Journal of Radiotherapy in Practice

cambridge.org/jrp

Are patients with a hearing impairment or other language barriers getting equitable access to deep inspiration breath hold (DIBH) techniques for breast cancer radiotherapy?

Tamryn Saby, Caitlyn Cardy and Zoe Grant

School of Health, Sciences and Society, University of Suffolk, Waterfront Building, 19 Neptune Quay, IP4 1QJ, Ipswich, UK

Original Article

Cite this article: Saby T, Cardy C, and Grant Z. (2025) Are patients with a hearing impairment or other language barriers getting equitable access to deep inspiration breath hold (DIBH) techniques for breast cancer radiotherapy? *Journal of Radiotherapy in Practice*. **24**(e35), 1–7. doi: 10.1017/S1460396925100216

Received: 24 April 2025
Revised: 27 June 2025
Accepted: 1 July 2025

Keywords:
Breast cancer radiotherapy; cardiac sparing; DIBH; equitable access; hearing impairment; language barriers

Corresponding author:
Tamryn Saby;
Email: tamryn1708@gmail.com

Abstract

Introduction: Few breast cancer radiotherapy studies include either patients with a hearing impairment or non-English speakers. Literature about healthcare and cancer care in general provided insights into reports by patients of disparities. Given technological advancements, it is reasonable to believe communication barriers should be surmountable, prompting a survey of radiotherapy departments to assess the status quo.

Methods: A survey was conducted of all UK National Health Service (NHS) radiotherapy departments in England. A questionnaire was designed to determine if a deep inspiration breath hold (DIBH) technique was used for breast cancer radiotherapy, the equipment that was used and whether patients with a hearing impairment or other language barriers received the same treatment.

Results: A total of 22 radiotherapy departments responded to the survey. All respondents reported using DIBH as a heart-sparing technique; 100% ($n = 22$) reported offering DIBH to non-English speakers and 73% ($n = 16$) DIBH to patients with a hearing impairment. 45% ($n = 10$) stated that they use verbal instruction only, and 23% ($n = 5$) a combination of both verbal and visual aids and references.

Conclusion: The study highlights some novel efforts in radiotherapy departments to increase equitable access to DIBH; however, the results indicate that verbal communication methods still dominate practice, and these are not inclusive of all hearing-impaired patients. Such methods would also require translation for non-English speakers. The study suggests that more work needs to be done before equitable access is achieved for patients with a hearing impairment or other language barrier.

Introduction

Breast cancer is the most common cancer in the UK.[1] Advances in UK breast cancer radiotherapy have improved patient outcomes,[2] with conformal techniques reducing cardiac risks.[3] There is a linear relationship between mean heart dose and the risk of cardiac events, with pre-existing cardiac risk factors further compounding the risk.[4] Voluntary breath hold reduces mean heart dose.[5] 26 Gy in 5 fractions over 1 week[6] has been adopted as a new standard of care for patients with operable breast cancer requiring adjuvant radiotherapy. Surface guided radiotherapy (SGRT) is positively impacting breast cancer patients,[7] and investigations continue to find alternative treatment techniques to reduce late effect cardiac toxicity, with the PARABLE trial comparing proton beam therapy to photon therapy.[8]

The publication of postoperative radiotherapy for breast cancer: UK consensus statements,[9] states that all UK radiotherapy departments should have a breathhold technique available. The National Institute for Health and Care Excellence (NICE)[10] now recommends using a technique that minimises the dose to the lung and heart and using a deep inspiration breath hold (DIBH) technique for left-sided breast cancer radiotherapy to reduce cardiac toxicity. DIBH is the established standard of care; however, it is unclear how many radiotherapy departments in England use the technique. Patient selection is on a clinical basis,[11,12] but there is limited evidence of patients with a hearing impairment or other language barriers being treated with this technique.

DIBH improves radiotherapy accuracy by reducing organ motion and is feasible on most treatment systems.[12] Systems vary between commercial products and may have some in-house-designed equipment as an add-on. Giap[13] designed a virtual reality (VR) interactive 3D game to assist patients with breathing depth feedback. Ku *et al.*'s[14] homemade self-held respiration monitoring device gives a green light signal with an alarm to guide patients during respiratory

motion. The primary object of these two studies was improving reproducibility during DIBH but would have visual references that would be of great benefit to patients with a hearing impairment or other language barrier.

An increased number of radiotherapy departments using DIBH could provide equitable access geographically. However, this study considers whether diverse patient groups in each department are included for DIBH. The UK has approximately 70,000 individuals who are deaf (British Sign Language users) and many more who are hard of hearing (deaf with a lower-case d).[15] These two groups will be inclusively referred to as D/deaf. With an ageing population and older age being the main risk factor for cancer,[16] about one in seven people will be experiencing some kind of hearing loss.[15] Additionally, 9% of England's population have a primary language other than English,[17] posing communication challenges during radiotherapy for breast cancer.

