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HITCHINS, C. R.

DOCTOR OF MEDICINE

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University of Plymouth

ASSESSING TEAMS IN ENDOSCOPY: DOES GOOD NON-TECHNICAL SKILLS PERFORMANCE CORRELATE WITH GOOD CLINICAL OUTCOMES?

by

CHARLOTTE RUTH HITCHINS

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"Don't let yourself be. Find something new to try, something to change. Count how often it succeeds and how often it doesn't. Write about it. Ask a patient or a colleague what they think about it. See if you can keep the conversation going."
Atul Gawande

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AUTHORS DECLARATION

At no time during the registration for the degree of Doctor of Medicine has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

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- Assessing non-technical skills in gastrointestinal endoscopy. Do better skills improve patient outcomes?

South West Academic Health Science Network Patient Safety Office Training, 18th September 2017 (Oral presentation)

- Do good non-technical skills in endoscopy lead to good patient outcomes? Setting up and carrying out an MD project

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Date   …………………………………………………………

Abstract   Assessing teams in endoscopy: does good non-technical skills performance correlate with good clinical outcomes?

Charlotte Ruth Hitchins

Background

Failures in non-technical skills (NTS) contribute to adverse events in healthcare. Previous research has explored the assessment and training of these skills, and yet there is a lack of evidence for their impact on clinical outcomes. Gastrointestinal endoscopy is a high-pressure specialty, but to date there is little on the role of NTS in this area, or a method for their assessment.

This MD project aims to measure NTS in endoscopy, explore their relationship with clinical outcomes, and identify those specific to this area of healthcare.

Methods

An observational study of endoscopy teams in real time, using the Oxford NOTECHS II assessment tool. Comparison of NTS performance with procedure outcomes and patient satisfaction.

A qualitative interview study with staff members to establish the NTS specifically relevant to working in gastrointestinal endoscopy.

Results

Reliability of the Oxford NOTECHS II tool by a single rater in this environment was good.

Positive relationships were found between NTS scores and polyp detection, scope withdrawal time and completion of items on a safety checklist. However, relationships with other outcomes, including patient satisfaction were weak, or inconclusive.

The themes identified relating to NTS in gastrointestinal endoscopy were leadership, working together as a team, situation awareness, making decisions, the patient and communication.

Conclusions

Although few conclusive relationships were found between NTS performance and procedure outcomes, those positive associations found seem logical as they are likely to reflect increased care and vigilance. This may have been affected by a lack of variation in scores.

The NTS relevant to this area are similar to other areas of healthcare. However, the interaction with and around the awake patient is unique to endoscopy and an important influence on the NTS that staff must possess.

There is scope to develop a more specific tool for the assessment of NTS in endoscopy

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Glossary of abbreviations

ADR	Adenoma Detection Rate
ANTS	Anaesthestists Non-Technical Skills
ANTS-AP	Anaesthestists Non-Technical Skills for Anaesthetic Practitioners
ASGE	American Society for Gastrointestinal Endoscopy
BCSP	Bowel Cancer Screening Programme
BSG	British Society of Gastroenterology
CDM	Critical Decision Method
CH	The MD Student – Dr Charlotte Hitchins
CINAHL Plus	An index of English-language and selected other-language journal articles about nursing, allied health, biomedicine and healthcare.
CIT	Critical Incident Technique
CRM	Crew (or Cockpit) Resource Management
CTA	Cognitive Task Analysis
CW	The Supervisor – Dr Catherine Ward, Consultant Anaesthetist, Plymouth Hospitals NHS Trust, Plymouth University Peninsula School of Medicine & Dentistry
DM	Problem Solving and Decision Making
Embase	A biomedical and pharmacological database of published literature.
GI	Gastrointestinal
GRS	Global Rating Scale
JAG	Joint Advisory group on GI Endoscopy
JG	Advisor of Qualitative methods and analysis – Julie Griffin, Lead Teaching & Research Associate, School of Psychology, Plymouth University
KPI	Key Performance Indicators
L&M	Leadership & Management
MEDLINE	A database of life sciences and biomedical information including medicine, nursing, pharmacy, dentistry, veterinary medicine, and health care.
NCEPOD	National Confidential Enquiry into Patient Outcome and Death
NHS	National Health Service
NOPEs	Non-Operative Procedural Errors
NOTSS	Non-Technical Skills for Surgeons
NTS	Non-Technical Skills
OGD	Oesophago-Gastro-Duodenoscopy
OTAS	Observational Teamwork Assessment for Surgery
OTEs	Operative Technical Errors
PDR	Polyp Detection Rate
PROMs	Patient Reported Outcome Measures
PsychINFO	A database of abstracts of literature in the field of psychology.
PubMed	PubMed is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics.
SA	Situation Awareness
SPLINTS	Scrub Practitioners List of Non-Technical Skills
T&C	Teamwork & Co-operation
TA	Thematic Analysis
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

Chapter 1 Introduction

1.1 Background

Failures in the non-technical aspects of human and team performance are thought to account for a significant proportion of adverse events in healthcare (Chief Medical Officer, 2000, Vincent et al., 2001). The causes of such adverse events often stem not from deficiencies in clinical or technical skills, but from the non-technical aspects of human and team performance (Robertson et al., 2014, Yule et al., 2006a, Sharma et al., 2011).

Much of the early research in this field comes from the aviation industry where "non-technical skills" are defined as "the cognitive and social skills of flight crew members in the cockpit" (Flin et al., 2003). Failures in teamwork in cockpit crews have been linked to half of adverse events in aviation (Haller et al., 2008) and further work within surgery has shown a significant reduction in adverse events when teams perform well (Haynes et al., 2009). The identification, assessment and training of non-technical skills (NTS) in healthcare has expanded dramatically over recent years with increasing acknowledgement of their importance for safe, high quality care (Sevdalis, 2013, Kohn et al., 2000). Behavioural ratings systems were initially developed in aviation and other high-risk industries to facilitate the assessment and training of NTS and more recently similar such tools or taxonomies have been developed in healthcare, particularly within surgery, anaesthesia and emergency care.

Although the link between adverse events and failures in NTS is well established, objective evidence that better NTS result in improvements in outcomes is lacking. Studies investigating the role of team training have shown some positive effects on

outcomes such as technical and procedural error rates, Safety Attitude Questionnaire scores and participant perception of team work (McCulloch et al., 2009, Thomas et al., 2007, Morey et al., 2002, Halverson et al., 2009), but only one to this student's knowledge identified a reduction in surgical mortality (Neily et al., 2010, Young-Xu et al., 2011). It therefore seems possible that a direct link between NTS and successful outcomes exists, but there is much work to be done in clarifying this, as well as the role that training plays in the advancement of these skills.

Gastrointestinal endoscopy is a procedure-based specialty with significant operational pressures and rapidly advancing technology, however there has been little research into NTS in this area. Endoscopy units are akin to day-case operating theatres, undertaking procedures that vary from relatively simple diagnostics to complex therapeutic interventions. The demand for endoscopy has increased dramatically over recent years, putting additional operational pressure on units to perform high quality investigations, efficiently and within national targets. Although severe adverse events are rare in endoscopy, they can be potentially life threatening, and with advancing technology, increasingly complex therapeutic procedures inevitably carry higher risks of complications.

Endoscopy units share many characteristics with theatre complexes and yet there is little literature relating to the assessment or training of team performance in this area; even within other areas of healthcare there is little correlation with clinical outcomes. This lack of interest in NTS in this area is despite the publication of a National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report "Scoping Our Practice" in 2004. This report reviewed outcomes and adverse events within endoscopy

departments in the United Kingdom (UK), highlighting a number of deficiencies in the non-technical aspects of care (NCEPOD, 2004). It is therefore surprising that there has been so little investigation into the role of NTS in this area to date.

Taxonomies for team performance and non-technical skills assessment in surgery are well established and yet evidence of their use in or adaptation for endoscopy is lacking. There is therefore scope for research into the evaluation and development of a non-technical skills assessment tool within this area, as well as the correlation of such skills with clinical and other outcomes.

1.2   Aims and objectives

This MD project aims to develop the measurement of non-technical skills in gastrointestinal endoscopy and to delineate the relationships between successful clinical outcomes and non-technical skills. In addition, a qualitative study exploring the role of NTS specifically in the area of gastrointestinal endoscopy will be undertaken to investigate the most important skills and behaviours for working this environment.

The subsequent chapters will serve to report on all aspects of this project, and thus fulfil the aims in the following manner: Chapter Two will review the existing literature on NTS in healthcare, including within gastrointestinal endoscopy, the role of NTS assessment and training and relationships with outcomes. Chapter Three will detail a quantitative observational study of NTS in endoscopy using an existing tool, and explore the relationship with procedure outcomes and patient satisfaction. Chapter Four will report a qualitative interview study with endoscopy staff members, exploring the role of NTS within this specific area of healthcare and highlighting any differences and similarities in relation to the existing literature. Chapter Five will discuss the findings of both the quantitative and qualitative studies, with conclusions and areas for further work. Chapter Six will reflect on the process of undertaking an MD project, including experiences, challenges and lessons learnt.

Chapter 2 Non-technical skills: assessment, training and relationships with outcomes in endoscopy

2.1   Chapter aims

This chapter will present a narrative review of the published literature on non-technical skills. It will explore the history of NTS assessment and training within healthcare and other industries, as well as more specifically within the area of gastrointestinal endoscopy. It will aim to answer the following questions:

- What are non-technical skills? What is their role in healthcare and more specifically in gastrointestinal endoscopy?

- How are non-technical skills assessed? What assessment tools are available in healthcare? Are there any assessment tools specific to use in gastrointestinal endoscopy?

- Is there any evidence for a relationship between NTS and patient outcomes in healthcare or in endoscopy?

- What is the gap in the existing literature and how can this be explored to develop the aims of this MD project?

2.2   The history of non-technical skills

2.2.1   Definitions

Non-technical skills (NTS) are "the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance" (Flin et al., 2008). These skills have gained increasing recognition for their role in safe, effective human performance over recent decades, but there are still areas of healthcare where they are yet to receive sufficient attention. This chapter will explore the history of NTS in healthcare and identify the need for further research into the role of NTS in gastrointestinal endoscopy and significantly into measuring the effects of improving NTS on outcomes.

NTS can be divided into cognitive skills such as situation awareness, decision making, risk assessment and adaptability, and inter-personal skills such as communication, teamwork, leadership, task management and coping with stress and fatigue (Flin et al., 2008, Yule et al., 2006b). These skills are generic, but some may be more or less important in a particular environment according to the nature of the occupation or workplace, particularly in terms of the descriptions of observable behaviours.

Situation awareness can be briefly described as "knowing what is going on around you". Although first described in the aviation industry, it is relevant to all high-risk industries. Endsley defined this more formally as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status for the near future" (Endsley, 1988). She went on to describe three levels of SA which are both hierarchical and interlinked. The first is perception of information in the environment; within healthcare this could include

knowledge of the patient's past medical history or medications, or noticing a change in their vital signs. The second level is understanding what that information means and integrating this with goals. For example, comprehending that the administration of an anticoagulant medication increases the risk of bleeding during an invasive procedure. The third level is "projection"; understanding what effect this information will have in the near future (Endsley, 1988, Wickens, 2008, Endsley, 2013). SA is relevant at both individual and team levels, with team situation awareness and shared mental models being particularly important when undertaking complex tasks or in high-stress, busy environments (Flin et al., 2008, Sevdalis et al., 2012).

Good decision making relies on interpretation of all available information to choose the option with the best likely outcome (Flin et al., 2008).

Leadership within a team goes beyond directing and co-ordinating the activities of its members to include motivating, monitoring and developing skills (Flin et al., 2008). Despite this, many leaders are promoted to their role based on technical expertise or seniority, and training or appraisal of the skills required is often neglected (Sevdalis et al., 2012). For effective team working, members need to support each other, communicate effectively and coordinate their activities.

Fatigue and stress from both inside and outside the workplace are well known to impact on performance. Thus the ability to recognise these in oneself and others is an important non-technical skill with the potential to implement coping strategies and safeguard against their negative effects (Flin et al., 2008).

2.2.2   History: aviation and high-risk industries

Research into NTS has developed over the last 30 years, initially influenced by aviation and other safety critical industries.

Analysis of cockpit recorders following accidents in aviation in the early 1990's identified the contribution of NTS such as poor leadership, team work, communication, decision making, inability to speak up, as well as the effects of stress and fatigue all to be significant (Flin et al., 2008).

In fact, up to 80% of accidents across high risk industries are thought to be due to these causes, with examples of high profile accidents from nuclear, maritime, oil and gas, military, police, aviation, healthcare, transport and petrochemical industries all due, at least to some extent, to failures in NTS (Flin et al., 2008).

In addition, Reason (1997) described his 'Swiss Cheese Model', suggesting that accidents were usually due to a series of errors in a system and that humans were the last line of defence, not just causing or allowing mistakes to happen, but being able to identify problems and correct errors, mitigating actual harm. This is often referred to as resilience and can be reinforced by team members who monitor and assist each other, particularly when overloaded (Burke et al., 2004). It was concluded that if NTS could be trained or improved to allow workers to behave as they would on a 'good day', every day, safety would be improved and errors reduced (Flin et al., 2008).

The aviation industry's response to this evidence was to commission further international research utilising analysis of accident reports, interviews with pilots and flight-deck simulators, to identify important NTS behaviours and establish a means of training and assessing these skills (Flin et al., 2008). This lead the development of Cockpit

or Crew Resource Management (CRM) courses aimed at training skills that would improve safety and efficiency, and ultimately reduce the chance of accidents occurring. These principles were taken on by other high-risk industries and adapted according to their specific requirements.

2.2.3 Non-technical skills in healthcare

The need for improvement of safety in healthcare came to the fore at the turn of the 21st century with the publication of research and national reports from the United Kingdom (UK) and the United States of America (USA) (Chief Medical Officer, 2000, Kohn et al., 2000, Vincent et al., 2001, Intitute of Medicine, 2001). The average rate of adverse events during a hospital inpatient stay was estimated at 10%, with approximately half of these due to preventable causes and a direct financial cost to the UK National Health Service (NHS) of up to £2 billion per year (Chief Medical Officer, 2000, Vincent et al., 2001). These events were attributed to a number of causes, with concern that there was a distinct lack of learning from mistakes. Further work included an analysis of emergency department malpractice claims which found an average of 8.8 teamwork failures per case, concluding that better teamwork could improve safety and care quality and reduce litigation costs (Risser et al., 1999). Recommendations called for better error reporting systems and mechanisms to learn from mistakes, facilitated by designing safety into systems, changing organisational culture and improving inter-professional team training (Kohn et al., 2000, Chief Medical Officer, 2000).

Although team performance and NTS were not the only areas where improvements were recommended, they received significant attention. This is likely due to the reliance of modern healthcare on teamwork. As technology and science has advanced,

healthcare has become increasingly complex. This is coupled with operational pressures including increasing patient numbers, a patient population that is more informed, and government targets for the delivery of care. The concept of an 'expert team' such as a pit stop crew that always work together and have spent hours rehearsing their tasks rarely exists. Instead healthcare relies on individuals that come together to form a team and undertake their job together on a particular day, a so-called 'team of experts'. These teams lack stability and therefore rely more heavily on the skills of individuals to establish good working relationships quickly and efficiently, to successfully, safely and effectively carry out their work (Sevdalis et al., 2012, Yule et al., 2009). This is well illustrated in the operating theatre, a high risk and high-pressure environment, often using new or unfamiliar technologies, where it is critical that a team performs well, and yet team members may change on a daily basis.

2.2.4 Non-technical skills and gastrointestinal endoscopy

Endoscopy units are akin to day-case operating theatres, undertaking procedures that vary from relatively simple diagnostics to complex therapeutic interventions. The demand for endoscopy has increased dramatically over recent years (Bourikas et al., 2013). This has undoubtedly been influenced by the introduction of asymptomatic screening pathways, as well as heightened education and awareness of bowel symptoms within the general population, putting additional operational pressure on units to perform high quality investigations, efficiently and within national targets.

As with all aspects of healthcare, safety is essential. Although severe adverse events are rare in endoscopy, they can be potentially life threatening (Bourikas et al., 2013). Increasingly complex therapeutic procedures, for example excision of large polyps,

inevitably carry higher risks of complications such as bleeding and perforation, and skills such as situation awareness, judgement, decision making and communication are all key in both prevention and management. Events like patient misidentification are also thankfully rare and often don't lead to actual harm (Matharoo et al., 2014a), but it is these 'near misses' and the accumulation of minor errors that are thought to lead to more serious errors (Flin et al., 2008).

To explore the role of NTS in endoscopy a review of existing published literature was undertaken. MEDLINE, Embase, Cochrane Library, PsychINFO, CINAHL Plus and PubMed databases were systematically searched using the following terms: Non-Technical Skills, Team Performance or Team Skills AND Endoscopy, Colonoscopy, OGD or Gastroscopy. Titles and abstracts were reviewed and papers not reporting team or non-technical skills in gastrointestinal endoscopy were rejected. Where the abstract was not clear, the full paper was reviewed. Bibliographies were reviewed for further relevant references.

The search revealed a total of 80 publications. Sixteen met the inclusion criteria and review of bibliographies identified a further two relevant publications. Of these 18 publications, only eight were full text articles (Anderson, 2012, Bourikas et al., 2013, Haycock et al., 2012, Heard et al., 2011, Matharoo et al., 2014a, Grover et al., 2015a, Walsh et al., 2014, Walsh et al., 2015), nine were conference abstracts (Grover et al., 2016, Grover et al., 2015b, Hawkes and McDonald, 2014, Hawkes et al., 2015, Haycock et al., 2010, Hewett et al., 2010, Matharoo et al., 2012, Pyati, 2012, Scaffidi et al., 2016) and one a National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report (NCEPOD, 2004).

The NCEPOD report, 2004 (Scoping our practice), investigated the deaths of patients following therapeutic endoscopy. Significant variation in care was found across different units with 20 of 21 recommendations highlighting deficiencies in the non-technical aspects of practice (NCEPOD, 2004, Matharoo et al., 2014a). These included poor communication with patients regarding consent, variability in Endoscopists' review of pre-procedure information and a lack of guidelines related to sedation practice and monitoring. There has been little other research into NTS within endoscopy, however some early work within this area has shown a potential positive correlation between NTS and improved safety behaviours (Matharoo et al., 2012).

Non-technical skills, by their nature, are transferable across different areas of healthcare practice (as well as other high risk industries) (Flin et al., 2008). However, as previously highlighted, different NTS can be more or less relevant to different areas.

The literature reviewed established situation awareness as the commonest theme and an essential NTS in endoscopy (Bourikas et al., 2013, Grover et al., 2016, Hawkes and McDonald, 2014, Haycock et al., 2012, Hewett et al., 2010, Matharoo et al., 2014a, Scaffidi et al., 2016, Haycock et al., 2010). This is not surprising as pre-procedure information gathering provides the team with background information about the patient, their relevant history and factors which could increase the technical difficulty of the procedure to be undertaken (Bourikas et al., 2013). This information can be gleamed from a pre-procedure assessment or consultation and should be communicated to allow the whole team to have a shared understanding or mental model and plan for the case. It is essential that team members are aware of each other's abilities and experience and what their roles will involve. During a procedure, active observation and communication allow for anticipation of equipment needs, early response to problems and the

avoidance of errors. In their analysis of Endoscopists' reflective diaries, Hawkes and McDonald (2014) found issues relating to situation awareness resulted in more in-depth reflective practice thus illustrating its importance.

Decision making and judgement are also key cognitive skills in endoscopy (Grover et al., 2016, Hawkes and McDonald, 2014, Haycock et al., 2010, Hewett et al., 2010, Scaffidi et al., 2016, Matharoo et al., 2014a). This was the commonest theme for learning points identified by the group of Endoscopists surveyed by Hawkes and McDonald (2014), particularly relating to the assessment and management of lesions found at colonoscopy. Although knowledge and technical skills are required to inform decision making, it is heavily influenced by an individual and team's response to a dynamic situation, particularly when under pressure or in emergent circumstances.

The social skills of leadership, professionalism, teamwork and communication were all common themes in the literature reviewed (Hawkes and McDonald, 2014, Haycock et al., 2012, Haycock et al., 2010, Grover et al., 2016, Scaffidi et al., 2016, Matharoo et al., 2014a). Effective teamwork requires team members to understand and support each other in their roles. Within endoscopy the team can be defined as the group of people working together in a procedure room or can be expanded to the whole department. These teams may be different with each session or even change during a session. Good communication requires exchange and receipt of information, ideally in a standardised way. This is particularly important with the interchangeable "teams of experts" that are so common in endoscopy (Haycock et al., 2012).

These themes are similar to those in the surgical literature, where the cognitive skills of situation awareness and decision making, and social skills of leadership and teamwork

are predominant (Mishra et al., 2008, Mishra et al., 2009, Sevdalis et al., 2008, Yule et al., 2008b, Yule et al., 2006b).

2.3 How are non-technical skills assessed?

There is a clear consensus that developing non-technical skills has the potential to improve the way teams perform within safety critical industries, including healthcare. If this is the case, means to train and assess these skills are required.

2.3.1 History – aviation, development of CRM training and NOTECHS

The assessment of NTS evolved from a requirement from aviation authorities to evaluate the effectiveness of Crew Resource Management (CRM) training (Flin et al., 2003). Rating scales such as the 'University of Texas (UT) Behavioural Markers' were incorporated into CRM training manuals to aide examiners in assessment of interpersonal skills, and many airlines developed their own in-house assessment scales (Flin et al., 2008, Klampfer et al., 2001). The 'NOTECHS' tool was commissioned by the European Joint Aviation Authority to assess pilots' (rather than whole crew) non-technical skills, in conjunction with CRM training. The aim was to develop a tool that was easy to understand and feasible for use across Europe, unhindered by language or cultural barriers (Flin et al., 2003).

The NOTECHS tool assesses pilots in four non-technical skill categories. Two social: "Cooperation" and "Leadership & Managerial Skills", and two cognitive: "Situation Awareness" and "Decision Making". Each of these categories has a list of example observable behaviours (positive and negative) for the assessor to reference. A score of "very poor", "poor", "acceptable", "good" or "very good" is allocated for each category (Klampfer et al., 2001, Flin et al., 2003).

During the last two decades, similar tools have been designed in healthcare, most notably within the fields of emergency medicine, anaesthetics and surgery. These have

varied slightly in their development and structure with some assessing individual practitioners within a team and others assessing the team as a whole. The following paragraphs will explain in more detail how these tools have been developed, established and their intended uses.

2.3.2 Development of a non-technical skills assessment tool

A number of criteria for developing a behavioural rating scale or assessment tool have been suggested. These are to ensure the tool is fit for purpose and can therefore reliably assess the non-technical skills of the target professional or team. According to these criteria an assessment tool should be (Yule et al., 2006a, Flin et al., 2008, Sevdalis et al., 2012, Klampfer et al., 2001):

- **Context specific** – developed for the environment or workplace in which it will be used, focus on the needs or training goals of those being assessed

- **Explicit** – comprise important, well defined, and observable behaviours; sufficiently sensitive to distinguish between good and bad examples with minimal overlap between components

- **Transparent** – those being assessed should understand the performance criteria against which they are rated

- **Usable** – framework should be simple and easy to understand, behaviours easy to observe in the target environment and sensitive to rater workload

- **Valid** – content and construct

- **Reliable** – internal, test-retest and inter-rater reliability must be adequate

Before a tool can be developed, and to fulfil the criteria "context specific", the skills and behaviours specific to the occupation or work environment need to be established.

Table 2.1 demonstrates some of the techniques that can be used (Flin et al., 2008). In addition to these techniques, reviewing existing literature and similar tools can add information regarding both structure and content. Ideally a combination of at least two techniques, for example observation and interview or focus groups, should be used, as each individually is unlikely to yield a full set of relevant behaviours (Flin et al., 2008).

Type	Techniques
Event-based analyses: Examining accident or near-miss reports to identify patterns of behaviour	• Accident/near-miss analysis • Confidential reporting systems analysis (including reports of safety concerns, as well as actual events)
Questioning techniques: Soliciting information directly from role-holder/s from the job under investigation	• Interview (structured, unstructured, semi-structured) • Focus groups • Questionnaires and surveys
Observational techniques: Watching individuals or teams carrying out one or more tasks	• Direct • Participant • Remote (e.g. from video recording)

Table 2.1 Techniques to identify non-technical skills (Table 9.1, page 217 (Flin et al., 2008))

The commonest use for NTS assessment tools to date has been in formative assessment and the evaluation of team training programmes; but, with increasing focus on the importance of NTS, these tools may have a role in summative assessment and revalidation (Anderson, 2012, Yule et al., 2006b). Such tools can also be a useful aide memoire to facilitate self-reflection or debriefing after a critical incident or complex case, both in simulation and in vivo. In addition, another potential use, still in its infancy, is in recruitment and selection (Gale et al., 2010).

2.3.3   Tools in healthcare and endoscopy

Within healthcare, anaesthesia and surgery were the first specialties to develop tools to assess non-technical skills. This however rapidly expanded to other areas including,

amongst others, other members of the operating team, emergency medicine, resuscitation teams and trauma teams. Table 2.2 shows a selection of healthcare NTS assessment tools, including their target environment and a brief summary of how they were developed and validated.

The most widely known of these assessment tools are the ANTS, NOTSS and SPLINTS tools developed by a team at the University of Aberdeen to respectively assess the individual NTS of Anaesthetists, Surgeons and Scrub Practitioners, and the Oxford NOTECHS tool, modified from the original aviation NOTECHS tool, to assess the NTS of the operating theatre team. They all use a structure similar to NOTECHS, with NTS categories and observable behaviours specific to their field of assessment.

The Oxford NOTECHS tool scores the NTS of the operating team as a whole and three sub-teams (Surgical, Anaesthetic, Nursing) in real-time across four categories: "Leadership and management", "Teamwork and cooperation", "Problem-solving and decision-making" and "Situation awareness" (McCulloch et al., 2009, Mishra et al., 2008, Mishra et al., 2009). In its original iteration, a score of 1-4 was allocated for each category, however this scale was expanded to 1-8 in its latest version (Oxford NOTECHS II) in an attempt to improve discrimination and increase variability between scores (Robertson et al., 2014). It has been shown to have good validity, reliability and usability for its target use.

Assessment tool	Area / Who assessed	References	How developed	Validation	Adaptations
Non-Technical Skills for Surgeons (NOTSS)	Operating theatre / Surgeon	(Crossley et al., 2011, Yule et al., 2008a, Yule et al., 2008b, Yule et al., 2006b)	Literature review. Cognitive Task Analysis interviews. 4 independent panels modified → skills taxonomy. Observable behaviours for each category.	Consistent internal structure, sensitive, moderate inter-rater reliability. Use as a feedback tool.	NOTSSdk (Spanager et al., 2012)
Anaesthetists Non-Technical Skills (ANTS)	Operating theatre / Anaesthetist	(Fletcher et al., 2003, Flin and Patey, 2011, Flin et al., 2010, Graham et al., 2010)	Literature review. Cognitive task analysis interviews – grounded theory approach. Organised by panel of experts into assessment tool.	Good internal consistency and accuracy, moderate inter-rater reliability.	ANTSdk (Jepsen et al., 2015) N-ANTS (Lyk-Jensen et al., 2014)
Scrub Practitioners List of Non-Technical Skills (SPLINTS)	Operating theatre / Scrub practitioner	(Flin et al., 2014, Mitchell et al., 2012, Mitchell et al., 2013)	Literature review. Interviews. Panel discussion of results to form assessment tool.	Inter-rater agreement acceptable. Reasonable accuracy. Good internal consistency. Usable.	
ANTS-Anaesthetic Practitioners (ANTS-AP)	Operating theatre / Anaesthetic practitioner	(Rutherford et al., 2015a, Rutherford et al., 2015b, Rutherford et al., 2015c)	Review of critical incident reports. Task analysis – interviews. Focus groups organised behaviours into taxonomy.	Acceptable internal consistency. Poor to moderate inter-rater reliability.	
Revised NOTECHS	Operating theatre / Team & Sub-teams	(Sevdalis et al., 2008)	Adapted from aviation NOTECHS scale. Revised following use in pilot observations.	Adequate internal consistency. Use in expert- and self-assessment.	

Assessment tool	Area / Who assessed	References	How developed	Validation	Adaptations
Oxford NOTECHS (II)	Operating theatre – Team & Sub-teams	(Mishra et al., 2008, Mishra et al., 2009, Robertson et al., 2014)	Adapted from aviation NOTECHS informed by task analysis & expert consensus. Scale expanded to improve intra-class discrimination.	Excellent inter-observer reliability. Good validity.	
Observational Team Assessment Tool (OTAS)	Operating theatre – Whole team	(Undre et al., 2006)	Task checklist informed by guidelines & interviews. Team behaviour assessment adapted from another tool.	Feasible.	
Behavioural Marker System for Neurosurgeons Non-Technical Skills (BMS-NNTS)	Operating theatre / Neurosurgeon	(Michinov et al., 2014)	Skills list from literature review and observations. Video analysis of behaviours.	Reliable & sensitive.	
Objective Structured Assessment of Non-Technical Skills (OSANTS)	Operating theatre / Surgical Residents in-training	(Dedy et al., 2015)	NTS items based on existing frameworks & literature. Pilot tool tested and definitions / descriptors assessed.	Reliable in simulation and in vivo. Internal consistency generally good.	
Team Emergency Assessment Measure (TEAM)	Resuscitation / Resuscitation team	(Cooper et al., 2016, Cooper et al., 2010, Taggart et al., 2014)	Literature review. Expert panel developed draft instrument. International expert panel rated content.	Content validity good. Internal consistency good. Inter-rater reliability fair.	fTEAM (Maignan et al., 2016)
Observational Skill-based Clinical Assessment tool for Resuscitation (OSCAR)	Resuscitation / Resuscitation team	(Walker et al., 2011, Walker et al., 2010)	Literature review. Expert review & rating of tool contents. Refined after reliability assessment.	Very high internal consistency. Intra-class correlation & inter-rater reliability strong.	

Assessment tool	Area / Who assessed	References	How developed	Validation	Adaptations
Imperial Paediatric Emergency Training Toolkit (IPETT)	Resuscitation – Paediatric Anaesthesia & ICU trainees	(Lambden et al., 2013)	Literature review NTS component based on NOTECHS. Tool tested in simulation.	Good reliability. Content validity good.	
Mayo High Performance Teamwork Scale	CRM / Medical team in CRM training	(Malec et al., 2007)	Based on ANTS & Ottawa GRS. Tested & revised. Rasch analysis.	Satisfactory reliability & content validity.	
Ottawa Crisis Resource Management Global Rating Scale (Ottawa GRS)	CRM / Medical team in CRM training	(Kim et al., 2006)	Based on work by Gaba. Expert panel assessment of content & Delphi process.	Good content validity, construct validity & acceptable inter-rater reliability.	
Emergency Medicine Physicians Non-Technical Skills (EM Physicians NTS)	Emergency department – Emergency Medicine Trainees	(Flowerdew et al., 2013, Flowerdew, 2010)	Literature review. Interviews with ED staff. Tool reviewed by expert panel.	Inter-rater reliability inadequate. Intra-class correlation adequate.	
Trauma-NOTECHS (T-NOTECHS)	Emergency department / Trauma Team	(Steinemann et al., 2012)	Expert panel reviewed literature and modified NOTECHS. Reviewed after pilot use.	Inter-rater reliability moderate – better in expert raters.	
Temporal Rating of Emergency Non-Technical skills (TRENT)	Simulated Ward – Foundation trainee doctors	(Ferguson et al., 2014)	Task analysis – review of video-recorded simulations & literature review. Revised following pilot.	Good intra- & inter-rater reliability. Valid for peer & self-assessment.	

Table 2.2: Non-technical skills assessment tools in healthcare

As is evident from the table (2.2), there are not yet any validated tools for assessing non-technical skills of the endoscopy team. On reviewing the literature, three conference abstracts were found detailing the development of tools which are yet to be tested for feasibility, validity, and reliability (see table 2.3) (Haycock et al., 2010, Hewett et al., 2010, Scaffidi et al., 2016). All three tools have been developed using qualitative methods utilising analysis of interviews or focus groups with Endoscopy staff, in keeping with the methods for tool development in other areas (Fletcher et al., 2004, Mitchell et al., 2013, Yule et al., 2006b, Mishra et al., 2009). In addition, Haycock et al. (2010) analysed video-recordings of live Endoscopic procedures to demonstrate the identified NTS behaviours in practice.

As can be seen in table 2.3, situation awareness (defined in section 2.2.1 as "knowing what is going on around you") is a NTS category common to all three tools. Decision making is included by Haycock et al. (2010) and Scaffidi et al. (2016), with Hewett et al. (2010) labelling a similar category "situation specific heuristics & strategies". The NTS specific tools also include domains to assess communication, teamwork and leadership. These themes are all common to the surgical team assessment tools previously mentioned. All three assessment tools require further testing for validity, reliability and usability. A validated, reliable tool would enable evaluation of training and investigation into the effects of NTS on outcomes.

Study	Skills assessed	How developed	Tool structure	How tested
Haycock et al. *GUT*. 2010 (Haycock et al., 2010) (abstract only)	NTS of Endoscopist	Semi-structured interviews (Critical Incident Technique) to identify taxonomy. Video analysis to identify behaviours in practice.	13 behavioural elements divided into 4 categories. Scored 1-4. Communication & teamwork Situation awareness Leadership Judgement & decision-making	Tool needs to be validated.
Hewett et al. *Gastrointestinal Endoscopy*. 2010 (Hewett et al., 2010) (abstract only)	Technical & NT Skills of Endoscopist	Hierarchical task analysis & verbal protocol analysis.	6 categories – 3 NTS, *3 technical skills.* No information on scoring. *Clinical knowledge & reasoning* *Scope handling* Situation awareness Situation specific heuristics & strategies *Detection of abnormalities* NTS such as intrapersonal stress coping	Not yet tested.
Scaffidi et al. *Canadian J of Gastroenterology & Hepatology*. 2016 (Scaffidi et al., 2016) (abstract only)	NTS – doesn't state if for assessment of team or individual	Literature search of other relevant tools. Focus groups (1x Medical, 1x Nursing, 1x Combined). Thematic analysis.	6 dimensions of NTS. Scored 1-5 (Likert-type). Teamwork Communication Situational awareness Decision Making Leadership Professionalism	Feasibility, validity and reliability testing required.

Table 2.3: Non-technical skills assessment tools in gastrointestinal endoscopy

2.4 Do good non-technical skills improve outcomes?

2.4.1 Non-technical skills and outcomes

Despite the number of tools available for assessing NTS in healthcare, no clear links between NTS performance and other factors such as safety culture, efficiency markers or patient outcomes have been established.

Mishra et al. (2009) and McCulloch et al. (2009) found significant negative correlations between Oxford NOTECHS scores and both operative technical errors (OTEs) and non-operative procedural errors (NOPEs), potential surrogate markers for safety. The strongest of these correlations was between surgical sub-team situation awareness and OTEs. NTS were measured with the tool both before and after NTS team training and the relationship with other outcomes explored. Scores significantly improved after training, with associated improvements in safety culture, but no significant change in operating time (a potential marker of efficiency) or patient length of stay. However, there was no blinding of assessors to training status and numbers were small.

2.4.2 Team training, NTS and other outcomes

It seems intuitive that team training which improves NTS would improve outcomes. This is based on the assumption that such a training programme would teach or improve the situation awareness, decision making ability, team working skills, leadership skills and resilience of both the individuals within a team and the team as a whole. This would better equip staff to maintain a higher standard of communication, and recognise and avoid potential errors before they happen. This could not only lower the risk of adverse events or complications, but actually improve the standard of care provided, thus improving outcomes. However, research in this area, and evidence to support this link,

is lacking. As yet studies are variable, with little conclusive evidence to link team training to improved NTS or improved outcomes. A number of reviews of team training have been undertaken, but study quality is generally poor with variable interventions, blinding and outcomes, making them difficult to compare (Burke et al., 2004, Salas et al., 2008, Sevdalis et al., 2012).

Kirkpatrick's learning levels are widely recognised for the evaluation of an educational intervention (Kirkpatrick and Kirkpatrick, 2006). Level 1 describes participant reaction to the training; level 2, changes in knowledge; level 3, changes in behaviour and application of knowledge to the workplace; and level 4 changes in outcome as a result of training. As these levels examine the success of different aspects of training they are considered independent of each other and therefore each important in their own right (Burke et al., 2004, Sevdalis et al., 2012). Despite this, few studies report on all four levels of learning, and most significantly there is minimal evidence for improvements in NTS performance (level 3) or patient outcomes (level 4) (Burke et al., 2004, Salas et al., 2008, McCulloch et al., 2011, Kirkpatrick and Kirkpatrick, 2006). The American Veterans Health Association study is the only programme with large numbers, that this MD student is aware of, to show significant clinical improvement (reduction in surgical mortality) following team training (Neily et al., 2010). This was a multi-centre cohort study comparing surgical outcomes in 74 hospitals which received team training against 34 hospitals that did not. A team brief and debrief was introduced at all centres. Surgical mortality decreased in both groups, but this was 50% greater in the team training centres and was thought to be attributed to better situation awareness and shared mental models, allowing issues to be caught before they became a problem, and thus prevent complications from occurring. Interestingly the lack of evidence of level 4

learning is not unique to healthcare literature, with similar findings in the aviation industry (Sevdalis et al., 2012).

Despite the attention on NTS training in other areas of healthcare there has been little investment in team training and development in endoscopy to date (Anderson, 2012). There is however, growing momentum for teaching NTS as well as, or alongside, technical skills, particularly with the development of the national Bowel Cancer Screening Programme (BCSP) and advancing therapeutic endoscopy (Anderson, 2012, Matharoo et al., 2014a).

The endoscopy literature reviewed revealed seven publications relating to NTS training interventions (see table 2.4). Four of the seven were conference abstracts, and in fact three were published by the same team during a two-year period. Of those reviewed, the majority (6 of 7) used a simulation based training intervention. Five studies incorporated both technical and non-technical skills (Pyati, 2012, Grover et al., 2016, Grover et al., 2015b, Hawkes et al., 2015, Grover et al., 2015a), one focussed solely on NTS (Matharoo et al., 2014a) and one on Crisis Resource Management (CRM) training (Heard et al., 2011).

