



## Impact of COVID-19 on service delivery in radiology and radiotherapy

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**Short title: Impact of COVID-19 on service delivery in radiology and radiotherapy.**

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## **Abstract**

### **Introduction**

The COVID-19 pandemic has had a profound impact on radiography services globally. The reshaping of service delivery continues to impact patient management and the experience of the radiography workforce should be evaluated to determine how effective service delivery can be maintained in the ongoing and post-pandemic world.

### **Methods**

A mixed methods approach was adopted. Questionnaires, designed using Qualtrics (Qualtrics, Provo, UT) online survey software, were used to survey radiographers throughout Northern Ireland (NI). Semi-structured interviews were conducted with radiography service managers in the NHS and private sector in NI. All interviews were digitally recorded, transcribed and coded independently by 2 researchers.

### **Results**

A total of 106 Radiographers completed the online survey i.e. 82 Diagnostic and 24 Therapeutic. Variations were reported regarding staff concern for contracting COVID-19 and passing it on. Clinical workload was reported to fluctuate during the early period of the pandemic, however, both diagnostic and therapeutic radiographers reported workloads which were higher than normal at the time of the data collection. Nine service managers participated in the interviews plus two band 8 superintendent radiographers. Staff faced many challenges whilst delivering services due to COVID-19. The two most frequently cited challenges included issues related to (i) Implementation of PPE and (ii) Changes to work practices.

### **Conclusion**

A pre-prepared pandemic plan should be established and stress tested for the future. The plan should be devised in consultation with both the public and private sector to determine the very best use of resources.

### **Implications for practice**

The radiography workforce has worked continuously throughout the pandemic and needs to be supported to deal with the potential increase in demand for services in the post-pandemic world.

**6 keywords**

COVID-19 pandemic, radiography, radiography service provision, radiography workforce, radiotherapy

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5 **Short title: Impact of COVID-19 on service delivery in radiology and radiotherapy.**  
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10 **Introduction**  
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14 The most recent viral outbreak “COVID-19” was first reported in China in December 2019,  
15 when a new strain of coronavirus emerged. On 11th March 2020, COVID-19 was officially  
16 classified by the World Health Organisation (WHO) as a pandemic<sup>1</sup>. In the UK attempts  
17 were made to protect the National Health Service (NHS) from the potential surge in  
18 patients falling critically ill from COVID-19. Resources within the NHS were largely  
19 directed to fighting the pandemic and as a direct result, many outpatient clinics were  
20 temporarily suspended and some surgical procedures postponed to facilitate reskilling  
21 and redeployment of staff to areas anticipated to need support. The reshaping of the NHS  
22 was designed to enable the service to manage the crisis in 2020 and the altered service  
23 delivery is still being felt in January 2022 <sup>2, 3, 4, 5</sup>.  
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33 The three UK cancer screening programmes for breast, bowel and cervical cancer were  
34 temporarily suspended with invitations and follow-up appointments delayed <sup>6,7</sup>. Diagnostic  
35 radiology departments were restructured to facilitate care for both COVID-19 and non-  
36 COVID patients which included patients suffering from acute emergency conditions in  
37 addition to all non-elective presentations to the hospital. Routine surgery has been  
38 delayed intermittently over the duration of the pandemic while radiology departments  
39 struggled to meet an unprecedented demand for medical imaging to confirm COVID-19  
40 diagnosis and extent of disease <sup>8</sup>.  
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49 In addition to COVID-19 affecting screening, diagnostic radiography and imaging  
50 services, therapeutic radiographers (TRs) working in regional Cancer Centres, were  
51 managing and implementing changes in radiotherapy protocols. An international  
52 specialist consensus statement was released recommending short-course radiotherapy  
53 as a means of delaying surgical excision for rectal cancers instead of the routine protocol  
54 <sup>9</sup>. For breast cancer radiotherapy the timely publication of the FAST-Forward trial  
55 results,<sup>10</sup> enabled treatment duration to be shortened to one week as opposed to the  
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4 established three-week delivery protocol <sup>11</sup>. Patients with prostate cancer, also felt the  
5 impact of COVID-19 as radiotherapy for localised disease was deferred for three months  
6 in most centres <sup>12</sup> to create capacity for radiotherapy referrals emanating from the  
7 reduction in surgery and the cautious approach to systemic anti-cancer therapy  
8 interventions during the pandemic.  
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14 Contingency planning and the reshaping of oncology services within radiotherapy  
15 departments has clearly made a considerable impact on patient treatments. Healthcare  
16 professionals, including radiographers, have adapted both their personal lifestyle and  
17 their professional working protocols and practices<sup>13</sup>. Akudjedu et al.'s <sup>14, 15</sup>, collected  
18 survey data from March-May 2020 (first wave of COVID-19 in the UK), and highlighted  
19 that COVID-19 resulted in changes to clinical working patterns and service delivery in the  
20 UK and Ghana with a corresponding increase in work related stress. Elshami et al.<sup>16</sup>  
21 reiterated this in their study of radiology workers (May-June 2020) in the Middle East,  
22 North Africa and India, their results indicating a workload increase specifically in general  
23 x-ray and Computed Tomography as these were the main modalities used for the  
24 diagnosis of COVID-19 and follow-up investigations. Further work by Ooi et al. <sup>17</sup>  
25 suggested the need for better organisational structure, resources and education to help  
26 the workforce deal with these difficulties whilst Shanahan et al <sup>18</sup> highlighted the need for  
27 further strategies to support and enhance staff well-being during subsequent waves of  
28 the pandemic. The experience of the Diagnostic Radiography (DR) and TR workforce  
29 should be evaluated in order that effective service delivery can be maintained, not only  
30 for the ongoing and future waves of the COVID-19 pandemic, but also for future  
31 challenges presented by delayed treatments, late presenting disease, and staff  
32 shortages/burn-out. The paucity of information available on radiographers' experience of  
33 service delivery in daily clinical practice during a pandemic provides a strong rationale for  
34 the design of a dedicated study.  
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54 This study aims to explore the experiences and perceptions of radiography managers  
55 and staff regarding changes to workload, workflow and protocols in diagnostic  
56 radiography and radiotherapy departments in Northern Ireland (NI) one year into the  
57 pandemic.  
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**Methodology:**

This was a mixed methods exploratory study investigating the opinions of DRs, TRs and radiography service managers using an online survey and semi structured interviews. A mixed methods approach was used to help explain the quantitative results. This enabled the study to give a voice to the radiographers and ensure that the research findings are grounded in the radiographers lived experiences. Phase 1 and Phase 2 were carried out independently and the findings of Phase 1 helped to inform the interview questions in Phase 2. Ethical approval for this study was obtained from the Nursing and Health Research Ethics Filter Committee in Ulster University and the NHS Research Ethics Committee in December 2020 (project ID 287032).

**Phase 1:** A multimedia electronic survey was created on Qualtrics® and promoted via social media (Twitter® / LinkedIn®). Participation was voluntary and the survey was designed and reported to adhere to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) <sup>19</sup>. The survey was open to all radiographers throughout NI (Diagnostic and Therapeutic) and ran from 26<sup>th</sup> February 2021 to 20<sup>th</sup> April 2021. Participants were recruited by snowball sampling. The link to the survey was also sent to the Radiology Service Managers throughout NI for dissemination to all colleagues, therefore ensuring maximum reach. The survey collected responses that were fully anonymous, hence, neither IP addresses or any other identifying information was collected. The start of the survey gave participants information regarding the study aims and rationale, informed participants of the approximate time commitment (10 minutes) to complete the survey and enabled them to give their consent to proceed. At the end of the survey respondents were notified that their responses had been submitted.

The questionnaire consisted of 46 questions in total, divided into five main sections or 'blocks' – 1. Professional / Personal Demographics, 2. Infection control measures, 3. Workforce and remote working, 4. Imaging procedures/radiotherapy treatments, 5.

