

Using a dark logic model to explore adverse effects in audit and feedback: a qualitative study of gaming in colonoscopy.

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Abstract

Background

Audit and feedback (A&F) interventions improve patient care but may result in negative effects. To evaluate plausible harms and maximise benefits, a-priori theorisation using dark logic models can be useful. We aimed to assess the unintended adverse effects of A&F in colonoscopy using Feedback Intervention Theory (FIT) based dark logic model.

Methods

As part of the National Endoscopy Database Automated Performance Reports to Improve Quality Outcomes Trial we undertook a qualitative study exploring current A&F practices in colonoscopy. Interviews were undertaken with endoscopists from six NHS endoscopy centres across England, purposively sampled for clinical background and professional experience. A framework method analysis of A&F in endoscopy was performed, mapping themes of paradoxical outcomes and patient harm to FIT and the theory of planned behaviour (TPB).

Results

Data saturation was achieved on 19th participant, with endoscopists from nursing, surgical and medical professional backgrounds and a median of 7 years' endoscopy experience (range 2–29 years).

Background

Audit and feedback (A&F) interventions have been shown to improve compliance with desired practice in healthcare professionals.[1] However, behaviour change interventions (BCI) may also generate negative effects. In the public health sector, similar interventions involving human agency and interruptions to complex social systems have been demonstrated to potentially have unintended or harmful consequences.[2] These have included BCIs that have been associated with higher rates of adolescent problem behaviour,[3] teenage pregnancy,[4] and rates of sexually transmitted infection in men who have sex with men.[5] In these examples, it was hypothesised that a better understanding of underlying mechanisms for harm or paradoxical effects may reduce harmful consequences. Predicting these potential problems does not mean a BCI should be wholly abandoned but, rather, provides the opportunity to modify it to avoid or minimise harms.[6]

Colonoscopy is a medical procedure that involves an endoscopist inserting a camera into the large bowel (intubation) then withdrawing the camera slowly looking for pathology (withdrawal). Before colonoscopy, the bowel is cleansed (bowel preparation) to allow visualisation.[7] Colonoscopy can be challenging to perform and poor-quality colonoscopy has serious consequences. Colorectal cancer (CRC) arises from

polyps, and polyp detection and resection at colonoscopy is pivotal in preventing CRC. Colonoscopists with lower polyp detection rates have higher rates of CRC after colonoscopy.[8–10]

Over the last 20 years the UK government has funded and supported implementation of a quality improvement programme overseen by the Joint Advisory Group on endoscopy (JAG). JAG and the British Society of Gastroenterology recommend key performance indicators (KPI) of colonoscopy quality, including completeness of procedure (caecal intubation rate), polyp detection rates and withdrawal time. [11,12] This period has seen the introduction of the UK's Bowel Cancer Screening Program (BCSP), requiring advanced accreditation for endoscopists undertaking screening work. These quality improvement interventions have been associated with a reduction in CRC mortality,[13] and further A&F interventions using a novel National Endoscopy Database (NED) are in development.[14] However, trials of A&F to improve colonoscopy performance to date have had heterogenous results, it is hypothesised this is due to colonoscopy being a complex motor skill and poor implementation or evaluation of BCIs. [15]

There are calls for the more explicit use of theory to understand mechanisms of change in BCIs to inform implementation[16] and evaluators are increasingly exhorted to develop logic models and descriptive theories of change.[17] Feedback intervention theory (FIT)[18] has been demonstrated to be such a suitable theoretical model for A&F interventions in healthcare settings.[19] Models often only focus on the intended benefits of the intervention. Dark logic models can be used to evaluate plausible harms and hypothesise their underlying mechanisms through a-priori theorisation[6]. In a clinical A&F context harms could include adverse outcomes which differentially affect patients in the care of practitioners who, themselves, are the target population for A&F interventions. This includes paradoxical effects, whereby an intervention increases a behaviour it seeks to prevent, and unintentional harmful effects to patient care.

In the development of the National Endoscopy Database Automated Performance Reports to Improve Quality Outcomes Trial (NED-APRIQOT) we undertook a qualitative interview study to explore the phenomenon of current A&F practices in colonoscopy to develop an A&F BCI.[20] The aim of this work is to explore the current phenomena of potential harms and adverse outcomes in A&F processes in endoscopy using a theoretical model based on FIT, to inform the design of a future BCI.

Methods

Independent endoscopists were recruited for face-to-face audio recorded semi-structured qualitative interviews at their workplace. Six English NHS endoscopy centres eligible for the NED-APRIQOT study were contacted by email, selected with convenience sampling for participants' availability. Eligible endoscopists[20] were purposively sampled with criteria comprising length of endoscopy experience and professional role (clinical lead, clinical-nurse endoscopist, gastroenterologist, surgeon, and trainee). Recruitment continued until sampling strata were filled and data saturation was reached, defined as no new themes arising in the last three interviews after 10 complete interviews.[21]

Interviewees were provided with a participant information sheet, explaining interviews would cover behaviours in endoscopy and A&F, and gave written consent. A topic guide was used, reviewed and revised (if needed) after each centre's interviews to facilitate depth and data saturation. Interviews were transcribed removing any identifiable information for analysis with demographic data pseudo-anonymised using a unique participant identifier. The interviewer (JC) kept a reflective log and made ethnographic observations about each endoscopy centre. Participants were provided with a copy of their transcripts to ensure anonymity and accuracy, and to drive meaningful conclusions from extracted quotes. Ethical approval was granted by Newcastle University Ethics Committee.