Course evaluation and satisfaction were measured in all studies except one (where no clear outcomes were stated (Pyati, 2012)). Two assessed candidate safety attitudes and safety awareness (Grover et al., 2016, Matharoo et al., 2014a) both pre- and post-course. In terms of evaluating NTS behaviour, two studies assessed communication as a stand-alone skill (Grover et al., 2015b, Grover et al., 2015a), but only one undertook an assessment of NTS in practice (Grover et al., 2016). Clinical transfer of skills was measured by Grover et al. in two of their studies (Grover et al., 2015a, Grover et al.,

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2015b), evaluating performance both during an integrated simulation and in the clinical setting. Universally, outcomes following a NTS training intervention were positive, however, it should be noted that all studies contained small numbers and only three re-measured outcomes after a delayed time period (4-6 weeks post-course) (Grover et al., 2016, Grover et al., 2015a, Grover et al., 2015b).

Despite agreement on the need for NTS training, the above studies have again shown there is variable measurement of the effectiveness of training (Grover et al., 2016). Most studies have assessed level 1 (reaction), but with little attempt to measure level 2 (knowledge) or level 3 (behaviour) and no assessment of level 4 learning (results) (Kirkpatrick and Kirkpatrick, 2006), mirroring the findings from both healthcare and aviation discussed above.

Study	Type of Training implemented	Outcome Measures	Findings
Heard et al. Gastroenterology Nursing. 2011 (Heard et al., 2011)	Simulation based – Crisis Resource Management. 15 Endoscopy nurses / technicians trained.	Evaluation of course.	"Enjoyable, applicable & realistic" tool for team training.
Pyati. 2012 (Pyati, 2012) (abstract only)	Didactic and simulation based. Training package to teach sedation skills in Endoscopy. Includes teamwork, communication and leadership skills.	Unclear.	
Matharoo et al. World Journal of Gastroenterology. 2014 (Matharoo et al., 2014a)	Didactic & interactive. 23 participants, 1 day programme covering human factors, adverse events and NTS.	Participants safety knowledge (pre-& post-), safety attitudes (pre- & post-). Global course evaluations.	Safety knowledge, attitudes and awareness improved post-course. Positive global course evaluations.
Grover et al. *Gastrointestinal Endoscopy.* 2015 (Grover et al., 2015a)	Simulation-based: structured comprehensive curriculum (SCC, didactic + virtual reality with feedback) vs. self-regulated learning (SRL, virtual reality without feedback). 33 participants randomised to two programmes. No details of NTS component.	Task knowledge. Performance in simulator + clinical transfer. Communication. Global rating. Measured immediately & 4-6 weeks post-course.	SCC group outperformed SRL group in simulator & clinical setting on colonoscopy performance, communication and global rating assessments.
Grover et al. *Gastrointestinal Endoscopy*. 2015 (Grover et al., 2015b) (abstract only)	Simulation based. 37 participants randomised to graded simulation or high-fidelity simulation programme. No details of NTS component.	Global outcomes. Communication.	Graded simulation group better global outcomes and communication.

Study	Type of Training implemented	Outcome Measures	Findings
Hawkes et al. *United European Gastroenterology Journal.* 2015 (Hawkes et al., 2015) (abstract only)	Integrated simulator training. 7 participants attended SPRINT programme.	Procedural logs compared to 14 traditionally trained individuals. Trainee evaluation of programme (simulator, lesion recognition & NTS).	SPRINT group shorter & more consistent procedure times. Training time halved. High satisfaction with program.
Grover et al. Canadian *Journal of Gastroenterology and Hepatology.* 2016 (Grover et al., 2016) (abstract only)	Simulation based. 20 participants randomised to training with / without NTS component.	Adapted NTS assessment tool (OSANTS). TEAMSTEPPS questionnaire (participant attitudes).	NTS group outperformed un-trained group immediately and after 4-6weeks in NTS attitudes, global performance & communication

Table 2.4: Non-technical skills training in gastrointestinal endoscopy

2.4.3 Outcomes in gastrointestinal endoscopy

There are clear indications for quality assurance in gastrointestinal endoscopy. In response to unacceptably long waiting times, significant variation in unit performance and increasing pressures of cancer targets in the early 2000's, the Joint Advisory Group on GI Endoscopy (JAG) Global Rating Scale (GRS) was launched to provide quality assurance and encourage quality improvement (Valori, 2012, Valori et al., 2010). The GRS is a peer assessed accreditation process which addresses all aspects of endoscopy unit function, including endoscopist training and workforce development. Alongside this the British Society of Gastroenterology (BSG) and JAG released guidelines of auditable outcomes for both quality and safety. Within the BCSP these are known as Key Performance Indicators (KPIs) (Rees et al., 2013, Valori, 2007). These measures reflect short term outcomes and are surrogate markers of longer term measures such as cancer prevention (for example by early detection of pre-malignant lesions).

Positive patient experience and satisfaction is essential in healthcare, even more so in asymptomatic screening pathways as the benefits of the service must outweigh the risks of the procedure. Studies have shown patient satisfaction to be highly dependent on interactions with staff members, and anxiety to be related to the content and delivery of pre-procedure information. This is especially important in endoscopy as patients undergo invasive procedures awake or with conscious sedation (Valori et al., 2010). It is reasonable to think that patient satisfaction is a potential marker of NTS and team function and performance in this setting.

2.5   Aims of study

Quality assurance is increasingly important for all medical services and is multi-factorial. Screening of asymptomatic patients in the national Bowel Cancer Screening Programme (BCSP) has increased public awareness of endoscopy and its performance indicators such as adenoma detection rate (Bourikas et al., 2013). There is increasing awareness that technical competence is just one aspect of practice and our desire to measure quality must include metrics which evaluate a combination of technical and non-technical skills, as well as patient outcomes and satisfaction, with mechanisms to promote continuous improvement (Bourikas et al., 2013, Matharoo et al., 2014a).

As in many other areas of healthcare, teams in Endoscopy are constantly changing. This results in "teams of experts" rather than "expert teams" (Haycock et al., 2012). This kind of team working relies far more heavily on positive safety attitudes, shared understanding and efficient exchange of information unimpeded by hierarchical or cultural factors.

Although the team within an endoscopy procedure room is small, often just three healthcare professionals, there is potential for a steep hierarchy due to the diversity of backgrounds of those team members (Endoscopist, Trained Nurse, Health-Care assistant). This can make it difficult for the untrained healthcare assistant to speak up against the other members of the team, particularly if they are unfamiliar, as often is the case with changeable teams. In addition, although the nursing team within the department are usually quite stable, Surgeon and Physician Endoscopists may attend for a procedure list and then leave again, as this is just one aspect of their clinical work (alongside inpatient care, the operating theatre and outpatient clinics). Team training

would not only aim to improve the non-technical skills of the team members, facilitating the function of teams of unfamiliar individuals, but if undertaken within the department, could also improve relationships, flatten hierarchies, and embed the endoscopists more within the multi-disciplinary team (MDT). It is hoped that this would reinforce resilience within the team, as they would be better equipped to monitor and assist each other and reduce the chance of errors occurring (Burke et al., 2004).

In addition to developing more supportive teams, NTS training could also improve overall safety climate by increasing general awareness of safety procedures and the influence that team interactions can have on these. This is supported by some evidence to show that safety attitudes improve following NTS training interventions (Mishra et al., 2009, McCulloch et al., 2009, Hitchins et al., 2017b, Hitchins et al., 2014, Matharoo et al., 2014a) and that they are negatively associated with making errors which have the potential to cause harm (Keswani et al., 2015).

Although the literature on NTS in endoscopy is sparse, there is a growing body of opinion that NTS are possibly the most important aspect of medical practice and NTS competence should be integral to training in this area (Anderson, 2012, Grover et al., 2016, Haycock et al., 2012, Matharoo et al., 2014a).

However, training these skills would require significant investment in terms of time and money, and needs organisational support to be a success. It is therefore vital that there is evidence to support the three-way relationship between non-technical skills, team training and other clinical outcomes to justify its role and expense. This study aims to investigate this relationship further with the following aims:

1) Establish links between non-technical skills and patient outcomes (in endoscopy)

- Undertake real-time observations using the Oxford NOTECHS II assessment tool in the endoscopy department.

- Measure the association between scores and patient satisfaction and scores and a number of procedural outcomes.

2) Establish the key non-technical skills behaviours in gastrointestinal endoscopy

- Review the use of Oxford NOTECHS II as a tool for measuring NTS in endoscopy. Determine its usability, relevance and validity.

- Interview staff to further explore role of NTS in gastrointestinal endoscopy and establish the most important non-technical skills and behaviours for working this environment.

Chapter 3   Using the Oxford NOTECHS II tool in gastrointestinal endoscopy and exploring the relationship between scores and outcomes

3.1   Introduction

This chapter will describe the introduction of the Oxford NOTECHS II Tool for the assessment of the non-technical skills of teams in gastrointestinal endoscopy and the relationships between scores and a number of patient and procedure outcomes. This introduction will expand on Chapter Two with additional information about the Oxford NOTECHS II Tool, as well as the procedure and patient outcomes collected.

3.1.1   Aims

- To undertake real-time observations using the Oxford NOTECHS II assessment tool in the endoscopy department.

- To explore the relationship between NTS performance, as measured by the Oxford NOTECHS II tool, and markers of clinical performance and patient satisfaction

3.1.2   Why the Oxford NOTECHS II tool?

The Oxford NOTECHS II tool was designed to assess the NTS of both a whole operating theatre team, and its sub-teams (Surgical, Anaesthetic & Nursing). It has been shown to have good usability, validity and reliability in this setting (Mishra et al., 2009, Robertson et al., 2014). The other well-established tools for use in the operating theatre setting (see section 2.3.3), such as NOTSS, ANTS and SPLINTS, only assess an individual member of the team and thus these were not deemed appropriate for this study.

The first of the criteria for an ideal NTS assessment tool discussed in section 2.3. is "context specific". Although the Oxford NOTECHS II tool was designed for use in the operating theatre, there is reason to suggest it could be transferred to use in endoscopy, as a number of similarities between endoscopy and the operating theatre can be drawn. Endoscopy units are functionally very similar to day-case theatre units. Procedures of varying complexity are undertaken on consenting patients, often with sedation, followed by a period of observation in a recovery area prior to discharge. The team within each procedure room consists of an Endoscopist (Surgeon, Physician or Advanced Nurse Practitioner), with or without a trainee, and a minimum of two nursing staff (at least one of whom will be trained). These roles are equivalent respectively to the Surgical and Nursing teams found in the operating theatre.

Non-technical skills assessment tools have been used both in real time and with video recordings. Video recording can be well suited to complex areas as it can be replayed easily to decrease the chance of missing a key event or encounter (Yule et al., 2006a). It allows for training and easy assessment of test-retest reliability and can be used for "black-box" type recording where staff are unaware that they are being observed. However, patients and staff not knowing that they are being observed raises ethical concerns. Recording also risks missing material out of the camera shot, as well as non-verbal or subtle communications which are more easily captured by an observer in real-time. One of the two departments within which this study would take place has no existing audio-visual capabilities for video-recording at present, and therefore, setting this up would also pose practical problems.

For logistical reasons, it was important to select a tool that could assess the whole team in real time by a single observer. This was principally to reduce the intrusion felt by staff being observed, reducing the potential for a Hawthorne effect, and also due to limited physical space within procedure rooms. In addition, unfortunately funding to employ and train another one or more observers to contribute to data collection was not available within the time period of the study. Not only was the Oxford NOTECHS tool designed with a single observer in mind, but has been shown to be usable and reliable for both clinicians and human factors experts in a real-time setting (Mishra et al., 2009, McCulloch et al., 2009, Robertson et al., 2014).

Due to the combination of the above factors, and in the absence of an established NTS assessment tool for endoscopy, the Oxford NOTECHS II appeared to be the best available tool for use in a study in this setting.

3.1.3 The safety checklist in endoscopy

Safety checklists, most notably the WHO (World Health Organisation) Checklist, have been commonplace in theatres for some years. They aim to ensure that the correct procedure is undertaken on the correct patient, and provide the team with a shared mental model of pertinent information and potential safety issues. They have contributed to improving team communication, decreasing morbidity and mortality and can be adapted to specific environments (Treadwell et al., 2014, Neily et al., 2010). In the context of NTS it is therefore not surprising that Robertson et al. (2014) found a significant relationship between WHO checklist completion and increased Oxford NOTECHS II scores.

A "Pause" or opportunity to check the Patient's identification, indication for procedure and other relevant information has been a recommendation by the American Society of Gastrointestinal Endoscopy (ASGE) for over a decade (Faigel et al., 2006). The advancement of technology, procedure complexity and operational demands have further increased the risk of adverse events and complications. In fact, in a prospective study, Matharoo et al. (2015) identified 41 patient safety incidents in just 90 cases. Although 49% of these were minor, 24% had the potential to be full 'Never Events' and identified significant safety weaknesses in the system. It was concluded that although a safety checklist couldn't prevent every potential adverse event, it might prevent some errors, and possibly more importantly could improve safety culture and teamwork in this setting (Matharoo et al., 2014b, Matharoo et al., 2015).

Safety checklists are in established use in the Endoscopy Units at both Plymouth Hospitals NHS Trust and Torbay & South Devon NHS Foundation Trust. It seems logical that there may be a relationship between completion of such safety checks and the NTS of the endoscopy team. Data on safety checklist completion will therefore be collected during this study.

3.1.4   Procedure outcomes

As discussed in Chapter Two, although it would seem sensible that good NTS would lead to better clinical outcomes, evidence for this relationship is limited. Within endoscopy there are a number of auditable standards for both quality and safety in relation to the outcome of procedures. These contribute to the Joint Association of Gastrointestinal Endoscopy (JAG) Global Rating Scale (GRS), an accreditation system for quality assuring endoscopy units in the United Kingdom (UK). They provide short term measures of the

success of a procedure, but over time are evidence of the quality of care and are potential surrogate markers of longer term measures such as cancer prevention (for example the rate of detection of polyps, or pre-malignant lesions) (Rees et al., 2013, Valori, 2007) (see table 3.1). Although there is no current evidence to suggest which of these outcomes might relate to the NTS of staff within this environment, the endoscopy quality measures that appear to be most applicable to this MD project include (highlighted in bold in table 3.1):

- Completeness of procedure – was the intended procedure completed in full as planned?

- Complications – including bleeding and perforation

- Adenoma (polyp) detection in lower gastrointestinal procedures (i.e. colonoscopy and flexible sigmoidoscopy) – the finding of polyps or growths within the lining of the colon during endoscopic inspection

- Colonoscopy withdrawal (or extubation) time – the time taken to examine the lining of the bowel on withdrawing the endoscope from its furthest point back to the start

These markers were felt to be the most likely to have a possible relationship with the behaviour of the team and were easily measureable within the bounds of the study (in real time or by accessing electronic records). More information and explanation about these measures is presented in the section 3.2.5.1.

As indicated above, Table 3.1 shows all the audit measures advised by JAG for monitoring quality and safety in gastrointestinal endoscopy. Those not highlighted in **bold** text were not collected for the purpose of this study. The rationale for their exclusion is presented below:

- Number of procedures by each operator – this is a long-term measure for the individual endoscopist to ensure they are maintaining their practice, not related to an individual case.

- Success of intubation – this is indirectly measured by procedure completeness.

- 30-day mortality – death following an endoscopic procedure is so rare that it would be unlikely to show a significant relationship with measures of NTS.

- Measures related to sedation practice

    o Use of flumazenil / naloxone (antidotes for sedation overdose).

    o Need for ventilation (treatment for sedation overdose & respiratory compromise).

    o Sustained drop in Oxygen saturations <90% (sedation overdose & respiratory compromise).

    o Sedation is not used for all cases and therefore was not generalizable to all.

- Colonoscopy specific

    o Polyp recovery – this is a technical marker.

    o Rectal retroversion – this is a technical marker.

    o Quality of bowel preparation – this is related to pre-procedure preparation and patient factors rather than the performance of the team in the room.

    o Tattooing of polyps / tumours – this is an infrequent occurrence and not generalizable to the majority of cases.

    o Biopsies in diarrhoea – this is specific to certain test indications and not generalizable to the majority of cases.

	Quality	Safety
General	Number of procedures performed by each operator Success of intubation **Completeness of procedure**	**Unplanned admissions** & operations within 8 days of procedure 30-day mortality Use of flumazenil Use of naloxone Need for ventilation **Perforation** **Bleeding** Sustained drop in O2 Saturation <90%
Colonoscopy / Flexible sigmoidoscopy	Sedation & analgesic doses **Comfort levels** Tattooing of suspected malignant polyps Tattooing of tumours if small or position not clear Standards: **Unadjusted completion / Caecal intubation rate** (Colonoscopy) >90% (aspirational >95%) **Adenoma detection rate** >10% (15-20% in screening) Polyp recovery >90% Good quality bowel preparation >90% (aspirational >95%) Rectal retroversion rate >90% **Colonoscopy withdrawal time (screening) >6mins** (aspirational >10mins) Diagnostic colorectal biopsies for persistent diarrhoea (100%)	Standards: **Colonoscopy perforation** rate <1:1000 (aspirational <1:3000) **Post-polypectomy bleeding requiring transfusion** <1:100 (for >1cm polyps, <1:200-1000 in screening) **Post-polypectomy perforation** rate <1:500 **Post-dilatation perforation** rate <1:33 (aspirational <1:100) **Flexible sigmoidoscopy perforation** rate <1:5000 (aspirational <1:10000)

*Table 3.1: Auditable outcomes in gastrointestinal endoscopy (Valori, 2007, Rees et al., 2013). Measures used in this study highlighted in **bold** text.*

3.1.5   Measures of process and efficiency

3.1.5.1   Glitch count

A common feature of other studies measuring NTS has been to record a measure of process or procedural errors. The added effect of multiple small errors or process deviations has been linked to serious safety and quality issues. Better NTS therefore could be associated with a reduced number of, or increased resilience to, the effect of

such events, potentially reducing error and improving safety. Morgan et al (2013) labelled these "Glitches", defined as undesired events related to process or non-operative procedures, and unrelated to the technical aspects of the case. They can include items such as problems with equipment, or interruptions (Robertson et al., 2014, Mishra et al., 2009, McCulloch et al., 2009, Mishra et al., 2008).

The Glitch count is a validated tool to record such process imperfections during procedures (Robertson et al., 2014, Morgan et al., 2013). These are sub-divided into categories including "Absence", "Communication", "Distractions", "Environment", "Equipment design", "Maintenance" and "Workspace" (for a full list with definitions and examples see appendix 1). It is a simple to use prospective count of events observed in real time, and has been successfully used alongside other NTS assessment tools, including the Oxford NOTECHS II (Robertson et al., 2014).

3.1.5.2   List units

As endoscopy procedures vary in complexity and duration, a measure of the length of a procedure is unlikely to be a helpful reflection of case turnover or efficiency. In order to book and plan lists realistically, endoscopy procedures are classified by a number of 'units'. For example, a straight forward gastroscopy is booked as 1 unit, and a colonoscopy as 2 units. If the procedure is predicted to be potentially difficult, or a therapeutic intervention is planned, this may be booked as a "double" case or an extra unit, i.e. 4 or 3 units. The majority of clinicians are expected to complete 10 units per half day list. This is sometimes reduced to 8 for training and is usually reduced to 8 units for BCSP.

3.1.6 Patient satisfaction

In the past, public sector healthcare systems have lagged behind the competitive private sector in their attention to patient experience (Valori, 2012). However, this has gradually changed with increasing importance being placed on patient satisfaction and Patient Reported Outcome Measures (PROMs) becoming standard in many areas of healthcare. Patient experience is considered a quality indicator by both the ASGE (Faigel et al., 2006) and the BSG and is one aspect of the GRS criteria for JAG accreditation in the UK (Sint Nicolaas et al., 2012, Valori, 2012). This is supported by evidence to suggest that patient satisfaction is highly dependent on interactions with staff members and anxiety is related to pre-procedure information, especially important in endoscopy, where awake patients undergo invasive procedures and in the context of the asymptomatic screening programme. A study investigating the most important concerns to patients attending for a colonoscopy found "being treated with respect", "being treated in a personal manner and therefore not as one of many", "being involved in the choice whether or not sedation is given", "discussion of risks and possible complications", "feeling of trust towards one's treating doctor" and "clear explanation beforehand of what is to be expected during the colonoscopy procedure" within the top ten. These all relate to the communication and interpersonal skills of the endoscopy team and were ranked higher by patients than factors such as "volume of bowel prep one is required to drink" and "pain experienced due to colonoscopy" (both within the top ten of concerns endoscopists thought would matter most to patients) (Denters et al., 2012).

Due to the awake nature of the patient within this environment, they are likely to have a much greater awareness of the way the team interacts than in other some areas of healthcare. Thus, their satisfaction with their patient experience may be influenced

positively or negatively by the NTS, and particularly the interpersonal skills, of the staff

caring for them. It is therefore reasonable to think that patient satisfaction could be a

potential marker of NTS and team function and performance in this setting.

3.2 Study design

3.2.1 Ethical approval

Ethical approval was granted by the NHS Health Research Authority, South West – Plymouth and Cornwall, Regional Ethics Committee (Ref 16/SW/0014) and the Plymouth University, Faculty of Health & Human Sciences, Peninsula Schools of Medicine & Dentistry, Faculty Research Ethics Committee (Ref 15/16-546).

3.2.2 The Oxford NOTECHS II tool and its adaptation for GI endoscopy

The Oxford NOTECHS II taxonomy (see appendix 2) has been shown to be valid and reliable in Surgery. Its selection for use in this study over other available tools, is explained in section 3.1.2. It measures non-technical skills within four different components: 'Leadership and management', 'Problem solving and decision making', 'Teamwork and co-operation', and 'Situation awareness' on a scale of one to eight (Mishra et al., 2009, Robertson et al., 2014). The starting point or default score for each component is six, reflecting "Consistently maintains an effective level of patient safety and team work". An increase or decrease in the score allocated is based on behaviours witnessed by the researcher during the observation episode. The structure of this scoring system was not altered or adapted in any way.

In the operating theatre, the team are divided into three sub-teams: Surgical, Nursing, and Anaesthetic, and a score for each of the four components allocated to each. During routine endoscopy procedures, an anaesthetist is not required, as sedation and analgesia are administered by the Endoscopist. The Oxford NOTECHS II tool was therefore adapted to assess the NTS performance of two sub-teams: Endoscopist (equivalent to surgeon) and Nursing, rather than the three in the original iteration. The

observable behaviours within each category or for each sub-team were not adjusted in any way.

During each procedure observed, two Oxford NOTECHS II measurements were made. Scores were calculated as follows:

- Sub-team total score: scores of four components totalled (maximal score range 4-32)

- Whole team scores: average of the two sub-team scores (range 1-8 for each component, 4-32 for total score)

- Overall scores for each case: calculated as an average of the two time-point measurements

3.2.3   Training

Prior to commencing this study, the MD student attended a non-technical skills assessment training course, "Non-Technical Skills for Surgeons", accredited by the Royal College of Surgeons of Edinburgh. This included knowledge and theory on the topic, as well as practical instruction in the use of the Non-Technical Skills for Surgeons (NOTSS) assessment tool (similar in structure and components to the Oxford NOTECHS II tool).

Specific instruction in the use of the Oxford NOTECHS II tool was provided by the supervisor (CW), a trained non-technical skills assessor. Practice observations were undertaken in the operating theatre (where a previous study had taken place) with verbal consent from all parties. Behaviours observed were discussed between the trainer and trainee to reach consensus on scores allocated.

3.2.4   The observations

Following training and with consent from all parties (see section 3.2.6.5) Oxford NOTECHS II observations commenced in March 2016. Prior to this the student (CH) had spent significant time in the Endoscopy department discussing the logistics of the study to ensure it would not disrupt the flow of work or cause any distress to patients or staff.

Observations were undertaken by a single observer (the student CH) using a data collection form created specifically for the purpose (see appendix 3). However, the trainer / supervisor (CW) regularly attended the observations. During these times both observers concurrently and independently assessed the team, using the standard data collection form, blinded to each other's scores. These measurements were used to assess inter-rater reliability and ensure consistency of assessment.

Baseline information for each procedure was collected on:

- Checklist adherence

    o Team brief – Binary Yes / No

    o Plan for procedure – Binary Yes / No

    o ID check in room – Binary Yes / No

    o Pre-start pause – Binary Yes / No

- Procedure – Colonoscopy / BCSP Colonoscopy / Flexible sigmoidoscopy / Gastroscopy

- Sedation & pain relief administered

    o Sedation – Binary Yes / No

    o Entonox (for colonoscopy / flexible sigmoidoscopy) – Binary Yes / No

    o Local Anaesthetic Throat spray (for gastroscopy) – Binary Yes / No

3.2.5   Other outcomes

3.2.5.1   Procedure outcomes

The following measures were collected in relation to each procedure. The justification

for which outcome measures were selected is explained in section 3.1.

- Completion of (intended) procedure – Binary Yes / No

- Polyp detection (colonoscopy & sigmoidoscopy) – Binary Yes / No

  o This indicates that a polyp was seen during the procedure

  o The adenoma detection rate (ADR) over a series of cases is used as a

    marker of quality i.e. the more thorough the examination of the colon

    the greater the number of small polyps noticed and recorded. This is

    based on evidence that lower ADRs are associated with higher interval

    cancer rates (diagnosis of a cancer before the next surveillance

    colonoscopy is due). Accurate ADR can only be proven by review of lab

    results. In its place, polyp detection, i.e. lesions clinically noted to be

    adenomatous polyps, but not confirmed by laboratory results, can be

    used. Polyp detection rate (PDR) is therefore a surrogate marker of the

    ADR) (Rees et al., 2013)

- Immediate complication – Binary Yes / No

- Unplanned admission – Binary Yes / No

- Pain / comfort score – Ordinal scale (0= None, 1= Minimal, 2= Mild, 3= Moderate,

  4= Severe)

- Colonoscopy withdrawal / extubation time (colonoscopy)

  o Recorded in whole minutes

  o Integer transformed to binary outcome of ≥ 6 minutes (Yes / No)

- o This is the time taken for the colonoscope to be withdrawn from the colon and is the part of the procedure used to examine the whole colonic mucosa for abnormalities. There is evidence that withdrawal times of 6 minutes or greater are associated with higher ADRs and the longer the withdrawal time, the more accurate the examination (Rees et al., 2013).

- Glitch count

  - o Continuous scale (integer) see section 3.1.5.1

- Units performed per list (half day)

  - o Continuous scale (integer) see section 3.1.5.2

Although it was not clear what relationships might be present, figure 3.1 illustrates the potential interactions between the NTS of the endoscopy team and the outcome measures recorded.
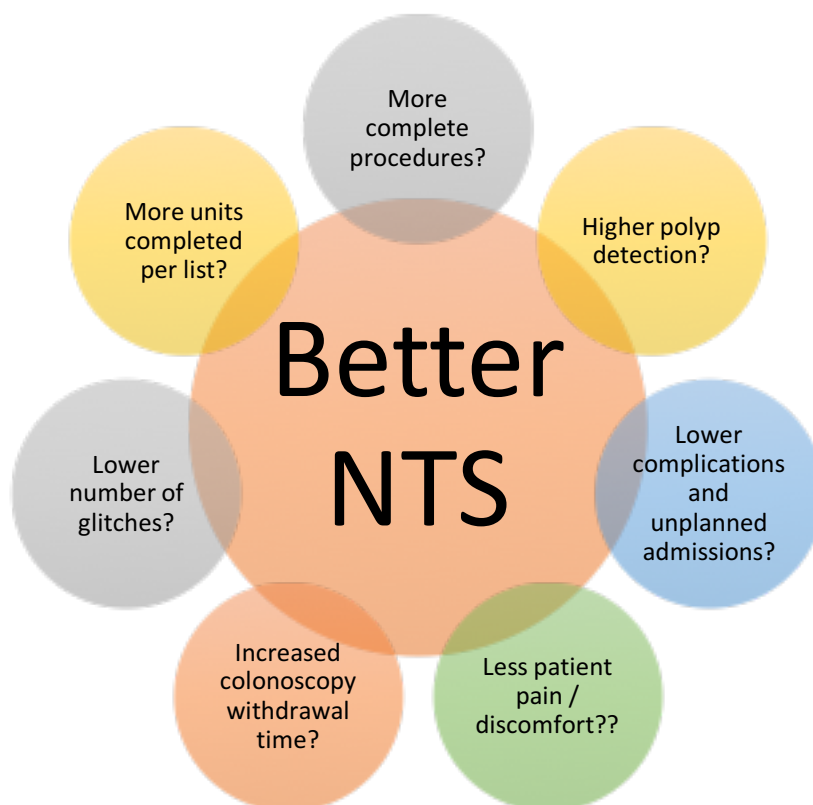
Figure 3.1 Diagram to show potential relationships between NTS scores and outcome measures

3.2.5.2 Patient satisfaction

A questionnaire assessing patient satisfaction was administered to all participating patients during the study period. A number of endoscopy patient questionnaires were examined in consideration for their use in this study. The questionnaire chosen by consensus of the MD student and the supervisory team was developed by the clinical effectiveness team at Torbay Hospital (Torbay & South Devon NHS Foundation Trust). It was selected as it had the most questions relevant to the non-technical skills of the team, rather than more generic questions about the hospital or unit in general (see appendix 6).

The patients completed the questionnaire after they had recovered from the procedure. For the majority, this took place whilst having refreshments in the department prior to their departure. This is consistent with the study by Denters et al. (2012) where patients were considered recovered from sedation if they could hold a normal conversation. If patients did not feel able to complete the questionnaire prior to discharge they were provided with a stamped-addressed envelope to enable them to post it back.

3.2.6 Patient and Staff involvement

3.2.6.1 Recruitment

Endoscopy staff (medical and non-medical) at Plymouth Hospitals NHS Trust and Torbay and South Devon NHS Foundation Trust were informed of the project with their senior clinical managers via formal and informal group presentations and written information (see appendix 4).

They were informed when observations would be taking place in their unit and were able to opt out if they did not wish to be observed. Staff members were under no obligation to take part in, and were free to withdraw from, the study at any time.

Patients were informed when observations were taking place. Patients attending the Endoscopy department during the study period were provided with written information explaining the study and inviting them to take part. In addition, posters explaining the study were displayed in the patient waiting area for the duration of observations. Patients who agreed to take part in the study were asked to complete a written consent form agreeing to observation of the staff performing their endoscopic procedure, access to their relevant clinical records and results of their patient satisfaction survey (see appendix 5).

3.2.6.2   Inclusion criteria

3.2.6.2.1   Staff

- Endoscopy staff consenting to take part in the study

- Staff work in Endoscopy as their main NHS job

3.2.6.2.2   Patients

- Patients consenting to be observed and complete a patient satisfaction survey

- Male or Female, aged 18 years or above

- Able (in the investigator's opinion) and wiling to comply with all study requirements

3.2.6.3 Exclusion criteria

3.2.6.3.1 Staff

- Endoscopy staff not consenting to take part in the study

3.2.6.3.2 Patients

- Patients not consenting to take part in the study

- Patients unable to understand the information provided or give consent to participate

    o This was determined by the researcher who in her role as surgical doctor has been trained to assess patients' capacity to give informed consent.

- Aged less than 18 years

3.2.6.4 Withdrawal criteria

Participants had the right to withdraw from the study at any time. On withdrawing from the study all identifiable information would be destroyed.

In addition, the investigator could discontinue a participant from the study at any time if they considered it necessary for any reason, including:

- Significant protocol deviation

- Follow-up failure

3.2.6.5 Consent

3.2.6.5.1 Staff

Each member of endoscopy staff was given written information explaining the study. They were asked to give written consent to the researcher observing the team whilst undertaking endoscopic procedures as part of their normal working day. They were free

to withdraw from the process at any time (see appendix 4). If any staff member working in a procedure room refused consent, none of that team could be observed. In this event one of two solutions was implemented: 1) the researcher moved to a different procedure room where all staff had consented to be observed or 2) where appropriate and convenient the non-consenting staff member swapped into another room with a colleague who had consented to be observed. The initials of the Endoscopist performing each procedure were recorded on the data collection form. However, the names of the rest of the staff members making up the team were not recorded. This reduced anxiety amongst staff that their individual performance may be scrutinised, and as scores related to the team or sub-team as a whole it was not deemed necessary to record this information.

3.2.6.5.2 Patients

Patients were given written information explaining the study. They were asked to give written consent to have a researcher in the room observing the team during their procedure. Although the patients were not being observed directly, their consent was required to allow the observer to: 1) be present in the room whilst they underwent an invasive procedure, possibly requiring sedation, thus reducing their conscious level, 2) access their clinical outcomes data, and 3) access their patient satisfaction questionnaire responses (see appendix 5). They were free to withdraw from the process at any time. Each participating patient was allocated a study ID number. This was recorded on the data collection form and patient questionnaire to enable this information to be linked anonymously for analysis.

3.2.6.6 Confidentiality

The Chief Investigator will preserve the confidentiality of participants that took part in the study and is registered under the Data Protection Act (1998).

3.2.7 Statistics and data analysis

Quantitative data was analysed using IBM SPSS Statistics version 23.0 (2015a).

3.2.7.1 Sample size

Sample size calculation was difficult to undertake as a relationship between Oxford NOTECHS II scores in endoscopy and the outcome measures has not previously been established. Other studies which have used the tool have measured variable outcomes and thus there was no literature of a similar nature on which to base a sample size estimate.

Of the outcome measures to be collected, completeness of procedure was chosen for the purpose of sample size estimation. It was difficult to decide which outcome measure to use, as without any existing literature or pilot data it was not clear which outcomes may or may not associate with NTS, as measured by the Oxford NOTECHS II score. However, of the choices available, completeness of procedure is an easy to measure, binary outcome with a clear audit standard. It would also apply to all the different endoscopy procedures to be observed within the study (some outcomes only apply to colonoscopy) and therefore the most appropriate choice.

After consultation with a research fellow in statistics at Plymouth University Peninsula Schools of Medicine & Dentistry, sample size calculations were undertaken based on the following assumptions:

- Primary outcome is completeness of procedure

- o Binary: Yes = completed, No = not-completed

- o Ratio of complete (n2) to not-complete (n1) is 9 (BSG standard for unadjusted completion rate ≥90% (Valori, 2007))

- There is no literature on the mean Oxford NOTECHS II score for endoscopy teams. The mean total score obtained by theatre teams in Robertson et al. (2014) of 74.5 (SD = 8) was therefore assumed for completed procedures.

- 5% level of significance

Table 3.2 produces estimated sample sizes for a number of possible differences in total Oxford NOTECHS II score between complete and not complete procedures (and corresponding effect size) (Faul et al., 2007).

Total Oxford NOTECHS II score for not-completed (Complete = 74.5)	Effect size	80% power		
		n1	n2	Total sample
72	.3125	90	806	896
71.5	.375	62	562	624
71	.4375	46	412	458
70.5	.5	35	317	352
70	.5625	28	250	278

Table 3.2: Estimated sample sizes based on differences in total Oxford NOTECHS II scores

Taking these calculations and the time available for data collection into account, a decision was made to observe a minimum of 300 procedures across the two hospital sites.

3.2.7.2   Inter-rater reliability

Inter-rater reliability was assessed between the MD student (CH) and the supervisor (CW) using intra-class correlation. Cases were observed jointly over the study period.

The observers used the same data collection form, but were blinded to each other's scores.

3.2.7.3 Intra-rater reliability

As observations were undertaken in real time with no method to video-record the event, a direct marker of intra-rater reliability was not possible. As a surrogate marker, data was analysed by taking the sequence of observations into account to determine if there was a tendency to assign lower or higher scores as the study progressed.

3.2.7.4 Oxford NOTECHS II score as the dependent variable

Non-parametric tests were used to assess the effect of baseline case characteristics on the Oxford NOTECHS II score obtained (i.e. Oxford NOTECHS II Score as the dependent variable). These included:

- Procedure type

- Presence of a trainee

- Adherence to safety checklist

- Type of sedation / analgesia administered

3.2.7.5 Oxford NOTECHS II score as the independent variable

Logistic regression was used to determine if Oxford NOTECHS II scores were predictors of categorical procedural outcomes:

- Procedure completion (binary)

- Polyp detection (binary)

- Complications (binary)

- Extubation time ≥6minutes (binary)

- Pain score (ordinal)

- Patient satisfaction questionnaire responses

Pearson's and Kendall's correlation coefficients were used to determine if there was a relationship between Oxford NOTECHS II scores and continuous outcomes.

- Glitch count

- Units done per list

3.3   Results

A total of 310 endoscopy cases were observed between March 2016 and February 2017 across two hospital sites. This included upper and lower gastrointestinal procedures, performed by 19 endoscopists. A trainee endoscopist was present in 40 cases.

