



FEP Medical Policy Manual

FEP 6.01.51 Interim Positron Emission Tomography Scanning in Oncology to Detect Early Response During Treatment

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Related Policies:

6.01.06 - Miscellaneous (Noncardiac, Nononcologic) Applications of Fluorine 18 Fluorodeoxyglucose Positron Emission Tomography

6.01.20 - Cardiac Applications of Positron Emission Tomography Scanning

6.01.26 - Oncologic Applications of Positron Emission Tomography Scanning (Genitourinary)

Interim Positron Emission Tomography Scanning in Oncology to Detect Early Response During Treatment

Description

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Positron emission tomography (PET) scanning has many established roles in oncology. One potential use of PET scanning is to assess treatment response early in the course of therapy, with the intent of potentially altering the regimen based on PET scan results. While several types of PET scanning are used for interim detection of cancer, this review refers to fluorine 18 fluorodeoxyglucose positron emission tomography (FDG-PET) unless otherwise noted.

OBJECTIVE

The objective of this evidence review is to evaluate the clinical validity and clinical utility of interim positron emission tomography in assessing early response to treatment in individuals with various types of cancer.

POLICY STATEMENT

The use of interim fluorine 18 fluorodeoxyglucose positron emission tomography scans to determine response to tyrosine kinase inhibitor treatment in individuals with gastrointestinal stromal tumors is considered **medically necessary**.

The use of positron emission tomography scans to determine early response to treatment (positron emission tomography scans done during a planned course of chemotherapy and/or radiotherapy) in individuals with gastrointestinal stromal tumors on palliative or adjuvant therapy, as well as all other cancers, is considered **investigational**.

POLICY GUIDELINES

Coding

A Healthcare Common Procedure Coding System (HCPCS) modifier created by Medicare might be helpful:

Modifier PS: Positron emission tomography or positron emission tomography plus computed tomography to inform the subsequent treatment strategy of cancerous tumors when the beneficiary's treating physician determines that the positron emission tomography study is needed to inform subsequent antitumor strategy.

BENEFIT APPLICATION

Experimental or investigational procedures, treatments, drugs, or devices are not covered (See General Exclusion Section of brochure).

FDA REGULATORY STATUS

A number of PET scan platforms have been cleared by the U.S. Food and Drug Administration (FDA) through the 510(k) process since the Penn-PET scanner was approved in 1989. These systems are intended to aid in detecting, localizing, diagnosing, staging, and restaging of lesions, tumors, disease, and organ function for the evaluation of diseases and disorders such as, but not limited to, cardiovascular disease, neurologic disorders, and cancer. The images produced by the system can aid in radiotherapy treatment planning and interventional radiology procedures.

PET radiopharmaceuticals have been evaluated and approved as drugs by the FDA for use as diagnostic imaging agents. These radiopharmaceuticals are approved for specific conditions. In December 2009, the FDA issued guidance for Current Good Manufacturing Practice for PET drug manufacturers², and, in August 2011, issued similar Current Good Manufacturing Practice Guidance for small businesses compounding radiopharmaceuticals.³ An additional final guidance document issued in December 2012 required all PET drug manufacturers and compounders to operate under an approved new drug application, abbreviated new drug application, or investigational new drug application, by December 12, 2015.⁴

Table 1 lists some of the radiopharmaceuticals granted FDA approval for use with PET for oncologic-related indications.

Table 1. Radiopharmaceuticals Approved for Use With PET for Carcinoma-Related Indications

Agent	Brand Name	Manufacturer	Date Approved	NDA No.	Carcinoma-Related Indication With PET
Carbon 11 choline	NA	Various	2012	203155	Suspected prostate cancer recurrence based on elevated blood PSA after therapy and noninformative bone scintigraphy, CT, or MRI
Copper 64 dotatate	Detectnet™	Curium	2020	213227	Localization of somatostatin receptor-positive NETs in adult patients
Fluorine 18 fluorodeoxyglucose	NA	Various	2000	20306	Suspected or existing diagnosis of cancer, all types
Fluorine 18 fluciclovine	Axumin™	Blue Earth Diagnostics	2016	208054	Suspected prostate cancer recurrence based on elevated blood PSA levels after treatment
Fluorine 18 fluoroestradiol	CERIANNA™	Zionexa	2020	212155	Detection of ER-positive lesions as an adjunct to biopsy in patients with recurrent or metastatic breast cancer
Gallium 68 dotatate	NETSPOT™	Advanced Accelerator Applications	2016	208547	Localization of somatostatin receptor-positive NETs in adult and pediatric patients
Gallium 68 dotatoc	NA	University of Iowa	2019	210828	Localization of somatostatin receptor-positive NETs in adult and pediatric patients
Gallium 68 PSMA-11	NA	University of California, Los Angeles and the University of California, San Francisco	2020	212642	PSMA positive lesions in men with prostate cancer with suspected metastasis who are candidates for initial definitive therapy or with suspected recurrence based on elevated serum PSA level
Piflufolastat fluorine-18	Pylarify	Progenics Pharmaceuticals, Inc	2021	214793	PSMA positive lesions in men with prostate cancer with suspected metastasis who are candidates for initial definitive therapy or with suspected recurrence based on elevated serum PSA level

CT: computed tomography; ER: estrogen receptor; MRI: magnetic resonance imaging; NA: not applicable; NDA: new drug application; NETs: neuroendocrine tumors; PET: positron emission tomography; PSA: prostate-specific antigen; PSMA: prostate-specific membrane antigen.

RATIONALE

Summary of Evidence

Breast Cancer

For individuals with breast cancer who receive interim fluorine 18 fluorodeoxyglucose positron emission tomography (FDG-PET) as an adjunct to interim computed tomography (CT), the evidence consists of several systematic reviews, randomized controlled trials (RCTs), and many observational studies. Relevant outcomes are overall survival (OS), disease-specific survival, change in disease status, quality of life (QOL), morbid events, and treatment-related morbidity. Results from systematic reviews have shown wide ranges in sensitivities, specificities, and negative [NPV] and positive predictive values [PPV]. The wide ranges might be due to small sample sizes, the use of various definitions of the outcome measure (pathologic complete response), and differences in breast cancer subtype populations. Two RCTs were identified in which therapy decisions were guided by FDG-PET results. In the first RCT, nonresponders, determined by positron emission tomography (PET) measures, were given more intensive chemotherapy. Although the results showed initially higher response rates in the more intensive treatment group, this did not translate to long-term improvements in disease-free survival. The second RCT found that patients receiving less intensive initial treatment who were determined to be responders by PET measures had significantly higher response rates to treatment; however, 3-year disease-free survival results have not yet been published. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Esophageal Cancer

For individuals with esophageal cancer who receive interim FDG-PET as an adjunct to interim CT, the evidence includes meta-analyses, nonrandomized studies, and retrospective studies. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. Results on clinical validity were inconsistent across the studies. The meta-analysis reported low pooled sensitivities and specificities, while a subgroup analysis including only patients with squamous cell carcinoma and 2 studies published after the meta-analysis reported an adequate potential in predicting responders to neoadjuvant therapy. No evidence was identified that examined the clinical utility of PET for patients with esophageal cancer. Evidence for clinical utility of FDG-PET for patients with esophageal cancer consists of 1 meta-analysis and 1 RCT. The meta-analysis found that patients considered to be responders early in therapy based on FDG-PET assessment were found to have improvements in progression-free survival (PFS) and OS compared to nonresponders. A single RCT found that PET-guided therapy led to improvements in PFS, but not OS, in patients considered nonresponders to initial therapy. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Gastrointestinal Stromal Tumors