A Framework Method analysis was undertaken; FIT provided variables of interest as highlighted in Figure 1 and a preliminary basis for a relationship between codes and development of an analytical framework. FIT suggests that if an individual identifies a gap between current performance and a goal/target, they may adopt a strategy to reduce this gap and develop a coping mechanism, abandon the standard, reject the feedback message, or change the standard. FIT describes behaviours as tasks at three possible levels:

- Meta task – beliefs about the self that are required to perform a task, for example “I am a good endoscopist”
- Task motivation – where one applies an already learnt behaviour, for example “I will resolve this loop in the sigmoid”
- Task learning – new tasks where one focuses on motor movements, for example “I will apply clockwise torque and pull the colonoscope back slowly”.

The theory of planned behaviour (TPB)[22] was used to explore beliefs about behaviours within FIT. The TPB identifies beliefs around actions and tasks as:

- Behavioural beliefs – attitudes towards the behaviour and effects of the behaviour
- Control beliefs – the perceived control of the behaviour by participants
- Normative beliefs – perceived social pressures around behaviours.

FIT proposes that A&F interventions should aim to improve performance by encouraging coping mechanisms through personal reflection and supervision (Figure 1). A&F processes should maintain the endoscopist workforce and provide credible data on performance to avoid rejecting feedback messages.

The Framework Method analysis using inductive ‘open coding’, based on Gale et al [23] involved the following steps:

- Preliminary reading of full transcripts, ensuring accuracy, and adding context
- Generation of initial descriptive codes, inductive ‘open coding’ paraphrasing the text ideally using participants own words

- Developing an analytical framework after 8 transcripts, grouping codes into subthemes tagged to FIT domains or TPB beliefs. Codes which did not sit within FIT or TPB were analysed in “bucket” subthemes
- Applying the analytical framework indexing subsequent transcripts codes
- Charting data: subthemes and their relationships were reviewed and mapped to FIT themes with corresponding quotes from data to ensure accuracy.

Interviews and analysis were undertaken by a single researcher (JC), codes were logged with a clear audit trail. Themes were reviewed with original quotation data to ensure accuracy and triangulated with observation data and personal reflection from the time of interview. As the coding and analysis progressed the authors met to critically review, challenge and discuss findings. Data are reported in two major areas: paradoxical effects and harmful effects. Illustrative quotes are provided.

Results

Six endoscopy centres were recruited from April 2019 to February 2020, four in the North East of England and two in the West Midlands. Centres had a median of 7 endoscopy rooms across sites; the range (2–8 rooms), demonstrated a good range of small to large endoscopy centres.

Saturation of themes was achieved by participant 19. Ten of the 19 participants identified as being female. Seven were from a gastroenterology medical background, six from a nursing background, four from a surgical background and two were gastroenterology trainees. There was a median of 7 years' endoscopy experience, with a range of 2–29 years (Table 1).

Table 1 Endoscopy centres and their participants' roles

*BCSP – bowel cancer screening program accredited endoscopist, trainer – train the trainers course accredited endoscopist.

Participant	Site ID	Endoscopy experience (years)	Professional title	Clinical background	Further accreditation BCSP or trainer*
P1	1	12	Consultant, unit lead	Gastroenterology	BCSP, trainer
P2	1	3	Clinical endoscopist	Nursing	Trainer
P3	1	7	Consultant	Gastroenterology	Trainer
P4	1	3	Consultant	Colorectal surgery	
P5	2	23	Consultant, unit lead	Gastroenterology	BCSP, trainer
P6	2	22	Consultant	Gastroenterology	BCSP, trainer
P7	2	20	Clinical endoscopist	Nursing	BCSP, trainer
P8	2	2	Consultant	Colorectal surgery	
P9	3	11	Consultant, unit lead	Gastroenterology	Trainer
P10	3	12	Clinical endoscopist	Nursing	Trainer
P11	3	2	Consultant	Colorectal surgery	
P12	3	6	Clinical endoscopist	Nursing	
P13	4	7	Consultant	Gastroenterology	Trainer
P14	5	17	Clinical endoscopist	Nursing	BCSP, trainer
P15	4	4	Consultant	Gastroenterology	Trainer
P16	5	2	Clinical endoscopist	Nursing	
P17	1	2	Specialist Trainee	Gastroenterology	Trainer
P18	6	2	Specialist Trainee	Gastroenterology	Trainer
P19	6	26	Consultant	Colorectal surgery	Trainer

Paradoxical effects

Paradoxical effects are summarised in Figure 2 in orange.

Rejecting the gap – seeing peers' performance

Participants often identified themselves in a social professional group of peers with comparable case mix, job plan or professional background, and this identity was viewed as important to them. Within these groups, social norms were identified for performance and endoscopists had a perception of "*what your level is at*" (Participant (P) 9). Performance being perceived as similar to others within this group provided reassurance and reduced motivation to improve, even if this performance was below an aspirational target (Table 2: Subtheme (S)1-2).

As well as national standards for minimum performance, all centres provided a normative comparison to peers with information about other endoscopists' performance within the centre. This is justified in FIT as providing an aspirational goal from a known expert. Participants saw the aspirational performance as motivating and benchmarking with colleagues whom they recognised as experts. It helped individuals to make plans to improve their performance. "*I looked at who had the best polyp detection rate and I thought, 'I would like my polyp detection rate to be nearer to that than what it is now'*" (P13).

Cognitive interference and quitting

Participants described that thinking about A&F data could impede performance and risked endoscopists getting "*bogged down*" (P10). One participant described "*thinking about your figures, it's probably not brilliant ... I mean I find it can be really emotionally draining*" (P1). Participants described how negative feedback, without a plan to improve performance, reduced their confidence, worsened performance, and increased the risk of quitting colonoscopy (Table 2:S3).

