American College of Radiology
ACR Appropriateness Criteria®

Staging and Post-Therapy Assessment of Head and Neck Cancer

Variant: 1 Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Not Appropriate	☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 2 Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O

MRI head without and with IV contrast	May Be Appropriate	O
CT maxillofacial with IV contrast	May Be Appropriate (Disagreement)	☢☢
CT maxillofacial without IV contrast	May Be Appropriate (Disagreement)	☢☢
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 3 Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
MRI head without and with IV contrast	May Be Appropriate	O
CT maxillofacial with IV contrast	May Be Appropriate	☢☢
CT maxillofacial without IV contrast	May Be Appropriate (Disagreement)	☢☢
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O

MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 4 Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Not Appropriate	☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 5 Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Not Appropriate	☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

<u>Variant: 6</u> Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
MRI head without and with IV contrast	May Be Appropriate	O
CT maxillofacial with IV contrast	May Be Appropriate (Disagreement)	☢☢
CT maxillofacial without IV contrast	May Be Appropriate (Disagreement)	☢☢
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢

MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 7 Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
MRI head without and with IV contrast	May Be Appropriate	O
CT maxillofacial with IV contrast	May Be Appropriate	☢☢
CT maxillofacial without IV contrast	May Be Appropriate	☢☢
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢

CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 8 Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.

Procedure	Appropriateness Category	Relative Radiation Level
MRI orbits face neck without and with IV contrast	Usually Appropriate	O
CT neck with IV contrast	Usually Appropriate	☢☢☢
FDG-PET/CT skull base to mid-thigh	Usually Appropriate	☢☢☢☢
US neck	May Be Appropriate	O
CT chest with IV contrast	May Be Appropriate	☢☢☢
CT chest without IV contrast	May Be Appropriate	☢☢☢
FDG-PET/MRI skull base to mid-thigh	May Be Appropriate	☢☢☢
Radiography chest	Usually Not Appropriate	☢
Radiography paranasal sinuses	Usually Not Appropriate	☢
MRA neck with IV contrast	Usually Not Appropriate	O
MRA neck without and with IV contrast	Usually Not Appropriate	O
MRA neck without IV contrast	Usually Not Appropriate	O
MRI head with IV contrast	Usually Not Appropriate	O
MRI head without and with IV contrast	Usually Not Appropriate	O
MRI head without IV contrast	Usually Not Appropriate	O
MRI orbits face neck with IV contrast	Usually Not Appropriate	O
MRI orbits face neck without IV contrast	Usually Not Appropriate	O
CT maxillofacial with IV contrast	Usually Not Appropriate	☢☢
CT maxillofacial without IV contrast	Usually Not Appropriate	☢☢
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head with IV contrast	Usually Not Appropriate	☢☢☢
CT head without and with IV contrast	Usually Not Appropriate	☢☢☢
CT head without IV contrast	Usually Not Appropriate	☢☢☢
CT maxillofacial without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without and with IV contrast	Usually Not Appropriate	☢☢☢
CT neck without IV contrast	Usually Not Appropriate	☢☢☢
CTA neck with IV contrast	Usually Not Appropriate	☢☢☢

Panel Members

Maria K. Gule-Monroe, MD[a], Susana Calle, MD[b], Bruno Policeni, MD, MBA[c], Amy F. Juliano, MD[d], Mohit Agarwal, MD[e], Laura QM Chow, MD[f], Prachi Dubey, MBBS, MPH[g], Elliott R. Friedman, MD[h], Mari Hagiwara, MD[i], Kate DuChene Hanrahan, MD, MME[j], Vikas Jain, MD[k], Tanya J. Rath, MD[l], Russell B. Smith, MD[m], Rathan M. Subramaniam, MD, PhD, MPH, MBA[n], M. Reza Taheri, MD, PhD[o], Sue S. Yom, MD, PhD[p], David Zander, MD[q], Judah Burns, MD[r]

Summary of Literature Review

Introduction/Background

Head and neck cancer comprises a heterogeneous group of malignancies that together represents the seventh most common cancer worldwide and ninth most common cancer in the United States [1]. Several anatomic sites are encompassed, including the oral cavity, oropharynx, hypopharynx, larynx, nasopharynx, paranasal sinuses, nasal cavity, and salivary glands. There is heterogeneity in histopathology; although, the majority of the cancers are squamous cell carcinomas. Head and neck cancers are clearly associated with alcohol and tobacco consumption, with human papillomavirus (HPV) and Epstein-Barr virus (EBV) linked to oropharynx cancer and nasopharynx cancer, respectively [2].

The approach to staging and posttreatment imaging varies and depends on the anatomic site and pathology. Initial staging of patients with suspected or diagnosed head and neck cancer is directed at establishing the correct tumor, nodal, and metastases (TNM) staging, which is based on the latest eighth edition of the American Joint Committee on Cancer classification of cancer [3], and directs prognosis and therapy. Tumor or "T" staging requires assessment of the primary tumor site, most often including mass size and always with an emphasis on extent of invasion of surrounding structures. A comprehensive evaluation of adenopathy is performed for nodal "N" staging purposes, comprising laterality, size of nodes, and, in the case of nasopharynx, nodal level. Presence of nodal metastases typically results in upstaging of the disease and will change treatment planning, including the extent of neck dissection or radiation field. Lastly, the assessment for detection of distant metastases "M" is generally pursued based on the degree of clinical suspicion in the presence of advanced locoregional disease. The presence of distant metastatic disease will have prognostic as well as treatment implications, generally shifting treatment toward more systemic options. Follow-up imaging and evaluation of suspected or known recurrence in treated head and neck cancer is tailored for the evaluation of treatment response and early detection of local, locoregional, and distant recurrent tumor. Timely detection and accurate delineation of the extent of recurrent disease can help guide salvage therapy and improve prognosis. Imaging is typically performed in conjunction with clinical examination.

Staging of thyroid cancer and evaluation of perineural tumor spread should be guided by the ACR Appropriateness Criteria® topics on "Thyroid Disease" [4] and "Cranial Neuropathy" [5]. Evaluation of a palpable neck mass should be guided by the ACR Appropriateness Criteria® topic on "Neck Mass/Adenopathy" [6].

Special Imaging Considerations

For the purposes of distinguishing between CT and CT angiography (CTA), ACR Appropriateness Criteria topics use the definition in the ACR-NASCI-SIR-SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA) [7]:

> "*CTA uses a thin-section CT acquisition that is timed to coincide with peak arterial or venous enhancement. The resultant volumetric dataset is interpreted using primary transverse reconstructions as well as multiplanar reformations and 3-D renderings.*"

All elements are essential: 1) timing, 2) reconstructions/reformats, and 3) 3-D renderings. Standard CTs with IV contrast also include timing issues and reconstructions/reformats. Only in CTA, however, is 3-D rendering a **required** element. This corresponds to the definitions that the CMS has applied to the Current Procedural Terminology codes. PET/CT imaging of head and neck cancers is frequently extended beyond the skull-base to the vertex to ensure inclusion of the

entirety of the tumor.

Discussion of Procedures by Variant

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.

Cancers in the oral cavity or oropharynx or hypopharynx or larynx, as well as tumors in which a primary site is not found but the patient presents with metastatic cervical adenopathy, encompass a heterogeneous group of malignancies with distinct staging and treatment depending on anatomic site and pathology. Together, these malignancies compose 3% of malignancies in the United States [8]. The vast majority (90%) of these cancers are squamous cell carcinomas [9] but also included are more uncommon histologies, such as those arising from minor salivary glands. Squamous cell carcinomas are typically linked to tobacco and alcohol use and, in some cases, HPV infection. HPV-related squamous cell carcinoma occurs primarily in the oropharynx, arising from the lymphoid tissue of the palatine and lingual tonsils and is associated with better prognosis relative to non–HPV-related squamous cell carcinoma of the head and neck [2]. Occasionally, the primary tumor may be small and asymptomatic while the patient presents with a neck mass due to nodal disease. However, most patients present with various signs and symptoms like pain, dysphagia, bleeding, hoarse voice, etc. depending on the involved anatomic site due to local tumor spread at the primary site.

Squamous cell carcinoma of the head and neck preferentially spreads to regional lymph nodes, with nodal disease conferring decreased survival rates. Presence of distant metastatic disease at the time of diagnosis has been reported in 10% to 18% of patients [10], and its occurrence is directly linked to the stage of tumor [11-13]. The lungs are the most frequent site for distant metastatic disease, and when other sites of distant metastatic disease are present, pulmonary nodules are almost always present [11,14]. Skeletal metastases, most frequently of ribs and vertebrae, confers morbidity, including pain and symptoms of hypercalcemia [11]. Detection of distant metastatic disease at initial staging is crucial because it will change prognosis and typically change the management strategy toward more systemic options. An increased rate of second primary malignancy and concurrent lung malignancy among head and neck cancer patients has been linked to the intake of tobacco and alcohol [15,16].

