post-polypectomy and post-colorectal cancer resection surveillance guidelines. *Gut* ;69:201-223.

Rutter, M.D., Beintaris, I., Valori, R., et al. 2018. World Endoscopy Organization Consensus Statements on Post-Colonoscopy and Post-Imaging Colorectal Cancer. *Gastroenterology* ;155:909 925.e3.doi:10.1053/j.gastro.2018.05.038

Rycroft-Malone, J. 2018. From Linear to Complicated to Complex Comment on "Using Complexity and Network Concepts to Inform Healthcare Knowledge

Translation". *Int J Health Policy Manag*.;7(6):566-568. Published 2018 Jun 1. doi:10.15171/ijhpm.2018.02.

Sandy, N.G., Sreenivasan, A.K., Pecoriello, J. et al. 2020. Polyp Detection Rate Correlates Strongly with Adenoma Detection Rate in Trainee Endoscopists. *Dig Dis Sci* 65, 2229–2233. https://doi-org.abc.cardiff.ac.uk/10.1007/s10620-020-06049-0.

Scholefield JH, Moss S, Sufi F, Mangham CM, Hardcastle JD. 2002 *Gut.* Jun;50(6):840-4. doi: 10.1136/gut.50.6.840

Seghal, S. 2017. Non-Bowel Cancer Screening Colonoscopy Has Inferior Rates of Polyp Retrieval and Adenoma Detection than Bowel Cancer Screening . *Gut*;65 (Suppl 1) PWE-122

Segnan, N., Patnick, S., von Karsa, L., eds. 2010. European Guidelines for Quality Assurance in Colorectal Cancer Screening and Diagnosis. Luxembourg: Publications Office of the European Union.

Sehgal, V., Jones, T., Ping, L. et al. 2016. Non-Bowel Cancer Screening Colonoscopy Has'Inferior Rates of Polyp Retrieval and Adenoma Detection than Bowel Cancer Screening. PWE-122. Gut ;65:A198.

Seoane A, Font X, Pérez JC, Pérez R, Enriquez CF, Parrilla M, Riu F, Dedeu JM, Barranco LE, Duran X, Ibáñez IA, Álvarez MA. 2020. Evaluation of an educational telephone intervention strategy to improve non-screening colonoscopy attendance: A randomized controlled trial. *World J Gastroenterol* (47): 7568-7583

Shah, H.A., Paszat, L.F., Saskin, R., et al. 2007. Factors associated with incomplete colonoscopy: a population-based study. *Gastroenterol*;132:2297–303.

Shapiro, S. S., M. B. Wilk. 1965. An Analysis of Variance Test for Normality (Complete Samples). *Biometrika*, vol. 52, no. 3/4, pp. 591–611. *JSTOR*, https://doi.org/10.2307/2333709. Accessed 28 Jun. 2022.

Shenbagaraj, L., Thomas-Gibson, S., Stebbing, J. *et al.* 2019. Endoscopy in 2017: a national survey of practice in the UK. *Frontline Gastroenterology* ;10**:**7-15.

Shilun, L., Maas, J., Brokl, D., Lee, N. 2017. Adenoma Detection Rate is Dependent on the Colonoscopy Case Volume and Experiences of the Provider: 294. [Abstract] *American Journal of Gastroenterology.* 112 (Supplement 2017 ACG Annual Meeting Abstracts):S160-S161, October 0002-9270.

Shine R, Bui A, Burgess A. 2020. Quality indicators in colonoscopy: an evolving paradigm. ANZ J Surg. Mar;90(3):215-221. doi: 10.1111/ans.15775. Epub 2020 Feb 21. PMID: 32086869.

Silva, S.M., Rosa, V.F., Santos, A.C., Almeida, R.M., Oliveira, P.G., Sousa, J.B. 2014. Influence of patient age and colorectal polyp size on histopathology findings. *Arq Bras Cir Dig*.;27(2):109-113.

Simmons, D.T., Harewood GC, Baron TH et al. 2006. Impact of endoscopist withdrawal speed on polyp yield: implications for optimal colonoscopy withdrawal time. *Aliment Pharmacol Ther*; 24: 965–971.

