Introduction

All health care professionals assuming the role of the operator under IR(ME)R have a responsibility to uphold the ALARP principle [(1)].

Fluoroscopy is responsible for a high proportion of the radiation dose received by the patient during the double contrast barium enema (DCBE), and therefore needs to be minimised [(2)]. Regular auditing of DCBE operator's fluoroscopy time and Dose Area Product (DAP) can help identify issues, change practice and reduce the radiation dose to the patient [(2)]. DAP (measured in $cGycm^2$), gives an indication of both the dose and area components of the X-ray beam and the radiation dose to the patient [(3)].

Historically, the radiologist was the operator for the DCBE. However, a combination of long waiting times for fluoroscopy, introduction of the National Health Service (NHS) Cancer plan [(4)] and shortage of radiologists changed this. Waiting times for diagnosis needed to be reduced [(4)]. This all led to the Skills Mix Project in Radiography [(5)], and development of the 4 tier structure, introducing the advanced practitioner role. In some trusts, radiographers have been trained to undertake the DCBE, allowing for extended role and affording the radiologist greater time to undertake more complex, interventional procedures. Radiographers at this hospital undertook masters level postgraduate training courses enabling them to perform and report their own DCBEs.

It is however crucial that patients receive the same high quality care, irrespective of the health care professional carrying out the examination.

Clinical audit is an integral part of clinical governance [6], and a requirement of the imaging department under regulation 8 of IR(ME)R [1].

The Diagnostic Reference Level (DRL) is a level set by employers, with regard to regional, national and European data, that should not be exceeded for standard-sized patients undergoing standard radiological examinations or procedures [7]. Employers are required to set these levels under regulation 4(3)(c) of IR(ME)R [1]. For fluoroscopic procedures DRLs should be stated in fluoroscopy time and DAP [7].

Aim

To collect, analyse and compare fluoroscopy time and DAP data from outpatient DCBEs, with that of the DRL, and of other operators, in order to deduce whether patients receive the same high quality care, in terms of radiation dose, irrespective of the health care professional carrying out the examination.

Objectives

1. To compare the fluoroscopy time and total DAP readings from each examination with the DRL.
2. To compare radiographer-performed DCBEs with radiologist-performed DCBEs in terms of:
    a. Fluoroscopy time
    b. Undercouch DAP
    c. Number of undercouch images
    d. Overcouch DAP
    e. Number of overcouch images

f. Total DAP

Literature Review

The introduction and development of the gastrointestinal radiographer

Various studies, reports and government plans have led to the introduction and development of the advanced practice radiographer, in particular the gastrointestinal (GI) radiographer.

A report from the Audit Commission [9] criticised radiology services, highlighting unacceptably long waiting times, particularly within fluoroscopy. The DCBE was a prime example, with long waiting lists meaning suspected cancer patients were waiting weeks, and in some cases months, between referral and diagnosis. However, delegation of the DCBE, a significant proportion of the radiologist's workload was not seriously considered until 1995 [10], with the publication of a three year audit, comparing aspects of radiographer-performed DCBEs with those undertaken by senior radiology registrars [10]. No significant difference was detected between the two groups. Radiographers performed at a consistently high standard, equal to the senior registrars. It was concluded that, when properly trained, it was safe, effective and acceptable to the patient for radiographers to perform DCBEs [10].

The pace of radiographer role development accelerated throughout the 1990s [11]. A survey of radiology managers (n=172) to investigate the adoption of role extension in radiography was carried out in 2000 [12], 69% of Trusts had radiographers undertaking the DCBE. When the situation was reviewed in 2007, the number of Trusts had increased to 83% [13].

Radiographers undertaking DCBEs are often referred to as GI radiographers. "A GI radiographer is one who has recognised postgraduate qualifications in GI radiography or who has undertaken a suitable departmental training course. A GI radiographer must demonstrate appropriate expertise in performing GI examinations and must maintain a proven development and competency record" [14, p7]. This refers to the need for the provision of appropriate mechanisms to ensure continuing competency. Clinical audit is a "powerful weapon" in assessing and monitoring competence [14, p9], this is the underpinning principle of this study.

The continuous monitoring of competence of the GI radiographer

It is important that patients receive the same high standard of care, in terms of radiation dose, irrespective of the health care professional undertaking the examination [15]. Advanced practice radiographers should regularly audit their practice to ensure this is the case [15]. This is of particular importance with extended roles for radiographers [12, 13]. Regular audit should result in the "identification of areas for improvement" [15, p81], and may help to facilitate changes to departmental standards and protocols. There is evidence that such audit activity is taking place [16, 17].