Cancer of unknown primary of the head and neck represents 1% to 4% of patients with malignant tumors of the head and neck and is diagnosed after identification of metastatic cervical lymphadenopathy in which no primary is evident [9]. When the pathology is consistent with HPV-related squamous cell carcinoma, the primary site is presumed to localize to the oropharynx. Initial staging should include every attempt at identifying the site of primary because this impacts prognosis and treatment planning, and it is important to document the extent of nodal disease in the neck. Despite multimodality imaging and endoscopic evaluation, 2% to 9% of primary sites remain undetected [17].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
A. CT chest with IV contrast

CT chest with intravenous (IV) contrast can accurately identify pulmonary metastases and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Screening for pulmonary metastases should be considered in patients presenting with advanced stage disease with risk

factors such as numerous (≥3) or bilateral nodal metastases, adenopathy ≥6 cm in size, low neck nodal disease, local tumor recurrence, and second primary tumors [11,15,19]. CT chest imaging confers a superior spatial localization and contrast resolution when compared to radiography, allowing for the improved detection of small pulmonary nodules [15].

A heavy smoking history may also be a separate indication for CT chest imaging at initial staging because tobacco use is a risk factor not only for non–HPV-related squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. Studies have shown that 7% to 14% of patients have a separate lung primary at the time of initial staging of head and neck squamous cell carcinoma [15,21]. This patient population may also qualify for annual chest CT imaging as per the U. S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels, and aid in delineation of soft tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastases and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Screening for pulmonary metastases should be considered in patients presenting with advanced stage disease with risk factors such as numerous (≥3) or bilateral nodal metastases, adenopathy ≥6 cm in size, low neck nodal disease, local tumor recurrence, and second primary tumors [11,15,19]. CT chest imaging confers a superior spatial localization and contrast resolution when compared to radiography, allowing for the improved detection of small pulmonary nodules [15].

A heavy smoking history may also be a separate indication for CT chest imaging at initial staging because tobacco use is a risk factor not only for non–HPV-related squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. Studies have shown that 7% to 14% of patients have a separate lung primary at the time of initial staging of head and neck squamous cell carcinoma [15,21]. This patient population may also qualify for annual chest CT imaging as per the U. S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels, and aid in delineation of soft tissue extension of skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.

D. CT head with IV contrast

There is no relevant literature to support the use of CT head with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT head without and with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
F. CT head without IV contrast

There is no relevant literature to support the use of CT head without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. CT maxillofacial may not include the primary site in the hypopharynx or larynx and typically will not include the entire neck soft tissues, making it inadequate for the staging of regional lymphadenopathy.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. Contrast-enhanced CT (CECT) of the neck has the advantage of detailed anatomic delineation of the primary tumor site,

aiding in the correct T staging as well as providing regional nodal staging of the neck. In oral cavity cancer, CECT has been shown to provide an accurate estimation of depth of invasion and tumor thickness in lesions >5 mm when compared to histopathologic findings, an important upstaging feature of oral cavity cancers [22-25], performing similar to MRI [26]. CT imaging also gives excellent delineation of osseous anatomy, including bony destruction by tumor with high sensitivity and specificity for osseous [27-29] and cartilage involvement [30], which are upstaging features. When compared to MRI, CECT of the neck performs similar or slightly better in correctly identifying osseous involvement [29,31,32]. Conversely, MRI has been reported to have higher sensitivity than CT in detecting cartilage invasion but similar specificity, an upstaging feature of larynx and hypopharyngeal malignancies [33,34]. In comparing the ability of CECT to fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-PET/CT to accurately diagnose regional nodal disease, CECT performs similar or slightly inferior to FDG-PET/CT [35-39]. Contrast enhancement is imperative in order to correctly identify and outline the primary site, and distinguishing it from the surrounding normal soft tissues. The puffed-cheek technique, consisting of requesting that the patient inflate their cheeks with pursed lips while undergoing CT examination, allows for a greater delineation of oral cavity tumors, particularly those along the gingiva and buccal mucosa. The maneuver allows for the separation of tumor from normal mucosa and provides a clearer picture of the size and extent of disease [40].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA of the neck with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. CTA of the neck can be used to identify patients at high risk of bleeding in the instance of locally advanced disease with involvement encroaching on the carotid arteries [41].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the detection and localization of primary tumor site, identification of regional nodal disease, and distant metastases. FDG-PET/CT is recommended by the National Comprehensive Cancer Network for stage III and IV cancer [42]. FDG-PET/CT alone is not

considered sufficient for initial staging because it may not provide detailed anatomic delineation of the primary site or detection of upstaging features needed for correct staging [43,44]. FDG-PET/CT will typically be used in conjunction with CECT or MRI of the neck. One advantage of FDG-PET/CT is that the whole body can be imaged, and FDG-PET is more sensitive in the detection of distant metastasis and synchronous tumors over radiography, CT, and MRI [10,42,45]. Although FDG-PET/CT is sensitive (72%-96%), there are some variations in the reported specificity rate for cervical nodal metastases [36,45-48], likely due to reactive lymph nodes resulting in false-positive findings on PET.

The utility of FDG-PET in lower-stage cancer is more controversial. There are conflicting results when evaluating the ability of FDG-PET/CT to accurately detect occult nodal disease in clinical node-negative cancer. A range of sensitivities and specificities and contradictory results when compared to CECT and MRI are reported, either performing similar to or outperforming these modalities [35-39]. This controversy led to the American College of Radiology Imaging Network 6685 multicenter trial, which conclusively demonstrated that FDG-PET/CT confers a high negative predictive value (NPV) of 87% (visual analysis) and 94% (standardized uptake value max analysis) for lymph node metastasis in N0 cancer, with moderate to substantial reader agreement and 99% for distant metastatic disease [37,42,49]. In addition, it changed surgical management in the 20% of the study population.

FDG-PET/CT is considered standard of care for the evaluation of metastatic cervical adenopathy with no primary evident on clinical examination or other imaging modalities [17]. FDG-PET/CT has been demonstrated to be superior in detecting the primary site (69%) at the time of diagnosis versus 15% on CECT alone and 41% when using the combination of CECT and MRI [17]. FDG-PET/CT has been demonstrated to have a higher diagnostic accuracy than MRI and CT for the detection of small tumors [50,51].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is a new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging, including the initial staging of head and neck tumors, with FDG-PET/MRI performing similar to FDG-PET/CT [42,44,52-57]. One study found that FDG-PET/MRI outperforms FDG-PET/CT in the diagnosis of primary site in the evaluation of unknown primary [58].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MR angiography (MRA) with IV contrast of the neck in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA of the neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or

hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA of the neck without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI of the head with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI of the head without and with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI of the head without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI of the orbits, face, and neck with IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue resolution compared to CT and with this an improved ability to delineate the soft tissue extent of the tumor, which is a key component in the T staging of disease and essential for surgical planning. The superior soft tissue contrast resolution allows for improved detection of perineural spread of disease. MRI is less susceptible to metal artifact and may perform better in the oral cavity where there can be significant artifact from dental implants. Conversely, MRI offers decreased spatial resolution compared to CT and is more susceptible to motion artifact due to longer scan times. When compared to CECT, MRI neck performs similarly in correctly identifying osseous involvement, with MRI better delineating marrow involvement and CT better depicting erosive cortical change

[29,31]. MRI and CT achieve similar capability in the detection of extranodal extension of tumor [59] and depth of invasion in oral tongue cancer [26]. Conversely, when compared to CT, MRI has been reported to have a higher sensitivity but a similar specificity in detecting cartilage invasion, an upstaging feature of larynx and hypopharyngeal malignancies [33,34]. Accuracy of local staging of larynx cancer has been reported to be higher with MRI than CECT (80% versus 70%) [60]. MRI performs similarly to CECT in the detection of nodal metastatic disease with sensitivity ranging from 64% to 92% and specificity from 40% to 81% [61]. Most studies show superiority of FDG-PET/CT compared to MRI for detection of nodal disease [61]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary tumor, distinguishing it from surrounding normal soft tissues.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
X. MRI orbits face neck without IV contrast

There is no relevant literature to specifically support the use of MRI orbits, face, and neck without IV contrast in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site, distinguishing it from the surrounding normal soft tissues. The absence of IV contrast limits the ability to accurately delineate margin and the soft tissue extent of the tumor, which is a key component in the T staging of disease and essential for treatment planning. However, noncontrast MR sequences are routinely used to identify the primary tumor, define tumor extent, in particular marrow involvement, and are used in nodal staging.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
Y. Radiography chest

Chest radiography (CXR) is not useful for the evaluation of pulmonary metastatic disease in the initial staging of suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Chest CT is far more sensitive in detecting pulmonary metastatic disease when compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% when compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because metastatic pulmonary nodules detectable on CXR tend to be associated with late-stage disease when it is not as amenable to treatment [18].

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the sinuses in the initial staging of suspected or diagnosed cancer the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 1: Suspected or diagnosed cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Initial staging.
[. US neck

Ultrasound (US) can be a useful adjunct to cross-sectional imaging, in particular for nodal staging of head and neck cancer. Coupled with fine-needle aspiration and/or core-needle biopsy, nodal evaluation with US is a reliable tool and correlates well with staging following neck dissection [62]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator-dependent nature of this technique. US alone has been shown to very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65].

