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# 'Cranking up', 'whacking up' and 'bumping up': X-ray exposures in contemporary radiographic practice

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ABSTRACT

This article explores the use of X-ray exposures following the introduction of direct digital radiography (DDR). Radiographers are central to delivering optimum levels of ionising radiation whilst maintaining sound image quality for radiological interpretation. Yet do radiographers utilise X-ray exposures appropriately? An ethnographic methodology provides insight of two general radiographic environments in the United Kingdom (UK) using participant observation and semi-structure interviews. A central theme uncovered as part of a Doctorate of Philosophy (PhD) study was the lack of autonomy concerning X-ray exposures within the general imaging environment. The findings highlight 'how radiographers behave'. For example, some radiographers do not alter 'pre-set' X-ray exposures, arguably failing to produce images of optimum diagnostic quality. Secondly, radiographers acknowledge 'whacking up', 'cranking up' and 'bumping up' X-ray exposures ensuring image production. In conclusion this article provides an original insight into the attitudes and behaviours of radiographers regarding X-ray exposures in contemporary practices using DDR. Dose and image optimisation are central tenets of radiographic practice that may be hindered in contemporary practices.



## Introduction

This article provides insight into the use of X-ray exposures within the general imaging environment. Medicine is an ever changing field and is becoming increasingly reliant upon technical equipment and practices.[1] In diagnostic radiography it is generally accepted that the introduction of direct digital radiography (DDR) has facilitated image production. For example, DDR has relieved tensions by capturing X-rays electronically, which are archived and rapidly retrievable through picture archiving communication systems (PACS). The digital detector is the key component of a DDR system consisting of pixel sizes affecting the systems resolution with typical ranges from 127 to 200 μm providing optimal detective quantum efficiency (DQE) and established as the most suitable parameter for describing imaging performance.[2] The continued improvement of image storage, 'bit depth', image matrix and crystal structure of DDR hardware is generally accepted to enhance the delivery of radiographic practice and radiological reporting.[3] For example, the convenience of immediate image acquisition coincided with dose reducing opportunities are clear advantages of all DDR equipment: 'exams are done easier and may result in fewer retakes and a low X-ray dose for your patients'.[4 (p.3)] In the United Kingdom (UK) radiographers are required to keep radiation doses 'as low as reasonably practicable' (ALARP) whilst ensuring optimum image quality for radiological reporting.[5] This legislative practice stems from the hypothetical linear non-threshold dose response model, which maintains there is 'no safe radiation dose', thus informing radiation safety today.[6] The importance of reducing ionising radiation is published in numerous studies demonstrating dose optimising opportunities in chest and skeletal radiography whereby 33–80% dose reduction is reportedly achieved (depending on clinical query).[7–11] Whilst dose optimisation can be achieved the aim of this article explores the use of X-ray exposures within the clinical environment because it is one of the fundamental options for implementing the ALARP principle limiting 'dose creep', whereby radiographers may favour excellent image quality by delivering higher exposures than normal.[3] Few studies have explored this phenomenon clinically,[12] thus the aim of this study is to provide original insight of X-ray exposures using DDR by observing 'what radiographers do and how they do it'. The objective is to inductively explore radiographic practices within the DDR environment supporting the National Health Service's (NHS) continuing focus to 'work at the limit of science – bringing the

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highest level of human knowledge and skill to save lives and improve health'.[13] (p.2) This is important to consider because the attitudes and behaviours of radiographers arguably impact on the use of ionising radiation within the general radiography environment. Murphy[14] (p.170) maintains that radiography as a profession has failed to 'critique or inquire into what is after all a technology driven environment and as a result there is inadequate consideration of radiological technology that examines its emergence or impact on both society and the profession itself'. In short, by exploring technological advances within the radiographic environment it may inform the future radiographic curriculum and facilitate student learning. It remains central to explore general radiographic practices in the UK because current estimates suggest that general radiographic examinations (combined with fluoroscopy) approximately constitutes 90% of all radiological examinations undertaken in the radiology department thus a majority of the radiographic workload undertaken clinically,[15] which may resonate with other general imaging departments nationally and internationally.