Singh, H., et al. 2010. Rate and Predictors of Early/Missed Colorectal Cancers After Colonoscopy in Manitoba: A Population-Based Study. *American Journal of Gastroenterology*;105 2588-2596.

Spada C, Koulaouzidis A, Hassan C, et al. 2021. Colonoscopy quality across Europe: a report of the European Colonoscopy Quality Investigation (ECQI) Group. Endosc Int Open. Sep 16;9(10):E1456-E1462. doi: 10.1055/a-1486-6729

Stratmann K, Bock H, Filmann N, et al. 2018. Individual invitation letters lead to significant increase in attendance for screening colonoscopies: Results of a

pilot study in Northern Hesse, Germany. *United European Gastroenterology Journal*.;6(7):1082-1088.

Stronach, I., Garratt, D., Pearce, C. & Piper, H. 2007. Reflexivity, the picturing of selves, the forging of method. *Qualitative Inquiry*, 13(2), 179-203.

Teddlie, C., and Tashakkori, A. 2003. Major Issues and Controversies in the Use of Mixed Methods in Social and Behavioral Science, in Handbook of Mixed Methods in Social and Behavioral Science, A. Tashakkori and C. Teddlie (eds.), Thousand Oaks, CA: Sage Publications, pp. 3-50.

Teddlie, C., and Tashakkori, A. 2009. Foundations of Mixed Methods Research, Thousand Oaks, CA: Sage Publications.

Timans, R., Wouters, P. & Heilbron, J. 2019. Mixed methods research: what it is and what it could be. Theor Soc 48, 193–216. https://doi.org/10.1007/s11186-019-09345-5

Towler, B., Irwig, L., Glasziou, P., et al. 1998. A systematic review of the effects of screening for colorectal cancer using the faecal occult blood test, hemoccult. BMJ;317:559e65.

UKRI 2021. UK Research and Innovation policy on the governance of good research practice 31st March. At: www.ukri.org/publications/ukri-policy-on-the-governance-of-good-research-practice/ Accessed 30-6-22.

Vavricka, S.R., Sulz, M.C., Degen, L. et al. 2016. Monitoring colonoscopy withdrawal time significantly improves the adenoma detection rate and the performance of endoscopists. *Endoscopy*; 48: 256 – 262.

Venkatesh, V., Brown, S. A., and Bala, H. 2013. “Bridging the Qualitative–Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems,” MIS Quarterly (37:1), pp. 21-54.

Verma, A.M. et al. 2012. A multi-centre audit of 16,064 colonoscopies looking at caecal intubation rates, over a 2-year period. Non-GI operators and those doing <100 P.A. Need to improve or stop performing colonoscopy. *Gut*;61: A150.

Ward, S.T., Mohammed, M.A., Walt, R., et al. 2014. An analysis of the learning curve to achieve competency at colonoscopy using the JETS database. *Gut*;63:1746–54.

Watson, A. et al. 2011. So many polyps, so little time: Where will our bowel cancer screening colonoscopists come from? *Gut*;60 (April): A254

Ngu, W.S., Bevan, R., Tsiamoulos, Z., Bassett, P., Hoare, Z., Rutter, M., Clifford, G., Totton, N., Lee, T., Ramadas, A., Silcock, J., Painter, J., Neilson, L., Saunders, B., Rees, C. 2018. Improved adenoma detection with Endocuff Vision: the ADENOMA randomised controlled trial, *Gut*, 10.1136/gutjnl-2017-314889, 68, 2, (280-288).

Williams, J.E., Le, T.D., Faigel, D.O. 2011. Polypectomy rate as a quality measure for colonoscopy. *Gastrointest Endosc* ;73:498–506. doi:10.1016/j.gie.2010.08.008.

Wilson, J.M.G., Jungner, G. 1968. Principles and practice of screening for disease. Geneva: World Health Organization.

Wood, J.C.; Wood, M.C., eds. 2003. Henry Ford: Critical Evaluations in Business and Management. London: Routledge Vol. 1.