For individuals with gastrointestinal stromal tumors receiving palliative or adjuvant therapy who receive interim FDG-PET as an adjunct to interim CT, the evidence includes a systematic review. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. The systematic review included 19 studies, 2 of which reviewed FDG-PET scans more than 6 months after the start of treatment. CT is currently recommended for standard long-term follow-up and surveillance of gastrointestinal stromal tumors. FDG-PET is equivalent to CT in the detection of treatment response when follow-up is long-term. No studies were identified that tested outcomes following PET-guided treatment. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals with gastrointestinal stromal tumors treated with tyrosine kinase inhibitors (TKIs) for 6 months or less who receive interim FDG-PET as an adjunct to interim CT, the evidence includes a systematic review. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. The systematic review included 19 studies, 17 of which showed that FDG-PET detected an early response to TKI therapy, which was a strong predictor of clinical outcomes. FDG-PET detected treatment response as early as 1 week after initiation of treatment. While CT detects anatomic changes in the tumor, PET detects changes in the metabolic activity of the tumor. Because metabolic changes precede anatomic changes by several weeks or sometimes months, PET can detect treatment response earlier than CT. PET is therefore preferred if a rapid read-out of response to targeted therapy is needed to guide treatment decisions (eg, change in targeted therapy or surgery). While no studies were identified that tested outcomes following PET-guided treatment, it is possible to construct a chain of evidence demonstrating improved patient outcomes. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

Head and Neck Cancer

For individuals with head and neck cancer who receive interim FDG-PET as an adjunct to CT, the evidence includes several systematic reviews. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. There was an overlap of studies among the systematic reviews. Most studies included in the reviews showed that FDG-PET used during radiotherapy, with or without chemotherapy, can adequately predict disease-free and OS. Meta-analyses to determine response could not be performed in any of the systematic reviews due to the heterogeneity in the methods across the studies. Most studies used SUVmax, however, threshold values to determine response varied across studies. No studies were identified that provided evidence for the clinical utility of PET. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Lymphoma

For individuals with lymphoma who receive interim FDG-PET as an adjunct to interim CT, the evidence includes systematic reviews with meta-analyses and RCTs. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. The systematic review evaluating the validity of interim FDG-PET showed high false-positive rates for both Hodgkin and non-Hodgkin lymphomas. After the systematic review, 2 studies were published; 1 focused on patients with follicular lymphoma and the other on patients with T-lymphoblastic leukemia/lymphoma. These studies showed a potential for FDG-PET to predict survival rates for these specific lymphomas. Evidence for the clinical utility of interim PET for guiding treatment in patients with lymphoma consists of 2 Cochrane reviews and several RCTs. One Cochrane review reported lower PFS in patients receiving PET-guided therapy compared with patients receiving standard care. Another Cochrane review found moderate-certainty evidence that interim PET scan results predict OS, and very low-certainty evidence that interim PET scan results predict PFS in treated individuals with Hodgkin lymphoma. The RCTs that compared PET-guided therapy with standard therapy did not demonstrate noninferiority. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Non-Small-Cell Lung Cancer

For individuals with NSCLC who receive interim FDG-PET as an adjunct to interim CT, the evidence includes numerous small observational studies. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. While most studies showed correlations between FDG-PET measurements and progression-free and OS, the generalizability of the results is limited. The studies were small, with most population sizes fewer than 50 patients. The studies were also heterogeneous, including patients at different stages of the disease, undergoing different treatment regimens, and receiving PET at different times during treatment cycles. No studies were identified that evaluated outcomes after PET-guided therapy. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Ovarian Cancer

For individuals with ovarian cancer who receive interim FDG-PET as an adjunct to interim CT, the evidence includes a systematic review. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. The systematic review identified 9 studies that calculated hazard ratios for various FDG-PET parameters (eg, SUVmax, MTV, tumor lesion glycolysis). The only parameter consistently showing prognostic value was tumor lesion glycolysis. Additionally, no studies were identified that evaluated outcomes after PET-guided therapy. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Other Cancers

For individuals with other malignant solid tumors (eg, bladder, colorectal, prostate, thyroid) who receive FDG-PET as an adjunct to interim CT, the evidence includes a systematic review, National Comprehensive Cancer Network (NCCN) task force report, and single-arm observational studies published after the task force report. Relevant outcomes are OS, disease-specific survival, change in disease status, QOL, morbid events, and treatment-related morbidity. Results have been inconsistent on the use of interim FDG-PET among the various cancers. While some have reported associations between interim FDG-PET and recurrence or survival, there is a lack of comparative trials evaluating outcomes in patients whose treatments were altered based on PET measurements. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

SUPPLEMENTAL INFORMATION

Practice Guidelines and Position Statements

Guidelines or position statements will be considered for inclusion in 'Supplemental Information' if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

American College of Radiology and Society for Pediatric Radiology

The American College of Radiology and the Society for Pediatric Radiology (2016; revised 2021) updated their joint practice parameter for performing fluorine 18 fluorodeoxyglucose positron emission tomography (FDG-PET) coupled with computed tomography (CT) in oncology.¹¹⁴ The practice parameter states that examples of indications for FDG-PET/CT include, but are not limited to, the following:

- "Staging on presentation for guiding initial treatment strategy in patients with a known malignancy;
- Monitoring response to therapy to include determining whether residual abnormalities identified with another imaging modality represent persistent viable tumor or posttreatment changes (inflammation, fibrosis, or necrosis);
- Restaging in the setting of relapse;
- Attempting to localize the site of primary tumor when metastatic disease is the initial manifestation of malignancy;
- Verifying and localizing "occult" disease, especially in the presence of clinical indicators such as elevated tumor markers;
- Evaluating an abnormality considered "indeterminate" by another imaging modality to determine whether glucose metabolism in that abnormality favors a benign or malignant process;
- Guiding treatment goals, such as curative versus palliative therapy;
- Guiding biopsy and radiation therapy planning."

European Association of Nuclear Medicine

The European Association of Nuclear Medicine (2021) published guidelines on FDG-PET/CT in the management of ovarian cancer, which are endorsed by the American College of Nuclear Medicine, the Society of Nuclear Medicine and Molecular Imaging, and the International Atomic Energy Agency.¹¹⁵ The guidelines acknowledge the lack of clinical trials evaluating the role of FDG-PET scanning when used for assessment of response to therapy in patients with ovarian cancer (Level of evidence, II; grade B recommendation). Further recommendations are not provided.

National Comprehensive Cancer Network

Current National Comprehensive Cancer Network recommendations for interim PET scanning during treatment to assess early response in a variety of cancers are summarized in Table 2.