3.3.1   Distribution of scores

Although the Oxford NOTECHS II scale is from 1-8, actual scores for each of its four components ranged between 5 and 8. Overall team and sub group scores (sum totals of the four components) ranged between 22 and 32 rather than the maximum potential range of 4-32. Tables 3.3-3.5 describe this in more detail. For histograms illustrating the distribution of scores see appendix 7.1.

n=310		Endoscopist Leadership & Management	Endoscopist Teamwork & cooperation	Endoscopist Decision making	Endoscopist Situation awareness	Endoscopist mean score
Minimum		5.50	5.50	5.50	5.00	22.50
Maximum		8.00	8.00	8.00	8.00	32.00
Mean	Statistic	6.6758	6.5823	6.5129	6.6419	26.4129
	Std. Error	.02866	.02982	.02934	.03112	.10269
Median		7.00	6.50	6.50	7.00	26.50
Std. Deviation		.50457	.52495	.51655	.54788	1.80806
Variance		.255	.276	.267	.300	3.269
Skewness	Statistic	-.065	.190	.693	.042	.370
	Std. Error	.138	.138	.138	.138	.138

Table 3.3: Endoscopist sub-team Oxford NOTECHS II Scores

n=309		Nurse Leadership & management	Nurse Teamwork & cooperation	Nurse Decision making	Nurse Situation awareness	Nurse mean score
Minimum		5.50	5.50	5.50	5.50	23.00
Maximum		7.50	8.00	7.50	8.00	31.00
Mean	Statistic	6.3479	6.5680	6.2217	6.6165	25.7540
	Std. Error	.02610	.02836	.02176	.03020	.08988
Median		6.00	6.50	6.00	6.50	25.50
Std. Deviation		.45886	.49861	.38251	.53088	1.57991
Variance		.211	.249	.146	.282	2.496
Skewness	Statistic	.894	.298	1.593	.097	.773
	Std. Error	.139	.139	.139	.139	.139

Table 3.4: Nursing sub-team Oxford NOTECHS II Scores

n=310		Team Leadership & management	Team Teamwork & cooperation	Team Decision making	Team Situation awareness	Team mean score
Minimum		5.75	5.75	5.75	5.50	23.25
Maximum		7.75	8.00	7.75	8.00	31.50
Mean	Statistic	6.5113	6.5750	6.3669	6.6282	26.0833
	Std. Error	.02412	.02729	.02281	.02894	.09210
Median		6.50	6.50	6.25	6.75	26.00
Std. Deviation		.42461	.48042	.40155	.50951	1.61897
Variance		.180	.231	.161	.260	2.621
Skewness	Statistic	.475	.391	1.125	.160	.632
	Std. Error	.138	.138	.138	.138	.139

Table 3.5: Team Oxford NOTECHS II Scores

3.3.1.1 Sub-team comparison

Analysis of mean and median scores between sub-teams identified some differences.

The Related Samples Wilcoxon-Signed Ranks Test confirms this, showing the Endoscopy

sub-team scored significantly higher than the nursing sub-team in Leadership &

Management (L&M), Problem Solving & Decision making (DM), and Overall score (see

table 3.6). There was no significant difference between sub-team scores for Teamwork & cooperation (T&C) or Situation awareness (SA).

Oxford NOTECHS II Score	Median score		Related-Samples Wilcoxon Signed Rank Test (z)
	Endoscopist sub-team	Nursing sub-team	
Leadership & Management	7.00	6.00	-9.93***
Teamwork & Cooperation	6.50	6.50	-0.80
Problem solving & Decision making	6.50	6.25	-9.97***
Situation awareness	7.00	6.75	-1.23
Total score	26.50	25.50	-9.70***
*p< .05, **p< .01, ***p< .001 all values to 2 decimal places			

Table 3.6: Non-parametric comparison of sub-team Oxford NOTECHS II scores

3.3.2   Inter-rater reliability

Nineteen cases were observed concurrently by two independent raters (the student CH and the supervisor CW). The two observers used the same data collection form and were blinded to each other's scores. Scatter graphs of mean team scores for each of the components of the Oxford NOTECHS II tool show good linear fit (see figure 3.1 for overall team scores and appendix 7.2 for additional plots). Table 3.7 compares means of the Oxford NOTECHS II scores allocated by each observer for the whole team and each of its sub-teams. Inter-rater agreement using intra-class correlation (ICC) for whole team scores was excellent (r=0.87). Agreement was good (r=0.60-0.74) or excellent (r=0.75-1.0) for all scores (Cicchetti, 1994).
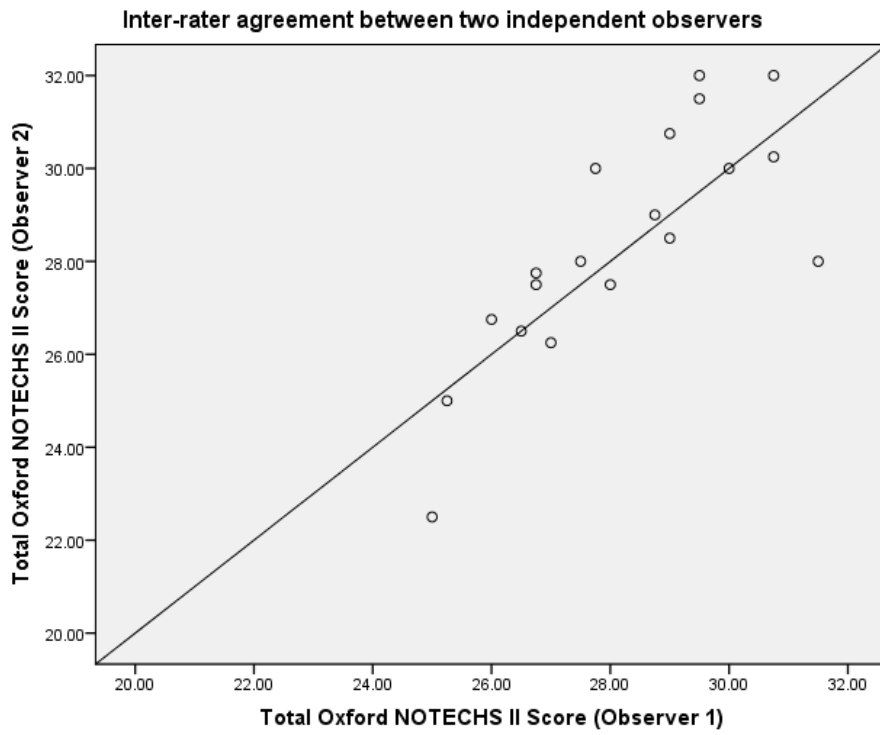
Figure 3.1: Inter-rater agreement between two independent observers

	Observer 1 Mean (SD)	Observer 2 Mean (SD)	Intra-class correlation (2-way random, average measures)
Endoscopist Sub-team Leadership & Management	7.29 (0.48)	7.13 (0.78)	.80**
Teamwork & cooperation	7.21 (0.48)	7.21 (0.79)	.78**
Decision making	7.05 (0.57)	7.16 (0.82)	.72**
Situation awareness	7.26 (0.51)	7.16 (0.82)	.76**
Total score	28.82 (1.84)	28.58 (3.08)	.80**
Nurse Sub-team Leadership & management	6.71 (0.56)	7.11 (0.64)	.74**
Teamwork & cooperation	7.08 (0.56)	7.05 (0.69)	.74**
Decision making	6.63 (0.62)	7.03 (0.66)	.75**
Situation awareness	7.10 (0.59)	7.10 (0.64)	.85***
Total score	27.53 (2.08)	28.29 (2.39)	.86***
Team Leadership & management	7.00 (0.48)	7.12 (0.63)	.86***
Teamwork & cooperation	7.14 (0.50)	7.11 (0.68)	.83***
Decision making	6.84 (0.55)	7.09 (0.67)	.79**.
Team Situation awareness	7.18 (0.53)	7.09 (0.62)	.85***
Total score	28.17 (1.90)	28.41 (2.47)	.87***
Interpretation of ICC: <0.40 – Poor 0.40 – 0.59 – Fair 0.60 – 0.74 – Good 0.75 – 1.00 – Excellent	*p< .05, **p< .01, ***p< .001 all values to 2 decimal places		

Table 3.7: Inter-rater agreement between two independent observers

3.3.3   Intra-rater reliability / Consistency

As a surrogate marker of intra-rater reliability or observer consistency over the study period, scores were assessed for drift over time. Scatter plots were drawn to assess Oxford NOTECHS II scores against observation sequence number (see appendix 7.3). Correlation analysis (see table 3.8) shows no significant relationship between sequence number and score except for two groups. A weak but significant positive correlation was

found for Endoscopist sub-team SA scores (R=.13, p=.024), and a weak, but significant negative correlation was found for Nurse sub-team L&M scores (R=-.16, p=.021).

Linear regression analysis using the enter method with sequence number as regressor and Oxford NOTECHS II score as the dependent variable was conducted (see table 3.6). Sequence number was not a significant predictor of change in Oxford NOTECHS II score component except for Endoscopist SA and Nurse L&M. However, in both these cases the Coefficient B rounded to 2 decimal places is 0.00 and the R^2 values of .02 indicate a poor fit for each model, only accounting for 2% of the variation in score. This supports the null hypothesis that time was not a predictor of change in Oxford NOTECHS II score, indicating good intra-rater consistency.

	Pearson correlation R	R^2	Unstandardised Coefficients		Standardised Coefficients
			B	SE B	β
Endoscopist Sub-team					
Leadership & Management	-.04	.00	0.00	0.00	-.04
Teamwork & cooperation	.04	.00	0.00	0.00	.04
Decision making	.04	.00	0.00	0.00	.04
Situation awareness	.13*	.02	0.00	0.00	.13*
Total score	.05	.00	0.00	0.00	.05
Nurse Sub-team					
Leadership & management	-.16*	.02	-0.00	0.00	-.16*
Teamwork & cooperation	.04	.00	0.00	0.00	-.04
Decision making	-.00	.00	-0.00	0.00	-.00
Situation awareness	.06	.00	0.00	0.00	.06
Total score	-.04	.00	-0.00	0.00	-.04
Team					
Leadership & management	-.10	.01	0.00	0.00	-.10
Teamwork & cooperation	.00	.00	0.00	0.00	.01
Decision making	.03	.00	0.00	0.00	.03
Team Situation awareness	.10	.01	0.00	0.00	.10
Total score	.01	.00	0.00	0.00	.02
*p < .05 all values to 2 decimal places					

Table 3.8: Pearson's correlation and Linear Regression Analysis of observation sequence number (regressor) against Oxford NOTECHS II Score (dependent variable)

3.3.4 Oxford NOTECHS II scores against baseline characteristics

Oxford NOTECHS II scores were analysed against a number of baseline characteristics using non-parametric tests (Mann-Whitney U if 2 groups, Kruskal-Wallis if 3 or more

groups) to determine if there are any predictors of good Non-technical skills performance in endoscopy.

3.3.4.1 Procedure

Three types of Endoscopy procedure were observed; colonoscopy, flexible sigmoidoscopy and gastroscopy (see Table 3.9). The colonoscopies were divided into those undertaken as part of the Bowel Cancer Screening Programme (BCSP) and those undertaken for any other indication.

Procedure type	Number (%) n=310
Colonoscopy	181 (58.4)
- Bowel cancer screening colonoscopy	- 61 (19.7)
- Other indication	- 120 (38.7)
Flexible sigmoidoscopy	37 (11.9)
Gastroscopy	92 (29.7)

Table 3.9: Frequency chart of procedures observed

The Kruskal-Wallis Test was used to test for relationships between procedure type and Oxford NOTECHS II Scores. Procedure type was analysed with bowel cancer screening programme (BCSP) colonoscopies both as a separate group and included with all other colonoscopies (see table 3.10).

When analysed with BCSP colonoscopies as a separate group, a significant difference was found between procedure groups for Endoscopist sub-team L&M, DM, SA & total scores and whole team DM (see figure 3.2 & table 3.10).

- Endoscopist L&M: Colonoscopy median score is lower than the other 3 groups (6.50 compared to 7.00)

- Endoscopist DM: Median scores were the same for all groups, however the upper quartile and maximum values were greater for BCSP Colonoscopy and Colonoscopy than for Flexible sigmoidoscopy or gastroscopy.

- Endoscopist SA: Median scores were higher for BCSP colonoscopy and gastroscopy (7.00) than for colonoscopy or flexible sigmoidoscopy (6.50)

- Endoscopist total score: Median scores were higher for BCSP colonoscopy and gastroscopy (27.00 and 26.50 respectively) than for colonoscopy or flexible sigmoidoscopy (26.00)

- Team SA: Median score was higher for BCSP colonoscopy (6.50) than the other three groups (6.25)

When analysed with all colonoscopies together as one group, a significant difference was found between procedure groups for Endoscopist DM and whole team DM (see figure 3.3).

- Endoscopist DM: Median scores were the same for all groups, however the upper quartile and maximum values were greater for colonoscopy than for flexible sigmoidoscopy or gastroscopy.

- Team DM: Median scores were the same for all groups, however the maximum values were lower for gastroscopy than the other two groups.

	Median Oxford NOTECHS II Score						Kruskal-Wallis test (*H*)	
	BCSP Colonoscopy N=61	Colonoscopy N=120	All Colonoscopy N=181	Flexible sigmoidoscopy	Gastroscopy N=92	Total N=310	Between all procedure sub groups (*3 degrees of*)	Between procedure sub-groups all colonoscopy together (*2 degrees of*)
Endoscopist Sub-team								
Leadership & Management	7.00	6.50	7.00	7.00	7.00	7.00	13.82**	1.31
Teamwork & cooperation	7.00	6.50	6.50	6.50	6.50	6.50	6.38	1.75
Decision making	6.50	6.50	6.50	6.50	6.50	6.50	16.53**	12.15**
Situation awareness	7.00	6.50	6.50	6.50	7.00	7.00	8.95*	0.87
Total score	27.00	26.00	26.50	26.00	26.50	26.50	9.60*	2.03
Nurse Sub-team								
Leadership & management	6.00	6.00	6.00	6.00	6.00	6.00	4.79	4.79
Teamwork & cooperation	6.50	6.50	6.50	6.50	6.50	6.50	6.47	5.49
Decision making	6.00	6.00	6.00	6.00	6.00	6.00	5.81	2.61
Situation awareness	6.50	7.00	6.50	6.50	6.50	6.50	2.88	2.61
Total score	26.00	26.00	26.00	25.00	25.00	25.50	4.69	4.19
Team								
Leadership & management	6.50	6.50	6.50	6.50	6.50	6.50	6.00	3.22
Teamwork & cooperation	6.75	6.50	6.50	6.50	6.50	6.50	6.47	3.67
Decision making	6.50	6.25	6.25	6.25	6.25	6.25	13.82**	9.94**
Team Situation awareness	6.75	6.75	6.75	6.75	6.75	6.75	3.75	1.13
Total score	26.50	26.00	26.25	25.50	25.75	26.00	6.66	3.18

*p< .05, **p< .01, ***p< .001
all values to 2 decimal places

Table 3.10: Non-parametric analysis of the influence of Procedure type on Oxford NOTECHS II Score

Figure 3.2: Box and whisker plots comparing Oxford NOTECHS II scores by procedure type (BCSP as separate group)
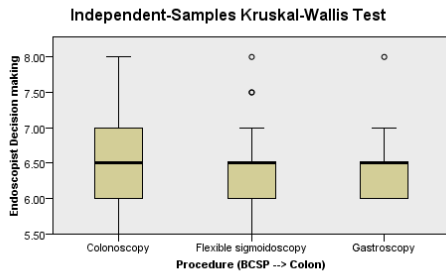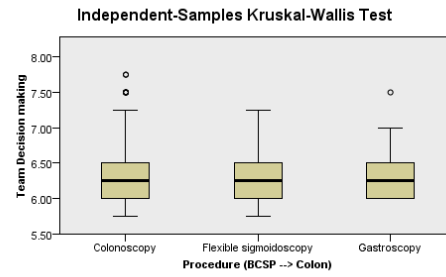
Figure 3.3: Box and whisker plots comparing Oxford NOTECHS II scores by procedure type (All colonoscopy as one group)

3.3.4.2   Training case

A trainee endoscopist was present in 40 out of 310 (12.9%) cases. The Mann Whitney U Test was used to investigate if there was any relationship with Oxford NOTECHS II Scores (see table 3.11).

The only significant difference between groups was found for Endoscopist sub-team T&C *(U = 4354.00, z = -1.12, p= .039)*. Although median scores were the same (6.50), figure 3.4 indicates a greater frequency of higher scores in the "no trainee present" group.

	Median Oxford NOTECHS II Score		Mann-Whitney U Test (*U*)
	No Trainee present N=270	Trainee present N=40	
Endoscopist Sub-team			
Leadership & Management	7.00	7.00	5558.00
Teamwork & cooperation	6.50	6.50	4354.00*
Decision making	6.50	6.50	5668.00
Situation awareness	7.00	6.50	4456.00
Total score	26.50	25.75	4889.50
Nurse Sub-team			
Leadership & management	6.00	6.00	4932.00
Teamwork & cooperation	6.50	6.50	4993.00
Decision making	6.00	6.00	5276.50
Situation awareness	6.50	6.50	4743.00
Total score	25.50	25.00	4841.00
Team			
Leadership & management	6.50	6.50	5278.50
Teamwork & cooperation	6.50	6.375	4613.50
Decision making	6.25	6.25	5609.00
Team Situation awareness	6.75	6.50	4510.00
Total score	26.25	25.75	4790.50
*p< .05 all values to 2 decimal places			

Table 3.11: Non-parametric analysis of the influence of the presence of a trainee endoscopist on Oxford NOTECHS II Scores

Independent-Samples Mann-Whitney U Test
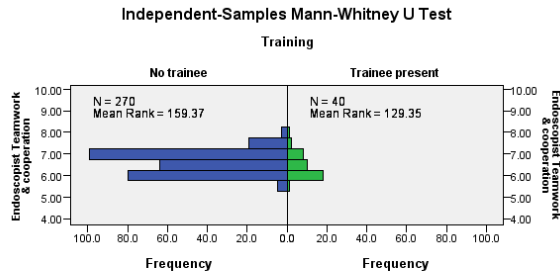
Total N	310
Mann-Whitney U	4,354.000
Wilcoxon W	5,174.000
Test Statistic	4,354.000
Standard Error	505.621
Standardized Test Statistic	-2.069
Asymptotic Sig. (2-sided test)	.039

Figure 3.4: Plot to compare Oxford NOTECHS II scores with and without a trainee present

3.3.4.3 Safety checklist

Prior to the commencement of each procedure four tasks should be performed. These include a team brief, procedure plan, patient identification check (in the procedure room) and a pause or stop moment just before the procedure begins.

The team brief was completed in all cases. A plan for the procedure was stated in 309 of 310 cases (99.7%).

The ID check in the room was not undertaken in 35 of 310 cases (data missing or unknown for 3 cases). The Mann Whitney U test was used to investigate the relationship between ID check and Oxford NOTECHS II Scores (see table 3.12). A significant relationship was found with all components of the Oxford NOTECHS II Score except for Endoscopist DM. Median scores were higher in the "ID check in room" group for all groups except Nurse sub-team L&M and DM and whole team DM where the values were

the same. In these three groups, there was a greater frequency of low scores within the

"No ID check" group (see figure 3.5).

	Median Oxford NOTECHS II Score		Mann-Whitney U Test (*U*)
	ID Check in room N=272	No ID check in room N=35	
Endoscopist Sub-team			
Leadership & Management	7.00	6.50	5763.90*
Teamwork & cooperation	6.50	6.50	5853.00*
Decision making	6.50	6.00	5522.50
Situation awareness	7.00	6.00	6460.00***
Total score	26.50	25.00	6174.00**
Nurse Sub-team			
Leadership & management	6.00	6.00	5599.00*
Teamwork & cooperation	6.50	6.50	5605.50*
Decision making	6.00	6.00	5652.00**
Situation awareness	6.50	6.00	6269.00***
Total score	25.50	24.50	6238.50**
Team			
Leadership & management	6.50	6.25	6076.50**
Teamwork & cooperation	6.50	6.25	5913.50*
Decision making	6.25	6.25	5779.50*
Team Situation awareness	6.75	6.00	6604.00***
Total score	26.25	25.00	6407.00**
*p< .05, **p<.01, ***p< .001 all values to 2 decimal places			

Table 3.12: Non-parametric analysis of the influence of checking patient ID on Oxford NOTECHS II Scores

Independent-Samples Mann-Whitney U Test — ID Check in room (Nurse Leadership & management)

Total N	306
Mann-Whitney U	5,599.000
Wilcoxon W	42,727.000
Test Statistic	5,599.000
Standard Error	434.530
Standardized Test Statistic	2.244
Asymptotic Sig. (2-sided test)	.025

Independent-Samples Mann-Whitney U Test — ID Check in room (Nurse Decision making)

Total N	306
Mann-Whitney U	5,652.000
Wilcoxon W	42,780.000
Test Statistic	5,652.000
Standard Error	395.276
Standardized Test Statistic	2.601
Asymptotic Sig. (2-sided test)	.009

Independent-Samples Mann-Whitney U Test — ID Check in room (Team Decision making)

Total N	307
Mann-Whitney U	5,779.500
Wilcoxon W	42,907.500
Test Statistic	5,779.500
Standard Error	477.682
Standardized Test Statistic	2.134
Asymptotic Sig. (2-sided test)	.033

Figure 3.5: Plot to compare Oxford NOTECHS II scores against completion of the ID check

The pre-procedure Pause was not undertaken in 39/310 (data missing or unknown in 12). The Mann Whitney U test was used to investigate the relationship between Pause and Oxford NOTECHS II Scores (see table 3.13). Significantly, relationships were found with T&C, SA & total scores for the endoscopist sub-team and the whole team (but not

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for the nursing sub-team). In all cases median scores were higher when the pre-procedure pause was witnessed by the observer.

	Median Oxford NOTECHS II Score		Mann-Whitney U Test (*U*)
	Pause N=259	No Pause N=39	
Endoscopist Sub-team			
Leadership & Management	7.00	6.50	5814.00
Teamwork & cooperation	6.50	6.00	6417.00**
Decision making	6.50	6.50	5512.00
Situation awareness	7.00	6.50	6304.00**
Total score	26.50	25.50	6344.50*
Nurse Sub-team			
Leadership & management	6.00	6.00	5146.50
Teamwork & cooperation	6.50	6.50	5637.00
Decision making	6.00	6.00	5109.50
Situation awareness	6.50	6.50	5765.50
Total score	25.50	25.00	5622.00
Team			
Leadership & management	6.50	6.25	5655.00
Teamwork & cooperation	6.50	6.25	6166.00*
Decision making	6.25	6.25	5379.00
Team Situation awareness	6.75	6.50	6136.00*
Total score	26.25	25.00	6019.00*
*p< .05, ** p< .01, ***p<.001 all values to 2 decimal places			

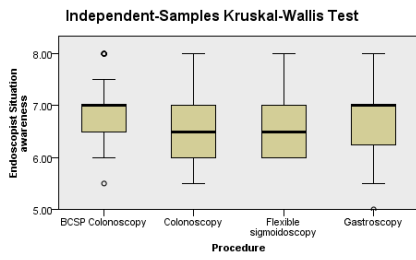*Table 3.13: Non-parametric analysis of the influence of pre-procedure pause on Oxford NOTECHS II Scores*

3.3.4.4 Sedation and pain relief

Sedation was administered in 218 out of 310 (70.32%), no sedation in 78 (25.16%), no record or missing data in 14. The Mann Whitney U test was used to investigate the relationship between Sedation and Oxford NOTECHS II Scores. No significant differences were found between groups (see appendix 7.4).

Entonox was administered in 54 out of 218 colonoscopies & flexible sigmoidoscopies (24.77%). The Mann Whitney U test was used to investigate the relationship between Entonox and Oxford NOTECHS II Scores. A significant difference was found in DM for both sub-teams and the whole team (see table 3.14). The median score for whole team DM was higher in the Entonox group. Median scores between groups for DM in both the Endoscopy and nursing sub-teams were equal (6.50 and 6.00 respectively), however there was a greater frequency of lower scores in the "no Entonox" groups (see figure 3.6).

	Median Oxford NOTECHS II Score		Mann-Whitney U Test (*U*)
	Entonox N=54	No Entonox N=164	
Endoscopist Sub-team			
Leadership & Management	7.00	6.50	5196.00
Teamwork & cooperation	6.50	6.50	4749.50
Decision making	6.50	6.50	5499.00**
Situation awareness	6.75	6.50	4950.50
Total score	27.00	26.00	5170.50
Nurse Sub-team			
Leadership & management	6.25	6.00	4554.50
Teamwork & cooperation	6.50	6.50	4938.00
Decision making	6.00	6.00	5332.00**
Situation awareness	7.00	6.50	5174.50
Total score	26.00	25.50	5105.50
Team			
Leadership & management	6.50	6.50	4877.00
Teamwork & cooperation	6.50	6.50	4845.00
Decision making	6.50	6.25	5561.00**
Team Situation awareness	6.75	6.50	5061.00
Total score	26.50	26.00	5145.50
*p< .05, ** p< .01, ***p<.001 all values to 2 decimal places			

Table 3.14: Non-parametric analysis of the influence of Entonox on Oxford NOTECHS II Scores
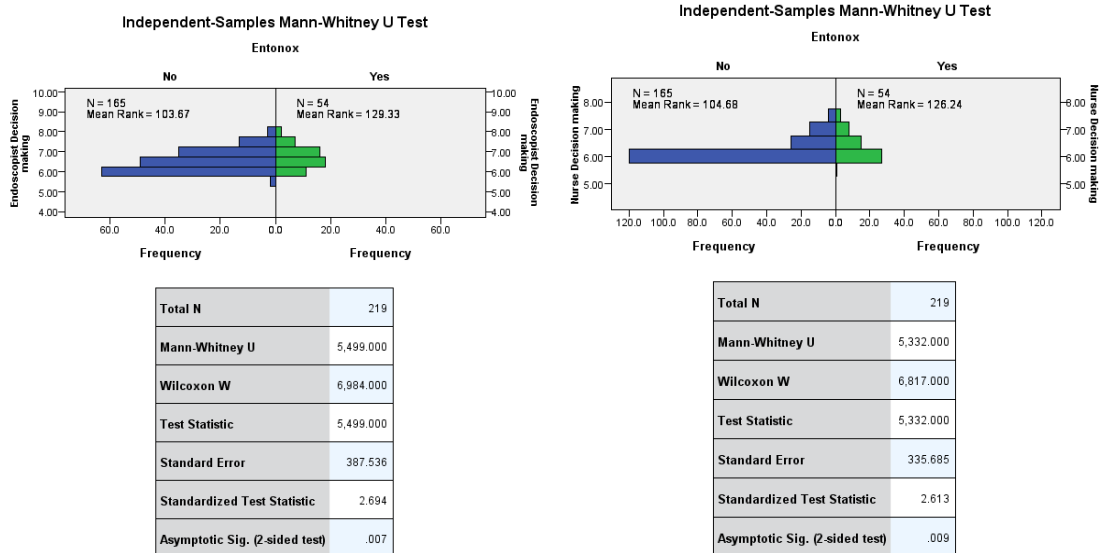
Figure 3.6: Plot to compare Oxford NOTECHS II scores against the use of Entonox

Throat-spray was administered in 51 of the 92 (55.43%). No throat spray was given in 38 (41.30%) and data was missing in 3 cases. No significant differences were found between groups (see appendix 7.4).

3.3.5   Exploring relationships between Oxford NOTECHS II scores and outcomes

3.3.5.1   Procedure outcomes

3.3.5.1.1   Categorical outcomes

3.3.5.1.1.1 Procedure completion

The procedure was completed as intended in 298 of 310 cases (96.8% valid), not complete in 10 and missing in 2 (see table 3.15). This is above the audit standard of 90% (95% aspirational).

Procedure	Complete (%)	Not complete (%)
BCSP Colonoscopy n=61	61 (100)	0 (0)
Colonoscopy n=120	115 (95.8)	5 (4.2)
Flexible sigmoidoscopy n=37	35 (94.6)	2 (5.4)
Gastroscopy n=92	89 (96.7)	3 (3.3)
All n=310	300 (96.8)	10 (3.2)

Table 3.15: Frequency chart of procedures completed

To assess the relationship between Oxford NOTECHS II scores and procedure completion, point-biserial correlation (r_{pb}) and logistic regression analyses were undertaken with each component of the Oxford NOTECHS II Score as the regressor, and procedure completion as the dependent variable (see appendix 7.5.1). No significant relationships were found and therefore score is not a predictor of procedure completion.

3.3.5.1.1.2 Polyp detection

Polyps were detected in 107 of 218 lower gastrointestinal cases (46.8% of Colonoscopies & Sigmoidoscopies). This is above the audit standard of 10% (15-20% in screening).

To assess the relationship between Oxford NOTECHS II score and polyp detection, point-biserial correlation (r_{pb}) and logistic regression analyses were undertaken with each component of the Oxford NOTECHS II Score as the regressor, and polyp detection as the dependent variable (see table 3.16).

Significant positive relationships were found between all components of the Oxford NOTECHS II score and the outcome polyp detection. However, R^2 (Nagelkerke) values were all less than .17, at best accounting for 17% of the variation in outcome (Team

Decision Making R^2 = .17). In this case the estimated Odds Ratio was 6.92, but the 95%

confidence interval was wide (3.19 - 15.02).

	r_{pb}	R^2 (Nagelkerke)	B (S.E.)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	.15*	.03	0.60* (0.27)	1.07	1.82	3.09
Teamwork & cooperation	.24***	.07	0.92** (0.27)	1.48	2.50	4.24
Decision making	.35***	.16	1.46***(0.30)	2.41	4.30	7.67
Situation awareness	.21**	.06	0.80** (0.26)	1.34	2.22	2.22
Total score	.27***	.10	0.31*** (0.08)	1.17	1.37	1.60
Nurses						
Leadership & management	.19**	.05	0.83** (0.30)	1.28	2.28	4.07
Teamwork & cooperation	.24***	.08	1.00*** (0.29)	1.56	2.72	4.75
Decision making	.27***	.10	1.45*** (0.38)	2.01	4.26	9.01
Situation awareness	.31***	.13	1.26*** (0.29)	2.02	3.53	6.20
Total score	.30***	.12	0.39*** (0.09)	1.24	1.48	1.78
Team						
Leadership & management	.19**	.05	0.88** (0.32)	1.29	2.42	4.51
Teamwork & cooperation	.25***	.08	1.06*** (0.29)	1.62	2.88	5.12
Decision making	.36***	.17	1.93*** (0.39)	3.19	6.92	15.02
Situation awareness	.28***	.10	1.16*** (0.29)	1.80	3.20	5.66
Total score	.30***	.12	0.38*** (0.09)	1.23	1.46	1.75
*p <.05, **P <.01, ***p <.001 all values to 2 decimal places						

Table 3.16: Point-biserial correlation and logistic regression analysis of Oxford NOTECHS II Scores and Polyp detection (lower GI procedures only)

3.3.5.1.1.3 Complications

Complications occurred in 2 out of 310 cases (0.6%).

To assess the relationship between Oxford NOTECHS II score and complications, point-biserial correlation (r_{pb}) and logistic regression analyses were undertaken with each component of the Oxford NOTECHS II Score as the regressor, and complications as the dependent variable (see table 3.17). Significant weak positive correlations were identified for Nurse L&M, Nurse total and Team L&M scores with complications. However, logistic regression models did not reveal any of these score components to be significant predictors of complications.

	r_{pb}	R^2 (Nagelkerke)	B (S.E.)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	.09	.12	2.55 (1.57)	0.58	12.80	280.39
Teamwork & cooperation	.06	.05	1.52 (1.38)	0.31	4.57	68.05
Decision making	.08	.07	1.53 (1.20)	0.44	4.60	48.45
Situation awareness	.05	.04	1.21 (1.31)	0.26	3.35	43.70
Total score	.08	.08	0.51 (.037)	0.81	1.67	3.42
Nurses						
Leadership & management	.12*	.15	2.67 (1.60)	0.63	14.44	329.08
Teamwork & cooperation	.07	.06	1.66 (1.38)	0.35	5.27	79.23
Decision making	.11	.11	2.21 (2.85)	0.70	9.15	119.36
Situation awareness	.10	.12	2.33 (1.41)	0.66	10.29	161.79
Total score	.12*	.14	0.69 (0.38)	0.95	2.00	4.21
Team						
Leadership & management	.12*	.16	3.11 (1.68)	0.84	22.41	599.08
Teamwork & cooperation	.07	.06	1.69 (1.38)	0.36	5.40	80.11
Decision making	.10	.10	2.20 (1.36)	0.63	8.98	128.51
Situation awareness	.08	.08	1.87 (1.37)	0.45	6.47	94.06
Total score	.10	.12	0.63 (0.38)	0.90	1.87	3.91
*$p <.05$, **$P <.01$, ***$p <.001$ all values to 2 decimal places						

Table 3.17: Point-biserial correlation and logistic regression analysis of Oxford NOTECHS II Scores and Complications

3.3.5.1.1.4 Scope withdrawal / extubation time ≥ 6 minutes

Extubation time was equal to or longer than 6 minutes in 85 out of 181 colonoscopies (90.4% valid). It was less than 6 minutes in 9 and not recorded in 87 cases.

To assess the relationship between Oxford NOTECHS II score and extubation time ≥6 minutes, point-biserial correlation (r_{pb}) and Logistic regression analyses were

undertaken with each component of the Oxford NOTECHS II Score as the regressor, and extubation time ≥6 minutes as the dependent variable (see table 3.18).

Weak significant correlations (r_{pb}) were found with the following Oxford NOTECHS II scores: Endoscopist SA, Endoscopist total, Nurse DM, Nurse total, Team L&M, Team SA and Team total. Logisitic regression analysis identified all of these to be significant predictors of the outcome extubation time ≥6 minutes except for Nurse DM. However, R^2 (Nagelkerke) values for all were between .10 and .14, indicating all models were a poor fit.

	r_{pb}	R^2 (Nagelkerke)	B (S.E.)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	.19	.08	1.28 (0.71)	0.88	3.60	14.68
Teamwork & cooperation	.20	.09	1.34 (0.72)	0.93	3.84	15.81
Decision making	.14	.04	0.94 (0.73)	0.62	2.57	10.66
Situation awareness	.24*	.13	1.66* (0.76)	1.19	5.26	23.22
Total score	.21*	.10	0.43* (0.22)	1.00	1.53	2.35
Nurses						
Leadership & management	.20	.11	2.00 (1.13)	0.82	7.42	67.36
Teamwork & cooperation	.18	.08	1.43 (0.83)	0.82	4.20	21.52
Decision making	.21*	.14	3.70 (2.19)	0.56	40.58	2950.04
Situation awareness	.18	.07	1.14 (0.66)	0.86	3.13	11.45
Total score	.22*	.13	0.62* (0.30)	1.02	1.85	3.34
Team						
Leadership & management	.22*	.11	2.01* (1.01)	1.03	7.48	54.10
Teamwork & cooperation	.20	.09	1.54 (0.83)	0.91	4.66	23.77
Decision making	.18	.09	1.96 (1.16)	0.73	7.11	69.32
Situation awareness	.22*	.11	1.56* (0.76)	1.07	4.73	20.87
Total score	.22*	.12	0.55* (0.27)	1.03	1.74	2.94
*$p <.05$, **$P <.01$, ***$p <.001$ all values to 2 decimal places						

Table 3.18: Point-biserial correlation and logistic regression analysis of Oxford NOTECHS II Scores and Extubation time ≥ 6 minutes

3.3.5.1.2 Continuous outcomes

3.3.5.1.2.1 Glitch count

As discussed in section 3.1.5.1, the Glitch count is a marker of process imperfections or procedural errors observed. A total of 879 glitches were recorded during the study observations. The mean number of glitches per procedure was 2.84 (range 0-13). Table

3.19 presents these according to their sub-categories (as defined in appendix 1). Glitches were most frequently due to "patient related" factors, followed by "distractions", and least frequently due to "health & safety" factors and none due to "slips".

Patient related	339
Distractions	241
Training	70
Communication	52
Maintenance	40
Planning & preparation	35
Process deviation	27
Equipment design	23
Environment	23
Workspace	17
Absence	8
Health & safety	4
Slips	0
Total	*879*

Table 3. 19: Glitch count according to category

Scatter plots were drawn to assess the relationship between glitch count and components of the Oxford NOTECHS II score (see appendix 7.5.2). Correlation analysis was then undertaken using both Pearson's *r* correlation coefficient and Kendall's τ correlation coefficient (for non-parametric & small data sets with a number of values of the same rank) (see table 3.19).

Pearson's *r* correlation coefficient showed a significant weak positive relationship with decision making & total scores for the endoscopist sub-team and the whole team.

Kendall's τ correlation coefficient showed a significant weak positive relationship with decision making & total scores in both sub-teams and the whole team.

	Pearson Correlation Coefficient (*r*)	Kendall Correlation Coefficient (τ)
Endoscopist Sub-team		
Leadership & Management	.07	.07
Teamwork & cooperation	.05	.06
Decision making	.29***	.30***
Situation awareness	.09	.09
Total score	.14*	.13**
Nurse Sub-team		
Leadership & management	.06	.07
Teamwork & cooperation	.11	.09
Decision making	.07	.12*
Situation awareness	.07	.08
Total score	.09	.10*
Team		
Leadership & management	.07	.08
Teamwork & cooperation	.08	.07
Decision making	.21***	.26***
Team Situation awareness	.08	.08
Total score	.12*	.12**
p <.05, **P* <.01, ***p* <.001 all values to 2 decimal places		

Table 3.20: Correlation between Oxford NOTECHS II Score and Glitch count

Units done per list reflects the volume of endoscopy procedures completed, measured by units (see 3.1.5).

Scatter plots were drawn to assess the relationship between units done and components of the Oxford NOTECHS II score (see appendix 7.5.3 for plots of statistically significant relationships). Correlation analysis was then undertaken using both Pearson's *r* correlation coefficient and Kendall's τ correlation coefficient (for non-parametric & small data sets with a number of values of the same rank) (see table 3.20).

Both Pearson's *r* correlation coefficient and Kendall's τ correlation coefficient identified significant weak negative relationships with Nurse L&M, T&C and Total.

	Pearson Correlation Coefficient (*r*)	Kendall Correlation Coefficient (τ)
Endoscopist Sub-team		
Leadership & Management	.06	.05
Teamwork & cooperation	-.04	-.04
Decision making	-.01	.01
Situation awareness	.00	.03
Total score	.00	.01
Nurse Sub-team		
Leadership & management	-.15*	-.14**
Teamwork & cooperation	-.14*	-.13**
Decision making	-.09	-.08
Situation awareness	-.07	-.04
Total score	-.13*	-.12*
Team		
Leadership & management	-.05	-.05
Teamwork & cooperation	-.10	-.09
Decision making	-.05	-.02
Team Situation awareness	-.04	-.02
Total score	-.07	-.06
*p <.05, **P <.01, ***p <.001 all values to 2 decimal places		

Table 3.21: Correlation between Oxford NOTECHS II Score and Units done per list

3.3.5.2 Patient outcomes

3.3.5.2.1 Pain or discomfort score (ordinal)

Pain or discomfort score was measured independently by the observer during the procedure using an ordinal scale (0=none, 1=minimal, 2=mild, 3=moderate, 4=severe) in 214 of 310 cases (missing in 96). Scores were distributed across all groups, but with the majority of patients experiencing minimal or mild discomfort (39.7% and 28.0% respectively) (see table 3.21).