Zhao et al.2020

Zorzi,M. et al. 2015. Quality of colonoscopy in an organised colorectal cancer screening programme with immunochemical faecal occult blood test: the

EQuIPE study (Evaluating Quality Indicators of the Performance of Endoscopy). *Gut*;64 (9): 1389-1396.

Appendices

3.1 Colonoscopist inclusion criteria

How does perception of the bowel cancer screening colonoscopy service differ between Screening and non-Screening Colonoscopists and what are the differences in quality and productivity?

Participant Inclusion Criteria

Please identify the following members of staff to be approached for consideration of inclusion in this study:

- 2 Screening Colonoscopists
- 2 Non-screening Colonoscopists
- 1 Specialist Screening Practitioner
- 1 Unit Manager

Please ensure as far as is possible that individual screening colonoscopists have similar experiences to Non-Screening Colonoscopists relating to:

- Annual procedure numbers
- Lifetime procedure numbers
- Usual case mix

Please provide contact details for staff identified and compile anonymised data reports upon receipt of proof of consent.

3.2 Data request form

Work Package 1- Quantitative Analysis of Anonymised Data

How does perception of the bowel cancer screening colonoscopy service differ between Screening and non-Screening Colonoscopists and what are the differences in quality and productivity?

Primary research questions for work package 1 (quantitative):

1. Is there a significant difference in specific key performance indicator values between screening and non- screening Colonoscopists?
2. Is there a significant difference in the productivity of screening colonoscopy services compared to non- screening colonoscopy services when considering the rate of repeat procedures and list utilisation?

Data Collection

Time points:

- 2012- or as near as possible depending on individual Health Boards access to electronic historical data
- 2019/20 financial year- representing the most recent complete financial year outside of pandemic (1st April 2019-31st March 2020)

Individual data:

Screening Colonoscopists only:

- Bowel Screening Wales key performance indicator reports from:
  - April 2019-September 2019 and
  - October 2019-March 2020

All Colonoscopists- data relating to colonoscopy only:

- Procedure numbers
- Completion rate
- Polyp detection rate
- Comfort scores

- Withdrawal time
- Sedation rates- Midazolam use in <70-year olds and > 70-year olds
- Unsedated procedure rate

Unit data

For screening and non-screening lists separately:

- Number of annual planned lists
- Number of actual lists undertaken
- Number and rate of repeat colonoscopy by reason
- Number and rate of DNA's (Did Not Attend)
- Number and rate of CNA's (Could not attend)

Please anonymise data to indicate:

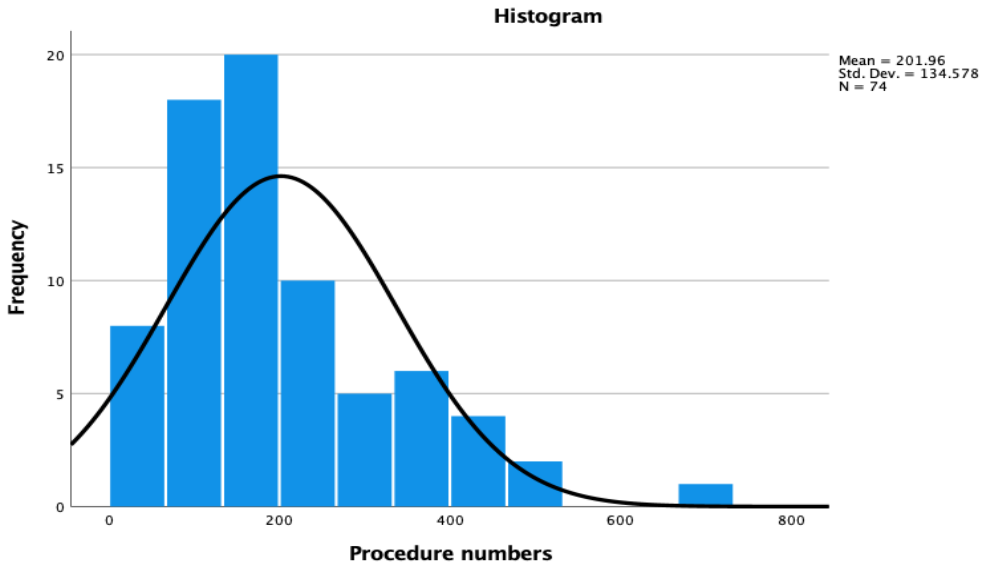
- Screening Colonoscopists (SC)
- Non- Screening Colonoscopists (NSC)