Colonoscopy is a complex motor skill, with many underlying task-motivation processes which participants were able to describe, including: position changes, managing air and resolving loops (Table 2:S4). However, some of these task-motivation processes were higher-level behaviours which participants struggled to describe: one participant described "*using 'the force'*" (P19, Table 2:S4), suggesting colonoscopy is related to confidence, a meta-task self-perception behaviour. A clinical lead described the reason endoscopists quit endoscopy "*wasn't because of any technical ability, it was just [their] confidence*" (P1). There were concerns that an individual's feedback "*might end up being a little bit negative and a bit destructive*" with the risk that "*you think 'I'm not very good here. I'm not benchmarking very well ... that might be quite demotivating'*" (P1). However, participants recognised being receptive to negative feedback was an important part of a clinical role and a culture for quality improvement.

Participants generally accepted that KPIs showing repeated underperformance suggested something was wrong, and if an endoscopist was unable to address underperformance they should consider or may be

asked to stop scoping: "*if we're not good at something and we've tried to address it and we can't find what's wrong and you can't address it, then maybe you just need to think about something else or giving it up, I guess.*" (P18).

These high stakes lead to cognitive interference and anxieties focused on possible motives of the feedback other than to improve performance. These suspected ulterior motives included accusing endoscopists of not doing enough, persecuting endoscopists who were wrongly perceived to be incompetent, and policing performance to stop people from scoping (Table 2:S5). Cognitive interference put endoscopists "*under pressure ... to go the extra mile*" (P5) to reach targets, which could lead to gaming and harmful externalities. One participant described how if endoscopists were made aware of targets "*but they're not showed down our throats*" (P8) this may reduce the pressure to consider gaming (Table 2:S6).

Table 2: Paradoxical effects subthemes and illustrative quotations

Subtheme	Quotation
1. TPB normative belief: norms for identified group	<i>"I think you kind of have a concept in your mind of what your level is at and who you should be, what group you should be in." (P9)</i>
	<i>"When I look at other endoscopists they always seem to be a little bit higher than mine. There was also one of our other nurse endoscopist colleagues who was always the same as me and we did a lot of endoscopy, us two, and I wondered whether it was because we did so many that that had an effect and that the people who were actually higher detection rates did very few colons... the ones who actually had higher detection rates than me were actually, I thought personally, not as good endoscopists." (P10)</i>
	<i>"you want to see where you stand within the group and everyone else. So, for me, it reinforced to do what I was doing. I don't think I made any particular changes, to be honest." (P17)</i>
2. TPB normative belief: seeing others' underperformance reassurance	<i>"I guess if your performance is not so good but everybody else's is similar then you're a bit like, 'Well that's probably okay,' and that's probably not quite the right way to go about it." (P3)</i>
	<i>"I would want to see more people at my level, on the report, to know if I'm as crap as the report is making out or if this is reality of where I fall." (P16)</i>
3. FIT cognitive interference: reduced confidence	<i>"Probably I would but I don't want to bog myself down with [KPI]. Because I know there are some endoscopists who get bogged down with completion rates and things like that and you know at the end of the day if you can't manage to get where and you've tried every avenue to get that caecum you have to accept that" (P10).</i>
	<i>"It was all quite negative feedback and all not positive, which I came back from the course seriously reconsidering whether I should actually continue in endoscopy. I lost a lot of confidence and I think by giving that sort of feedback without any positives ... can actually destroy your confidence and I think to do this job you need to be confident in what you're doing ... [since the feedback] I struggled with a lot of different things. Things I had been doing naturally, I had been doing what I had been taught I was very hesitant to do, because it had not worked on the course, and all the crappy feedback I got." (P2)</i>
	<i>"I feel quite confident and competent, although I suppose, like everybody, you get dips and peaks and troughs, which is the world, especially, of colonoscopy... Or you get a run, which you tend to, of incomplete colonoscopies, and you think, 'What am I doing here?'" (P14)</i>
4. FIT goal hierarchy: task motivation processes	<i>"So you're busy thinking 'get to the caecum', what am I going to do, change position, withdraw some air, put some water in, what can I do to optimise my position and you're thinking all these things in your head." (P12)</i>
	<i>"I tend to break operations up into lots of little steps, that have to be achieved, before you proceed to the next one. So, I would achieve it by saying, the first step is intubation, ... check the patient's position, check you've given them the correct medications and then you can start the second part, which is withdrawal and detection and resection." (P4)</i>
	<i>"It's quite a nice technical challenge...Using the force and I use that in the 'Star Wars' thing to work out how you're going to coax the scope round. So, hope the force is with you and you can be like Luke with the helmet off, dropping the scope just down into the middle of the Death Star." (P19)</i>

5. FIT cognitive interference: feedback's ulterior motives	<p><i>"I think initially I'll often be like, 'I'm not doing enough. Why am I not doing enough? Am I being got at?" (P3).</i></p>
	<p><i>"I think what you need to be very careful of is that you don't move beyond monitoring to ensure safe standard and to drive up and improve standards into persecution, ... making more of an issue for an individual than is actually the case when perhaps that individual needs time just to settle in and let things calm down, rather than actually that individual is not competent at doing what they are doing." (P11)</i></p>
	<p><i>"I know that there is concern amongst my colleagues that this kind of data is used against you and I think there's some people that feel that it may be used to stop you doing certain procedures, which I think is worrying and I hope that's not the intention of it." (P8)</i></p>
	<p><i>"if [my performance] dropped then I guess there is always a worry of whether they will stop me doing this". (P15)</i></p>
6. FIT cognitive interference: leading to gaming	<p><i>"I think the danger is not having people get too bogged down in [KPI] so they start gaming their numbers." (P3)</i></p>
	<p><i>"I mean that a lot of my biggest concern about these KPI's is they're either encouraging people to lie, or they are encouraging people to attempt to do something which is maybe to the detriment of the patient, because they are concerned about their outcomes. ... We didn't want [endoscopists] to feel that they were under pressure to do these or to go the extra mile if the patient had comorbidity or was finding discomfort". (P5)</i></p>
	<p><i>"We're all aware of the goals of the unit but they're not shoved down our throats, so we're not made to do things that make us feel uncomfortable to hit these targets. We're told what our data is and have the opportunity to discuss that with the endoscopy lead and if there are any concerns, that would be raised but it's not rammed down us all the time, this is what you have to achieve, not at all." (P8)</i></p>

