

# The quality of radiographs accompanying endodontic referrals to a health authority clinic

B. S. Chong,\*<sup>1</sup> J. Miller<sup>1</sup> and S. Sidhu<sup>1</sup>

## IN BRIEF

- Reports that the quality of digital radiographs accompanying endodontic referrals was significantly lower compared with conventional radiographs.
- Highlights a need for quality improvement to avoid repeat radiographs and unnecessary ionising radiation exposure.
- Recommends that digital radiographs accompanying referrals should be provided in electronic form, rather than printed.

**Aim** To assess the quality of radiographs accompanying endodontic referrals, from general dental practitioners, to a health authority clinic. **Methods** A total of 200 conventional film and digital radiographs accompanying referrals were assessed and rated as 'excellent', 'diagnostically acceptable' or 'unacceptable' according to the National Radiographic Protection Board (NRPB) guidelines. Statistical analyses of the results included inter- and intra-observer agreement to achieve a kappa score and the chi-squared test. **Results** Out of the 200 radiographs assessed, 38 (19%) were conventional film and 162 (81%) were digital. Of the conventional film radiographs, 55% were rated 'excellent' and 37% were 'diagnostically acceptable', whilst 27% of digital radiographs were rated 'excellent' and 40% were 'diagnostically acceptable'. In the 'unacceptable' category, 33% were digital and 8% were conventional film radiographs ( $p < 0.001$ ). **Conclusions** The quality of digital radiographs was significantly lower compared with conventional film radiographs. The percentage of 'unacceptable' digital radiographs was above the target according to the NRPB guidelines. Hence, there is a need for improvement in quality to avoid repeat radiographs and unnecessary ionising radiation exposure. Instead of hard, printed copies, digital radiographs accompanying referrals should, within the parameters of information governance, be supplied electronically so that they may be optimised, if necessary, for better diagnostic value.

## INTRODUCTION

An estimated one million non-surgical root canal treatments are performed in the UK every year.<sup>1</sup> In most cases, non-surgical root canal treatment may be considered as routine and may be carried out in general dental practice or other primary care settings. However, experience levels, equipment availability or tooth-related complications such as access limitations, or canal sclerosis, may necessitate the need to refer patients onwards for management.<sup>2</sup> A survey in England of newly qualified dentists in vocational training reported that most expressed a lack of preparedness with regards to complex or molar endodontics.<sup>3</sup> In addition, the UK regulatory body, the GDC, considers that dental practitioners have a duty of care to refer a patient onwards when it is in the patient's best interest.<sup>4</sup>

Radiographs of acceptable quality are essential for accurate diagnosis and treatment planning.<sup>5,6</sup> They should accompany

Table 1 Subjective quality criteria (based on NRPB 2001 guidelines<sup>9</sup>)

Rating	Quality	Basis
1	Excellent	No errors of patient preparation, exposure, positioning, processing or handling
2	Diagnostically acceptable	Some errors of patient preparation, exposure, positioning, processing or handling, but which do not detract from the diagnostic use of the radiograph
3	Unacceptable	Errors of patient preparation, exposure, positioning, processing, or handling, which render the radiograph diagnostically unacceptable

Table 2 Recommended minimum targets for quality (based on NRPB 2001 guidelines<sup>9</sup>)

Rating	Quality	Percentage of radiographs taken
1	Excellent	Not less than 70%
2	Diagnostically acceptable	Not greater than 20%
3	Unacceptable	Not greater than 10%

patient referrals to reduce the need for repeat radiographs and further radiation exposure; this also avoids delays and ensures correct allocation of cases via the referral triage system. There is no shortage of research evidence showing that the quality of radiographs, in primary dental care, is often poor.<sup>7</sup>

In clinical practice, every radiograph should be subjected to quality control and it has been recommended that a formal audit of radiograph quality, either prospectively or retrospectively, should be carried

out approximately every six months.<sup>6,8</sup> The quality guidelines<sup>9</sup> published by the National Radiological Protection Board (NRPB), now part of Public Health England, include a rating system (Table 1) and targets for radiographic quality (Table 2). The European Commission<sup>7</sup> has also published guidelines, which reflect those of the NRPB, on radiation protection and quality assurance in dental radiology. The latest, third edition of guidelines on selection criteria and quality assurance for all aspects of dental radiography, including

