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Breast Setup with IDENTIFY for SGRT

Clinical practice, workflow recommendations, and verification

Icon Network

Content

Executive Summary

Icon Cancer Care, a network of over 40 centres across Australia and Asia, has chosen to implement Varian's IDENTIFY system for surface-guided radiotherapy (SGRT) with the intent of improving radiotherapy treatment across all centres. At the time of writing, IDENTIFY is installed on 23 linacs, including TrueBeam, Halcyon, and Ethos, across 22 radiotherapy centres.

This white paper leverages the Icon clinical experience to provide recommendations on the implementation of SGRT for breast breath-hold treatments. Particularly, aspects such as region of interest (ROI) selection, clinical workflow on both Halcyon and TrueBeam, as well as accuracy with respect to verification imaging, are discussed.

With implementing IDENTIFY, the team at Icon has succeeded in meeting a series of clinical goals: improving patient safety by implementing SGRT based deep inspiration breath hold treatments (DIBH), improving patient comfort by transitioning to tattoo-less treatments, saving time by streamlining patient set-up, and providing a unified care experience by standardising workflows across the entire organisation.

Clinical data collection was performed across six Icon centres and two delivery systems (TrueBeam and Halcyon), over a period of five months. A total of 586 treatment fractions were included. To capture system behaviour for a diverse patient population, several patient breast types were included.

Results show a good correlation between SGRT and verification imaging. The mean difference was below 0.05 cm for TrueBeam and below 0.11 cm for Halcyon, and these were deemed clinically acceptable.

Being well-received by radiotherapists and physicists, IDENTIFY is an important component used to accurately set up and monitor breath-hold breast treatments at Icon Cancer Centres all over Australia.

Background

Icon Cancer Care is an international cancer care provider with a single primary aim, to deliver the best cancer care possible, to as many patients as possible, as close to home as possible. This drive has seen the Icon footprint grow to over 40 centres across Australia and Asia and integrate technology with the intent to improve radiotherapy treatment accuracy across all centres. One particularly successful example of technology integration to improve patient care has been the implementation of surface guided radiotherapy (SGRT) across the Icon network. At the time of writing, Icon Cancer Care Centres have clinically implemented the Varian IDENTIFY system on 23 linacs (18 TrueBeam, 4 Halcyon, 1 Ethos) across 22 radiotherapy centres. An internal survey of over 50 Icon staff currently using IDENTIFY has shown that, given the option when setting up future new departments, 89% were in favour of the use and implementation of IDENTIFY for SGRT, with 11% neutral and 0% opposed.

Icon staff experience with IDENTIFY for SGRT:

> *"Patients like not having tattoos. Quicker in CT sim, not having to do tattoos."*
>
> *"Patients requiring re-setup post-IGRT happens less frequently with the introduction of SGRT."*
>
> *"Increased efficiency in setting up patients due to the ability to auto-go to isocentre and mitigating inconsistencies with tattoos. Increased confidence in monitoring intrafraction motion, including patient movement, coughs, etc."*

In this white paper, we leverage the clinical experience across the Icon network to provide recommendations on the implementation of SGRT for breast treatments. In this process, we also consider the existing literature.[1-8]

In preparation, an organization-wide review of SGRT was undertaken that allowed for the development of more standardised processes. Our underlying clinical goals and implementation strategies are described in the following sections.

Clinical Goals

The Icon network decided to implement IDENTIFY to help with our goals of improving patient comfort by transitioning to tattoo-less treatments, saving time by streamlining patient set-up, and standardising workflows across the entire organisation.

Specifically, Icon looks to improve breast radiotherapy by the following process changes:

- Implementation of tattoo-free radiotherapy treatment.
- DIBH radiotherapy monitored by surface guidance.
- More efficient initial patient setup and reduction in magnitude of applied shifts via use of SGRT prior to IGRT.

This white paper addresses the following considerations for SGRT implementation:

- The impact of ROI definition on patient positioning and monitoring.
- Recommended treatment workflows on both TrueBeam and Halcyon systems.
- Methods for addressing ROI shadowing and camera occlusion.

Implementation Strategies

The intention of this study was to validate the approach developed at Icon. To achieve this aim workflows and guidelines were provided to all sites to ensure consistency of approach and adherence to developed processes.

General Simulation Principles

Whilst site specific practices for breast radiotherapy are outlined within this document, a number of underlying simulation principles are applied within Icon when using SGRT for patient treatment:

Ensuring that the intended ROI surface area and surroundings are free of clothing and linen for the scan can help with SGRT workflows. It should be explained to the patient that the region of the body near the treatment site will be exposed for simulation and treatment (particularly for breast and pelvis patients).

The impact of setup equipment and any items around the treatment area obscuring the ROI from the cameras (e.g. vacuum bags) should be considered. Ideally, dimensions for equipment should be minimised where possible to reduce shadowing on IDENTIFY, without compromise to reproducibility and positioning of the patient.

When utilising IDENTIFY for inspiration breath-hold gating, it is important to ensure there is enough difference within the ROI between the surface at breath-hold and surface at free-breathing positions to enable appropriate monitoring. This can be approached with several methods:

- Pre-simulation mock up sessions on a linac with IDENTIFY.
- Ensuring CT images for free-breathing and breath-hold positions cover the intended ROI surface.

- Historical datasets can be leveraged to correlate external surrogate values with surface motion for treatment monitoring.
- Analysis of the patient mock-up or CT images to determine the type of breathing (thoracic vs diaphragmatic) the patient naturally favours.