Harmful effects

"when you are getting performance figures ... at times you've got to think are you doing this [behaviour] for your figures or are you doing it for the patient ... when you do it more for the patient, then you do notice your figures drop. So it is a hard one, to manage that." (P12)

Harmful effects are summarized in Figure 2 in red and were mapped to a "gaming" (P3) theme. Themes describing 'harm' were categorised as being indirect and direct. Indirect harms were generated from inaccurate documentation ("fudging" (P8)), and direct patient harms from removing polyps without clinical indication and persevering to complete procedures.

Inaccurate documentation – withdrawal time

A minimum withdrawal time of six minutes is set by the British Society of Gastroenterology[11]. There was a perception that this was not taken seriously by some endoscopists who would document six minutes on the report without accurately noting the time. *"So, for the purposes of a quiet day I'm going to*

say this is six minutes and I really don't care if anyone around me knows it isn't. I think that does happen, I'm sure it happens in every department" (P5).

In three centres, nursing assistants were trained to note the withdrawal time on behalf of endoscopists with the goal of improving withdrawal time as demonstrated in previous trials.[25] This was initially perceived as intimidating external scrutiny by participants but they had come to consider that it reduced fudging withdrawal times. "*I would like to think I wouldn't [game withdrawal time] but it is hard for me to hide now because the nurses are documenting it so... [Laughter]" (P15).* When assistants noted the withdrawal time participants described other endoscopists engaging in time-wasting behaviours, such as starting the withdrawal timer early and "*hanging around*" in the rectum at the end of the test, these behaviours prolong the length of the test without improving colonic inspection or benefiting the patient (Table 3:S1).

Most participants expressed beliefs that polyp detection is important, and that longer withdrawal time improves detection. Participants assumed that endoscopists who undertake time-wasting behaviours did not appreciate the clinical importance of withdrawal time on polyp detection, "*a lot of people just see it as getting the scope out. And maybe aren't as aware that it's a really key part of the examination, especially if they trained quite a long time ago" (P12).*

Inaccurate documentation – completion rates

The participants described examples where bowel preparation and procedure documentation could be used to artificially inflate completion rates. Participants reported if endoscopists were unable to complete a colonoscopy that some converted the procedure documentation from a colonoscopy to a flexible sigmoidoscopy (Table 3:S2). One participant noted that if the insertion was difficult, endoscopists may inaccurately document inadequate bowel preparation, "*oh poor bowel prep, let's just come out" (P12), to later justify a low completion rate (Table 3:S3).* Bowel preparation was not perceived to be under the endoscopist's control, "*you can't change bowel prep" (P17)*, therefore inadequate preparation reduced the perception of fault for low completion or detection rates (Table 3:S3).

Comfort score and patient experience inaccuracy

The participants perceived patient experience and comfort as being important to colonoscopy quality and to patients. Measures of patient comfort are recommended as a national marker of colonoscopy quality and used in colonoscopy A&F practice.[11] Comfort scores are an assessment of the patient's experience by the endoscopist or nursing assistant, these were perceived as inconsistent and of variable quality (Table 3:S4).

One participant described their experience as a trainer, reviewing a trainee endoscopist's portfolio and their patient comfort scores. The participant noted that in all 230 procedures, all patients were documented as being comfortable and noted that this would not be possible. This "*horrified*" the

participant, “[the trainee] said, ‘Well that’s what the consultant’s put on the thing.’... it just wasn’t important to [them]” (P7).

Table 3: Harmful effects –documentation subthemes and illustrative quotations.