<sup>1</sup>Adult Oral Health, Institute of Dentistry, Barts and The London School of Medicine and Dentistry, Turner Street, London, E1 2AD

\*Correspondence to: Professor B. S. Chong  
Email: b.s.chong@qmul.ac.uk

## Refereed Paper

Accepted 9 April 2015

DOI: 10.1038/sj.bdj.557

©British Dental Journal 2015; 219: 69-72

for endodontics, was recently published by the Faculty of General Dental Practice (UK).<sup>10</sup>

The aims of this prospective study were to assess the type and comparative quality of the radiographs accompanying endodontic referrals to a health authority clinic. The results may inform on quality assurance and provide guidance on radiographic requirements accompanying endodontic referrals for the benefit of patients.

**MATERIALS AND METHODS**

**Patient selection**

The Oxfordshire Priority Dental Service operates a clinic one day a week at The East Oxford Access Centre, Oxford, for the assessment and treatment of non-routine endodontic cases. General dental practitioners who wish to refer their patients for this service are required to provide a referral note and a radiograph.

Approval for this study was obtained from the Dental Directorate, Oxfordshire Primary Care Trust. Digital and conventional film radiographs accompanying the first 200 referrals received from 1 January 2012 onwards were collected. Patient confidentiality was strictly respected and no personal information was divulged.

Conventional film radiographs were evaluated under standardised and optimised conditions using a light-box and a Brynolf magnifier in a darkened room. Digital radiographs sent as an email attachment or on a computer disc were viewed on a 22 inch professional widescreen, flat panel computer monitor calibrated for medical imaging;<sup>11</sup> those supplied printed on paper were viewed in ambient room light.

**Assessor calibration**

An initial, separate, 20 radiographs accompanying referrals were assessed jointly by two examiners, both experienced dentists with enhanced skills in endodontics, overseen by a specialist in endodontics and a lecturer in dental maxillofacial radiology. The variables assessed, inclusive of the three-category quality-rating criteria (Table 1) based on NRPB guidelines<sup>9</sup> are shown in Table 3. The 'visible target area' referred to whether the radiographs showed the whole tooth including at least 2 mm beyond the apex; failure to satisfy this requirement would entail the need to take another radiograph. In addition, the quality of the digital radiographs, as a function of the size, was noted. Any digital radiographs which were equivalent to a conventional periapical film size (≤31 mm × 41 mm) were categorised as 'small'; those printed on A4 size (210 mm × 297 mm) paper were categorised as 'large', while any sizes in-between were assigned the 'medium' category. To ensure

**Table 3 Variables and features assessed**

Variables						
Type	Digital			Film-based		
Sharpness	Yes	No		Yes	No	
Angulation	Correct		Incorrect	Correct		Incorrect
Density/contrast	Light	Correct	Dark	Light	Correct	Dark
Visible target area	Yes		No	Yes		No
Errors	Yes		No	Yes		No
Repeat radiograph	Yes		No	Yes		No
Image size	Small	Medium	Large	N/A		
Format	Printed on paper		Disc/email	N/A		
Overall quality	1	2	3	1	2	3

**Table 4 Frequency and percentage of variables for digital and conventional film radiographs (n = 200)**

Variable	Digital (%) n = 162	Conventional film (%) n = 38	p-value
<b>Density/contrast</b>			
Light	59 (36)	8 (2)	-
Correct	63 (39)	22 (58)	-
Dark	40 (25)	8 (21)	0.084
<b>Sharpness</b>			
Yes	93 (57)	38 (100)	-
No	69 (43)	0 (0)	0.000
<b>Area</b>			
Yes	135 (83)	36 (95)	-
No	27 (17)	2 (5)	0.053
<b>Errors</b>			
Yes	23 (14)	7 (18)	-
No	139 (86)	31 (82)	0.332
<b>Quality</b>			
1	43 (27)	21 (55)	-
2	65 (40)	14 (37)	-
3	54 (33)	3 (8)	0.001
<b>Angulation</b>			
Yes	155 (96)	37 (97)	-
No	6 (4)	1 (3)	0.000
<b>Digital radiograph size</b>			
Small	32 (20)	-	-
Medium	69 (42)	-	-
Large	61 (38)	-	0.000

reproducibility, the assessor calibration exercise was repeated twice within a three-month period, using a further 20 cases, to determine the inter- and intra-examiner agreement.