Due to the location of the IDENTIFY cameras with respect to the bore, further consideration should be applied to the ROI movement between breath-hold and free-breathing on Halcyon systems. In general, typical breast ROIs are sufficiently visible for DIBH techniques. However, it is advised that full ROI visibility of the patient anterior surface between Align and Load positions be evaluated at fraction 1.

These fundamental principles form the basis of the specific site-based implementations utilized to address the target clinical goals.

Transitioning to Tattoo-Free Treatments

Transitioning from simulation with tattoos to patient setup using surface guidance required education around anatomical landmarking. To implement this, both online and in-person training was conducted with changes made to patient-specific setup notes to ensure anatomical landmarking was able to be replicated during treatment. This was required as a backup method for patient setup if IDENTIFY was unavailable, otherwise patient setup with SGRT would be used.

Organisation-Wide Implementation

Given the requirement of new treatment workflows when implementing SGRT, a series of dedicated documents were created to cover simulation, IDENTIFY data preparation, ROI selection, and treatment workflows. This documentation was supported by an internal online training course and in-person demonstrations provided by both Varian Clinical Application specialists and local education radiotherapists.

Ongoing Reflective Practice and Check-Ins to Review Process

Once new SGRT techniques were implemented at sites, local Icon education staff provided ongoing reflective practice sessions to assist with problem solving and offer guidance in areas of potential improvements. This review process was deemed necessary in the early stages of system use and decreased with experience. An example of review frequency for consideration would be weekly for the first month and ad-hoc guidance thereafter.

Methods

Data Collection

Clinical data collection was performed across six Icon centres and two delivery systems (TrueBeam and Halcyon), over a collection period of five months. Several patient breast types were included to explore any difference depending on clinical setup. In total, 586 fractions were recorded as part of the study.

To evaluate the accuracy of IDENTIFY for SGRT with respect to verification imaging, a series of screenshots were taken at different points in the workflow. These screenshots were manually transferred from the IDENTIFY workstation, for each participating centre. This was performed periodically by site physicists on evenings after clinical treatment (typically weekly). A custom code was developed to extract and quantify the patient shift detected by IDENTIFY from the screenshots. This data was compared to the shift applied post-CBCT using data extracted from

ARIA Offline Review. The result is a delta in centimetres where 0 cm reflects perfect agreement between the shifts applied post-CBCT and shifts detected by IDENTIFY.

Image guidance was performed with internal imaging matched using volume of interest extended superior and inferiorly to include as much of the breast/CW PTV as possible, posteriorly to include anterior aspect of vertebral bodies and covering the patient sternum, anterior ribs, and breast. For this study, couch rotations were not applied following image match. As the plans were intentionally created with anterior flash/overshoot, priority is given to matching the breast tissue through the GTV/CTV, with <5 mm variance from the sternum and chest wall at the ribs. For patients treated on the Halcyon, as vertical couch shifts directly impact the baseline for range of inspiration within IDENTIFY, shifts >2 mm required application of couch moves in BH with a new reference surface capture prior to BH release. Instances of >2 mm vertical shift flagged a review of current IDENTIFY ROI to exclude areas of swelling where applicable for subsequent fractions.

To assist other sites in analysing their IDENTIFY data accuracy, the authors of this white paper are willing to share the extraction code to any interested parties. Please contact ben.archibald-heeren@Icon.team or tai.tran@Icon.team for more information.

ROI Selection

When selecting ROIs for SGRT treatment, some general principles for breast radiotherapy should be followed (illustrated in Figure 1):

- Draw the ROI close to isocentre.
- ROI must be visible and of appropriate size.
- ROI must include enough distinctive topography (ROI strength 'optimal').
- Minimize areas of un-correlated motion.
- Minimize areas of shadowing.

Further to the above, specific considerations must be implemented for the Halcyon system. Inherent to bore designs, the area superior to the breast is often not visualised by the cameras at the isocentre position. As a result, the ROI may not be registered if too much of the ROI is in this shadow. Excluding ROIs in shadowed surface areas can significantly improve surface monitoring.

Within this study, we distinguished between the following breast types for the drawing of the ROI:

- General
- Pendulous/Mobile
- Chest Wall/Mastectomy
- Bilateral

Each of these case/anatomy presentations provides different optimal ROI selections to address specific challenges based on patient anatomy and were considered in this study. Recommendations for each case/anatomy type are provided in Figure 1, which includes a short information summary and example images.

General

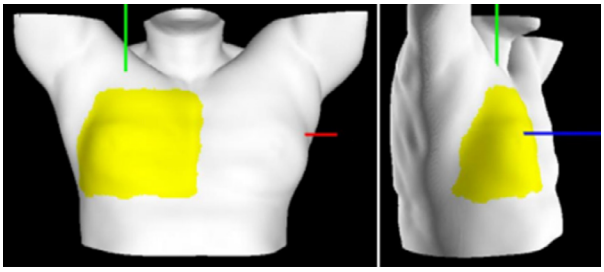
Include:

- Only cover the affected breast.
- Slight extension onto the medical aspect of contralateral breast and breast posteriorly will increase complexity.
- If nodal involvement, consider including SCF and extend the ROI superomedial.

Avoid:

- Areas of independent mobility (shoulder/armpit).
- Areas which could potentially shadow such a lateral breast surface or superior to the marker block placement (if used). Review on day 1 and amend accordingly.