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4 Learning from the COVID-19 experience. Most questions were either in multiple choice  
5 format or used a Likert scale with some free text options to allow for more detailed  
6 responses. Eleven questions permitted an open response. “Skip logic” was used at  
7 question 26 to filter responses specific to Radiotherapy treatments and Imaging  
8 procedures (see appendix 1). Only the results of the first four sections of the survey are  
9 discussed in this paper; the remaining will be presented in further publications to adhere  
10 within word limitations and allow in-depth exploration of the data.  
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18 Initially, the questionnaire was piloted amongst a panel of experts in the medical imaging  
19 and radiotherapy fields which included 8 qualified radiographers and academics, with a  
20 range of clinical experience from less than five years to greater than 30 years. Changes  
21 to the final survey were made following a review of the feedback to correct minor  
22 formatting issues, ambiguous questions and errors in Qualtrics involving the use of “skip  
23 logic”. The content of the survey was also ensured by its design being based on the  
24 most relevant current research evidence and Department of Health guidelines <sup>20, 21, 22</sup> .  
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27 All issues were corrected before final dissemination of the survey.  
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37 **Phase 2:** Ten radiography service managers across all five Health and Social Care (HSC)  
38 trusts and independent sectors in NI were invited via email to participate in an interview.  
39 The interview guide (see appendix 2) was developed by the research team who are  
40 comprised of Diagnostic and Therapeutic academic radiographers. The questions in the  
41 interview guide were guided by preliminary data from Phase 1. Managers were shown  
42 the interview guide in advance of the interview and encouraged to discuss it with their  
43 modality leads to maximise the richness of the data received. All interview dates and  
44 times were agreed via email. Semi-structured online video interviews were conducted  
45 with the aid of Microsoft Teams by one experienced researcher who is trained in  
46 conducting semi-structured interviews. The interview guide was used for all interviews  
47 and questions were asked in a consistent order. Interview data was digitally recorded,  
48 transcribed and coded independently by 2 researchers. Interviews were conducted during  
49 March and April 2021 until data saturation was reached i.e. analysis of the data revealed  
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4 that no new information was being introduced. Confidentiality was guaranteed at the  
5 outset. Participants had access to the participant information sheet at the time of  
6 invitation, and consent was obtained before the interview (both written and audio-  
7 recorded for the online interviews).  
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### 10 *Data Analysis*

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15 IBM SPSS (version 27) was used for analysis of the data <sup>23</sup> and providing descriptive  
16 statistics. Qualitative data from both the survey and the interviews was transcribed  
17 verbatim, checked for accuracy and then analysed in NVivo<sup>24</sup> using an iterative approach  
18 following Braun & Clarke's<sup>25</sup> six stage framework for thematic analysis i.e. Step 1:  
19 Become familiar with the data, Step 2: Generate initial codes, Step 3: Search for themes,  
20 Step 4: Review themes, Step 5: Define themes, Step 6: Write-up. Two researchers  
21 independently coded the interviews, as recommended by Cuttcliffe & McKenna <sup>26</sup>, finding  
22 an alignment of over 90% with coding comparison in NVivo prior to any discussion.  
23 Through discussion, the researchers reached agreement on all remaining coding and  
24 worked together to place codes into appropriate categories and themes.  
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## 34 **Results**

### 35 **Phase 1: Staff Survey**

#### 36 **1. Professional / Personal Demographics**

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43 A total of 106 survey responses were available for analysis. i.e. 82 DR and 24 TR (See  
44 Table 1).  
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47 A range of years of experience was indicated in both diagnostic radiography and  
48 radiotherapy. All age groups were represented except for the over 61 years old group.  
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9 The ratio of therapeutic to diagnostic radiographers broadly represents the UK workforce  
10 ratio of 3,794 therapeutic to 20,231 diagnostic radiographers <sup>27</sup>. In May 2021, there were  
11 1,348 radiographers in NI registered with the Health and Care Professions Council  
12 (HCPC) although it is unclear how many of these radiographers are currently employed  
13 in radiography departments in NI (this data was obtained directly from the Health and  
14 Care Professions Council through the Freedom of Information Act 2000).  
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21 The male/female distribution was comparable to the UK radiographer workforce, which  
22 has an approximate 1:3 ratio of male to female <sup>27</sup>. In total 18, 49, 28 and 11 respondents  
23 were graded as Band 5, Band 6, Band 7 and Band 8 respectively (according to the  
24 Agenda for Change Pay Structure) of Radiographers <sup>28</sup>.  
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## 29 **2. Infection control measures**

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32 Respondents reported varying levels of experience working with infectious patients prior  
33 to the pandemic and different levels of concern over contracting the virus at work or at  
34 home (See Table 2).  
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39 Overall, 78% (n=83) of all respondents reported that they did receive additional training  
40 in infection control measures since the pandemic started (66 DR, 17 TR). 93% (n=98) of  
41 all respondents (DR and TR) reported that they felt “confident and comfortable” working  
42 in the department during the pandemic but 17% (n=18) of all respondents identified that  
43 they would like further training in infection control measures in case another wave of  
44 COVID-19 happened. Free text responses for suggestions included:  
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51 *“Yes as PPE guidance changes regularly I would like specific evidence to support each*  
52 *change and not just cost effectiveness”.*  
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55 *“All our training has been online for infection control.. it has been very difficult to find time*  
56 *to do online training as we have been short staffed and CPD time has been difficult to*  
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4 *gain due to increased pressures. A lot of this training has had to be done outside of work*  
5 *hours, which is not practical”.*  
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9 Participants were asked to retrospectively scale their level of satisfaction with access to  
10 PPE each month from March 2020 to February 2021 (See Table 3).  
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### 13 14 15 16 **3. Workforce and remote working** 17

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19 Almost 30% of all respondents (n=31) had taken sick leave at some stage since March  
20 2020 that was not attributed to the pandemic (23 DR, 8 TR). A further 70% (n=73) reported  
21 that they had contact with asymptomatic patients who had subsequently been confirmed  
22 as COVID-19 positive (56 DR, 17 TR). 66% (n=70) indicated that their department was  
23 able to facilitate remote working and networking if required (49 DR, 21 TR) . Of these 15,  
24 40% (n=6) had difficulty adapting to working remotely (2 DR, 4 TR). See Table 4.  
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31 10 DRs were redeployed as a result of the COVID-19 pandemic, 6 of whom would like to  
32 continue in the new role either full time or part time after the pandemic subsides. Of the  
33 10 redeployed, 3 were moved to an area/role where they did not have prior experience  
34 and 1 respondent felt they did not receive any additional training for the new role. Overall,  
35 confidence working in the new role was recorded as “confident” to “very confident”.  
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### 41 **4. Imaging procedures/radiotherapy treatments** 42

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44 Respondents were asked to retrospectively determine how their workload had been  
45 impacted from March 2020-February 2021 (See Table 5)  
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4 Diagnostic Radiography  
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7 73% of DRs (n=60) report that patients are now receiving routine diagnostic appointments  
8 again with 40% of respondents (n=33) indicating that imaging protocols have changed  
9 since COVID-19. 60% (n=49) believe the changes in imaging protocols will remain for the  
10 foreseeable future; the majority indicating that they are likely to return to pre-COVID-19  
11 status.  
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17 80% (n=66) of DRs expressed some level of concern regarding patient imaging disruption  
18 with 83% (n=68) reporting that patients themselves had expressed concern (See Table  
19 6).  
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24 Free text responses identified that respondents perceived that oncology patients,  
25 screening services and orthopaedic patients were most affected. At the time of the survey  
26 73% of respondents (n=60) thought these patients were now receiving appointments  
27 again but with a delay of approximately 3-5 months.  
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32 40% (n=33) of respondents thought that imaging/scanning protocols had changed since  
33 COVID-19 started. Examples of modifications identified through the free text response  
34 included the following:  
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39 *“All appointment times have been extended. CT Colon patients now require a negative*  
40 *PCR test prior to appointment and must follow isolation protocols before their scan. The*  
41 *room is then deep cleaned and time added between appointments for air changes. Image*  
42 *guided injection patients attending the DPU follow same pathway. Patients who have*  
43 *been vaccinated must wait 2 weeks before steroid injections”.*  
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49 *“In CT stroke patients must have an unenhanced chest prior to carotid imaging or the*  
50 *stroke service will not accept their referral for thrombectomy”*  
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54 *“Abdomen scans for CT are required to take oral contrast 1 hour before the scan; this is*  
55 *not being done in 2/3 sites in the trust as there is not enough space to social distance and*  
56 *remove a mask to drink the contrast.”*  
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4 7% (n=6) of DRs reported experiencing atypical referrals, e.g. patients receiving  
5 alternative imaging modalities due to COVID-19 creating an increased demand on CT  
6 services. Examples of alternative imaging were identified through free text;  
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11 *“Large increase in CT pulmonary angiograms; V/Q scans were unavailable for a long*  
12 *time”*  
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15 *“In nuclear medicine we are doing increasing numbers of MPI heart scans, as they are*  
16 *the only diagnostic cardiac service being offered in the trust. We have also increased our*  
17 *SPECT lung numbers”.*  
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### 20 21 22 Radiotherapy 23