**Statistical analysis**

The anonymised data was recorded on an Excel spreadsheet and analysed using SPSS statistical analysis software to calculate the kappa, weighted kappa and confidence intervals (CI). The frequency of the different variables for conventional and digital radiographs was calculated; the Chi-squared test and probability scores were used to assess whether the frequencies differed significantly from those observed.

**Table 5 Quality ratings (1, 2, 3) in relation to digital radiograph size (small, medium, large)**

Digital radiograph size	Number of images (%)	p-value
Small (n = 32)		
1	16 (50)	-
2	9 (28)	-
3	7 (22)	0.000
Medium (n = 69)		
1	21 (31)	-
2	28 (40)	-
3	20 (29)	0.000
Large (n = 61)		
1	7 (12)	-
2	27 (44)	-
3	27 (44)	0.000

## RESULTS

A total of 200 radiographs accompanying referrals were received from 42 practices. The vast majority ( $n = 36$ , 86%) of these practices use digital radiography. Out of the 200 radiographs evaluated, 38 (19%) were conventional film and 162 (81%) were digital. All the conventional film radiographs submitted were unmounted ( $n = 38$ , 100%) whereas almost all the digital radiographs ( $n = 161$ , 99.5%) were in the printed form apart from one ( $n = 1$ , 0.5%), which was provided on a computer disc.

The inter-observer variability had a Kappa score of 84% and weighted Kappa score of 88%. The intra-observer variabilities were 76% and 80%; both had a CI of 95%. The frequency and percentage of each variable for the conventional film or digital radiographs including the p-values as a measure of statistical chance are shown in Table 4.

The digital radiographs, categorised according to size (small, medium or large), were also assessed in relation to quality (Table 5). The 'small' radiographs were of better quality with 50% categorised as 'excellent', while 44% of the radiographs printed on A4 paper (large) were 'unacceptable'. Regardless of size, digital radiographs in the 'unacceptable' category (33%) exceeded the NRPB (2001) recommended maximum of 10%.

## DISCUSSION

The advent of digital radiography has led to increased adoption of this technology.<sup>12,13</sup> It has been reported that 45% of practices in the UK employ digital radiography<sup>14</sup> as opposed to 20% reported in a Swedish study<sup>12</sup> or an estimated 10–20% in the USA.<sup>15</sup> In this study, a significantly higher number (85%), of referring general dental practitioners used digital radiography. However, it was not possible to ascertain which digital system was used by each referring practitioner and this may have affected the quality of the radiographs.<sup>13,16,17</sup>

The number of 'excellent' scores for conventional film radiographs was over twice that of digital radiographs and this was unchanged even with the inclusion of the 'diagnostically acceptable' category. A more significant difference was noted with those considered 'unacceptable', which comprised of 33% digital, compared with 8% conventional film, radiographs; the difference may decrease as digital radiography becomes more common and expertise in its use improves. In addition, the relatively small number of practices still using conventional film radiography (14%) may mean the results are less relevant. However, it may also be true that practices which still use conventional film radiography may be very experienced with this format and are capable of producing good quality radiographs,

and therefore, do not feel the need to adopt newer, digital technology.<sup>18</sup>

According to NRPB guidelines,<sup>9</sup> no more than 10% of radiographs should be rated 'unacceptable'. The 8% of conventional film radiographs rated 'unacceptable' in this study is within the NRPB guideline target and lower than the 19% reported in a similar study carried out in Sweden;<sup>12</sup> the difference may be because in the Swedish study,<sup>12</sup> 86% of radiographs were conventional film compared with only 19% in this study.