US is not typically used to stage the primary site, although there is a growing body of research demonstrating the utility of US in delineating primary tumors of the oral cavity, oropharynx, hypopharynx, and larynx. Recent studies comparing transcervical US to CT and FDG-PET/CT and US to CT and MRI demonstrated increased accuracy of US in detecting primary site in patients with HPV-related oropharyngeal carcinoma [51,66]. Intraoral US of the tongue has been proven to be accurate in the evaluation of depth of invasion, which is an important staging feature of oral cavity cancers that has prognostic and therapeutic implications [67,68]. A few studies demonstrated the utility of US in the delineation of oral cavity primary in patients in which the tumor was obscured by metal on cross-sectional imaging [25,69]. In a study comparing US to CECT for the staging of hypopharyngeal cancer, US failed to detect significant findings seen on CT in 22.5% of cases, although US proved accurate in diagnosing cartilage invasion and vocal cord immobility [70]. Conversely, US was found to approach the accuracy of CECT and MRI in the evaluation of larynx primary site with 80% to 83.3% accuracy in delineating the correct T stage versus 88.8% for CECT and 76.7% for MRI [71-73].

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

Nasopharyngeal carcinoma (NPC) is a relatively rare cancer with a worldwide incidence of 0.5 to 1.0/100,00 per year [74], with higher endemic rates in Southeast Asian countries. NPC arising from the nasopharyngeal epithelium represents at least 70% of tumors of the nasopharynx and, for this reason, will be the focus of the upcoming discussion [74]. Other histologies, including nasopharyngeal lymphoma, constitute a minority of nasopharyngeal malignancies and will therefore not be emphasized in this section. The World Health Organization classifies squamous cell carcinoma of the nasopharynx based on histopathologic features into keratinizing squamous cell carcinoma, nonkeratinizing squamous cell carcinoma, which is further subdivided into differentiated and undifferentiated type, and basaloid squamous cell carcinoma. Alcohol and smoking are associated with NPC, with the strongest link to keratinizing squamous cell carcinoma, which carries the worst prognosis [75]. Almost all nonkeratinizing squamous cell carcinoma and basaloid squamous cell carcinomas are associated with EBV infection with a slightly weaker association of EBV to keratinizing squamous cell carcinoma [18]. The undifferentiated subtype is most common in endemic areas, representing as many as 93% of all cases [75].

In addition to the epithelial tumors of the nasopharynx, cancers of the nasopharynx can also originate from minor salivary glands, most commonly adenoid cystic and mucoepidermoid carcinomas. Cancer of unknown primary of the head and neck represents 1% to 4% of patients with malignant tumors of the head and neck and is diagnosed after identification of metastatic lymphadenopathy in which no primary is evident [9]. When the pathology is positive for EBV, the primary site is presumed to localize to the nasopharynx.

Patients often present with a neck mass or findings secondary to local invasion of structures, with

symptoms such as epistaxis or nasal blockage, hearing loss secondary to Eustachian tube dysfunction, or findings of cranial nerve involvement [76]. Advanced local disease in NPC is common at presentation with skull base involvement in 25% to 35% of cases and intracranial invasion in 3% to 12% of cases [77]. Accurate staging of the primary tumor includes evaluation of involvement of osseous structures, including the skull base and extension into the adjacent soft issues such as the pterygoid musculature, which are upstaging features. NPC has a high rate of regional nodal disease at presentation, including retropharyngeal and cervical lymph nodes, with as many as 75.8% of patients presenting with nodal mass at initial presentation [78]. Identification of nodal disease is critical in staging because it confers decreased survival, and the presence of nodal disease or advanced local disease is associated with increased risk for distant metastases. NPC also has a relatively high rate of distant metastases compared with other head and neck cancers, and distant metastases are found in 5% to 11% of patients at the time of diagnosis. The most common sites of metastasis are bone (20%), lung (13%), and liver (9%) [79,80]. Detection of distant metastatic disease at initial staging is crucial because it will change prognosis and typically convert the management strategy toward more systemic options.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastases and be used to detect thoracic nodal and skeletal metastases to ribs or vertebrae. NPC has a relatively high rate of distant metastases with the lung being the second most common site of distant disease after osseous metastases. Although FDG-PET/CT is preferred for the staging of advanced stage NPC because it allows for simultaneous detection of metastatic disease outside the thorax, CT chest may be considered for screening of pulmonary metastatic disease. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. CT chest may also be useful in patients with NPC associated with smoking and alcohol intake, given the risk for synchronous lung cancer. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aid in delineation of soft tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. NPC has a relatively high rate of distant metastases with the lung being the second most common site of distant disease after osseous metastases. Although FDG-PET/CT is preferred for the staging of advanced stage NPC because it allows for simultaneous detection of metastatic disease outside the thorax, CT chest

may be considered for screening of pulmonary metastatic disease. CT chest confers a superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. CT chest may also be useful in patients with NPC associated with smoking and alcohol intake, increasing the risk for synchronous lung cancer. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aiding in delineation of soft tissue extension of skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
D. CT head with IV contrast

There is no relevant literature to support the use of CT head with IV contrast in treated cancer of nasopharynx or EBV-associated cancer of unknown primary of the head and neck. Although CT head may be able to delineate skull base and intracranial involvement, inclusion of the neck is useful to evaluate for cervical adenopathy for staging purposes.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT head without and with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
F. CT head without IV contrast

There is no relevant literature to support the use of CT head without IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated cancer of unknown primary of the head and neck. CT maxillofacial with IV contrast may provide sufficient evaluation of the primary site and can be particularly helpful for the evaluation of osseous erosion. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast in the initial staging of suspected or diagnosed nasopharynx cancer or EBV-associated cancer of unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated cancer of unknown primary of the head and neck. CT maxillofacial without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site, in particular for the evaluation of osseous erosion. CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of nasopharyngeal tumors as well as regional nodal staging. CT imaging is excellent for the delineation of osseous anatomy and in the detection of subtle cortical erosion. However, because of improved soft tissue contrast resolution, MRI is considered superior to CT in outlining the extent of soft tissue disease, including involvement of neighboring structures, findings that are necessary for the correct T staging of disease. Although MRI has largely surpassed the use of CECT for NPC staging with high sensitivity and specificity for correctly identifying the primary site [81,82], CT has a complementary role in staging and is often used for radiation planning purposes. FDG-PET/CT is considered the imaging modality of choice for detecting cervical and distant metastases in patients with NPC [83] and demonstrates high sensitivity and specificity, when compared to CECT, in detecting nodal metastasis [82,84,85]. When CT is performed, IV contrast is recommended to better outline the soft tissue extent of the primary tumor.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated cancer of unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated cancer of unknown primary of the head and neck. CT neck without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site in particular for the evaluation of osseous erosion.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.

M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA neck with IV contrast for the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck. CTA of the neck can be used to identify patients at high risk of bleeding in the instance of locally advanced disease encroaching on the carotid arteries [41].

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the detection and localization of primary tumor site and identification of regional nodal disease and distant metastases. FDG-PET/CT alone is not considered sufficient in the initial staging of NPC because it does not provide detailed anatomic delineation of the primary site or detection of upstaging features needed for correct staging, including a tendency to underestimate the involvement of the skull base, brain, cavernous sinuses, and orbits compared to MRI [74,85,86]. FDG-PET/CT has also been found to have a higher false-negative rate than MRI for detection of retropharyngeal nodal disease [82].

FDG-PET/CT is useful for detecting cervical and distant metastases in patients with NPC [83] and demonstrates high sensitivity and specificity, when compared to CECT or MRI alone, in detecting nodal metastasis [82,84,85]. Furthermore FDG-PET/CT has a high sensitivity and accuracy in detecting distant metastases, including osseous and pulmonary metastases [82,87,88], the most common sites for distant metastatic disease in NPC. Studies have shown that for early stage (I-II) disease, FDG-PET/CT may not confer additional benefit [74].

FDG-PET/CT is useful for the evaluation of metastatic cervical adenopathy with no primary evident on clinical examination or other imaging [17]. Comparison between FDG-PET/CT, CECT neck alone, or in combination with IV contrast-enhanced MRI, showed FDG-PET to be superior in detecting the primary site (69%) of the time versus 15% on CT alone and 41% when using the combination of CT and MRI [17].

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is a new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging, including the initial staging of NPC with similar results to FDG PET/CT [53,86]. A study found that this imaging modality may provide more accurate staging than the combination of FDG-PET/CT and MRI [89].

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI head with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI head without and with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck. The coverage of an MRI of the head and MRI sequences tailored for assessment of the brain may be insufficient to completely evaluate the primary site in the nasopharynx and will not include regional nodal staging. MRI head without and with IV contrast may be used to further delineate advanced intracranial extension of disease if it is suspected based on clinical examination or other imaging modalities.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI head without IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI of the orbits, face, and neck with IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
W. MRI orbits face neck without and with IV contrast

MRI of the orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution and with this an improved ability to delineate the soft tissue extent of the tumor at the primary site. MRI provides high sensitivity and specificity for correctly identifying the primary site [81,82], and the superior soft tissue contrast resolution allows for accurate evaluation of local extent of disease, including identification of subtle skull base marrow involvement, intracranial extension, and detection of perineural spread of disease [90,91]. Furthermore, MRI has been found to correctly identify the site of the tumor in endoscopically occult disease [81,92]. MRI has demonstrated a mildly lower sensitivity than FDG-PET/CT in detecting cervical nodal disease [82] but is considered superior in detecting retropharyngeal lymph node metastases [74,82]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate

the primary site, distinguishing it from the surrounding soft tissues. This includes the evaluation of tumor size and local extent of disease, including the invasion of surrounding structures.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the use of MRI of the orbits, face, and neck without IV contrast in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site, distinguishing it from the surrounding normal soft tissues. The absence of IV contrast limits the ability to accurately delineate margin and the soft tissue extent of the tumor, which is a key component in the T staging of disease and essential for treatment planning. However, noncontrast MR sequences are routinely used to identify the primary tumor and define tumor extent, in particular marrow involvement, and are used in nodal staging.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
Y. Radiography chest

CXR is not considered the imaging modality of choice for evaluation of pulmonary metastatic disease in suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported to be as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis, because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the sinuses in the initial staging of suspected or diagnosed NPC or EBV-associated unknown primary of the head and neck.

