Effective on or after May 1, 2015, refer to:
Blue Cross and Blue Shield of Alabama Radiation Therapy Management – RTM Policies

Name of Policy: Real-Time Intra-Fraction Motion Management During Radiation Therapy
Policy #: 336  Latest Review Date: September 2014
Category: Radiology  Policy Grade: B

Background/Definitions:
As a general rule, benefits are payable under Blue Cross and Blue Shield of Alabama health plans only in cases of medical necessity and only if services or supplies are not investigational, provided the customer group contracts have such coverage.

The following Association Technology Evaluation Criteria must be met for a service/supply to be considered for coverage:

1. The technology must have final approval from the appropriate government regulatory bodies;
2. The scientific evidence must permit conclusions concerning the effect of the technology on health outcomes;
3. The technology must improve the net health outcome;
4. The technology must be as beneficial as any established alternatives;
5. The improvement must be attainable outside the investigational setting.

Medical Necessity means that health care services (e.g., procedures, treatments, supplies, devices, equipment, facilities or drugs) that a physician, exercising prudent clinical judgment, would provide to a patient for the purpose of preventing, evaluating, diagnosing or treating an illness, injury or disease or its symptoms, and that are:

1. In accordance with generally accepted standards of medical practice; and
2. Clinically appropriate in terms of type, frequency, extent, site and duration and considered effective for the patient’s illness, injury or disease; and
3. Not primarily for the convenience of the patient, physician or other health care provider; and
4. Not more costly than an alternative service or sequence of services at least as likely to produce equivalent therapeutic or diagnostic results as to the diagnosis or treatment of that patient’s illness, injury or disease.
**Description of Procedure or Service:**
This policy discusses the use of real-time intra-fraction tracking during radiation therapy (“real-time tracking”). These techniques enable adjustment of the target radiation while it is being delivered (i.e., intra-fraction adjustments) to compensate for movement of the organ inside the body. Real-time tracking, which may or may not use radiographic images, is one of many techniques referred to as “image-guided radiation therapy” (IGRT). For this policy real-time tracking is defined as frequent or continuous target tracking in the treatment room during radiation therapy, with periodic or continuous adjustment to targeting made on the basis of target motion detected by the tracking system. This policy does not address approaches used to optimize consistency of patient positioning in setting up either the overall treatment plan or individual treatment sessions (i.e., inter-fraction adjustments), instead it deals with approached to monitor target movement within a single treatment session, which includes technologies using respiratory gating.

In general, image guided adjustments can be grouped into two categories: on-line and off-line. An on-line correction occurs when corrections or actions occur at the time of radiation delivery on the basis of pre-defined thresholds. An off-line approach refers to imaging without immediate intervention.

During radiation therapy, it is important to target the tumor so that radiation treatment is delivered to the tumor but surrounding tissue is spared. This targeting seems increasingly important as dose-escalation is used in an attempt to improve long-term tumor control and improve patient survival. Over time, a number of approaches have evolved to improve targeting of the radiation dose. Better targeting has been achieved through various approaches to radiation therapy, such as 3-D conformal treatment and intensity-modulated radiation therapy (IMRT). For prostate cancer, use of a rectal balloon has been reported to improve consistent positioning of the prostate and thus reduce rectal tissue irradiation during radiation therapy treatment of prostate cancer. In additions, more sophisticated imaging techniques, including use of implanted fiducial markers, has been used to better position the tumor (patient) as part of treatment planning and individual radiation treatment sessions.

Intra-fraction target motion can be caused by many things including breathing, cardiac and bowel motion, swallowing or sneezing. Data also suggest that a strong relationship may exist between obesity and organ shift, indicating without some form of target tracking, the target volume may not receive the intended dose of patients who are moderately to severely obese. Respiration affects the position of all thoracic and abdominal organs, primarily the lungs, liver, and breast. The American Association of Physicists in Medicine Task Group 76 recommends motion management for tumor motion that exceeds 5mm in any direction or if significant normal tissue-sparing can be gained. Measurement of tumor motion commonly uses fluoroscopy or 4-dimensional computed tomography (4D-CT), a sequence of 3D-CT images over time, with or without fiducial markers.