A major problem with comparing studies of radiograph quality is the criteria used and the rating system chosen; there is the inevitable element of subjectivity and this could lead to difficulties in achieving a high agreement score.<sup>19</sup> The number, experience and training of the assessors will also have an influence on the results. Instead of the NRPB three-category system<sup>9</sup> adopted in this study, other studies have chosen a two-category ('acceptable' and 'unacceptable')<sup>12</sup> or even four-category ('excellent', 'diagnostically acceptable', 'diagnostically compromised' and 'unacceptable') system.<sup>20</sup> The four-category system was reported to be a more flexible and sensitive but the inter-observer agreements were reduced, although the kappa scores were still rated as good or moderate despite there being 14 assessors.<sup>20</sup>

In this study, in 17% of the digital and 5% of conventional film radiographs, coverage did not include the apex and the surrounding 2 mm or 2–3 mm periapex as recommended by the guidelines of the European Society of Endodontology<sup>21</sup> and the European Commission<sup>7</sup> respectively. The higher percentage of insufficient coverage of the area of interest with digital radiographs may be dependent on the sensor used. Charged couple device (CCD) or complementary metal oxide semiconductor (CMOS) sensors are more bulky than conventional film whereas photo-stimulable phosphor (PSP) plates resemble conventional film in size and shape.<sup>6,13,17</sup> The image quality of digital radiographs was also reported to be superior with a PSP plate system.<sup>17</sup>

Digital radiography sensors generally perform well in terms of spatial and contrast resolutions.<sup>13,22–24</sup> However, the results from this study showed that only 39% of digital radiographs were judged to be of the correct density or contrast; 36% were too light and 25% were too dark. The greater percentage of conventional film radiographs which achieved the correct density and contrast (58%) may be due to automated processing largely superseding hand processing.

Since nearly all of the digital radiographs were supplied as hard copies, printing had significantly degraded image quality;<sup>12,25</sup> most printers are not able to reproduce 256 shades

of grey.<sup>8</sup> The choice of paper is also a factor;<sup>25</sup> in this study, only one digital radiograph was printed on photographic paper compared with one-third<sup>12</sup> or two-thirds<sup>26</sup> in other studies. In addition, the digital radiographs were printed in different sizes, ranging from that equivalent to a periapical radiograph up to A4 size paper. The smaller printed digital radiographs were of better quality with 50% being rated as 'excellent' and 28% as 'diagnostically acceptable'. Of the largest, A4 size, 44% of the prints were 'unacceptable'; hence, if digital radiographs accompanying referrals have to be printed, a smaller size would be more appropriate. However, it may be argued that the quality of digital radiographs in the form of paper copies is too poor to justify the use of printed copies.<sup>12,25</sup> Therefore, within the parameters of information governance, digital radiographs should, ideally, be provided electronically via a secure image/mail web portal or computer disc to prevent quality degradation and to permit manipulation of the image to maximise the diagnostic information obtainable. In the future, software for digital radiography may include tools that will automatically optimise image quality without the need for manual manipulation.<sup>24</sup> Since digital radiographic image quality is also dependent on the computer display performance and viewing conditions,<sup>6,14,27</sup> these factors should be included in any quality assurance programme. Only if it is not possible to supply an electronic copy with referrals, then digital radiographs should be printed on radiographic film or photographic paper to ensure limited loss of quality.<sup>25</sup>

If the quality of the radiographs is considered 'unacceptable' or the periapical area of interest is not included, then a repeat radiograph would be necessary; in this study, this would apply to 33% of digital compared with 8% of conventional film radiographs. Given the very high percentage of repeat radiographs necessary with digital radiographs, it would negate the advantages of digital radiography including a reduction in radiation exposure.<sup>28–30</sup> The poorer quality of digital radiographs confirmed the need for quality control<sup>6,31</sup> to facilitate correct diagnosis, to avoid the need for repeat radiographs and unnecessary radiation exposure. Furthermore, the results of this study support the recommendation of regulatory bodies, such as the GDC, that radiography and radiation protection is among the topics to undertake as part of compulsory continuing professional development requirements.<sup>32</sup>

## CONCLUSIONS

The use of digital radiography is increasing as exemplified by the greater number accompanying referrals. The quality of digital

radiographs was significantly lower compared with conventional film radiographs and the percentage of 'unacceptable' digital radiographs was above the target as recommended by the NRPB guidelines. Digital radiographs printed on paper were of reduced quality so unless they are supplied in electronic form, the inability to optimise the images using the appropriate computer software negates the benefits of using a digital system.

The authors would like to thank S. Islam for the statistical analysis; G. Di Filippo for assistance in assessing the radiographs; M. Taylor and S. Moosajee from the Oxford Health Authority Clinic for their support.