Table 2. Recommendations for Interim PET Scanning

Guideline	Version	Recommendation
Bladder cancer ^{116,}	3.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Breast cancer ^{117,}	4.2023	"Studies of functional imaging, such as radionuclide bone scans and PET imaging, are particularly challenging when used to assess response... PET imaging is challenging because of the absence of a reproducible, validated, and widely accepted set of standards for disease activity assessment."
CNS cancers ^{118,}	1.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Cervical cancer ^{119,}	1.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Colon cancer ^{120,}	2.2023	"PET/CT should not be used to monitor progress of therapy. PET/CT scans should not be used to assess response to chemotherapy because a PET/CT scan can become transiently negative after chemotherapy. False-positive PET/CT scan results can occur in the presence of tissue inflammation after surgery or infection."
Esophageal and EGJ cancers ^{121,}	2.2023	"Regardless of the cut-off values used,...studies...concluded that FDG-PET is predictive of pathologic response and survival in patients with esophageal cancer who undergo preoperative treatment." "Increased FDG uptake due to radiation-induced inflammation limits the use of FDG-PET for early response assessment of esophageal carcinomas. To reduce the incidence of false-positive results due to inflammation, the guidelines recommend that FDG-PET/CT (preferred) or FDG-PET should be performed at least 5 to 8 weeks after the completion of preoperative therapy. However, the guidelines caution that post-treatment FDG-PET results should not be used to select patients for surgery since FDG-PET cannot distinguish microscopic residual disease."
Soft tissue sarcoma ^{122,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed. "PET/CT scan may be useful in staging, prognostication, grading, and determining response to neoadjuvant therapy."
Head and neck cancers ^{123,}	2.2023	Short-term (<6 months) locoregionally advance disease: "FDG PET/CT should be performed within 3 to 6 months of definitive radiation of systemic therapy/RT for assessment of treatment response and to identify any residual tumor." "Early FDG-PET/CT scans before 12 weeks are associated with significant false-positive rates and should be avoided in the absence of signs of recurrence or progression." "The optimal timing of PET scans after radiation treatment appears to be at the 3- to 6-month window. A negative PET at this time point predicts improved overall survival at 2 years."
Hepatocellular Carcinoma ^{124,}	1.2023	Interim PET for assessing response to ongoing treatment is not addressed."PET/CT has limited sensitivity but high specificity, and may be considered when there is an equivocal finding. ¹³ When an HCC is detected by CT or MRI and has increased metabolic activity on PET/CT, higher intralesional standardized uptake value is a marker of biologic aggressiveness and might predict less optimal response to locoregional therapies."
Extrahepatic Cholangiocarcinoma ^{125,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed."PET/CT has limited sensitivity but high specificity and may be considered when there is an equivocal finding. ⁵ The routine use of PET/CT in the preoperative setting has not been established in prospective trials"
Hodgkin lymphoma ^{126,}	2.2023	"Interim FDG-PET scans can be prognostic and are increasingly being used to assess treatment response during therapy as they can inform treatment adaptation, including treatment escalation and de-escalation. Early interim FDG-PET imaging after chemotherapy has been shown to be a sensitive prognostic indicator of treatment outcome in patients with advanced-stage disease. Interim FDG-PET scans may be useful to identify a subgroup of patients with early- and advanced-stage disease that can be treated with chemotherapy alone. The NCCN Guidelines emphasize that the value of interim FDG-PET scans remains unclear for some clinical scenarios, and all measures of response should be considered in the context of

		management decisions. It is important that the Deauville score be incorporated into the nuclear medicine FDG-PET scan report, since subsequent management is often dependent upon that score."
Cutaneous melanoma ^{127,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed. "Recent studies in patients with stage III or IV melanoma... indicated that additional information provided by PET/CT may impact treatment decisions in up to 30% of patients, with the greatest impact seen in surgical management."
Malignant pleural mesothelioma ^{128,}	1.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Multiple myeloma ^{127,}	3.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Non-Hodgkin lymphoma: B-cell ^{129,}	5.2023	"Further prospective studies are warranted to determine whether interim PET scans have a role in guiding post-induction therapeutic interventions." "A negative PET scan after 2 to 4 cycles of induction therapy has been associated with significantly higher EFS and OS rates in several studies. However, interim PET scans can produce false-positive results and many patients treated with chemoimmunotherapy have a favorable long-term outcome despite a positive interim PET scan."
Non-Hodgkin lymphoma: T-cell ^{130,}	1.2023	"The guidelines recommend interim restaging with PET/CT (preferred) or CT after 3 to 4 cycles of chemotherapy."
Primary Cutaneous Lymphomas ^{131,}	1.2023	Interim PET for assessing response to ongoing treatment is not addressed.
NSCLC ^{132,}	3.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Ovarian cancer ^{133,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed. Primary chemotherapy regimens include monitoring with chest/abdominal/pelvic CT or MRI with contrast, PET/CT (skull base to mid-thigh), or PET as indicated ^a
Pancreatic adenocarcinoma ^{134,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed. "PET/CT scan may be considered after formal pancreatic CT protocol in high-risk patients to detect extrapancreatic metastases. It is not a substitute for high-quality, contrast-enhanced CT."
Prostate cancer ^{135,}	2.2023	"F-18 FDG-PET/CT should not be used routinely since data are limited in patients with prostate cancer and suggest that its sensitivity is significantly lower than that seen with the above described tracers."
Rectal cancer ^{136,}	4.2023	"Chest/abdominal/pelvic CT with contrast or chest CT and abdominal/pelvic MRI with contrast to monitor progress of therapy. PET/CT should not be used. "
SCLC ^{137,}	3.2023	"PET/CT is not recommended for routine follow-up."
Thyroid carcinoma ^{138,}	3.2023	Interim PET for assessing response to ongoing treatment is not addressed.
Uterine neoplasms ^{139,}	2.2023	Interim PET for assessing response to ongoing treatment is not addressed.

CNS: central nervous system; CT: computed tomography; EFS: event-free survival; EGJ: esophagogastric junction; FDG: fluorine 18 fluorodeoxyglucose; HCC: hepatocellular carcinoma; MRI: magnetic resonance imaging; NCCN: National Comprehensive Cancer Network; NSCLC: non-small-cell lung cancer; OS: overall survival; PCBCL: primary cutaneous B-cell lymphoma; PET: positron emission tomography; SCLC: small-cell lung cancer; SUV: standardized uptake value.

^a This statement is a footnote to epithelial ovarian cancer/fallopian tube cancer/primary peritoneal cancer treatment recommendations

U.S. Preventive Services Task Force Recommendations

Not applicable.

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Medicare National Coverage

The national coverage determination on FDG-PET for oncologic conditions (220.6.17) makes the following coverage decisions:¹⁴⁰,

"Three FDG PET scans are nationally covered when used to guide subsequent management of anti-tumor treatment strategy after completion of initial anti-cancer therapy. Coverage of more than three FDG PET scans to guide subsequent management of anti-tumor treatment strategy after completion of initial anti-cancer therapy shall be determined by the local Medicare Administrative Contractors."