Hearing and understanding of vocal commands are listed consistently on inclusion criteria for studies of DIBH.[18–24] A study by Jahraus *et al.*[25] to assess the effectiveness of education programmes for patients with breast cancer undergoing radiotherapy also has fluent English as an inclusion criterion. Visual aids such as scans or plan diagrams may have been used to aid communication in a study by Schnitzler *et al.*;[26] however, there is no mention of translation or use of text on a screen. These studies may have helped to ascertain what patients might want to know and have highlighted differing patient information needs, yet have not provided any evidence base for patients with a hearing impairment or other language barrier undergoing radiotherapy for breast cancer.

In addition to having available technology, effective DIBH requires patient compliance,[12] influenced by coaching and preparatory education. Patient preparation for DIBH is delivered in many forms and can vary significantly between centres.[27] Studies like Berman *et al.*[28] of 68 D/deaf breast cancer survivors highlighted gaps in their knowledge about their cancer and treatment, potentially due to a reliance on lip reading and insufficient adaptations in communication by healthcare professionals. Shukla *et al.*[29] concluded that there were disparities in the application of DIBH between English-speaking versus non-English-speaking patients. Hill *et al.*[30] literature search like this study did not reveal any data on whether D/deaf patients are getting treatment that adheres to national guidelines. Yamauchi,[31] demonstrated improved reproducibility of DIBH by testing a visual feedback system in a clinical setting.

Improved communication may equally boost patient engagement. Patients have reported that holding their breath made them feel like they were contributing to their treatment.[27] Patients' engagement during treatment can be an additional safety barrier.[32] Without engagement and compliance, patients could be the source of errors, unknowingly threatening their own safety.[32] Raising an alarm and identifying an error during patient setup and treatment, in addition to better knowledge of their own disease and treatment options, and being able to advocate for themselves more and self-manage toxicities better.

Existing resources, such as Respire training tools[33] and Cancer Research UK videos[16] with BSL interpretation, are available to radiotherapy departments to help support patient education. Virtual reality education has also shown improved patient understanding and reduced anxiety.[34]

This study explores DIBH implementation in NHS radiotherapy departments in England and investigates technology in use with a particular interest in the use of non-verbal communication. This survey enquires whether patients are coached in the DIBH technique and what adaptations are in place in radiotherapy departments for patients with a hearing impairment and other language barriers. Findings will inform best practice, ensuring equitable access to optimal breast cancer radiotherapy.

Methods

This cross-sectional mixed-methods study used a Society of Radiographers (SOR) contact list[35] (last updated 2021) of 56 NHS Radiotherapy department managers in England. These were contacted via email with a link to a questionnaire (Appendix A). The other home nations and private practice were excluded due to potential differences in funding, adding to an already lengthy list of potential variables between radiotherapy departments. Of the 56 departments contacted, delivery failed to 4, and 22 responded.

Data collection was carried out over a 2-week period from 13 December 2023 to 5 January 2024, following ethical approval to proceed from a UK university reference SREC 23003 (Appendix B). The email invite provided details of the survey, and participants were informed that submission of a questionnaire would be an acknowledgement of consent (Appendix C).

A pilot study of 8 questionnaires, distributed at two radiotherapy departments, helped with the clarity of the questions and the completeness of the multiple-choice answers.[36] Microsoft Forms[37] was used to design the questionnaire. Respondents were allocated unique reference numbers to maintain the anonymity of the responding radiotherapy centres ('respondents' hereafter).

Microsoft Forms data was exported to Excel, and descriptive statistical analysis was used to present graphical data and tables. Researchers identified qualitative themes independently prior to reviewing together to improve the validity of the data.

Results

All respondents ($n = 22$) indicated that their departments practised DIBH for breast cancer radiotherapy techniques. Just over half ($n = 12$) stated that the decision of whether the patient is for DIBH or not is made when radiotherapy is decided as a course of treatment, 32% ($n = 7$) stated at the pre-treatment planning scan and 14% ($n = 3$) responded in terms of the clinical requirement of the target being treated. When asked what may make a patient unsuitable for DIBH, respondents answered as in Figure 1 and Table 1 below.

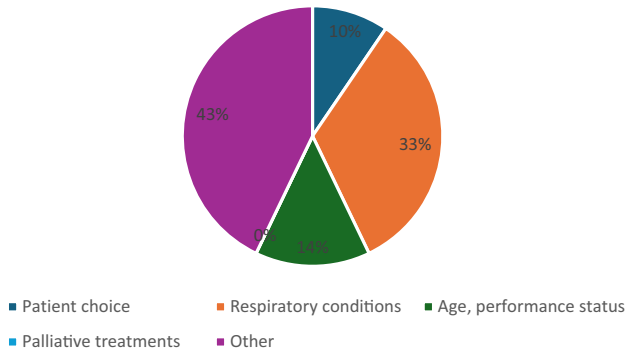

Figure 1. Reasons for DIBH unsuitability.

https://doi.org/10.1017/S1460396925100216 Published online by Cambridge University Press

All left breast cancer treatments were considered for DIBH by 91% ($n = 20$) of respondents. One respondent was more inclusive with all breast cancer treatments, and one respondent did not select either all breast or all left breast as options but answered '*Internal mammary chain (IMC) treatments; Left breast lower quadrant tumours; Bilateral breast, High cardiac risk or on Herceptin (CCO discretion) Dosimetry replan for high cardiac dose, Inner half (LIQ, UIQ)*'.