To assess the relationship between Oxford NOTECHS II score and pain score, Pearson's correlation (*r*) and ordinal logistic regression analysis was undertaken with each component of the Oxford NOTECHS II Score as the regressor, and pain score as the dependent variable (see table 3.22).

Significant weak positive correlations (*r*) were found with Endoscopist DM and Whole team DM. Ordinal logistic regression found these two variables to be significant predictors of pain score, however effect sizes were very small (R^2 = 0.02 in both cases).

Discomfort score	Frequency	Percent (%)	Valid Percent (%)
None	35	11.3	16.4
Minimal	85	27.4	39.7
Mild	60	19.4	28.0
Moderate	30	9.7	14.0
Severe	4	1.3	1.9
Missing	*96*	*30.9*	
Total	310		

Table 3.22: Frequency chart of Discomfort score awarded by observer

	R	Pseudo R^2 (Nagelkerke)	Estimated B	S.E.	95% Confidence Intervals	
					Lower	Upper
Endoscopists						
Leadership & Management	.02	.00	0.06	0.24	-0.41	0.53
Teamwork & cooperation	.03	.00	0.12	0.23	-0.33	0.58
Decision making	.15*	.02	0.50*	0.23	0.05	0.96
Situation awareness	.07	.01	0.23	0.22	-0.21	-0.66
Total score	.08	.01	0.08	0.07	-0.05	0.21
Nurses						
Leadership & management	.09	.01	0.34	0.28	-0.22	0.89
Teamwork & cooperation	.11	.01	0.38	0.25	-0.10	0.86
Decision making	.10	.01	0.47	0.32	-0.16	1.09
Situation awareness	.11	.01	0.33	0.23	-0.12	0.77
Total score	.12	.01	0.13	0.08	-0.02	0.28
Team						
Leadership & management	.06	.00	0.23	0.29	-0.35	0.81
Teamwork & cooperation	.07	.01	0.27	0.25	-0.22	0.76
Decision making	.14*	.02	0.61*	0.30	0.03	1.20
Situation awareness	.10	.01	0.29	0.24	-0.17	0.76
Total score	.101	.01	0.11	0.08	-0.04	0.25
*p <.05, **P <.01, ***p <.001 all values to 2 decimal places						

Table 3.23: Pearson correlation and ordinal logistic regression analysis of Oxford NOTECHS II Scores and Pain score

3.3.5.2.2   Patient satisfaction questionnaire outcomes

Table 3.23 shows patient questionnaire responses to the ten questions most likely to be

influenced by the non-technical skills of the endoscopy team.

Question	0 – No (% valid)	1 – Yes (% valid)	Other response	Missing
5 – Was any delay explained?	54 (55.7)	43 (44.3)	N/A 181	32
7 – Would you prefer sedation next time?	23 (36.5)	40 (63.5)	Maybe 13 N/A 137	97
8 – Were you informed of the risks?	9 (3.3)	262 (96.7)	Do not remember 13	26
9 – Were you able to discuss your concerns?	6 (2.2)	271 (97.8)		33
10 – Was information sufficient for you to consent?	2 (0.7)	277 (99.3)		31
14 – Were you treated politely and with respect?	0	281 (100.0)		29
17 – Did you experience any problems that could have been avoided?	255 (95.5)	12 (4.5)		43
18 – Are there any ways the service could be improved?	225 (86.9)	34 (13.1)		51

Question	1 – Acceptable, I would have again if necessary (% valid)	2 – Acceptable but unconfortable, I would only have again if essential (% valid)	3 – Totally unacceptable, I would not have the procedure again (% valid)	Missing
11 – What was the procedure like?	212 (74.9)	69 (24.4)	2 (0.7)	27

Question	0 – Not at all (% valid)	1 – Insufficiently (% valid)	2 – Partially (% valid)	3 – Completely (% valid)	Missing
12 – Were your results explained?	5 (1.9)	1 (0.4)	23 (8.8)	231 (88.8)	50

Table 3.24: Patient satisfaction questionnaire responses

3.3.5.2.2.1 Q5 – If there was a delay to your appointment time, were you given an explanation for the delay?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 5 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 5 outcome.

3.3.5.2.2.2 Q 7 – If you were not offered sedation, would you prefer to have it next time, if you had this procedure again?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 7 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 7 outcome.

3.3.5.2.2.3 Q8 – Before your procedure, were you informed of any potential risks?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 8 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 8 outcome.

3.3.5.2.2.4 Q9 – Did you have the opportunity to discuss the procedure and any concerns you may have had prior to the procedure?

Point-biserial correlation (r_{pb}) identified significant but weak negative correlations with Nurse sub-team L&M, SA and total Oxford NOTECHS II scores (see table 3.24).

Logistic regression analysis confirmed these three score components as predictors of Question 9 outcome with odds ratios respectively of 0.21, 0.12 and 0.60, i.e. an increase in the Oxford NOTECHS II score decreases the likelihood that patients had the opportunity to discuss the procedure and any concerns that they had. However, effect sizes were very small (maximum Nagelkerke R^2 = 0.13).

	r_{pb}	R^2 (Nagelkerke)	B (S.E.)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	-.07	.03	-1.03 (0.85)	0.07	0.36	1.88
Teamwork & cooperation	-.10	.05	-1.31 (0.82)	0.06	0.27	1.34
Decision making	-.07	.03	-0.87 (0.74)	0.10	0.42	1.79
Situation awareness	-.03	.01	-0.42 (0.76)	0.15	0.66	2.92
Total score	-.08	.03	-0.29 (0.22)	0.49	0.75	1.15
Nurses						
Leadership & management	-.13*	.07	-1.58* (0.80)	0.04	0.21	1.00
Teamwork & cooperation	-.11	.06	-1.44 (0.84)	0.05	0.24	1.22
Decision making	-.11	.05	-1.36 (0.80)	0.05	0.26	1.22
Situation awareness	-.16**	.13	-2.11* (0.85)	0.02	0.12	0.64
Total score	-.15*	.10	-0.52* (0.22)	0.38	0.60	0.92
Team						
Leadership & management	-.11	.06	-1.63 (0.90)	0.03	0.20	1.15
Teamwork & cooperation	-.11	.06	-1.48 (0.84)	0.04	0.23	1.17
Decision making	-.10	.04	-1.34 (0.84)	0.05	0.26	1.36
Situation awareness	-.10	.05	-1.31 (0.81)	0.06	0.27	1.31
Total score	-.12	.07	-0.43 (0.23)	0.42	0.65	1.01
*p <.05, **P <.01, ***p <.001 all values to 2 decimal places						

Table 3.25: Point-biserial correlation and Logistic regression analysis of Oxford NOTECHS II Scores and Patient Satisfaction question 9

3.3.5.2.2.5 Q10 – Did you feel that you were given enough information to decide whether or not you wished to go ahead (give written consent) to the procedure?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 10 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 10 outcome.

3.3.5.2.2.6 Q11 – What was your procedure like?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 11 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 11 outcome.

3.3.5.2.2.7 Q12 – Were the results of your procedure explained to you afterwards?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 12 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 12 outcome.

3.3.5.2.2.8 Q14 – Were you treated politely and with respect in the Endoscopy Unit?

All patients who answered this question (281/310) gave a positive response and therefore neither correlation nor logistic regression analyses were possible.

3.3.5.2.2.9 Q17 – Whilst in the Endoscopy Unit did you experience any problems that in your opinion could have been avoided?

Point-biserial correlation (r_{pb}) did not show any significant relationships between Oxford NOTECHS II Scores and question 17 outcomes.

Logistic regression analysis did not show Oxford NOTECHS II score to be a predictor of question 17 outcome.

Point-biserial correlation (r_{pb}) identified a significant weak negative correlation with Endoscopist T&C (see table 3.25)

Logistic regression analysis confirmed Endoscopist T&C score as a predictor of Q18 outcome with an odds ratio of 0.43, indicating as score increased there is a decreased likelihood of patients responding 'Yes' to this question, i.e. they are less likely to feel the service could be improved. However, effect size was very small (Nagelkerke R^2 = .04).

	r_{pb}	R^2 (Nagelkerke)	B (S.E.)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	-.06	.01	-0.35 (0.37)	0.34	0.70	1.44
Teamwork & cooperation	-.14*	.04	-0.86* (0.39)	0.20	0.43	0.91
Decision making	-.03	.00	-0.16 (0.37)	0.41	0.85	1.77
Situation awareness	-.11	.02	-0.59 (0.34)	0.28	0.56	1.09
Total score	-.10	.02	-0.17 (0.11)	0.68	0.84	1.05
Nurses						
Leadership & management	-.05	.00	-0.31 (0.42)	0.32	0.73	1.67
Teamwork & cooperation	-.05	.01	-0.31 (0.38)	0.35	0.74	1.55
Decision making	-.12	.03	-1.27 (0.68)	0.07	0.28	1.07
Situation awareness	-.02	.00	-0.14 (0.35)	0.44	0.87	1.73
Total score	-.07	.01	-0.13 (0.13)	0.69	0.88	1.12
Team						
Leadership & management	-.06	.01	-0.43 (0.45)	0.27	0.65	1.57
Teamwork & cooperation	-.10	.02	-0.68 (0.42)	0.23	0.51	1.15
Decision making	-.08	.01	-0.63 (0.53)	0.19	0.53	1.50
Situation awareness	-.07	.01	-0.41 (0.37)	0.32	0.66	1.37
Total score	-.09	.02	-0.17 (0.12)	0.66	.084	1.07
*p <.05, **P <.01, ***p <.001 all values to 2 decimal places						

Table 3.26: Point-biserial correlation and Logistic regression analysis of Oxford NOTECHS II Scores and Patient Satisfaction question 18

3.4 Discussion

3.4.1 Score distribution and sub-team comparison

The Oxford NOTECHS II Scores for all components were confined to the upper half of the scale indicating generally good NTS (score of 5 corresponds to "inconsistently maintains a level of patient safety and teamwork"; score of 8 corresponds to "consistently enhances patient safety and teamwork"). This distribution is similar to that found by Robertson et al. (2014) using the Oxford NOTECHS II in the operating theatre. Median scores for all components and sub-teams were equal to or greater than the default score of 6 ("consistently maintains a level of patient safety & teamwork"). This may imply that no behaviours which compromised patient safety or effective teamwork were observed during the study period and good NTS behaviours were often observed. Alternatively, it is possible that the scale was not applied correctly to the behaviours observed.

It was also apparent that for an uncomplicated endoscopy, the default score of 6 was often awarded. This may reflect that during straight-forward cases the team are not particularly challenged and therefore less likely to demonstrate positive or negative NTS behaviours and thus there was no evidence to award a higher or lower score.

As the scores were confined to the upper half of the scale, the distribution was deemed to be skewed. If the scale is changed to 5-8 (as no score lower than 5 was awarded), the data appears to fit a more normal distribution (see appendix 7.1). However, based on the skewed distribution of the data using the full Oxford NOTECHS II scale, it was treated as non-parametric for the purposes of analysis.

The Endoscopist sub-team significantly outperformed the Nursing sub-team in leadership & management, problem solving and decision making, and total score. This

may be due simply to better non-technical skills in this group. However, it could also have been influenced by the difficulty or complexity of a case. In the event of a more challenging case, the Endoscopist may have had greater opportunity to overtly demonstrate their NTS, than the nursing sub-team, particularly those relating to leadership or decision making. Due to the medical background of the observer (the MD student), they may also have been more sensitive to the NTS demonstrated by the endoscopist sub-team than the nursing sub-team. It would be interesting to compare their scores with those of an observer with a nursing or human factors background in order to investigate this further. The study by Mishra et al. (2008) using the Oxford NOTECHS tool in the operating theatre similarly found the surgeon sub-team scores to be significantly higher than Nursing sub-team (or Anaesthetist sub-team) scores. They do not however suggest any explanation for these differences in scores. Although Robertson et al. (2014) (using the Oxford NOTECHS II tool) did not find any significant differences in NTS performance between sub-teams, there was a greater variation of scores within the surgeon sub-team. This is consistent with the increased standard deviation and variance found here within the endoscopist sub-team compared to the nursing sub-team. It is suggested that the increased variance within the surgical team scores may be due to the combination of surgical team members as "classic external processors" and the overt nature of the technical tasks they perform. In contrast, the nurse assistant is often dependent on the rest of the nursing team and thus the combined score allocated to the individuals that comprise the nursing sub-team may be more equivocal (Robertson et al., 2014).

3.4.2 Inter-rater reliability

Inter-rater reliability for the 19 cases observed concurrently by the student CH and the supervisor CW was good or excellent for all Oxford NOTECHS II components for both sub-teams and the whole team (Cicchetti, 1994). This was measured using the intra-class correlation coefficient, in line with the previous Oxford NOTECHS II study by Robertson et al. (2014). The findings of good to excellent agreement are also consistent with Robertson et al. (2014), although in their study, two types of observers (Clinicians versus Human Factors Experts) were compared, rather than two individual observers. These findings do however, support the reliability of a single observer in this environment.

3.4.3 Intra-rater reliability

As a surrogate marker of intra-rater reliability scores were assessed for drift over the time-course of the observations. Two significant relationships were found between Oxford NOTECHS II score and sequence number. A weak positive trend was identified with the Endoscopist sub-team situation awareness scores, suggesting either their performance in just this area improved, or the observer became more lenient as time progressed. Conversely, a weak negative trend was identified with nursing sub-team leadership and management scores, potentially suggesting their performance in just this area declined, or the observer became harsher as time progressed. This is difficult to explain and it should be noted that no trends were found with total Oxford NOTECHS II scores, for either sub-team or the whole team.

Intra-rater reliability, or a surrogate marker of it, has not been assessed in other publications using this scale. An unpublished study undertaken by individuals within this research team identified a significant negative trend in Oxford NOTECHS II whole team

total scores over time. This study was performed in the operating theatre, and the observer was a Psychology student, not a clinician, and thus does not provide a direct comparison (Hitchins et al., 2017a). The weak and inconsistent nature of the trends described above make them unlikely to be clinically significant but could be explored further in future work.

3.4.4 Case predictors of NTS performance

3.4.4.1 Procedure

Significant differences were found between Oxford NOTECHS II scores for the Endoscopist sub-team in all domains and for whole team decision making when compared by procedure type (with BCSP colonoscopy as a separate group). Median scores were highest for the BCSP colonoscopy group in all these areas except Endoscopist DM (where it was equal to other groups).

In order to undertake a bowel cancer screening colonoscopy, Endoscopists undergo extra training and are required to complete a more rigorous technical skill assessment. Other studies have shown positive relationships between technical and non-technical skills although the causality of such relationships is unclear (McCulloch et al., 2009, Mishra et al., 2008, von Wyl et al., 2009, Catchpole et al., 2008, Krage et al., 2017).

Screening colonoscopies are more likely than other colonoscopies to require biopsy or polypectomy. It is possible that this is therefore a more challenging or complex procedure, which may provide greater opportunity to demonstrate positive NTS behaviours and thus be awarded a higher score.

Due to the extra training required, the composition of the team during BCSP colonoscopies tends to be more consistent and includes the addition of a screening

practitioner. This is a senior nurse specifically employed to look after patients during their journey through the bowel cancer screening pathway. This team is therefore closer to the ideal "expert team" than some, which may also contribute to the higher Oxford NOTECHS II scores achieved.

3.4.4.2 Presence of a trainee endoscopist

When a trainee was present during the procedure, scores were significantly lower for endoscopist sub-team teamwork and cooperation. In these cases, endoscopist sub-team scores were awarded to the endoscopist and the trainee collectively. It is possible that if the trainee was performing a relatively challenging procedure, the extra cognitive load decreased their capacity to demonstrate good NTS. This hypothesis is supported by other studies that have found the NTS of trainees to improve with both post-graduate year of training and case experience (Gostlow et al., 2017, Szasz et al., 2017). Information on the seniority and experience of endoscopy trainees could help to clarify this in future work.

3.4.4.3 Checklist completion

Two elements of the safety checklist were associated with a change in Oxford NOTECHS II scores: checking the patient's ID in the room, and the pre-procedure pause.

Checking the patient's ID in the room confirms for the whole team that the procedure about to be undertaken is on the correct patient. It is usually followed by checking the patient's understanding of what will happen next and confirming consent. Missing this step (11.3%) was significantly associated with reduced scores in all areas except Endoscopist sub-team DM. It seems logical that this could reflect reduced situation awareness, leadership and teamwork skills in the Endoscopist and Nursing sub-teams,

by either failing to initiate this safety check, or to remind and question team members that it needs to be completed. However, this also implies that checklist completion and Oxford NOTECHS II scores are not independent.

Missing the pre-procedure pause (12.6%) was significantly associated with lower Endoscopist sub-team and whole team T&C, SA and total Oxford NOTECHS II Scores. This step involves the Endoscopist making a final check that all team members are ready to commence the procedure, and allows the opportunity for individuals to speak up if there are any concerns. It demonstrates situation awareness and requires communication and therefore, it is not surprising that Oxford NOTECHS II scores were lower in the areas discussed.

There is however a risk that these results are subject to bias. Adherence to the safety checklist was observed by the MD student at the same time as the Oxford NOTECHS II assessments were undertaken. It is therefore likely that the behaviours exhibited by the team in completing these steps directly influenced the Oxford NOTECHS II scores they were awarded.

Robertson et al. (2014) similarly found a positive relationship between completion of the World Health Organisation (WHO) checklist in full and Oxford NOTECHS II scores in the operating theatre, and in fact used it as evidence of the construct validity of the scale, suggesting it supported the "hypothesised mechanistic effect of a well performed WHO surgical safety checklist on intra-operative non-technical skills performance".

Further support for this relationship is found in a study undertaken in Endoscopy. Endoscopists with better NTS were more likely to perform safety checks, and over a

quarter of safety incidents occurred on lists where NTS performance was poor (Matharoo et al., 2012).

Although these results are likely to be subject to bias, it does seem logical that there is an association between the completion of safety checks and NTS. Not only are these checks essential for ensuring the correct procedure is undertaken on the correct patient, but in an environment where teams frequently change they can also act as an icebreaker, as they can present an opportunity for dialogue between team members. This can improve the familiarity of the team and empower, for example, the most junior member the opportunity to speak up when required, or encourage discussions which facilitate better decision making. In addition, jointly undertaking these safety tasks may improve the situation awareness of the team, resulting in better shared mental models, preventing errors due to misunderstandings or miscommunication.

3.4.4.4   Sedation and analgesia

The administration of sedation and throat spray did not reveal any association with Oxford NOTECHS II Scores. Decision making scores for both sub-teams were higher when Entonox was used. The use of Entonox is sometimes in addition to sedation, commenced mid-way through a procedure, if the patient is finding it particularly uncomfortable. The decision to introduce this as another form of analgesia can be suggested by any member of the team, allowing the demonstration of decision making skills such as generating and discussing options, therefore resulting in a higher Oxford NOTECHS II score in the DM domain.

3.4.5 Procedure Outcomes

3.4.5.1 Categorical

3.4.5.1.1 Procedure completeness

The overall completion rate of procedures observed was 96.7%, ranging from 94.6% for flexible sigmoidoscopy to 100% for bowel cancer screening colonoscopy. These figures are higher than the national audit target of 90% and indicate very good performance. No significant relationships were found between this outcome and the Oxford NOTECHS II scores, and thus a change in NTS performance did not seem to predict the chance of the procedure being complete. The estimated sample size required was based on the national audit target for this outcome (i.e. 90% procedure completion). As the observed completion rate was higher, if there is indeed a relationship between these two measures, larger numbers would be required to demonstrate it. The choice of this outcome measure for calculating the sample size estimate will be discussed further in section 3.4.7.

3.4.5.1.2 Polyp detection (gastroscopies excluded)

The observed polyp detection rate (PDR) of 46.8% is much higher than the national audit target of 20%. A significant positive relationship was found between all Oxford NOTECHS II scores and this outcome.

As described in section 3.2.5, adenoma detection rate (ADR) is a marker of quality, based on evidence that low ADRs are associated with an increased risk of interval cancers and PDR is used as a surrogate marker of ADR (Rees et al., 2013) To ensure all polyps are identified and no lesion is missed, the Endoscopist must obtain good views of the whole colonic mucosa, including round corners and behind folds. This relationship therefore

could reflect the need for good individual situation awareness, concentration and the avoidance of interruptions in the Endoscopist, to detect even very small polyps. Other members of the team can contribute via increased vigilance, awareness, and speaking up and alerting the Endoscopist to lesions not initially noticed. In addition, a polyp that subsequently requires a therapeutic procedure indicates a potentially more challenging case, which may give the team more opportunity to demonstrate a range of good NTS and thus increasing the Oxford NOTECHS II scores awarded.

The use of PDR may have given a falsely increased estimate of ADR, as the lesions detected as polyps during colonoscopy have not been histologically confirmed as adenomas. This may explain why the results are greater than the national audit standard. However, the hypothesised relationship between NTS and PDR still seems reasonable, as the detection of any suspicious lesion is likely to be enhanced by better NTS as described above.

3.4.5.1.3 Immediate complications

A weak but significant relationship was found between nurse sub-team and whole team L&M and immediate complications. However, the rate of complications was very low (0.6%) and none of these were serious or required further treatment. Although a low complication rate in itself is a positive finding, the numbers are too small to draw any definite conclusions about this relationship.

3.4.5.1.4 Extubation time ≥ 6minutes (colonoscopy only) – KPI for BCSP and ideal for all colonoscopy

Extubation time of equal to or longer than 6 minutes is an auditable outcome which indicates the time taken to examine the colonic mucosa during withdrawal of the

endoscope. In the cases where this outcome was recorded, it was positive in 90.4% (data missing in 48.1% of colonoscopies observed). It is considered a surrogate marker of the quality of the procedure based on the hypothesis that the longer the extubation time, the more thoroughly the colon is examined and the lower the chance of missing a lesion. Endoscopist sub-team SA and total score, nursing total score and whole team L&M, SA and total score were all possible predictors of this outcome, however all relationships were weak and a poor fit.

Although these findings indicate a positive relationship between scores and this outcome, it can only be a surrogate marker of the quality of the endoscopy. Procedures which are more difficult or include a therapeutic element such as polypectomy, could potentially bias the results, as extubation time will be increased in these cases whether or not the colonic mucosa was carefully examined in its entirety.

3.4.5.2 Continuous

3.4.5.2.1 Glitch count

Positive (weak) correlations were found between glitch count and Endoscopist sub-team DM, whole team DM and total Oxford NOTECHS II scores. This indicates that these NTS were better when there were more process deviations noted, and is contrary to the study undertaken in the operating theatre by Robertson et al. (2014), where a negative correlation between score and glitch count was found. However, they do acknowledge this negative correlation to be much weaker than those found in previous work comparing NTS scores with technical and process errors (Mishra et al., 2009, Robertson et al., 2014). These negative relationships with glitch count and other markers of technical errors or process deviation, have been presumed to be due to the hypothesis

that a team with poorer non-technical skills will make more errors and there will be more glitches. However, glitches can be caused by a number of factors outside of the team. It is possible that the weakness of the negative correlation in Robertson et al. (2014) in contrast to other studies, and the positive relationship found in this study, indicate that an increased glitch count may give the team more opportunity to utilise and demonstrate NTS, and therefore score higher on the Oxford NOTECHS II scale.

3.4.5.2.2 Units per list

No significant relationships were found between scores and volume of work completed per list, and therefore there does not appear to be a clear link between case turnover or efficiency and NTS. This may be biased however by the way the lists are planned and booked. As previously discussed, Oxford NOTECHS II scores were slightly higher for bowel cancer screening procedures, however, these lists are booked with eight rather than ten units, and are therefore not directly comparable with service lists. Cases can be variable in their complexity and therefore a better marker in future studies could something such as the time taken between cases, as this may better represent the efficiency of the team.

3.4.6 Patient outcomes

3.4.6.1 *Pain or discomfort scores*

A weak positive relationship was found between Oxford NOTECHS II scores and discomfort scores, i.e. higher scores were associated with more pain and discomfort. This seems counter-intuitive, as it might be assumed that a better functioning team were better able to anticipate and alleviate the patient's discomfort more effectively. However, a patient's sensitivity to, and the pain they experience, during an endoscopy

procedure is both individual and multifactorial in its aetiology. Rather than the NTS of the team influencing the pain or discomfort experienced, it is possible that a patient with a more pain and the challenge this presents, requires the team to demonstrate better NTS behaviours and thus they achieved higher Oxford NOTECHS II scores in these more complex cases.

3.4.6.2 Patient satisfaction results

In general, patients' satisfaction with their experience in the endoscopy department was good, with 99.3% finding their endoscopy procedure "acceptable" or "acceptable but uncomfortable". However, responses to just two questions on the patient satisfaction questionnaire were shown to be influenced by Oxford NOTECHS II scores.

3.4.6.2.1 Question 9: "Did you have the opportunity to discuss the procedure and any concerns you had?"

Nursing sub-team L&M, SA and total scores were weak predictors of a negative "No" response to this question. This indicates that higher Oxford NOTECHS II scores were associated with patients feeling they had less opportunity to discuss their concerns. This seems counter-intuitive, as you might predict that improved NTS, such as communication and situation awareness, would make staff more sensitive to patients concerns and more receptive to their questions. However, effect sizes were very small and it is difficult to interpret the significance or causality of this relationship.

3.4.6.2.2 Question 18: "Are there any ways the service could be improved?"

Endoscopist sub-team T&C was a weak predictor of a positive "No" response. This indicates that higher Oxford NOTECHS II scores for this area were associated with better patient satisfaction with the service (i.e. they did not feel the service could be improved).

This relationship seems more likely, as it is sensible that a patient exposed to an Endoscopist with better teamwork skills is more content with the service as a whole. A relationship between NTS and patient satisfaction would be supported by previous studies that show that patients rank clinician's personal skills, such as communication, highly when asked what aspects of care are most important to them (Tierney et al., 2016, Yacavone et al., 2001). However, considering that only one component of Endocopist sub-team scores was shown to be related to the questionnaire response and effect size was very small, it is again difficult to interpret the significance of this relationship.

3.4.7 Sample size

The sample size estimate was based on information from a study undertaken in the operating theatre and the outcome measure "procedure completion". This outcome measure was chosen as it was applicable to all cases, was clear and easy to measure and had an audit target ($\geq$90% of procedures should be complete). This selection was difficult to make as no existing information was available for relationships between procedure outcomes and NTS in this area. The overall procedure completion rate found proved greater than the audit target, and thus what was expected. If the sample size had been estimated based on this increased rate of completeness (96%) it would have been much greater and thus this study could be underpowered. However, with no pre-existing information on which procedure outcomes might be related to the NTS of the team, there was not another marker which stood out to be superior, and it was never certain that any of the outcomes would be directly related to the NTS of the team. Where no relationship was found between NTS and an outcome measure, it is possible that the study was underpowered and therefore that observing a greater number of cases may provide clarity. However, due to the small variation in Oxford NOTECHS II

scores, clear relationships may be difficult to prove. This is despite using the expanded scoring range of 1-8 of the Oxford NOTECHS II, rather than the range 1-4 from the original Oxford NOTECHS assessment tool. Due to the routine nature of the majority of endoscopy cases, higher scores tended to be awarded to more complex cases where staff had more opportunity to demonstrate good NTS. This infers some bias, but it is difficult to ascertain the extent of this and it is unlikely that it could be eliminated in any further work undertaken. Data from this study for the relationship between Oxford NOTECHS II scores and polyp detection rate or endoscope withdrawal time could potentially be used to calculate a sample size estimate for further studies which focus on colonoscopy alone.

3.5   Conclusions

This study has explored the relationships between Oxford NOTECHS II scores in GI endoscopy and a number of procedure and patient outcome measures. Although some hypotheses were made, it was not clear at the study outset what the findings would be.

Although no relationship was found between Oxford NOTECHS II scores and rates of procedure completion or complications, some positive relationships were found with polyp detection and extubation time. Both of these outcomes suggest increased care and attention in the examination of the whole colonic mucosa. This relationship therefore could reflect the need for good individual situation awareness, concentration and the avoidance of interruptions in the Endoscopist, and increased vigilance and the ability to speak up in other team members, to adequately examine the colon and subsequently identify all lesions, however small.

The relationship between items on the safety checklist and NTS score is supported by similar findings in other studies. The NTS of situation awareness, leadership and communication, and a culture where speaking up is encouraged, could all contribute and therefore the link is a logical one to make.

Outcomes of the patient satisfaction questionnaire are not clear. Further work could include an interview study with patients to provide clarification of the role of the NTS of staff on their experience in this area.

The Oxford NOTECHS II tool has proven reliable for use in real time in the endoscopy environment. However, it may be possible to refine this to improve its specificity for this environment. The qualitative interview study with endoscopy staff described in Chapter

4 may provide the necessary information for this by identifying themes with similarities

or indeed differences to those important in the operating theatre.

Chapter 4 A qualitative study to explore the non-technical skills

specific to gastrointestinal endoscopy

4.1   Introduction

4.1.1   Aims

This study aims to establish the non-technical skills behaviours specifically important for

effective team work within an endoscopy unit by interviewing a range of endoscopy staff

members.

4.1.2   Identifying Non-Technical Skills

As introduced in Chapter Two, a number of methods can be used to identify the NTS

specific to an occupation or work environment. These include questioning techniques,

such as interviews or focus groups, with subject matter experts. These have been used

successfully in the development of a number of NTS taxonomies, including the

Anaesthetists Non-Technical Skills (ANTS), the Non-Technical Skills for Surgeons

(NOTSS), the Oxford NOTECHS, the Scrub Practitioners List of Non-Technical Skills

(SPLINTS) and the Anaesthetic Non-technical Skills for Anaesthetic Practitioners (ANTS-

AP) tools (Fletcher et al., 2004, Yule et al., 2006b, Mishra et al., 2009, Mitchell et al.,

2011, Rutherford et al., 2015c). Cognitive Task Analysis (CTA) has been used to guide

these processes. CTA encompasses a number of methods which aim to "elicit, explain

and represent the mental processes involved in performing a task" (Klein and Militello,

2001). The methods most commonly used in this field are Critical Decision Method

(CDM) and Critical Incident Technique (CIT). These both require a subject matter expert

to recall an incident or experience and explore the cues and judgments involved in

problem solving, decision making and actions undertaken. The role of the interviewer is to facilitate the recall of events and to use probe questions to elicit specific information pertaining to the cognitive processes involved (Hoffman et al., 1998, Klein and Militello, 2001).

The type of interview best suited to CDM is semi-structured. This provides the interviewer with a clear list of points to be addressed, but allows flexibility to adapt the timing and wording of questions and the interviewee to develop their ideas more widely (Hoffman et al., 1998, Denscombe, 2014). Focus groups can provide a rich source of information, but can be difficult to control and due to work patterns and work load, are difficult to organise with healthcare staff. Individual interviews also ensure confidentiality of responses and therefore interviewees are likely to feel more secure and thus provide a more honest account of events (Denscombe, 2014).

4.1.3   Thematic Analysis

Thematic analysis (TA) is a method which identifies themes and patterns across a qualitative dataset (Braun and Clarke, 2013). Thematic coding is central to most qualitative analysis processes, however TA has only been described and recognised as a method in its own right quite recently (Braun and Clarke, 2006). It is flexible in terms of the type of data it can be applied to and is accessible, using a simple to follow six-step process (see table 4.1), making it particularly suitable for researchers with moderate existing qualitative experience (Braun and Clarke, 2013).

Phase	Description of the process
1. Familiarizing yourself with your data:	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

Table 4.1: Phases of thematic analysis (Braun and Clarke, 2006)

4.2 Study design

4.2.1 Ethical approval

Ethical approval was granted by the NHS Health Research Authority, South West – Plymouth and Cornwall, Regional Ethics Committee (Ref 16/SW/0014) and the Plymouth University, Faculty of Health & Human Sciences, Peninsula Schools of Medicine & Dentistry, Faculty Research Ethics Committee (Ref 15/16-546).

4.2.2 The interviews

Semi-structured interviews were undertaken with a range of Endoscopy staff members to explore the non-technical skills behaviours most important in this setting. A combination of checklists and critical incident techniques were used to guide questioning. The interview schedule was designed to allow the interviewee to discuss the details of a challenging case, with flexible probe questions to facilitate exploring the cognitive processes and specific behaviours involved (see appendix 9).

The interviews were individual and took place in a quiet room within the hospital, following informed written consent. They were hosted by the MD student (CH), lasted approximately 30 minutes and were audio-recorded. Each staff member was allocated a study number for pseudo-anonymisation of data. The interviews were transcribed verbatim by the MD student during the study period. Any identifying features or comments were anonymised. Information collected is held securely at Plymouth Hospitals NHS Trust under the provisions of the Data Protection Act (1998).

Staff members were not expected to answer any questions they did not feel comfortable with. The details of incidents discussed remained confidential, as the analysis focussed on the non-technical skills and behaviours that were important within the situation,

rather than the details of the situation itself. A policy was in place regarding termination of interviews if a staff member demonstrated any signs of being upset, including referral to Occupational Health (Staff Health & Wellbeing), but no such concerns arose. Similarly, no concerns arose regarding bullying or harassment.

Prior to commencing staff interviews, the MD student (CH) undertook four practice interviews with surgical colleagues. This was in order to familiarise herself with the interview schedule and troubleshoot any issues that might arise. These mock interviews were not recorded or transcribed.

4.2.3 Sample selection

Other similar studies have interviewed a range of "expert" individuals from 9 to 29 (Mishra et al., 2009, Fletcher et al., 2004, Yule et al., 2006b). It is difficult to predict the sample number required to achieve data saturation (Liamputtong, 2012). Following a purposive sampling technique to ensure data was obtained from all grades of endoscopy staff, it was planned to interview a minimum of two members of staff from each of the following categories (minimum 10 individuals):

- Health care assistant (Band 2-3)

- Assistant practitioner (Band 4)

- Staff nurse (Band 5)

- Sister / Clinical nurse specialist (Band 6-8)

- Endoscopist (Medical & Surgical)

In practice sixteen interviews were undertaken with a minimum of two members of staff from each category. A subjective assessment of data saturation (the point where further sampling will not expose any more information) was made by the MD student

undertaking the interviews (Liamputtong, 2012). This was possible as transcription, initial data immersion and analysis commenced during the interview process. Thus, when thematic coding did not reveal any new codes, data saturation was considered achieved, and no further interviews were undertaken.

4.2.4   Recruitment and consent

Volunteers were recruited by an open invitation to take part after explanation of the process. Staff members who volunteered to take part in semi-structured interviews were given full written information regarding the process (see appendix 8). If they agreed to take part, written consent was obtained (see appendix 8). Confidentiality was emphasised to ensure the trust of the participants and reduce bias.

4.2.5   Coding and analysis

Qualitative analysis was undertaken using a combination of traditional "manual" coding and the computer software programme NVivo Pro 11.0 for Windows (2015b).

The "thematic analysis" technique outlined in section 4.1.3 was used to extract, code and analyse the data (Braun and Clarke, 2006, Braun and Clarke, 2014). The interviews were transcribed verbatim by the MD student (CH) (see appendix 10). The transcripts were reviewed extensively and following the steps in table 4.1, data were coded into themes or categories. An independent advisor (JG) with experience in qualitative research, and more specifically in Thematic Analysis, reviewed the data and provided a second opinion on coding and themes. These themes were discussed over the course of two one- to two-hour meetings.

4.2.6   Additional data

In addition to the interview data, free text comments from the patient satisfaction questionnaires and notes taken during the observations were reviewed to identify additional codes and themes.

4.3   Results

4.3.1   The interviews

Sixteen semi-structured interviews took place during March to May 2017. The mean endoscopy experience of staff interviewed was 9.5 years (range 1-24), 11 (68.8%) staff members were female and 3 (18.8%) worked across the two hospital sites. As planned, a minimum of two staff members from each role / grade were interviewed (see table 4.2). One interview failed to record and thus could not be transcribed; in this case the interviewer (CH) realised the problem immediately after the interview and recorded notes of the discussion from memory to contribute to the analysis.

Staff Role	Number
Consultant Endoscopist	5
Senior Nurse (Band 6-8)	4
Staff Nurse (Band 5)	3
Assistant Practitioner (Band 4)	2
Health Care Assistant (Band 2-3)	2
Total	*16*

Table 4.2: Roles of interviewees

4.3.2   Coding the data and establishing themes

The interviews were transcribed by the MD student (CH). Although this was a time-consuming activity, it provided the opportunity to repeatedly review the interviews and thus allowed the student to become immersed in the data. Initial notes and thoughts were recorded in a journal during this time. Following this, formal coding was undertaken, with subsequent organisation of codes into themes. During coding the MD student aimed to keep the main question in focus: "what non-technical skills are important for gastrointestinal endoscopy?". This was especially important as the interviews provided a rich source of information about both this and other aspects of

working in an endoscopy unit. The themes which emerged from the data are described in table 4.3.

Theme	Description
Leadership	The team leader and the leadership skills of the team
Working together as team	Skills and behaviours that facilitate teamwork
Situation awareness	Knowledge and understanding of what is going on around you
Making decisions	Skills and behaviours that facilitate making decisions based on the clinical situation
The patient	How the team interact with and around the patient
Communication	The role of communication skills and behaviours in endoscopy

Table 4.3: Themes relating to non-technical skills in gastrointestinal endoscopy

This analysis will define and explain the themes extracted from the data which answer the research question above, as well as expanding on some areas which, although are not NTS, play a role in influencing the way that the team performs in endoscopy as a unique environment.

4.3.3 What non-technical skills are important in gastrointestinal endoscopy?

4.3.3.1 Leadership – the "leader" and leadership skills

There was a consensus amongst the interviewees that the Endoscopist is the team "leader", in the sense that they are in charge and ultimately responsible for the patient and the procedure.