Five principal respiratory motion management techniques are commonly used: integration of respiratory movements (i.e., mean tumor position, range of motion) into treatment planning; abdominal compression plates to force shallow breathing; breath-hold, often using spirometry; respiratory gating; and real-time tumor-tracking. Respiratory gating delivers radiation during a
particular portion of the breathing cycle. This “gate” is defined by monitoring respiratory motion with external sensors and selecting a constant cycle amplitude or phase (e.g., end-inspiration or end-expiration) for radiation delivery. Respiratory gating assumes a consistent association between the respiratory cycle and tumor position. For patients in whom this association is unreliable, real-time target tracking techniques can be used. These techniques involve fluoroscopic, radiograph, or digital tracking of external respiratory surrogates, e.g., an abdominal belt, or, like other real-time tumor-tracking techniques described here, implanted fiducial markers.

As noted above, the next step in this evolving process of improved targeting is the use of devices to track the target (tumor motion) during radiation treatment sessions and allow adjustment of the radiation dose during a session based on tumor movement. Some of the devices cleared by the US Food and Drug Administration (FDA) are referred to as “4-D imaging” (not to be confused with 4D-CT, described above). One such device is the Calypso® 4D Localization System (Varian Medical Systems; Palo Alto, CA). This system uses a group of three electromagnetic transponders (Beacon®) implanted in or near the tumor to allow continuous localization of a treatment isocenter. The transponders are 8.5 mm long and have a diameter of 1.85mm. The three transponders have a “field of view” of 14-cm square with a depth of 27 cm.

This policy does not address IGRT used as part of stereotactic (body) radiation therapy.

**Policy:**

**Effective for dates of service on or after May 1, 2015 refer to Blue Cross and Blue Shield of Alabama Radiation Therapy Management – RTM Policies**

**Effective for dates of service on or after September 6, 2014 and prior to May 1, 2015:**

Real-time intra-fraction target tracking during radiation therapy to adjust radiation doses or monitor target movement during individual radiation therapy treatments sessions does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage and is considered investigational.

Respiratory gating techniques for the delivery of radiation therapy does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage and is considered investigational.

**Effective for dates of service March 1, 2012 through September 5, 2014:**

Real-time intra-fraction target tracking during radiation therapy to adjust radiation doses or monitor target movement during individual radiation therapy treatments sessions does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage.

When image guided radiation therapy is used with a form of radiation therapy that meets Blue Cross and Blue Shield of Alabama’s medical criteria for coverage, the radiation itself would be covered while the image guided component is non-covered.
Key Points:
Randomized trial data are needed to show the impact on clinical outcomes of real-time tracking devices that allow for adjustments during radiation therapy or monitor the tumor target during individual treatment sessions. The clinical outcomes could be disease control (patient survival) and/or toxicity (e.g., less damage to adjacent normal tissue). Since intensity-modulated radiation therapy (IMRT) and IMRT plus real-time tracking are likely to produce equivalent therapeutic results, given the increased cost of real-time tracking, the technique (tracking) needs to demonstrate incremental clinical benefit over IMRT. To date, clinical outcome studies have not been reported for any tumor site but will be required to show that target tracking during radiotherapy leads to a clinically meaningful change in outcomes. The majority of the work in this evolving area is in prostate cancer, although there are also studies of the technique in other organs such as lung, breast and bladder.

Studies have focused on movement of the target during radiation therapy sessions. This is considered an initial step in evaluating this technology but is not sufficient to determine if patient outcomes are improved. As Dawson and Jaffray comment, the clinically meaningful thresholds for target tracking and re-planning of treatment during a course of radiation therapy are not yet known. Even less is known about the impact of target tracking within a single treatment session.