Overall, audits published regarding advanced practice radiographers performing the DCBE have been positive [18], in terms of quality and diagnosticity of images [19, 16], and radiation dose [10].

Ionising radiation has the potential to damage human cells and tissues [20], hence the requirement for keeping an individual's exposure to ionising radiation to a minimum [1]. Results of research suggesting no significant difference in radiation dose measurement between the radiographer and radiologist groups, are positive and encouraging [10]. One study, demonstrated statistically significant reductions in fluoroscopy times and radiation dose with radiographer-performed DCBEs [21].

Another study, in which DAP measurements from over 1000 DCBEs, performed by both radiographers and radiologists were recorded found that examinations carried out by radiographers did not have a significantly higher undercouch DAP than the radiologists [22]. However, the total DAP was significantly higher for radiographers, as a result of increased overcouch DAP [22]. This was attributed to the departmental protocol requiring radiographers to produce additional overcouch images for the reporting radiologist, whilst a radiologist undertaking an examination is free to produce the images he chooses. All examinations were reported by the consultant radiologist. This is not a factor in this study, as the radiographers report their own DCBEs, and are not subject to the protocols prescribed by consultant radiologists. It was concluded that future monitoring is required to ascertain whether overall DAP remains higher when examinations are undertaken by radiographers, as practices that increase patient dose require "very careful consideration by the professions involved" [22, p404]. A study carried out following an amendment to the protocol (in which radiographers were not required to undertake additional overcouch images) showed that radiographers performed the examination without dose penalty to the patient [23].

Audit is important in ensuring that there isn't a significant increase in radiation dose when radiographers perform the DCBE [24]. A questionnaire survey to 100 radiology departments within the United Kingdom showed that radiographers were undertaking the DCBE in 49 out of the 96 hospitals returning the questionnaire [25]. Audits of radiation dose rates between radiographer- and radiologist-performed DCBEs, were carried out in 40% of the departments [25].

There is a requirement for further research and audit into the effectiveness of radiographer-performed DCBEs, and in particular “radiation dose rates between radiographer- and radiologist-performed barium enemas” [25, p22].

72.3% of radiologists surveyed, stated that delegation of the DCBE allowed them more time for other duties [25]. Furthermore, 59.6% of radiographers identified a reduction in waiting lists due to delegation to radiographers [25]. Similarly, 78% of radiographers noted improvements in service delivery, reflected in patient waiting times [26].

The DRL for the DCBE

The first objective of this study is to compare the fluoroscopy time and total DAP readings from each examination with the DRL. DRLs are set for “typical examinations for groups of standard-sized patients” [1, p1], and should not be consistently exceeded. The DRL can be used as a gold standard for DAP and fluoroscopy times for the DCBE.

Table 1 - The DRL for the DCBE [8]

Examination	DAP per exam ($Gycm^2$)	Fluoroscopy time per exam (minutes)
Barium enema	31	2.7

31 $Gycm^2$ is equal to 3100 $cGycm^2$, in concurrence with the units used in this study.

Methodology

Study Design

The overall methodology was quantitative [27], and adopted a survey methodology. Surveys are a cost-efficient and easy way of collecting large amounts of numerical data that can be statistically analysed. The disadvantages of surveys are that they are open to bias, and can be time consuming to plan [28].

Data Collection

The data was collected prospectively. This allowed immediacy and accuracy of appropriate patients for the study. High quality data needs to be collected close to the source by staff who understand and value the data [(29)]. The data was recorded by the supporting radiographer, at the time of the examination.

The data collection sheet used was adapted from the national NRPB survey [(8)]. The examination date, patient's date of birth, sex (M or F) and patient size (small, average, large or very large) were recorded. Ideally, a more objective measure would have been recorded as the patient's size; small, average, large or very large, is a subjective measure.

The fluoroscopy time (in minutes), the undercouch DAP (in $cGycm^2$), the number of undercouch images taken, the overcouch DAP (in $cGycm^2$) and the number of overcouch images taken were recorded.

The degree of difficulty was also recorded (easy, textbook, difficult or very difficult). This referred only to factors which may have meant the patient incurred a justified, prolonged fluoroscopy time or increased DAP, for example, a tortuous bowel. The supporting radiographers were instructed not to consider factors such as reduced patient mobility or communication difficulties here, as they did not justify an increased fluoroscopy time or DAP. Finally, the operator's initials were recorded so that analysis of the data in terms of the operator could be performed.