REFERENCES

- Hillner BE, Siegel BA, Shields AF, et al. The impact of positron emission tomography (PET) on expected management during cancer treatment: findings of the National Oncologic PET Registry. *Cancer*. Jan 15 2009; 115(2): 410-8. PMID 19016303
- Food and Drug Administration (FDA). PET Drugs - Current Good Manufacturing Practice (CGMP). 2009; <https://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM070306.pdf>. Accessed August 3, 2023.
- Food and Drug Administration (FDA). PET Drugs - Current Good Manufacturing Practice (CGMP) Small Entity Compliance Guide. 2011; <https://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM266640.pdf>. Accessed August 2, 2023.
- Food and Drug Administration (FDA). Guidance: Investigational New Drug Applications for Positron Emission Tomography (PET) Drugs. 2012; <https://www.fda.gov/downloads/Drugs/GuidanceComplianceRegulatoryInformation/Guidances/UCM291573.pdf>. Accessed August 1, 2023.
- Li H, Yao L, Jin P, et al. MRI and PET/CT for evaluation of the pathological response to neoadjuvant chemotherapy in breast cancer: A systematic review and meta-analysis. *Breast*. Aug 2018; 40: 106-115. PMID 29758503
- Lindenberg MA, Miquel-Cases A, Retl VP, et al. Imaging performance in guiding response to neoadjuvant therapy according to breast cancer subtypes: A systematic literature review. *Crit Rev Oncol Hematol*. Apr 2017; 112: 198-207. PMID 28325260
- Chen L, Yang Q, Bao J, et al. Direct comparison of PET/CT and MRI to predict the pathological response to neoadjuvant chemotherapy in breast cancer: a meta-analysis. *Sci Rep*. Aug 16 2017; 7(1): 8479. PMID 28814795
- Boers-Sonderen MJ, de Geus-Oei LF, Desar IM, et al. Temsirolimus and pegylated liposomal doxorubicin (PLD) combination therapy in breast, endometrial, and ovarian cancer: phase Ib results and prediction of clinical outcome with FDG-PET/CT. *Target Oncol*. Dec 2014; 9(4): 339-47. PMID 24577626
- Groheux D, Hindi E, Giacchetti S, et al. Early assessment with 18F-fluorodeoxyglucose positron emission tomography/computed tomography can help predict the outcome of neoadjuvant chemotherapy in triple negative breast cancer. *Eur J Cancer*. Jul 2014; 50(11): 1864-71. PMID 24841218
- Humbert O, Cochet A, Riedinger JM, et al. HER2-positive breast cancer: ¹⁸F-FDG PET for early prediction of response to trastuzumab plus taxane-based neoadjuvant chemotherapy. *Eur J Nucl Med Mol Imaging*. Aug 2014; 41(8): 1525-33. PMID 24647576
- Andrade WP, Lima EN, Osrio CA, et al. Can FDG-PET/CT predict early response to neoadjuvant chemotherapy in breast cancer?. *Eur J Surg Oncol*. Dec 2013; 39(12): 1358-63. PMID 24120422
- Mghanga FP, Lan X, Bakari KH, et al. Fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography in monitoring the response of breast cancer to neoadjuvant chemotherapy: a meta-analysis. *Clin Breast Cancer*. Aug 2013; 13(4): 271-9. PMID 23714689
- Humbert O, Riedinger JM, Charon-Barra C, et al. Identification of Biomarkers Including 18FDG-PET/CT for Early Prediction of Response to Neoadjuvant Chemotherapy in Triple-Negative Breast Cancer. *Clin Cancer Res*. Dec 15 2015; 21(24): 5460-8. PMID 26130460
- Humbert O, Riedinger JM, Vrigneaud JM, et al. 18F-FDG PET-Derived Tumor Blood Flow Changes After 1 Cycle of Neoadjuvant Chemotherapy Predicts Outcome in Triple-Negative Breast Cancer. *J Nucl Med*. Nov 2016; 57(11): 1707-1712. PMID 27103025
- Lee HW, Lee HM, Choi SE, et al. The Prognostic Impact of Early Change in 18F-FDG PET SUV After Neoadjuvant Chemotherapy in Patients with Locally Advanced Breast Cancer. *J Nucl Med*. Aug 2016; 57(8): 1183-8. PMID 27033896
- Luo J, Zhou Z, Yang Z, et al. The Value of 18F-FDG PET/CT Imaging Combined With Pretherapeutic Ki67 for Early Prediction of Pathologic Response After Neoadjuvant Chemotherapy in Locally Advanced Breast Cancer. *Medicine (Baltimore)*. Feb 2016; 95(8): e2914. PMID 26937935
- Pahk K, Kim S, Choe JG. Early prediction of pathological complete response in luminal B type neoadjuvant chemotherapy-treated breast cancer patients: comparison between interim 18F-FDG PET/CT and MRI. *Nucl Med Commun*. Sep 2015; 36(9): 887-91. PMID 25932536
- Lin NU, Guo H, Yap JT, et al. Phase II Study of Lapatinib in Combination With Trastuzumab in Patients With Human Epidermal Growth Factor Receptor 2-Positive Metastatic Breast Cancer: Clinical Outcomes and Predictive Value of Early [¹⁸F]Fluorodeoxyglucose Positron Emission Tomography Imaging (TBCRC 003). *J Clin Oncol*. Aug 20 2015; 33(24): 2623-31. PMID 26169615
- Kitajima K, Miyoshi Y, Yamano T, et al. Assessment of tumor response to neoadjuvant chemotherapy in patients with breast cancer using MRI and FDG-PET/CT-RECIST 1.1 vs. PERCIST 1.0. *Nagoya J Med Sci*. May 2018; 80(2): 183-197. PMID 29915436
- Kitajima K, Nakatani K, Yamaguchi K, et al. Response to neoadjuvant chemotherapy for breast cancer judged by PERCIST - multicenter study in Japan. *Eur J Nucl Med Mol Imaging*. Sep 2018; 45(10): 1661-1671. PMID 29754160
- Yoon HJ, Kim Y, Chung J, et al. Predicting neo-adjuvant chemotherapy response and progression-free survival of locally advanced breast cancer using textural features of intratumoral heterogeneity on F-18 FDG PET/CT and diffusion-weighted MR imaging. *Breast J*. May 2019; 25(3): 373-380. PMID 29602210
- Groheux D, Biard L, Giacchetti S, et al. ¹⁸F-FDG PET/CT for the Early Evaluation of Response to Neoadjuvant Treatment in Triple-Negative Breast Cancer: Influence of the Chemotherapy Regimen. *J Nucl Med*. Apr 2016; 57(4): 536-43. PMID 26697967