These new devices do appear to provide accurate localization. Santanam et al reported on the localization accuracy of electromagnetic tracking systems and on-board imaging systems. In this study, both the imaging system and the electromagnetic system showed submillimeter accuracy during a study of both a phantom and a canine model. Kindblom et al similarly showed electromagnetic tracking was feasible with the Micropos transponder system and that the accuracy of transponder localization was comparable to x-ray localization of radiopaque markers. Smith et al successfully coupled an electromagnetic tracking system with linear accelerator gating for lung cancer. A currently registered trial looking at the movement of the cervix during radiation therapy has been withdrawn (NCT00907634).

Movement
Prostate Cancer
In a 2007 clinical study, Kupelian et al described differences found in radiation therapy sessions performed on 35 patients with prostate cancer. In this paper, six of the initial 41 patients could not be studied because body habitus (A-P dimension) was too large to allow imaging. The results showed good agreement with x-ray localization. Displacements of 3mm or more and 5mm or more for cumulative duration of at least 30 seconds were observed during 41% and 15% of radiation sessions, respectively. The clinical sites for the study developed individualized
protocols for responding to observed intra-fraction motion. This publication did not report on clinical implications or clinical outcomes, either for control of disease or treatment complications, e.g., proctitis. The clinical impact of these displacements and resultant adjustments in treatments needs to be explored in much greater detail.

In a 2008 retrospective analysis of data collected from the treatment of 21 patients with prostate cancer treated with CyberKnife (Accuray; Sunnyvale, CA), Xie et al reported on the intra-fractional movement of the prostate during hypofractionated radiotherapy. The analysis included 427 datasets composed of the time it took for the prostate to move beyond an acceptable level (approximately 5mm). The data suggest that it takes approximately 697 seconds for the prostate to move beyond 5mm relative to its planned position and that motion of greater than 2mm at 30 seconds was present in approximately 5% of datasets. The percentage increases to 8%, 11%, and 14% at 60, 90, and 120 seconds, respectively. They concluded that these movements could be easily managed with a combination of manual couch movements and adjustment by the robotic arm. As noted earlier, the clinical impact of these displacements and resultant adjustments in treatments needs to be explored in much greater detail.

Langen et al reported on 17 patients treated at one of the centers in the study noted in the preceding paragraph. In this study, overall, the prostate was displaced by greater than 3mm in 13.6% of treatment time and by greater than 5mm in 3.3% of treatment time. Results for median treatment time instead of mean were 10.5% and 2.0%, respectively. Again, the clinical impact of this movement was not determined. The authors did comment that potential clinical impact would depend on a number of factors including the clinical target volume (CTV). In this small series, intra-fraction movement did not change a large degree during treatment. However, the likelihood of displacement did increase as time elapsed after positioning.

In 2009, Noel et al published data showing that intermittent target tracking is more sensitive than pre- and post-treatment target tracking to assess intra-fraction prostate motion, but to reach sufficient sensitivity, intermittent imaging must be performed at a high sampling rate. They concluded that this supports the value of continuous real-time tracking. While this may be true, there is a major gap in the literature addressing the actual consequences of organ motion during radiation therapy. Li et al analyzed data from 1,267 tracking sessions from 35 patients to look at the dosimetric consequences on intra-fraction organ motion during radiation therapy. Results showed that even for the patients showing the largest overall movement, the prostate uniform equivalent dose was reduced by only 0.23%, and the minimum prostate dose remained over 95% of the nominal dose. When margins of 2mm were used, the equivalent uniform dose was reduced by 0.51%, but sparing of the rectum and bladder was significantly reduced using the smaller margins. This study did not report on clinical outcomes, and data from a larger randomized cohort will be needed to verify these results.