Table 2 details the responses to the question *what aspects of DIBH do you find challenging* with 14% ($n = 3$) experiencing no challenges with the treatment technique.

77% ($n = 17$) of respondents use the same equipment for DIBH at the pre-treatment computer tomography (CT) scan and for treatment delivery.

77% of respondents ($n = 17$) used multiple methods to provide information about DIBH to the patient prior to the pre-treatment (CT) appointment. 91% ($n = 20$) use face-to-face either on its own or in combination with other methods, as shown in Table 3 below.

In response to *who provides the patient with the information prior to the pre-treatment (CT) appointment,* this list provides a breakdown: oncologist $n = 15$, consultant radiographer $n = 6$, advanced practitioner $n = 3$ and radiographer $n = 7$. 46% of respondents ($n = 10$) expanded their response by listing additional options provided in the 'Other' option, and these have been included in the figures.

50% ($n = 11$) of respondents do not offer DIBH coaching prior to a patient's pre-treatment CT scan. Of those that do, 6 offer coaching in person and 5 online.

86% ($n = 19$) of respondents offer breath-hold coaching on treatment, of which 45% ($n = 10$) use verbal instruction only, with 18% ($n = 4$) using visual aids or references and 23% ($n = 5$) using a combination of both verbal and visual. Figure 2 displays these data visually.

Patients with a hearing impairment are offered DIBH by 73% ($n = 16$) of respondents. Table 4 shows how this is achieved.

55% ($n = 12$) are investigating or implimenting changes to enable equitable access for patients with a hearing impairment. These developments can be seen in Table 5.

Of the respondents who do not currently offer DIBH for hearing-impaired patients (27%, $n = 6$), five of these suggested visual aids, screens and coaching would be required to do so. $N = 1$ responded that the use of red and green lights, prior coaching with a BSL interpreter and hearing aids, would be necessary.

All respondents ($n = 22$) reported offering DIBH to non-English speakers and provided multiple adaptations which are grouped together in themes in Table 6.

Of the five respondents in Table 6 who reported using screens or other visual aids for DIBH delivery, two use surface guide radiotherapy (SGRT), one uses Varian real-time position management (RPM), one uses SGRT Varian and an in-house system, and one uses a screen with instructions on breathing appearing in text.

In response to *Are you aware of any new approaches or equipment departments will be introducing to be more accessible for non-English speaking patients?*, 55% ($n = 12$) answered 'no'. Three did not provide an answer, and one responded that the question was not applicable. Of the remaining six respondents, one is looking at possible future upgrade options available on Respiratory Gating for Scanners (RGSC) in different languages, one is investigating light prompts, one is currently auditing visual and verbal techniques following the implementation of coloured lights, one has recently implemented a screen with breathing instruction appearing as text, one answered 'breath hold lights' and one answered 'visual aids'.

Table 1. 'Other' reasons given for DIBH unsuitability

Patient unable to hold breath/unable to hold breath for 20 secs (no mention of respiratory conditions)	6
Patient inability to comply with instructions or failure to grasp instructions.	2
Anxiety	1
Respiratory conditions, performance status	1
No reason given	1

Table 2. Challenging aspects of DIBH

Communication	8
Equipment	6
Consistent breath hold	4
No visual cues/aids	4
None	3
Patient compliance	2
Consistency of set up	1
Patient specific issues	1
No response	1

Table 3. Information methods used with patients

Face to face chat;	5
Face to face chat; Leaflet	5
Face to face chat; Leaflet; Website links	4
Face to face chat; Leaflet; Website links; Telephone call	3
Face to face chat; Leaflet; Telephone call	2
Leaflet; Website links	2
Face to face chat; Website links	1

Discussion

It is encouraging that 100% of respondents, representing 39% of the NHS radiotherapy departments in England, use DIBH for breast cancer radiotherapy. According to a European Organisation for Research and Treatment of Cancer (EORTC) survey with a 47% response rate, 19% of institutions used breathhold techniques.[38] This is also much increased from the 4% reported in the audit mentioned within Bartlett *et al.*;[39] however, the details of this are unpublished, and the sample size, methods and full results are therefore not able to be further interrogated. This suggests England is moving towards more equitable access to the breathhold technique as per the expectations of both the UK consensus statements[9] and the NICE (2018) recommendations.[10] All ($n = 22$) responses to the questionnaire indicated that this was the case.