> Int012: *The clinician was the leader definitely.*

> Int014: *Decision making was done by (the) endoscopist who was in leadership role.*

> Int001: *leadership role for that was definitely the colonoscopist*

This appears to be based on their status and medical training, or in the case of a Nurse Endoscopist their training to perform the procedure. This is despite the fact that at times

the procedure can absorb almost all their attention, making it harder for the Endoscopist to maintain a good overview of everything else in the room. In emergency or challenging situations, for example managing bleeding or a technical therapeutic intervention, this often results in the need to multi-task, especially if the rest of the team are inexperienced.

> *Int007: I'm aware in that environment that I should be focussing on the patient, screen and endoscopy and sort of being intuitively asking for things and being given the correct bits of kit, but in that environment you're doing much more looking around, taking your eye off the patient and having to be responsible for management of the kit and operation of the kit as well.*

Although the Endoscopist is labelled as the leader, leadership behaviours are relevant to the whole team. These behaviours may differ between members of the team with some more important for the Endoscopist and some more important for the nursing staff.

Good leadership behaviours in the Endoscopist include the ability to motivate the team; encouraging them and empowering them to speak up, especially the more junior members.

> *Int004: they're very much into empowering the nurses to say "you're not in the caecum yet, don't try to kid anybody", and you know "maybe you've put too much air in, maybe?"*

It is important to take charge when necessary, for example in an emergency, which may require a change in communication style to more essential or direct communication or simple instructions.

> *Int013: my approach to that is "look, I'll talk you through step by step, you don't need to know beforehand, but I know what to do and I know how to tell you what to do so don't worry, I've got responsibility and I'll talk you though it".*

> *Int013: I think you need to be mat- you need to be very cool with your instructions; you need to be very matter of fact, err and very focussed,*

They also need to listen to the team and demonstrate self-awareness; avoiding being intimidating or frightening, or taking their frustration out on other team members.

> *Int002: sometimes the clinicians get frustrated; they'll say things like "I want someone in here who knows what they're doing". But again that's their frustration. I'm not saying that's right, but...*

> *Int007: potentially would have been a situation where you're becoming more and more rattled, and then you're going to start to become terse and monosyllabic with the other team members, you know, making it a bit obvious that you're annoyed with the situation*

> *Int003: there are endoscopists that are perhaps seen as intimidating, or just generally unpleasant*

Nursing staff often have the responsibility of coordinating work. This can include the running of the routine list and unexpected tasks such as arranging investigations or procedures.

> *Int006: I think you get more confident with coordinating and having to interact with different people, and you are the point of call, so you are, you're not the solely responsible person, but you are the person that people come to when they have issues and problems.*

> *Int011: you've got a lot of people that you need to communicate with in the room, you have to talk to the coordinator up here, and they're dealing with everything that's going on up here, and you're trying to see if there's extra staff to bring bits of kit down to you, or are you going to send extra staff back up to collect it when you need all hands on deck down there?*

Nursing staff should speak up and intervene if there have concerns or questions. This demonstrates good leadership behaviour on their part but requires an atmosphere where they feel listened to and their opinion valued to be done successfully.

> *Int001: It's just having the confidence to say "I'm not happy", you know, "I'm new to it, I'm not happy to do it", 'cause I think the colonoscopists would prefer that to just carrying on and doing it and not...*

This can be facilitated by the protocols and procedures in place for dealing with certain aspects of the case, such as ensuring the team brief is undertaken or specimens are labelled correctly.

> *Int012: So that's a way of managing it, it's stopping and saying "hang on a minute we haven't done the WHO", or "we haven't done this, something's missed, we've missed something here" or "hang on a minute we've got to check these biopsies before we do the next patient" and "we've got to get these out of here before we start the next one." You know it could be anything,*

4.3.3.2 Working together as a team

Many tasks in endoscopy rely on the team working together.

> *Int004: having everyone working together should be greater than a single person on their own.*

> *Int005: it was just a really good way that everyone came together in the team*

This also includes physical tasks such as using equipment which requires two operators, for example biopsy forceps and snares, for which the endoscopist and assisting nurse are reliant on each other for a successful procedure.

> *Int009: even if you've got the most experienced endoscopist, you know, a sizeable proportion of taking those polyps off is done by your endoscopy nurse. You know, they are your hands.*

Role clarity is important for the team to function well, as is trust in each other to perform roles competently. There is a responsibility for team members to speak up and be open about their abilities and experience, but also a responsibility from other team members to support more junior staff.

> *Int015: I always make it very clear at the beginning who's doing what role for that procedure, so I find that that always helps, and if you stay within that role as best you can*

Int006: I think it has to be quite highly organised to work well. And I think people need to know their job roles very very well to be able to work together

Int001: you need to have trust in the person that's with the patient, because you're not always watching the screen, you're not always seeing what's going on with the obs and whatever.

Int009: you want to think you know your endoscopy assistant has all the equipment to hand and is able to respond you know, if there's a bleed or you know, they need confidence in their assistance.

It is also necessary to be able to trust and rely on the extended team to have re-stocked or set up equipment adequately and to highlight issues or problems, particularly in the context of frequent handovers. If tasks haven't been completed as they should be by others this is a potential source of conflict or frustration, and at worst a patient safety issue.

Int011: certain bits of equipment that we didn't have down there. Usually we stock up, and again communicating when we come back up after we've done a case in ERCP of what we need to take back down there…we should have things in there, but again people use it, come upstairs, forget to replenish it, so it's not a case of...

It is important for the team to support and appreciate each other and to value the opinions and contributions of each member.

Int002: the staff nurse I was working with was very good, she supported me, she didn't interfere with what I was doing, she was on standby

Int016: then the next day when the, this was when we knew it was passed on and the sisters come and "oh the people had come and said something nice, and said that you did well yesterday" and doctor brought us some little treats to say thank you

Int002: the clinician was very good, he helped talking me through, he was obviously aware it was the first time I'd done anything like. I'd done a couple but not something as extensive as this, so I felt I had the support, which made me feel more confident

> *Int011*: *If you've got supportive, a supportive environment and an environment that you're not made to feel if you don't know something or you make a mistake*

Effective listening and communication are essential team skills, especially in the context of an awake patient, as the team must do these successfully without causing any alarm or concern.

> *Int009*: *the ability to have good communication skills, which is important for everywhere that we work, but to be able to respond appropriately in a clinical environment where you've got a patient there*

> *Int012*: *always communication. Definitely. I think it is the most key element to anything… Effective communication. Clear communication between every single person in the environment that you're working in. It's got to be.*

> *Int011*: *Don't listen to everyone in the room, listen to the person who's asking for the equipment that they need and is at the table.*

> *Int011*: *if I hadn't have thought of something someone else in the team was pre-empting and showing me "I've got this on the side just in case you need it..." or whatever. So I think in that situation it was probably a good example, good communication, team working. Yeh.*

It is understandable that relationships between individual team members will vary.

> *Int001*: *there are some people that work better together, than others, you know.*

> *Int009*: *Different personalities I think, some endoscopists will always work better with some nurses. We all do within teams, there are always going to be some people that you work better with,*

> *Int011*: *Sometimes it's the endoscopist. I can look at the list and think "I'm going to have a good day" or maybe I think "it may not to be such a good day!!"*

However, it is an important skill to be able to ignore personal differences and get on with job in hand.

> *Int008*: *If the relationship is icy or not great in times of crisis, you know it will still work*

> *Int016: I don't let things get to me as much so say an incident's happened where I might have felt a bit stressed or you think "aah, things are a little bit unfair there" I would just let it, once it's done it's done for me, I won't let it carry on with my rest of my day, so the next thing you know I'm in with a different patient and it's*

4.3.3.3 Situation awareness – knowing and understanding what's going on around you

As with other areas in healthcare, situation awareness is an important non-technical skill in endoscopy.

Staff gather information from a number of different sources before and during each procedure. At the beginning of a list (or after staff changeover) it is helpful to establish the skill mix and ability of the team, including their confidence levels and comfort zone.

> *Int001: it's really important that everybody knows what everybody else's level of, you know, expertise is*

> *Int007: "is anyone familiar with the use of banding?" "Yes, I've used banding before." "OK, so you can do that." In similar situations I would say "Do you know how to use the gold probe machine? Do you know how to use clips?" and if there are blank faces then that would probably change the direction of travel.*

Information specific to the patient and procedure being undertaken should be obtained from the patient's notes and the patient themselves, and discussed at the team brief.

> *Int008: going through the patient's history and picking out essentials if they're recorded is essential, and also whoever's doing the procedure you have to read the notes*

During the procedure information can be gathered via team communication and non-verbal cues such as the screen, scope guide and observations machine.

> *Int003: so the use of scope guide equipment and things made, meant it was made obvious to everyone the configuration of this bowel was not usual*

Int002: you see what you are going to be doing on the way in, so you got... You look at the screen and think there's a polyp, it's going to need lifting, we're going to need possibly...

The information gathered needs to be interpreted and understood in order to be useful. This may require previous knowledge or experience to understand the implications of a decision, as well as judgement of what is appropriate, for example whether to interrupt an endoscopist during a procedure or respond to a ringing telephone or knock at the door.

Int004: the implications of stopping and having to repeat the test in some other form... So even if you have a CTC, they're still going to have to go through the whole bowel prep again

Int007: But actually it would have been a more difficult situation, there would have been a lot of blood around and it would have been more difficult than doing it at ten in the morning

Int002: you can't necessarily interrupt the clinician when they're in their (?) 'cause obviously they're concentrating and that, so again it's knowing when to speak and when not to speak.

Int002: The same as if the phone rings, if you're in the middle obviously of a really... you know, you just ignore it.

Int006: when I'm working in a room sometimes I'll get people coming in going "erm... 'X'... dedededeh." And I'm like "no, I'm clinical, I'm in the room I'm not sorting any issues out, you'll have to go..." Unless it's an emergency, which is very different.

Int006: the same goes for people disrupting the doctors when they're scoping as well, unless it's a dire emergency, I think that's not helpful.

Int012: you can be in a situation where you're needing to communicate something and that person isn't necessarily ready to receive the information from you.

For each procedure undertaken in endoscopy, the team need to have a shared mental model of the plan for the case and any changes to the plan. This includes a shared understanding of the role that each team member is contributing. The team brief

facilitates this by providing the opportunity to discuss the details of the case and particular requirements or issues involved and clarify the contributions of individual team members.

> *Int002: when we do the WHO, erm, we're given instructions for what we're doing in the procedure, and in this case obviously we had erm knowledge of what we would be doing, so you make sure you're prepared beforehand, you've got everything to hand,*

> *Int009: you've got a patient coming in for a double slot EMR, for the endoscopist to actually say you know, "this is what we've got, this is what I'm likely to need", so you've given them a heads up beforehand.*

> *Int003: so all of the team were kind of aware that the end goal was to get all the way round. So everyone could kind of see what we were trying to achieve and working together to help the patient do that.*

> *Int005: it was a very high importance, high of importance case, that there was a stent placed, erm and so it was really down to... That's what was so great about working as a team, because we knew how important, the fact that they'd had sedation, we needed to get it done, you know...*

In endoscopy, there are often times when staff must switch between states of attention. For example, it's often necessary to be having an informal conversation with a patient (as this can distract them from the procedure and keep them at ease), but if something with the procedure changes quickly the team member must notice this and respond accordingly.

> *Int009: you want to think you know your endoscopy assistant has all the equipment to hand and is able to respond you know, if there's a bleed or you know, they need confidence in their assistance.*

This requires the team to anticipate what might happen next, from having equipment ready to planning for potential complications or adverse events.

> *Int003: there is the element of begin able to predict, or pre-empt what might then happen next, so I think that means that procedures run more smoothly*

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> *because perhaps the assisting nurse is anticipating what the endoscopist might require and that makes it a much smoother process.*

> *Int002: I would guess myself what size snare, so I'd have perhaps that snare ready and obviously the others would be around there anyway*

> *Int011: I was asking the staff behind me to get things out that I thought might be needed. So I was saying, you know, "go to the cupboard and get", "make sure we've got haemospray", "make sure we've got, you know, some adrenaline and a needle" and things like that.*

Staff need to maintain their awareness during a procedure, paying attention to what is going on.

> *Int002: So it's making sure you're actually stood there and not wandering off. And also making sure you are actually focussed and stood there for the whole procedure. You know, from the start so that you're not just turned around...*

> *Int002: to be told this is what we're doing and be "oh my god I'm not prepared for this"*

But also realise that it is possible to become focussed on a task, and it is important to update the team of changes they may not have noticed, and to check key information or check equipment is set up correctly to ensure patient safety. This relies on dialogue between staff and a culture where everyone can speak up.

> *Int002: even though we've done the WHO, they might have said they've got metal work but you still double check*

> *Int003: it always seems to run more smoothly when the assisting nurse verbalises what they're doing. Often the endoscopist is obviously looking straight ahead at the screen, and sometimes if they've asked them to do something I find that there is a better response when the assisting nurse has confirmed the instruction.*

4.3.3.4 Decision making

The interviews revealed that the majority of decisions regarding the procedure are made by the endoscopist. However, the Nursing team are often more involved with decisions

regarding extra analgesia or if the organisation of other investigations or procedures needs to occur. Examples where input from the whole team occurs include where a problem is discussed or worked through openly. The skills of decision making often require a number of steps. The first step involves generating options. Evidence of this includes talking through, thinking out loud, discussing options, and taking suggestions from other team members.

> *Int001: we did talk about maybe the patient needed to go to surgery to get the scope removed… we were talking about maybe organising a theatre and things like that as well,*

> *Int016: Yeh so the doctor and the nurse endoscopist were kind of communicating together on this "this is what we should do"*

> *Int004: the nurses suggest sometimes more sedation that the doctor hasn't thought of*

> *Int003: or whether they're thinking out loud, and again coming from that training experience I know that thinking out loud is really helpful to you as an endoscopist because you can verbalise or rationalise what you're doing*

Some interviewees felt a problem-solving approach was key, particularly in dealing with a challenging or unknown situation. This approach draws on previous experience and knowledge, using the information available, and staying cool, calm and focussed.

> *Int011: So I was thinking "what will I need?" from past experiences you know, where I've worked before, just making sure we had bits we might have needed*

> *Int013: "Okay, put the scope down, we're going to use the scope later, put the lights on, because we actually don't need the lights dimmed for this, we're going to watch what we're doing... we're going to see what we're going to do and the bit of equipment" and then we were just working through it.*

> *Int013: you need to have a problem-solving approach and you need to have confidence,*

Weighing up the evidence shows a logical approach, based on the known facts, and projecting ahead to what the potential outcome of different options might be.

> *Int008: You know, I told her she was short of breath, she had you know all kind of problems. I said you know "giving you sedation is not a sensible thing to do with you know", you know she was short of breath, significantly, "and that I was going to arrange a CT colon for you".*

> *Int013: But then we've got a situation where, the patient was still reasonably ok, it had taken quite a long time to work out the basket and we had two choices there: 1) was we could either leave it there or 2) was actually we complete the procedure so we decided "ok, rather than just leave a potentially blocked bile duct with some stone debris around it we'll complete the procedure",*

4.3.3.5 Managing stress

Stress appears to be generated from a number of sources within an endoscopy unit. Recognising stress and anxiety in one's self and others and then managing that stress is an important non-technical skill.

Inexperience can result in performance anxiety and the fear of criticism or not doing the right thing. This can be exacerbated by working with people that are intimidating or are either not aware or don't acknowledge that a team member is inexperienced.

> *Int002: you're nervous to make sure you're actually capable of doing the job that you've got to do and, that's more a pressure thing, it's that thing "I don't want to mess up, what if I drop something...."*

> *Int002: and I know sometimes perhaps people are a little bit nervous or feel intimidated by the clinician. Especially if they're new, and sometimes the clinicians do get a bit "rrr", that's not them getting cross with you, they're just getting a bit frustrated, they're getting cross with the procedure...*

The capacity to be "thick skinned" seems to convey resilience and the ability to cope with negativity.

Int007: I'm aware in that environment that I should be focussing on the patient, screen and endoscopy and sort of being intuitively asking for things and being given the correct bits of kit, but in that environment you're doing much more looking around, taking your eye off the patient and having to be responsible for management of the kit and operation of the kit as well.

Int002: But sometimes the clinicians get frustrated, they'll say things like "I want someone in here who knows what they're doing". But again that's their frustration. I'm not saying that's right, but

Recognition and acknowledgement that humans do not always perform at 100% and that this can be influenced by external factors is an important skill. Recognising this in oneself and communicating it to the team shows insight and professionalism and allows the team to adapt accordingly.

Int002: everyone has a bad day, something happens at home personally, if someone says… you know I normally say "I'm not feeling too great today" and let them know. Some people don't. That's fine, but you've got to take that into account with people, not everybody's... especially if you know someone well, I'll think, well actually they're a bit out of sorts today. You've just got to take that into consideration and think, "well ok, that's the way it is". And the same with clinicians, they might have been up all night in surgery, you just don't know do you? They're not necessarily going to come and say "I've had a really bad night, blah blah blah" or "I've got a patient that's dying, I'm really worried about them".

The majority of procedures in endoscopy are straightforward; however, the team always need to be prepared to manage more challenging cases and complications. This often requires an adaptation to the original plan or a change of pace. The ability to cope with this situation appears to be facilitated by experience, being prepared for the unexpected and keeping calm and focussed.

Int013: the key point here is not to rush, the patient's perfectly safe, staff are flapping a bit because the anxiety levels are high, but actually, the key thing in that sense is to settle everyone down "not a worry, we can cope with this" and "but let's get it right" with reading the instructions. So light on, so we can read the instructions

> *Int011: certain people erm, can erm lead a team like that, erm and can erm sort of like, I'm just trying to think of the word, not instil... Can keep the team calm and focussed*

This is more challenging if members of the team are inexperienced, as it applies more stress to the endoscopist or more senior staff. In this situation it is even more important to stay calm and manage one's frustration.

> *Int007: potentially would have been a situation where you're becoming more and more rattled, and then you're going to start to become terse and monosyllabic with the other team members, you know, making it a bit obvious that you're annoyed with the situation.*

> *Int009: it is hard to hide frustration, but that only makes things worse because it's a vicious circle then*

> *Int008: My understanding from feedback from the nursing staff is that some people get more stressed in any given situation. If it's less controlled, it's more likely to become fractious.*

As will be discussed in more detail in the following paragraphs, a unique feature of endoscopy is the "awake patient". This adds a layer of complexity and additional pressure, as the team have to be mindful of this as well as dealing with the problem.

> *Int009: you need to be able to you know, make sure the room stays calm for that patient*

> *Int009: you know to get the information you need from your endoscopist, but in the environment that's still supportive and calm for the patient*

External and environmental factors can also contribute to the stress and pressure staff is under. These include staff shortages, operational pressure, the culture within the unit and within the hospital and healthcare system as a whole.

> *Int012: There's a lot of stress here and I don't think that's addressed a lot in these sort of times, and that's probably the same trust-wide not just here, unique to here, it's everywhere.*

> *Int015: I mean it's quite difficult at the moment with being so stretched, staff-wise, it's quite difficult to do all the processes we normally do and have*

the time and the bodies to do it all. So, you just have to think more I think, and consider everything a bit more because you're doing more than one person's job most of the time. So that's a bit difficult…. we all look a bit more stressed, because we're just a little more on edge, so it just makes the day harder I think,

Int016: And I felt we needed positive after the last couple of days we had, felt like we all, everybody, there was an atmosphere in here, not between staff as in anyone's angry at each other but just the stress levels of how busy it's been… I think the whole unit's morale was quite down and we needed more of a pick me up

Int012: Of course it does. I mean you can't work at this pace for sustained periods of time without people feeling that. And everyone deals with it in different ways don't they, I suppose.

4.3.3.6 The Patient

The "awake patient" separates endoscopy cases from the majority of surgical cases. The team's interaction both with and around the patient is extremely important for effective team function and a successful procedure. This theme encompasses a number of NTS behaviours which are all tied together in their role in looking after the patient, who remains the central focus of any endoscopic procedure.

Interacting with the patient requires empathy and good communication skills. Information needs to be delivered to the patient in a manner they can understand and provide them with all they need, to know what to expect from the procedure.

Int008: you must go to great lengths to try and make the patient understand, and communicate with the patient at a level that you normally wouldn't with a patient in theatre,

Int008: The patients I think find it helpful if things are explained… and by that I mean going briefly though the colonoscopy process, letting them know what to expect.

And if there's a problem too… explaining to the patient why they have pain, you know "it's the gas filling your tummy and stretching the bowel, and if you want to pass wind you can"… If they are watching the screen

and watching the… scope guide, they can see that it's not straight and you can explain to them you know that around this area it's normal, but it may stretch. And I think communication… and with the patient helps a lot.

It is common for patients to be anxious or to have discomfort during an endoscopic procedure. Staff should be able to recognise and understand this, to be able to manage it effectively, for example by providing reassurance or chatting to them to distract from the procedure.

<u>Int003</u>: *have a relaxed team, involve the patient in conversation, and I think that's a really good way of running a smooth endoscopy list*

<u>Int004</u>: *Chatting to the patient. The amount of times I've heard about strictly come dancing*

((both laugh)) dancing on ice, all these things… it's like, it's sort of trying to take your mind off.

<u>Int016</u>: *I was trying to calm them, you could see at this point he was in so much pain he was trying to climb off the trolley*

<u>Int005</u>: *obviously we were all quite concerned that the patient was distressed.*

Each patient will approach and cope with an endoscopic procedure differently. The ability to understand each patient and what support they require is important to master.

<u>Int001</u>: *Being sure that you treat each patient individually... You know what to say to them, if they don't want to talk, you know you need to be quiet and don't speak… different individuals want different things don't they… It's just being aware of it and making sure you get the right balance.*

<u>Int003</u>: *it's important to adjust or alter your manner or your communication style (to) the patient that you've got in the room*

Whilst communicating with and reassuring the patient, staff also needs to maintain an awareness of what is going on with the procedure and react appropriately as required.

Sometimes information needs to be withheld from the patient during a procedure, for example if a cancer is discovered or a difficult complication arises. This is to prevent

causing the patient distress whilst the procedure is ongoing. During this time, the team need to maintain effective communication amongst themselves (expanded on in the following section), whilst protecting the patient from this potential upset. When the procedure is complete and the patient has recovered safely from the procedure and any sedation used, the team need to inform them of the results and outcome in an appropriate way and place. This should ideally occur in a quiet room, with a relative or other close contact, and often with the support of another team member such as a cancer nurse specialist or screening practitioner.

> *Int003: what I didn't want to do was mid-procedure make it overt that he would need to be coming back for a 3rd investigation, because I wanted to do that at a point where he was not in a compromised position, where I could explain it better*

> *Int009: the last thing you want is for them to be able to appreciate that it's not going as well as it could be, or there's something bleeding, or...*

> *Int003: after the procedure when we come to counsel them and give them their results, erm you tend to find that they say "I did think that something was going on", and it's almost like a gentle preparation for a conversation you're going to have.*

As touched on above, interacting with the rest of the team effectively around the patient can be challenging. This often needs to be done whilst withholding certain information from the patient. It therefore relies, not just on good verbal communication, but effective non-verbal communication and interpretation of non-verbal cues such as the screen or scope guide. This is all whilst maintaining calm and focus on the task which could be challenging or complicated.

> *Int001: You have to be mindful that there is a patient there, and that they're able to listen and hear what you're talking about and what you're doing*

> *Int003: it's very difficult when somebody is alert and orientated and they're watching and engaging with the screen*

> *Int009: the ability to have good communication skills, which is important for everywhere that we work, but to be able to respond appropriately in a clinical environment where you've got a patient there*

> *Int009: you know to get the information you need from your endoscopist, but in the environment that's still supportive and calm for the patient*

> *Int012: without sort of attracting too much attention to the situation, because of the patient being in a semi-awake sedated state. So you're trying to keep an air of decorum and professionalism for the patient whilst knowing that all of this has gone on.*

> *Int001: You have conversations, you know like cancers are found and whatever and the patient doesn't actually, if they're not looking at the screen, has no idea what's going on until you give them the results*

4.3.3.7 Communication skills

It is apparent that communication skills are interwoven with all the other NTS in endoscopy discussed above. However, as communication was such a recurrent theme in the interviews, it seems pertinent to expand on this.

4.3.3.7.1 Team Communication

Verbal communication amongst team members needs to be clear. It can affect morale, encouraging or motivating the team and ensures they have a shared goal.

> *Int010: the primary thing I think is relying on clear communication, and sort of signposting.*

> *Int002: the important bit like I said really is the communication from the very early stages of the procedure… it's letting people know what's going on, not just assuming that people know*

> *Int008: I think if you get the communication and relationship between the endoscopist and nurses right a lot of things will go right, you know.*

The team regularly need to check or confirm information and actions, usually for safety reasons for example, ensuring the diathermy machine is set up correctly or checking the patient isn't taking anticoagulants before a therapeutic procedure is undertaken.

> *Int002: I always make sure that I say to the clinician, "is this what you want, you know, definitely what you want?" You know, using diathermy and stuff like that, making sure you say "it's on this setting".*

> *Int011: I was asking the staff behind me to get things out that I thought might be needed. So I was saying, you know, "go to the cupboard and get", "make sure we've got haemospray", "make sure we've got, you know, some adrenaline and a needle" and things like that.*

When procedures are challenging or when managing a complication, the nature of communication often changes to a more direct "essentials only" form. This is often necessary to deliver specific information effectively for example talking another team member through the steps of a procedure as it is done or giving instructions.

> *Int010: my vocabulary changes to a more shortened form of things. Rather than a discussed one.*

> *Int008: "open the packet, take this out, put this on there", and yes, so skills, verbal skills have to change*

Non-verbal cues can come from a number of sources which team members need to be aware of, for example, the screen, the scope guide and the observations machine. Each team member must interpret this information and come to the same conclusion or to alert another team member who isn't aware of such information is required. As discussed in section 4.3.3.6 non-verbal or altered communication is often required to transfer essential information without alerting the patient to it as this may not be of benefit to them mid-invasive procedure.

> *Int003: No, so erm that was all non-verbal… There were a few sort of glances, at each other, erm as if to sort of non-verbally query "why are you carrying on if we can't see anything?"*

> *Int008: there was no verbal communication, but the body language and the non-verbal communication from the nurses, particularly the nurse who was sitting with the patient you know. And I could tell from the eye glances that, "look we're struggling here, you have to do something, you may need to do something", yeh, so you can tell.*

4.3.3.7.2 Communication with the patient

Clarity is again important when communicating with the patient, as it is important they understand what to expect from the endoscopy procedure, and are often required to cooperate with manoeuvres such as changing position or having physical pressure applied to their abdomen.

> *Int003: (what) I like to try and do personally is make it that one patient is speaking to the patient, sorry one person is speaking to the patient at a time.*

> *Int002: Obviously communicating with the patient. Making sure the patient is included, he was aware what to expect anyway and it's always explained to them erm.*

> *Int008: The patients I think find it helpful if things are explained. Umm yeh, if they have things explained to them at the beginning it makes life so much easier for everyone. For the patient, and by that I mean going briefly though the colonoscopy process, letting them know what to expect*

As discussed in section 4.3.3.6 delivery of investigation results and bad news should be done sensitively with the appropriate timing, environment and people present. Discretion is often needed during and immediately after the procedure itself to allow this to be done successfully.

> *Int001: the consultant was going to speak to the patient when they were being discharged and explained that there was a problem, because we hadn't completed what we needed to do. And that they would need to come back and that they would need surgery*

> *Int003: what I didn't want to do was mid-procedure make it overt that he would need to be coming back for a 3rd investigation, because I wanted to do that at a point where he was not in a compromised position, where I could explain it better.*

Communication strategies can also be used to facilitate how the patient copes with the procedure, particularly if it is causing them discomfort. This includes reassuring them when required as well as chatting to distract them from the procedure and the

discomfort that might be involved. This is all whilst maintaining an overview of the situation and the ability to react to changes or issues if required.

> *Int004: it is sort of trying to take their mind off things. Clearly you can't always do that but I think it does have an impact*

> *Int008: a tense patient has a tense colon and it goes into spasm, and when you relax the patient I think it does help*

> *Int012: The beginning of the procedure was quite uncomfortable for the patient, so there was a lot of calling out and reassurance having to be given to the patient, extra sedation was given to the patient, patient did settle somewhat.*

4.3.4   Additional data

Thematic coding of observer notes and patient satisfaction free text comments did not uncover any additional themes.

Coding of data from the observer's notes contributed to all the themes discussed above.

Coding of data from patient satisfaction free-text comments contributed to the themes of 'communication', 'decision making', 'situation awareness', 'working together as a team' and 'the patient'. More specifically, data supporting the theme 'communication' related to communication with the patient, particularly in the context of reassuring them and managing their expectations. Data supporting the theme 'the patient' related to empathy and professionalism, and 'situation awareness' related to the vigilance of staff during the procedure.

4.4   Discussion

The cognitive skills of situation awareness and decision making are common to the existing NTS assessment tools published for use in the operating theatre. In the endoscopy literature (as reviewed in Chapter 2), situation awareness was the commonest NTS identified (Bourikas et al., 2013, Grover et al., 2016, Hawkes and McDonald, 2014, Haycock et al., 2012, Haycock et al., 2010, Hewett et al., 2010, Matharoo et al., 2014a, Scaffidi et al., 2016). Similarly, decision making was also a common theme in the literature reviewed, and the commonest theme for learning points in the reflective diaries of endoscopists analysed by Hawkes and McDonald (Grover et al., 2016, Hawkes and McDonald, 2014, Haycock et al., 2010, Hewett et al., 2010, Matharoo et al., 2014a, Scaffidi et al., 2016). The data revealed that the ability to respond to a dynamic situation and use a problem-solving approach is particularly important in this setting, especially if an unknown or unexpected situation occurs.

The role of interpersonal skills such as leadership, professionalism, teamwork and communication are supported by the existing literature (Grover et al., 2016, Hawkes and McDonald, 2014, Haycock et al., 2010, Hewett et al., 2010, Matharoo et al., 2014a, Scaffidi et al., 2016). As in other areas of healthcare teams are often changing and it is common to work within teams where members lack familiarity (Haycock et al., 2011). The interviews exposed the necessity for good leadership in such situations and the increased pressure and responsibility that can go in hand with that. Stress in all team members can be induced or exacerbated by both external and internal pressures or by acute stressors including relationships with others and the effect of others behaviours (Flin et al., 2008). An ability to recognise and manage this, and cope with unexpected events or challenges is thus extremely important (Hewett et al., 2010). Resilience and

the ability to cope in adverse or challenging situations is a strong theme. This implies that teams and individuals who develop these skills would be safer and more effective, however, it seems unrealistic that these could fully compensate for staff shortages or an inappropriate mix of technical skills.

The emergence of the theme "the patient" is new compared to existing literature in endoscopy and other areas of healthcare. Although not a non-technical skill in itself, the influence of the patient in the way the team behave was sufficiently strong that it was felt necessary to include this as a separate theme. Even if this is considered under the theme of "communication", the specific sub-themes of communicating with and around the patient have not been previously published in the endoscopy literature, or indeed in the surgical literature that this student is aware of. As well as communication, the skills of professionalism and empathy appear particularly important.

4.4.1   Quality and limitations of the study

Although qualitative research cannot be assessed by the same criteria as quantitative research, other rigorous criteria can be applied. The variability and flexibility of different qualitative approaches may preclude a "one-size fits all" technique, however there are resources available to aide this assessment (Braun and Clarke, 2006). Braun and Clarke (2013, 2006) have written extensively on how quality can be assessed in this type of research, by focussing more on the robustness of the methodology, rather than traditional quantitative approaches to reliability and validity.

Due to the role the researcher plays in obtaining the data, they inevitably influence the process and the knowledge produced. Qualitative data is context bound and it is possible that the pre-conceived ideas of the MD student, based on their existing knowledge and

experience of both NTS and gastrointestinal endoscopy, led to a more "top down" rather than "bottom up" approach to the analysis. This may have led to assumptions about what constitutes "good" or "bad" practice, both in the way the interviews were directed and in what the analysis revealed. Conversely, however, this knowledge and experience also enabled them to engage actively with the participants, and therefore it could be argued that this may have increased the richness of the data produced. The semi-structured nature of the interviews and the use of the interview schedule ensured the MD student some control, whilst still allowing the flexibility for participants to explore different areas of NTS practice according to their experience. During the analysis, repeatedly returning to the research question ("What NTS are important in endoscopy?") facilitated the student to extract relevant codes and themes.

In qualitative studies the trustworthiness or dependability of the methods should be considered. Section 4.2 explains the rationale for the type of interview and sampling technique selected. Individual interviews allowed participants the security and confidentiality to feel safe, and the semi-structured format the flexibility to explore their ideas within the context of the specific research question. Purposive sampling ensures a range of opinions from the whole team, but specific to endoscopy. A degree of selection bias is possible, as the interviewees were all volunteers, however, it wouldn't have been ethical to force staff to undertake such interviews, and any data obtained in these circumstances would be unlikely to be as honest or in depth. Transcription was undertaken by the MD student, allowing immersion in the data. The analysis is supported by quotes from all participants across the themes, and thus is felt to be true to the opinions of the interviewees.

Transferability is the extent to which the results could be transferred to other groups and contexts. The results obtained from this study could potentially be applied to other areas of healthcare where patients undergo procedures under sedation or local anaesthetic, for example interventional radiology, but some caution would need to be applied. The methods outlined could certainly be replicated in order to plan similar studies in other such areas. In addition, triangulation of the results with other sources can support their reliability. In this study, the additional data analysed from the observer notes and patient satisfaction free text comments, as well as the literature reviewed and discussed supports the results obtained.

4.4.2 Final themes and coding structure

Theme	Sub-theme	Codes
Leadership	Endoscopist	Is the leader
		Motivates team
		Encourages team to speak up
		Reassures team
	Nurses	Speaks up
		Organises / coordinates
		Follows protocols
	Whole team	Resolves conflict
		Open & honest
		Keeps team focussed
		Intervenes when necessary
		Appreciates hard work
		Listens to others
		Gives clear instructions
Teamwork	Working together	Reliance on others to complete task
		Coordinated
	Atmosphere / culture	Resolve conflict
		Support each other
		Appreciate others
		Value opinions / contributions
	Clear communication	Essential communication when necessary
		Listening skills
	Relationships	Ignore personal differences
	Trust	Responsibility / accountability
		Clear roles
		Flexibility
		Reliance on previous team
Situation awareness	Gathering information	Know team & skill mix
		Knowledge of patient information
		Non-verbal cues
		Verbal communication
		Vigilance / maintaining awareness
	Understanding information	Judging time to interrupt / deliver information
		Updating team
		Shared team understanding / mental model
		Re-establish goals
	Projecting / planning	Anticipating what's next - Equipment - Problems / adverse events
		Checking information / equipment
Decision making	Generating options	Thinking out loud
		Discussing options
		Making suggestions
	Problem solving	

Theme	Sub-theme	Codes
	Weighing up the evidence	
Managing stress	Recognises stress / has insight	Cognitive overload
	Keeping calm	Calm for team
		Calm for patient
	Open & honest with team	Ask for help when needed
	Keeping focus	
	Outside pressures	
	Challenging case	
	Unexpected event	
Interacting with the patient	Communication WITH the patient	Distracting the patient
		Reassuring the patient
		Managing expectations
		Breaking bad news
		Timing / location of communication
	Communicating AROUND the patient	"Protecting" the patient
		Measured / Reserved
		Keeping calm
	Empathy	Understanding the individual
		Sensitive to invasion of patient's space & body
		Caring, sensitive attitude
		Awareness of patient comfort
Communication	Team	Clarity - Handover - Checking key information - Confirming action - Essential communication
		Non-verbal cues and communication
		Effective
	Patient	Right time & place
		Clarity
		Reassurance
		Delivering information & managing expectation
		Distraction

Table 4.4: Final themes and coding structure

4.5   Conclusions

Endoscopy is a high pressure, high turnover area of healthcare with rapidly advancing technology, reliant on the effective teamwork of its healthcare professionals for safe care. The role of NTS have long been accepted in other areas of healthcare, but to date there has been little research into their role in this area.

The NTS of situation awareness, leadership, decision making, teamwork and communication identified by this interview study are similar to those found important in other areas of healthcare. However, due to the conscious state of the patient, the interaction between staff and the patient, and between staff around the patient is unique to gastrointestinal endoscopy and seems to be an important influence on the range of NTS that staff must possess. The ability to work effectively and safely as a team whilst maintaining a calm, relaxed and non-threatening environment, can be particularly challenging, and requires the specific behaviours discussed.

This study has produced a list of behaviours which could be utilised to further develop the training and assessment of NTS specific to endoscopy. There is scope for a validated, reliable instrument for use in this area. A robust tool could have a role in formative and summative assessment, as well as in debriefing teams or individuals and the evaluation of NTS training. The themes, sub-themes and codes could be explored further, or indeed refined, to consider those behaviours or skills considered 'good' or 'bad' in this setting; particularly those that may facilitate or obstruct the way team members interact with each other and the patient. This could result in the adaptation of a tool already in existence, such as the Oxford NOTECHS II, or the development of a bespoke NTS assessment tool for this environment.

Chapter 5 Further discussion, conclusions and future work

This chapter will provide an overall discussion of the use of the Oxford NOTECHS II tool in endoscopy, the relationship between scores and outcomes, and the role of NTS assessment in this specific area of healthcare.

5.1 Using the Oxford NOTECHS II assessment tool in endoscopy

The Oxford NOTECHS II tool was found to be practical for use by a single observer in real time. The score sheet devised listed observable good and poor behaviours within each of the four categories (Leadership & Management, Teamwork & Cooperation, Problem solving & Decision making and Situation awareness). This was easy to follow and complete, and in conjunction a chart defining each score level, provided a user-friendly aide to score allocation (see appendices 2 & 3).