Subtheme	Quotation (Participant (P))
1. FIT gaming indirect harm: fudge withdrawal time	<p><i>"That's always one of the things that you worry about is are you just going to take off a load of rectal polyps in the same way that you could just withdraw and sit in the rectum for five minutes, couldn't you, and then say your withdrawal times."</i> (P3)</p>
	<p><i>"when it comes to withdrawal times ... some people will say, "Start the clock," and then [the nurses] say well, "Are you actually at the caecum?" ... "some endoscopists who had then kind of hung around the rectum for a couple of minutes saying, 'I'm staying here around the rectum for a couple of minutes because I have to".</i> (P5)</p>
	<p><i>"Of course, you have to be wary of withdrawal time. I hear anecdotally from the nurses that: 'So and so has a long withdrawal time but eight minutes of that [they are] sitting in the rectum talking.'</i> (P19)</p>
2. FIT gaming indirect harm: conversion to sigmoidoscopy	<p><i>"people have changed what was an intended colonoscopy to a flexi sig because of poor prep or that's as far as they've got and you can see the nursing documentation, the original referral."</i> (P7)</p>
	<p><i>"I know some people kind of falsify figures and I always put if it's a colon it's a colon. If it's a failed colon it's a failed colon. It's not a sigmoidoscopy it's a colonoscopy and I know that people do not always follow that... That skews the figures as well... It's very common."</i> (P10)</p>
3. FIT gaming indirect harm: bowel preparation	<p><i>"I do understand that some endoscopists could potentially fudge their figures and are feeling tired, "oh poor bowel prep, let's just come out". So I do understand that, so I don't know what the answer is but it is hard because you do get poor bowel preps."</i> (P12)</p>
	<p><i>"my caecal intubation rate is lower than it should be perhaps, mainly because of poor bowel prep."</i> (P2)</p>
	<p><i>"Well part of the problem with [detection rates] is some that will be down to poor prep. I can think of a number of cases recently where the prep in the right colon is fairly smeary. If you had better prep, you'd probably have [detection]."</i> (P19)</p>
4. TPB control belief: comfort	<p><i>"There's no consistency with regard to whether the data is the endoscopist's personal view or whether it's they have taken feedback from the nurses in the room talking to the patient".</i> (P5)</p>
	<p><i>"I was signing off a colonoscopy portfolio for somebody for JAG certification and I just said, "You've done your 230 or whatever." I said, "Why is everyone of your patients comfortable?" ... I hadn't done individual training with this person. And I just thought, "Oh my God. What on earth." They said, "Well that's what the consultant's put on the thing..." ... But it just wasn't important to him. I just thought, oh my goodness, throughout his training, where has that perception come from. And I was really worried ... I said, "I'm not signing you off until you go back and we do some more work and have a look at sort of these comfort scores with patients and whatever." But it was through no fault of their own in some ways but I was absolutely horrified."</i> (P7)</p>
	<p><i>"Comfort has been such a difficult thing ... every unit does it differently, newer nurses will call your patients as higher discomfort because they've never seen the procedures before ... we've got everybody using different nursing scales".</i> (P7)</p>

Harmful effects – patient care

Perseverance despite patient discomfort

Participants perceived that colonoscopy can be painful, and that persistent patient discomfort should limit colonoscopy (Table 4:S1). Participants described being "*frightened*" (P7) by their completion rate performance figures causing them to "*drive on and cause [patients] discomfort and pain*" (P14) in order to achieve a complete test. One participant highlighted inappropriately completing procedures with poor bowel preparation and being aware that the behaviour "*was unsafe, I'm going to miss loads of pathology here*" (P12), due to perceived pressure to have a high completion rate to achieve a bowel cancer screening accreditation (Table 4:S2).

Unnecessary polypectomy

Detection and removal of colonic polyps was mentioned as important by all participants and described as the "*main goal*" (P12) of colonoscopy. Participants described polyp detection and polypectomy KPIs as incentivising the removal of clinically insignificant lesions such as distal colon diminutive hyperplastic polyps (Table 4:S3). International guidance does not recommend the removal of such lesions.[26,27] This behaviour to increase the recorded detection rate was recognised as having no clinical benefit to the patient, "*snipping those off isn't going to help a patient*" (P8), and potentially increasing the risks of complications particularly in the "*elderly and frail*" causing them "*more harm*" (P7). Removing and leaving a polyp was not always a clear decision, and assessing the risks and pragmatism was recognised as being important (Table 4:S4).

Table 4: Harmful effects - patient care subthemes and illustrative quotations.

Subtheme	Quotation (Participant (P))
1. TPB normative belief: patient experience should limit colonoscopy	<p><i>"I'm not one who's going to push through a very painful, uncomfortable, difficult colonoscopy, just to get caecal intubation, if that's not right for the patient, then I'm not going to do it." (P8)</i></p> <p><i>"... [If] you've had a run of a few people who are uncomfortable, I don't think that actually saying that you said, no I'm not going to torture you anymore and withdrew, I don't think that's an unreasonable situation to be in. Rather than when we have reasonable alternatives, in terms of CT colonography". (P11)</i></p>
2. FIT gaming direct harm: perseverance despite patient comfort	<p><i>"I know sometimes people persevere with things that they shouldn't be persevering with because they're frightened of their figures, performance data. And I think that has become a bit of a danger." (P7)</i></p> <p><i>"If you're going to have bad bowel prep, do you then fight your way through the bad bowel prep to get to caecum. So then you get your caecal intubation high or do you actually say, look this is unsafe, I'm going to miss loads of pathology here, let's call it a day. But then obviously recently, because I'm going for bowel cancer screening, caecal intubation rates is very important to me. So I have been fighting against poor bowel prep, where normally I would just call it a day, rebook, give enhanced bowel prep." (P12)</i></p> <p><i>"If you're looking at completion rates it's different. Because people then drive on and cause people discomfort and pain". (P14)</i></p>
3. FIT gaming direct harm: Unnecessary polypectomy	<p><i>"I guess if you're always slightly under you'd say, 'Well do I need to start thinking about looking a bit harder or taking off something, rectal hyperplastic ones?" (P3)</i></p> <p><i>"The goalposts have moved. So, I think initially, it was just, as I say, when we first started, people were leaving the small stuff in the 74-year old whereas now you're just accepting that you're taking everything off." (P7)</i></p> <p><i>"Simply a polyp detection rate isn't good enough because you can always find metaplastic polyps in an elderly population". (P19)</i></p>
4. FIT gaming direct harm: Unnecessary polypectomy risks harm	<p><i>"In a [frail elderly] patient where you find the diminutive polyp and are you really going to risk that patient having a perforation by taking off a small polyp which is not going to ever have any effect on their life span? ... I think the [endoscopy] standards are potentially causing risk in those two areas. ... the wrong incentive is there." (P5)</i></p> <p><i>"More senior gastroenterologists will be more pragmatic ... if I actually take that [insignificant polyp] off and make a hash of it and they're elderly and frail, I'm doing this [colonoscopy] to prove that they haven't got a big cancer ... taking something little off, that could cause them more harm, they're not going to do it". (P7)</i></p>

Discussion

Statement of principal findings

Our study is the first to explore paradoxical effects and potential harms of current A&F interventions in colonoscopy, using a dark logic model. Paradoxical effects included social norms reassuring underperformance and performance anxiety causing cognitive interference. Participants described inaccurately completed documentation so that completion rate and withdrawal time targets appeared to

be achieved. Harmful behaviours included perseverance with the colonoscopy procedure despite patient discomfort and unnecessary polypectomy.