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25 71% (n=17) of TR respondents reported treating patients who might otherwise have been  
26 referred for surgery or systemic anti-cancer treatment.  
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29 96% (n=23, 1 non-responder) of TRs reported that patients had treatments disrupted,  
30 altered, or postponed since the outbreak of the pandemic. 46% (n=11) of TRs expressed  
31 concern regarding patient treatment disruption, with 67% (16) of TRs reporting that  
32 patients themselves had expressed some level of concern (see table 6). As of June 2021,  
33 63% (n=15) of TRs, reported that patients were now receiving pre-COVID-19 treatment  
34 protocols again. 71% (n=17) of TRs thought that the modified treatment protocols are now  
35 likely to remain in place for the future.  
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43 Free text responses identified commonly cited changes to protocols;  
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46 *‘Breast treatment protocols shortened as a result of a trial whose results were published*  
47 *at the start of COVID. I think these regimes would have been amended but maybe just*  
48 *not quite as quickly.’*  
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53 *Pancreatic 15 fraction regimes and 5 fraction high dose "SABR" regimes*  
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56 *‘Head & Neck protocol shorted to 30#s. Prostate protocol shorted to 20#s. Usual length*  
57 *protocols still in place but when possible, the shorter prescriptions are used.’ (# - an*  
58 *abbreviation for fraction)*  
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4 **Phase 2: Interviews**  
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7 A total of 10 radiography service managers were invited from across the five Trusts and  
8 Independent sector in Northern Ireland. 9 of the 10 service managers participated in  
9 interviews. The managers expressed the need to include the opinions of team leads in  
10 different modalities also, hence, two band 8 superintendent radiographers were also  
11 interviewed. Many of the managers were given time to discuss the research with other  
12 team leads which enabled them to provide additional comments during the interview (this  
13 included the leads of all modalities and a paediatric superintendent radiographer).  
14 Interviews lasted from 45 minutes to 1.5 hours. In total 11 interviews and one written  
15 reply were analysed.  
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19 Two central themes arose regarding challenges encountered by managers to service  
20 provision;  
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25 1. Implementation of PPE  
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27 2. Changes to work practices  
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32 **1. Implementation of PPE**  
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37 Almost exclusively, managers felt that the most challenging aspect at the start of the  
38 pandemic was the implementation of PPE. Implementation was challenging due mainly  
39 to a) insufficient and changing PPE guidance a, b) availability of PPE and c) the impact  
40 of PPE on staff/patient communication.  
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49 **a) Insufficient and changing PPE Guidance**  
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53 Insufficient and changing PPE guidance was cited most frequently by managers as being  
54 their greatest challenge during the initial period of the pandemic. They described having  
55 to create COVID-19 departmental response plans themselves based on very little  
56 guidance including preparation of action plans and trigger points in the department e.g.  
57 loss of 25% of CT staff would mean the closure of one CT scanner.  
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4 Managers described PPE decisions being made within the trust, without their input which  
5 were not suitable for their radiography team e.g. the standard introduction of visors for all  
6 patients which had the potential to increase physical injury when worn continuously while  
7 performing imaging techniques and also impact the accuracy of imaging assessment.  
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12 Managers felt that support for and access to PPE within their departments was sub  
13 optimal until the Society of Radiographers (SOR) issued guidance on the 20<sup>th</sup> April <sup>29</sup>,  
14 indicating that if staff did not have access to appropriate PPE then they would support  
15 them in refusing to work.  
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### 20 21 b) Availability of PPE 22

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24 As the need for and specifications for PPE became firmly established, managers felt that  
25 overall, they experienced few issues with PPE supply though availability was 'tight' in the  
26 early stages  
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### 30 31 c) The impact of PPE on staff communication with patients 32

33 Managers indicated that staff found communicating with patients, especially children,  
34 while wearing a mask difficult. The paediatric superintendent indicated that, initially,  
35 paediatric radiographers felt that children were quite nervous of staff wearing PPE and  
36 they found it difficult to balance reassuring the child against wearing sufficient and  
37 appropriate PPE. The superintendent felt that as the pandemic progressed, children  
38 became more familiar with PPE (sometimes wearing their own) but that children remained  
39 anxious when staff wore 'Red PPE' for Aerosol Generating Procedures (AGP)  
40 procedures. To minimise anxiety, the team had incorporated child friendly posters  
41 throughout the department explaining PPE. They described the use of a 'toe tap' which  
42 quickly replaced a 'high five'. Additional challenges to service delivery for paediatric  
43 patients included maintaining a clean waiting area for children as children rarely sit in one  
44 place for long. Additionally, the superintendent indicated that the team had to remove the  
45 toys and play area for children waiting for imaging to reduce the risk of cross-  
46 contamination and have not been able to reinstate these toys yet.  
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7 **(2) Changes to Working Practices**  
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10 All managers consistently described the need to implement changes to working practice.  
11 These changes included a) increasing working hours, b) restructuring of staff and  
12 resources and c) changes to general departmental protocols.  
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16 **a) Increasing working hours**  
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19 All managers indicated that their teams were under increased time pressures due the  
20 additional time needed for donning and doffing PPE and cleaning between patients.  
21 Managers felt that this additional time per procedure/treatment, resulted in a need to  
22 adapt shift patterns in their radiography services. Subsequently, many diagnostic services  
23 increased to a 24/7 service with others adding an on-call rota to provide an out-of-hours  
24 service. While many diagnostic managers anticipated that they would need to move  
25 towards a 7-day service prior to the pandemic, they felt that COVID-19 had significantly  
26 accelerated this transition. Managers with smaller teams described the challenges of  
27 implementing an on-call rota, often asking for volunteers rather than introducing  
28 compulsory on-call.  
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38 Radiotherapy managers spoke of the positive impact of the publication of the 'The Fast  
39 Forward trial' early on in the pandemic resulting in implementation of shorter breast  
40 radiotherapy protocols increasing capacity in both radiotherapy centres in Northern  
41 Ireland. Managers indicated that this helped to combat the extra time needed for PPE  
42 and cleaning between patients. While the breast fraction reduction aided the workflow,  
43 shifts were extended in both radiotherapy centres initially to accommodate the increased  
44 time needed for PPE and cleaning. Additionally, managers indicated that  
45 delays/postponement of cancer surgery resulted in increased numbers of patients with  
46 certain cancers receiving radiotherapy as their primary treatment. Post-radiotherapy  
47 reviews were moved to a telephone format to help to manage the changes in workload.  
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7 b) Restructuring of staff and resources  
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10 Staffing levels in smaller departments were particularly vulnerable during the pandemic  
11 and managers were concerned that having multiple staff members contract COVID-19 or  
12 become “close contacts”, would result in the need to self-isolate, potentially having a large  
13 impact on service delivery. At the end of May 2020 the UK government launched the NHS  
14 Test and Trace strategy with the aim of reducing the spread of COVID-19. This involved  
15 guidance for the public sector and recommended the download of an NHS app to identify  
16 close contacts with possible COVID-19 infection, enabling people to isolate as early as  
17 possible<sup>30</sup>. UK guidance, which also applied to radiographers, stated that close contacts  
18 should isolate until a Polymerase Chain Reaction (PCR) test is completed at which point  
19 the person can return to normal activities if negative or self-isolate for 10-14 days from  
20 the positive result<sup>31</sup>. Managers indicated that staffing was most severely impacted when  
21 the “Test and Trace” strategy was implemented rather than during the initial stages of the  
22 pandemic. Managers described their departments as operating with a ‘skeleton staff’ at  
23 times.  
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36 Diagnostic radiography managers explained how some of their radiographers were  
37 redeployed to completely new sites. Breast screening teams were particularly affected  
38 due to the cessation of screening services in the initial stages of the pandemic until July  
39 2020 although a higher risk breast screening programme was maintained.  
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45 Managers explained that redeployment meant that radiographers often needed some  
46 refresher training as their skills had decreased in some areas of their practice over time.  
47 Diagnostic departments often needed to split their staff between sites – those where  
48 COVID-19 positive patients would attend e.g. emergency departments and those where  
49 COVID-19 negative patients would attend.  
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55 A number of radiography managers, as well as the paediatric superintendent, provided  
56 an insight into how paediatric radiography service provision was impacted by the  
57 pandemic. One manager explained how the pandemic resulted in the need for the  
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4 paediatric age limit for one trust site to increase from 14 years to 16 years. This involved  
5 the introduction of different types of trauma imaging which meant that X-ray and CT  
6 protocols were adjusted to meet the needs of this cohort. Other managers described the  
7 increased numbers of children attending for radiography procedures through the  
8 emergency department (ED).  
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### 14 c) Changes to General Departmental Protocols