4.1 Missing and valid data

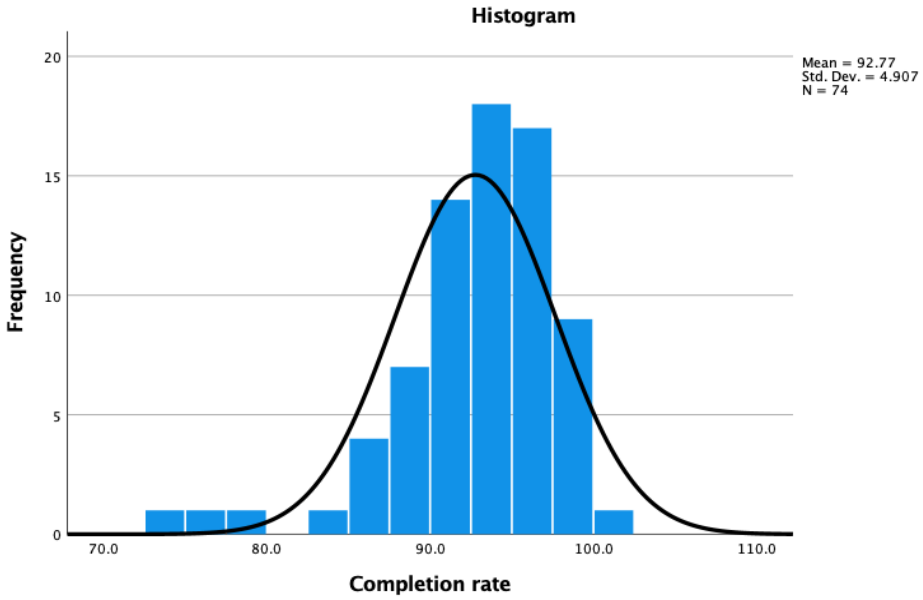
KPI	Valid data	Missing data	Mean	Median	Range
Procedure number	73	0	201.96	172.00	7-708
Completion rate	73	0	92.76	93.11	72.5-100
Polyp detection rate	73	0	50.03	54.79	14.5-83.5
Comfort score	62	11 (15%)	14.04	9.60	1.4-40.6
Sedation <70 years	66	7(9%)	1.910	2.00	1-2.7
Sedation >70 years	67	6(8%)	1.781	1.90	1-2.7
No Sedation	50	23 (31%)	30.90	34.45	2.04-64.15
Withdrawal time	39	34 (46%)	10.13	9.50	2-18.8

4.2 Histograms to illustrate distribution of data for each KPI relating to individual colonoscopists using the complete data set of all 3 cohorts