Pilot Study

A pilot study was conducted for the period of one afternoon to assess the data collection sheet prior to implementation[30].

Sampling Strategy

The target population for this study was all outpatients undergoing the DCBE at the hospital. Convenience sampling was used, this is a non-probability sampling technique, using non-random methods [31]. Data was collected from each outpatient DCBE for four weeks. A sample that is not randomly selected may not be representative of the population, and cannot therefore be generalised. The purpose of this study was not to make inferences about other hospitals, but to be used descriptively at the hospital at which the data was collected.

It is suggested that a sample size of 25 cases per operator is sufficient for this study [2]. This was not practical using a convenience sampling technique as each of the operators conducted a different number of examinations per week.

By adapting the NRPB's survey [8], the reliability and validity of the study was increased. The NRPB survey is a well-designed, national survey carried out by a recognised and respected body.

Survey research is open to bias [30]. A bias is understood to limit the overall validity of research [32]. A bias known as the 'Hawthorne Effect' may result in lower fluoroscopy times or DAP readings when operators are aware that their readings are being recorded [33]. This has been observed when recording fluoroscopy times for DCBEs [34], and when recording DAP [22]. This is similar to the 'Halo Effect', in which the subject wants to be seen in a favourable light, and reacts to the situation differently from normal, to influence the researcher's judgement of them [35]. In order to minimise the effect of the bias, data was collected for a period of four weeks, as the 'halo effect' tends to subside over time. The 'Rosenthal Effect' refers to the way in which the experimenter's expectations may bias the data collected [30], reducing the construct validity of the study. This was eliminated from the study by requiring the supporting radiographers to complete the data collection sheet.

The DAP meter was calibrated by the on-site X-ray engineer prior to data collection commencing, to ensure accurate readings were displayed.

Data Analysis

A descriptive statistical analysis was carried out [30], however no statistical tests were performed in the analysis of the data. The mean and median [36] were calculated for the group of radiographers, and the group of radiologists. Boxplots were created using the five figure summary: minimum, lower quartile, median, upper quartile, maximum [30]. The range was also used to provide further information regarding the spread of the data values. It is useful to have an indication of how the values are spread around the measures of central tendency[36].

Ethical Issues

It is essential that all staff involved in the collection of data are fully informed of the project [37, 27]. Information regarding the study was distributed to each of the staff involved. In order to maintain the confidentiality of the operators, operators were allocated a number in the discussion of the results. Written assurance that confidentiality would be maintained was given to each operator [31]. No patient identifiers were recorded in order to maintain the anonymity of the patient [27, 31].

As the Trust regarded the study as an audit, the study was registered with the Clinical Audit Department. Research and Development (R&D) and the Local Research and Ethics Committee (LREC) approval was not required for this study. Clinical Audit is an essential component of Clinical Governance legislation and should be viewed as a continuous, cyclical process. With each completed cycle, one is aspiring to “a higher level of quality” [6, p3]. Criteria Based Audit requires definition of “specific criteria that can be compared to actual practice, either prospectively or retrospectively” [38, p65]. The ‘standard’ used for this study was the DRL for the DCBE. A comparison of actual practice (recorded fluoroscopy time and DAP) with best practice (the DRL) was possible. Once standards are set, re-auditing is easily carried out, and is comparable with previous audits [39]. A disadvantage of criteria based audit is that agreeing the standard can be difficult and time consuming [39]. However, the DRL is already set and recognised.

Results

Data was collected from 109 DCBEs, 17 of were deemed incomplete and excluded from data analysis.

Table 2 – The number of DCBE examinations undertaken by each individual operator

Operator	No. of DCBE examinations
Radiographer 1	39
Radiographer 2	16
Radiographer 3	16
Radiographer 4	12
Radiologist 1	5
Radiologist 2	2
Radiologist 3	2

The number of complete examinations was 92 (n=92), 83 undertaken by radiographers (90.2%), 9 undertaken by radiologists (9.8%). Radiographer 1 carried out more examinations (n=39) than other operators, with radiologists 2 and 3 carrying out the fewest (n=2 for both operators), see table 2 above.

All of the results are summarized in table 8.

Age of patient under examination (in years)

Table 3

Summary	Radiographer-performed DCBEs	Radiologist-performed DCBEs
Minimum	39	44
Lower quartile	54.5	59
Median	69	66
Upper quartile	78	74
Maximum	87	89

The mean age of patients undergoing radiographer-performed DCBEs was 66.0 years, and of patients undergoing radiologist-performed DCBEs was 66.4 years.