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17 Managers described the prioritisation of additional training in Infection Control for all staff  
18 at the start of the pandemic with some departments training staff over weekends to ensure  
19 100% completion. Changing protocols and guidelines needed to be quickly disseminated  
20 to and signed off by all radiographers.  
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25 Managers described how some mandatory training was postponed at the beginning of  
26 COVID-19 but that one year on, mandatory training is generally running on course though  
27 some managers expressed a backlog starting to form again. A significant portion of the  
28 training was transferred to an online format which managers felt worked well where there  
29 was a strong IT infrastructure but was more challenging for smaller departments where  
30 physical space and resources were an issue. The social distancing guidelines also  
31 resulted in fewer available spaces in face-to-face training over the year resulting in delays.  
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33 Not all training was offered online as explained by manager 2:  
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41 Managers explained how appointment systems that were previously used to book  
42 patients, no longer worked with new social distancing requirements. Departments that  
43 had already adopted Microsoft Teams or similar software, were able to transfer  
44 appointments/reviews over to this media more efficiently.  
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### 50 Discussion

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53 Radiography service provision faced many challenges during the first year of the COVID-  
54 19 pandemic. Managers reported that their greatest challenge was establishing and  
55 maintaining a safe environment for their staff and patients. During a time of delayed,  
56 conflicting and often inappropriate PPE/COVID-19 guidance, radiography managers  
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4 demonstrated their strong leadership skills by creating and adapting guidance and  
5 protocols to ensure maximum protection for their radiographers and patients. These  
6 findings are consistent with Naylor et al.'s qualitative study of diagnostic radiographers,  
7 who also highlighted frustration with changing government guidance in the early stages  
8 of the pandemic <sup>32</sup>. While the frustration felt as a result of this lack of government guidance  
9 was not limited to radiography <sup>33</sup>, the pandemic highlighted a lack of understanding by  
10 other healthcare professionals, regarding the role of the radiographer and the need for  
11 unique PPE and safety guidance at a departmental level to account for specialist  
12 procedures within each area of the department. Almost fifty percent of radiographers  
13 surveyed were dissatisfied with access to PPE in the early stages of the pandemic  
14 aligning closely with Zervide et al.'s figures from May 2020 <sup>34</sup>.

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17 Inevitably, the workforce was directly impacted by the pandemic with forty-two percent of  
18 surveyed radiographers indicating that they had to take time off work as a result of  
19 COVID-19 due to illness or needing to isolate. This increased pressure on the workforce  
20 resulted in the majority of radiography departments extending their hours temporarily with  
21 many diagnostic departments changing their hours of work permanently. However, Ooi  
22 et al. caution that while extending radiography shifts to 12 hours can be effective in the  
23 short-term, in the long-term this work pattern is likely to result in burnout <sup>17</sup>. Establishing  
24 remote working and training is vitally important at this time to enable radiographers who  
25 are isolating or shielding to continue to work from their home. However, only sixty-seven  
26 percent of radiographers surveyed felt that their department could facilitate remote  
27 working. The implementation of a strong IT infrastructure within all radiography  
28 departments is essential to ensure that the workforce is somewhat resistant to future  
29 waves of the pandemic. Management also need to prioritise the continued adaptability of  
30 the workforce by ensuring that specialist radiographers maintain competencies to enable  
31 them to move quickly into clinical roles when required.

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34 One year into the COVID-19 pandemic, perceived workload by both DR and TR is higher  
35 than normal though many protocols have returned to pre-pandemic times. PPE standards  
36 are now well-established within departments and ninety-five percent of staff are satisfied  
37 with access to PPE. However, the procedure/treatment time needed per patient continues

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4 to be high due to the continued need for PPE and risk-assessed cleaning between  
5 patients.  
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8 The UK has emerged from a new wave of the pandemic due to the emergence of the  
9 Omicron variant, which appears to have a greater ability to evade immunity from prior  
10 infection<sup>35</sup>. Every COVID-19 positive patient who is admitted to hospital will require the  
11 expertise of a radiographer and around half of all people with a cancer diagnosis will  
12 receive radiotherapy<sup>36</sup>. Given the lengthy hospital waiting lists in Northern Ireland that  
13 pre-date COVID-19, any efforts to provide efficient and timely services to the public that  
14 not only clear the COVID-19 backlog, but address the legacy issues, will require  
15 substantial funding. With approximately 80% of both therapeutic and diagnostic  
16 radiographers indicating that patients had expressed concern about their treatment being  
17 delayed or disrupted, it is becoming even more difficult to reassure our patients that their  
18 health is not being impacted by the pandemic.  
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30 Limitations of this study include the small number of radiographers and responses to the  
31 survey in NI. The authors highlight caution that the findings may not be generalisable  
32 beyond the study sample. A response rate is not available as snowball sampling was  
33 used and respondents were recruited via social media. The sample of respondents  
34 included little diversity in terms of ethnicity. In addition, due to time and financial  
35 constraints the participants were not offered the possibility to review and/or validate the  
36 transcribed interview data. It is also possible that the perceptions of radiographers  
37 regarding events which occurred several months prior to the survey e.g. availability of  
38 PPE, may not be as accurate as collecting the data earlier on in the pandemic at the  
39 time of the PPE shortage.  
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## 50 **Conclusion**

51 While departments are undoubtedly more prepared for future waves, the workforce  
52 continues to face pressure with unpredictable long-term outcomes for both staffing levels  
53 and service efficiency for some time to come. Radiographers, and other health staff, have  
54 remained at the “coal front” throughout the pandemic despite fears of shortages of PPE,  
55 reacting promptly to changing government guidelines and managing changing duties and  
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4 shift patterns effectively. Even though the hard work of radiographers has clearly helped  
5 to maintain service delivery in these adverse conditions, NHS professionals still perceive  
6 that the “Northern Ireland health system is one step from chaos”<sup>37</sup>.  
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## 10 **Acknowledgments**

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15 The authors would like to acknowledge all radiography staff and managers in NI for  
16 maintaining service delivery throughout the pandemic. We are grateful they took the time  
17 to participate in the survey and interviews during a very challenging time.  
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## **Acknowledgments**

The authors would like to acknowledge all radiography staff and managers in NI for maintaining service delivery throughout the pandemic. We are grateful they took the time to participate in the survey and interviews during a very challenging time.