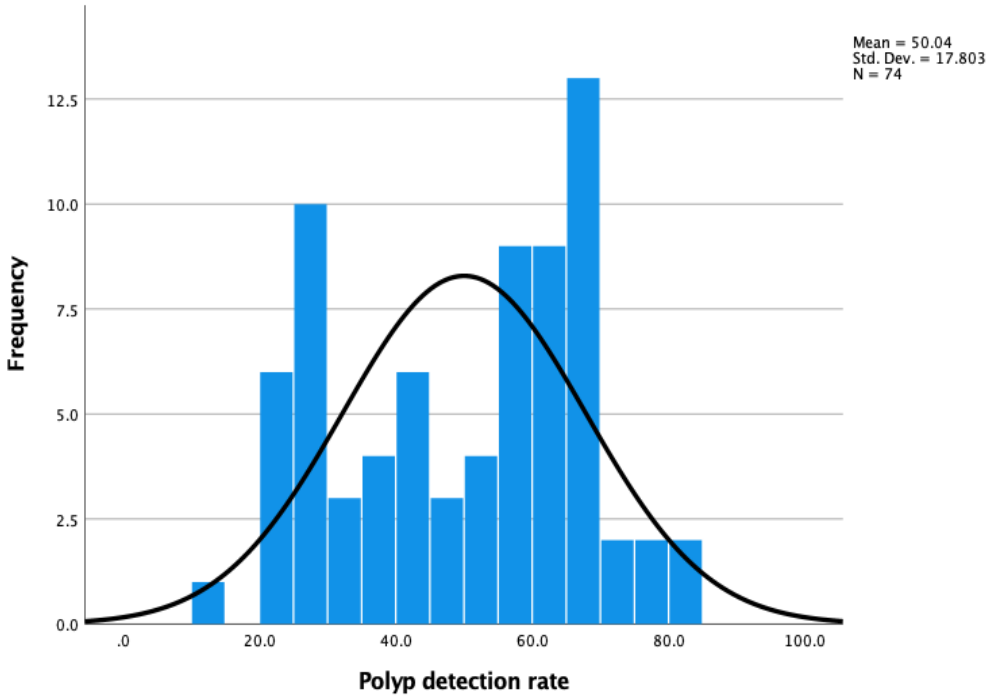
4.2.1 Procedure numbers



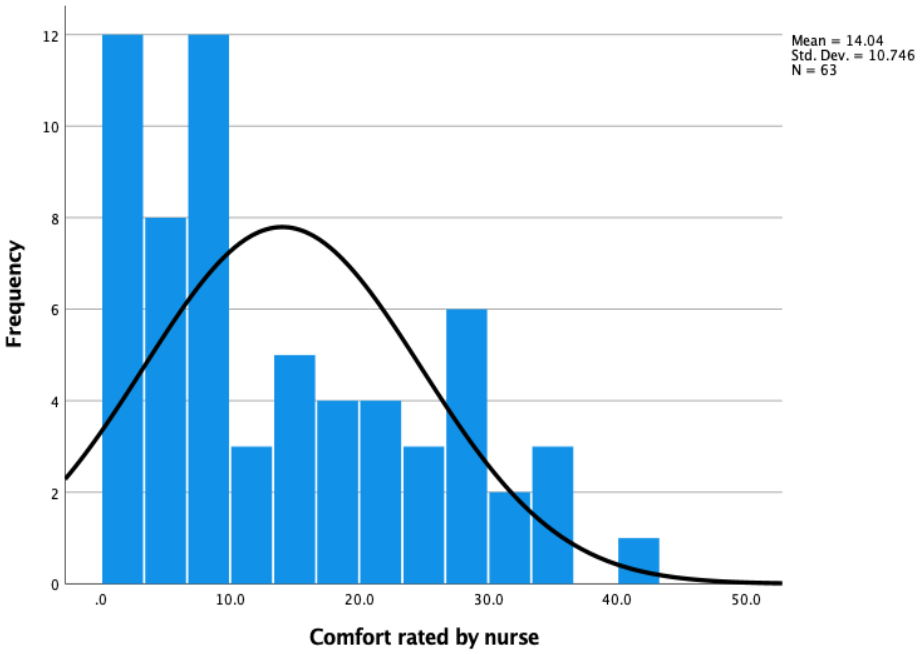
4.2.2 Completion rate