Fluoroscopy Time (in minutes)

Table 4

Summary	Radiographer-performed DCBEs	Radiologist-performed DCBEs
Minimum	0.9	1.3
Lower quartile	1.2	2.3
Median	1.6	2.5
Upper quartile	2.05	3.2
Maximum	5.2	5.2

The mean fluoroscopy time for radiographer-performed DCBEs was 1.74 minutes, and for radiologist-performed DCBEs was 2.82 minutes.

Figure 1: A boxplot to illustrate the fluoroscopy times recorded for radiographer- and radiologist-performed barium enema examinations.

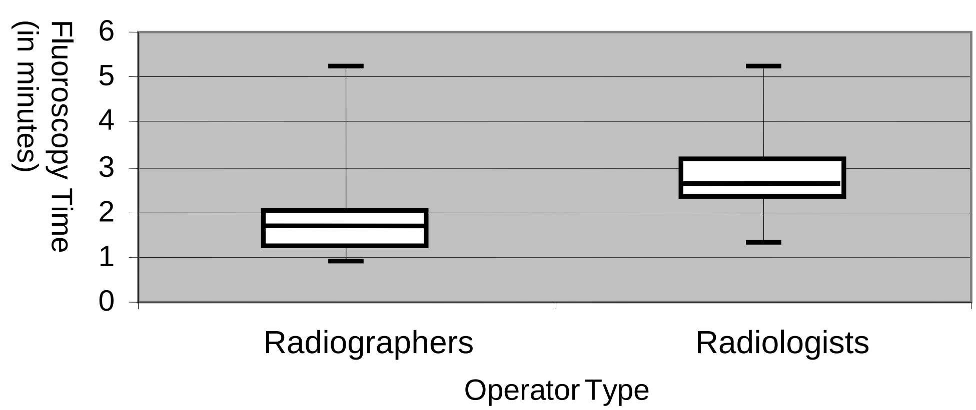

Table 4 and Figure 1 compare fluoroscopy times recorded for radiographer and radiologist-performed DCBEs. The mean fluoroscopy time is higher for radiologists (2.82 mins) when compared with radiographers (1.74mins). The interquartile range is similar for both groups (0.85 mins for radiographers and 0.9 mins for radiologists). The median is higher for radiologists (2.5 mins), than radiographers (1.6mins).

Undercouch Dose Area Product (DAP) (in $cGycm^2$)

Table 5

Summary	Radiographer-performed DCBEs	Radiologist-performed DCBEs
Minimum	367	1077
Lower quartile	892	1432
Median	1145	1850
Upper quartile	1514.5	2346
Maximum	4179	2977

The mean undercouch DAP for radiographer-performed DCBEs was 1244.9 $cGycm^2$, and for radiologist-performed DCBEs was 1971.3 $cGycm^2$.

Figure 2: **A boxplot to illustrate undercouch Dose Area Product (DAP) readings for radiographer- and radiologist-performed barium enema examinations.**

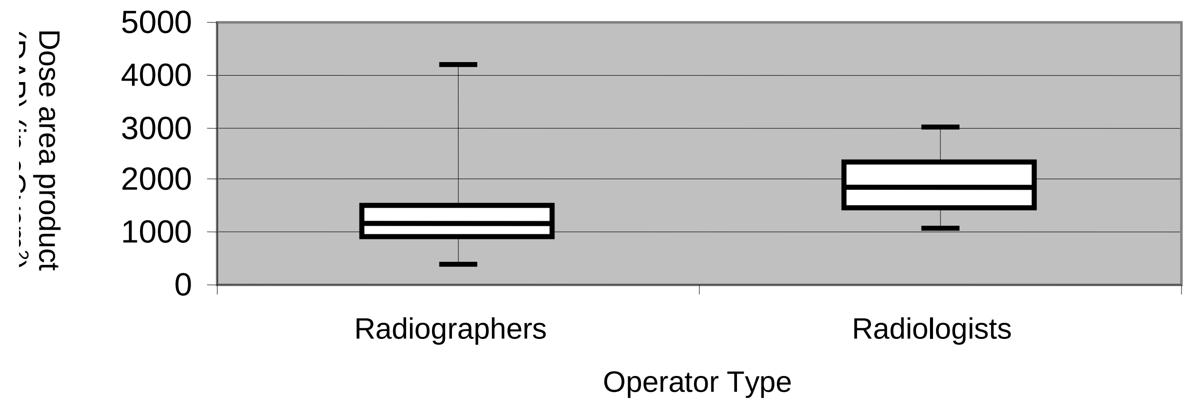

Table 5 and Figure 2 compare undercouch DAP readings recorded for radiographer and radiologist-performed DCBEs. The mean undercouch DAP is higher for radiologists (1971.3 $cGycm^2$) when compared with radiographers (1244.9 $cGycm^2$). The interquartile range is higher for radiologists (914 $cGycm^2$) than radiographers (622.5 $cGycm^2$). The median is higher for radiologists (1850 $cGycm^2$), than radiographers (1145 $cGycm^2$).