Strengths and weaknesses of the study

The study team perceived possible harms would be a difficult topic to discuss, however participants were frank in their discussion about gaming behaviours. On reflection, the interviewer was an endoscopist, who understood and recognised participants' experiences and could use the same language and references. The interviewer was acquainted with four participants through academic or clinical work (P2, P4, P15, P17) and had previously received training from 5 participants (P1, P3, P9, P10, P13). These were not close friendships and the interviewer was junior to the participants in age, his position as a trainee, and experience. It is possible that this shared clinical speciality and, in some instances, prior acquaintance helped to build rapport, encouraging participants to be open and frank, although occasionally communication had vestiges of the trainer-trainee relationship.

In responding to correspondence and agreeing to be interviewed about performance in endoscopy, we may have a self-selected group of those with a personal interest in endoscopy A&F or quality more generally. Although the prevalence of gaming behaviours in endoscopists is unknown, examples of gaming were described by endoscopists from all professional backgrounds and varied length of experience. Participants rarely described their own negative behaviours, but often described these as the actions of unnamed others. These were disclosed in a conversational tone, with an implied intention to prevent them from arising. The findings of this work were presented to unsuspecting disinterested endoscopy colleagues at an endoscopy meeting locally, who confirmed they recognised these behaviours in their own practice, and the pressures to undertake them.

Strengths and weaknesses in relation to other studies

The Cochrane review found A&F interventions were modestly effective, but that there was high variation in effectiveness.[28] Application of behavioural theories, such as Clinical Performance Feedback Intervention Theory, have been used to retrospectively explain why feedback may not have been effective, but without prospective theorisation of potential harms or paradoxical effects.[29] Past research evaluating A&F harms has focussed on organisational effects such as the negative impact of on-off actions, which may worsen variation in performance,[30] rather than individual practitioner behaviours and patient harms. Our study demonstrates a theoretical model can be used to map both benefits and adverse effects of A&F, in accordance to FIT, including patient harms.

Exploration of paradoxical effects was enriched with normative beliefs in the TPB. National social norm feedback is effective in changing healthcare behaviours when practitioners see themselves as an outlier, such as reducing overprescribing of antibiotics.[31] Psychology literature has described social norms having paradoxical "*boomerang*" effects on high performers.[32] Our participants did not describe

boomerang effects, perhaps as there was no ambiguity that high detection is positive which can reduce the impact of a social comparison.[33] However, low performers were reassured by similar peers. Social comparison theory suggests when individuals identifying performance is aligned with others in a group it reduces the motivation to change behaviour, this highlights the importance of using an aspirational social comparison.[34,35]

Participants described examples of gaming where endoscopists identified completion rates as an important KPI and expressed a wish to appear to reach the target. Documentation converting a failed colonoscopy to a flexible sigmoidoscopy, a shorter procedure without a completion target, is a recognised unintended consequence of A&F.[36] The inaccurate documentation falsely elevates performance and may cause a *ratchet effect*, where this creates future unrealistic targets and puts more pressure on endoscopists.[37]

Inaccurate colonoscopy documentation from A&F pressures is postulated in the literature, particularly for withdrawal time with the view that "*not all 7 minutes are equal*".[38] This study indicates that endoscopists identify a performance gap, with a withdrawal target they desire to appear to meet, but reject behaviours that increase inspection time. This may be related to factors reducing perceived control of withdrawal time such as competing time pressures or difficult prolonged insertion, which are associated with lower detection of pathology.[39] We identified potential educational needs around the importance of inspection technique, withdrawal time and documentation accuracy; educational interventions addressing these and supplementing A&F may be effective for colonoscopy improvement. [15]

Mechanisms and implications for clinicians or policymakers

Cognitive interference

Colonoscopy performance has been described as a complex psychomotor skill requiring higher cognitive tasks,[40] and our participants described confidence (a meta-task belief) as a requirement. FIT suggests receiving negative feedback can change perceptions of the self and interfere with meta-tasks. Anxiety about negative performance leads to individuals thinking about their own unmet goals, which draws attention away from undertaking tasks or increases pressure on their performance, called cognitive interference.[18] Our participants' anxiety was increased by underperforming in perceived important targets, such as completion rates and polyp detection KPIs, which are emphasised in national quality guidelines.[11]

Participants described cognitive interference and how anxiety about underperformance pressurises endoscopists to perform gaming behaviours. To avoid harmful behaviours in endoscopy A&F, interventions need to address the underlying cognitive interference which drives these behaviours.[41] Cognitive interference and gaming pressures are highest on behaviours with outputs perceived as being

inaccurate or unmeasured, which may be sacrificed to achieve measured targets.[37] Therefore, the challenge for endoscopy A&F is to measure what is important well.

Measuring performance

Adequate bowel preparation is recognised as essential for high quality colonoscopy, and required for caecal intubation and polyp detection.[11] All participating centres used the Aronchick or Ottawa bowel preparation scales, however documentation remains subjective, using non-standardised criteria with poor quality assessment of these scales.[42] Blaming bowel preparation, which is not perceived to be under endoscopists control, offers the endoscopist an opportunity to protect themselves from a perception of fault for low completion rates. This incentivises inaccurate documentation, which improving standardisation of bowel preparation scores may reduce.