Three prospective cohort studies assessed the impact of real-time intra-fraction target tracking on planning target volume (PTV) margins. Tanyi et al and Curtis et al both used the Calypso® system in men with prostate cancer undergoing IMRT (total N=45). Each patient had three transponders implanted in the prostate gland. To deliver 95% of the prescribed dose to 95% of the clinical target volume in 90% of patients, margin requirements with intra-fraction target tracking ranged from 1.4mm in the lateral direction to 2.3mm in the vertical direction. Without
intra-fraction target tracking, required margins were 2.1mm and 10.5mm, respectively, using bony alignment, and 2.8mm and 3.2mm, respectively, using image-guided marker alignment. Curtis et al found that without intra-fraction adjustments, PTV margins of 5mm were needed to ensure complete geometric coverage. With image-guided adjustments every four minutes, margins could be reduced to 3mm. In the third study, Langsenlehner et al enrolled 44 men with prostate cancer undergoing 3D conformal radiotherapy (3D-CRT). PTV margins could be reduced from 2.6mm in the lateral direction and 9.6mm in the vertical direction using bony alignment, to 2.5mm and 4.6mm, respectively, using alignment to four implanted gold fiducial markers. None of these studies reported survival or morbidity outcomes associated with margin reductions.

In the 2013 Langsenlehner et al study just described, the authors noted that PTV margins could be reduced even further (to 2.4mm laterally and 3.9mm vertically) if treatment time was reduced to four minutes or less. This finding was confirmed by Cramer et al in their 2013 study of 143 men with localized prostate cancer who were undergoing conventional IMRT (47%) or faster intensity-modulated arc therapy (IMAT) (53%). Continuous (10 Hz) intra-fraction motion tracking was used in all patients. Positions of implanted electromagnetic transponders were validated at least weekly by volumetric cone-beam computed tomography (CBCT). For each treatment technique evaluated (i.e., IMRT vs IMAT and setups based on electromagnetic transponders only vs electromagnetic transponders plus CBCT verification), prostate motion increased progressively as a function of elapsed treatment session duration (IMRT with CBCT verification longest).

**Lung Cancer**

In 2013, Shah et al reported an observational study of the Calypso® system in seven patients with non-small-cell lung cancer (NSCLC). The purpose of the study was to assess the feasibility of transponder implantation and data acquisition; motion-tracking data were not used to alter radiation treatment. Beacon® transponders and fiducial markers (used to fix transponders in place) were placed bronchoscopically in all patients. However, implantation was “difficult and unreliable for routine clinical use,” e.g., due to pneumothorax in one patient and transponder migration during implantation. Similarly, motion tracking was possible but “required additional techniques not practical in a clinical setting,” e.g., use of surface transponders to bypass limitations of the Calypso® system, such as a requirement for at least two transponders to initiate tracking.

**Breast Cancer**

A 2012 systematic review reported on inter- and intra-fraction motion during whole-breast irradiation in the supine position. Literature search was conducted in November 2011, and 18 articles met inclusion criteria. Seven studies (total N=73 patients, >10,000 images) reported on intra-fraction motion. Pooled motion variation was approximately 2mm in several dimensions (left-right [lateral], anterior-posterior [vertical], cranio-caudal [longitudinal]), indicating that inter-fraction motion may have larger effects on radiation dosing. However, because inter-fraction motion also was small (<5mm), the authors suggested that PTV margins of 5mm may be acceptable. A 2012 study of whole-breast irradiation in the supine position (N=23) aligned with this result. Li et al outlined the breast using radio-opaque wires on the skin (optical surface-guided whole-breast irradiation). Mean (SD) intra-fraction motion was 0.1mm (2.8)
horizontal and 0.0mm (2.2) in the longitudinal domain. Given the small amount of intra-fraction motion detected in these studies, real-time intra-fraction tracking may be unnecessary in unselected patients with breast cancer.

**Morbidity**
Sandler et al reported on 64 patients treated with IMRT for prostate cancer in the Assessing the Impact of Margin Reduction (AIM) study. Patients were implanted with Beacon transponders (Calypso Medical Technologies, Inc., Seattle, WA) and were treated with IMRT to a nominal dose of 81Gy in 1.8Gy fractions. Patients in this study were treated with reduced tumor margins, as well as real-time tumor tracking. Patient-reported morbidity associated with radiotherapy was the primary outcome. Study participants were compared to historic controls. Study participants reported fewer treatment-related symptoms and/or worsening of symptoms after treatment than the comparison group. For example, the percentage of patients in the historic comparison group reporting rectal urgency increased from 3% pre-treatment to 22% post-treatment, no increase was observed in the current experimental group.