Overcouch Dose Area Product (DAP) (in cGycm^2)

Table 6

Summary	Radiographer-performed DCBEs	Radiologist-performed DCBEs
Minimum	53	170
Lower quartile	149	201
Median	215	235
Upper quartile	354	308
Maximum	1674	451

The mean overcouch DAP for radiographer-performed DCBEs was 291.9 cGycm^2, and for radiologist-performed DCBEs was 264.7 cGycm^2.

Figure 3: A boxplot to illustrate overcouch Dose Area Product (DAP) readings for radiographer- and radiologist-performed barium enema examinations.

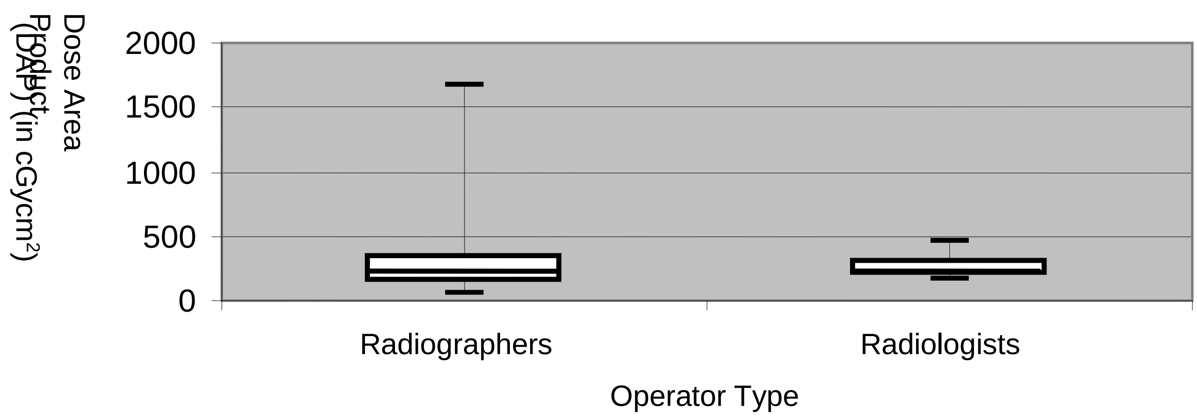

Table 6 and Figure 3 compare overcouch DAP readings recorded for radiographer and radiologist-performed DCBEs. The mean overcouch DAP is lower for radiologists (264.7 cGycm^2) when compared with radiographers (291.9 cGycm^2). The interquartile range is lower for radiologists (107 cGycm^2) than radiographers (205 cGycm^2). The median is higher for radiologists (235 cGycm^2), than radiographers (215 cGycm^2).

Total Dose Area Product (DAP) (in cGycm^2)

Table 7

Summary	Radiographer-performed DCBEs	Radiologist-performed DCBEs
Minimum	439	1351
Lower quartile	1101	1883
Median	1393	2020
Upper quartile	1789	2654
Maximum	4585	3167

The mean total DAP for radiographer-performed DCBEs was 1536.8 cGycm^2, and for radiologist-performed DCBEs was 2236.0 cGycm^2.

Figure 4: A boxplot to illustrate the total Dose Area Product (DAP) readings recorded for radiographer- and radiologist-performed barium enema examinations.