23. Groheux D, Majdoub M, Sanna A, et al. Early Metabolic Response to Neoadjuvant Treatment: FDG PET/CT Criteria according to Breast Cancer Subtype. *Radiology*. Nov 2015; 277(2): 358-71. PMID 25915099
24. van Ramshorst MS, Teixeira SC, Koolen BB, et al. Additional value of 18 F-FDG PET/CT response evaluation in axillary nodes during neoadjuvant therapy for triple-negative and HER2-positive breast cancer. *Cancer Imaging*. May 25 2017; 17(1): 15. PMID 28545563
25. Schmitz AMT, Teixeira SC, Pengel KE, et al. Monitoring tumor response to neoadjuvant chemotherapy using MRI and 18F-FDG PET/CT in breast cancer subtypes. *PLoS One*. 2017; 12(5): e0176782. PMID 28531188
26. Riedl CC, Pinker K, Ulaner GA, et al. Comparison of FDG-PET/CT and contrast-enhanced CT for monitoring therapy response in patients with metastatic breast cancer. *Eur J Nucl Med Mol Imaging*. Aug 2017; 44(9): 1428-1437. PMID 28462446
27. Coudert B, Pierga JY, Mouret-Reynier MA, et al. Use of [(18)F]-FDG PET to predict response to neoadjuvant trastuzumab and docetaxel in patients with HER2-positive breast cancer, and addition of bevacizumab to neoadjuvant trastuzumab and docetaxel in [(18)F]-FDG PET-predicted non-responders (AVATAXHER): an open-label, randomised phase 2 trial. *Lancet Oncol*. Dec 2014; 15(13): 1493-1502. PMID 25456368
28. Coudert B, Pierga JY, Mouret-Reynier MA, et al. Long-term outcomes in patients with PET-predicted poor-responsive HER2-positive breast cancer treated with neoadjuvant bevacizumab added to trastuzumab and docetaxel: 5-year follow-up of the randomised Avataxher study. *EClinicalMedicine*. Nov 2020; 28: 100566. PMID 33205032
29. Prez-Garca JM, Gebhart G, Ruiz Borrego M, et al. Chemotherapy de-escalation using an 18 F-FDG-PET-based pathological response-adapted strategy in patients with HER2-positive early breast cancer (PHERGain): a multicentre, randomised, open-label, non-comparative, phase 2 trial. *Lancet Oncol*. Jun 2021; 22(6): 858-871. PMID 34019819
30. Han S, Kim YI, Woo S, et al. Prognostic and predictive values of interim 18 F-FDG PET during neoadjuvant chemoradiotherapy for esophageal cancer: a systematic review and meta-analysis. *Ann Nucl Med*. Apr 2021; 35(4): 447-457. PMID 33471289
31. Cong L, Wang S, Gao T, et al. The predictive value of 18F-FDG PET for pathological response of primary tumor in patients with esophageal cancer during or after neoadjuvant chemoradiotherapy: a meta-analysis. *Jpn J Clin Oncol*. Dec 2016; 46(12): 1118-1126. PMID 27702836
32. van Rossum PSN, Fried DV, Zhang L, et al. The value of 18 F-FDG PET before and after induction chemotherapy for the early prediction of a poor pathologic response to subsequent preoperative chemoradiotherapy in oesophageal adenocarcinoma. *Eur J Nucl Med Mol Imaging*. Jan 2017; 44(1): 71-80. PMID 27511188
33. Hagen PV, Heijl MV, Henegouwen MI, et al. Prediction of disease-free survival using relative change in FDG-uptake early during neoadjuvant chemoradiotherapy for potentially curable esophageal cancer: A prospective cohort study. *Dis Esophagus*. Feb 01 2017; 30(2): 1-7. PMID 27001344
34. Odawara S, Kitajima K, Katsuura T, et al. Tumor response to neoadjuvant chemotherapy in patients with esophageal cancer assessed with CT and FDG-PET/CT - RECIST 1.1 vs. PERCIST 1.0. *Eur J Radiol*. Apr 2018; 101: 65-71. PMID 29571803
35. Manoharan V, Lee S, Chong S, et al. Serial imaging using [18F]Fluorodeoxyglucose positron emission tomography and histopathologic assessment in predicting survival in a population of surgically resectable distal oesophageal and gastric adenocarcinoma following neoadjuvant therapy. *Ann Nucl Med*. May 2017; 31(4): 315-323. PMID 28299585
36. Goodman KA, Ou FS, Hall NC, et al. Randomized Phase II Study of PET Response-Adapted Combined Modality Therapy for Esophageal Cancer: Mature Results of the CALGB 80803 (Alliance) Trial. *J Clin Oncol*. Sep 01 2021; 39(25): 2803-2815. PMID 34077237
37. Treglia G, Mirk P, Stefanelli A, et al. 18F-Fluorodeoxyglucose positron emission tomography in evaluating treatment response to imatinib or other drugs in gastrointestinal stromal tumors: a systematic review. *Clin Imaging*. 2012; 36(3): 167-75. PMID 22542374
38. Podoloff DA, Advani RH, Allred C, et al. NCCN task force report: positron emission tomography (PET)/computed tomography (CT) scanning in cancer. *J Natl Compr Canc Netw*. May 2007; 5 Suppl 1: S1-22; quiz S23-2. PMID 17509259
39. Helsen N, Van den Wyngaert T, Carp L, et al. FDG-PET/CT for treatment response assessment in head and neck squamous cell carcinoma: a systematic review and meta-analysis of diagnostic performance. *Eur J Nucl Med Mol Imaging*. Jun 2018; 45(6): 1063-1071. PMID 29478080
40. Min M, Lin P, Liney G, et al. A review of the predictive role of functional imaging in patients with mucosal primary head and neck cancer treated with radiation therapy. *J Med Imaging Radiat Oncol*. Feb 2017; 61(1): 99-123. PMID 27469298
41. Castelli J, De Bari B, Depeursinge A, et al. Overview of the predictive value of quantitative 18 FDG PET in head and neck cancer treated with chemoradiotherapy. *Crit Rev Oncol Hematol*. Dec 2016; 108: 40-51. PMID 27931839
42. Dos Anjos RF, Dos Anjos DA, Vieira DL, et al. Effectiveness of FDG-PET/CT for evaluating early response to induction chemotherapy in head and neck squamous cell carcinoma: A systematic review. *Medicine (Baltimore)*. Aug 2016; 95(32): e4450. PMID 27512861
43. Adams HJA, Kwee TC. Proportion of false-positive lesions at interim and end-of-treatment FDG-PET in lymphoma as determined by histology: Systematic review and meta-analysis. *Eur J Radiol*. Nov 2016; 85(11): 1963-1970. PMID 27776647
44. Sickinger MT, von Tresckow B, Kobe C, et al. Positron emission tomography-adapted therapy for first-line treatment in individuals with Hodgkin lymphoma. *Cochrane Database Syst Rev*. Jan 09 2015; 1: CD010533. PMID 25572491
45. Radford J, Illidge T, Counsell N, et al. Results of a trial of PET-directed therapy for early-stage Hodgkin's lymphoma. *N Engl J Med*. Apr 23 2015; 372(17): 1598-607. PMID 25901426
46. Picardi M, De Renzo A, Pane F, et al. Randomized comparison of consolidation radiation versus observation in bulky Hodgkin's lymphoma with post-chemotherapy negative positron emission tomography scans. *Leuk Lymphoma*. Sep 2007; 48(9): 1721-7. PMID 17786707
47. Raemaekers JM, Andr MP, Federico M, et al. Omitting radiotherapy in early positron emission tomography-negative stage I/II Hodgkin lymphoma is associated with an increased risk of early relapse: Clinical results of the preplanned interim analysis of the randomized EORTC/LYSA/FIL H10 trial. *J Clin Oncol*. Apr 20 2014; 32(12): 1188-94. PMID 24637998
48. Aldin A, Umlauff L, Estcourt LJ, et al. Interim PET-results for prognosis in adults with Hodgkin lymphoma: a systematic review and meta-analysis of prognostic factor studies. *Cochrane Database Syst Rev*. Jan 13 2020; 1(1): CD012643. PMID 31930780
49. Deniz K, O'Mahony S, Ross G, et al. Breast cancer in women after treatment for Hodgkin's disease. *Lancet Oncol*. Apr 2003; 4(4): 207-14. PMID 12681264