- Steele J. NHS dental services in England. 2009. Department of Health. Online information available at [http://www.sigwales.org/wp-content/uploads/dh\\_101180.pdf](http://www.sigwales.org/wp-content/uploads/dh_101180.pdf) (accessed May 2015).
- Patel J, Fox K, Grieveson B, Youngson C C. Undergraduate training as preparation for vocational training in England: a survey of vocational practitioners' and their trainers' views. *Br Dent J* 2006; **201**: 9–15.
- Chong B S. Introduction and overview. In Chong B S (ed) *Harty's endodontics in clinical practice*. 6th ed. pp 1–8. Edinburgh: Churchill Livingstone, 2010.
- General Dental Council. Standards for the dental team. 2013. Online information available at <http://www.gdc-uk.org/Dentalprofessionals/Standards/Documents/Standards%20for%20the%20Dental%20Team.pdf> (accessed May 2015).
- Bolas A, Fitzgerald M. Quality assurance in dental radiography: intra-oral image quality analysis. *J R Dent Assoc* 2008; **54**: 274–278.
- Rout J, Brown J. Ionizing radiation regulations and the dental practitioner: 3. Quality assurance in dental radiography. *Dent Update* 2012; **39**: 334–339.
- European Commission. Radiation protection. 2004. Online information available at <http://ec.europa.eu/energy/sites/ener/files/documents/136.pdf> (accessed May 2015).
- Whaite E, Drage N. *Essentials of dental radiography and radiology*. 5th ed. Edinburgh: Churchill Livingstone, 2013.
- National Radiological Protection Board. Guidance notes for dental practitioners on the safe use of x-ray equipment. 2001. Department of Health. Online information available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/337178/misc\\_pub\\_DentalGuidanceNotes.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/337178/misc_pub_DentalGuidanceNotes.pdf) (accessed May 2015).
- Horner K, Eaton K A. *Selection criteria for dental radiography*. 3rd ed. London: Faculty of General Dental Practice, 2013.
- American Association of Physicists in Medicine. Assessment of display performance for medical imaging systems. 2005. Online information available at [www.aapm.org/pubs/reports/OR\\_03.pdf](http://www.aapm.org/pubs/reports/OR_03.pdf) (accessed May 2015).
- Hellén-Halme K, Johansson P M, Håkansson J, Petersson A. Image quality of digital and film radiographs in applications sent to the Dental Insurance Office in Sweden for treatment approval. *Swed Dent J* 2004; **28**: 77–84.
- Vandenbergh B, Jacobs R, Bosmans H. Modern dental imaging: a review of the current technology and clinical applications in dental practice. *Eur Radiol* 2010; **20**: 2637–2655.
- Health Protection Agency. HPA-CRCE043: trends in dental radiography equipment and patient dose in the UK and Republic of Ireland. 2013. Online information available at [www.phe-protectionservices.org.uk/cms/assets/gfx/content/resource\\_3320c36ed197b3f.pdf](http://www.phe-protectionservices.org.uk/cms/assets/gfx/content/resource_3320c36ed197b3f.pdf) (accessed May 2015).
- van der Stelt P F. Filmless imaging: the uses of digital radiography in dental practice. *J Am Dent Assoc* 2005; **136**: 1379–1387.
- Borg E, Attalmanan A, Gröndahl H G. Subjective image quality of solid-state and photostimulable phosphor systems for digital intra-oral radiography. *Dentomaxillofac Radiol* 2000; **29**: 70–75.
- Farrier S L, Drage N A, Newcombe R G, Hayes S J, Dummer P M. A comparative study of image quality and radiation exposure for dental radiographs produced using a charge-coupled device and a phosphor plate system. *Int Endod J* 2009; **42**: 900–907.
- Ting N A, Broadbent J M, Duncan W J. Dental radiography in New Zealand: digital versus film. *N Z Dent J* 2013; **109**: 107–114.
- Devlin C V, Horner K, Devlin H. Variability in measurement of radiomorphometric indices by general dental practitioners. *Dentomaxillofac Radiol* 2001; **30**: 120–125.
- Rodgers G D, Sharif M O, Smith A B, Kellett M, Brunton P A. Making the grade? Modification of dental radiograph quality ratings. *Prim Dent Care* 2011; **18**: 119–124.
- European Society of Endodontology. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J* 2006; **39**: 921–930.
- Farman A G, Farman T T. A comparison of 18 different x-ray detectors currently used in dentistry. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005; **99**: 485–489.
- Nair M K, Nair U P. Digital and advanced imaging in endodontics: a review. *J Endod* 2007; **33**: 1–6.
- van der Stelt P F. Better imaging: the advantages of digital radiography. *J Am Dent Assoc* 2008; **139**: 75–135.
- Gerrard G. Printed radiographs – is what you see what you get? *Dent Update* 2013; **40**: 637–641.
- Wenzel A, Møystad A. Experience of Norwegian general dental practitioners with solid state and storage phosphor detectors. *Dentomaxillofac Radiol* 2001; **30**: 203–208.
- Butt A, Mahoney M, Savage N W. The impact of computer display performance on the quality of digital radiographs: a review. *Aust Dent J* 2012; **57**(Suppl 1): 16–23.
- Sommers T M, Mauriello S M, Ludlow J B, Platin E, Tyndall D A. Pre-clinical performance comparing intra-oral film and CCD-based systems. *J Dent Hygiene* 2002; **76**: 26–33.
- Berkhout W E, Sanderink G C, van der Stelt P F. Does digital radiography increase the number of intraoral radiographs? A questionnaire study of Dutch dental practices. *Dentomaxillofac Radiol* 2003; **32**: 124–127.
- Berkhout W E, Beuger D A, Sanderink G C, van der Stelt P F. The dynamic range of digital radiographic systems: dose reduction or risk of overexposure? *Dentomaxillofac Radiol* 2004; **33**: 1–5.
- Hellén-Halme K, Nilsson M, Petersson A. Digital radiography in general dental practice: a field study. *Dentomaxillofac Radiol* 2007; **36**: 249–255.
- General Dental Council. Continuing professional development for dental professionals. 2013. Online information available at <http://www.gdc-uk.org/Newsandpublications/Publications/Publications/Continuing%20Professional%20Development%20for%20Dental%20Professionals.pdf> (accessed May 2015).