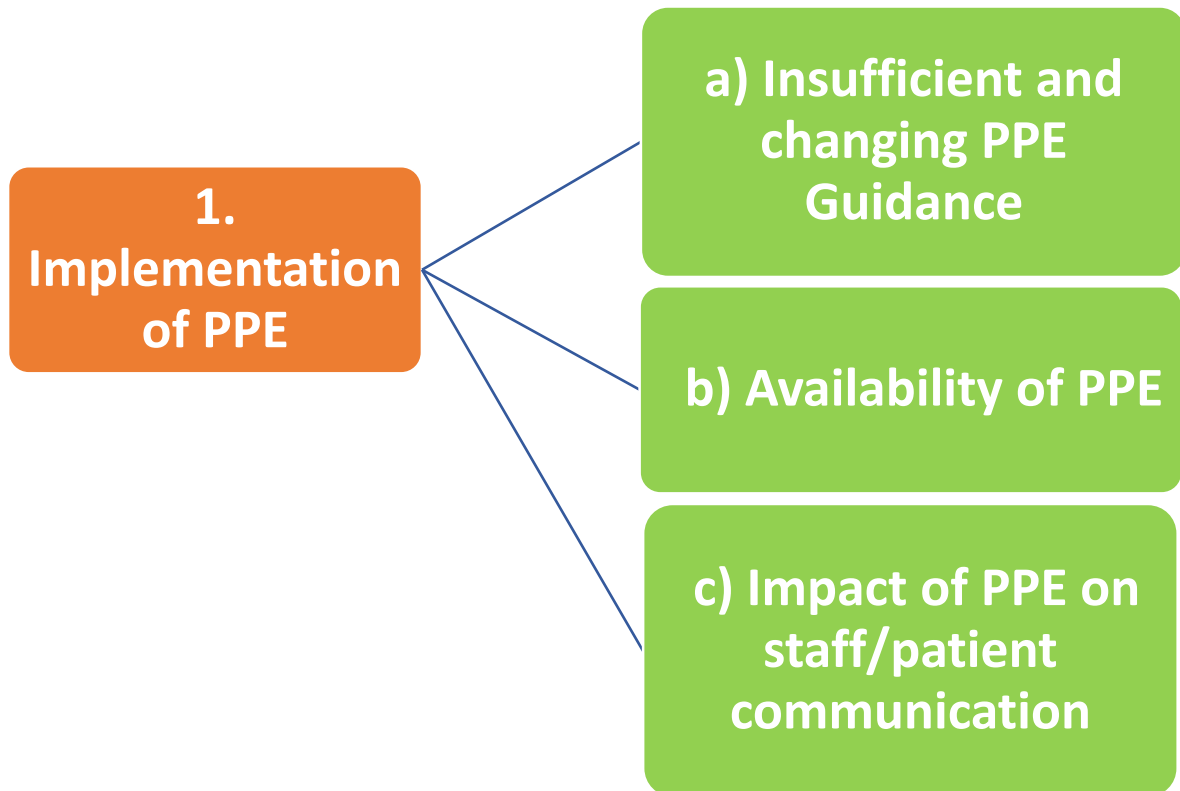


Figure 1: Theme 1 with sub-categories (highlighted in green)

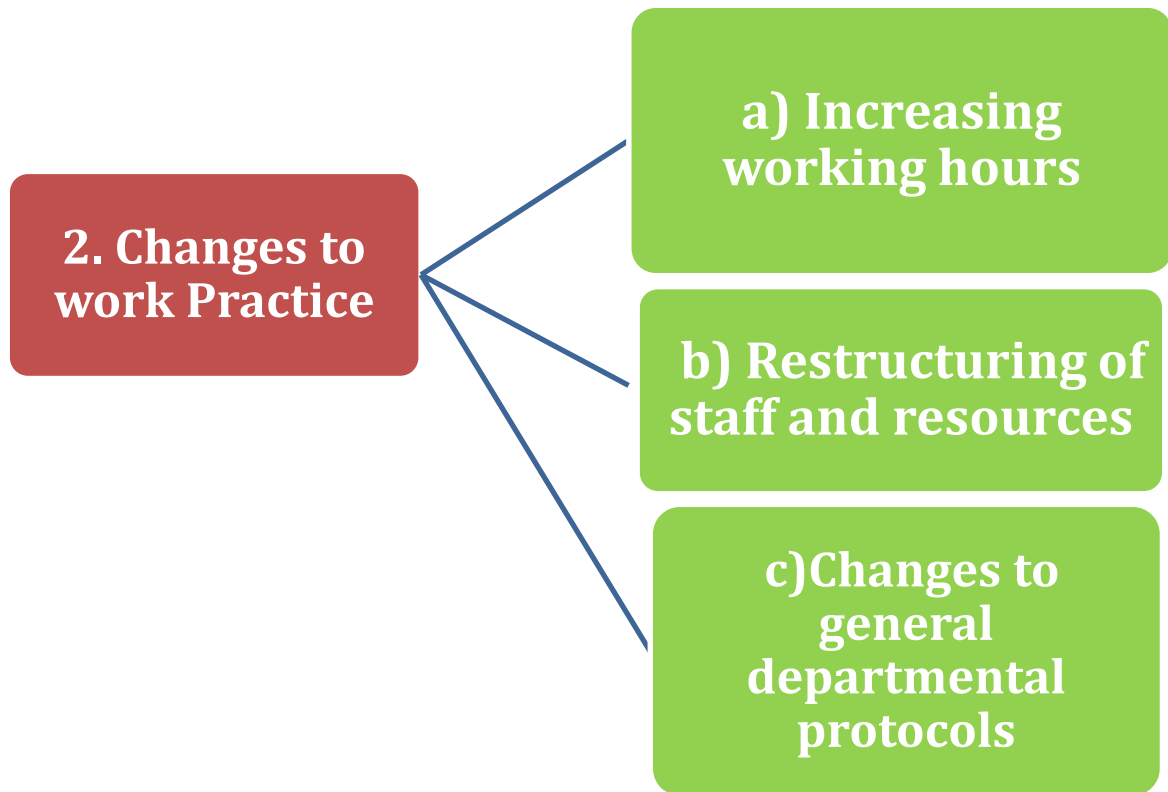


Figure 2: Theme 2 with sub-categories (highlighted in green)

**Table 1.** Respondents' demographic details

		<b>Diagnostic radiographers</b>	<b>Therapeutic radiographers</b>
		<b>% and number of participants*</b>	
<b>Hospital where currently work</b>	Belfast HSC Trust	33% (n=27)	54% (n=13)
	South Eastern HSC Trust	2% (n=2)	0% (n=0)
	Western HSC Trust	20% (n=16)	42% (n=10)
	Northern HSC Trust	0% (n=0)	0% (n=0)
	Southern HSC Trust	34% (n=28)	0% (n=0)
	Private sector	11% (n=9)	4% (n=1)
<b>Years in radiography practice</b>	0< years	20% (n=16)	17% (n=4)
	5-10 years	17% (n=14)	21% (n=5)
	11-15 years	16% (n=13)	4% (n=1)
	16-20 years	9% (n=7)	17% (n=4)
	> 20 years	20% (n=16)	21% (n=5)
	No response	18 % (n=16)	21% (n=5)
<b>Gender</b>	Male	18% (n=15)	21% (n=5)
	Female	79% (n=65)	79% (n=19)
	Other	1% (n=1)	
	Preferred not to say	1% (n=1)	
<b>Ethnicity</b>	White	99% (n =81)	100% (n=24)
	Black, Asian and minority ethnic (BAME)	1% (n=1)	0% (n=0)
<b>Age range</b>	20-30 years old	38% (n=31)	33% (n=8)
	31-40 years old	35% (n=29)	46% (n=11)
	41-50 years old	22% (n=18)	13% (n=3)
	51-60 years old	5% (n=4)	8% (n=2)

	> 61years old	0% (n=0)	0% (n=0)
<b>Current area of specialism/ role</b>	General radiographer	22% (n=18)	
	CT	18% (n=15)	
	Dental	1% (n=1)	
	DEXA	2% (n=2)	
	Fluorography	1% (n=1)	
	Education/ Governance	1% (n=1)	4% (n=1)
	Intervention	2% (n=2)	
	Mammography	6% (n=5)	
	Management	7% (n=6)	4% (n=1)
	MRI	21% (n=17)	
	Nuclear Medicine	1% (n=1)	
	Paediatrics	4% (n=3)	
	Reporting radiographer	4% (n=3)	
	Ultrasound	5% (n=4)	
	Clinical Specialist Radiotherapy		17% (n=4)
	Radiotherapy		67% (n=16)
No response	4% (n = 3)	8% (n=2)	