50. Travis LB, Gospodarowicz M, Curtis RE, et al. Lung cancer following chemotherapy and radiotherapy for Hodgkin's disease. *J Natl Cancer Inst.* Feb 06 2002; 94(3): 182-92. PMID 11830608
51. Galper SL, Yu JB, Mauch PM, et al. Clinically significant cardiac disease in patients with Hodgkin lymphoma treated with mediastinal irradiation. *Blood.* Jan 13 2011; 117(2): 412-8. PMID 20858859
52. Swerdlow AJ, Higgins CD, Smith P, et al. Myocardial infarction mortality risk after treatment for Hodgkin disease: a collaborative British cohort study. *J Natl Cancer Inst.* Feb 07 2007; 99(3): 206-14. PMID 17284715
53. Borchmann P, Plitschow A, Kobe C, et al. PET-guided omission of radiotherapy in early-stage unfavourable Hodgkin lymphoma (GHSG HD17): a multicentre, open-label, randomised, phase 3 trial. *Lancet Oncol.* Feb 2021; 22(2): 223-234. PMID 33539742
54. Borchmann P, Goergen H, Kobe C, et al. PET-guided treatment in patients with advanced-stage Hodgkin's lymphoma (HD18): final results of an open-label, international, randomised phase 3 trial by the German Hodgkin Study Group. *Lancet.* Dec 23 2017; 390(10114): 2790-2802. PMID 29061295
55. Casasnovas RO, Ysebaert L, Thieblemont C, et al. FDG-PET-driven consolidation strategy in diffuse large B-cell lymphoma: final results of a randomized phase 2 study. *Blood.* Sep 14 2017; 130(11): 1315-1326. PMID 28701367
56. Johnson P, Federico M, Kirkwood A, et al. Adapted Treatment Guided by Interim PET-CT Scan in Advanced Hodgkin's Lymphoma. *N Engl J Med.* Jun 23 2016; 374(25): 2419-29. PMID 27332902
57. Kreissl S, Goergen H, Buehnen I, et al. PET-guided eBEACOPP treatment of advanced-stage Hodgkin lymphoma (HD18): follow-up analysis of an international, open-label, randomised, phase 3 trial. *Lancet Haematol.* Jun 2021; 8(6): e398-e409. PMID 34048679
58. Wong-Sefidan I, Byrtek M, Zhou X, et al. [18F] Positron emission tomography response after rituximab-containing induction therapy in follicular lymphoma is an independent predictor of survival after adjustment for FLIPI in academic and community-based practice. *Leuk Lymphoma.* Apr 2017; 58(4): 809-815. PMID 27562750
59. Raemaekers JM. Early FDG-PET adapted treatment improved the outcome of early FDG-PET positive patients with stages I/II Hodgkin lymphoma (HL): final results of the randomized Intergroup EORTC/LYSA/FIL H10 trial. Paper presented at: 13th International Conference on Malignant Lymphoma; 2015; Lugano, Switzerland.
60. Andr MPE, Girinsky T, Federico M, et al. Early Positron Emission Tomography Response-Adapted Treatment in Stage I and II Hodgkin Lymphoma: Final Results of the Randomized EORTC/LYSA/FIL H10 Trial. *J Clin Oncol.* Jun 01 2017; 35(16): 1786-1794. PMID 28291393
61. Seifert R, Kersting D, Rischpler C, et al. Interim FDG-PET analysis to identify patients with aggressive non-Hodgkin lymphoma who benefit from treatment intensification: a post-hoc analysis of the PETAL trial. *Leukemia.* Dec 2022; 36(12): 2845-2852. PMID 36241697
62. Dann EJ, Bar-Shalom R, Tamir A, et al. Risk-adapted BEACOPP regimen can reduce the cumulative dose of chemotherapy for standard and high-risk Hodgkin lymphoma with no impairment of outcome. *Blood.* Feb 01 2007; 109(3): 905-9. PMID 17018856
63. Dann EJ, Blumenfeld Z, Bar-Shalom R, et al. A 10-year experience with treatment of high and standard risk Hodgkin disease: six cycles of tailored BEACOPP, with interim scintigraphy, are effective and female fertility is preserved. *Am J Hematol.* Jan 2012; 87(1): 32-6. PMID 21956220
64. Ittis A, Eder V, Blasco H, et al. Decisional early interim (18)F-fluoro-2-deoxy-D-glucose positron emission tomography after two cycles of chemotherapy in de novo Hodgkin lymphoma. *Acta Haematol.* 2015; 133(2): 172-8. PMID 25301496
65. Pardal E, Coronado M, Martn A, et al. Intensification treatment based on early FDG-PET in patients with high-risk diffuse large B-cell lymphoma: a phase II GELTAMO trial. *Br J Haematol.* Nov 2014; 167(3): 327-36. PMID 25066542
66. Kasamon YL, Wahl RL, Ziessman HA, et al. Phase II study of risk-adapted therapy of newly diagnosed, aggressive non-Hodgkin lymphoma based on midtreatment FDG-PET scanning. *Biol Blood Marrow Transplant.* Feb 2009; 15(2): 242-8. PMID 19167684
67. Kedmi M, Apel A, Davidson T, et al. High-Risk, Advanced-Stage Hodgkin Lymphoma: The Impact of Combined Escalated BEACOPP and ABVD Treatment in Patients Who Rapidly Achieve Metabolic Complete Remission on Interim FDG-PET/CT Scan. *Acta Haematol.* 2016; 135(3): 156-61. PMID 26588173
68. Press OW, Li H, Schder H, et al. US Intergroup Trial of Response-Adapted Therapy for Stage III to IV Hodgkin Lymphoma Using Early Interim Fluorodeoxyglucose-Positron Emission Tomography Imaging: Southwest Oncology Group S0816. *J Clin Oncol.* Jun 10 2016; 34(17): 2020-7. PMID 27069074
69. Engert A, Haverkamp H, Kobe C, et al. Reduced-intensity chemotherapy and PET-guided radiotherapy in patients with advanced stage Hodgkin's lymphoma (HD15 trial): a randomised, open-label, phase 3 non-inferiority trial. *Lancet.* May 12 2012; 379(9828): 1791-9. PMID 22480758
70. Zinzani PL, Broccoli A, Gioia DM, et al. Interim Positron Emission Tomography Response-Adapted Therapy in Advanced-Stage Hodgkin Lymphoma: Final Results of the Phase II Part of the HD0801 Study. *J Clin Oncol.* Apr 20 2016; 34(12): 1376-85. PMID 26884559
71. Han EJ, O JH, Yoon H, et al. FDG PET/CT response in diffuse large B-cell lymphoma: Reader variability and association with clinical outcome. *Medicine (Baltimore).* Sep 2016; 95(39): e4983. PMID 27684851
72. Kanazu M, Maruyama K, Ando M, et al. Early pharmacodynamic assessment using ¹⁸F-fluorodeoxyglucose positron-emission tomography on molecular targeted therapy and cytotoxic chemotherapy for clinical outcome prediction. *Clin Lung Cancer.* May 2014; 15(3): 182-7. PMID 24518101
73. Stefano A, Russo G, Ippolito M, et al. Evaluation of erlotinib treatment response in non-small cell lung cancer using metabolic and anatomic criteria. *Q J Nucl Med Mol Imaging.* May 09 2014. PMID 24809275
74. Tiseo M, Ippolito M, Scarlattei M, et al. Predictive and prognostic value of early response assessment using 18FDG-PET in advanced non-small cell lung cancer patients treated with erlotinib. *Cancer Chemother Pharmacol.* Feb 2014; 73(2): 299-307. PMID 24258456
75. Tsuchida T, Morikawa M, Demura Y, et al. Imaging the early response to chemotherapy in advanced lung cancer with diffusion-weighted magnetic resonance imaging compared to fluorine-18 fluorodeoxyglucose positron emission tomography and computed tomography. *J Magn Reson Imaging.* Jul 2013; 38(1): 80-8. PMID 23239463