Variant 2: Suspected or diagnosed nasopharynx cancer or EBV-associated unknown primary of the head and neck. Initial staging.
[. US neck

US can be a useful adjunct to cross-sectional imaging, in particular for nodal staging in NPC or EBV-associated unknown primary of the head and neck. Coupled with fine-needle aspiration and/or core-needle biopsy, nodal evaluation with US is a reliable tool and correlates well with staging following neck dissection [62]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator dependent nature of this technique. US alone has been shown to be very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65]. One study has shown similar accuracy of US to MRI in the detection of the primary site in patients with suspected NPC, which suggests that US may have a role as a screening tool [93].

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

Sinonasal tumors are rare neoplasms and make up only 3% of head and neck carcinomas and approximately 0.5% to 1% of all malignancies [94,95]. Despite its relatively small anatomic confine, a wide range of malignancies can arise from the sinonasal cavity. Neoplasms can be classified as either epithelial or nonepithelial. Of the epithelial tumors, squamous cell carcinoma is by far the most common malignancy and accounts for up to 80% of sinonasal cancers and, for this reason, will be the focus of the upcoming discussion. The maxillary sinus and nasal cavity constitute the most common sites of origin [95,96]. The most frequent nonepithelial malignancies are malignant lymphomas, which comprise approximately 6% to 13% of extranodal lymphomas of the head and neck [95]. Additional malignancies encountered in this region include adenocarcinoma, salivary gland tumors, olfactory neuroblastoma, and melanoma, among others. Olfactory neuroblastomas are rare and constitute only around 2% of sinonasal tumors. They arise from the olfactory epithelium found at the roof of the ethmoid sinuses, cribriform plate, upper nasal septum, and superior turbinates. Because of its site of origin, olfactory neuroblastomas have a propensity to invade the anterior cranial fossa [96,97]. Paranasal sinus cancers differ from other squamous cell cancers of the upper aerodigestive tract in their risk factors, such as occupational exposures (ie, adenocarcinoma linked to wood dust exposure), and in the presence of premalignant lesions such as Schneiderian papillomas [98].

Patients most commonly present with nasal obstruction, rhinorrhea, and/or epistaxis. Symptoms can oftentimes be unilateral and can frequently be overlooked because of their overlap with more common benign etiologies [98]. Furthermore, pain is generally absent until there is associated skull base or nerve involvement. For these reasons, sinonasal tumors are commonly large at presentation [55,98]. Additionally, the sinonasal cavity has close proximity to complex skull base anatomy, the orbits, and the pterygopalatine fossae, which facilitates early disease extension.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Screening for pulmonary metastases should be considered in patients presenting with advanced stage disease with risk factors such as numerous (≥3) or bilateral nodal metastases, adenopathy ≥6 cm in size, low neck nodal disease, local tumor recurrence, and second primary tumors [11,15,19]. CT chest confers a superior spatial localization and contrast resolution compared to radiography, allowing for the improved detection of small pulmonary nodules [15].

A heavy smoking history may also be a separate indication for CT chest imaging at initial staging, because tobacco use is a risk factor not only for squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. Studies have shown that 7% to 14% of patients have as second lung primary at the time of initial staging of head and neck squamous cell carcinoma [15,21]. This patient population may also qualify for annual chest imaging as per the U.S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aid in delineation of soft-tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of suspected or diagnosed initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Screening for pulmonary metastases should be considered in patients presenting with advanced stage disease with risk factors such as numerous (≥3) or bilateral nodal metastases, adenopathy ≥6 cm in size, low neck nodal disease, local tumor recurrence, and second primary tumors [11,15,19]. CT chest confers a superior spatial localization and contrast resolution compared to radiography, allowing for the improved detection of small pulmonary nodules [15].

A heavy smoking history may also be a separate indication for CT chest imaging at initial staging, because tobacco use is a risk factor not only for squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. Studies have shown that 7% to 14% of patients have as second lung primary at the time of initial staging of head and neck squamous cell carcinoma [15,21]. This patient population may also qualify for annual chest imaging as per the U.S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aid in delineation of soft tissue extension of skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
D. CT head with IV contrast

There is no relevant literature to support the use of CT of the head with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. CT head may provide sufficient coverage for the anatomic evaluation of the primary tumor site in the sinonasal cavity; however, inclusion of the neck is recommended to evaluate for cervical adenopathy for staging purposes.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT of the head without and with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
F. CT head without IV contrast

There is no relevant literature to support the use of CT of the head without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. CT maxillofacial may be complementary in the anatomic evaluation of the primary site, in particular for the evaluation of osseous erosion. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. CT maxillofacial without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site, in particular for the evaluation of osseous erosion. CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of sinonasal tumors as well as regional nodal staging. CT provides excellent delineation of the sinonasal skeleton and is superior to MRI in the depiction of osseous anatomy [96]. The presence of skull base foraminal widening, which can be detected on thin-section CT and reconstructions, may alert to perineural tumor spread [96], and the precise determination of bony destruction or remodeling may prove useful in the characterization of slow-growing versus aggressive sinonasal tumors [99]. MRI is considered superior to CT in the delineation of the soft tissue extent of disease, including involvement of neighboring structures, findings that are necessary for the correct T staging of disease. Contrast-enhanced imaging is imperative to correctly identify and outline the primary tumor, distinguishing it from the surrounding normal soft tissues.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. CT neck without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site in particular for the evaluation of osseous erosion.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA with IV contrast of the head and neck in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. CTA of the neck can be used to identify patients at high risk of bleeding in the instance of locally advanced disease encroaching on the carotid arteries [41].

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the detection and localization of primary tumor site and identification of regional nodal disease and distant metastases. FDG-PET/CT alone is not considered sufficient in initial staging because it may not provide detailed anatomic delineation of the primary site or detection of upstaging features needed for correct staging, surgical, and treatment planning [100]. Furthermore, previous authors have suggested that PET/CT may in fact overestimate the extension of the tumor [101]. However, FDG-PET/CT is recommended by the National Comprehensive Cancer Network as an adjunct in the workup of stage III and IV cancers [42]. FDG-PET/CT has shown increased sensitivity for detection of regional nodal disease, distant metastasis, and synchronous tumors over radiography and cross-sectional imaging with CT and MRI [42]. At initial staging, one study showed that distant metastases or a secondary cancer was discovered in 22% of patients, which in turn led to adjustments in planned therapy [102]. The utility of FDG-PET in lower-stage cancer is more controversial. However, FDG-PET/CT does confer a high NPV of 87% for lymph node metastasis in N0 cancer and 99% for distant metastatic disease [37,49,85], which is valuable in directing therapy.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is a new imaging modality with a growing body of evidence demonstrating the feasibility of use in routine clinical evaluation of head and neck tumors with FDG-PET/MRI shown to have similar results to FDG-PET/CT [42,52-54,56,57].

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.

P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI head with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI head without and with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. The coverage of an MRI of the head and the sequences used may be insufficient to completely evaluate the primary site in the paranasal sinuses or nasal cavity and will not include regional nodal staging. MRI head without and with IV contrast may be a useful adjunct to further delineate advanced intracranial extension of disease when suspected based on clinical grounds or prior imaging.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI head without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck with IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution and with this an improved ability to delineate the soft tissue extent of the tumor [96], which is a

key component in the T staging of disease and essential for surgical planning. Perineural tumor spread is more easily recognized with MRI compared to CT, as is the regional extension to neighboring structures such as the orbits, dura, and brain, and subtle marrow involvement [96]. Furthermore, the superior soft tissue contrast resolution of MRI can better distinguish tumors from sinus inflammatory changes and retain secretions compared to CT. Advanced tools, including higher-resolution imaging, diffusion-weighted and diffusion-tensor sequences, and MR perfusion techniques such as dynamic-contrast-enhanced MRI show promise in improving anatomic and functional imaging [103-105]. These tools may help to distinguish between benign and malignant disease, however, as of now they are not consistently used in routine clinical practice. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site, distinguishing it from the surrounding normal soft tissues.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck without IV contrast in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site, distinguishing it from the surrounding normal soft tissues. The absence of IV contrast limits the ability to accurately delineate margin and the soft tissue extent of the tumor, which is a key component in the T staging of disease and essential for treatment planning. However, noncontrast MRI sequences are routinely used to identify the primary tumor and to define tumor extent, in particular marrow involvement, and are used in nodal staging.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
Y. Radiography chest

CXR is not useful in the evaluation of pulmonary metastatic disease in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis, because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the initial staging of suspected or diagnosed cancer of the paranasal sinuses or nasal cavity.