What is of concern, however, is that only 73% ($n = 16$) of respondents reported that they offer DIBH to patients with a hearing impairment. The term hearing impairment encompasses a

https://doi.org/10.1017/S1460396925100216 Published online by Cambridge University Press

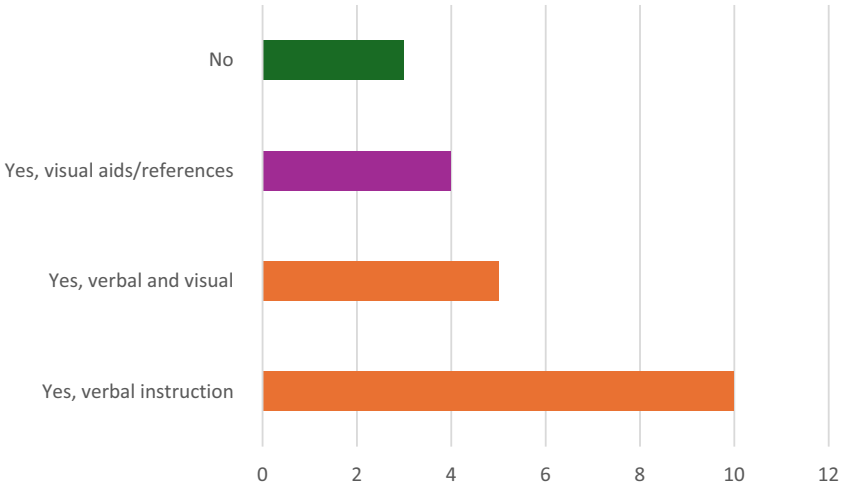

Figure 2. Delivery of breath hold coaching treatment.

Table 4. Adaptations made for patients with a hearing impairment

Louder, shorter verbal cues	3
Visual aids and verbal cues	2
Surface guided radiotherapy (SGRT) visual aids	2
Sign language interpreters and visual aids	1
Portable hearing loop system	1
Visual coaching display	3
Coloured lights	1
No adaptions, verbal instructions	3

range of hearing abilities and may be open to interpretation; had the questionnaire specified D/deaf, that percentage may have been considerably lower. Information provided in response to what adaptations had been made to deliver DIBH to patients with a hearing impairment highlights that 56% ($n = 9$) used verbal instruction, making it less likely that patients with very limited hearing or those reliant on lip reading would have been treated with DIBH at these sites. This view is supported by the following two quotes.

'Depends on hearing impairment level. We have not had a patient who is deaf and unable to hear commands, this would likely prevent us being able to offer DIBH however we would try to adapt if possible, especially as our treatment is gated'. (Respondent 21)

'Depends on level of impairment - visual display screen can be used to assist but still need to be able to hear breathe in command'. (Respondent 12)

Although Table 5 highlights positive changes that are being implemented, 32% ($n = 7$) of respondents were not aware of any new initiatives to increase accessibilty to DIBH for patients with a hearing impairment.

By contrast, 100% ($n = 22$) of respondents offer DIBH to non-English-speaking patients. 50% ($n = 11$) adapt by using more succinct instruction. The patient learns the commands 'breathe in' and 'breathe out' in English. 68% ($n = 15$) of respondents mentioned using an interpreter; however, it is unknown exactly when interpreters were present, and this figure includes using digital translation. With a reliance on predominantly verbal feedback and translation, the risk for both is that expediting patient

Table 5. Awareness of new approaches or equipment departments will be introducing to be more accessible for patients with a hearing impairment

'No'	7
Surface guided radiotherapy (SGRT)	4
Sentinel on CT	1
Investigations/audits on the go	2
Lights	2
Hearing loop	1
Visual aids	1
Recent introduction of text on screen	1
No response	3

Table 6. Adaptations made for non-English speakers

Single words/phrases 'in' 'out' 'hold', 'breathe in' 'breathe out'	11
Use of interpreter	15
Written information in different languages	2
Use staff with languages	2
Coloured lights	2
Screens/visual aids	5
Recorded instructions via google translate	1

treatment may be prioritised over patient comprehension,[28,29] most likely due to time constraints.

By comparison, in the Shukla *et al.*[28] study, 51% had an interpreter present for 76%–100% of the time at CT, 31% at the first fraction and 11% at subsequent fractions. Respondents from both studies mention using radiographers or other staff who speak the patient's language. The following response demonstrates how workarounds can be found to deliver patient-centred treatment.

> *'DIBH instructions are recorded into the CT scanner using Google Translate on an iPod. Standard phrases for CT & trt are verified by a staff member/ interpreter and stored on an iPod prior to CT. These are then used through the intercom on treatment'. (Respondent 11).*

https://doi.org/10.1017/S1460396925100216 Published online by Cambridge University Press

Communication challenges were frequently cited ($n = 8$), yet hearing impairment and language barriers were rarely mentioned, likely due to limited exposure to these specific patient groups. Additionally, consistent breath hold, patient compliance, consistency of setup and no visual cues or aids were mentioned ($n = 12$, see Table 2), and these may also relate to aspects of communication, which, if more patients with a hearing impairment or other language barrier were to be treated with DIBH, would most likely make treatment delivery more challenging. Verbal and visual feedback had improved reproducibility compared to just verbal feedback in Kron *et al.*'s[27] multi-centre feasibility study of DIBH. Poor communication may result in patients not tolerating a breathhold technique.[21] These data illustrate multiple challenges associated with the delivery of DIBH and the inconsistencies across departments and differing resources. Kron *et al.*[27] have commented on these inconsistencies too. Although this study focuses on the inclusion of D/deaf and non-English-speaking patients, these findings raise concerns about the potential number of hearing English speakers who may also be excluded due to inadequate communication and the lack of person-centred care.