76. Usmanij EA, de Geus-Oei LF, Troost EG, et al. 18F-FDG PET early response evaluation of locally advanced non-small cell lung cancer treated with concomitant chemoradiotherapy. *J Nucl Med*. Sep 2013; 54(9): 1528-34. PMID 23864719
77. Podoloff DA, Ball DW, Ben-Josef E, et al. NCCN task force: clinical utility of PET in a variety of tumor types. *J Natl Compr Canc Netw*. Jun 2009; 7 Suppl 2: S1-26. PMID 19555588
78. Grootjans W, Usmanij EA, Oyen WJ, et al. Performance of automatic image segmentation algorithms for calculating total lesion glycolysis for early response monitoring in non-small cell lung cancer patients during concomitant chemoradiotherapy. *Radiother Oncol*. Jun 2016; 119(3): 473-9. PMID 27178141
79. Han EJ, Yang YJ, Park JC, et al. Prognostic value of early response assessment using 18F-FDG PET/CT in chemotherapy-treated patients with non-small-cell lung cancer. *Nucl Med Commun*. Dec 2015; 36(12): 1187-94. PMID 26375438
80. Nygrd L, Vogelius IR, Fischer BM, et al. Early lesion-specific (18)F-FDG PET response to chemotherapy predicts time to lesion progression in locally advanced non-small cell lung cancer. *Radiother Oncol*. Mar 2016; 118(3): 460-4. PMID 26806265
81. Mattoli MV, Massaccesi M, Castelluccia A, et al. The predictive value of 18 F-FDG PET-CT for assessing the clinical outcomes in locally advanced NSCLC patients after a new induction treatment: low-dose fractionated radiotherapy with concurrent chemotherapy. *Radiat Oncol*. Jan 05 2017; 12(1): 4. PMID 28057034
82. Crandall JP, Tahari AK, Juergens RA, et al. A comparison of FLT to FDG PET/CT in the early assessment of chemotherapy response in stages IB-IIIa resectable NSCLC. *EJNMMI Res*. Dec 2017; 7(1): 8. PMID 28102506
83. Romine PE, Martins RG, Eaton KD, et al. Long term follow-up of neoadjuvant chemotherapy for non-small cell lung cancer (NSCLC) investigating early positron emission tomography (PET) scan as a predictor of outcome. *BMC Cancer*. Jan 14 2019; 19(1): 70. PMID 30642285
84. Suppiah S, Chang WL, Hassan HA, et al. Systematic Review on the Accuracy of Positron Emission Tomography/Computed Tomography and Positron Emission Tomography/Magnetic Resonance Imaging in the Management of Ovarian Cancer: Is Functional Information Really Needed?. *World J Nucl Med*. 2017; 16(3): 176-185. PMID 28670174
85. Ko WS, Kim SJ. Predictive Value of 18 F-FDG PET/CT for Assessment of Tumor Response to Neoadjuvant Chemotherapy in Bladder Cancer. *Clin Nucl Med*. Jul 01 2023; 48(7): 574-580. PMID 36976654
86. Singh S, Poon R, Wong R, et al. 68Ga PET Imaging in Patients With Neuroendocrine Tumors: A Systematic Review and Meta-analysis. *Clin Nucl Med*. Nov 2018; 43(11): 802-810. PMID 30247209
87. Beckers RCJ, Lambregts DMJ, Lahaye MJ, et al. Advanced imaging to predict response to chemotherapy in colorectal liver metastases - a systematic review. *HPB (Oxford)*. Feb 2018; 20(2): 120-127. PMID 29196021
88. Facey K, Bradbury I, Laking G, et al. Overview of the clinical effectiveness of positron emission tomography imaging in selected cancers. *Health Technol Assess*. Oct 2007; 11(44): iii-iv, xi-267. PMID 17999839
89. Engelmann BE, Loft A, Kjr A, et al. Positron emission tomography/computed tomography and biomarkers for early treatment response evaluation in metastatic colon cancer. *Oncologist*. Feb 2014; 19(2): 164-72. PMID 24451199
90. Hong YS, Kim HO, Kim KP, et al. 3'-Deoxy-3'-18F-fluorothymidine PET for the early prediction of response to leucovorin, 5-fluorouracil, and oxaliplatin therapy in patients with metastatic colorectal cancer. *J Nucl Med*. Aug 2013; 54(8): 1209-16. PMID 23804324
91. Li C, Lan X, Yuan H, et al. 18F-FDG PET predicts pathological response to preoperative chemoradiotherapy in patients with primary rectal cancer: a meta-analysis. *Ann Nucl Med*. Jun 2014; 28(5): 436-46. PMID 24623152
92. Memon S, Lynch AC, Akhurst T, et al. Systematic review of FDG-PET prediction of complete pathological response and survival in rectal cancer. *Ann Surg Oncol*. Oct 2014; 21(11): 3598-607. PMID 24802909
93. Formiga MN, Fanelli MF, Dettino AL, et al. Is early response by (18)F-2-fluoro-2-deoxy-D-glucose positron emission tomography-computed tomography a predictor of long-term outcome in patients with metastatic colorectal cancer?. *J Gastrointest Oncol*. Jun 2016; 7(3): 365-72. PMID 27284468
94. Hendlisz A, Deleporte A, Delaunoit T, et al. The Prognostic Significance of Metabolic Response Heterogeneity in Metastatic Colorectal Cancer. *PLoS One*. 2015; 10(9): e0138341. PMID 26421426
95. Kim SJ, Chang S. Volumetric parameters changes of sequential 18F-FDG PET/CT for early prediction of recurrence and death in patients with locally advanced rectal cancer treated with preoperative chemoradiotherapy. *Clin Nucl Med*. Dec 2015; 40(12): 930-5. PMID 26204222
96. Koo PJ, Kim SJ, Chang S, et al. Interim Fluorine-18 Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography to Predict Pathologic Response to Preoperative Chemoradiotherapy and Prognosis in Patients With Locally Advanced Rectal Cancer. *Clin Colorectal Cancer*. Dec 2016; 15(4): e213-e219. PMID 27316919
97. Garca Vicente AM, Soriano Castrejón Á, Len Martín A, et al. Early and delayed prediction of axillary lymph node neoadjuvant response by (18)F-FDG PET/CT in patients with locally advanced breast cancer. *Eur J Nucl Med Mol Imaging*. Jul 2014; 41(7): 1309-18. PMID 24744045
98. Koolen BB, Valds Olmos RA, Wesseling J, et al. Early assessment of axillary response with ¹⁸F-FDG PET/CT during neoadjuvant chemotherapy in stage II-III breast cancer: implications for surgical management of the axilla. *Ann Surg Oncol*. Jul 2013; 20(7): 2227-35. PMID 23456316
99. Giannatempo P, Alessi A, Miceli R, et al. Interim fluorine-18 fluorodeoxyglucose positron emission tomography for early metabolic assessment of therapeutic response to chemotherapy for metastatic transitional cell carcinoma. *Clin Genitourin Cancer*. Dec 2014; 12(6): 433-9. PMID 24787972
100. Truong MT, Viswanathan C, Godoy MB, et al. Malignant pleural mesothelioma: role of CT, MRI, and PET/CT in staging evaluation and treatment considerations. *Semin Roentgenol*. Oct 2013; 48(4): 323-34. PMID 24034264
101. Francis RJ, Byrne MJ, van der Schaaf AA, et al. Early prediction of response to chemotherapy and survival in malignant pleural mesothelioma using a novel semiautomated 3-dimensional volume-based analysis of serial 18F-FDG PET scans. *J Nucl Med*. Sep 2007; 48(9): 1449-58. PMID 17704250
102. Bhatnagar P, Subesinghe M, Patel C, et al. Functional imaging for radiation treatment planning, response assessment, and adaptive therapy in head and neck cancer. *Radiographics*. 2013; 33(7): 1909-29. PMID 24224586