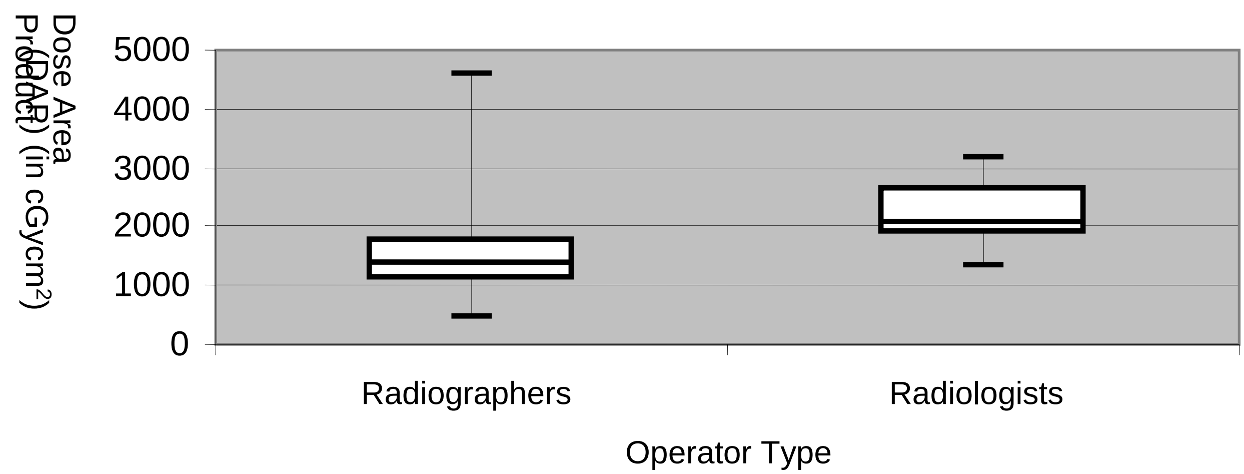

Table 7 and Figure 4 compare total DAP readings recorded for radiographer and radiologist-performed DCBEs. The mean total DAP is higher for radiologists (2236 cGycm^2) when compared with radiographers (1536.8 cGycm^2). The interquartile range is higher for radiologists (771 cGycm^2) than radiographers (688 cGycm^2). The median is higher for radiologists (2020 cGycm^2), than radiographers (1393 cGycm^2).

Table 8 – **Summary of mean, range and standard deviation values**

Data	Radiographers			Radiologists		
	Mean	Range	Standard Deviation	Mean	Range	Standard Deviation
Age of patient	66.0	39-87	13.11	66.4	44-89	13.56
Fluoroscopy time	1.7	0.9-5.2	0.75	2.8	1.3-5.2	1.13
Undercouch DAP	1244.9	367-4179	544.42	1971.3	1077-2977	638.51
No. of undercouch images	12.1	4-18	2.05	9.3	3-20	5.20
Overcouch DAP	291.9	53-1674	238.21	264.7	170-451	86.64
No. of overcouch images	2.4	2-3	0.49	2.6	2-3	0.53
Total DAP	1536.8	439-4585	691.23	2236.0	1531-3167	590.35

Discussion

Incomplete examinations

17 examinations were considered incomplete and excluded from the data analysis. The reasons for this were; incomplete data collection sheets, information required on the data collection sheet was unavailable or abandoned examinations.

Age of patient under examination

The mean age of the patients examined by radiographers was 66.0 years, compared with 66.4 years for radiologists, there is no noticeable difference between the operator groups.

Many hospitals employ patient selection systems which allocate patients to operators. Younger, more mobile outpatients are often examined by radiographers, whilst older, less mobile patients (often inpatients) are examined by radiologists. This has been noted in various studies comparing radiographer- and radiologist-performed DCBEs [10, 22, 23]. However, this hospital does not employ such a system. The researchers decided to include patient age in order to ensure there was not a noticeable difference in the ages of the patients examined by each operator group. Patient age and/or mobility may have an effect upon the examination. Difficulties in performing the DCBE in elderly patients include the inability to retain the barium sulphate suspension and to cooperate or maintain the positions required [40]. Older, less mobile patients are often considered more complicated cases, so some hospitals prefer that these patients are examined by the radiologist. The issue of distinguishing inpatients from outpatients does not arise as this study only looks at outpatient examinations. Age is not considered by the researchers as an extraneous factor and is not considered further.

Comparison with the DRL

Table 9 – Summary of the examinations exceeding the DRL

No.	Operator	Fluoroscopy Time (in minutes)	Total DAP (in $cGycm^2$)	What was exceeded (Fluoroscopy time, total DAP or both)	Evidence of justification (including patient size, degree of difficulty of examination & comments)
1	Radiologist 1	5.2	3167	Both	Difficult examination
2	Radiographer 1	3.7	1742	Fluoroscopy time	Difficult examination
3	Radiologist 1	3.7	2911	Fluoroscopy time	Large patient
4	Radiologist 1	2.8	2654	Fluoroscopy time	None recorded
5	Radiographer 1	3.0	658	Fluoroscopy time	None recorded
6	Radiologist 2	3.2	2402	Fluoroscopy time	None recorded
7	Radiographer 1	4.2	2384	Fluoroscopy time	Difficult examination
8	Radiographer 3	5.2	4585	Both	Very difficult examination “Tortuous, long colon”
9	Radiographer 1	3.3	2620	Fluoroscopy time	Large patient Difficult examination “multiple loops”