Variant 3: Suspected or diagnosed cancer of the paranasal sinuses or nasal cavity. Initial staging.
[. US neck

US can be a useful adjunct to cross-sectional imaging, in particular for nodal staging of head and neck cancer. Coupled with fine-needle aspiration and/or core-needle biopsy, nodal evaluation with

US is a reliable tool and correlates well with staging, following neck dissection [62]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator-dependent nature of this technique. US alone has been shown to very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.

The salivary glands are classified into major and minor. The major salivary glands are paired bilateral parotid, submandibular, and sublingual glands. The minor salivary glands are located along the mucosa of the aerodigestive tract, including the oral cavity, nasal cavity, and pharynx, and tumors of the minor salivary glands occurring in various sites are included in the discussion of Variants 1, 2, and 3 above. Tumors of the major salivary glands are considered rare and account for 3% to 5% of all head and neck neoplasms and only 0.5% of all malignancies [106,107]. The most common site is the parotid gland, with about 70% arising from this site [108], followed by the submandibular gland, and lastly the sublingual gland. In general, the risk of malignancy is inversely proportional to the size of the gland. Therefore, the risk of cancer is greater in a sublingual gland lesion as opposed to a lesion in the parotid gland. The majority, approximately 70% to 80%, of these tumors are benign, with the most common benign tumor being pleomorphic adenoma (60%-70%) and Warthin tumor (5%-12%) [107]. A smaller percentage are malignant tumors, of which mucoepidermoid carcinoma, adenoid cystic carcinoma, lymphoma, and acinic cell carcinoma are the most common subtypes [107,109]. Furthermore, intraglandular lymphatic tissue predisposes the parotid glands to metastatic disease from locoregional cancers of the head and neck, as well as from distant tumors including the thyroid, breast, and lung [110]. Patients typically present with a palpable abnormality or pain. When there is perineural spread of disease, the patient may experience weakness of the facial muscles.

Surgery is considered the primary treatment in the majority of salivary gland tumors and imaging is obtained in large part to determine feasibility of resection [108]. Imaging plays a crucial role in the characterization of these lesions and is aimed at determining anatomic location, relation to surrounding structures, size, multiplicity, presence of perineural spread, and internal features. In turn, this information in conjunction with histologic type serves to define treatment approach and management. The appropriate imaging technique is generally determined by the site of origin [108]. Fine-needle aspiration remains the most definitive tool to determine the benign or malignant nature of salivary gland masses [106]. US, cross-sectional imaging (CT, MRI), and functional imaging with FDG-PET/CT may be used independently or in combination to enhance the diagnostic strength and reduce the deficiency of each modality [106]. Furthermore, imaging characteristics are particularly helpful when fine-needle aspiration cannot be performed because of inaccessible location or patient preference. In established malignancy, staging to include nodal disease and distant metastases may be warranted. Locoregional metastatic adenopathy is seen in approximately 10% to 15% of malignant salivary gland tumors and is more common in high-grade than in low-grade cancer [108]. Distant metastatic disease is identified in 10% to 50% of patients at initial staging, and both lymph node and distant metastases are more common in the setting of tumor recurrence [108]. Perineural tumor spread is especially prevalent in adenoid cystic carcinoma and is reported in >50% of patients [108].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.

A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and can be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. The most common site of metastatic involvement beyond the head and neck in up to 90% of cases is to the lungs. A distant second are the bones followed by the liver, brain, and other sites [108]. For this reason, CT of the chest may be considered in cases of increased risk of metastatic disease, in particular in patients with high-grade malignant tumors. CT chest confers a superior spatial and contrast resolution when compared to radiography, allowing for the detection of small pulmonary nodules [15]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aid in delineation of soft tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. The most common site of metastatic involvement beyond the head and neck in up to 90% of cases is to the lungs. A distant second are the bones followed by the liver, brain, and other sites [108]. For this reason, CT of the chest may be considered in cases of increased risk of metastatic disease, in particular in patients with high-grade malignant tumors. CT chest confers a superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy and aid in delineation of the soft tissue extension of skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
D. CT head with IV contrast

There is no relevant literature to support the routine use of CT of the head with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
E. CT head without and with IV contrast

There is no relevant literature to support the routine use of CT of the head without and with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
F. CT head without IV contrast

There is no relevant literature to support the routine use of CT of the head without IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the routine use of CT maxillofacial with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland. CT of the maxillofacial region may provide sufficient coverage for the anatomic evaluation of the primary tumor site. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the routine use of CT maxillofacial without and with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the routine use of CT maxillofacial without IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland. CT maxillofacial without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site in particular for the evaluation of osseous erosion. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy when performed alone and may best be used in combination with MRI or FDG-PET/CT.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck can give detailed anatomic delineation of the primary tumor site and adjacent anatomy, as well as provide regional nodal staging of the neck. Soft tissue resolution of CT is considered inferior to that of MRI [108], and certain cancers such as adenoid cystic carcinoma, mucoepidermoid carcinoma, and acinic cell carcinomas may lack significant contrast enhancement on CT, making their detection difficult by this modality [111]. Furthermore, MRI is considered superior in the detection of perineural spread and the soft tissue extent of disease [107,108], which are features needed for accurate T staging. Generally, CT is reserved for patients when there are indeterminate findings on MRI regarding osseous invasion [107,108]. CT may prove to be especially useful in the setting of suspected bone involvement because of its improved detection of cortical erosion [112]. Furthermore, CT is superior to MRI in the detection of calculus disease resulting in sialadenitis, which may behave as a tumor mimic [112]. Both CT and MRI are capable of assessing internal tumor features, extraglandular extension, enhancement, and in detecting regional adenopathy

[112]. Conflicting results have been published regarding the ability of imaging to distinguish benign from malignant salivary gland tumors. Some studies suggest no statistically significant difference in diagnostic accuracy between US, CT, MRI, and PET/CT [106,113], whereas others have reported that CT is less accurate than MRI in the prediction of malignancy [107]. The use of IV contrast is recommended to better outline the extent of the primary site.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
K. CT neck without and with IV contrast

There is no relevant literature to support the routine use of CT neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
L. CT neck without IV contrast

There is no relevant literature to support the routine use of CT neck without IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland. CT neck without IV contrast would not provide sufficient evaluation of the soft tissue extent of disease but may be complementary in the anatomic evaluation of the primary site in particular for the evaluation of osseous erosion.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA neck with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland. CTA of the neck can be used to identify patients at high risk of bleeding in the instance of locally advanced disease encroaching on the carotid arteries [41].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the detection and localization of primary tumor site and identification of regional nodal disease and distant metastases. The utility of FDG-PET/CT depends on the tumor grade because low-grade salivary gland tumors have relatively low metabolism and may be occult on FDG-PET/CT. FDG-PET/CT is therefore not routinely recommended for initial staging of low-grade salivary gland tumors [108]. FDG-PET/CT has been shown to correctly identify the site of the primary tumor at a similar rate as MRI [114]. FDG-PET/CT alone is not considered sufficient in the initial staging of salivary gland cancer because it does not provide detailed anatomic delineation of the primary site and detection of upstaging features needed. FDG-PET/CT is inferior to MRI for the diagnosis of perineural tumor spread because the small volume of disease and the limited spatial resolution of PET [42,115].

FDG-PET/CT in the initial staging of salivary gland tumors remains a controversial subject [108]. FDG-PET/CT may be superior to conventional cross-sectional imaging in staging of regional neck nodal disease and preoperative planning for neck dissection [114]. One study showed an increased detection rate of regional nodal metastases calculated at 100% with FDG-PET/CT versus 50% with MRI in combination with CXR [114]. Furthermore, FDG-PET/CT may be recommended in the setting

of high-grade malignancy because of the increased frequency of distant metastases [108,114]. Other studies have shown that PET/CT provides additional information regarding cervical lymph nodes and distant disease in particular in patients with high-grade carcinomas [114]. The rate of change in treatment plan based on detection of regional and/or distant metastases in patients with salivary gland carcinoma with PET or PET/CT has been calculated at 15% to 47% [114].

The utility of FDG-PET imaging in the setting of a salivary gland "incidentaloma" is limited. PET/CT is inadequate in distinguishing benign from malignant tumors, and, compared to MRI, FDG-PET does not improve diagnostic discrimination [114]. Benign tumors such as Warthin tumor present with increased FDG uptake [108,110], whereas low-grade malignant masses may be hypometabolic and "cold" on FDG-PET/CT [110]. Furthermore, intrinsic FDG uptake in a healthy salivary gland may obscure tumors with relatively low metabolism [114].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging. A potential application of FDG-PET/MRI has been studied in the setting of suspected perineural tumor spread. Combining the soft tissue resolution of MRI and the functional evaluation of FDG-PET may be an attractive tool for diagnosis of the perineural spread in major salivary gland tumors [110].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
S. MRI head with IV contrast

There is no relevant literature to support the routine use of MRI of the head with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
T. MRI head without and with IV contrast

There is no relevant literature to support the routine use of MRI of the head without and with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
U. MRI head without IV contrast

There is no relevant literature to support the routine use of MRI of the head without IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the routine use of MRI orbits, face, and neck with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution and with this an improved ability to delineate the soft tissue extent of tumor including the extraglandular extension of disease and perineural spread, which are key components in the T staging of disease and essential for treatment planning. Because of its superior soft tissue contrast resolution, MRI is considered the modality of choice for initial staging of major salivary gland cancer [108,112] relative to CECT. MRI overcomes many of the limitations encountered by US by providing extended cross-sectional anatomic view of the area of interest and allowing for the detection of perineural tumor spread, deep-tissue extension, and marrow involvement [107]. Additionally, MRI may identify signal change and signs of extranodal extension in regional lymph nodes [112]. In the setting of sublingual and submandibular gland tumors, MRI accurately depicts the anatomy of the floor of the mouth, which is imperative in preoperative staging [107]. Because of the increased risk of malignancy of sublingual gland lesions, MRI is the imaging modality of choice [112].