**Disease Control/Patient Survival**
**Prostate Cancer**
A 2013 review of image-guided radiation therapy (IGRT) technologies for prostate cancer acknowledged the lack of clinical trials demonstrating improved clinical outcomes with Calypso® 4D.

**Bladder Cancer**
Nishioka et al developed a prototype real-time target tracking system in Japan. Using the system, this group conducted a prospective study of 20 patients with clinically inoperable (or surgery refused), Stage II/III (node-negative) urothelial bladder carcinoma. All patients had undergone transurethral tumor resection followed by 40Gy whole-bladder irradiation and implantation of fiducial markers. This was followed by a 25Gy boost using the prototype target tracking system. Fourteen patients (70%) with adequate renal function (creatinine clearance ≥45 mL/min) received concurrent chemoradiotherapy with nedaplatin, a second-generation platinum complex with reduced gastrointestinal and renal toxicity. Patients were followed every three months with cystoscopy and urine cytology; median follow-up was 56 months (range, 9-126). Acute Grade 3 toxicities were urinary tract infections in two patients and thrombocytopenia in one patient; none were attributed to implantation of fiducial markers. Late treatment-related, Grade 3 toxicities were hemorrhagic cystitis and intestinal obstruction due to adhesions in one patient each. Estimated five-year local control rate (defined as absence of pathologically-proven recurrence in the bladder) and overall survival were 64% and 61%, respectively. These results support further investigation in larger controlled studies.

**Other Cancers**
There are few registered clinical trials of these techniques, and none of a randomized design focused on showing how these additional procedures may improve clinical outcomes, including a decrease in toxicity to surrounding tissue.
Respiratory Gating
Because current non-gated radiotherapy techniques achieve adequate tumor coverage, the goal of adding respiratory gating is to reduce irradiation of normal tissue to reduce toxicity and facilitate dose escalation.

Lung Cancer
Two small studies compared respiratory-gated and non-gated treatment plans in patients with thoracic tumors. Vlachaki et al evaluated ten patients (eight with NSCLC, one with small cell lung cancer [SCLC], and one undetermined due to risk of pneumothorax associated with biopsy) who were treated at several U.S. centers. All patients underwent gated and non-gated radiotherapy treatment planning using 4D-conformal treatment (4D-CT). PTV was determined by adding a 1.5cm or 0.5cm margin to the clinical target volume in non-gated and gated plans, respectively. In each patient, PTVs were smaller in gated compared with non-gated plans (mean PTV, 293mL vs 575mL, p<0.001), which was attributed to the smaller (0.5cm) margin used in gated plans. Mean and maximum PTV doses were similar in both plans, but minimum dose was higher in gated plans (53Gy vs 48Gy). Mean percentage of total lung volume (outside the PTV) exposed to 20Gy or more of radiation (lung V20) was 26% in gated and 35% in non-gated plans (p<0.001). Mean doses to the heart and esophagus also were lower with gated versus non-gated plans (11Gy and 17Gy vs 16Gy and 22Gy, respectively; p≤0.003).