It is reasonable to consider the Hawthorne effect with regards to real-time assessment, with teams being on their "best behaviour" when an observer is present. Other studies have considered this, but despite the likelihood of this effect being maximal at the beginning of a study, found scores to significantly increase with time (following a training intervention) (McCulloch et al., 2009). This research team undertook an earlier study in the operating theatre with similar experience; staff quickly became accustomed to a researcher's presence and scores again increased with time (post team training intervention) (Hitchins et al., 2017a). Although the chance of the Hawthorne effect could be reduced by the use of video recording with hidden cameras, it would not be eliminated, as for ethical reasons staff and patients would still need to be aware of and consent to such observation taking place.

In support of the more subjective findings of the practicality of using the Oxford NOTECHS II tool in endoscopy, and in concordance with its development in the operating theatre (Mishra et al., 2009, Robertson et al., 2014), both inter-rater reliability and intra-rater consistency over time were good. The tool therefore appears robust and reliable for use by an appropriately trained single observer, in real time, in this environment. In this study, both of the observers (the MD student CH and the supervisor CW) were medically trained. The Oxford NOTECHS system has previously been used by, and found to be reliable with, both Human Factors experts and Clinicians (Robertson et al., 2014, Mishra et al., 2009). However, to this student's knowledge, it has not been tested for use by other healthcare professionals such as nurses. During their assessment of anaesthetic trainees in the workplace, Crossingham et al. (2012) used both anaesthetists and Operating Department Practitioners (ODPs) to concurrently rate NTS, however, they found poor inter-rater reliability between the two groups. The tool they used had been developed by Anaesthetists, without input from ODPs, and they proposed the two disciplines could in fact be focussing on different aspects of performance. It would be interesting to investigate if there are differences in the way the Oxford NOTECHS II system is used, and how scores are affected, by different professionals, including clinicians, human factors experts and nursing or non-medical staff in this environment.

Despite the apparent reliability of the tool, its use in gastrointestinal endoscopy is based on the assumption that the same NTS found to be relevant in the operating theatre, are also relevant in this environment. This is due to the multiple similarities between the operating theatre and the endoscopy procedure room, and the makeup of teams in both environments. However, there are also some differences, notably the rare use of general anaesthesia in endoscopy and thus an awake or mildly sedated patient, with and around

whom the team must interact. It is likely that the NTS categories are similar, however there may be differences in the lists of observable behaviours within each category. As with other tools, the score sheet used in this study lists the relevant positive and negative observable behaviours under each subheading as a reference for score allocation. If the observable behaviours relevant to endoscopy are different, this would require adaptation to improve the accuracy of assessment.

To further assess the suitability and construct validity of the Oxford NOTECHS II tool in this environment, future work may be required to compare this taxonomy's observable behaviours with those specific to endoscopy. This could include a comparison of the taxonomy with the findings of the qualitative interview study presented in Chapter 4. In addition, the score sheets and notes taken during observations could be reviewed to explore the frequency with which specific behaviours were observed in this environment. This could highlight the similarities and suggest differences, if for example, certain behaviours were always, or never observed. It is unclear from the literature whether this type of mapping has previously taken place where a tool has been adapted for use in a different industrial or clinical environment. Similarly to the Oxford NOTECHS tool, the development of the ANTS tool for the assessment of Anaesthetist's NTS was based on the structure of the original aviation NOTECHS tool. Its contents however, were identified by a combination of literature review and cognitive task analysis, followed by observations in theatre during which time "alterations and adaptations" took place (Fletcher et al., 2004). This implies that some analysis of the practicality with which skills and behaviours were actually observable was undertaken, and that the same approach could be used in this area. In their work to validate the ANTS tool, Fletcher et al. (2003) evaluated its use by anaesthetists in a simulated environment following training. The

group were surveyed to assess its validity and usability. This survey included questions regarding the completeness of the system, observability of the non-technical skills categories and elements, and the acceptability and design of the tool. If an assessment tool were to be developed or adapted for use specifically in endoscopy, a similar approach could be undertaken to examine its validity and usability in practice.

5.2 Associations between NTS and patient outcomes in endoscopy

As discussed in Chapter 3, conclusive relationships were not found between the NTS of endoscopy teams (as assessed by the Oxford NOTECHS II tool) and the outcomes investigated. However, some important points were identified. The positive associations between NTS and polyp detection and scope withdrawal time are likely to reflect increased care and vigilance. It therefore makes sense that an endoscopist with better situation awareness, decision making and the ability to avoid distractions would perform better in these two aspects of the procedure.

The relationship between Oxford NOTECHS II scores and items on the safety checklist suggests that teams with better safety practices had better NTS, and may therefore actually validate the tool in this environment. This is supported by the literature (Matharoo et al., 2012, Robertson et al., 2014). As discussed in Chapter 3, Matharoo et al. (2012) found a strongly positive correlation (r>0.8) between NTS and performing safety checks, and Robertson et al. (2014) found a statistically significant association between NTS performance and completing the WHO safety checklist. Safety checks and checklists fulfil a number of functions in healthcare environments. In their purest sense, safety checklists ensure that safety-critical tasks and checks have been undertaken. However, beyond that, they can provide an opportunity for team members to familiarise themselves with each other and a platform to empower staff, of any level, to speak up. This is particularly important in teams that lack familiarity or when staff changeovers take place. Individuals that welcome the opportunity to establish team relationships and who ensure the undertaking of safety check procedures, by virtue, have good interpersonal skills and demonstrate vigilance. Therefore, this relationship seems a reasonable outcome and a potential validator for a NTS assessment tool.

It is difficult to be certain whether relationships exist between NTS and the outcomes investigated, but were not demonstrable within this study, or indeed if there are relationships with other outcomes that were not considered. As discussed in Chapter 3, the sample size estimate was based on information from a study undertaken in the operating theatre, and was a difficult prediction to make. It is therefore possible that the study was underpowered, and a larger sample size may have revealed clearer relationships or associations between Oxford NOTECHS II scores and the outcome measures explored. However, the lack of variation in scores is likely to continue to make such relationships difficult to prove.

There are a number of possible explanations for the lack of variation in scores, which were clustered in the upper half of the scale, between 5 and 8. Crossingham et al. (2012) described a similar "ceiling effect", with scores skewed at the top end of the scale, when they assessed the NTS of anaesthetic trainees in the workplace. This was contrary to their earlier work using simulated scenarios within a trainee recruitment selection process, where scores were more equally distributed throughout their scale. A number of potential explanations were proposed, and should be considered in this study, and in any future work undertaken: trainees being assessed were of high calibre, performance was improved under scrutiny, insufficient discrimination in the scoring scale, assessor leniency and a lack of challenge in the cases. It is possible that the NTS of the teams observed in endoscopy in this study were always good and thus they always achieved high scores. However, it is also conceivable that the tool is insufficiently sensitive to discriminate between subtle differences in performance. This is despite the observer using the second iteration of the Oxford NOTECHS scale which was adapted from the original to have a larger scale (1-8, rather than 1-4) in an attempt to improve this exact

issue (Robertson et al., 2014). The tool describes using a score of 6 as the default from which the assessor can increase or decrease according to the behaviours witnessed (see table 5.1 for scale descriptors). The scoring systems for some other NTS assessment tools, such as ANTS and NOTSS, have an option for a score of 'Not Observed' in the case that no good or bad behaviours within a category are witnessed (Fletcher et al., 2004, Yule et al., 2006b). This option does not exist for the Oxford NOTECHS scales and therefore if no behaviours are observed within a NTS category, performance is assumed to be at the level of the default, and given a score of 6. This predisposes scores to the upper half of the scale. In addition, the descriptors for scores of less than 5 indicate behaviours that do, or potentially could, compromise patient safety have been observed. Despite the confidentiality and anonymity of the scores applied in this study, there may have been be a reluctance to label a whole sub-team in this way, particularly if poor behaviours did not lead to harm, or were witnessed in combination with, and thus balanced by, good behaviours, resulting in a sub-team score of 5 or 6.

Behaviour	Frequency	Oxford NOTECHS II score
Compromises patient safety and effective team work	Consistently	1
	Inconsistently	2
Could directly compromise patient safety and effective team work	Consistently	3
	Inconsistently	4
Maintains an effective level of patient safety and team work	Inconsistently	5
	Consistently	6
Enhances patient safety and effective team work	Inconsistently	7
	Consistently	8

Table 5.1: Behavioural Paramaters of Oxford NOTECHS II (Table 2 (Robertson et al., 2014))

Another consideration in this study, is that having been developed for use in the operating theatre, the Oxford NOTECHS II tool may not be specific enough for use in

endoscopy. If the list of observable behaviours by which the assessor bases their score is incomplete or inaccurate for this environment, then it could be difficult to make an accurate assessment of the NTS demonstrated.

In addition, it may be that the impact of subtle changes in NTS on hard, and mostly binary, outcomes is difficult to assess. If such relationships exist they may be more complex than can be measured in such a simple way. A link between NTS performance and measures of efficiency could be explored further, as this has previously been shown to be affected by teamwork and team effectiveness (Sevdalis et al., 2012). Proving such a relationship could also go some way to support the financial investment that would be required to train and assess these skills. Measurement of other outcomes, such as safety culture and team morale may give a greater insight into the effect of NTS on team function, the workplace environment, and in turn on the experience and safety of patients. There is some evidence to suggest that Safety Attitudes improve following NTS training (Matharoo et al., 2014a, Hitchins et al., 2017b) and that they are negatively associated with making errors which have the potential to cause harm (Keswani et al., 2015). Equally, the effect of occupational stress and burnout, which are measured in safety culture surveys such as the Safety Attitudes Questionnaire (SAQ) (Sexton et al., 2006) and the SCORE Survey (Safe & Reliable Healthcare), could reasonably have an effect on NTS such as managing stress and fatigue, and situation awareness, and thus influence team and individual performances in these areas.

5.3 What does the interview data add to existing knowledge?

The results of the interview study presented in Chapter 4 have confirmed the importance of the NTS situation awareness, decision making, leadership, teamwork and communication in gastrointestinal endoscopy. These findings are in-line with the existing literature to date regarding NTS and teamwork in healthcare, particularly within the operating theatre and gastrointestinal endoscopy. This supports the transferability of an assessment tool developed for use with a surgical team such as the Oxford NOTECHS II, into the endoscopy environment.

However, it also revealed that the presence of an "awake patient" in endoscopy makes this area of healthcare and the way the team interact within it quite unique. The ability to perform to a high standard, whilst communicating and dealing with the extra dimension of patient interaction mid-procedure, is exceptional to this area and requires skills in communication, professionalism, empathy, situation awareness and managing stress. Although the Oxford NOTECHS II directly assesses situation awareness, behaviours related to these other NTS are assessed more indirectly via the influence they have on leadership, teamwork and decision-making. In view of this, it may be that tools designed for use in the operating theatre do not sufficiently acknowledge the behaviours involved in interacting both with and around the patient, and thus it is possible they do not assess the full range of NTS required by endoscopy teams. Solutions to this include the development of a novel gastrointestinal endoscopy specific NTS assessment tool, or the adaptation of an existing tool such as the Oxford NOTECHS II for use in this area. This could incorporate the addition of a "communication" category and adjustment of the observable behaviours within all NTS categories to reflect the importance of how the team functions with and around an "awake patient", or indeed

an "interacting with the patient" category specifically for this interaction. As per the development of NTS assessment tools in other areas of healthcare, expert panel agreement or a Delphi consensus approach could be used to create or refine a taxonomy and assessment tool specific to this area (Mishra et al., 2009, Yule et al., 2006b, Fletcher et al., 2003).

As well as endoscopy healthcare staff and human factors practitioners, this process could also include expert patients. Interviews or focus groups could be used to explore patient opinion on the NTS of staff that impact most on their experience during an episode of care in endoscopy, and an expert panel could include a patient voice. In their research into perception of the endoscopy experience, Arney et al. (2014) found that patients based this on their memory of previous encounters. In addition, patients have been found to prioritise aspects of their care related to personal treatment by the clinician and team, and the role they take in decision making more highly than clinicians expect them to (Denters et al., 2012, Yacavone et al., 2001). These studies indicate that clinicians do not always understand which aspects of care are most important to patients. Both The King's Fund and The Health Foundation have published guidance on the role of collaboration between healthcare providers and patients, carers and communities, termed respectively "Patients as Partners" and "Co-productive research" (Seale, 2016, Realpe and Wallace, 2010). Clinicians are experts in terms of their knowledge of a condition and its management, but patients are experts in terms of their experience of an illness, its treatment, and the impact of the different aspects of those things on their life. Collaborating with patients will enable more accurate understanding of these factors and thus hopefully improve the way services are designed and care is

delivered. There is no reason why this should not also apply to the way staff behaviour

affects patients and the way they experience care in this area.

5.4   Is there value in training and assessing NTS in endoscopy?

There is good evidence from high risk industries, that a significant proportion of adverse events are due to failures in the non-technical aspects of human and team performance (Flin et al., 2008, Chief Medical Officer, 2000, Kohn et al., 2000, Vincent et al., 2001, Intitute of Medicine, 2001). Within healthcare, much of the existing literature regarding the training and assessment of NTS is from anaesthetics, surgery and emergency care. Although literature on this subject within gastrointestinal endoscopy is sparse, it is conclusive to the necessity of these skills for personnel in this area, and should form part of their assessment and development (Haycock et al., 2011, Anderson, 2012). This seems logical based on the comparisons that can be drawn between endoscopy and the operating theatre, and the rapidly advancing technology, high turnover, operational pressures and changeable teams common to this field. It thus suggests the hypothesis that good NTS will have a positive impact on the safety, experience and outcomes of patients undergoing endoscopic procedures.

Training of team's and individual's NTS requires the investment of resources in terms of expertise, time and finances, as well as buy-in and support at an organisational level, and yet, as discussed in Chapter 2, there is limited evidence to support the link between NTS performance and patient outcomes, or indeed an improvement in outcomes following team training interventions. A key aim for this study was therefore to explore this relationship further within this area of healthcare. Although the results are not conclusive, there are some promising findings. Potential associations with safety behaviours and those procedure outcomes which may benefit from increased awareness and attention to detail, as well as the higher scores found during procedures

that were more complex or challenging, maintain the possibility that such relationships exist.

Results of the interview study presented in Chapter 4 support the value that staff place on NTS in managing challenging cases safely and successfully. The data identified a range of NTS important for teams and individuals in endoscopy, with many similarities to the skills previously recognised in other areas of healthcare, in particular the operating theatre environment. However, it also identified additional skills that are required to function in the unique context of the "awake patient". In addition, the ability to manage stress, particularly from operational or external pressures, was a strong theme. Within the financial constraints of the current UK NHS, such skills are only likely to become more essential.

Although a concrete relationship between NTS and outcomes is yet to be proven, this study does present new qualitative evidence for the role that NTS contribute to team performance in this environment. It would therefore seem reasonable that investment in NTS training could improve team performance. The development of a validated, reliable instrument specific to gastrointestinal endoscopy might enable both formative and summative assessment of these skills.

5.5 Future work

5.5.1 Further exploration of the link between NTS and outcomes in gastrointestinal endoscopy

Further observations with the same outcome measures could provide additional evidence to clarify the weak associations found in the study presented in Chapter 3. However, it may still be difficult to prove such relationships exist. It would also be interesting to explore the association between NTS and other outcomes such as safety culture and team morale, or markers of process or efficiency. If more substantial relationships with outcomes could be proven, there would be better justification for the investment required to assess and train NTS in the future.

5.5.2 Development of an endoscopy specific non-technical skills assessment tool

In line with the development of previous NTS assessment tools, and as discussed in sections 5.1 and 5.3, an endoscopy specific tool could be developed. Qualitative data from the study presented in Chapter 4, enriched by analysis of the score sheets and notes taken during the observations in Chapter 3, could be used to develop a de novo tool, or to adapt an existing tool such as the Oxford NOTECHS II, to improve its specificity for this area of healthcare. In favour of adaptation of the Oxford NOTECHS II tool for this purpose, is its usability and reliability by a single observer in this environment. Expert panel discussion and agreement, or a Delphi consensus approach could be used to facilitate the development of a taxonomy of non-technical skills and behaviours, and the most practical scale with which to create such an assessment tool. A contribution from expert patients, via either a qualitative study of their opinion, or within this process,

could also provide valuable supplementary information to ensure the specificity of a tool for assessing NTS in endoscopy.

5.5.3   The role of team training

In addition to the development of a NTS assessment tool, evidence from the qualitative study presented in Chapter 4 could contribute to the design of a NTS team training program catering to the specific needs of endoscopy team members. Introduction of something like this would also provide scope for the re-assessment of NTS following a team training intervention, including whether such a program would result in a significant improvement in NTS or indeed patient outcomes.

Chapter 6 Reflections on the process and my development as a researcher: trials, tribulations and lessons learnt

6.1 Initial challenges

Despite trying to plan as much in advance of starting full-time research as possible, things didn't go quite as desired. I'd written the proposal and had it accepted by the medical school for an MD, been released from my surgical training by the post-graduate deanery for "Out of Program Research (OOPR)" to start in October 2015, but there was still one major hurdle. The staff in the department in which I was to carry out the project were not on board. In fact, they were far from it. This was despite months of attempted groundwork to make it all happen, which culminated in a presentation of the study details to the department, just one week before my start date, that had gone terribly. A mentor was concerned that I should defer the start of the project until these issues had been resolved, which in turn caused problems with both the deanery and the hospital, as they would have to find another job for me to go into. However, I felt that the work that was necessary to get the department on board and start, or if necessary modify, the project, required my full attention: a task that was proving difficult when trying to fit it around a full-time clinical job. So, in the end, after much thought, and with significant uncertainty, I proceeded with my start date as planned.

To add some background, I will try to explain the situation in the department and how my study fitted into this. I had developed the idea for an MD, in conjunction with my future supervisors, looking into non-technical skills. My early reading had led me to realise that there was a gap in the literature with regards to non-technical skills in gastrointestinal endoscopy, and their influence on patient outcomes. In addition, NTS

training had already been rolled out within the operating theatres and some other acute areas within the hospital, but at the time there was no immediate plan to introduce anything similar to the endoscopy department. It was therefore an area with potential for a study investigating these aspects of NTS and ultimately an opportunity to search for ways to improve patient safety and the working environment for staff. In addition, it allowed the possibility of developing an evidence-based staff training program specifically for this area of healthcare in the future. Unbeknownst to me, and due to a combination of factors, the department was under significant pressures which unfortunately were contributing to the reception the study received.

I had thought it important to have a clear plan for the study set out before approaching staff, and had been falsely reassured that the idea had already been discussed with the senior nursing team. This resulted in approaching staff with a study that was seemingly already planned, but of which they knew very little. The observations were perceived as an invasion of their workspace. Despite my genuine intentions to explore a subject that might lead to improvements in patient care and the working environment for staff, I was seen as a threat. Someone they didn't know, coming into their department to check up on them. They were suspicious of where this was coming from, of how it would interfere with the way they worked, and of the changes it might result in; they clearly felt that "things were fine as they were". I had thought the opportunity for staff training at the end of the study would be welcomed, but it was taken as a suggestion that training was needed, i.e. 'they weren't good enough'. In addition, due to the operational pressures the department was under, all staff training had been put on hold as time couldn't be made to accommodate it.

These initial issues resulted in two courses of action. The first was to continue to build a relationship with the endoscopy team at the primary site, with the hope that over time, and with information, the study would proceed as originally planned. The second was to explore the options of additional data collection sites, something that I had planned from the beginning, but became more important at this stage. I spent time in the department, continuing my practical endoscopy training, and integrating with the staff. I contributed to all aspects of patient care, "mucking in" with the nursing staff, and I spent time in the staff-room discussing the project, answering concerns and questions, as well as getting to know the staff on a more personal level. By December 2015 I'd built relationships with the staff and was receiving a much warmer welcome. I'd answered most of their questions, they no longer saw me as a threat, and were much more welcoming of the prospect of the study. Meanwhile, the option of data collection on another site was successfully arranged.

6.2 Other hurdles encountered

As mentioned above, my initial intention had been to complete the planning stages of my MD project before I left my clinical post and started as a full-time student. As well as writing and having the proposal accepted, this also included the NHS paperwork required, and if necessary ethical approval. I sought advice early but unfortunately this was conflicting and after starting in October 2015, the level of ethical approval I would require was still unclear. I just wanted to make sure that I was doing things correctly, and if ethical approval was needed I could get on and submit the application as soon as possible to prevent further delays. After consulting the hospital, university and discussing with my supervisors, I decided that I should apply to the NHS Health Research Authority Regional Ethics Committee for proportionate review and submitted this in the November. This application was unfortunately rejected in lieu of submitting additional information to the more in-depth process of a full regional ethics committee review. This resulted in a rush to complete the additional paperwork and re-submit in time for the meeting in early January 2016. The meeting itself was a challenging experience as a number of issues were highlighted, and at times it felt more a personal attack on me than a review of the ethics of the study. However, despite this, and some more additional paperwork, the study was successfully granted ethical approval to commence in February. I had not been through the process of gaining ethical approval for a study before, and it was certainly a challenge, but one that I successfully navigated and I will be more equipped to deal with in the future. Perhaps just all part of the journey!

The delay in gaining ethical approval, in addition to gaining the consent of the staff to go ahead with the study, meant that data collection didn't commence until March 2016, more than five months after my enrolment. I felt that I'd achieved little in this time. I

often felt lost, and that I needed a surprising, and perhaps embarrassing, amount of guidance and reassurance, particularly when it came to anything that involved writing. Thankfully, once data collection began, the staff were remarkably welcoming and supportive of the study, even those who had opted out of being observed themselves. When it finally came to finding volunteers for the interview study, there were no problems at all. In fact, the only issues that arose were again related to under-staffing within the department, and releasing those involved from their work for the short time that the interviews took.

Writing became a challenge again, and I realised that this was the area I procrastinated about the most. I had had a plan to write a review article and my review chapter from early on, but a year in, I still hadn't completed these pieces. I overcame this by attending an immersive writing workshop (something I would not have considered doing prior to my MD) and by setting some clear targets with my supervisors for what I needed to achieve. I continued to use target setting and the other techniques I'd learned from the workshop throughout my final year. Breaking the somewhat daunting task of writing a whole thesis into manageable chunks was essential, and setting deadlines made me accountable to both myself and my supervisors to complete the work.

6.3 Taking ownership and building relationships

Early on, I shied away from approaching staff directly, thinking that deferring to seniors was the more appropriate thing to do. I didn't realise how important it was to take ownership of the study or who the essential stakeholders would be. I thought I needed to have a clear plan for the study before involving others, but in hindsight, it would have been better to initiate early, general, discussions with the department, and invite involvement from the people it would affect the most. Consciously identifying all the potential stakeholders and talking to them early in the process would have saved me a lot of time and stress. It would have facilitated a better understanding of the motivations of staff and the practical impact the study would have on their working environment, and would have helped me to refine the goals of the study to better suit the department (NICE, 2007). In addition, earlier discussions of my motivations would have demonstrated the transparency that I had thought was obvious, but was undoubtedly not clear enough. It would also have ensured that staff felt more "connected to the vision", and might have identified champions to promote earlier acceptance from those who initially had concerns or questions (Brickman, 2016). Although it may be a cliché, this taught me that as with many things in life, communication is definitely the key!

Considering the journey over the past three years from conception to completion, I have learnt a lot about processes in research, communication within a team, and my own working style; including its strengths and weaknesses. Despite the hurdles, the study was a success and I have confidently completed my project. I am proud of what I have achieved and how I eventually overcame all obstacles.

Appendices

Appendix 1   Glitch categories

1.1   Glitch categories with definition and examples (Morgan et al., 2013)

See Table 1, Page 2 of

Morgan L, Robertson E, Hadi M, Catchpole K, Pickering S, New S, et al. Capturing intraoperative process deviations using a direct observational approach: the glitch method. *BMJ Open*. 2013;3(11):e003519.

Appendix 2 The Oxford NOTECHS II non-technical skills assessment tool

2.1   Oxford NOTECHS II Taxonomy (Robertson et al., 2014)

See Table 1, Page 3 of

Robertson ER, Hadi M, Morgan LJ, Pickering SP, Collins G, New S, et al. Oxford NOTECHS II: a modified theatre team non-technical skills scoring system. *PLoS One*. 2014;9(3):e90320.

2.2   Oxford NOTECHS II Score system (Robertson et al., 2014)

See Table 2, Page 3 of

Robertson ER, Hadi M, Morgan LJ, Pickering SP, Collins G, New S, et al. Oxford NOTECHS II: a modified theatre team non-technical skills scoring system. *PLoS One*. 2014;9(3):e90320.

Appendix 3 Data collection form for Gastrointestinal endoscopy

Date:	Time:	Procedure:	Endoscopist:
Checklist	Brief: Y/N	Plan: Y/N	ID: P/T
Oxford NOTECHS II	**Surgeon / Endoscopist subteam**	ID check: Y/N	Pause: Y/N
			Nursing subteam

Leadership & Management

Positive modifiers
- Raises team morale
- Intervenes if deviation
- Prioritises tasks
- Takes control when required
- Demonstrates desire for high standard

Negative modifiers
- Deflates or fails to motivate team
- Does not attempt to build cohesion
- Inappropriate task distribution

/8

Positive modifiers (Nursing subteam)
- Assisting nurse provides clear instructions to circulating nurse(s)
- Senior nurse makes sure protocols are followed
- Speaks up when unhappy

Negative modifiers
- Senior nurse does not support juniors

/8

Teamwork and cooperation

Positive modifiers
- Open
- Appropriate use of abilities within team
- Supportive of other subteam when necessary

Negative modifiers
- Aggressive in conflicts
- Does not appreciate others' abilities

/8

Positive modifiers (Nursing)
- Nurses cooperate and support each other well
- Senior nurse covers for junior nurse

Negative modifiers
- Poor coordination between equipment needs and those provided

/8

Problem-solving and decision-making

Positive modifiers
- Demonstrates generation of options
- Open discussion and agreement over anatomy
- Incorporates other subteam issues

Negative modifiers
- Decisions made unsystematically
- Does not utilise team where it may benefit

/8

Positive modifiers (Nursing)
- Takes an active part in decision-making
- Suggests solutions to problems – e.g. alternative equipment

Negative modifiers
- Blames the surgeon / endoscopist when faced with problems

/8

Situation awareness

Positive modifiers
- Periodically gathers awareness of surroundings
  - Has awareness of patient condition / comorbidity
  - Appreciates stage of procedure
  - Aware of who is in the room, what skills they have and what they are doing

Negative modifiers
- Is fixated on procedure field

/8

Positive modifiers (Nursing)
- Anticipates equipment needs

Negative modifiers
- Absent at stages when needed to provide service

/8

Start time:	Sedation Y/N	Notes / Glitches
Finish time:	Entonox Y/N	
Start of Extub:	Throat Spray Y/N	
Extent:	Pain score:	

Appendix 4 Staff information and Consent forms for Observation of team work in Endoscopy (presented in Chapter 3)

4.1   Staff information sheet

PARTICIPANT INFORMATION SHEET

For Staff Observation

Study Title: Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?

PART 1

1.   Invitation

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully, and discuss it with others if you wish.

PART 1 tells you the purpose of this study and what will happen to you if you take part.

PART 2 gives you more detailed information about the conduct of the study.

Ask us if there is anything that is not clear, or if you would like more information. Take time to decide whether or not you wish to take part.

2.   What is the purpose of the study?

We know from other studies that when teams work well together, the chance of something going wrong is reduced. We think that good team work would also lead to good quality care, more satisfied patients and a more efficient service, but few studies have looked at this area. The aim of this study is to see if there is a link between good team work, good quality care and patient satisfaction.

The study involves a researcher observing the team work of Endoscopy staff while you perform procedures. This observation should not change the way you do your job and will be as un-intrusive as possible. You will be able to go about your tasks as normal.

The study will form part of a Medical Doctorate qualification being undertaken by the researcher, Dr Charlotte Hitchins, with Plymouth University Peninsula School of Medicine and Dentistry in collaboration with Plymouth Hospitals NHS Trust.

Patients involved will be provided with written information and asked to consent to have the researcher present during their procedure. They will also be asked to complete a patient satisfaction survey about their experience in the department.

We hope the results will help to guide the way we provide care and the way we train staff in the future.

3.   Why have I been invited?

You have been invited to take part because you work as a member of staff within the Endoscopy department and you are involved as part of the team carrying out endoscopy procedures on patients.

4.   What will happen to me if I take part?

If you consent to take part, the researcher will sit in the treatment room while you work. She will observe your team as you undertake Endoscopic procedures. She will use the Oxford NOTECHS II tool to score the Non-technical Skills of the team as a whole for each procedure. This will be anonymised and individuals will not be scored or identified.

5.   Do I have to take part?

No. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form to confirm that you understand what is involved when taking part in this study. If you decide to take part you are free to leave the study at any time and without giving a reason. If you withdraw, unless you object, we will still keep records of the observations up to this point, as this is valuable to the study. A decision to withdraw at any time, or a decision not to take part, will not disadvantage you or affect your employment in the department.

6   What do I have to do?

If you agree to take part in the study we will ask you to sign a consent form.

7.   What are other possible disadvantages and risks of taking part?

Sometimes being observed can make people feel worried or anxious about their performance; the researcher will ensure that all endoscopy staff members are made fully aware that the study will involve looking at the team as a whole and not at individual performance. We will do our best to ensure that there is minimal disruption to the way you go about your normal tasks and to the running of Endoscopy unit.

We undertook a similar study in theatres at PHNT. Feedback from the staff involved was very positive regarding the presence of the observer; they "almost forgot" that the observer was present.

In the unlikely event that the researcher does witness any issues of poor practice then she has a duty of care to the patient and would be required to report it to the Endoscopy team manager.

8.   What are the possible benefits of taking part?

We hope the information gained from this study will guide the development of a non-technical skills training programme to provide to teams in the Endoscopy department in the future and ultimately improve patient care.

9.   What if there is a problem?

If you have a concern about any aspect of this study, or the way you have been approached then please speak with the researchers who will do their best to answer your questions. If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

10.   Will my taking part in this study be kept confidential?

Yes. All the information about your participation in this study will be kept confidential. The details are included in Part 2.

This completes Part 1 of the Information Sheet.

If the information in Part 1 has interested you and you are considering participation, please continue to read the additional information in Part 2 before making any decision.

PART 2

11.   What will happen if I don't want to carry on with the study?

You are free to withdraw from the study at any time.

If you withdraw from the study, we will destroy all your identifiable information, but if you agree we will use the data collected up to the time of your withdrawal.

12.   Will my part in this study be kept confidential?

If you consent to take part in this study, the data obtained will remain strictly confidential at all times. The information will be held securely on paper and electronically at Plymouth Hospitals NHS Trust under the provisions of the Data Protection Act (1998). Your name will not be passed to anyone else outside the research team or the sponsor, who is not involved in the study.

Your name will only appear on your consent form, which will be kept separately and securely to any results collected for the study. All other records will have your name removed.

Study results will be available to people authorised to work on the study but may also need to be made available to people authorised by the Research Sponsor, which is the organisation responsible for ensuring that the study is carried out correctly. A copy of your consent form may be sent to the Research Sponsor during the course of the study. By signing the consent form you agree to this access for the current study and any further research that may be conducted in relation to it, even if you withdraw from the current study.

The information collected about you may also be shown to authorised people from the UK Regulatory Authority and Independent Ethics Committee; this is to ensure that the study is carried out to the highest possible scientific and regulatory standards. All will have a duty of confidentiality to you as a research participant.

If you withdraw consent from further study participation, unless you object, your data will remain on file and will be included in the final study analysis.

All study data collected as part of the researcher's Medical Doctorate will be stored confidentially in an anonymised (non-identifiable) secure format, in line with the University of Plymouth's Ethics Policy for a period of 10 years. Any computer software or recordable devices used for the purpose of this research study will be encrypted to protect your data in a confidential manner.

13.   What will happen to the results of this study?

The results of the study will be available on completion and will usually be published in a medical journal or be presented at a scientific conference. The data will be anonymous and none of the participants involved in the study will be identified in any report or publication.

A report of the study will be available within the Endoscopy department.

14.   Who is organising and funding this study?

The study has been organized as part of a Medical Doctorate with Plymouth University Peninsula School of Medicine and Dentistry in partnership between Professor J Edworthy (Plymouth University), Dr Catherine Ward (Consultant Anaesthetist, Plymouth Hospitals NHS Trust), and Dr Magdalena Metzner (Consultant Gastroenterologist, Plymouth Hospitals NHS Trust).

We have secured a grant from Bowel Cancer West. If additional funds are needed we will apply for further grants from sources aimed at Endoscopy and Improving the Patient Experience.

15.   Who has reviewed the study?

This study has been approved by Plymouth Hospitals NHS Trust Research and Development Department and has been given favourable ethical opinion for conduct in the NHS by the Health Research Authority (HRA) Research Ethics Committee, South West Cornwall and Plymouth.

16.   Contact for further information

Should you have any queries about this study you may contact the researcher Dr Charlotte Hitchins (Research Fellow in General Surgery) through the main hospital switchboard on 0845 1558155 (bleep 89958) or her academic supervisor Professor Edworthy (Plymouth University).

If you have concerns while on the study

Whilst it is something we hope will not happen, if you have concerns about any aspect of research please speak to the researchers using the contact details above.

If you decide you would like to take part then please read, sign and date the consent form. You will be given a copy of this information sheet and the consent form to keep; a copy will be filed securely, locked in a cabinet separate from the main research study records and one may be held by the Research Sponsor.

Thank you for taking the time to read this information sheet and to consider taking part in this study.

4.2 Staff consent form

CONSENT FORM - Staff Observation

Title of Project: **Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?**

Name of Researcher: **Dr Charlotte Hitchins** (MD Student, Plymouth University Peninsula School of Medicine & Dentistry; Research Fellow in General Surgery, PHNT)

Please initial box

1. I confirm that I have read the information sheet dated 1st February 2016 (version 1) for the above study. I have had the opportunity to consider the information, ask questions and have

    had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

3. I understand that data collected during the study, may be looked at by individuals from University of Plymouth, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research.

4. I understand that the information collected about me may be used to support improvements in the future care of patients, and may be shared anonymously with other researchers and clinicians.

5. I consent to the storage of personal information for the purposes of this study. I understand that any information that could identify me will be kept strictly confidential (as required by the Data Protection Act 1998), and that no personal information will be included in the study report or other publication.

6. I agree to take part in the above study.

_____   _____   _____
Name of Participant   Date   Signature

_____   _____   _____
Name of Person   Date   Signature
receiving consent

Thank you for agreeing to participate in this research

When completed: 1 for participant; 1 for researcher site file.

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Appendix 5   Patient information and Consent forms for Observation of team work in Endoscopy (presented in Chapter 3)

5.1   Patient invitation letter

Plymouth Hospitals NHS
NHS Trust

Department of Endoscopy
Derriford Hospital
Derriford Road
Plymouth
PL6 8DH
01 February 2016

Study Title: Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?

Dear Sir / Madam

We are writing to ask for your help in a research study being conducted within the Endoscopy Department by Dr Charlotte Hitchins, Research Fellow in General Surgery, as part of Medical Doctorate with Plymouth University Peninsula School of Medicine and Dentistry. The study aims to see if there is a link between good team work, good quality care and patient satisfaction.

Why we would like your help

We know from other studies that when teams work well together, the chance of something going wrong is reduced. We think that good team work would also lead to good quality care, more satisfied patients and a more efficient service, but few studies have looked at this area. To address this we would like to conduct an observational study of the team work of the Endoscopy staff.

How to take part

There are two ways in which you will be invited to take part:

1) **By allowing a researcher to be present during your Endoscopy Procedure.** The researcher will observe the team work of the staff as they undertake your procedure.

2) **By completing a patient satisfaction questionnaire** to tell us about your experience in the Endoscopy department.

Please find enclosed some more information from the research team about this study and how to take part.

If you would like to take part please complete the enclosed consent form. If you do not wish to take part this time, we understand.

Thank you for taking the time to read this information.

With Kind regards

Dr Charlotte R Hitchins   Dr Catherine Ward   Professor Judy Edworthy

Principle Investigator   Consultant Anaesthetist   School of Psychology

Plymouth Hospitals NHS Trust   Plymouth Hospitals NHS Trust   Plymouth University

Plymouth University PSMD

PLYMOUTH UNIVERSITY PENINSULA
SCHOOLS OF MEDICINE & DENTISTRY

Plymouth Hospitals NHS
NHS Trust

Do good non-technical skills correlate with good clinical outcomes in Endoscopy?

A study is taking place in the endoscopy department looking at the way teams work together.

What is this study about?

We know from other studies that when teams work well together, the chance of something going wrong is reduced. We think that good team work would also lead to good quality care, more satisfied patients and a more efficient service, but few studies have looked at this area.

How to take part

There are two ways in which you will be invited to take part:

1) By allowing a researcher to be present during your Endoscopy Procedure. The researcher will observe the team work of the staff as they undertake your procedure.

2) By completing a patient satisfaction questionnaire to tell us about your experience in the Endoscopy department.

Please ask at reception for more information if you would like to consider taking part.

Who is organising this study?
Dr Charlotte Hitchins in partnership with Professor J Edworthy (Plymouth University), Dr Catherine Ward (Consultant Anaesthetist), and Dr Magdalena Metzner (Consultant Gastroenterologist).

Leading with excellence, caring with compassion

Sponsor ID 15/P/101   V2   1/2/2016

5.3   Patient information sheet

PATIENT INFORMATION SHEET

Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?

PART 1

1.   Invitation

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully, and discuss it with others if you wish.

PART 1 tells you the purpose of this study and what will happen to you if you take part.

PART 2 gives you more detailed information about the conduct of the study.

Ask us if there is anything that is not clear, or if you would like more information. Take time to decide whether or not you wish to take part.

2.   What is the purpose of the study?

We know from other studies that when teams work well together, the chance of something going wrong is reduced. We think that good team work would also lead to good quality care, more satisfied patients and a more efficient service, but few studies have looked at this area. The aim of this study is to see if there is a link between good team work, good quality care and patient satisfaction.

The study involves a researcher observing the team work of the Endoscopy staff while they perform your endoscopy procedure. This observation will not change the way your procedure is done – the team will be working just as they would normally.