Studies have reported no statistically significant difference in diagnostic accuracy between US, CT, MRI, and PET/CT to distinguish benign from malignant salivary gland tumors [106,113]. However, one meta-analysis showed MRI to have a higher sensitivity and specificity for differentiating between benign and malignant tumors [113]. The addition of advanced MRI techniques including diffusion-weighted imaging and perfusion imaging, such as dynamic contrast-enhanced, may improve the ability of MRI to distinguish benign from malignant salivary gland tumor with reported similar results to fine-needle aspiration [107], although these tools are not consistently used in routine clinical practice. Furthermore, preprocedural assessment with advanced MRI techniques may serve to identify internal sites of greater cellularity as a target for fine-needle aspiration [107]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site. Contrast administration aids in detecting of subtle mass extension and invasion of surrounding structures and in identifying perineural tumor spread [108].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the routine use of MRI orbits, face, and neck with IV contrast in the initial staging of suspected or diagnosed cancer of a major salivary gland. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate the primary site. The absence of IV contrast limits the ability to accurately delineate the margin and the soft tissue extent of the tumor, which is a key component in the T staging of disease and essential for surgical planning. However, noncontrast MR sequences are routinely used to identify the primary tumor, define tumor extent, in particular marrow involvement, and are used in nodal staging.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
Y. Radiography chest

CXR is not considered useful in the evaluation of pulmonary metastatic disease in the initial staging of suspected or diagnosed cancer of a major salivary gland. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the initial staging of suspected or diagnosed cancer of a major salivary gland.

Variant 4: Suspected or diagnosed cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Initial staging.
[. US neck

US allows for the detection and localization of major salivary gland tumors as well as regional nodal staging. US is often considered an appropriate first-line examination in the characterization of accessible salivary masses, in particular for submandibular gland tumors and masses of the superficial lobe of the parotid gland [107,108,112]. The superficial location of the major salivary glands renders their evaluation with high-resolution US an effective and safe modality for initial assessment [112,116]. US provides information regarding tissue characterization, anatomic delineation, and intralesional vascular pattern via Doppler technique. Additionally, nodal involvement may also be established by US, and this modality may serve as guidance for fine-needle aspiration. However, some caveats exist. US may be insufficient in the detection and characterization of masses located in the deep lobe of the parotid gland [107,112]. Additional limitations of US include the inability to appropriately assess deep compartment extension, perineural tumor spread, bone invasion, and oropharyngeal/retropharyngeal nodal involvement [112].

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Tumors of the oral cavity, oropharynx, hypopharynx, and larynx as well as tumors in which a primary site is not identified but the patient presents with metastatic cervical adenopathy are generally treated with a combination of surgery, chemotherapy, and/or radiation therapy [117]. This represents a heterogeneous group of tumors with posttreatment prognosis dependent on the site of origin and histology, although the majority of tumors are squamous cell carcinomas. As many as 40% of patients suffer recurrence after therapy, and up to 25% of patients will develop distant metastases [118,119], with the majority of recurrences occurring in the first 2 years following treatment [16]. Rate of recurrence and distant metastatic disease is directly linked to advanced stage of disease before treatment. The early detection of residual disease and recurrence, diagnosis of distant metastases, and differentiation from posttreatment changes is vital in the follow-up imaging in order to offer salvage therapy and improved survival. The exact delineation of recurrence is crucial in determining the type of salvage therapy offered. Cross-sectional imaging remains the mainstay of posttreatment surveillance. Additionally, imaging in the posttreatment setting may be geared to detecting complications secondary to therapy, which include but are not limited to osteoradionecrosis, infection, and flap failure. The appropriate imaging modality to evaluate each potential suspected complication will depend on the clinical scenario and is beyond the scope of this document.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Patients with recurrent head and neck squamous cell carcinoma are significantly more likely to have pulmonary metastatic disease [21,120]. Development of lung metastases is also increased in advanced stage disease [15]. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the improved detection of small pulmonary nodules [15]. The use of screening CT chest in patients treated with definitive therapy has been shown to detect metastatic disease that was successfully treated with salvage therapy [121]. The rates of detection of pulmonary metastatic disease in the setting of recurrent disease for chest CT is similar to that of FDG-PET/CT [122]. A heavy smoking history may also be a separate indication for CT chest imaging at surveillance because tobacco use is a risk factor not only for non–HPV-related squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. This patient population may also qualify for annual chest CT imaging as per the U. S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aiding in the delineation of the soft tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Patients with recurrent head and neck squamous cell carcinoma are significantly more likely to have pulmonary metastatic disease [21,120]. Development of lung metastases is also increased in advanced stage disease [15]. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the improved detection of small pulmonary nodules [15]. The use of screening CT chest in patients treated with definitive therapy has been shown to detect metastatic disease that was successfully treated with salvage therapy [121]. The rates of detection of pulmonary metastatic disease in the setting of recurrent disease for chest CT is similar to that of FDG-PET/CT [122]. A heavy smoking history may also be a separate indication for CT chest imaging at surveillance because tobacco use is a risk factor not only for non–HPV-related squamous cell carcinoma of the head and neck but also for primary lung cancer [15,20]. This patient population may also qualify for annual chest CT imaging per the U. S. Preventative Services Task Force guidelines for annual lung cancer screening with low-dose CT in well-defined groups of high-risk smokers [20]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aiding in delineation of the soft tissue extension of skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
D. CT head with IV contrast

There is no relevant literature to support the use of CT head with IV contrast as follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT head without and with IV contrast as follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
F. CT head without IV contrast

There is no relevant literature to support the use of CT head without IV contrast as follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or

cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast for the evaluation of known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck. CT maxillofacial will typically not include the neck and therefore would be inadequate for the staging of regional lymphadenopathy and may not include the primary site in the hypopharynx or larynx.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast for the evaluation of known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast for the evaluation of known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of recurrent tumor and the evaluation of regional nodal disease. CT is also used to monitor treatment changes and assess for treatment complications such as infection or osteoradionecrosis. Evaluation of the treated neck is very often complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. Much like MRI, it has an overall low sensitivity and positive predictive value [123] for detecting recurrence. Posttreatment CECT has been shown to detect local failure and nodal recurrence earlier than clinical examination alone [124,125]. A reported high NPV of 97.7% suggests that CT is helpful in excluding recurrence [123]. CT imaging also allows for excellent delineation of osseous anatomy, including bony destruction that can be seen in the context of recurrence or as a complication of treatment such as in osteoradionecrosis. FDG-PET/CT confers increased sensitivity compared to CECT in detecting recurrence and confers similarly to slightly increased specificity [117,119,126-128]. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes. The puffed-cheek technique, consisting of requesting that the patient inflate their cheeks with pursed lips while undergoing CT examination, allows for a greater delineation of oral cavity tumors, particularly those along the gingiva and buccal mucosa. The maneuver allows for the separation of

the tumor from normal mucosa and provides a clearer picture of the size and extent of disease [40].

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast for the evaluation of known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast for the evaluation of known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA of the neck with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck. In the specific case of recurrent disease encroaching on the carotid arteries, CTA of the neck can be used to identify patients at high risk of bleeding [41].

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the assessment of treatment response and detection and localization of recurrence, regional nodal disease, and distant metastases. The evaluation of the posttreatment of the neck is complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence.

Studies have shown FDG-PET/CT to have high sensitivity and specificity for detection of local and nodal recurrence, with a higher sensitivity and similar or higher specificity to CT or MRI of the neck [117,119,126-128]. FDG-PET/CT has a very high NPV and therefore is very accurate in excluding recurrence [129-131]. FDG-PET/CT has been shown to be effective in identifying subclinical recurrences in the posttreatment setting [132,133]. The presence of posttreatment inflammatory change decreases the specificity of findings on FDG-PET/CT [131,134,135]. For this reason, imaging with FDG-PET/CT should ideally occur no earlier than 12 weeks after completion of therapy [117,118] to allow for treatment effects to subside, although imaging as early as 8 weeks after therapy has been suggested [136]. Concurrent infection can similarly give false-positive findings. One study found that the combination of MRI with FDG-PET/CT has the best detection of

locoregional recurrence [128]. FDG-PET/CT has been found to accurately diagnose distant metastatic disease in the posttreatment setting [19,119] and may be indicated in treated advanced stage disease because of the increased rate of distant metastases.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging including in the response assessment and evaluation of recurrence following treatment of cancer of the head and neck with FDG-PET/MRI performing similar to FDG/PET CT [137,138].