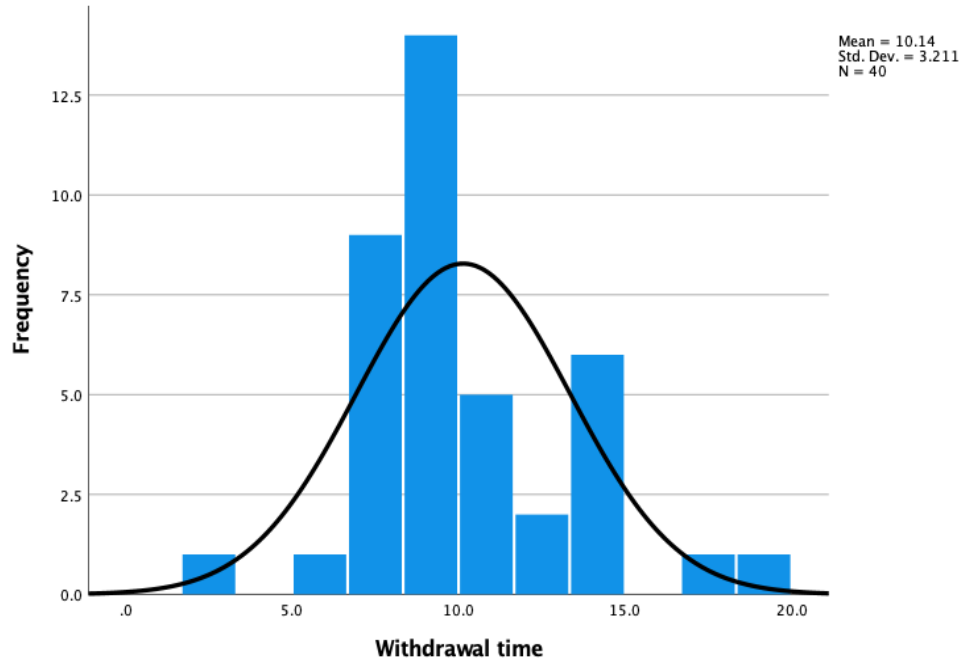
4.2.3 Polyp detection rate



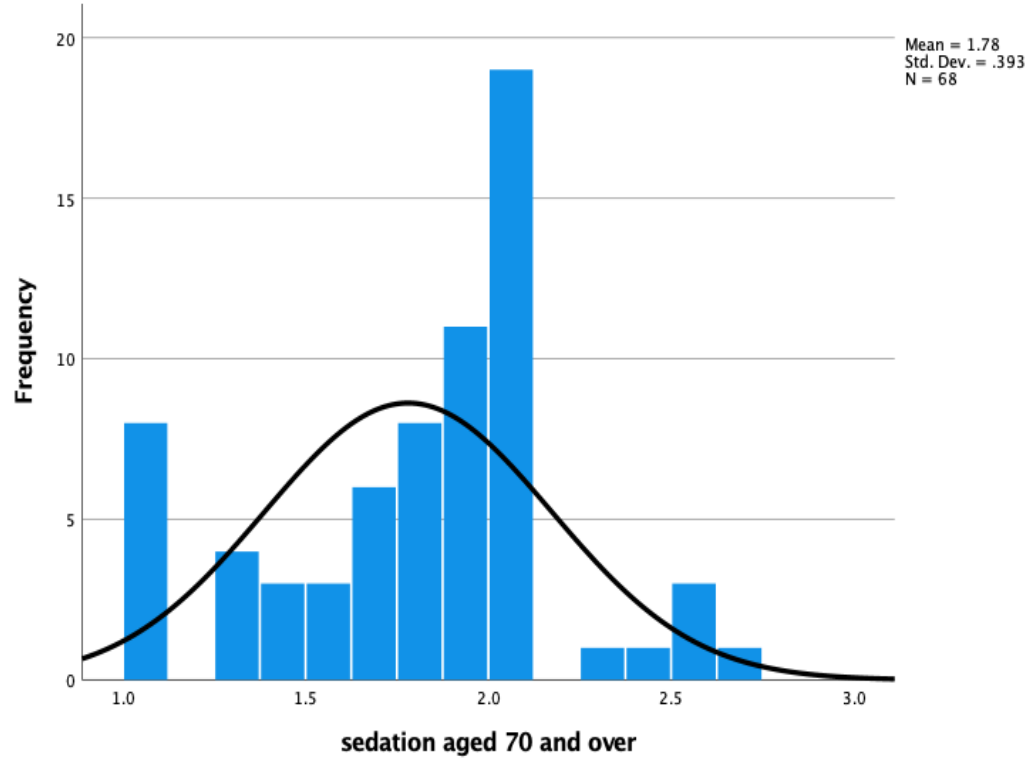
4.2.4 Comfort scores



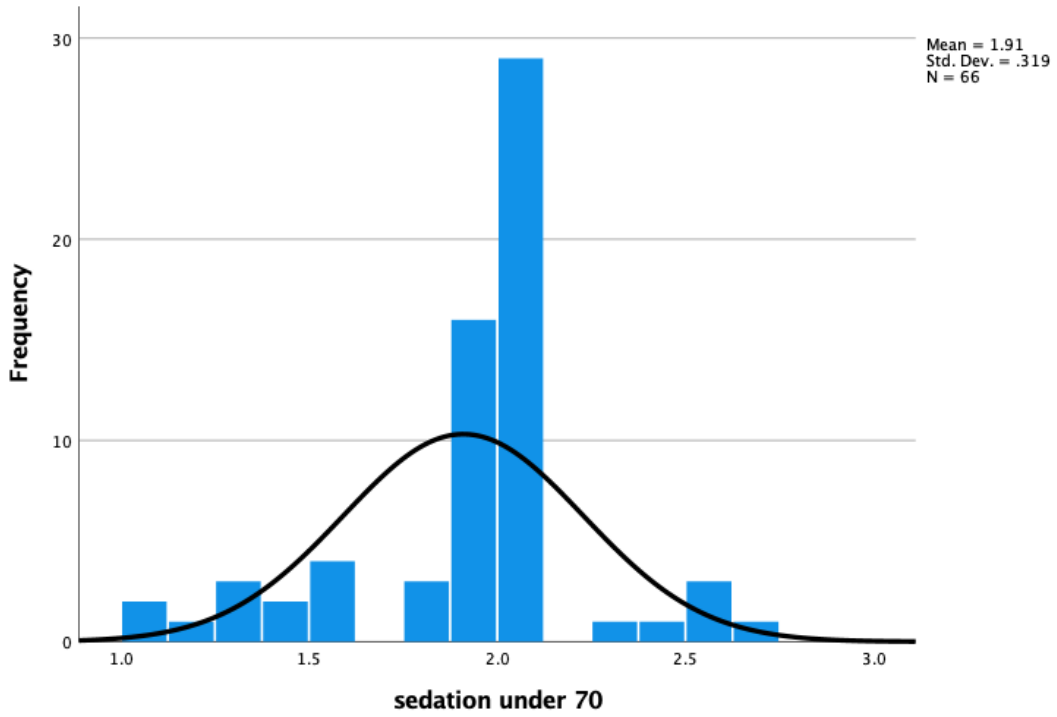