The study will form part of a Medical Doctorate qualification being undertaken by the researcher, Dr Charlotte Hitchins, with Plymouth University Peninsula School of Medicine and Dentistry in collaboration with Plymouth Hospitals NHS Trust.

We hope the results will help to guide the way we provide care and the way we train our staff in the future.

3.   Why have I been invited?

You have been chosen because you are due to undergo an endoscopic procedure during the period that we are doing this study.

4.   What will happen to me if I take part?

If you consent to take part, the researcher will be in the room during your procedure and you will be given a survey to fill out in the recovery area before you go home. Your procedure will be exactly the same whether you decide to take part in the study or not.

5.   Do I have to take part?

No. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form to confirm that you understand what is involved when taking part in this study. If you decide to take part you are free to leave the study at any time and without giving a reason. If you withdraw, unless you object, we will still keep records relating to your endoscopy department visit, as this is valuable

to the study. A decision to withdraw at any time, or a decision not to take part, will not affect the quality of care you receive.

6 What do I have to do?

If you agree to take part we will ask you to sign a consent form before your procedure. Your procedure will be performed in the same way it would if you were not taking part in the study. We will ask you to fill in a patient satisfaction survey before you go home.

7. What are other possible disadvantages and risks of taking part?

Taking part in the study will not affect the care that you receive today. The only difference will be the additional presence of the researcher, who will be observing the Endoscopy team, during your procedure.

8. What are the possible benefits of taking part?

There may be no direct benefit to you by taking part but the information we get might help improve the way we provide care and the way we train our staff in the future.

9. What if there is a problem?

If you have a concern about any aspect of this study, or the way you have been approached then please speak with the researchers who will do their best to answer your questions. If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital's Patient Advice and Liaison Service.

10. Will my taking part in this study be kept confidential?

Yes. All the information about your participation in this study will be kept confidential. The details are included in Part 2.

This completes Part 1 of the Information Sheet.

If the information in Part 1 has interested you and you are considering participation, please continue to read the additional information in Part 2 before making any decision.

PART 2

11. What will happen if I don't want to carry on with the study?

You are free to withdraw from the study at any time. Withdrawal from the study will not affect your current or ongoing care.

If you withdraw from the study, we will destroy all your identifiable information, but if you agree we will use the data collected up to the time of your withdrawal.

12. Will my part in this study be kept confidential?

If you consent to take part in this study, the records obtained while you are in this study, as well as related health records, will remain strictly confidential at all times. The information will be held securely on paper and electronically at your treating hospital and Plymouth Hospitals NHS Trust under the provisions of the Data Protection Act (1998). Your name will not be passed to anyone else outside the research team or the sponsor, who is not involved in the study. You will be allocated a study number, which will be used as a code to identify you on all study forms.

Your name will only appear on your consent form, which will be kept separately and securely to any clinical results collected for the study. All other records will have your name removed and will only feature your study number.

Your records will be available to people authorised to work on the study but may also need to be made available to people authorised by the Research Sponsor, which is the organisation responsible for ensuring that the study is carried out correctly. A copy of your consent form may be sent to the Research Sponsor during the course of the study. By signing the consent form you agree to this access for the current study and any further research that may be conducted in relation to it, even if you withdraw from the current study.

The information collected about you may also be shown to authorised people from the UK Regulatory Authority and Independent Ethics Committee; this is to ensure that the study is carried out to the highest possible scientific and regulatory standards. All will have a duty of confidentiality to you as a research participant.

If you withdraw consent from further study participation, unless you object, your data will remain on file and will be included in the final study analysis.

All study data collected as part of the researcher's Medical Doctorate will be stored confidentially in an anonymised (non-identifiable) secure format, in line with the University of Plymouth's Ethics Policy for a period of 10 years. Any computer software or recordable devices used for the purpose of this research study will be encrypted to protect your data in a confidential manner.

13.   What will happen to the results of this study?

The results of the study will be available on completion and will usually be published in a medical journal or be presented at a scientific conference. The data will be anonymous and none of the patients involved in the study will be identified in any report or publication.

A brief report of the study will be available within the Endoscopy department. If you would like a report of the results we will ask for your address so we can send this in the post.

14.   Who is organising and funding this study?

The study has been organized as part of a Medical Doctorate with Plymouth University Peninsula School of Medicine and Dentistry in partnership between Professor J Edworthy (Plymouth University), Dr Catherine Ward (Consultant Anaesthetist, Plymouth Hospitals NHS Trust), and Dr Magdalena Metzner (Consultant Gastroenterologist, Plymouth Hospitals NHS Trust).

We have secured a grant from Bowel Cancer West. If additional funds are needed we will apply for further grants from sources aimed at Endoscopy and Improving the Patient Experience.

15.   Who has reviewed the study?

This study has been approved by Plymouth Hospitals NHS Trust Research and Development Department and has been given favourable ethical opinion for conduct in the NHS by the Health Research Authority (HRA) Research Ethics Committee, South West Cornwall and Plymouth.

16.   Contact for further information

Should you have any queries about this study you may contact the researcher Dr Charlotte Hitchins (Research Fellow in General Surgery) through the main hospital switchboard on 0845 1558155 (bleep 89958) or her academic supervisor Professor Edworthy (Plymouth University).

If you have concerns while on the study

Whilst it is something we hope will not happen, if you have concerns about any aspect of research please speak to the researchers using the contact details you will have been provided with. Alternatively, you may wish to contact the hospital's Patient Advice and Liaison Service (PALS).

PALS offers support, information and assistance to patients, relatives and visitors.

PALS can be contacted at:

Patient Advice & Liaison Service

Level 7

Derriford Hospital

Plymouth

PL6 8DH

Email: plh-tr.PALS@nhs.net

If you decide you would like to take part then please read, sign and date the consent form. You will be given a copy of this information sheet and the consent form to keep. One copy of the consent form will be filed in your patient notes; one will be filed securely, locked in a cabinet separate from the main research study records and one may be held by the Research Sponsor.

You can have more time to think this over if you are at all unsure.

Thank you for taking the time to read this information sheet and to consider taking part in this study.

5.4 Patient consent form

Participant Identification Number for this trial:

CONSENT FORM - Patient

Title of Project: **Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?**

Name of Researcher: **Dr Charlotte Hitchins** (MD Student, Plymouth University Peninsula School of Medicine & Dentistry; Research Fellow in General Surgery, PHNT)

Please initial box

1. I confirm that I have read the information sheet dated 17th Feb 2016 (version 2.3) for the

   above study. I have had the opportunity to consider the information, ask questions and have

   had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

3. I understand that relevant sections of my medical notes and data collected during the study, may be looked at by individuals from University of Plymouth, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.

4. I understand that the information collected about me may be used to support improvements

   in the future care of patients, and may be shared anonymously with other researchers and clinicians.

5. I consent to the storage of personal information for the purposes of this study. I understand that any information that could identify me will be kept strictly confidential (as required by the Data Protection Act 1998), and that no personal information will be included in the study report or other publication.

6. I agree to take part in the above study.

| Name of Participant | Date | Signature |

| Name of Person receiving consent | Date | Signature |

Thank you for agreeing to participate in this research

When completed: 1 for participant; 1 for researcher site file; 1 (original) to be kept in medical notes.

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Appendix 6 Patient Satisfaction Questionnaire

PATIENT SATISFACTION QUESTIONNAIRE

Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?

Thank you for consenting to take part in the above study. Please complete the following satisfaction questionnaire to inform us of your experience in the Endoscopy department.

Please note that any responses that you make will be anonymous, and will not affect your future care, and anything that you say will be treated confidentially.

Q1. What procedure did you have?

☐**Gastroscopy:** An examination of the inside of your stomach using a thin flexible tube passed through the mouth and oesophagus

☐**Colonoscopy:** An examination of the inside of the colon (bowel) using a thin, flexible tube inserted into the rectum

☐**Flexible sigmoidoscopy:** inspection of the lower colon (bowel) using a thin, flexible tube inserted into the rectum

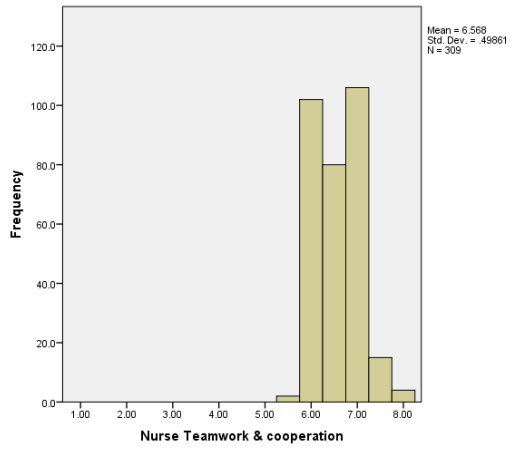☐**ERCP:** A procedure to x-ray the bile and pancreatic ducts. In this procedure a thin, flexible tube is passed through the mouth and down into the first part of the small intestine (duodenum).

☐**Unsure or don't know**

Q2. Were you given or sent leaflets about your procedure beforehand?

☐Yes   ☐No

Q3. If yes, did the leaflets explain your procedure in a clear manner?

☐Completely   ☐Partially   ☐Insufficiently   ☐Not at all

Q4. Did you find this information helpful?

☐Completely   ☐Partially   ☐Insufficiently   ☐Not at all

Please comment on the information, if you wish

[ ]

Q5. If there was a delay to your appointment time, were you given an explanation for the delay?

☐Yes   ☐No   ☐Not applicable

Q6. Were you offered sedation for your procedure?

☐Yes   ☐No   ☐Do not remember

Q7. If you were not offered sedation, would you prefer to have it next time, if you had this procedure again?

☐Yes   ☐No   ☐Maybe

Please comment on the sedation if you wish

[ ]

Q8. Before your procedure, were you informed of any potential risks?

☐Yes ☐No ☐Do not remember

Q9. Did you have the opportunity to discuss the procedure and any concerns you may have had prior to the procedure?

☐Yes ☐No

Q10. Did you feel that you were given enough information to decide whether or not you wished to go ahead (give written consent) to the procedure?

☐Yes ☐No

Q11. What was your procedure like?

☐Acceptable, I would have it again if necessary

☐Acceptable but uncomfortable, I would only have again if essential

☐Totally unacceptable, I would not have the procedure again

Please comment if you wish

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Q12. Were the results of the procedure explained to you afterwards?

☐Completely ☐Partially ☐Insufficiently ☐Not at all

Q13. Were you given an information sheet when you left the unit explaining what reactions to expect and where to telephone for further advice?

☐Yes ☐No

Q14. Overall, were you treated politely and with respect in the Endoscopy unit?

☐Yes ☐No (please comment)

Please comment if you wish

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Q15. Did you feel that your privacy and dignity were respected while you were in the unit?

☐Yes ☐No

Q16. Did you find the environment in the unit pleasant and comfortable?

☐Yes ☐No

Q17. Whilst in the Endoscopy Unit did you experience any problems that in your opinion could have been avoided?

☐Yes   ☐No

Please comment if you wish

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Q18. In your opinion are there any ways in which we could improve the service in the Endoscopy Unit?

☐Yes   ☐No

Please comment if you wish

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If there are any further comments you wish to make, please use the space below

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If you wish to have feedback regarding this questionnaire, please write your name and address here:

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Thank you for completing this questionnaire.

Please return it to a member of staff / in the envelope provided.

Produced by the Clinical Effectiveness Department Torbay Hospital April 2014.

Adapted for use in the study *"Do good non-technical skills correlate with good clinical outcomes in Endoscopy?"*
December 2015

Appendix 7 Chapter 3 additional tables and figures

7.1 Histograms to show the distribution of Oxford NOTECHS Scores (figures not included in main text)

7.1.1 Histograms to show the distribution of Endoscopist Sub-team Oxford NOTECHS II Scores
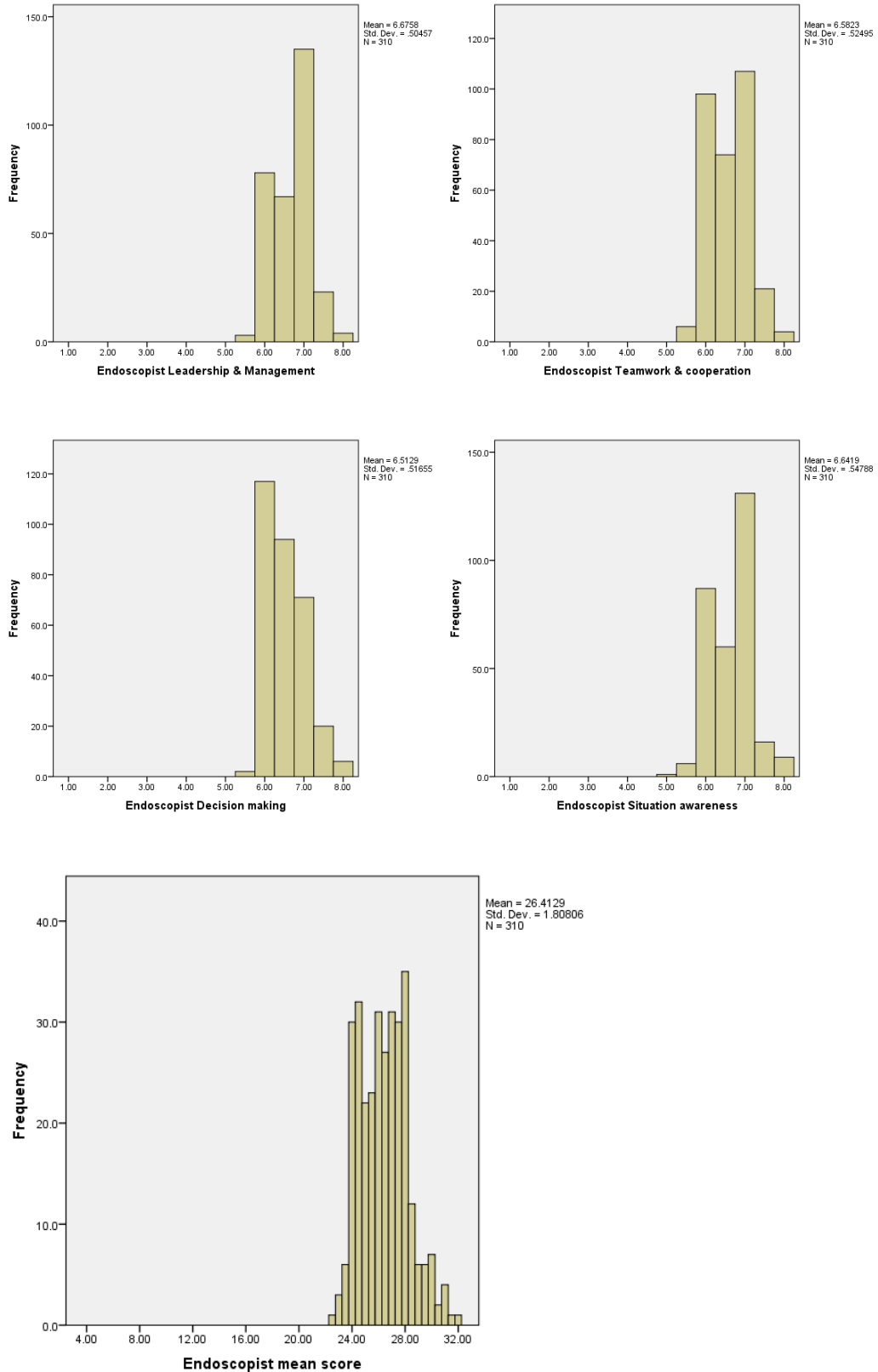
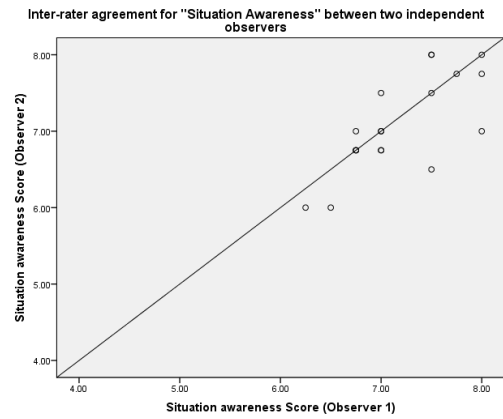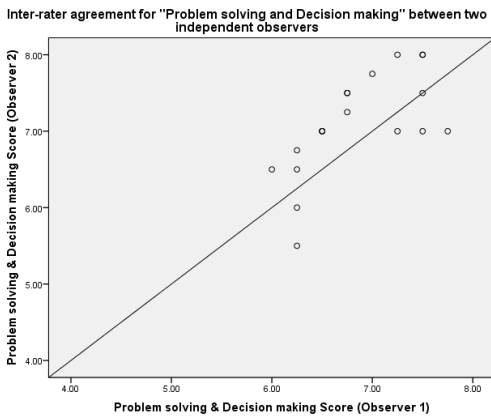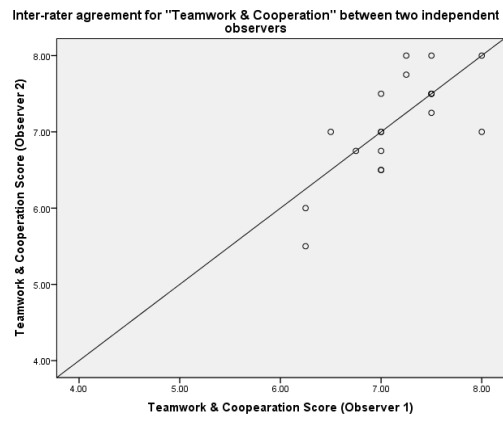### 7.1.2 Histograms to show the distribution of Nurse Sub-team Oxford NOTECHS II Scores

Mean = 6.3479
Std. Dev. = .45886
N = 309

Nurse Leadership & management

Mean = 6.568
Std. Dev. = .49861
N = 309

Nurse Teamwork & cooperation

Mean = 6.2217
Std. Dev. = .38251
N = 309

Nurse Decision making

Mean = 6.6165
Std. Dev. = .53088
N = 309

Nurse Situation awareness

Mean = 25.754
Std. Dev. = 1.57991
N = 309

Nurse mean score
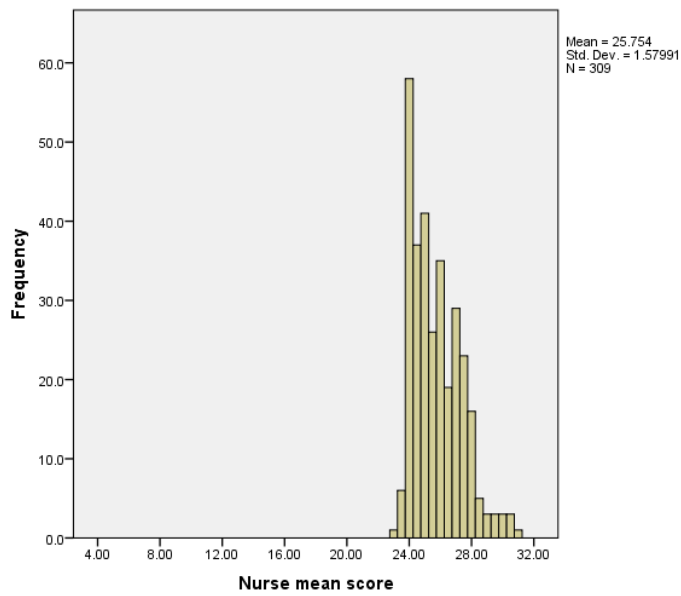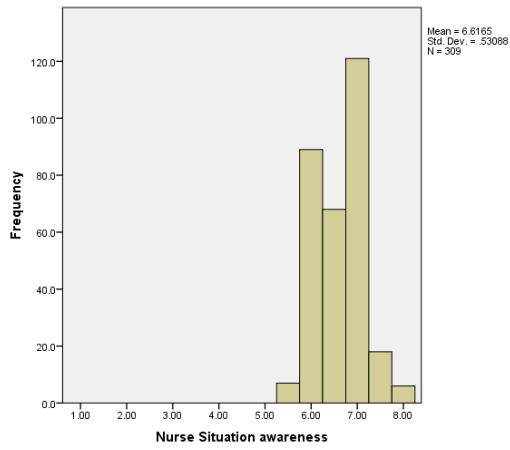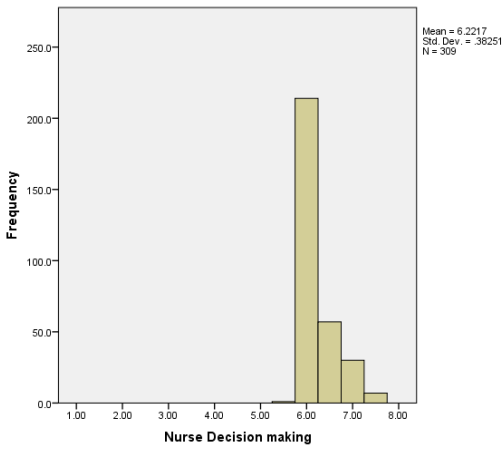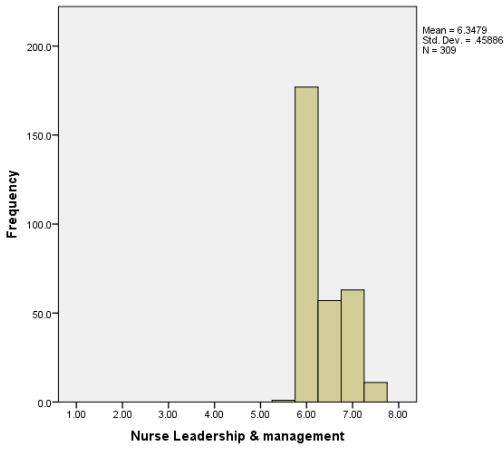
7.1.3 Histograms to show the distribution of Team Oxford NOTECHS II Scores
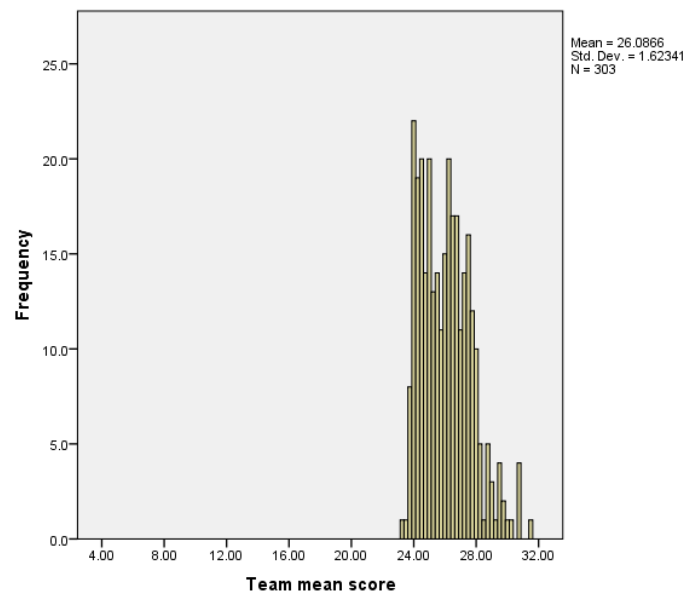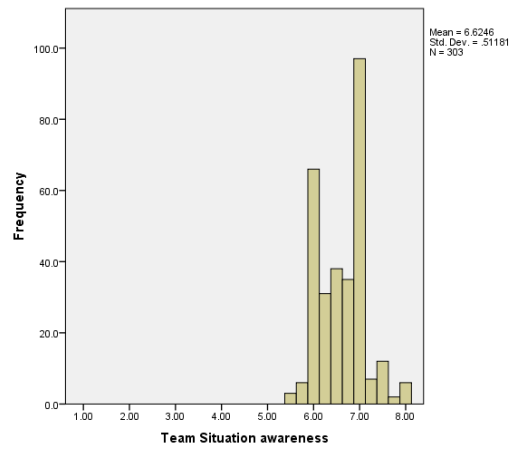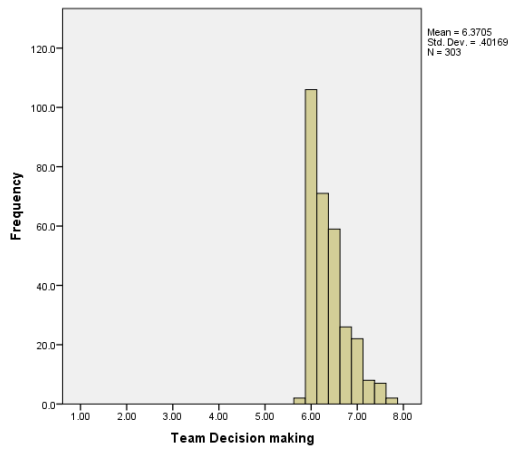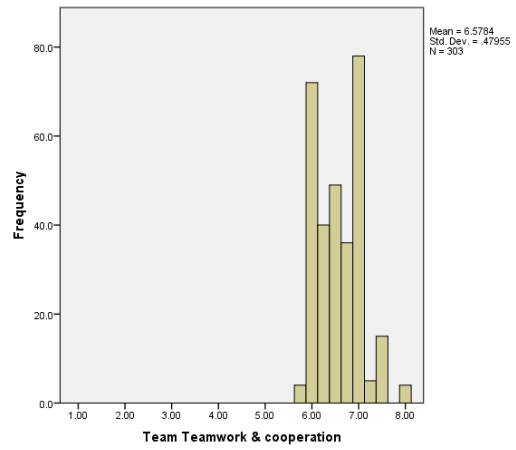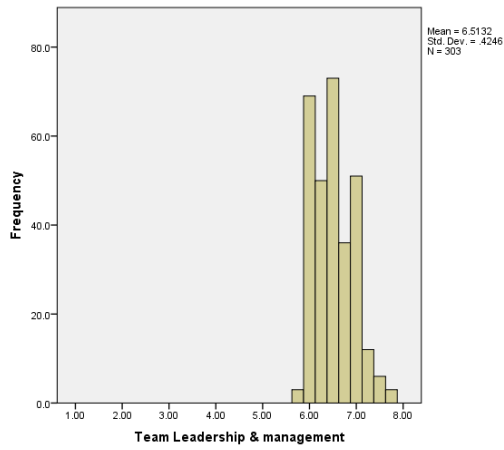
## 7.2 Inter-rater reliability (figures not included in main text)

### 7.2.1 Scatter plots to compare two independent raters

Inter-rater agreement for "Leadership & Management" between two independent observers

Inter-rater agreement for "Teamwork & Cooperation" between two independent observers

Inter-rater agreement for "Problem solving and Decision making" between two independent observers

Inter-rater agreement for "Situation Awareness" between two independent observers

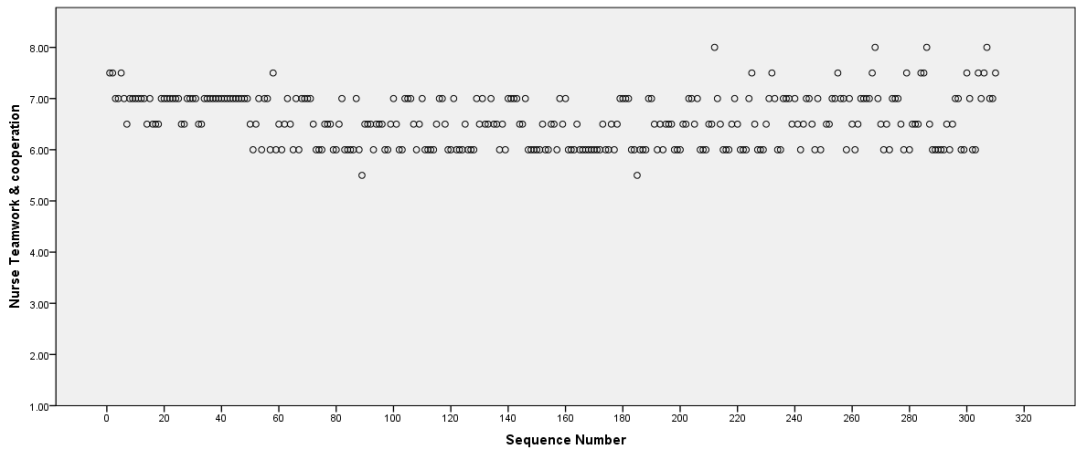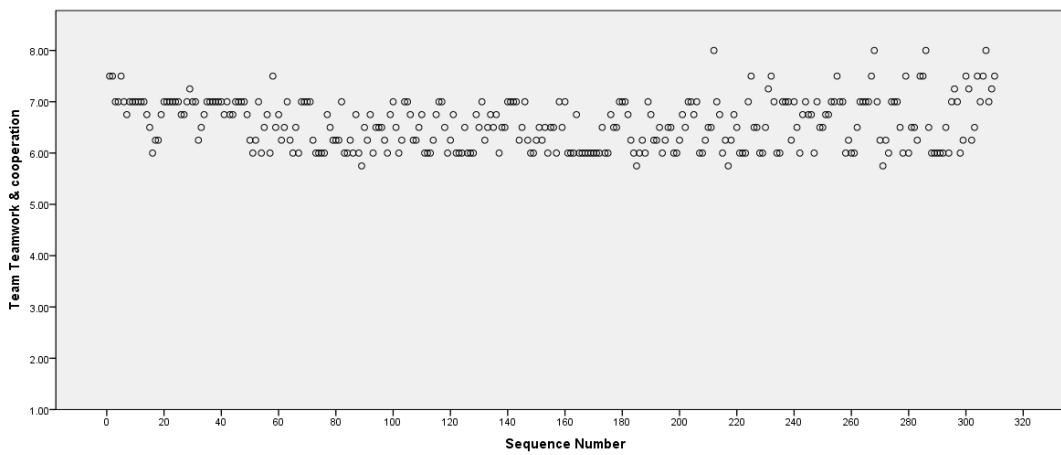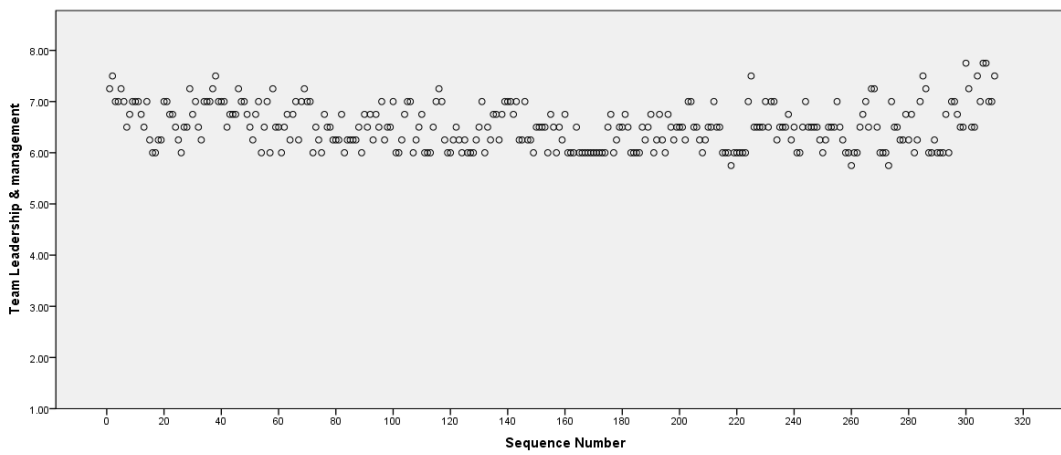Inter-rater agreement between two independent observers
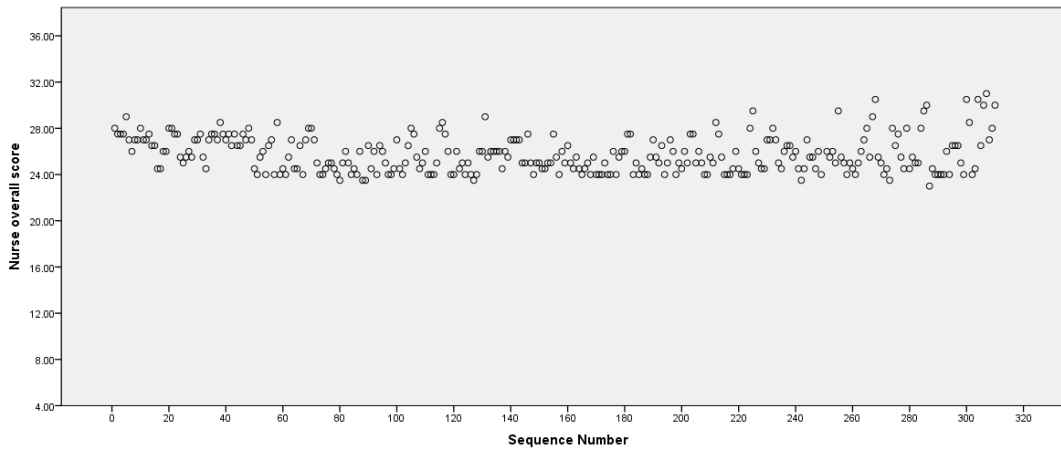
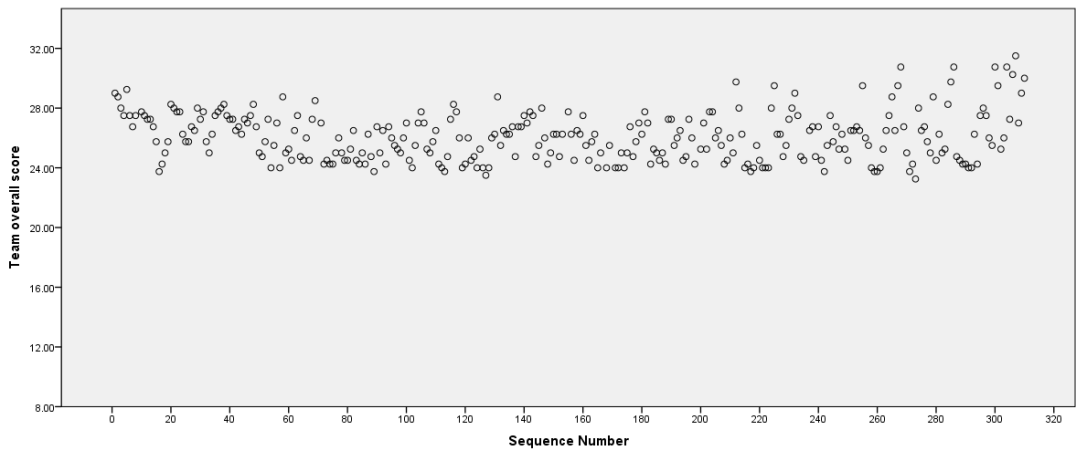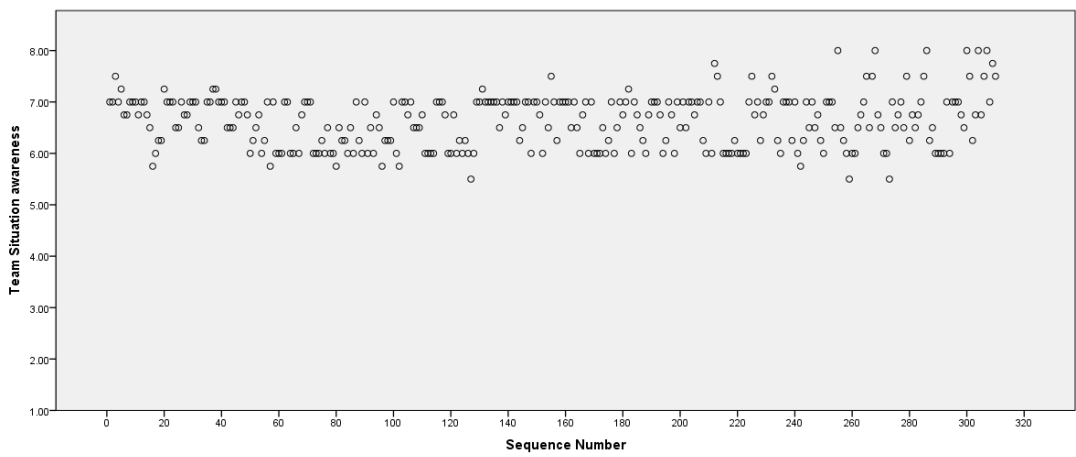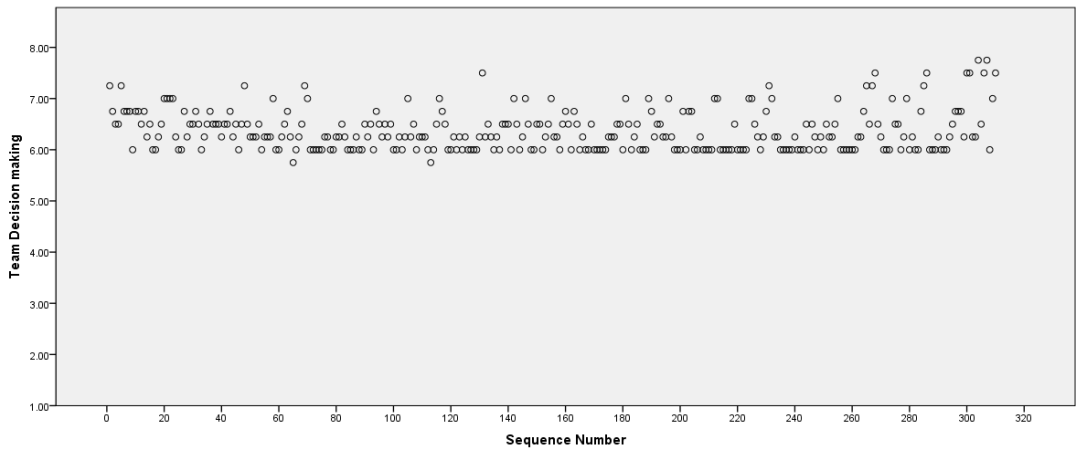## 7.3 Intra-rater reliability (figures not included in main text)