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI head with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI head without and with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI head without IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI of the orbits, face, and neck with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution, which facilitates assessment of local recurrence and can be helpful in distinguishing tumor from treatment-related change and in evaluating local tumor response. Evaluation of the treated neck is complicated by significant treatment-related changes that can be difficult to differentiate from persistent disease after therapy or recurrence. MRI is less susceptible to metal artifact than CT and may perform better in the oral cavity where there can be significant artifact from dental implants. Conversely, MRI offers decreased spatial resolution compared to CT and is more susceptible to motion artifact because of longer scan times. One study found that MRI, much like CT, has low sensitivity and positive predictive value for detecting recurrence in treated oropharynx cancer but has importance in excluding recurrence with a high NPV (94%) [139]. FDG-PET/CT confers increased sensitivity compared to MRI and confers similarly to slightly increased specificity when evaluating for recurrence [43]. One study found that the combination of MRI with FDG-PET/CT has the best detection of locoregional recurrence [128]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate recurrent tumor, distinguishing it from surrounding soft tissues and treatment changes.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the use of MRI of the orbits, face, and neck without IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck. Combined pre- and postcontrast imaging provides the best opportunity to identify

and delineate local tumor recurrence, distinguishing it from treatment-related change and in evaluating local tumor response. The absence of IV contrast limits the ability to accurately delineate the margin and the soft tissue extent of tumor. However, noncontrast MR sequences are routinely used to identify tumor recurrence and can define tumor extent, in particular marrow involvement, and are used in nodal assessment.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Y. Radiography chest

CXR is not considered useful for the evaluation of pulmonary metastatic disease in treated cancer of the oral cavity or oropharynx or hypopharynx, or larynx or cancer of unknown primary of the head and neck. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck.

Variant 5: Treated cancer of the oral cavity or oropharynx or hypopharynx or larynx or cancer of unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
[. US neck

US coupled with fine-needle aspiration and/or core-needle biopsy can be a useful tool in regional nodal evaluation following treatment of cancer of the oral cavity, oropharynx, hypopharynx, larynx, or cancer of unknown primary of the head and neck [140]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator dependent nature of this technique. US alone has been shown to very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65]. In the presence of bulky nodal disease, US combined with FDG-PET/CT was found to be a reliable strategy to identify patients with complete nodal response to therapy with a higher combined NPV [65]. US has been shown to perform similar to CT in detection of recurrence of head and neck squamous cell carcinomas [141] but is inherently limited by operator skill and its inability to evaluate deep neck structures.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Nasopharynx cancer and EBV-associated unknown primary of the head and neck is known to be responsive to radiotherapy and, in advanced disease, the combination of radiation and

chemotherapy. The early accurate identification of residual or recurrent disease, distant metastases, and de-differentiation from posttreatment changes is vital in posttreatment imaging and evaluation in order to determine the need for salvage therapy for improved survival. The incidence of recurrent disease following therapy has been reported to range from 6% to 16% with around half of recurrences occurring in the first 2 years [142,143]. The presence of recurrence is associated with increased risk for distant metastatic disease, reported at 30%, with distant metastatic disease the most common cause of death after treatment in NPC [142].

Direct visualization with flexible endoscopy is considered the most sensitive method for detecting mucosal recurrence. However, submucosal and deep-seated recurrences are best identified by imaging, preferably cross-sectional imaging such as MRI or functional imaging with FDG-PET/CT. Additionally, imaging in the setting of treated NPC may be geared toward detecting complications secondary to therapy, which include but are not limited to osteoradionecrosis of the skull base, brain parenchymal radiation necrosis, and infection, among others. The appropriate imaging modality to evaluate each potential suspected complication will depend on the clinical scenario and is beyond the scope of this document.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to ribs or vertebrae. NPC has a relatively high rate of distant metastases with the lung being the second most common site of distant disease after osseous metastases. Although FDG-PET/CT is preferred for the restaging of advanced stage NPC because it allows for simultaneous detection of metastatic disease outside the thorax, CT chest may be considered for screening of pulmonary metastatic disease. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. CT chest may also be indicated in patients with NPC associated with smoking and alcohol intake, increasing the risk for synchronous lung cancer. The use of IV contrast may improve detection of mediastinal and hilar adenopathy by distinguishing nodes from mediastinal vessels. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of treated nasopharynx cancer or EBV-associated unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to ribs or vertebrae. NPC has a relatively high rate of distant metastases with the lung being the second most common site of distant disease after osseous metastases. Although FDG-PET/CT is preferred for the restaging of advanced stage NPC because it allows for simultaneous detection of metastatic disease outside the thorax, CT chest may be

considered for the screening of pulmonary metastatic disease. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. CT chest may also be indicated in patients with NPC associated with smoking and alcohol intake, increasing the risk for synchronous lung cancer. The use of IV contrast may improve detection of mediastinal and hilar adenopathy by distinguishing nodes from mediastinal vessels. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
D. CT head with IV contrast

There is no relevant literature to support the use of CT head with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck. Although CT head may be able to delineate skull base and intracranial involvement, inclusion of the neck is recommended to evaluate for cervical adenopathy for staging purposes.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT head without and with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
F. CT head without IV contrast

There is no relevant literature to support the use of CT head without IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck. CT maxillofacial may provide sufficient coverage for the anatomic evaluation of the primary site. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast in treated

cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of nasopharyngeal tumor, treatment response assessment, and regional nodal staging. The evaluation of the posttreatment neck is often complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. MRI confers improved soft tissue contrast over CT and is generally the preferred imaging modality for evaluating NPC recurrence. CT imaging does allow for excellent delineation of osseous anatomy, including bony destruction that can be seen in the context of recurrence or as a complication of treatment such as in osteoradionecrosis [144]. CT is also used to monitor treatment changes and assess for treatment complications such as infection. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast in treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA of the neck with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck. In the case of recurrent disease encroaching on the carotid arteries, CTA of the neck can be used to identify patients at high risk of bleeding [41].

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the assessment of treatment response, detection and localization of recurrence, regional nodal disease, and distant metastases in treated NPC [75,90,145-147]. The presence of posttreatment inflammatory changes decreases the specificity of FDG-PET/CT, and, for this reason, imaging ideally occurs at a minimum of 12 weeks from completion of therapy to allow

for treatment effects to subside, although imaging as early as 8 weeks after therapy has been suggested [136]. Concurrent infection can similarly give false-positive findings. The high NPV of FDG-PET/CT is very useful in excluding recurrence [147]. FDG-PET/CT has demonstrated similar detection rates of local recurrence as MRI but increased specificity of imaging findings, in particular in patients with treated advanced disease [143,145,146,148]. Metabolic response on posttreatment FDG-PET/CT has been shown to be an independent prognostic indicator conferring improved survival [149]. FDG-PET/CT has a high sensitivity and accuracy in detecting distant metastases, including osseous and pulmonary metastases [82,87,88], the most common sites for distant metastatic disease in NPC.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is a new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging, including the response assessment and evaluation of recurrence following treatment of cancer of the head and neck with FDG-PET/MR performing similarly to FDG/PET CT [137,138].

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI head with IV contrast in follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI head without and with IV contrast in follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated unknown primary of the head and neck. The coverage of MRI of the head and its associated sequences may be insufficient to completely evaluate the primary site in the nasopharynx and will not include regional nodal staging. MRI head without and with IV contrast may be used to further delineate advanced intracranial extension of disease.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI head without IV contrast in follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck with IV contrast in follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution, which facilitates assessment of local recurrence, and can be helpful in distinguishing it from treatment related change and for evaluating local tumor response. The superior soft tissue contrast resolution relative to CECT is critical in distinguishing recurrence from treatment changes and in the delineation of tumor recurrence, including extension into adjacent structures such as the orbits, skull base, and intracranial compartment, and the perineural spread of disease. MRI has been reported to detect up to 27.8% of deep-seated recurrences that were occult on endoscopic evaluation [142]. However, posttreatment inflammatory changes, reactive mucosal change, postradiation scarring, or osteoradionecrosis may complicate MRI interpretation, and FDG-PET/CT has been shown to have increased specificity in detecting local recurrence, in particular in treated advanced disease [143,145,146,148]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate recurrence site, distinguishing it from the surrounding soft tissues and treatment changes.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck without IV contrast in follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated unknown primary of the head and neck. Combined pre- and postcontrast imaging provides the best opportunity to identify and delineate local tumor recurrence, distinguishing it from treatment-related change and in evaluating local tumor response. The absence of IV contrast limits the ability to accurately delineate the margin and the soft tissue extent of the tumor. However, noncontrast MR sequences are routinely used to identify

tumor recurrence and can define tumor extent, in particular marrow involvement, and are used in nodal assessment.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Y. Radiography chest

CXR is not considered the imaging modality of choice for the evaluation of pulmonary metastatic disease in treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the follow-up imaging or evaluation of suspected or known recurrence of treated cancer of the nasopharynx or EBV-associated cancer of unknown primary of the head and neck.