## COMMENTARY

Achieving high quality dental radiographs is fundamental in meeting the statutory requirements of IRMER (2000). In undertaking any dental radiography, dental surgeons and dental care professionals are accepting one or more of the defined roles under the IRMER regulations, ensuring appropriate measures are taken to ensure high quality images. These requirements are dictated by the ICRP principle 'as low as reasonably practical' (ALARP), highlighting the need to restrict doses to patients as much as possible when obtaining diagnostic radiographs.

The ALARP principle goes beyond the capture and processing of images, extending to the sharing of such images with other health professionals to avoid repeat radiographs. With digital radiography, difficulties can arise in sending an appropriate copy of the radiograph to the second clinician for adequate diagnosis.

This paper by Chong *et al.* considers the quality of dental radiographs received within

an endodontic service. The findings and problems arising are likely to be similar within many specialties throughout the UK. It is clear from the results demonstrated, and personal experience, that digital radiographs printed in large format on paper are not acceptable for diagnosis, but at best could be used to record that a digital radiograph exists.

There is clearly a need to improve the ease of safe exchange of digital radiographs from the primary dental setting to secondary and tertiary referral centres. The Image Exchange Portal allows a simple and safe transfer of digital radiographs from one NHS trust to another, significant improving the exchange of images within secondary and tertiary centres. It seems unlikely that this facility will be opened to primary care clinicians, despite the dental professions being the only significant group of primary care clinicians requiring such a facility to great extent.

Alternative methods of transfer could include the use of an encrypted CD and password. However, this can create logistical

problems for an NHS trust in ensuring the password and the CD are available for a patient when required; in the present study only one radiograph (0.5%) was provided in this way. Alternatively, an email transfer could be sent with the referral, but this would require a secure email such as NHS Mail (nhs.net). Unfortunately not all dental practitioners have access to this service and many trusts do not provide a means of referring via email.

Over the coming years the majority of dental radiographs captured will transfer to digital format. Each clinician can strive to optimise the quality of the radiographs they capture but the diagnostic benefit can be lost if the radiographs are not managed appropriately when transferred to other clinicians. This is an area that needs urgent attention from our profession and also from the NHS trusts with whom we work.

Dr Bethan Thomas  
Consultant Dental and Maxillofacial  
Radiology, King's Health Partners