4.2.5 Withdrawal times



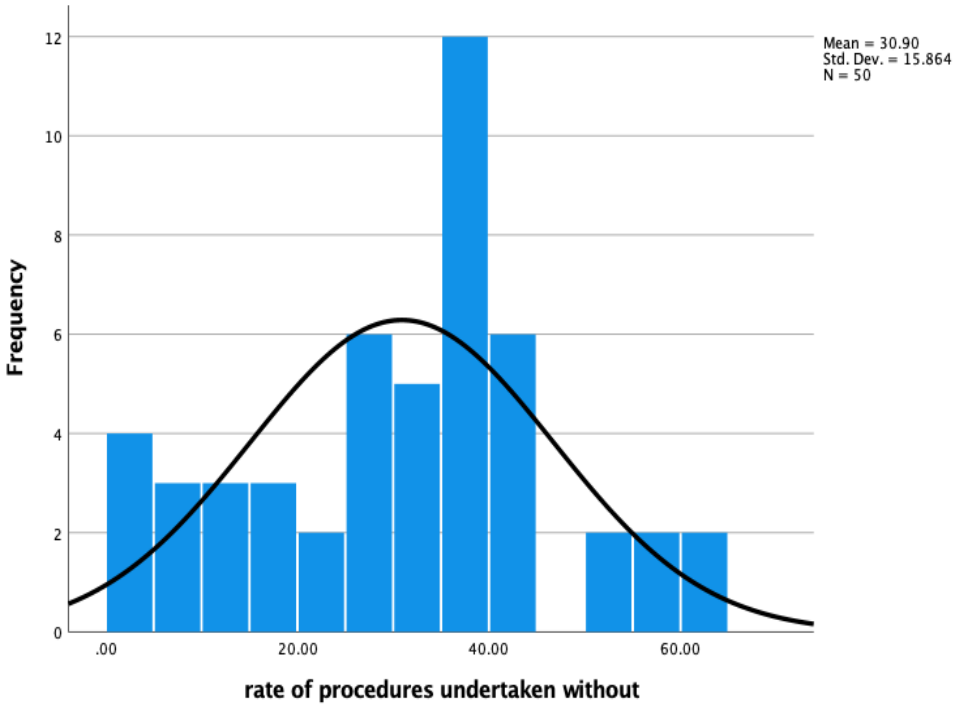
4.2.6 Sedation used in patients aged 70 years and over