On Halcyon, at the Align position, the area superior to the breast is often not visualised by the cameras. As a result, the ROI may not be registered if too much of the ROI is in the shadow. Exclude ROI in shadowed surface areas. Swelling present within the ROI can affect setup accuracy.



Bilateral

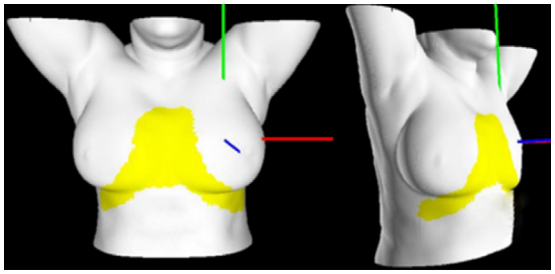
Include:

- Inverted Y shape for larger/mobile breasts.
- Centrally across sternum (including medial aspects of both breasts).
- Inferiorly along ribs.
- Extension onto inferior mammary fold can help ROI strength. (Caution: including the lateral extension of inferior mammary fold may not be visible/reliable).

Avoid:

- Areas of increased mobility/variance:
  - Lateral breast tissue.
  - Upper abdomen.

Superior ROI inclusion is patient dependent and may be excluded if shadowed. Superior addition can be made on day 1 or thereafter after reviewing patient setup.



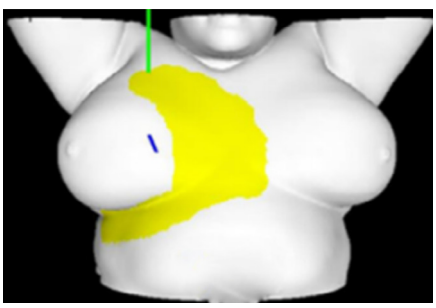
Pendulous/Mobile

Include:

- Centrally across sternum (including medial aspects of both breasts).
- Inferiorly along ipsilateral ribs.
- Slight extension onto contralateral inferior mammary fold can help ROI strength. (Caution: including lateral extension of inferior mammary fold potentially might not be visible/reliable. Superior ROI inclusion is patient dependent and may be excluded if shadowed. Superior addition can be made on day 1 or thereafter after reviewing patient setup).

Avoid:

- Areas of increased mobility/variance:
  - Lateral breast tissue.
  - Upper abdomen.



Chest Wall/Mastectomy

Include:

- Extend further across midline than standard breast.
- Include inferior medial portion of contralateral breast (if present).
- Irregularly shaped to improve the strength and matching accuracy across a reasonably flat surface.

Avoid:

- Patient armpits or areas of drastic patient contour divots as this can cause shadowing.
- Areas of increased mobility/variance. Eg: upper abdomen.

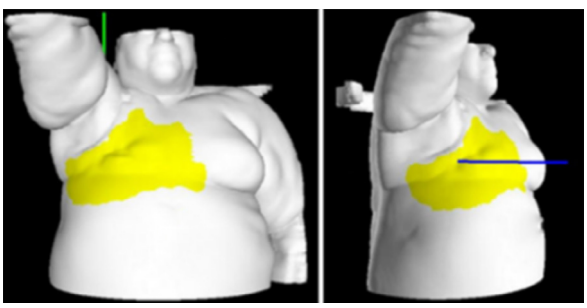


Figure 1. General recommendations for breast ROI. Each anatomical presentation provides different optimal ROI selections to address specific challenges and were considered in this study.

Breath-hold Breast Workflow

For the purposes of this study, new workflows were produced to allow the collection of data, across both TrueBeam and Halcyon.

Across these workflows, currently implemented at Icon, several central tenants are common:

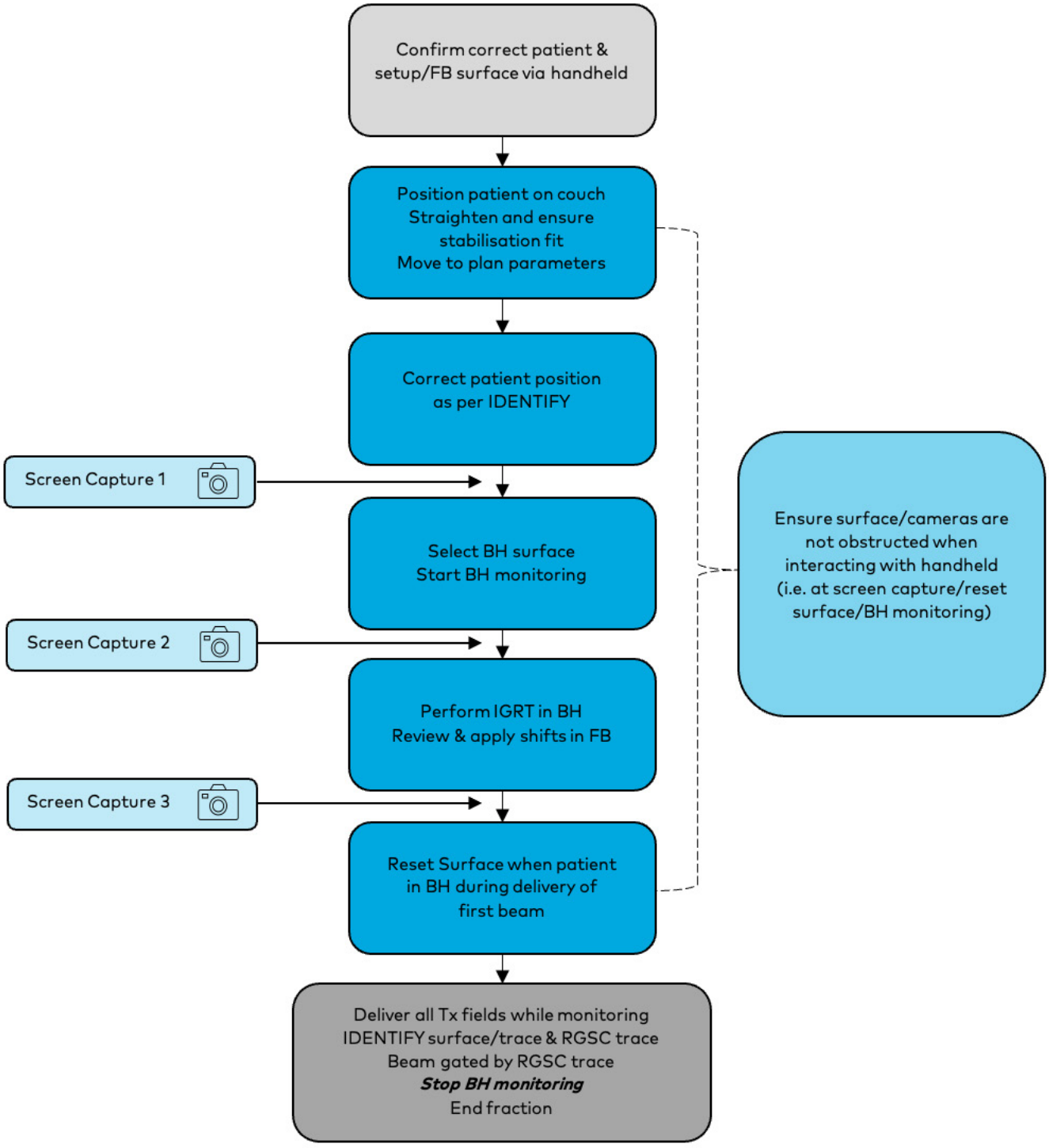
- The stability and accurate representation of the isocentre in the SGRT system is verified daily prior to patient treatment.
- The patient position is adjusted at isocentre on the couch using the IDENTIFY for SGRT feedback against surfaces derived from the planning DICOM structure set.
- On TrueBeam systems the delta couch is not used on plans implementing SGRT due to an inability to adjust the couch to match minor surface offsets once the delta couch shifts are applied. On Halcyon systems the delta couch function must be used in order to align the patient with the isocentre at the load position.
- During treatment setup, aligning patient positioning to SGRT thresholds is required prior to IGRT (kV CBCT) imaging.
- All photon patients received kV CBCT imaging to validate SGRT position prior to treatment delivery.

Where necessary IDENTIFY surface references are reset directly following IGRT match application to ensure an optimal reference surface for patient monitoring. Consistency of surface is maintained in such scenarios by ensuring surface match in breath-hold before applying any couch shifts. New references are then taken in the breath-hold at the new corrected position. This process ensures both localisation and breath-hold magnitude accuracy/consistency.

Individual workflows between machines differ slightly, predominantly due to the necessary distinction between the virtual isocenter (Align) and the treatment isocenter (Load) positions on the Halcyon systems.

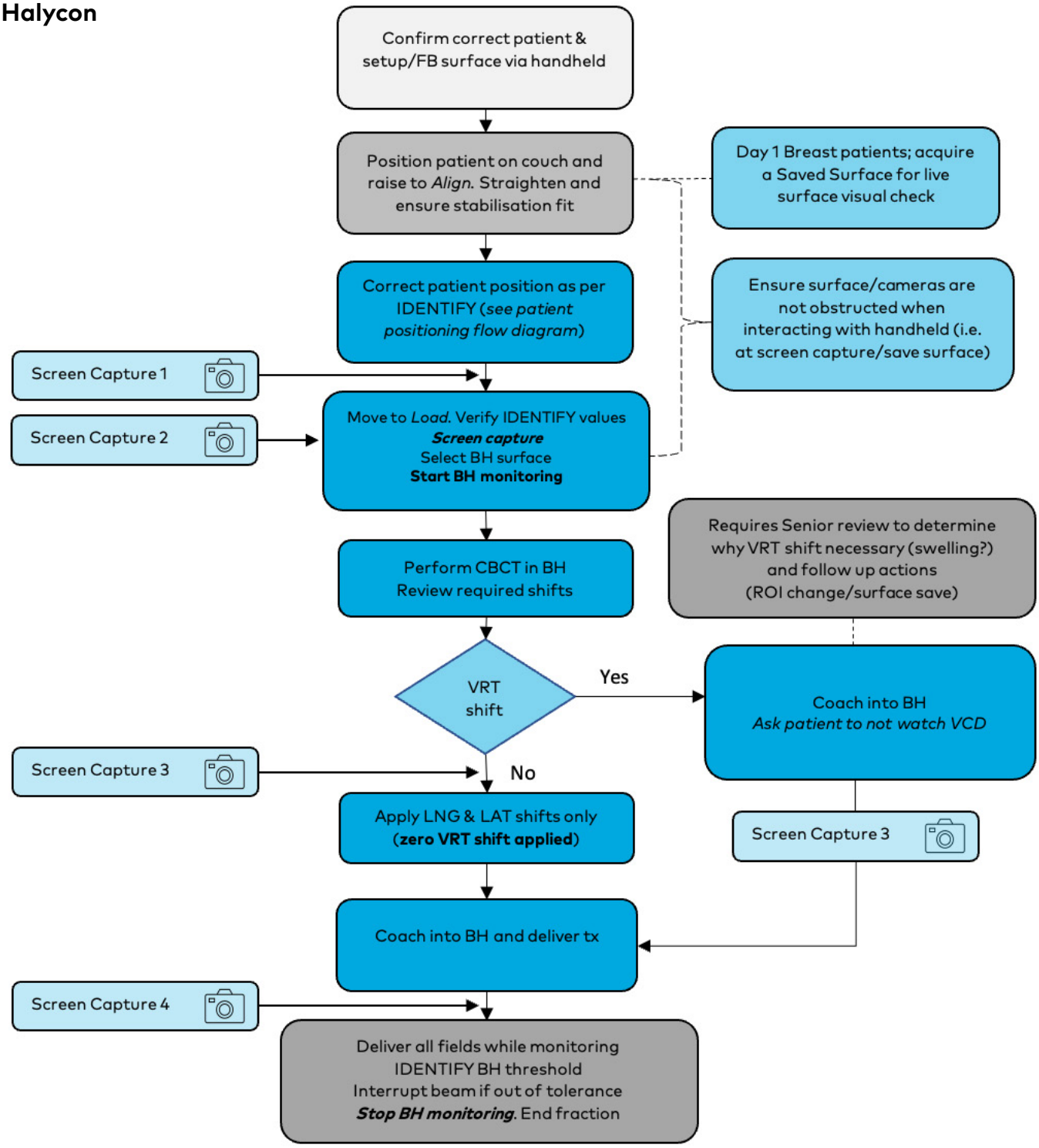
These workflows are supplemented with data collection processes as outlined on the next page.