In 2013, Hau et al evaluated 34 consecutive patients who were treated for thoracic malignancy (23 [68%] NSCLC, 10 [29%] SCLC, and one [3%] atypical carcinoid) at a single center in Australia. All patients underwent radiotherapy treatment planning using both a respiratory-gated approach and a free-breathing (non-gated) approach. In both plans, a 5.5mm margin was added to the clinical target volume to derive PTV margins. For respiratory-gated radiotherapy, PTV was selected to cover any tumor motion within the gating window. For the free-breathing approach, PTV was determined to encompass tumor throughout the respiratory cycle. PTV was smaller in respiratory-gated compared with non-gated plans (388cm3 vs 421cm3, p<0.001), but 95% uniform dose coverage was similar between the two plans (94% vs 96%, p=0.028). Bonferroni correction for multiple comparisons yielded a p value less than 0.003 for statistical significance. A priori, a minimum 5% reduction in lung V20 was considered clinically significant. Mean (SD) lung V20 was 23% (9) in gated plans and 25% (9) in non-gated plans, for a difference of two percentage points (95% confidence interval, 1 to 3; p<0.001). Dosimetric data indicated no statistical difference in radiation doses to the spinal cord, heart, or esophagus. Four patients (12%) had lung V20 reductions of 5% or greater; 75% of these patients had superior-inferior tumor displacement of more than 1cm compared with two (7%) of 30 patients whose lung V20 reduction did not exceed 5% (Fisher exact test, p<0.006). The four patients also tended to have gross tumor volumes less than 100cm3. Based on these observations, the authors suggested that respiratory gating be applied selectively to patients with gross tumor volumes less than 100cm3 and superior-inferior tumor displacement of more than 1cm.

Breast Cancer
A 2011 prospective, nonrandomized study by the French Ministry of Health compared respiratory-gated radiotherapy with standard conformal radiotherapy. Women (N=401) from 20 centers in France who had early stage breast cancer requiring radiotherapy only were enrolled. In the respiratory-gated group (n=218 [54%]), PTV margins were determined by computed
tomography (CT) images of radio-opaque surface markers encircling the breast. For most patients in this group (93%), a spirometric breath-holding system was used for gating; 15 patients were gated by a real-time respiratory tracking system that used surface markers. In the standard conformal group (n=183 [46%]), PTV margins were determined by adding 10mm to the clinical target volume. PTVs were statistically smaller in the respiratory-gated group compared with the standard conformal group (p<0.001). Total radiation dose did not differ statistically between groups. Dosimetric data indicated statistically greater radiation doses to the lungs, heart, and esophagus (organs at risk) in the standard conformal group. This benefit was attributed to the deep inspiration breath-hold respiratory gating technique because these patients had markedly increased total lung volumes, and therefore reduced normal lung tissue irradiated compared with patients treated with real-time tracking. Acute pulmonary toxicity (all grades) occurred in 48% of the standard conformal group and 36% of the respiratory-gated group (p=0.02). This difference persisted until the 12-month assessment. Other acute toxicities did not differ between groups in severity or type (e.g., cutaneous, esophageal, cardiac). Late esophageal toxicity (all grades) occurred at six months in 6% of the standard conformal group and 3% of the respiratory-gated group, but no longer differed between groups at 12 or 24 months. Other late toxicities did not differ between groups. After a median follow-up of 26 months (range, 1-47), there was no difference between groups in overall survival or disease-free survival.

Summary

Real-Time Intra-Fraction Target Tracking
Evidence for the use of real-time intra-fraction target tracking for delivery of radiotherapy comprises studies, mostly in patients with prostate cancer that demonstrate the ability of the technology to track tumor motion. Planning studies indicate that planning target volumes can be reduced with real-time intra-fraction target tracking compared with usual set-ups (e.g., bony alignment). One study in patients with lung cancer reported difficulties with implantation of radio-emitting transponders, and 1 study in patients with breast cancer indicated little use for real-time intra-fraction target tracking because breast tumor motion was small.

However, there are no data that indicate that use of real-time tracking during radiation therapy to adjust the intra-fraction dose of radiation therapy or monitor target motion during radiation treatment improves clinical outcomes over existing techniques. Clinical input was mixed, with several reviewers agreeing that head-to-head comparative trials with and without the use of real-time target tracking are necessary to determine whether the use of real-time tracking leads to improved outcomes. Because current evidence is insufficient to demonstrate health benefits, real-time intra-fraction target tracking is considered investigational.

Respiratory Gating
Current non-gated radiotherapy techniques achieve adequate tumor coverage. Therefore, the goal of adding respiratory-gating is to reduce irradiation of normal tissue to reduce toxicity and facilitate dose escalation. Increased treatment time and patient inconvenience associated with respiratory gating may be offset if these benefits are realized.