Although face-to-face communication may be preferable for some and used by 91% ($n = 20$) of respondents, being able to use technology such as Microsoft Teams for video calls[40] could be of benefit for those who are hearing impaired or have other language barriers due to the subtitle and translation features. Table 3 details the multiple combinations of communication methods across departments. In the Pembroke[24] study, although patients received both written and spoken information, 6 of the 17 participants recommended implementing video education.

Communication challenges may be further compounded by a lack of coaching; 50% ($n = 11$) of respondents stated that DIBH coaching is not offered prior to a patient's pre-treatment CT scan. Prior to pre-treatment (CT) was identified as a time when patient need was highest.[41] Without adequate preparation, hearing-impaired patients may struggle, as lip reading and sign language become impractical during treatment. Of the 86% ($n = 19$) that offer DIBH coaching during treatment delivery, 79% ($n = 15$) use either some or only verbal instruction, whilst only 18% ($n = 4$) use visual aids. Therefore, whilst 100% offer DIBH, only 18% could realistically deliver DIBH to a patient with no hearing at all.

Further to the lack of coaching discussion, there could be increased challenges with patient compliance and patient experience.[21] A study exploring anxiety in the radiotherapy department by Gimson *et al.*[23] found personal, effective and timely communication was essential in mitigating anxiety for their participants. A study by Anastasi *et al.*[12] reported over half of respondents treating breast cancer provided a dedicated coaching session. Duration ranged from 15 minutes to an hour; however, it is not known at which stage of treatment that coaching session took place. It does, however, indicate the requirement for suitably qualified staff and time.

Table 1 shows only one participant gave anxiety as the reason a patient may not be suitable for DIBH; however, it is worthy of note that this is perceived anxiety by the respondent. The literature suggests that anxiety is commonly experienced by patients. Difficulty identifying anxious patients due to stoicism could lead to an underestimation of anxiety by radiographers.[23] As cancer patients undergoing radiotherapy, it is likely that those with a hearing impairment or other language barrier will experience similar levels of anxiety as a minimum and quite likely to a higher degree should communication be less effective.

Kron *et al.*[27] compared anxiety, as a secondary objective, in patients undergoing DIBH for left breast radiotherapy to patients free breathing during radiotherapy to the right breast and concluded that anxiety levels between the two groups were on a parr. This emphasises the need for improved communication for all patient groups, as it is known from other studies that this anxiety can be substantial.[23]

Whilst there are alternative cardiac sparing techniques such as heart shielding, according to Bartlett *et al.*,[42] dose coverage is not as good. Proton beam therapy is less robust to changes in the treatment volume; breast size and contour can change with seroma.[11] Even if the outcome of the PARABLE trial favours proton beam therapy and robustness proves not to be an issue, the capacity is limited with just two proton centres in the UK.[8] The alternative of treating the patient in the prone position may also not be suitable, as the heart position can still be variable.[11] DIBH is effective in sparing heart tissue and is reproducible and feasible in a multicentre setting.[5] For patients not currently being offered DIBH due to a hearing impairment or language barrier, any awareness of this disparity of treatment may further increase anxiety.

The results show that patients could receive information from different healthcare professionals prior to the pre-treatment (CT) appointment. The answers refer to radiotherapy professions specifically; however, oncology nurses have a patient education role too.[25] What is unknown is who delivers what information. The regular attendance in radiotherapy departments for fractionated treatments lends itself well to delivering and reinforcing quality information,[26] so it is disappointing that shortfalls exist in communication and quality of patient care in radiotherapy departments across England today.

With only 22 responses out of 56 NHS radiotherapy departments, generalisation of findings is not possible. Additionally, the overall data analysis could be strengthened via the application of an appropriate theoretical framework. The role or experience of the respondent is not known so the reliability of these data cannot be confirmed. In addition, the variable size and location of departments could result in different levels of experience with non-English-speaking patients or hearing-impaired patients as well as account for the variable resources across departments. The short data collection period, compounded by the dates falling over the Christmas period, may have affected the number of responses received. A university dissertation submission deadline following ethics approval left a small window for data collection.

Questionnaire design limited data obtained regarding the equipment used for DIBH. Clarification of in-house equipment or SGRT was not sought, leaving the only manufacturer specified as Varian.[43] Technological disparities across departments affect inclusivity, with advanced systems like SGRT and Varian Respiratory Gating for Scanners (RGSC) facilitating DIBH for patients with a hearing impairment or language barrier more easily with fewer adaptations required. Further research is needed to standardise adaptations, and collaboration with professional groups such as the SOR Breast Radiotherapy Interest Group (BRIG) could promote best practices. Improved patient data collection on communication needs would also help radiographers tailor support.