The data collected was compared with the DRL. There were 9 examinations in which the DRL was exceeded (table 4). Exceeding the DRL is justifiable in certain situations, e.g. when the patient under examination is large. DRLs are based upon standard sized patients [(1)]. Hart et al. [(8)] considered average sized patients to be those weighing 70kg +/- 10kg. The weight of the patient was not recorded in this study, instead a subjective measure (small, average, large or very large) was utilized.

Examinations that are considered difficult for a clinical reason, may also be justified, e.g. a long/tortuous colon. This is because manipulation of the barium sulphate suspension, in order to facilitate coating and demonstration of the entire bowel may take longer, resulting in higher fluoroscopy times and undercouch DAP readings, e.g. Examination 8. Examination 9 (table 4) may also be justified for this reason, as the patient was considered 'large' and the examination 'difficult' as a result of 'multiple loops' of bowel.

Three examinations were also recorded as 'difficult' examinations. However, no reasons were given so the researchers are unable to comment further. Similarly, the remaining examinations were recorded as average sized patients undergoing textbook examinations and the researchers are unable to decide whether or not exceeding the DRL may be justified.

Fluoroscopy Time

The mean fluoroscopy time for radiographer-performed DCBEs was 1.74 minutes (range= 0.9-5.2), compared with 2.82 minutes (range= 1.3-5.2) for radiologist-performed examinations.

Although fluoroscopy time was not recorded by in other studies [22, 23], it was included in this study as it is considered by the NRPB to provide a useful indication of patient radiation dose [30]. Mannion et al. [10] recorded fluoroscopy times and found the mean for radiographer-performed examinations to be 3.12 minutes (range= 1.75-6) compared with 2.61 minutes (range= 1.5-7) for radiologist-performed examinations. There was no major difference between the two operator types [10, p717]. In contrast, the results of this study demonstrated a considerable difference (in terms of mean) of 1.08 minutes, with very similar ranges (table 2). Radiographers in this study have been shown to provide a lower fluoroscopy time than radiologists.

Undercouch DAP

The mean undercouch DAP for radiographers was 1244.9cGycm^2 compared with 1971.3cGycm^2 for radiologists. The mean number of undercouch images taken by radiographers was 12.1 compared with 9.3 for radiologists.

Although the radiographers produced more undercouch images, the radiologist-performed examinations have a longer fluoroscopy time and higher undercouch DAP. Thus, it can be deduced that radiologists carry out more ‘screening’ without acquiring images.

It is possible to speculate that radiographers, although no longer subject to a set protocol, may in fact still choose to perform the examination in the sequential and systematic manner in which they were initially taught. Thus, they can be certain to have visualised the entire bowel, without succumbing to the ‘satisfaction of search’ phenomenon in which “the detection of one abnormality interferes with the detection of other abnormalities” [41, p895]. It is possible to speculate that radiologists do not adopt a systematic approach, but instead visualize the entire bowel using fluoroscopy (explaining the resultant higher fluoroscopy time) and only acquire images when an abnormality has been detected (explaining the lower mean number of undercouch images produced). Further research would be required in order to accurately compare and contrast the technique of the radiographer with that of the radiologist to aim to explain the differences.

Overcouch DAP

The mean overcouch DAP for radiographers was 291.9 $cGycm^2$ compared with 264.7 $cGycm^2$ for radiologists. The mean number of overcouch images taken by radiographers was 2.4 and 2.6 for radiologists.

The mean overcouch DAP was similar for both operator groups, however, the range was different, 53 – 1674 $cGycm^2$ for radiographer-performed examinations, compared with 170 – 451 $cGycm^2$ for radiologist-performed examinations (table 2). Review of the raw data demonstrated two high overcouch DAP readings which may account for the wide range of readings recorded for radiographer-performed examinations. The highest reading, 1674 $cGycm^2$, was recorded on a patient described as ‘very large’, with the second highest reading, 1058 $cGycm^2$, recorded on a patient described as ‘large’. An automatic exposure device (AED) is used to “exercise accurate control on the quantity of radiation” [(42, p80)], and it is reasonable to suggest that the higher readings provided were as a result of the patient’s size, rather than the operator’s technique. These outliers, cause the data to be positively skewed. The mean (291.9 $cGycm^2$) is greater than the median (215 $cGycm^2$), and the data is not normally distributed. Statistical analysis of such data must be considered carefully [(43)].