As was evident in this study, underperformance against detection targets risks incentivising removal of distal hyperplastic polyps, potentially risking patient safety. Increasing the accuracy of polyp detection KPI could be achieved by assessing a polyps histology to calculate an adenoma detection rate (ADR): future iterations of NED may link with histological databases to facilitate this.[43] However, ADR does not include significant non-adenomatous polyps. As part of the preliminary Delphi process in NED-APRIQOT a proximal polypectomy rate in conjunction with traditional polyp detection KPI was considered by participants to promote the removal of clinically significant right-sided lesions and reduce the incentive to remove distal hyperplastic polyps.[20,44]

Patient experience is a key aspect of healthcare quality. Comfort scores that are endoscopist reported have been criticised, as patients and endoscopists have been shown to have different priorities around the endoscopy experience.[41,45] We found that patient comfort documentation was perceived as variable and its accurate documentation was not always important to all endoscopists. In the poor recording of the patient experience, A&F processes potentially expose patients to the risk of discomfort as endoscopists may prioritise achieving better-measured performance targets. Better assessment and recording of the patient experience with validated patient-reported experience measures for endoscopy, such as the “*Newcastle ENDOPROM™*”, may reduce this risk.[41]

Unanswered questions and future research

Our dark logic model suggests addressing cognitive interference and anxiety of underperformance in A&F initiatives is key to reducing potential harms. Planned and targeted A&F, where possible, should focus on task-motivation behaviours, which practitioners can use to implement a plan to improve performance. In colonoscopy, examples from the literature to improve polyp detection includes: increasing withdrawal time[46], prescribing hyoscine butylbromide[47], and turning the patient’s position on withdrawal[48]. A colonoscopy BCI with task-motivation plans and supplemental educational material are being tested in the NED APRIQOT study.[20]

An A&F intervention aimed at improving leadership training in centre leads demonstrated improved colonoscopy performance centre wide[49]. Our study demonstrated that where there is underperformance in behaviours related to meta-tasks, such as poor completion rates due to endoscopist confidence, then addressing this is a complex social task. This is the challenging work of local clinical leads. Our study suggests feedback should be pragmatic and clearly identify its motivation to provide support and alleviate anxiety. Opportunities to be observed performing colonoscopy, or buddying, for those persistently underperforming may be used to explore understanding of targets, focus on and develop behaviours poorly assessed by KPI, and bolster confidence [50]. Further study of clinical leads experiences implementing support for those persistently underperforming, and identification of clinical leads own training needs should be explored in future qualitative research.

Conclusion

This example of using a dark logic model to map adverse effects has been insightful in our endoscopy setting and can be applied to different clinical settings where A&F is directly relevant to improve the clinical performance. Our study highlights that A&F interventions may create a mix of desired effects, in accordance to FIT, but also some adverse effects. Without theorising and focussing on adverse effects in A&F design, evaluations might fail to identify and reduce A&F's potential harms. In this setting, choosing aspirational social comparisons, using plans that target task-motivation behaviours and clarifying the motive of feedback may reduce paradoxical outcomes. Improved patient experience measures may reduce the risk of comfort being sacrificed to achieve other targets. To reduce harms driven by cognitive interference colleagues should be offered education and support to bolster confidence.

Declarations

Ethics approval

Ethics approval was granted as part National Endoscopy Database Automated Performance Reports to Improve Quality Outcomes Trial (NED-APRIQOT: Trial registration ISRCTN11126923). Qualitative interview study ethics approval was granted by Newcastle University Ethics Committee, Ref 9521/2018.

Consent for publication

All participants provided written consent for non-identifiable publication of transcript extracts and direct quotations from data.

Availability of data and materials

Data was accessed in conjunction with Newcastle University data security policy. The datasets generated and/or analysed during the current study are not publicly available due to possible identification of

participants through triangulation but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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<https://www.health.org.uk/research-projects/ned-apriqot-%E2%80%93-national-endoscopy-database-automated-performance-reports-to-improve>

The Health Foundation had no role in the design of the study, collection, analysis, interpretation of data or writing of manuscripts.

Authors' contributions

JC developed the qualitative methodology, interviewed participants, analysed and interpreted data, and wrote the manuscript.

RBG was a major contributor to the qualitative methodology, checked transcripts and codes, and was a major contributor in writing the manuscript.

LS was a major contributor to the qualitative methodology, checked transcripts and codes, and was a major contributor in writing the manuscript.

MR developed the NED-APRIQOT protocol, identified eligible NHS endoscopy centres, and was a contributor in writing the manuscript.

FS was a major contributor to both the qualitative methodology and in writing the manuscript.

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Abbreviations

A&F Audit and feedback

BCI Behaviour change intervention

CT Computer tomography

FIT Feedback intervention theory

JAG Joint advisory group on gastro-intestinal endoscopy

KPI Key performance indicator

NED National endoscopy database

NED-APRIQOT National endoscopy database automated performance reports to improve quality outcomes trial