Conclusion

With 100% of the respondents, representing 39% of all NHS radiotherapy departments in England, using a DIBH technique for patients with breast cancer, it can be concluded that equitable

https://doi.org/10.1017/S1460396925100216 Published online by Cambridge University Press

access for breast cancer patients to DIBH has greatly increased. The indications are that the figures are lower for D/deaf and non-English speakers; however, more specific enquiry is needed to determine their inclusion more accurately. Without published figures for the number of breast cancer patients with a hearing impairment or language barrier, quantifying equitable access is not possible. An alternative measurement in this study is the critical evaluation of adaptations in place for these patient groups. Although some of the more recent implementations of advanced technologies have made the use of digital and visual feedback mechanisms for D/deaf and non-English speakers easier to implement, the study has shown that it is feasible to implement adaptations for these patient groups on existing treatment delivery systems. On that basis, until all departments have made some reasonable adjustments along the radiotherapy treatment pathway for DIBH, access by those with a hearing impairment or other language barrier cannot be deemed to be equitable.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1460396925100216.

Acknowledgements. None.

Competing interests. The authors declare none.

References

1. Cancer Research UK [Internet]. 2023 [cited 2024 Feb 21]. Risks and causes of breast cancer. Available from: https://www.cancerresearchuk.org/about-cancer/breast-cancer/risks-causes
2. Probst H, Rosbottom K, Crank H, Stanton A, Reed H. The patient experience of radiotherapy for breast cancer: a qualitative investigation as part of the SuPPORT 4 All study. Radiography [Internet]. 2021 May 1 [cited 2023 Oct 3];27 (2): 352–359. Available from: https://www.radiographyonline.com/article/S1078-8174(20)30198-X/fulltext
3. Currey AD, Bergom C, Kelly TR, Wilson JF. Reducing the human burden of breast cancer: advanced radiation therapy yields improved treatment outcomes. Breast J [Internet]. 2015 [cited 2024 Jan 13];21 (6): 610–620. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/tbj.12495
4. Darby SC, Ewertz M, McGale P, Bennet AM, Blom-Goldman U, Brønnum D, et al. Risk of ischemic heart disease in women after radiotherapy for breast cancer. N Engl J Med [Internet]. 2013 Mar 14 [cited 2024 Feb 14];368 (11): 987–998. Available from: https://doi.org/10.1056/NEJMoa1209825
5. Bartlett FR, Donovan EM, McNair HA, Corsini LA, Colgan RM, Evans PM, et al. The UK Heartspare study (Stage II): multicentre evaluation of a voluntary breath-hold technique in patients receiving breast radiotherapy. Clin Oncol [Internet]. 2017 Mar 1 [cited 2024 Jan 11];29 (3): e51–6. Available from: https://www.sciencedirect.com/science/article/pii/S0936655516304058
6. Postoperative radiotherapy for breast cancer: hypofractionation RCR consensus statements | The Royal College of Radiologists [Internet]. [cited 2024 Feb 20]. Available from: https://www.rcr.ac.uk/our-services/all-our-publications/clinical-oncology-publications/postoperative-radiotherapy-for-breast-cancer-hypofractionation-rcr-consensus-statements/
7. Freislederer P, Kügele M, Öllers M, Swinnen A, Sauer TO, Bert C, et al. Recent advances in surface guided radiation therapy. Radiat Oncol [Internet]. 2020 [cited 2024 Feb 27];15 (1): 187. Available from: https://link.springer.com/epdf/10.1186/s13014-020-01629-w
8. Kirby AM, Holt F, Taylor CW, Haviland JS, MacKenzie M, Coles CE. Should patients requiring radiotherapy for breast cancer be treated with proton beam therapy? BMJ 2023 Jun 9;381: e072896.
9. rcr.ac.uk [Internet]. [cited 2024 Apr 9]. Postoperative radiotherapy for breast cancer: UK consensus statements | The Royal College of Radiologists. Available from: https://www.rcr.ac.uk/our-services/all-our-publications/clinical-oncology-publications/postoperative-radiotherapy-for-breast-cancer-uk-consensus-statements/
10. NICE. Early and locally advanced breast cancer: diagnosis and management [Internet]. 2018 [cited 2024 Apr 9]. Available from: https://www.nice.org.uk/guidance/ng101