TrueBeam



- Screen Capture 1 is taken with the patient at the isocentre location following the alignment of the patient to the planning surface using IDENTIFY in free-breathing.
- Screen Capture 2 is taken during CBCT imaging with the patient in breath-hold and the BH patient surface selected.
- Screen Capture 3 is taken after CBCT image match is applied with the patient in breath-hold and the breath-hold surface selected in IDENTIFY.

Halycon



- Screen Capture 1 is taken at the Align position once the patient is correctly aligned to the free-breathing surface.
- Screen Capture 2 is taken at the load position following the "move to load" function is completed on the Halcyon, comparing against the free-breathing surface.
- Screen Capture 3 is taken during the CBCT imaging. This image is taken with the patient breath-hold surface loaded and the patient in breath-hold to match that surface.
- Screen Capture 4 is taken after the CBCT image match shift is applied in breath-hold. (Note: a new surface is taken after the screenshot if vertical shifts are required from the CBCT match).

Align vs Load

Due to the nature of bore design, the Halcyon system requires that the patient is initially aligned outside the bore and away from the isocentre at the Align position.

The combination of the Align to Load workflow and IDENTIFY camera positions results in several effects requiring specific solutions.

1. Whilst the calibration process on the linac accounts for some couch sag, the vertical offset is dependent on the distribution and amount of patient weight along the couch. Therefore, it is expected that the correction for this offset should be tailored for each patient. The average couch sag is measured across the fleet of Halcyon systems in this project and is detailed in the results.
2. Due to the limited capacity to utilize the rear camera at the Align position the surface provided is visualized by the front cameras. Given the geometry of these cameras, this can result in variations in shadowing patterns between Align and Load, resulting in changes in SGRT offsets between the positions and/or an inability to create a suitable common ROI for both positions. Camera occlusion and shadowing by patient can result in a degradation in lateral field of view at the isocentre (and in the bore) when compared to the Align position. As such, ROIs with good visibility and lateral extension can be unusable when in the Halcyon bore.

To resolve the above issues, Icon instigates an "In, Out, and Adjust" workflow on the first fraction and any problematic fractions, on Halcyon systems. The practice allows for adjustment of couch height and ROI position considering conditions at the isocentre by duplicating or implementing necessary changes at the Align position. As a simple example, given systematic vertical offset noted between Load and Align positions a patient may be re-setup outside slightly anterior at the Align position to ensure agreement at isocentre. Where necessary, new reference surfaces are taken at the Align position to ensure efficient setup in subsequent fractions. This process is implemented in the study.

Shadowing and Field of View

Due to the geometry of the bore the field of view provided by the Halcyon camera configuration is typically smaller than that of the TrueBeam system.

There are two primary setup scenarios on Halcyon:

1. Full camera visibility of the ROI. SGRT can be completed without shadowing issues.
2. Isocentre to surface anterior-posterior distance 15-20 cm- occlusion of camera by bore starts to occur. Treatment may proceed if two cameras can visualize the isocentre. Preference to lower ROIs to ensure posterior camera view can be used to ensure treatment, however impact of ROI rotation (as above) needs to be considered.

In this study the treatment of breast cases and their typical isocentre location incurred ROIs that met the requirements to ensure full ROI coverage with minimal distance between isocentre and ROI geometry.

Data Analysis

Given the large number of clinical patients included in the review, the data collection process was intentionally devised to limit clinical workflow impact on the radiotherapy treatment staff. The screenshot functionality included within IDENTIFY was utilized to take captures of specific timepoints in the treatment workflow. These timelines are visualized in the treatment workflow diagrams in Appendix A and discussed in the treatment workflow section above.