\* Percent has been rounded to the nearest whole number so may not always equal 100% in each column

Table 2: Experience working with infectious patients and concerns about contracting COVID-19

		None	A little	A moderate amount	A lot	A great deal	Not specified
		% and number of participants*					
Prior to the COVID-19 pandemic how much experience did you have working with infectious patients ?	Diagnostic Radiographers	1% (n=1)	37% (n=30)	45% (n=37)	10% (n=8)	7% (n=6)	0% (n=0)
	Therapeutic Radiographers	4% (n=1)	63% (n=15)	29% (n=7)	0% (n=0)	0% (n=0)	4% (n=1)
At home, how concerned are you that you may contract or pass on COVID-19 to your family, because of your working environment?	Diagnostic Radiographers	12% (n=10)	21% (n=17)	33% (n=27)	17% (n=14)	17% (n=14)	
	Therapeutic Radiographers	17% (n=4)	37% (n=9)	13% (n=3)	4% (n=1)	25% (n=6)	4% (n=1)
At work, how concerned are you that you may contract or pass on COVID-19?	Diagnostic Radiographers	13% (n=11)	33% (n=27)	29% (n=24)	16% (n=13)	9% (n=7)	
	Therapeutic Radiographers	21% (n=5)	29% (n=7)	25% (n=6)	13% (n=3)	8% (n=2)	4% (n=1)



\* Percent has been rounded to the nearest whole number so may not always equal 100% in each row

Table 3. Level of satisfaction with access to PPE each month from March 2020 to February 2021

How do you rate your access to appropriate personal protective equipment (PPE) during the pandemic		Dissatisfied	Less than satisfied	Satisfied	Very satisfied	Unspecified
		% and number of participants*				
March 2020	Diagnostic Radiographers	22% (n=18)	24% (n=20)	32% (n=26)	15% (n=12)	7% (n=6)
	Therapeutic Radiographers	8% (n=2)	38% (n=9)	29% (n=7)	21% (n=5)	4% (n=1)
April 2020	Diagnostic Radiographers	16% (n=13)	27% (n=22)	33% (n=27)	15% (n=12)	10% (n=8)
	Therapeutic Radiographers	8% (n=2)	25% (n=6)	38% (n=9)	25% (n=6)	4% (n=1)
May 2020	Diagnostic Radiographers	7% (n=6)	16% (n=13)	43% (n=35)	26% (n=21)	9% (n=7)
	Therapeutic Radiographers	4% (n=1)	13% (n=3)	38% (n=9)	42% (n=10)	4% (n=1)
June 2020	Diagnostic Radiographers	2% (n=2)	16% (n=13)	43% (n=35)	31% (n=25)	9% (n=7)
	Therapeutic Radiographers	0% (n=0)	13% (n=3)	29% (n=7)	54% (n=13)	4% (n=1)

July 2020	Diagnostic Radiographers	1% (n=1)	11% (n=9)	45% (n=37)	34% (n=28)	9% (n=7)
	Therapeutic Radiographers	0% (n=0)	8% (n=2)	38% (n=9)	46% (n=11)	8% (n=2)
August 2020	Diagnostic Radiographers	1% (n=1)	9% (n=7)	49% (n=40)	38% (n=31)	4% (n=3)
	Therapeutic Radiographers	0% (n=0)	4% (n=1)	33% (n=8)	58% (n=14)	4% (n=1)
September 2020	Diagnostic Radiographers	0% (n=0)	6% (n=5)	52% (n=43)	38% (n=31)	4% (n=3)
	Therapeutic Radiographers	0% (n=0)	0% (n=0)	29% (n=7)	67% (n=16)	4% (n=1)
October 2020	Diagnostic Radiographers	0% (n=0)	4% (n=3)	51% (n=42)	42% (n=34)	4% (n=3)
	Therapeutic Radiographers	0% (n=0)	0% (n=0)	33% (n=8)	63% (n=15)	4% (n=1)
November 2020	Diagnostic Radiographers	0% (n=0)	4% (n=3)	50% (n=41)	43% (n=35)	4% (n=3)
	Therapeutic Radiographers	0% (n=0)	0% (n=0)	33% (n=8)	63% (n=15)	4% (n=1)
December 2020	Diagnostic Radiographers	0% (n=0)	5% (n=4)	48% (n=39)	45% (n=37)	2% (n=2)
		0%	4%	29%	63%	4%

	Therapeutic Radiographers	(n=0)	(n=1)	(n=7)	(n=15)	(n=1)
January 2021	Diagnostic Radiographers	0% (n=0)	4% (n=3)	50% (n=41)	44% (n=36)	2% (n=2)
	Therapeutic Radiographers	0% (n=0)	0% (n=0)	33% (n=8)	63% (n=15)	4% (n=1)
February 2021	Diagnostic Radiographers	0% (n=0)	6% (n=5)	48% (n=39)	44% (n=36)	2% (n=2)
	Therapeutic Radiographers	0% (n=0)	0% (n=0)	33% (n=8)	63% (n=15)	4% (n=1)

\* Percent has been rounded to the nearest whole number so may not always equal 100% in each row

Table 4 Shielding and remote working

		Yes	No	Don't know	Unspecified
		% and number of participants*			
At any time since March 2020 were you shielding/had suspected COVID-19 /had confirmed COVID-19/need to take sick leave due to COVID-19?	Diagnostic Radiographers	38% (n=31)	62% (n=51)	N/A	
	Therapeutic Radiographers	54% (n=13)	42% (n=10)	N/A	4% (n=1)
At any time since March were you on sick leave for an unrelated illness or health reason?	Diagnostic Radiographers	28% (n=23)	72% (n=59)	N/A	
	Therapeutic Radiographers	33% (n=8)	63% (n=15)	N/A	4% (n=1)
Have you been categorised as someone who should be shielding during the pandemic?	Diagnostic Radiographers	4% (n=3)	96% (n=79)	N/A	
	Therapeutic Radiographers	4% (n=1)	96% (n=23)	N/A	
Have you been categorised classified as "belonging to a high-risk category"?	Diagnostic Radiographers	5% (n=4)	95% (n=78)	N/A	
	Therapeutic Radiographers	12% (n=3)	88% (n=21)	N/A	
Do you have caring responsibilities or live with someone in your household who is shielding or high-risk?	Diagnostic Radiographers	20% (n=16)	80% (n=66)	N/A	
	Therapeutic Radiographers	13% (n=3)	83% (n=20)	N/A	4% (n=1)

Have you been able to adopt social distancing measures in the workplace?	Diagnostic Radiographers	85% (n=70)	15% (n=12)	N/A	
	Therapeutic Radiographers	83% (n=20)	17% (n=4)	N/A	
Is the IT department in your department capable of facilitating remote working and networking?	Diagnostic Radiographers	60% (n=49)	9% (n=7)	32% (n=26)	
	Therapeutic Radiographers	88% (n=21)	4% (n=1)	4% (n=1)	4% (n=1)
At any time since March 2020 were you working from home?	Diagnostic Radiographers	7% (n=6)	93% (n=76)	N/A	
	Therapeutic Radiographers	38% (n=9)	58% (n=14)	N/A	4% (n=1)

\* Percent has been rounded to the nearest whole number so may not always equal 100% in each row

Table 5 Impact of the pandemic on workload in departments.