11. Bergom C, Currey A, Desai N, Tai A, Strauss JB. Deep inspiration breath hold: techniques and advantages for cardiac sparing during breast cancer irradiation. Front Oncol [Internet]. 2018 Apr 4 [cited 2023 Dec 6];8: 87. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5893752/
12. Anastasi G, Bertholet J, Poulsen P, Roggen T, Garibaldi C, Tilly N, et al. Patterns of practice for adaptive and real-time radiation therapy (POP-ART RT) part I: intra-fraction breathing motion management. Radiother Oncol [Internet]. 2020 Dec 1 [cited 2024 Jan 10];153: 79–87. Available from: https://www.sciencedirect.com/science/article/pii/S0167814020303431
13. Giap HB. A novel system for deep inspiration breath hold (DIBH) using virtual reality, head-mounted device, 3-D game, camera and wireless body motion sensor. Int J Radiat Oncol Biol Phys [Internet]. 2018 Nov 1 [cited 2024 Jan 11];102 (3): e554. Available from: https://www.redjournal.org/article/S0360-3016(18)32996-1/fulltext
14. Ku KM, Ng YP, Yu SK, Kong CW, Kwok WM, Mui WL, et al. To evaluate the use of a homemade self-held respiration monitoring device (SHRMD) for deep inspiration breath Hold (DIBH) radiation therapy to left breast cancer patients. Int J Radiat Oncol Biol Phys [Internet]. 2018 Nov 1 [cited 2024 Jan 11];102 (3): e556. Available from: https://www.redjournal.org/article/S0360-3016(18)33001-3/fulltext
15. SignHealth [Internet]. 2014 [cited 2024 Feb 21]. Report: Sick Of It. Available from: https://signhealth.org.uk/resources/report-sick-of-it/
16. Cancer Research UK [Internet]. 2023 [cited 2024 Feb 21]. Having Radiotherapy for breast cancer. Available from: https://www.cancerresearchuk.org/about-cancer/breast-cancer/treatment/radiotherapy/radiotherapy-treatment
17. Office for National Statistics [Internet]. 2021 [cited 2024 Feb 23]. Language, England and Wales - Office for National Statistics. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/language/bulletins/languageenglandandwales/census2021#english-language-proficiency
18. Li Y, Zhan W, Jia Y, Xiong H, Lin B, Li Q, et al. Application of tangent-arc technology for deep inspiration breath-hold radiotherapy in left-sided breast cancer. Front Oncol [Internet]. 2023 Aug 18 [cited 2024 Jan 10];13: 1145332. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10547143/
19. Abdollahi S, Hadizadeh Yazdi MH, Mowlavi AA, Ceberg S, Aznar MC, Tabrizi FV, et al. A dose planning study for cardiac and lung dose sparing techniques in left breast cancer radiotherapy: can free breathing helical tomotherapy be considered as an alternative for deep inspiration breath hold? Tech Innov Patient Support Radiat Oncol 2023 Mar;25: 100201.
20. Rice L, Goldsmith C, Green MM, Cleator S, Price PM. An effective deep-inspiration breath-hold radiotherapy technique for left-breast cancer: impact of post-mastectomy treatment, nodal coverage, and dose schedule on organs at risk. BCTT [Internet]. 2017 Jun 14 [cited 2023 Oct 20];9: 437–446. Available from: https://www.dovepress.com/an-effective-deep-inspiration-breath-hold-radiotherapy-technique-for-l-peer-reviewed-fulltext-article-BCTT
21. Aznar MC, Fez P carrasco de, Corradini S, Mast M, McNair H, Meattini I, et al. ESTRO-ACROP guideline: recommendations on implementation of breath-hold techniques in radiotherapy. Radiother Oncol [Internet]. 2023 Aug 1 [cited 2024 Jan 3];185: 109734. Available from: https://www.thegreenjournal.com/article/S0167-8140(23)00272-4/fulltext
22. Jensen CA, Abramova T, Frengen J, Lund J. Monitoring deep inspiration breath hold for left-sided localized breast cancer radiotherapy with an in-house developed laser distance meter system. J Appl Clin Med Phys [Internet]. 2017 Jul 29 [cited 2024 Jan 11];18 (5): 117–123. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5875834/
23. Gimson E, Greca Dottori M, Clunie G, Yan Zheng C, Wiseman T, Joyce E, et al. Not as simple as 'fear of the unknown': a qualitative study exploring anxiety in the radiotherapy department. Eur J Cancer Care [Internet]. 2022 [cited 2024 Jan 13];31 (2): e13564. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ecc.13564