The timeline of imaging data is specifically determined in the workflows to allow for the assessment of system accuracy:

TrueBeam

- Offset values at screen capture 1 compared against internal imaging provide evaluations of the SGRT accuracy against current standard of care, including patient specific impacts such as tissue mobility.
- Variance in screen capture 1 and 2 compared with the applied IGRT couch corrections allows for evaluation of SGRT system sensitivity to offsets.
- Offsets in screen capture 3 demonstrate the residual process errors of the SGRT systems where the patient position is accurately aligned with internal imaging.

Halcyon

- Variance between screen capture 1 and 2 provides the incurred offset between the Align and Load positions on Halcyon systems, due to either system calibrations or the effect of couch sag at the linac isocentre.
- Offset values at screen capture 3 compared against internal imaging provide evaluations of the SGRT accuracy against current standard of care, including patient specific impacts such as tissue mobility.
- Variance in screen capture 3 and 4 compared with the applied IGRT couch corrections allows for evaluation of SGRT system sensitivity to offsets.

Results

Efficiency

Figure 2a illustrates treatment time data captured from breast patients treated on TrueBeam and Halcyon at Icon at three differing stages: pre-SGRT, during implementation of SGRT, and 1-2 years post implementation of SGRT. A total of 3747 (1896 TrueBeam and 1851 Halcyon) breast patient treatments were collated via a report comparing the difference in timestamps from patient mode up on the treatment console to capture of the patient appointment. With this method of data collection, it is important to acknowledge that the data may not accurately represent all fractions setup and treatment time due to the possible inclusion of variable wait times from when the patient is loaded up on the treatment console to when patient setup commences. The top and bottom 10% of each category were filtered out to remove outliers from the data.

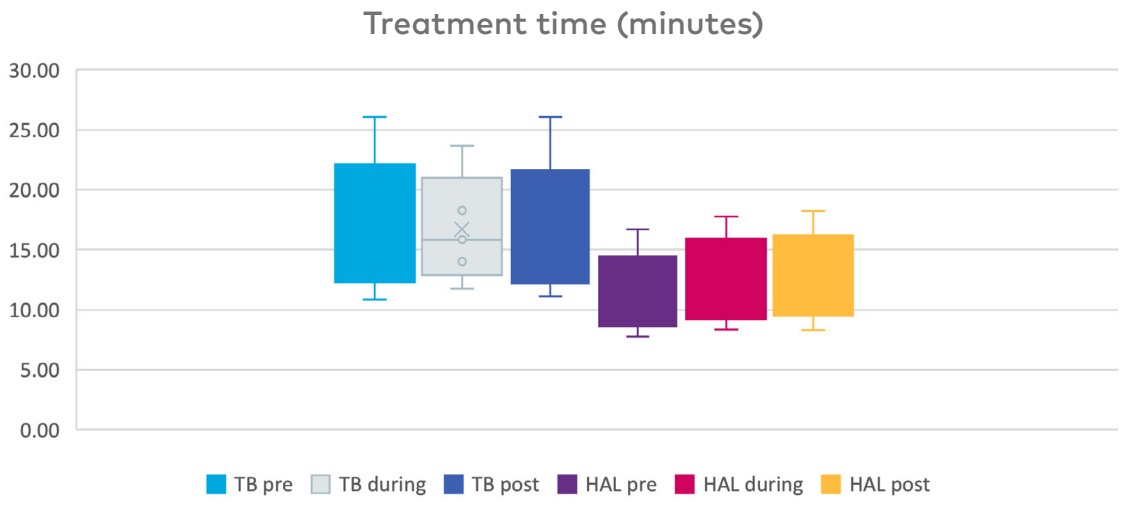


Figure 2a. Reported treatment times pre, during, and post implementation of IDENTIFY

The median TrueBeam treatment time decreased from 15.83 minutes pre-SGRT to 14.92 minutes post-SGRT, and the median Halcyon treatment time increased from 10.88 minutes pre-SGRT to 12.23 minutes post-SGRT; however, no DIBH treatments were performed on the Halcyon pre-SGRT.

In the timeframe from initial implementation to collation of post-implementation treatment timing data (1-2 years), a number of the Icon sites included in the study had experienced significant staff turnover. Figure 2b displays the data from one TrueBeam site that had consistency in staffing for both initial and post-implementation data collation.

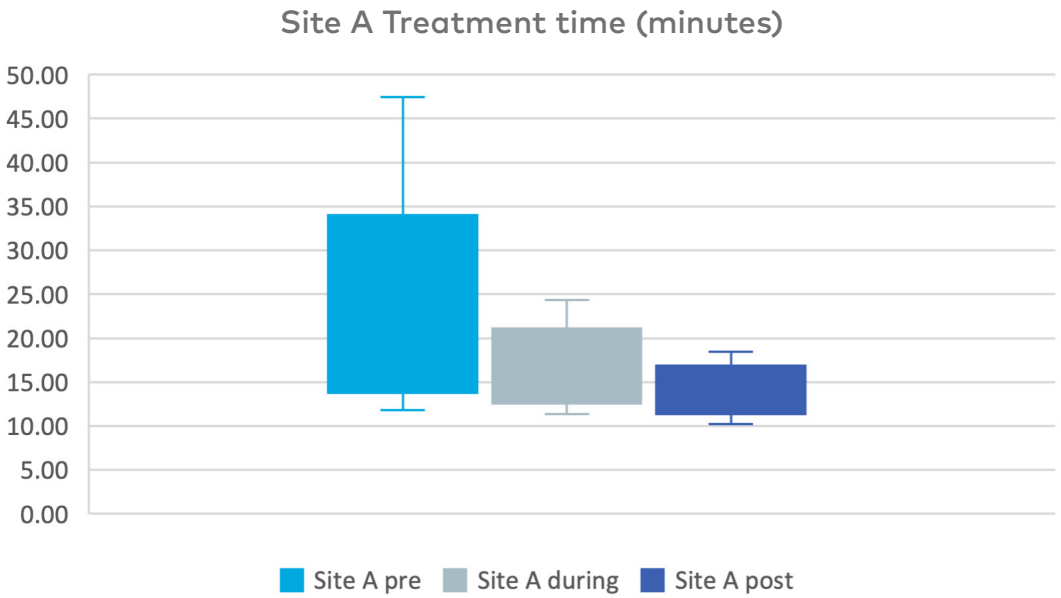


Figure 2b. Reported treatment times pre, during, and post implementation of IDENTIFY