During the pandemic, did your workload noticeably increase, decrease or stay the same?		Increased	Decreased	Stayed the same	Unspecified
		% and number of participants*			
March 2020	Diagnostic Radiographers	17% (n= 14)	54% (n=44)	15% (n=12)	15% (n=12)
	Therapeutic Radiographers	46% (n=11)	4% (n=1)	29% (n=7)	21% (n=5)
April 2020	Diagnostic Radiographers	17% (n=14)	57% (n=47)	9% (n=7)	17% (n=14)
	Therapeutic Radiographers	46% (n=11)	13% (n=3)	21% (n=5)	21% (n=5)
May 2020	Diagnostic Radiographers	33% (n=27)	34% (n=28)	16% (n=13)	17% (n=14)
	Therapeutic Radiographers	54% (n=13)	13% (n=3)	13% (n=3)	21% (n=5)
June 2020	Diagnostic Radiographers	43% (n=34)	22% (n=18)	18% (n=15)	18% (n=15)
	Therapeutic Radiographers	38% (n=9)	17% (n=4)	25% (n=6)	21% (n=5)

July 2020	Diagnostic Radiographers	43% (n=35)	16% (n=13)	24% (n=20)	17% (n=14)
	Therapeutic Radiographers	25% (n=6)	21% (n=5)	33% (n=8)	21% (n=5)
August 2020	Diagnostic Radiographers	48% (n=39)	15% (n=12)	26% (n=21)	12% (n=10)
	Therapeutic Radiographers	21% (n=5)	13% (n=3)	46% (n=11)	21% (n=5)
September 2020	Diagnostic Radiographers	55% (n=45)	11% (n=9)	21% (n=17)	13% (n=11)
	Therapeutic Radiographers	17% (n=4)	17% (n=4)	46% (n=11)	21% (n=5)
October 2020	Diagnostic Radiographers	57% (n=47)	10% (n=8)	21% (n=17)	12% (n=10)
	Therapeutic Radiographers	21% (n= 5)	17% (n=4)	42% (n=10)	21% (n=5)
November 2020	Diagnostic Radiographers	56% (n=46)	12% (n=10)	20% (n=16)	12% (n=10)
	Therapeutic Radiographers	29% (n=7)	13% (n=3)	38% (n=9)	21% (n=5)
December 2020	Diagnostic Radiographers	62% (n=51)	12% (n=10)	15% (n=12)	11% (n=9)
	Therapeutic Radiographers	29% (n=7)	17% (n=4)	33% (n=8)	21% (n=5)



January 2021	Diagnostic Radiographers	65% (n=53)	11% (n=9)	13% (n=11)	11% (n=9)
	Therapeutic Radiographers	50% (n=12)	4% (n=1)	25% (n=6)	21% (n=5)
February 2021	Diagnostic Radiographers	56% (n=46)	12% (n=10)	21% (n=17)	11% (n=9)
	Therapeutic Radiographers	54% (n=13)	0% (n=0)	21% (n=5)	25% (n=6)

\* Percent has been rounded to the nearest whole number so may not always equal 100% in each row

Table 6 Impact of the pandemic on patient appointments

		None at all	A little	A moderate amount	A lot	A great deal	Unspecified
		<b>% and number of participants*</b>					
How concerned are you about patients' imaging procedures/treatment being delayed or disrupted at your centre?	Diagnostic Radiographers	10% (n=8)	23% (n=19)	29% (n=24)	18% (n=15)	10% (n=8)	10% (n=8)
	Therapeutic Radiographers	33% (n=8)	25% (n=6)	13% (n=3)	8% (n=2)	0% (n=0)	21% (n=5)
If you had contact with patients, how concerned are they about their treatment being delayed or disrupted?	Diagnostic Radiographers	6% (n=5)	26% (n=21)	33% (n=27)	16% (n=13)	9% (n=7)	11% (n=9)
	Therapeutic Radiographers	8% (n=2)	25% (n=6)	21% (n=5)	17% (n=4)	4% (n=1)	25% (n=6)

\* Percent has been rounded to the nearest whole number so may not always equal 100% in each row

Table 7: Managers' perspectives regarding PPE Guidance

*'Infection prevention and control were brilliant but were in demand.. we were doing all our risk assessments.. it was difficult to communicate the message because it kept changing at the start.. our key thing was to keep everyone safe, to avoid an outbreak, which would render us unable to cope.. it was difficult to think things through, because we were just flat out trying to keep the service going.'* (Manager 1)

*'We as managers .. literally we took a day where we went in and wrote up COVID protocols.. we mapped out our zones for treatment; red, amber and green zones.. we had training sessions with the staff, .. people felt more confident.'* (Manager 2)

*"The mask and visors have presented challenges for us, where we monitor repeats of our mammograms.. we are a screening programme, our whole adage is do no harm.. we try and keep our repeats to a minimum.. across the board, including England, there has been a marked increase in the numbers of repeats.. various reasons, including wearing these shields or goggles, which is changing the perspective of what you are looking at when doing a mammogram."* (Manager 3)

Table 8: Managers discuss the availability of PPE in the early stages of the pandemic

*'In the first wave we were literally going to the fit testing team to say, listen, we've got a CT on call service this weekend. There's X people on it. Or we need X number of masks. It was as tight as that .. as we moved forward in the weeks and months to follow, that seemed to become less of an issue.'* (Manager 4)

*'PPE wasn't the concern. We were able to get enough PPE. Well sorry, it was a concern for the hospital, for me, but for the frontline staff, they were buffered from that.. they always had a supply. They were never rationed. Staff had everything they needed.'* (Manager 5)

Table 9: Discussion of communication issues associated with wearing PPE

*'Face to face. That's been a big thing, even. Communication behind the masks has been difficult.'* (Manager 6)

*'Pre-pandemic we would have close interactions with our patients (playing with them /showing them how equipment works etc). It has been difficult to maintain that whilst maintaining the safety of staff as majority of our patients cannot wear masks.'* (superintendent radiographer 1)

Table 10: Managers describe the impact of the pandemic to staff working hours

*'I suppose the fact that the patients actually are ventilated or they have to have the red PPE, which means that when we are finished there, the room has to be closed for an hour for things to settle, and then it's cleaned. So we have the same volume of patients, but it is taking three times as long to try and get them done.'* (Manager 7)

*"We went to a four-day week for a bit.. we had slightly longer days and then everybody had one day off a week. We were trying to facilitate childcare but also minimise the number of times the staff were coming into the department. So we could work across two machines, but on a longer day. And then everybody got a day off.. that worked. We did that throughout the first lockdown, then everybody was keen to return to normal working hours."* (Manager 2)

*"In the beginning, head and neck cancer patients weren't going for surgery or chemo. So they would have come for their radiotherapy initially.. we certainly had more oesophagus patients and pancreatic patients."* (Manager 2)

Table 11: Managers discuss impact of the pandemic on staffing and resources

*“whenever that track and trace system came in, that’s when we suffered the most with staff shortages.. there was a Friday afternoon there was just one radiographer and another had just got pinged on the app; it was horrendous. That was a worse time for us, in October, than the initial stages of COVID.” (Manager 1)*

*‘We retrained people who probably hadn’t taken an x-ray in a number of years. A lot of the ultrasonographers wouldn’t have done any x-rays or mobile imaging. We did a crash course .. it was good for the rest of the radiographers to see those staff out on the floor.. it wasn’t just limited to radiographers who work in A&E or general x-ray.’ (Manager 8)*

*“Then after that, some of my staff were redeployed.. we still maintained our red flag breast services, so there was a retained team kept. TRs who worked in mammography lacked the transferable skills to be moved to other diagnostic scanning units and therefore were retained as part of the core breast screening service.’ (Manager 3)*

*“Through the ED we noticed a significant increase in attendances from outside Belfast, with some patients travelling 2 hours to attend. Parents stated they were unable to get an appointment with their local GP and were nervous of attending their local adult hospital (or advised to skip local hospital). This had an obvious impact on the volume of work.” (Manager 9)*

Table 12: Managers' discuss changes to general departmental protocols

*“Basic life support, the tricky bit with that is getting the dolls in order to do the training, so the resuscitation, the Resusci Anne dolls.. it’s more about making sure they are cleaned\_properly, because obviously you’ll have multiple people using them. So some of that training has been adapted to try and reduce the actual practical application of the doll.” (Manager 2)*

*‘We use a smart clinic, which uses statistical probabilities to book things.. rather than waste appointments whenever people are not statistically likely to attend, they overbook on top of someone who is more statistically likely to attend. So that itself created a problem with social distancing.’ (Manager 3)*

*‘We have a small waiting area which serves x-ray, fluoroscopy (x2), ultrasound, CT, nuclear medicine and DEXA. To maintain social distancing we had to coordinate all modalities (so booking a slot into the waiting area rather than a modality slot). This involved a huge amount of coordination and consideration for the different time demands of each area (e.g. nuclear medicine). Clinics which required x-ray imaging were particularly difficult as previously the service was a walk-in service, so clinics did not need to coordinate with Radiology.’ (Manager 10)*