Studies in lung cancer and breast cancer have compared radiation treatment planning with and without respiratory gating using surface markers. Although studies have shown reductions in planning target volume margins, radiation doses to other organs at risk (lungs, heart, esophagus),
and local toxicity with respiratory gating, these studies were small and the largest study, in women with breast cancer, was nonrandomized. Increased survival or recurrence outcomes were not shown. Current evidence is therefore considered insufficient to determine whether respiratory gating improves patient outcomes, specifically by reducing toxicity and/or improving survival outcomes. Respiratory gating techniques for the delivery of radiotherapy are considered investigational.

Practice Guidelines and Position Statements

**National Comprehensive Cancer Network**

**Prostate Cancer**

Current National Comprehensive Cancer Network (NCCN) clinical practice guidelines for prostate cancer (version 2.2014) state “The accuracy of treatment should be improved by attention to daily prostate localization, with techniques of IGRT [image-guided radiation therapy] using CT [computed tomography], ultrasound, implanted fiducials, electromagnetic targeting/tracking, or an endorectal balloon to improve oncologic cure rates and reduce side effects.” NCCN has replaced “daily IGRT with 3D-CRT (conformal radiotherapy)/IMRT” with “highly conformal” or 3D-CRT/IMRT throughout the guidelines. For primary external beam radiation (EBRT), IGRT is required if the dose is ≥78Gy. NCCN is applying a broader definition of IGRT and is addressing inter-fraction (daily) adjustment rather than intra-fraction adjustments, which are the focus of this policy. Although NCCN states that unless otherwise noted, all recommendations are based on level 2A evidence, no specific citations are provided for basis of their conclusions.

**Lung Cancer**

Current NCCN guidelines for NSCLC (version 3.2014) and for SCLC (version 2.2014) state, “Respiratory motion should be managed when motion is excessive.” Recommended approaches include beam-gating with the respiratory cycle and dynamic tumor tracking. When motion is minimal or the internal target volume is small, “motion-encompassing targeting” is appropriate.

**Breast Cancer**

Current NCCN guidelines for breast cancer (version 3.3014) state that the goals of radiotherapy are “uniform dose distribution and minimal normal tissue toxicity.” Respiratory gating is one of several strategies recommended to accomplish these goals (along with prone positioning and use of wedges, IMRT, and/or forward planning using segments). A recommendation for real-time target tracking is not included.

**Bladder Cancer**

Current NCCN guidelines for bladder cancer do not include a recommendation for real-time intra-fraction target tracking in patients receiving radiotherapy.

**American College of Radiology**

ACR appropriateness criteria for radiotherapy in prostate cancer, cervical cancer, and non-small-cell lung cancer do not include ratings for real-time intra-fraction target tracking.
American Urological Association
A 2013 guideline issued jointly by AUA and the American Society for Radiation Oncology addressed adjuvant and salvage radiotherapy after prostatectomy. This guideline did not include real-time intra-fraction target tracking.

U.K. National Institute for Health and Care Excellence
A 2014 NICE guideline on the diagnosis and treatment of prostate cancer did not include a recommendation for real-time intra-fraction target tracking during radiotherapy.

Key Words:
Image guided radiation therapy, IGRT, Calypso® 4D localization, Calypso®, Calypso® 4D, implanted Beacon® transponders, intra-fraction localization, 3D positional tracking, 3D surface tracking, Beacon electromagnetic transponders, electromagnetic tracking, Real-time Position Management, RPM, Active Breathing Coordinator System, ABC, SDX

Approved by Governing Bodies:
The Calypso® 4D Localization System obtained FDA clearance for prostate cancer in March 2006 through the 510(k) process (K060906) and for other soft tissue tumors in May 2008 (K080726). This system was considered equivalent to existing devices such as implanted fiducials and other body-positioning technologies.

Respiratory-gating systems by several manufacturers have received FDA-approval, e.g., Real-time Position Management™ (RPM, Varian Medical Systems, Palo Alto, CA; K102024), Active Breathing Coordinator System®, (ABC, Aktina, Congers, NY; K003330), and SDX™ (Dyn’R, Toulouse, France; K092479).