Crawley et al [22] found that overcouch DAP was significantly higher when the examination was undertaken by a radiographer. This finding was highlighted to be as a result of radiographers following a protocol prescribed to them by the radiologist. This protocol required additional overcouch images to be produced for reporting by the radiologist. However, radiographers at this hospital are no longer subject to a protocol, as they report their own examinations. The overcouch DAP was not higher for radiographers at this hospital.

The range for the number of overcouch images was 2 – 3 for both operator groups. This is because two images (left and right lateral decubitus projections) are undertaken routinely, with a further projection (prone with a 30^{o} caudal angulation) used if required. As the ranges were the same, and the mean number of overcouch images (2.4 for radiographers and 2.6 for radiologists) is similar, the researchers have chosen not to consider the number of overcouch images further.

Total DAP

The mean total DAP for radiographers was 1536.8 $cGycm^2$ compared with 2236.0 $cGycm^2$ for radiologists.

There is a lower total DAP when radiographers perform the DCBE. It is possible to attribute the lower total DAP recorded by radiographers to the fluoroscopy time and undercouch DAP elements of the examination – which are lower for the radiographers than the radiologists. One possible cause for this has been identified by the researchers as the frequency of examinations, radiographers perform the majority of the DCBEs undertaken in this hospital.

The data collected indicates a lower fluoroscopy time and total DAP for DCBEs undertaken by a radiographers, as opposed to a radiologists, at this hospital.

Recommendations for practice

Clinical audit is a continuous process, requiring periodic re-audit [2]. It is recommended that this study be repeated in two years time to reassess practice. However, it is recommended that the limitations of the data collection sheet are addressed prior to re-audit – subjective measures should be replaced by more objective measures. The results of this study may be used for comparison with the results of future studies. Re-audit provides part-fulfilment of the department’s responsibility to clinical governance [6].

At this hospital, radiographers do not perform inpatient DCBEs, however, the researchers recommend that the Trust consider inpatient examinations as an area in which radiographers could further extend their practice.

Recommendations for further research

As stated, the results of this study are not generalisable. It is recommended that this study is undertaken at other hospitals in order to provide a more accurate reflection of the situation throughout the United Kingdom.

The researchers feel it may also be valuable to examine the fluoroscopic technique of the individual operators, to elicit differences in technique that may affect the radiation dose to the patient. Anecdotal evidence provided by a GI radiographer, has highlighted the possibilities for peer observation in order to inform and improve practice. If one operator practices a technique that results in a significantly lower radiation dose to the patient [22], it may benefit other operators to observe that practice, in order to inform and improve their own practice. The Department of Health [44] places great emphasis upon sharing good practice, to improve the health of the nation.

Limitations & Evaluation

As a result of the short time frame for data collection, there were only a limited number of radiologist-performed examinations. An extended period of data collection may yield additional radiologist-performed examinations, allowing more extensive analysis and discussion.

Subjective measures for patient size and degree of difficulty were used which limit the accuracy of the data. Radiographers have different opinions of what constitutes ‘small’, ‘average’, ‘large’ and ‘very large’, and what constitutes ‘easy’, ‘textbook’, ‘difficult’ and ‘very difficult’. A more objective measure for patient size, for example body mass index (BMI), may add to the accuracy of the information collected.

Some data was lost during an examination as a result of mains power failure. It is not possible in situations like this to retrieve the original data. In addition, the data collection sheet was not always filled in completely, and sometimes not at all. These results had to be excluded from the data analysis.

This study was undertaken at a general hospital in East Anglia, and thus provides a description of the performance of operators at that hospital alone. Therefore the results of the study are not generalisable to other hospitals.

Conclusions

This study found that the fluoroscopy time and undercouch DAP, and thus total DAP, were lower for radiographer-performed DCBEs than radiologist-performed DCBEs for the limited number of examinations recorded. However, because no statistical analysis was carried out on the data these conclusions are limited to the description of the data.

This study suggests that after appropriate training, a radiographer may be able to perform this examination at a standard equal to, or exceeding that of, a radiologist. This emphasises the notion that role extension is now a distinct career possibility for diligent and meticulous, high performing radiographers in the future.

This study found that the DRL is occasionally exceeded, usually in terms of fluoroscopy time. This appears to be as a result of larger patients and more difficult examinations. Monitoring should continue in order to ensure the DRL is not consistently exceeded [(1)].

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