NHS National health service

P Participant

Prep Bowel preparation – bowel cleansing before colonoscopy

S Subtheme

TPB Theory of planned behaviour

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Figures

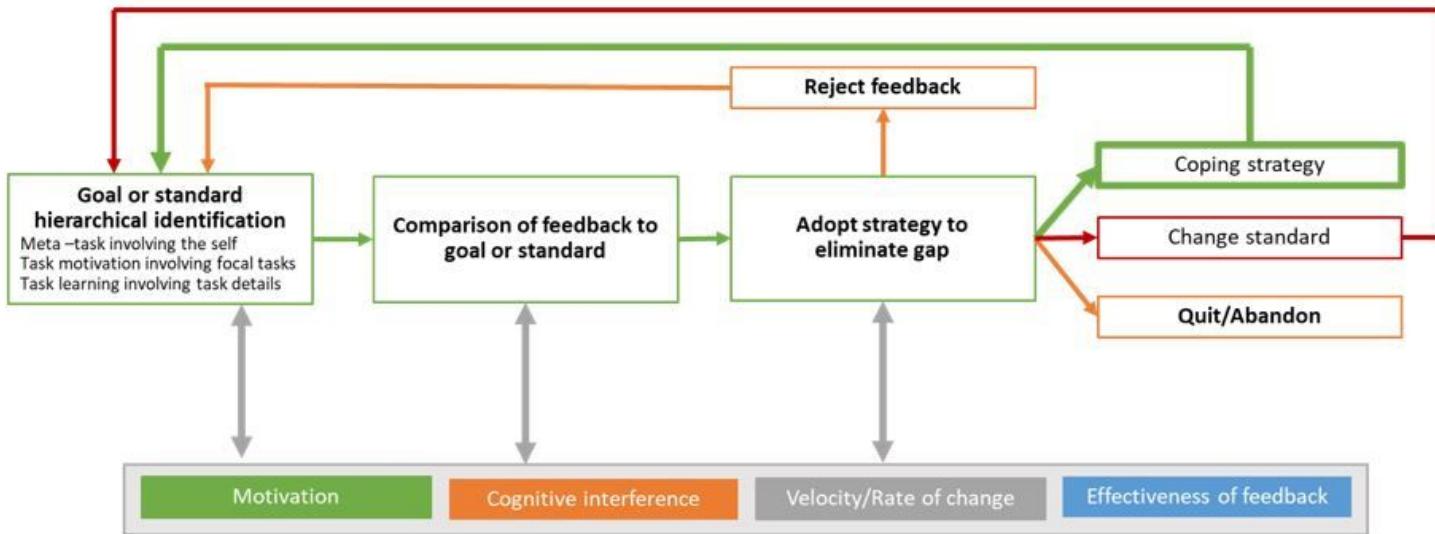


Figure 1

Feedback intervention theory (FIT) logic model for Audit and Feedback in endoscopy. Green demonstrates proposed improvement in performance through recognising a performance gap and adapting a coping strategy. Orange demonstrates where A&F processes cause practitioners to reject the feedback or quit the process. Red demonstrates participants identifying a feedback gap and changing the standard, by engaging in gaming behaviours.

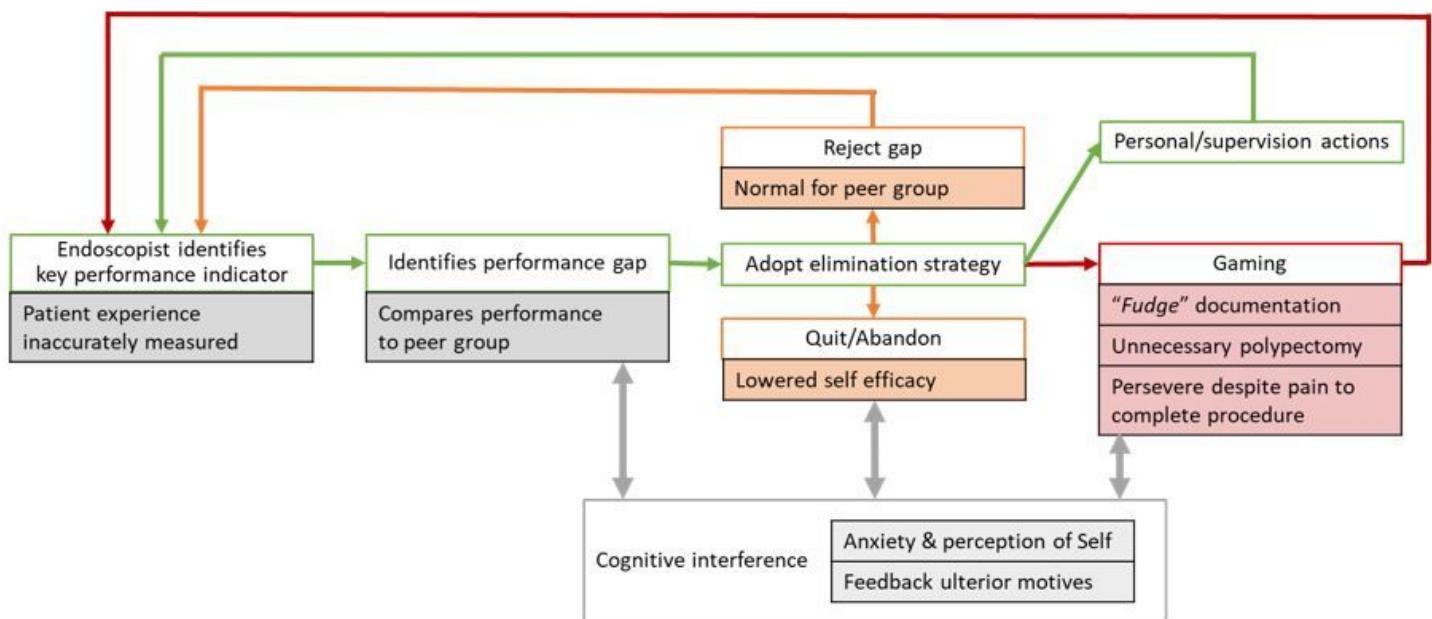


Figure 2

Dark logic model for Audit and Feedback harms in endoscopy using Feedback Intervention Theory.

Supplementary Files

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- [SRQRUsingadarklogicmodeltoexploreadverseeffects.docx](#)