Site A's median TrueBeam treatment time decreased from 18.12 minutes to 13.8 minutes post-implementation of IDENTIFY. Part of the reason we may see this difference between Site A and the rest of the cohort may be due to the following reasons:

- All of the staff at Site A participated in the initial implementation.
- Initial implementation focussed on team-based learning and reflective practice.
- Other sites consist of various new staff which may not have participated in the initial implementation and underwent post-implementation training upon on-boarding.
- Focus of training in the post-implementation setting is individual based and as such may have contained less reflective practice.

The current approach of training new staff in the post-implementation setting may require further investigation at Icon.

Breath-Hold Breast Accuracy

TrueBeam

Distribution of variance between IDENTIFY and internal CBCT imaging is provided in Figure 3. The mean agreement between the systems is -0.05 cm ± 0.27 cm, -0.05 cm ± 0.28 cm, -0.02 cm ± 0.19 cm in the vertical, longitudinal, and lateral axis, respectively. The distribution of variance was observed to be normal between all translational axes, which shows good correlation between the accuracy of positional setup utilizing IDENTIFY.

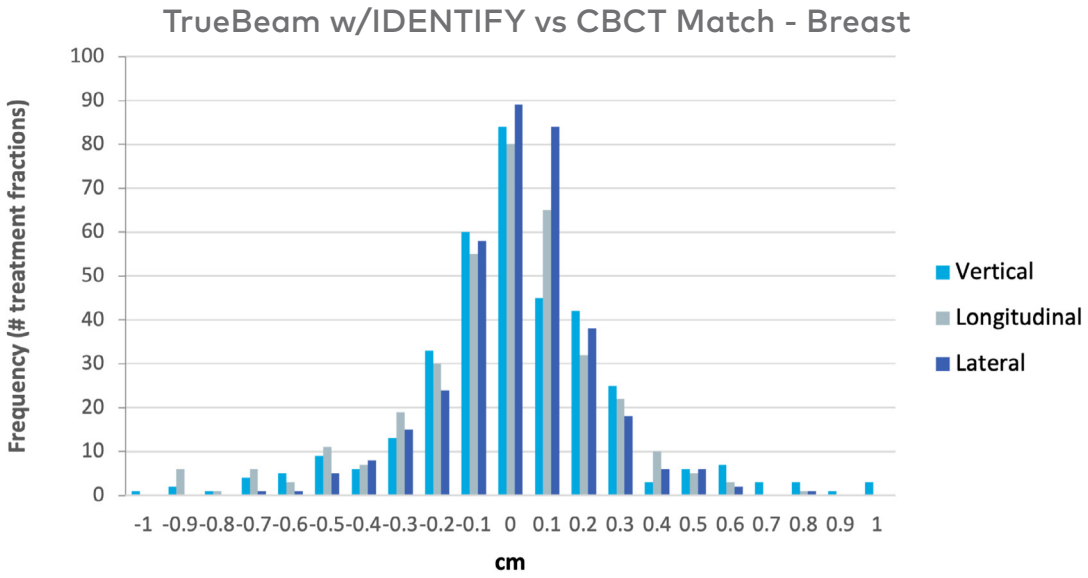


Figure 3. A comparison of all translational axes of variance between IDENTIFY for SGRT and radiographic imaging on TrueBeam.

Halcyon

Distribution of variance between IDENTIFY and internal CBCT imaging for Halcyon patients is provided in Figure 4. The mean agreement between the systems is -0.02 cm ± 0.13 cm, -0.11 cm ± 0.26 cm, 0.0 cm ± 0.18 cm in the vertical, longitudinal, and lateral axis, respectively. The distribution of variance was observed to be normal in the vertical and lateral axes. However, variance in the longitudinal axis was observed to be skewed in the negative direction. Possible reasons for this will be explored within the discussion. Across the fleet of Halcyon systems an average vertical offset of 2.70 mm ± 0.82 mm is noted between the Align and Load positions when moving a 100 kg patient into the bore.