103. Hoang JK, Das SK, Choudhury KR, et al. Using FDG-PET to measure early treatment response in head and neck squamous cell carcinoma: quantifying intrinsic variability in order to understand treatment-induced change. *AJNR Am J Neuroradiol.* Jul 2013; 34(7): 1428-33. PMID 23391836
104. Lalami Y, Garcia C, Flamen P, et al. Phase II trial evaluating the efficacy of sorafenib (BAY 43-9006) and correlating early fluorodeoxyglucose positron emission tomography-CT response to outcome in patients with recurrent and/or metastatic head and neck cancer. *Head Neck.* Mar 2016; 38(3): 347-54. PMID 25332069
105. Wong KH, Panek R, Welsh L, et al. The Predictive Value of Early Assessment After 1 Cycle of Induction Chemotherapy with 18F-FDG PET/CT and Diffusion-Weighted MRI for Response to Radical Chemoradiotherapy in Head and Neck Squamous Cell Carcinoma. *J Nucl Med.* Dec 2016; 57(12): 1843-1850. PMID 27417648
106. Wilson JM, Mukherjee S, Brunner TB, et al. Correlation of 18 F-Fluorodeoxyglucose Positron Emission Tomography Parameters with Patterns of Disease Progression in Locally Advanced Pancreatic Cancer after Definitive Chemoradiotherapy. *Clin Oncol (R Coll Radiol).* Jun 2017; 29(6): 370-377. PMID 28190636
107. Evangelista L, Zucchetto P, Moletta L, et al. The role of FDG PET/CT or PET/MRI in assessing response to neoadjuvant therapy for patients with borderline or resectable pancreatic cancer: a systematic literature review. *Ann Nucl Med.* Jul 2021; 35(7): 767-776. PMID 34047926
108. Eary JF, Conrad EU, O'Sullivan J, et al. Sarcoma mid-therapy [F-18]fluorodeoxyglucose positron emission tomography (FDG PET) and patient outcome. *J Bone Joint Surg Am.* Jan 15 2014; 96(2): 152-8. PMID 24430415
109. Hyun O J, Lubner BS, Leal JP, et al. Response to Early Treatment Evaluated with 18F-FDG PET and PERCIST 1.0 Predicts Survival in Patients with Ewing Sarcoma Family of Tumors Treated with a Monoclonal Antibody to the Insulinlike Growth Factor 1 Receptor. *J Nucl Med.* May 2016; 57(5): 735-40. PMID 26795289
110. Farnebo J, Grybck P, Harmenberg U, et al. Volumetric FDG-PET predicts overall and progression-free survival after 14 days of targeted therapy in metastatic renal cell carcinoma. *BMC Cancer.* Jun 06 2014; 14: 408. PMID 24906441
111. Chen JL, Appelbaum DE, Kocherginsky M, et al. FDG-PET as a predictive biomarker for therapy with everolimus in metastatic renal cell cancer. *Cancer Med.* Aug 2013; 2(4): 545-52. PMID 24156027
112. Gilles R, de Geus-Oei LF, Mulders PF, et al. Immunotherapy response evaluation with (18)F-FDG-PET in patients with advanced stage renal cell carcinoma. *World J Urol.* Aug 2013; 31(4): 841-6. PMID 21739122
113. Horn KP, Yap JT, Agarwal N, et al. FDG and FLT-PET for Early measurement of response to 37.5 mg daily sunitinib therapy in metastatic renal cell carcinoma. *Cancer Imaging.* Sep 03 2015; 15(1): 15. PMID 26335224
114. American College of Radiology (ACR) and the Society for Pediatric Radiology (SPR). ACRSPR practice parameter for performing FDG-PET/CT in oncology, revised 2021. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/fdg-pet-ct.pdf>. Accessed August 2, 2023.
115. Delgado Bolton RC, Aide N, Colletti PM, et al. EANM guideline on the role of 2-[18 F]FDG PET/CT in diagnosis, staging, prognostic value, therapy assessment and restaging of ovarian cancer, endorsed by the American College of Nuclear Medicine (ACNM), the Society of Nuclear Medicine and Molecular Imaging (SNMMI) and the International Atomic Energy Agency (IAEA). *Eur J Nucl Med Mol Imaging.* Sep 2021; 48(10): 3286-3302. PMID 34215923
116. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Bladder Cancer. Version 3.2023. https://www.nccn.org/professionals/physician_gls/pdf/bladder.pdf. Accessed July 2, 2023.
117. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Breast Cancer. Version 4.2023. https://www.nccn.org/professionals/physician_gls/pdf/breast.pdf. Accessed July 3, 2023.
118. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Central Nervous System Cancers. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/cns.pdf. Accessed July 4, 2023.
119. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Cervical Cancer. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/cervical.pdf. Accessed July 5, 2023.
120. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Colon Cancer. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/colon.pdf. Accessed July 6, 2023.
121. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Esophageal and Esophagogastric Junction Cancers. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/esophageal.pdf. Accessed July 8, 2023.
122. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Soft Tissue Sarcoma. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/sarcoma.pdf. Accessed July 22, 2023.
123. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Head and Neck Cancers. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf. Accessed July 9, 2023.
124. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Hepatocellular Carcinoma. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/hcc.pdf. Accessed July 10, 2023.
125. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Extrahepatic Cholangiocarcinoma. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/btc.pdf. Accessed July 11, 2023.
126. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Hodgkin Lymphoma. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/hodgkins.pdf. Accessed July 13, 2023.
127. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Cutaneous Melanoma. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/cutaneous_melanoma.pdf. Accessed July 7, 2023.
128. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Malignant Pleural Mesothelioma. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/meso_pleural.pdf. Accessed July 14, 2023.
129. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: B-Cell Lymphomas. Version 5.2023. https://www.nccn.org/professionals/physician_gls/pdf/b-cell.pdf. Accessed July 1, 2023.

130. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: T-Cell Lymphomas. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/t-cell.pdf. Accessed July 23, 2023.
131. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Primary Cutaneous Lymphomas. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/primary_cutaneous.pdf. Accessed July 19, 2023.
132. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Non-Small Cell Lung Cancer. Version 1.2023. https://www.nccn.org/professionals/physician_gls/pdf/nscl.pdf. Accessed July 16, 2023.
133. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Ovarian Cancer. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/ovarian.pdf. Accessed July 17, 2023.
134. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Pancreatic Adenocarcinoma. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/pancreatic.pdf. Accessed July 18, 2023.
135. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Prostate Cancer. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/prostate.pdf. Accessed July 20, 2023.
136. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Rectal Cancer. Version 4.2023. https://www.nccn.org/professionals/physician_gls/pdf/rectal.pdf. Accessed July 12, 2023.
137. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Small Cell Lung Cancer. Version 3.2023. https://www.nccn.org/professionals/physician_gls/pdf/sclc.pdf. Accessed July 21, 2023.
138. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Thyroid Carcinoma. Version 3.2023. https://www.nccn.org/professionals/physician_gls/pdf/thyroid.pdf. Accessed July 24, 2023.
139. National Comprehensive Cancer Network (NCCN). NCCN Clinical Practice Guidelines in Oncology: Uterine Neoplasms. Version 2.2023. https://www.nccn.org/professionals/physician_gls/pdf/uterine.pdf. Accessed July 25, 2023.
140. Centers for Medicare & Medicaid Services. National Coverage Determination (NCD) for Positron Emission Tomography (FDG) for Oncologic Conditions (220.6.17). 2014; <https://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?ncdid=331>. Accessed August 1, 2023.

POLICY HISTORY - THIS POLICY WAS APPROVED BY THE FEP® PHARMACY AND MEDICAL POLICY COMMITTEE ACCORDING TO THE HISTORY BELOW:

Date	Action	Description
June 2012	New policy	
December 2013	Replace policy	Policy updated with literature review. References 1-3, 5-11, 18, 20, 21, and 23 added. Others removed or renumbered. No change in policy statement.
December 2014	Replace policy	Policy updated with literature search; adding references 3, 9-12, 17-25, and 27-67; updating references 13, 16, and 68; references 1-11 (trial registrations) deleted. No change to policy statements. Title revised, added "Interim,."
December 2015	Replace policy	Policy updated with literature review through July 8, 2015; references 13- 16, 18-9, 25, and 27 (NCCN) deleted; references 3-5, 24, and 36 added; reference 58 updated. Policy statement unchanged.
December 2016	Replace policy	Policy updated with literature review; references 1-2, 5-10, 16-19, 23, 28- 31, 42-44, 55-60, 68-69, 71, 74, and 78 were added. Policy statement unchanged.
December 2017	Replace policy	Policy updated with literature review through July 21, 2017; references 5, 19, 20, 24-27, 30-34, 44-56, 66-68, 71, 84, and 94-95 were added. The following policy statement was added: The use of interim positron emission tomography scans to determine response to tyrosine kinase inhibitor treatment in patients with gastrointestinal stromal tumors is considered medically necessary.
December 2018	Replace policy	Policy updated with literature review through July 26, 2018; references 5, 7, 19-21, 26, 31, 34, 39, 80, 134 added; references 38 and 111-133 updated. Policy statement unchanged.
December 2019	Replace policy	Policy updated with literature review through July 8, 2019; references added, references on NCCN updated. Policy statements unchanged.
December 2020	Replace policy	Policy updated with literature review through July 30, 2020; references added. Policy statements unchanged.

The policies contained in the FEP Medical Policy Manual are developed to assist in administering contractual benefits and do not constitute medical advice. They are not intended to replace or substitute for the independent medical judgment of a practitioner or other health care professional in the treatment of an individual member. The Blue Cross and Blue Shield Association does not intend by the FEP Medical Policy Manual, or by any particular medical policy, to recommend, advocate, encourage or discourage any particular medical technologies. Medical decisions relative to medical technologies are to be made strictly by members/patients in consultation with their health care providers. The conclusion that a particular service or supply is medically necessary does not constitute a representation or warranty that the Blue Cross and Blue Shield Service Benefit Plan covers (or pays for) this service or supply for a particular member.

Date	Action	Description
December 2021	Replace policy	Policy updated with literature review through August 6, 2021; references added. Policy statements unchanged.
December 2022	Replace policy	Policy updated with literature review through August 1, 2022; reference added. Minor editorial refinements to policy statements; intent unchanged.
December 2023	Replace policy	Policy updated with literature review through August 2, 2023; references added. Policy statements unchanged.

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