Benefit Application:
Coverage is subject to member’s specific benefits. Group specific policy will supersede this policy when applicable.

ITS: Home Policy provisions apply
FEP contracts: Special benefit consideration may apply. Refer to member’s benefit plan. FEP does not consider investigational if FDA approved and will be reviewed for medical necessity.

Current Coding:
CPT Code:
There are no specific codes for the Beacon transponders. The implantation of the transponders can be coded based on anatomical location using:

32553 Placement of interstitial device(s) for radiation therapy guidance (e.g., fiducial markers, dosimeter), percutaneous, intra-thoracic, single or multiple
49411: percutaneous, intra-abdominal, intra-pelvic (except prostate), and/or retroperitoneum, single or multiple

55876: prostate (via needle, any approach), single or multiple.

77387: Guidance for localization of target volume for delivery of radiation treatment delivery, includes intrafraction tracking, when performed (Effective 1/1/15)

The following HCPCS code may be used for the permanently implantable electromagnetic transponders used 3D and/or 4D localization during the delivery of radiation therapy

**HCPCS Code:**

- **A4648** Tissue marker, implantable, any type, each
- **C9718** Placement of interstitial device(s) for radiation therapy/surgery guidance (e.g., fiducial markers, dosimeter), for other than the following sites (any approach); abdomen, pelvis, prostate, retroperitoneum, thorax, single or multiple) is also available for assignment
- **G6017** Intra-fraction localization and tracking of target or patient motion during delivery of radiation therapy (e.g., 3d positional tracking, gating, 3d surface tracking), each fraction of treatment (Effective 1/1/15)

**Previous Coding:**

- **0197T** Intra-fraction localization and tracking of target or patient motion during delivery of radiation therapy (e.g., 3D positional tracking, gating, 3D surface tracking), each fraction of treatment (Deleted 1/1/15)

**References:**


Policy History:
Medical Policy Group, January 2009 (2)
Medical Policy Administration Committee, February 2009
Available for comment February 24-March 10, 2009
Medical Policy Group, November 2010 (2)
Medical Policy Administration Committee, February 2011
Available for comment February 9 – March 25, 2011
Medical Policy Panel, January 2012
Medical Policy Group, March 2012 (2): Updated: Title, Description, Policy, Key Points, Key Words, References
Medical Policy Administration Committee, March 2012
Available for comment March 15 – April 30, 2012
Medical Policy Panel, January 2013
Medical Policy Group, January 2014 (3): 2013 Updates to Description, Key Points & References; no change in policy statement
Medical Policy Group, June 2014 (3): Updated policy with link to CareCore National© medical policies effective August 1, 2014
Medical Policy Administration Committee, June 2014
Available for comment June 16 through July 31, 2014
Medical Policy Group, July 2014: Removed CareCore link. Transfer to CareCore is on hold until further notice. The policy has been returned to FINAL.
Medical Policy Panel, May 2014
Medical Policy Group, May 2014 (3): 2014 Updates to Title, Description, Key Points, Key Words, Governing Bodies, References & Policy statement – added “Respiratory gating techniques for the delivery of radiation therapy does not meet Blue Cross and Blue Shield of Alabama’s medical criteria for coverage and is considered investigational.”
Medical Policy Administration Committee September 2014
Available for comment September 6 through October 20, 2014
Medical Policy Group, November 2014 (4): 2015 Annual Coding update. Updated current coding to include new code 77387 and HCPCS section to include G6017. Added Previous coding section to include deleted code 0197T.
Medical Policy Group, February 2015: Added Care Core Draft link
Available for comment February 12 through April 30, 2015
Medical Policy Group, May 2015: Changed RTM link from Draft to Current, removed Draft from header.
Medical Policy Group, October 2015: Changed RTM link from Current to Draft then removed draft, added/removed Draft in header, added/removed comment period

This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member’s plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield’s administration of plan contracts.