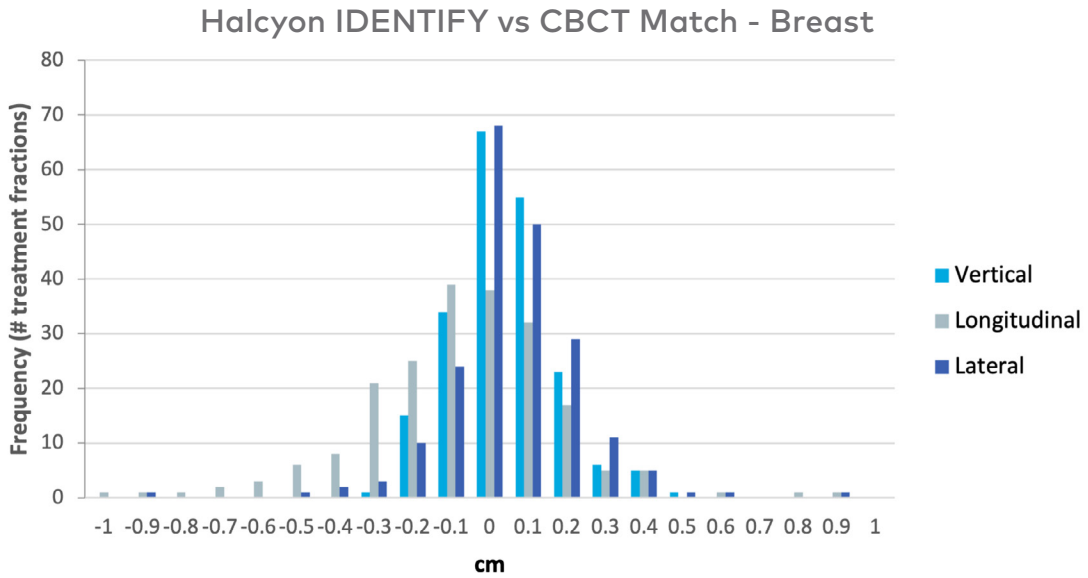


Figure 4. A comparison of all translational axes of variance between IDENTIFY for SGRT and radiographic imaging on Halcyon.

Discussion

Agreement Between IDENTIFY and CBCT Imaging

On TrueBeam, the variance between IDENTIFY and CBCT imaging was observed to be normally distributed in all axes. The symmetry of distribution implies it is unlikely that patient monitoring on IDENTIFY is preferentially skewed in any direction. This is expected since the triple camera positioning close to 90 degrees apart provides excellent field of view of the ROI in most scenarios.

On Halcyon, the variance between IDENTIFY and CBCT imaging was observed to be normally distributed only in the vertical and lateral direction.

In the longitudinal direction, the distribution was observed to be noticeably skewed in the negative direction. Several factors may contribute to this difference and are offered below:

- Camera positioning
    - A C-arm linac configuration naturally allows for more information to be always projected/ received by the camera. In a bore linac configuration, the likelihood in the reduction of information received by Camera 3 can be influenced by many factors:
        - Increased shadowing due to camera blockage by the gantry.
        - Reduction in surface detection if the patient is forward pitched, which results in the loss of line-of-sight.
- The ROI angle of incidence between the Align and Load position.
    - Due to the inherent functionality of bore linacs, the patient is set up at the Align position and sent to isocentre at the Load position. The angle of incidence of the ROI surface received by Camera 1 and 2 differs at both the Align and Load longitudinal positions. Combined with other factors such as camera positioning, this may lead to shadowing present at the Load position only.
- Contribution of pitch rotation on the longitudinal axis.

Conclusion

This white paper discusses IDENTIFY implementation strategies and the workflow for breast breath-hold treatment. By establishing this standardised workflow, we were able to achieve a good correlation between external and internal anatomy. This workflow standardisation translates into a good agreement between internal verification imaging and surface guidance on both TrueBeam and Halcyon. On TrueBeam, the mean agreement was -0.05 cm, -0.05 cm, -0.02 cm in the vertical, longitudinal, and lateral axis, respectively. On Halcyon, the mean agreement was -0.02 cm, -0.11 cm and 0.0 cm in the vertical, longitudinal, and lateral axis, respectively. Most of the differences were <0.05 cm and these were deemed clinically acceptable.

IDENTIFY has enabled us to achieve our clinical goals of transitioning to tattoo-less patient setup, increased efficiency, and standardising workflows across our large organisation. Being well received by radiotherapists and physicists, IDENTIFY is an important component used to accurately setup and monitor breath-hold breast treatments at Icon Cancer Centres all over Australia.

References

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Ben Archibald-Heeren is the Group Manager of Development & Implementation at ICON Cancer Care. Ben is the current chair of the ACPSEM MIRSIG. His research, including over 30 publications, has focused on adaptive radiotherapy, automation in radiotherapy planning, and the implementation of new technologies to improve patient care.

Lee Anderson is currently the Development and Implementation Lead where he is primarily involved in the implementation of new technologies and technique development across the ICON group. Some key projects include the development of a national stereotactic program and, more recently, the implementation of Varian IDENTIFY for SGRT on both TrueBeam and Halcyon platforms, delivering the world's first clinical use of IDENTIFY for DIBH breast treatment on Halcyon.

Tim Burke has been a Radiation Therapist at ICON for seven years and is primarily interested in utilising and learning new technologies to advance staff skillset, learn collaboratively, and achieve optimal patient care. Outside of work, Tim is a dad of two and has a passion for football and gardening.

Nigel Middlebrook is currently the Regional Medical Physics Manager for the nine ICON Cancer Centre sites in Victoria & Tasmania. He has worked with Varian products for over 15 years and has been fortunate enough to be part of the ICON Group as early adopters of Varian technology. Nigel has a particular passion for advancing patient treatment efficiency.

Yunfei Hu is a Senior Medical Physics Specialist and Chair of the Imaging and Contouring Technical Stream at ICON Cancer Centre. He is particularly interested in imaging, adaptive radiotherapy, and artificial intelligence in radiotherapy. Valuing research as much as clinical practice, Yunfei has so far published over 20 papers in different areas of radiotherapy and is actively engaged in implementing new technologies.

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