24. Pembroke M. Breast cancer survivors' unmet needs after completion of radiation therapy treatment. Number 4/July 2020 [Internet]. 2020 Jul 1 [cited 2024 Jan 13];47(4):436–45. Available from: https://store.ons.org/onf/47/4/breast-cancer-survivors-unmet-needs-after-completion-radiation-therapy-treatment
25. Jahraus D, Sokolosky S, Thurston N, Guo D. Evaluation of an education program for patients with breast cancer receiving radiation therapy. Cancer Nurs [Internet]. 2002 Aug [cited 2024 Feb 19];25 (4): 266. Available from: https://journals.lww.com/cancernursingonline/fulltext/2002/08000/evaluation_of_an_education_program_for_patients.2.aspx
26. Schnitzler L, Smith SK, Shepherd HL, Shaw J, Dong S, Carpenter DM, et al. Communication during radiation therapy education sessions: The role of medical jargon and emotional support in clarifying patient confusion. Patient Educ Couns [Internet]. 2017 Jan 1 [cited 2024 Feb 19];100 (1): 112–120. Available from: https://www.sciencedirect.com/science/article/pii/S073839911630338X
27. Kron T, Bressel M, Lonski P, Hill C, Mercieca-Bebber R, Ahern V, et al. TROG 14.04: multicentre study of feasibility and impact on anxiety of DIBH in breast cancer patients. Clin Oncol [Internet]. 2022 Sep 1 [cited 2023 Oct 16];34 (9): e410–9. Available from: https://www.sciencedirect.com/science/article/pii/S0936655522002692
28. Berman BA, Jo AM, Cumberland WG, Booth H, Wolfson AA, Stern C, et al. D/deaf breast cancer survivors: their experiences and knowledge. J Health Care Poor Underserved [Internet]. 2017 [cited 2024 Jan 13];28 (3): 1165–1190. Available from: https://muse.jhu.edu/pub/1/article/666605
29. Shukla U, Sueyoshi M, Diamond B, Chowdhury I, Stambaugh C, Wazer DE, et al. Disparities in radiation therapy: practice patterns analysis of deep inspiratory breath hold use in non-English speakers. Int J Radiat Oncol Biol Phys [Internet]. 2022 May 1 [cited 2024 Feb 19];113 (1): 21–25. Available from: https://www.sciencedirect.com/science/article/pii/S0360301621034441
30. Hill C, Deville C, Alcorn S, Kiess A, Viswanathan A, Page B. Assessing and providing culturally competent care in radiation oncology for deaf cancer patients. Adv Radiat Oncol [Internet]. 2020 May 1 [cited 2024 Feb 21];5 (3): 333–344. Available from: https://www.sciencedirect.com/science/article/pii/S2452109420300324
31. Yamauchi R, Mizuno N, Itazawa T, Masuda T, Akiyama S, Kawamori J. Assessment of visual feedback system for reproducibility of voluntary deep inspiration breath hold in left-sided breast radiotherapy. J Med Imaging Radiat Sci [Internet]. 2021 Dec 1 [cited 2024 Feb 23];52 (4): 544–551. Available from: https://www.sciencedirect.com/science/article/pii/S1939865421002034
32. Pernet A, Mollo V, Bibault JE, Giraud P. Evaluation of patients' engagement in radiation therapy safety. Cancer/Radiothérapie [Internet]. 2016 Dec 1 [cited 2024 Jan 11];20 (8): 765–767. Available from: https://www.sciencedirect.com/science/article/pii/S1278321816300488
33. RESPIRE Project [Internet]. [cited 2024 Feb 21]. Available from: https://www.respire.org.uk/
34. Grilo AM, Almeida B, Rodrigues C, Isabel Gomes A, Caetano M. Using virtual reality to prepare patients for radiotherapy: a systematic review of interventional studies with educational sessions. Tech Innov Patient Support Radiat Oncol [Internet]. 2023 Mar 1 [cited 2024 Jan 11];25: 100203. Available from: https://www.sciencedirect.com/science/article/pii/S2405632423000033
35. The Society of Radiographers [Internet]. 2020. Available from: https://www.sor.org/
36. Hicks, C. (2009) Research methods for clinical therapists: applied project design and analysis. 5th edn. Edinburgh: Churchill Livingstone. Available at: https://r1.vlereader.com/EpubReader?ean=1780702041884# (Accessed: 24 February 2024)
37. Microsoft.com [Internet]. 2024. [cited 2024 February 25]. Microsoft forms. Available from: https://www.microsoft.com/en-gb/microsoft-365/online-surveys-polls-quizzes
38. van der Laan HP, Hurkmans CW, Kuten A, Westenberg HA. Current technological clinical practice in breast radiotherapy; results of a survey in EORTC-radiation oncology group affiliated institutions. Radiother Oncol [Internet]. 2010 Mar 1 [cited 2024 Feb 23];94 (3): 280–285. Available from: https://www.sciencedirect.com/science/article/pii/S0167814010000095
39. Bartlett FR, Colgan RM, Carr K, Donovan EM, McNair HA, Locke I, et al. The UK HeartSpare Study: Randomised evaluation of voluntary deep-inspiratory breath-hold in women undergoing breast radiotherapy. Radiother Oncol [Internet]. 2013 Aug 1 [cited 2024 Feb 23];108 (2): 242–247. Available from: https://www.sciencedirect.com/science/article/pii/S0167814013001965
40. Video Conferencing, Meetings, Calling | Microsoft Teams [Internet].2024. [cited 2024 Feb 25]. Available from: https://www.microsoft.com/en-us/microsoft-teams/group-chat-software
41. Halkett GKB, Merchant S, Smith SK, O'Connor M, Jefford M, Aranda S, et al. Supporting and preparing patients for radiotherapy: patients' and radiation therapists' perspectives on their one-to-one consultations. Eur J Cancer Care [Internet]. 2020 [cited 2024 Feb 19];29 (6): e13284. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ecc.13284
42. Bartlett FR, Yarnold JR, Donovan EM, Evans PM, Locke I, Kirby AM. Multileaf Collimation cardiac shielding in breast radiotherapy: cardiac doses are reduced, but at what cost? Clin Oncol [Internet]. 2013 Dec 1 [cited 2024 Feb 20];25 (12): 690–696. Available from: https://www.sciencedirect.com/science/article/pii/S0936655513003373
43. Varian [Internet]. 2024. [cited 2024 February 21] Available from: https://www.varian.com/en-gb

https://doi.org/10.1017/S1460396925100216 Published online by Cambridge University Press