Appendix 1 : Survey Questions

***An investigation into the impact of the COVID-19 pandemic on the Diagnostic and Therapeutic Radiography workforce and service provision in Northern Ireland with a view to planning for future waves of the pandemic.***

**Please read the participant information sheet and consent form. Completion of the questionnaire will infer implied consent.**

**Please circle answer**

**Section 1: Professional/Personal Demographics.**

1. How many years have you been working as a radiographer?

>5                      5-10                      11-15                      16-20                      20+

2. What is your race?

White                      BAME                      Other

3. Which HSC Trust do you work for?

Belfast                      South Eastern                      Western                      Southern  
Northern                      Private

4. What is your current radiographer grade?

5                      6                      7                      8

5. Please indicate which age bracket you belong to:

20-30                      31-40                      41-50                      51-60                      61+

6. What is your gender?

Male                      Female                      Other

7. Have you been categorised as someone who should be shielding during the pandemic?

Yes No

8. Are you classified as someone belonging to a high-risk category?

Yes No

9. Do you have caring responsibilities or live with someone in your household who is shielding or high-risk?

Yes No

10. Have you been able to adopt social distancing measures in the workplace?

Yes No

11. Within the radiography workforce what is your area of specialism/role?

12. Have you been asked to move into a different area of specialism/role as a result of the COVID-19 pandemic?

Yes No

If Yes. 12a. Is this an area/role where you have had experience before?

Yes No

12b. Did you receive any training for the role?

Yes No

12c. Using a scale of 1 (lacking confidence) to 5 (very confident) How confident are you working in the new role?

lacking confidence 1 2 3 4 5 very confident

12d. Would you like to continue in the new role either full time or part time after the pandemic subsides?

Yes

No

**Section 2: Infection control and PPE**

13. Prior to the COVID-19 pandemic how much experience did you have working with infectious patients?

None at all    a little    a moderate amount    a lot    a great deal

14. Have you received training in infection control measures since COVID-19 started?

Yes

No

15. Do you feel competent and confident working in the department during the pandemic?

Yes

No

16. Would you like further training in infection control measures in case another wave of COVID-19 happens?

Yes - can you identify anything in particular?

No.

17. How do you rate your access to appropriate personal protective equipment (PPE) during the pandemic? Place a tick in the appropriate boxes.

	Very satisfied	Satisfied	Less than satisfied	Dissatisfied
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March 2020				
April 2020				
May 2020				
June 2020				
July 2020				
August 2020				
September 2020				
October 2020				
November 2020				
December 2020				
January 2021				
February 2021				

18. At work, how concerned are you that you may contract or pass on COVID-19?

Not at all      a little      a moderate amount      a lot      a great deal

19. At home, how concerned are you that you might pass on COVID-19 to your family because of your working environment?

Not at all      a little      a moderate amount      a lot      a great deal

20. How many confirmed COVID-19 positive patients have you come into contact with in your working environment?

0                      1-5                      6-10                      11-20                      20+

21. How many asymptomatic patients might you have come into contact with and who you were subsequently informed were confirmed as COVID-19 positive?

0                      1-5                      6-10                      11-20                      20+

**Section 3: Workplace and remote working**

22. Is the IT department in your radiography department capable of facilitating remote working and networking?

Yes                      No

23. At any time since March were you working from home?

Yes

No

If Yes. 23a. How easy was it for you to adapt to working remotely?

Extremely Easy   Somewhat easy   Neither easy or difficult   Somewhat difficult  
Extremely difficult

24. At any time since March were you shielding/had suspected COVID-19 /had confirmed COVID-19/needng to take sick leave due to COVID-19?

Yes

No

25. At any time since March were you on sick leave for an unrelated illness or health reason?

Yes

No

26. Are you a Diagnostic Radiographer or a Therapeutic radiographer?

Diagnostic Radiographer – go to Q34

Therapeutic Radiographer – go to Q27 (Skip Q34 – Q40)

#### **Section 4 : Radiotherapy treatments (Therapeutic radiographers only)**

27. Did any of the patients at your department have their radiotherapy treatments disrupted, altered or postponed since the beginning of COVID-19?

Yes

No

If yes: 27a. Which patient groups have been most impacted in your department?

Please list up to 5 in rank order beginning with those most affected.

--	--


27b. Are these groups now receiving treatment according to pre-virus protocols?

Yes

No

28. Are treatment protocols the same as before COVID-19 or have they changed?

The same.

Changed - please explain.

If changed:

28a. Do you think the department will continue to use adapted protocols and new regimens for the foreseeable future?

Yes

No

29. How concerned are you about patients' treatment being delayed or disrupted at your centre?

Not at all

a little

a moderate amount

a lot

a great deal



34. Did any of the patients at your department have their imaging/screening appointments/interventional procedures disrupted, altered or postponed since the beginning of COVID-19?

Yes

No

If yes:

34a Which patient groups have been most impacted in your department?

Please list up to 5 in rank order beginning with those most affected.


34b Are these groups now receiving appointments again?

Yes

No

34c. How long was/is the approximate delay in appointment time?



35. Are imaging/scanning protocols the same as before COVID-19 or have they changed?

The same.

Changed - please explain.

If changed:

35a. Do you think the changes will remain for the foreseeable future?

Yes

No

36. How concerned are you about patients' imaging procedures being delayed or disrupted at your centre?

Not at all      a little      a moderate amount      a lot      a great deal

37. If you have had contact with patients, how concerned are they about their imaging procedures being delayed or disrupted?

Not at all      a little      a moderate amount      a lot      a great deal

38. Atypical referrals: Due to COVID-19 creating an increased demand on CT services, have you been imaging more patients with alternative imaging modalities who, prior to the pandemic, might have been offered a CT scan?

Yes - can you provide examples?

No

39. During the pandemic did the workload noticeably increase, decrease or stay the same in your department? Place a tick in the appropriate boxes.

	Increased	Decreased	Stayed the same
March 2020			
April 2020			
May 2020			
June 2020			
July 2020			
August 2020			
September 2020			
October 2020			
November 2020			
December 2020			
January 2021			
February 2021			

40. Currently, are your patient numbers what you would expect for this time of year?

Yes

No - they are up

No - they are down

End of survey: Thank you for taking the time to complete the survey.



## Appendix 2 : Interview guide

***An investigation into the impact of the COVID-19 pandemic on the Diagnostic and Therapeutic Radiography workforce and service provision in Northern Ireland with a view to planning for future waves of the pandemic.***

Topic	Question	Prompt
Introduction	Brief introductions, assure anonymity, obtain verbal consent to record the interview, reminder of the aim of the study, check the interview/audio-recording is working.	
COVID-19 impact	<p>Reflecting on the past 4 months, can you summarise the impact that the COVID-19 pandemic has had on your Imaging/Radiotherapy department?</p> <p>What changes have been most prominent?</p> <p>Have your departmental working practices changed significantly?</p> <p>What has been the most difficult thing to manage?</p> <p>With the benefit of hindsight, what might have been done differently?</p>	<p>Do you think any changes will be permanent?</p> <p>What has and what has not worked well?</p>
COVID-19 impact (Radiography workforce)	<p>Can you tell me about your experiences managing the workforce during the pandemic?</p> <p>What support, if any, has been introduced to ensure staff well-being?</p>	<p>Have radiographers proved resilient?</p> <p>On reflection, do you think there are other</p>

	<p>Do you believe the department will be able to cope with the challenges that lie ahead?</p> <p>What refresher training, if any, should be provided in order to support the future workforce?</p> <p>Do you believe that morale in your department is different since COVID-19?</p> <p>(Radiotherapy ONLY)</p> <p>Are you aware of the scientific debate considering low-dose whole lung radiotherapy to manage critically ill COVID-19 patients?</p>	<p>support services that might be offered?</p> <p>Can you explain why you think that?</p> <p>Has there been any discussion among the radiography workforce?</p> <p>Any contingency planning?</p>
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