## Methodology

The methodology used in this study was ethnography. Ethnography offered a valued insight into a specific culture underexplored within radiographic practice in the UK. It was first pioneered in the field of socio-cultural anthropology deriving from Greek words 'ethnos' (folk/people) and 'grapho' (to write) to learn and understand cultural phenomena which reflects the knowledge and system of means guiding the life of a cultural group.[16] This holistic approach to culture is cited in the early work of the Chicago School of Sociology, creating an ethnographic mosaic using a variety of methods to better understand the social and cultural world.[17] Ethnography is a qualitative and open-ended methodology, enhancing the understanding of relationships of clinical practices. Ethnography provided the tool to explore the world from the radiographers' perspective. Hammersely[18] p.35 terms this 'practitioner ethnography' following its recent uses in education and other professional disciplines. Social constructionism and interpretivism allowed the ethnographic fieldwork to explore the knowledge, understanding and cultural underpinnings of the imaging department.[19] Crucially, the nature of this research and in particular its relationship to practice allowed the researcher to get closer to social reality uncovering radiographic practices.[18] The methods included:

1) Participant observation: Observing contemporary radiographic practices using DDR exploring 'what radiographers do'.
2) Interviews: Explored key themes derived from the clinical observations uncovering deeper meanings into 'what had been seen and discussed informally'.

The aim of ethnography is to provide thick descriptions of patterns of behaviour belonging to individuals and groups within a particular culture.[16,18] It can play a pivotal role to a professional group that seeks to understand the behaviour of its members.[19] Saks and Alsop[20] argue that ethnography can be more integral to professional groups that seek to yield understanding of the behaviour and practices of its members, illuminating hitherto covert patterns of behaviour and decision-making in the field. The fieldwork contexualised behaviour and decision-making in a particular work domain during a recurring but delimited time such as a normal working day seeking to understand participants actions and their experiences of the world through observing the participants by learning about people by learning from them.[21] The intention of the fieldwork was to gain a rich description of radiographic practices from participant observations and interviews, tracing the process of 'definition of the situation' and interpret the findings.[22] (p.153) This supported the humanistic discovery aiming to capture and understand naturally occurring world activities in real-world settings because it was believed that radiography had its own culture in the development of DDR.[22] Ethical applications were submitted to two NHS Trusts in the south of England following the installation and clinical use of DDR equipment. Applications were considered and approved at both NHS hospitals and by the University.

### *Participant observation*

Empirical fieldwork began in October 2012 and finished in 2013. The choice of research sites were selected because DDR was used on a day-to-day basis by radiographers. Where informed consent was forthcoming observations were undertaken. In total approximately 30–40 operators were observed over 19 days (approximately 142 h). On a typical 09:00–17:00 working day observations commenced at 09:00 and ended at 12:00, I would break for lunch, gather notes and then begin the second observational block from 12:30 to 17:00. Participant observation provided immersion as a 'participant observer' and lasted for approximately two months. Barley[23] (p.83) maintains that to map emergent patterns of action and interpretation requires at least partial reliance on participant observation to record interactions. The observations were vital in this process as Larsson et al.[24] highlight; how work is done in the radiographic department depends on the individuals' knowledge as well as on his or her openness, flexibility, service-mindedness, willingness to develop professionally, and triggers for doing certain things. Throughout the observations I observed and informally discussed the use of DDR at both research hospital sites, known as 'site A' and 'site B'. Site A had used DDR since 2006 whereas site B since 2011. Field notes provided a useful tool capturing the behaviours, views and attitudes of radiographers, providing first-hand experience of action-in-process.[21] The observations allowed me to 'enter' the radiographers' world and discuss emerging concepts, which provided a platform for the interview transcript. Throughout the observations some participants altered their actions upon observation, for example operators became increasingly self-aware of their working behaviour illustrating the Hawthorne effect. The best evidence however to suggest that my presence did not noticeably alter all participants behaviours lies in the fact that some participants were willing to practice in a way that other radiographers may have disapproved of. This method observed and informally documented 'what radiographers did' in the DDR environment. This was later analysed and informed the development of the interview schedule.

### *Interviews*

Twenty-two interviews were undertaken. Nine interviews were undertaken at site A and thirteen interviews at site B. The radiographers observed were invited to interview, this was important in terms of theory development.[21] Interviewers were ceased following data saturation hence varying sample sizes at sites A and B. Semi-structured interviews lasted between 30 min and 1 h and 15 min and were directed by emerging themes uncovered during the observations and informal discussions thus remained sensitive to the language and concepts used by the researcher.[25] The interviews explored how long radiographers had been working with DDR whilst questioning the knowledge and understanding of DDR when performing radiographic examinations. Interviews provided significant data generation. The 'semi-structured style' of interviewing allowed the set of topics to form questions in the course of