4.2.7 Sedation used in patients under the age of 70 years



4.2.8 Rate of procedures undertaken without sedation



4.3 Non-parametric test- Kruskal Wallis results. Variation between two independent cohorts of colonoscopists

KPI	Kruskal Wallis significance
Procedure Numbers	.200
Completion rate	.690
PDR	.001*
Comfort	.001*
Withdrawal	.003*
Sedation >70	.197
Sedation<70	.001*
No sedation	.056

**Statistically significant result*

4.4 Non-parametric test- Mann-Whitney U test results. Variation between two independent cohorts of Colonoscopists.

KPI	N SC	N NSC	Mean SC	Mean NSC	U value	Mann Whitney U Significance
Procedure numbers	30	21	21.28	33.61	486.500	.004
Completion rate	30	21	30.57	20.95	208.000	.024
PDR	30	21	36.67	12.64	25.000	.000
Comfort	30	15	26.70	15.60	114.000	.008
Withdrawal	30	4	17.07	20.75	73.000	.519
Sedation ≥70	30	18	23.92	25.47	287.500	.707
Sedation<70	30	18	19.30	33.17	426.000	.001
No sedation	30	10	23.03	12.90	74.000	.017

Key:

SC= Screening Colonoscopist

NSC=Non-Screening Colonoscopist

4.5 Mann-Whitney U test results with Bonferroni correction to assess significance of variation between two independent cohorts of Colonoscopists.

KPI	Mann- Whitney U Test Significance	Bonferroni Correction P= .006 Significant Yes/No
Procedure Numbers	.004	Yes
Completion rate	.024	No
PDR	.000	yes
Comfort	.008	No
Withdrawal	.519	No
Sedation >70	.707	No
Sedation<70	.001	Yes
No sedation	.017	No

5.1 Endoscopy unit productivity KPI's – results of normality of data distribution tests

DNA	Kolmogorov-Smirnov Significance	Shapiro-Wilks Significance
Screening	.003	.003
Non-Screening	.200	.335

6.1 Semi structured interview guide

Semi structured interview guide	
Question	Notes
Warm up: • Welcome and introductions • Where are you working • What does your role involve?	• Consent • Confirm anonymity
Quality: • Views on potential difference in quality between the screening colonoscopy and the non-screening colonoscopy services? • Do you believe there is a 2-tier service? And why? • Has there been a change over time? • Quality assurance processes- do they differ? How?	• Procedure itself or general set up and management of the service? What are the differences? • In what way 2 tier? Is this inevitable? A good thing or not? • Gap in quality- difference to 2008 when screening started? • Is the QA process necessary? Can it be improved? • Such as repeat procedures, DNA, cancellations
Productivity: • Productivity- is there a difference between the 2 services? In what way? • Improvement- productivity and quality	• Improvement strategies- screening and non-screening
SC Assessment: • Do we need a screening colonoscopist assessment process? • Are there any barriers to accreditation? What are they? • How can they be overcome and how can we encourage more Colonoscopists to apply for accreditation? • How can the process of accreditation be improved?	• Formal process or is there another way? • Barriers to becoming a screener or the accreditation process • Practical suggestions