7.3.1 Scatter plot to show Oxford NOTECHS II scores by observation sequence number

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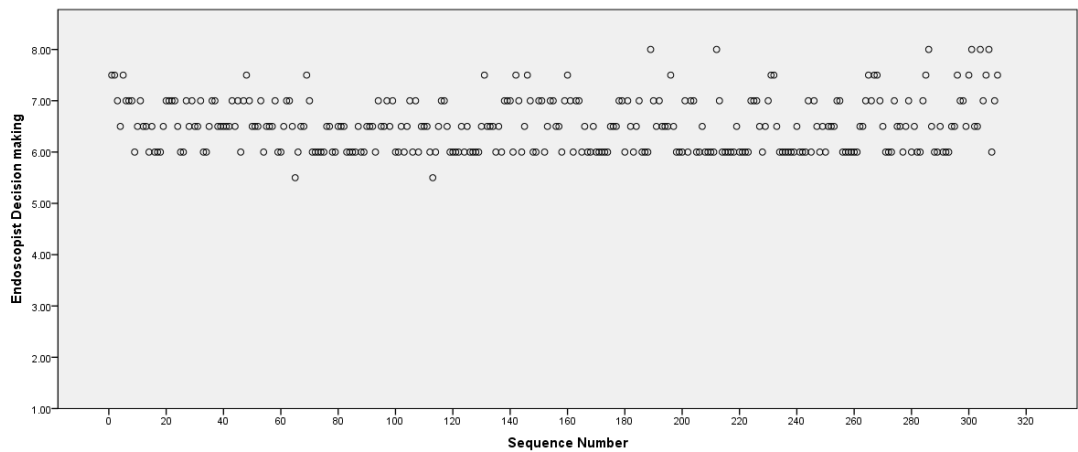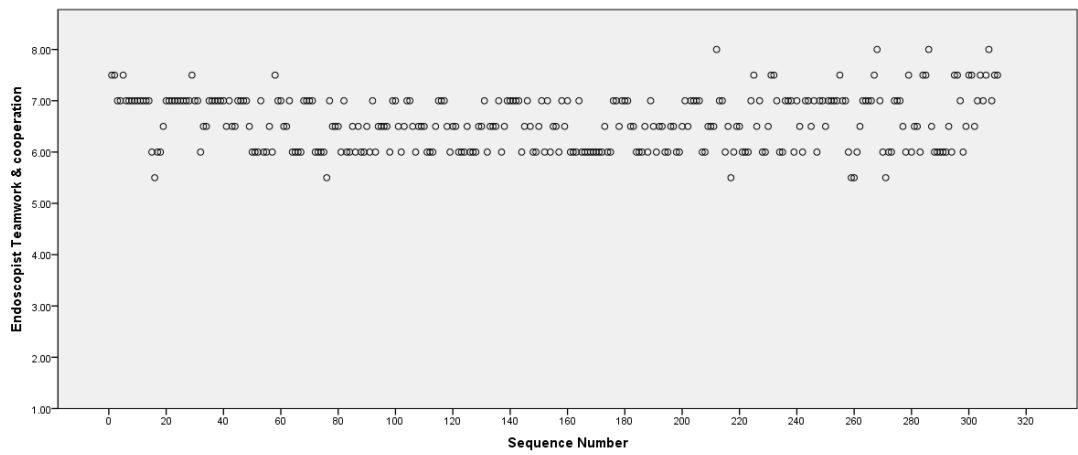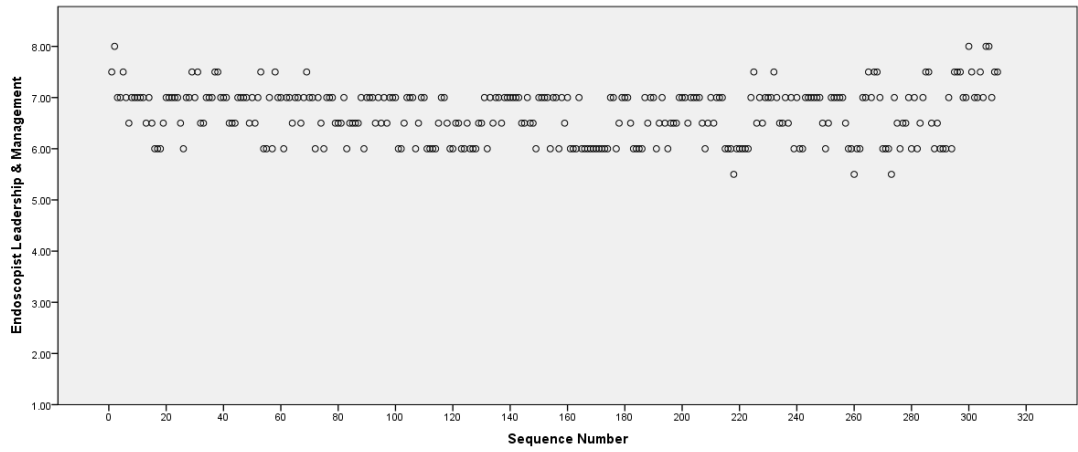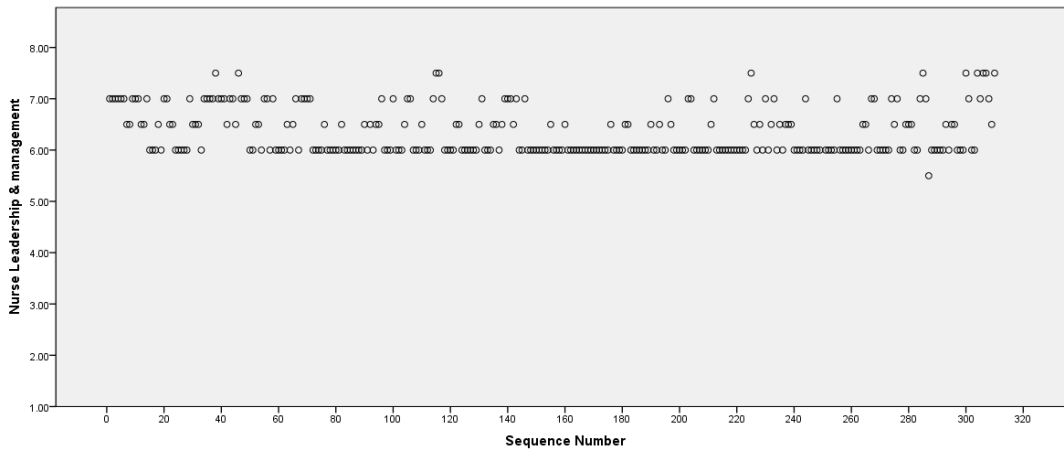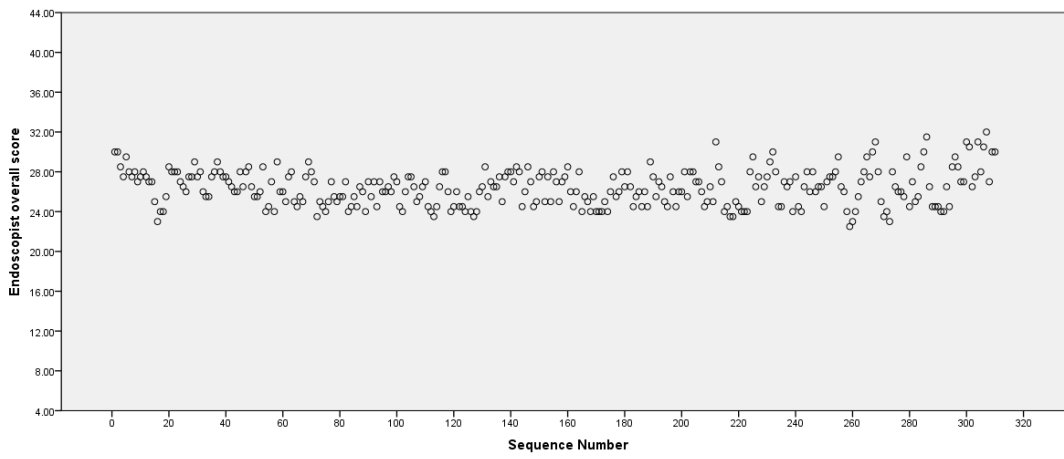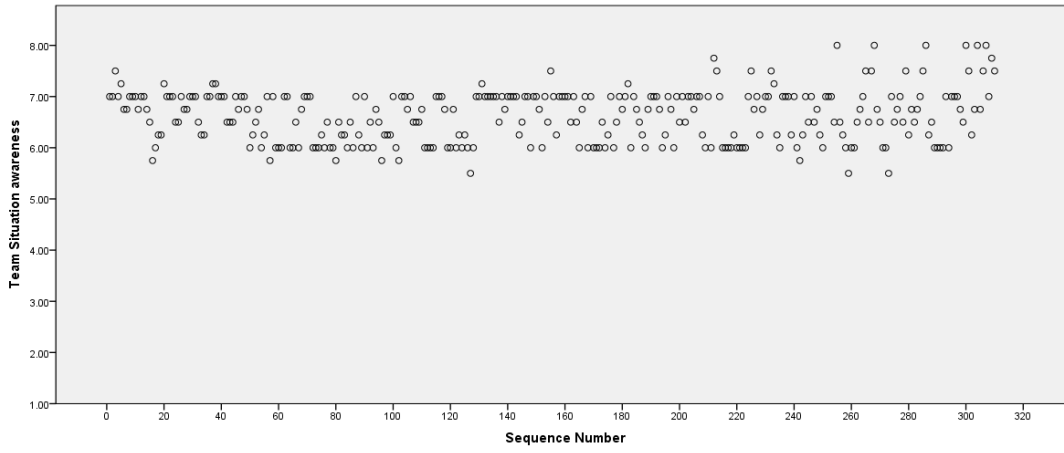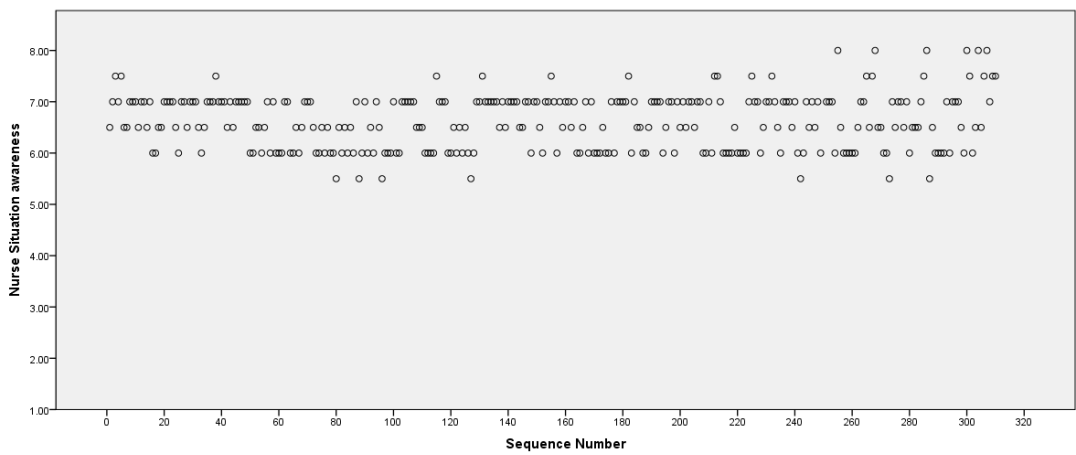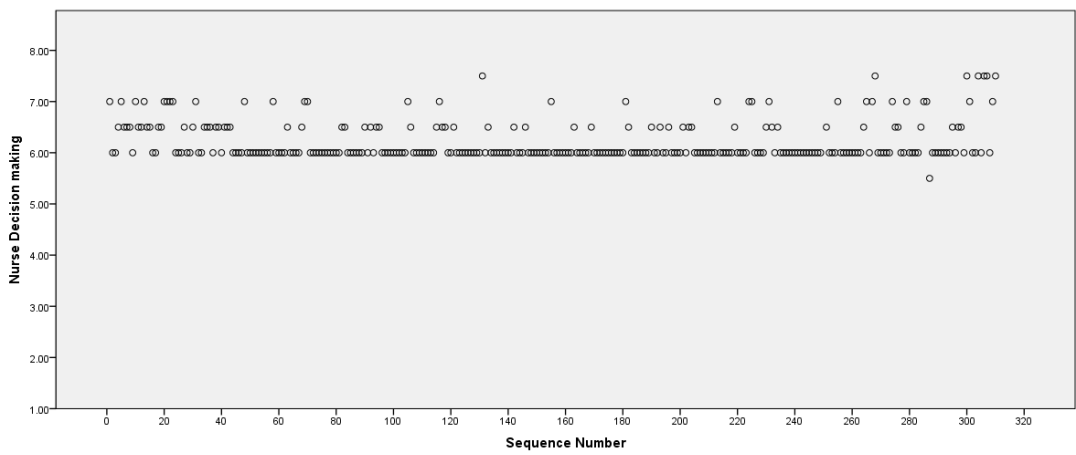
7.4 Effect of baseline characteristics on Oxford NOTECHS II Scores (tables not included in main text)

7.4.1 Table to show non-parametric analysis of the influence of Sedation on Oxford NOTECHS II Scores

	Median Oxford NOTECHS II Score		Mann-Whitney U Test
	Sedation N=218	No Sedation N=78	Sig. (p<0.05)
Endoscopist Sub-team			
Leadership & Management	7.00	7.00	.947
Teamwork & cooperation	6.50	6.50	.202
Decision making	6.50	6.50	.902
Situation awareness	7.00	6.50	.354
Total score	26.50	26.50	.518
Nurse Sub-team			
Leadership & management	6.00	6.00	.593
Teamwork & cooperation	6.50	6.50	.261
Decision making	6.00	6.00	.527
Situation awareness	6.75	6.50	.530
Total score	25.75	25.50	.438
Team			
Leadership & management	6.50	6.50	.770
Teamwork & cooperation	6.50	6.50	.189
Decision making	6.25	6.25	.884
Team Situation awareness	6.75	6.75	.352
Total score	26.25	26.00	.457
*p <0.5			

7.4.2 Table to show non-parametric analysis of the influence of throat spray on Oxford NOTECHS II Scores

|	Median Oxford NOTECHS II Score		Mann-Whitney U Test (*U*)
	Throat Spray N=51	No Throat Spray N=38	
Endoscopist Sub-team			
Leadership & Management	7.00	6.75	.737
Teamwork & cooperation	6.50	6.50	.931
Decision making	6.00	6.50	.993
Situation awareness	7.00	6.75	.655
Total score	26.50	26.00	.809
Nurse Sub-team			
Leadership & management	6.00	6.00	.833
Teamwork & cooperation	6.50	6.50	.700
Decision making	6.00	6.00	.652
Situation awareness	6.50	6.50	.779
Total score	25.00	25.00	.834
Team			
Leadership & management	6.50	6.50	.939
Teamwork & cooperation	6.50	6.50	.879
Decision making	6.25	6.25	.842
Team Situation awareness	6.75	6.625	.689
Total score	26.00	25.50	.923
*p <0.5			

7.5 Procedure outcomes (tables and figures not included in main text)

7.5.1 Procedure completion

7.5.1.1 Table to show Point-biserial correlation and logistic regression analysis of Oxford NOTECHS II Score and Procedure Completion

	r_{pb}	R^2 (Nagelkerke)	B (SE)	95% CI for Odds Ratio		
				Lower	Odds Ratio	Upper
Endoscopists						
Leadership & Management	.06	.02	0.72 (0.65)	0.58	2.06	7.33
Teamwork & cooperation	.03	.00	0.32 (0.66)	0.40	1.37	4.67
Decision making	-.07	.02	-0.66 (0.57)	0.17	1.52	1.59
Situation awareness	.03	.00	0.32 (0.59)	0.43	1.38	4.39
Total score	.02	.00	0.05 (0.18)	0.74	1.05	1.50
Nurses						
Leadership & management	.06	.02	0.88 (0.87)	0.44	2.42	13.23
Teamwork & cooperation	.06	.02	0.75 (0.70)	0.54	2.12	8.33
Decision making	-.01	.00	-0.19 (0.80)	0.17	0.83	3.96
Situation awareness	.01	.00	0.06 (0.61)	0.32	1.06	3.50
Total score	.04	.01	0.14 (0.22)	0.074	1.15	1.77
Team						
Leadership & management	.07	.02	1.04 (0.86)	0.52	2.84	15.38
Teamwork & cooperation	.05	.01	0.60 (0.72)	0.45	1.82	7.39
Decision making	-.05	.01	-0.61 (0.71)	0.13	0.54	2.19
Situation awareness	.02	.00	0.22 (0.64)	0.36	1.24	4.33
Total score	.03	.00	0.10 (0.21)	0.73	1.10	1.66
*p <.05 all values to 2 decimal places						

7.5.1.2 Box and whisker plot to show Oxford NOTECHS II scores compared by procedure completion
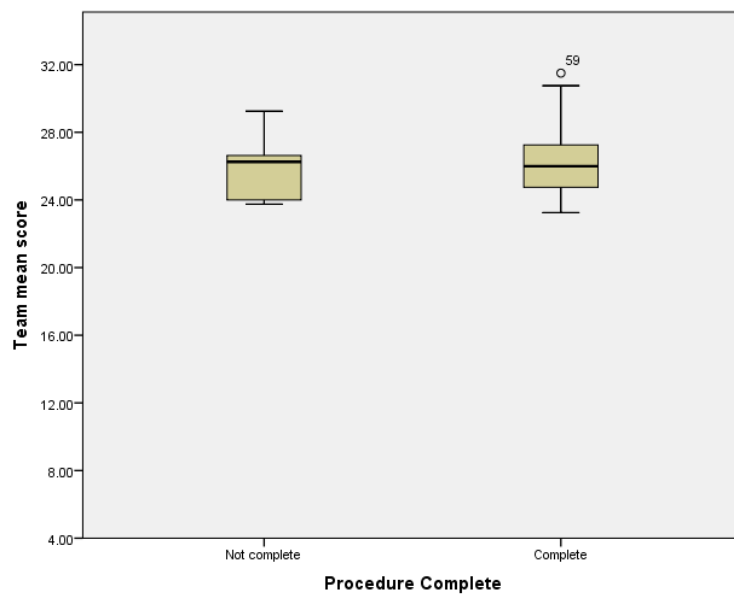
7.5.2 Glitch count

7.5.2.1 *Scatter plots to show Oxford NOTECHS II Scores against glitch count (for those sub-teams and score categories found to have a statistically significant relationship, see Table 3.19, Chapter 3, Section 3.4.5.1.2.1)*
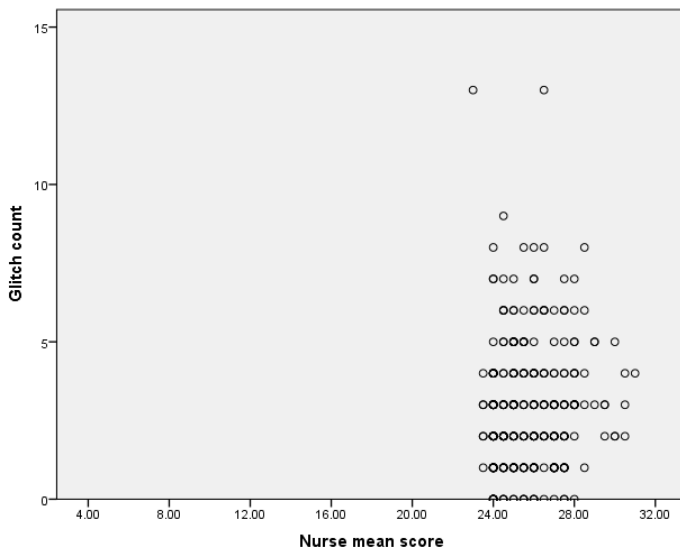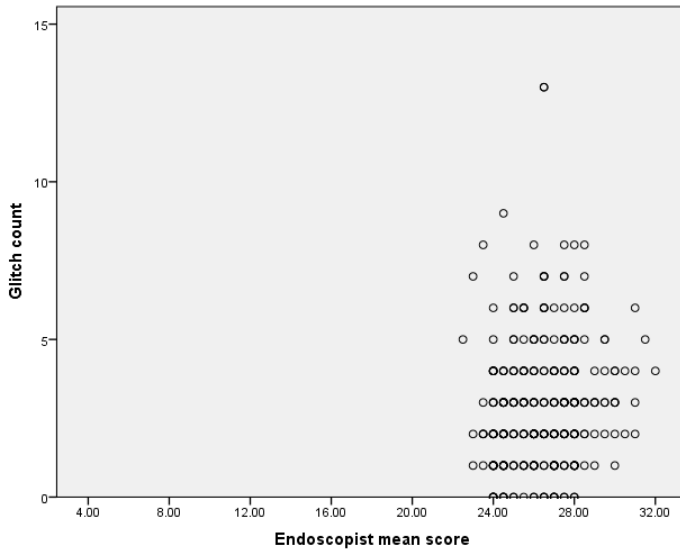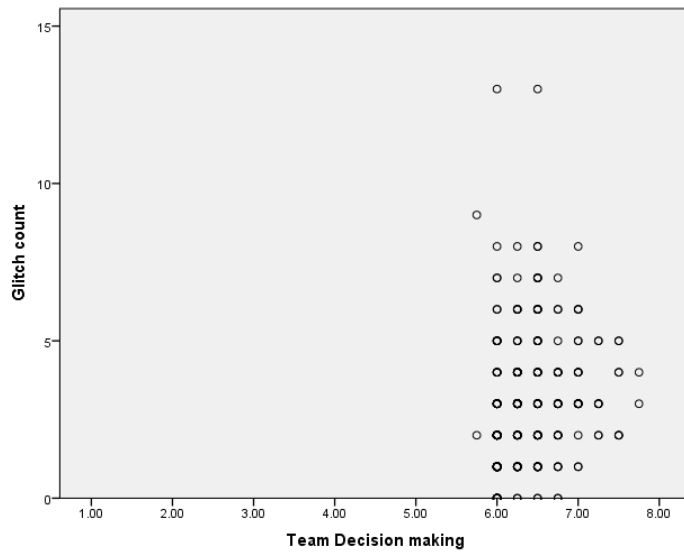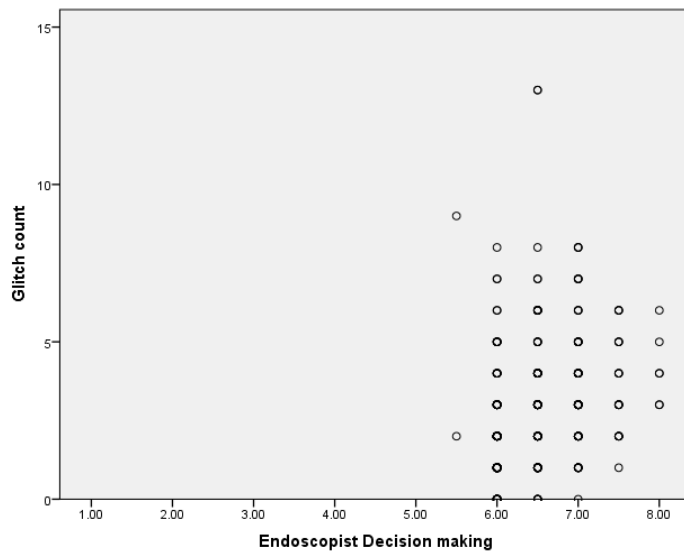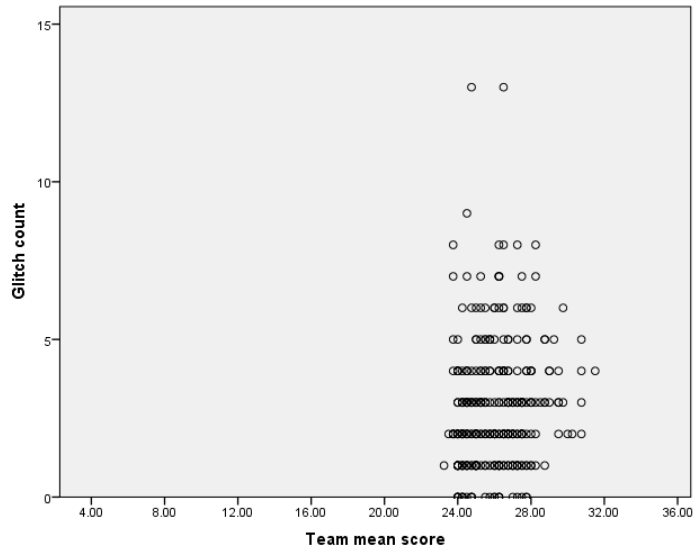
7.5.3 Units performed per list

7.5.3.1 Scatter plots to show Oxford NOTECHS II scores against Units performed per list (for those sub-teams and score categories found to have a statistically significant relationship, see Table 3.20, Chapter 3, Section 3.4.5.1.2.2)

Appendix 8 Staff information and Consent forms for qualitative interview study (presented in Chapter 4)

8.1   Staff information sheet

PARTICIPANT INFORMATION SHEET

For Staff Interviews

Study title: Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?

PART 1

1.   Invitation

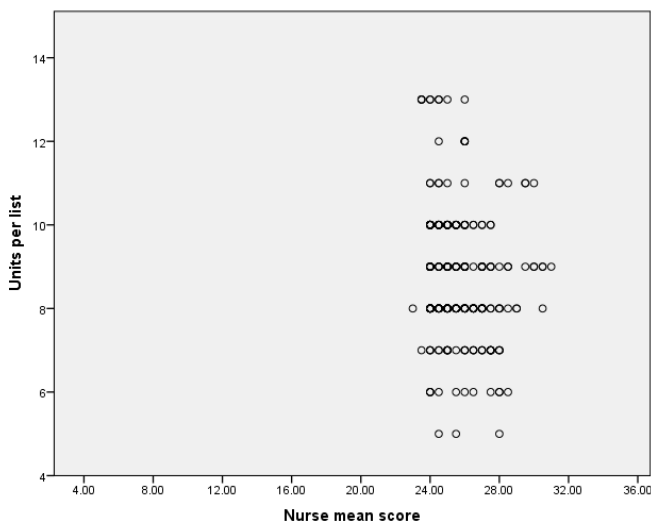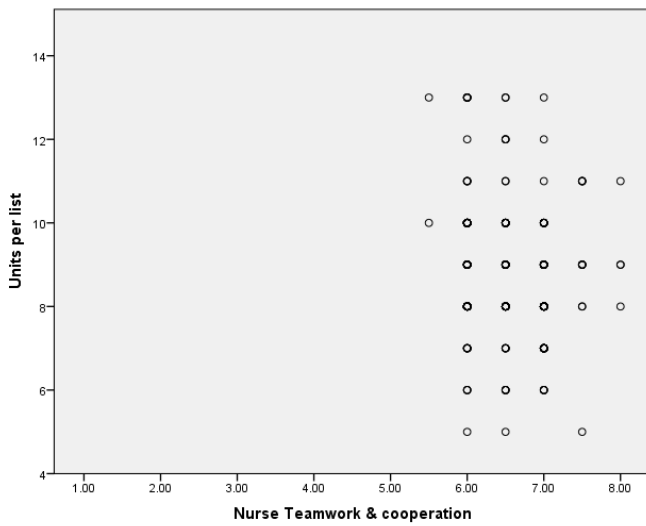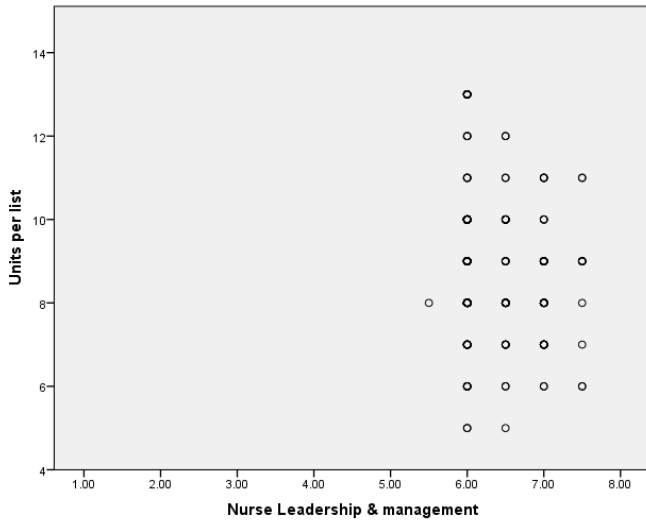You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully, and discuss it with others if you wish.

PART 1 tells you the purpose of this study and what will happen to you if you take part.

PART 2 gives you more detailed information about the conduct of the study.

Ask us if there is anything that is not clear, or if you would like more information. Take time to decide whether or not you wish to take part.

2.   What is the purpose of the study?

We know from other studies that when teams work well together, the chance of something going wrong is reduced. We think that good team work would also lead to good quality care, more satisfied patients and a more efficient service, but few studies have looked at this. The overall aim of this study is to see if there is a link between good team work, good quality care and patient satisfaction.

As part of this study we'd like to know what Endoscopy staff members feel are the most important behaviours that enable teams to function well. You are experts in your field and your views on this will help us to guide further team training and assessment within Endoscopy.

The study will form part of a Medical Doctorate qualification being undertaken by the researcher, Dr Charlotte Hitchins, with Plymouth University Peninsula School of Medicine and Dentistry in collaboration with Plymouth Hospitals NHS Trust.

3.   Why have I been invited?

You have been invited to take part because you work as a member of staff within the Endoscopy department and you are involved as part of the team carrying out endoscopy procedures on patients.

4.   Do I have to take part?

No. It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form to confirm that you understand what is involved when taking part in this study. If you decide to take part you are free to leave the study at any time and without giving a reason. If you withdraw, unless you object, we will still keep records relating to the information gathered.

5.   What will happen to me if I take part?

In addition to the observations that are taking place in the Endoscopy department we would like to gather information on what you feel are the most important non-technical skills required for your team to work well. If you are happy to take part, you will be interviewed by the researcher (Dr Charlotte Hitchins) at a time convenient to you. The interview will take

approximately thirty minutes and will be individual to ensure confidentiality of the information discussed. The interview will be audio-recorded. You will be asked questions relating to your experiences of teamwork within the Endoscopy department and your opinions on what behaviours are key to a successful team and working environment.

6. What are other possible disadvantages and risks of taking part?

If you agree to participate in the one-to-one interview then it will take half an hour of your time.

Interviews will be conducted on an individual basis, in a quiet room and will be kept strictly confidential. Audio-recordings and transcripts will be anonymised.

If you feel uncomfortable at any point during the interview process you will be free to withdraw. If you show any signs of distress, the interview will terminate. If required you will be referred to Occupational Health (Staff Health & Wellbeing). If there are any issues raised concerning bullying or harassment, the Plymouth Hospital NHS Trust Bullying and Harassment Policy will be followed. If the researcher uncovers any issues of poor practice then she has a duty of care to patients and would be required to report it to the Endoscopy team manager.

7. What are the possible benefits of taking part?

The researcher will gather information for the study from both the staff and patient perspective, it is hoped that the information obtained will go towards improving the way we provide care and the way we train staff in the future.

8. What if there is a problem?

If you have a concern about any aspect of this study or the way you have been approached, please ask to speak with the researcher or her supervisors who will do their best to answer your question. If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the hospital.

9. Will my taking part in this study be kept confidential?

Yes. All the information about your participation in this study will be kept confidential. The details are included in Part 2.

This completes Part 1 of the Information Sheet.

If the information in Part 1 has interested you and you are considering participation, please continue to read the additional information in Part 2 before making any decision.

PART 2

10. What will happen if I don't want to carry on with the study?

You are free to withdraw from the study at any time.

If you choose to withdraw from the study, we will destroy all your identifiable information, but if you agree we will use the data collected up to the time of your withdrawal.

11. Will my part in this study be kept confidential?

If you consent to take part in this study, the information obtained will remain strictly confidential at all times. It will be held securely on paper and electronically at Plymouth Hospitals NHS Trust under the provisions of the Data Protection Act (1998). Your name will not be passed to anyone else outside the research team or sponsor, who is not involved in the study. You will be allocated a study number, which will be used as a code to identify you on all study forms. All other records will have your name removed and will only feature your study number and staff grade.

Your interview results will be available to people authorised to work on the study but may also need to be made available to people authorised by the Research Sponsor, which is the organisation responsible for ensuring that the study is carried out correctly. A copy of your consent form may be sent to the Research Sponsor during the course of the study. By signing the consent form you agree to this access for the current study and any further research that may be conducted in relation to it, even if you withdraw from the current study.

The information collected about you may also be shown to authorised people from the UK Regulatory Authority and Independent Ethics Committee; this is to ensure that the study is carried out to the highest possible scientific and regulatory standards. All will have a duty of confidentiality to you as a research participant.

If you withdraw consent from further study participation, unless you object, your data will remain on file and will be included in the final study analysis.

All study data collected as part of the researcher's Medical Doctorate will be stored confidentially in an anonymised (non-identifiable) secure format, in line with the University of Plymouth's Ethics Policy for a period of 10 years. Any computer software or recordable devices used for the purpose of this research study will be encrypted to protect your data in a confidential manner.

12. What will happen to the results of this study?

The results of the study will be available on completion and will usually be published in a medical journal or be presented at a scientific conference. The data will be anonymous and none of the staff involved will be identified in any report or publication. A report of the study will be available within the Endoscopy department.

13. Who is organising and funding this study?

The study has been organized as part of a Medical Doctorate with Plymouth University Peninsula School of Medicine and Dentistry in partnership between Professor J Edworthy (Plymouth University), Dr Catherine Ward (Consultant Anaesthetist, Plymouth Hospitals NHS Trust), and Dr Magdalena Metzner (Consultant Gastroenterologist, Plymouth Hospitals NHS Trust).

We have secured a grant from Bowel Cancer West. If additional funds are needed we will apply for further grants from sources aimed at Endoscopy and Improving the Patient Experience.

14. Who has reviewed the study?

This study has been approved by Plymouth Hospitals NHS Trust Research and Development Department and has been given favourable ethical opinion for conduct in the NHS by the Health Research Authority (HRA) Research Ethics Committee, South West Cornwall and Plymouth.

15. Contact for further information

Should you have any queries about this study you may contact the researcher Dr Charlotte Hitchins (Research Fellow in General Surgery) through the main hospital switchboard on 0845 1558155 (bleep 89958) or her academic supervisor Professor Edworthy (Plymouth University).

If you have concerns while on the study

Whilst it is something we hope will not happen, if you have concerns about any aspect of research please speak to the researchers using the contact details above.

If you decide you would like to take part then please read, sign and date the consent form. You will be given a copy of this information sheet and the consent form to keep. One copy of your consent form will be filed securely, locked in a cabinet separate from the main research study records and one may be held by the Research Sponsor.

You can have more time to think this over if you are at all unsure.

Thank you for taking the time to read this information sheet and to consider this study.

8.2　Staff consent form

CONSENT FORM - Staff Interviews

Title of Project: **Do good Non-Technical Skills correlate with good clinical outcomes in Endoscopy?**

Name of Researcher: **Dr Charlotte Hitchins** (MD Student, Plymouth University Peninsula School of Medicine & Dentistry; Research Fellow in General Surgery, PHNT)

Please initial box

1. I confirm that I have read the information sheet dated 10th Feb 2016 (version 2.2) for the

   above study. I have had the opportunity to consider the information, ask questions and have

   had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.

3. I understand that interviews will be audio-recorded and transcribed. Identifiers will be removed to ensure my anonymity.

4. I understand that data collected during the study, may be looked at by individuals from University of Plymouth, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research.

5. I understand that the information collected about me may be used to support improvements

   in the future care of patients, and may be shared anonymously with other researchers and clinicians.

6. I consent to the storage of personal information for the purposes of this study. I understand that any information that could identify me will be kept strictly confidential (as required by the Data Protection Act 1998), and that no personal information will be included in the study report or other publication.

7. I agree to take part in the above study.

_____   _____   _____
Name of Participant   Date   Signature

_____   _____   _____
Name of Person   Date   Signature
receiving consent

Thank you for agreeing to participate in this research

When completed: 1 for participant; 1 for researcher site file.

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Appendix 9 Interview schedule for qualitative interview study

<u>Interview Schedule</u>

Introduction and development of rapport with the participant.

Explanation of the interview process to the participant.

Opportunity for questions and clarification of the process.

If participant agrees, consent form signed, collected and study number allocated.

Part 1:

Can you describe an Endoscopy case / procedure that was challenging? (Allow free speech to describe the situation).

Can you describe this situation again, allowing me to ask you questions about different aspects of the case and how the team worked together?

The interviewer will select probing questions from the list below to facilitate the conversation (adapted from Appendix 1, Development of a rating scale for surgeons' non-technical skills,   Yule et al. (2006b))

Social / Interpersonal

- *Who was in the leadership role?*
- *How was the leader appointed?*
- *Were any communications required?*
- *What would have happened if team members had been different?*
- *What role did you have on the case?*
- *How did you manage resources?*
- *Was there a briefing?*

Cognitive

- *What cues helped you understand the situation?*
- *What information did you use to recognize the situation?*
- *What were your goals at this time?*
- *Did your goals alter with the situation?*
- *How did you re-establish your goals?*
- *What options were open to you at this moment?*
- *How did you decide what option to take?*

- *Who in the team influenced decision making?*

- *What factors affected your decision?*

- *How did you reach your decision?*

- *Were other team members involved in the decision making?*

- *On what was your understanding of the unfolding situation based?*

- *How did you maintain awareness?*

- *To what extent did some of your situation awareness come from the team?*

- *What sort of projections were you making into the future?*

- *What sort of things were you anticipating?*

- *What helped you to maintain an overview of the situation?*

  Analogues/Experience

- *What could have gone wrong?*

- *What would a less experienced Endoscopist / nurse have done in the same situation?*

- *Do you need different skills to deal with crisis situations as opposed to routine procedures?*

- *What skills make an excellent Endoscopist / Endoscopy nurse / Endoscopy team member?*

Part 2:

What skills do you think are particularly important for the Endoscopy team to function well?

What behaviours do you feel positively impact the way the team works together?

Are there any particular behaviours that have a negative impact on the team?

Is there anything you feel is unique to the way the Endoscopy team works together compared with other teams you have worked in?

Is there anything I haven't asked that you feel is particularly important?

Do you have any questions?

Conclusion of the interview.

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