Variant 6: Treated nasopharynx cancer or EBV-associated unknown primary of the head and neck. Surveillance imaging or follow-up imaging for suspected or known recurrence.
[. US neck

US coupled with fine-needle aspiration and/or core-needle biopsy can be a useful tool in regional nodal evaluation following treatment of NPC [140]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator-dependent nature of this technique. US alone has been shown to very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65]. In the presence of bulky nodal disease in squamous cell carcinoma, US combined with FDG-PET/CT was found to be a reliable strategy to identify patients with complete nodal response to therapy with a higher combined NPV [65].

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.

Cancer of the paranasal sinuses or nasal cavity is generally treated with a combination of surgery, chemotherapy, and/or radiation therapy [117]. Despite aggressive therapy, recurrence rates may be high, estimated at up to 54% in cases of advanced head and neck squamous cell carcinomas, and these typically occur within the first 2 years following treatment [117].

Early diagnosis of recurrent disease allows for prompt treatment and for providing potential salvage options, which may portend increased survival rates [117]. However, complex posttreatment changes can distort anatomy and may interfere with the detection of subtle findings. Direct visualization with flexible endoscopy is considered the most sensitive method for detecting mucosal recurrence. However, submucosal and deep-seated recurrences are best identified by imaging, preferably cross-sectional imaging such as MRI or functional imaging with

FDG-PET/CT. Imaging is also crucial for the detection of distant metastatic disease. Additionally, imaging in the setting of treated sinonasal malignancy may be geared toward detecting complications secondary to therapy, which include but are not limited to cerebrospinal fluid leaks, epistaxis, meningitis, and osteoradionecrosis of the skull base, among others. The appropriate imaging modality to evaluate each potential suspected complication will depend on the clinical scenario and is beyond the scope of this document.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Patients with recurrent head and neck squamous cell carcinoma are significantly more likely to have pulmonary metastatic disease [21,120]. Development of lung metastases is also increased in advanced stage disease [15]. CT chest confers superior spatial localization and contrast resolution when compared to radiography, allowing for the improved detection of small pulmonary nodules [15]. The use of screening CT chest in patients treated with definitive therapy have been shown to detect metastatic disease that was successfully treated with salvage therapy [121]. The rates of detection of pulmonary metastatic disease in the setting of recurrent disease for chest CT is similar to that of FDG-PET/CT [122]. The use of IV contrast allows for improved detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aiding in the delineation of the soft tissue extension of skeletal metastatic disease. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Patients with recurrent head and neck squamous cell carcinoma are significantly more likely to have pulmonary metastatic disease [21,120]. Development of lung metastases is also increased in advanced stage disease [15]. CT chest confers a superior spatial localization and contrast resolution compared to radiography, allowing for the improved detection of small pulmonary nodules [15]. The use of screening CT chest in patients treated with definitive therapy have been shown to detect metastatic disease that was successfully treated with salvage therapy [121]. The rates of detection of pulmonary metastatic disease in the setting of recurrent disease for chest CT is similar to that of FDG-PET/CT [122]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy, distinguishing nodes from mediastinal vessels and aiding in the delineation of the soft tissue extension of the skeletal metastatic disease. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
D. CT head with IV contrast

There is no relevant literature to support the use of CT of the head with IV contrast in the evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity. CT head may provide sufficient coverage for the anatomic evaluation of the primary tumor site in the sinonasal cavity; however, inclusion of the neck is recommended to evaluate for cervical adenopathy for staging purposes.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
E. CT head without and with IV contrast

There is no relevant literature to support the use of CT of the head without and with IV contrast in the evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
F. CT head without IV contrast

There is no relevant literature to support the use of CT of the head without IV contrast in the evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
G. CT maxillofacial with IV contrast

There is no relevant literature to support the use of CT maxillofacial with IV contrast for the evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity. CT of the maxillofacial region may provide sufficient coverage for the anatomic evaluation of the primary tumor site. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the use of CT maxillofacial without and with IV contrast for evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
I. CT maxillofacial without IV contrast

There is no relevant literature to support the use of CT maxillofacial without IV contrast for the evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of recurrent sinonasal tumors, treatment response assessment, and regional nodal staging. CT provides excellent delineation of the sinonasal skeleton and is superior to MRI in the depiction of osseous anatomy [96]. The presence of skull base foraminal widening, which can be detected on thin-section CT and reconstructions, may alert to perineural tumor spread [96]. Evaluation of the treated neck is very often complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. MRI confers improved soft tissue contrast over CT and is generally the preferred imaging modality for evaluating for sinonasal recurrence. However, CT is often used to monitor treatment changes and assess for treatment complications such as infection or osteoradionecrosis. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
K. CT neck without and with IV contrast

There is no relevant literature to support the use of CT neck without and with IV contrast for evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
L. CT neck without IV contrast

There is no relevant literature to support the use of CT neck without IV contrast for evaluation of suspected or known recurrence of treated cancer of the paranasal sinuses or nasal cavity. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
M. CTA neck with IV contrast

There is no relevant literature to support the use of CTA of the neck with IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity. In the case of recurrent disease encroaching on the carotid arteries, CTA of the neck can be used to identify patients at a high risk of bleeding [41].

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the assessment of treatment response, detection, and localization of recurrence, regional nodal disease, and distant metastases in treated cancer of the paranasal sinuses or nasal cavity. Evaluation of the treated neck is very often complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. The presence of posttreatment inflammatory change decreases the specificity of findings on FDG-PET/CT [134]. For this reason, imaging with FDG-PET/CT is preferred to occur at a minimum of 12 weeks after completion of therapy to allow for treatment effects to subside

[117,118], although imaging as early as 8 weeks after therapy has been suggested [136]. Concurrent infection can similarly give false-positive findings. Because of the relatively low positive predictive values of FDG-PET/CT [150], physical examination as well as complementary imaging with MRI remains of utmost importance to elucidate findings discovered on PET/CT and to determine a degree of suspicion. FDG-PET/CT has a high NPV and therefore is very helpful in excluding recurrence [150]. One study calculated an NPV of 91% of a single PET/CT examination obtained at any time after completion of therapy for head and neck squamous cell carcinoma. NPV would increase to 98% if a second scan was also found to be negative [151]. FDG-PET/CT has been found to accurately diagnose distant metastatic disease in the posttreatment setting. In one series, distant metastases were detected in 27% of patients on FDG-PET/CT [102]. Of note, PET/CT is of limited value in cases in which the original tumor demonstrates poor FDG uptake. Tumors with low FDG metabolic activity result in suboptimal delineation of primary tumor recurrence, lymph node involvement, and distant disease [150].

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is a new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging, including the response assessment and evaluation of recurrence following treatment of cancer of the head and neck, with FDG-PET/MRI performing similarly to FDG/PET CT [137,138].

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
P. MRA neck with IV contrast

There is no relevant literature to support the use of MRA neck with IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Q. MRA neck without and with IV contrast

There is no relevant literature to support the use of MRA neck without and with IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
R. MRA neck without IV contrast

There is no relevant literature to support the use of MRA neck without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
S. MRI head with IV contrast

There is no relevant literature to support the use of MRI head with IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
T. MRI head without and with IV contrast

There is no relevant literature to support the use of MRI head with and without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity. The coverage of MRI of the head and its included sequences may be insufficient to completely evaluate the primary site in the paranasal sinuses or nasal cavity and will not include regional nodal staging. MRI head without and with IV contrast may be used to further delineate advanced intracranial extension of disease and can be considered in the follow-up of advanced stage olfactory neuroblastoma, which has a known propensity for intracranial dural-based metastases.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
U. MRI head without IV contrast

There is no relevant literature to support the use of MRI head without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
V. MRI orbits face neck with IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck with IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
W. MRI orbits face neck without and with IV contrast

MRI without and with IV contrast has superior soft tissue contrast resolution, which facilitates assessment of local recurrence and can be helpful in distinguishing it from treatment-related change and in evaluating local tumor response. Perineural tumor spread is more easily recognized with MRI compared to CT, as is regional extension of tumor to neighboring structures such as the orbits, dura, and brain, and subtle marrow involvement [96]. Evaluation of the treated neck is often complicated by significant treatment-related changes that can be difficult to differentiate from persistent disease after therapy or recurrence and may require clinical examination and complementary imaging studies such as FDG-PET/CT. Advanced tools, including higher-resolution imaging, diffusion-weighted and diffusion-tensor sequences, and MRI perfusion techniques such as dynamic contrast-enhanced MRI show promise in improving anatomic and functional imaging [103-105]. These tools may help to distinguish between treatment change and recurrence; however, as of now, they are not consistently used in routine clinical practice.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
X. MRI orbits face neck without IV contrast

There is no relevant literature to support the use of MRI orbits, face, and neck without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity. Combined pre- and postcontrast imaging provides the best

opportunity to identify and delineate local tumor recurrence, distinguishing it from treatment-related change and in evaluating local tumor response. The absence of IV contrast limits the ability to accurately delineate the margins and the soft tissue extent of tumor. However, noncontrast MR sequences are routinely used to identify tumor recurrence and can define tumor extent, in particular marrow involvement, and are used in nodal assessment.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Y. Radiography chest

CXR is not considered the imaging modality of choice for the evaluation of pulmonary metastatic disease in treated cancer of the paranasal sinuses or nasal cavity. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of the paranasal sinuses or nasal cavity.

Variant 7: Treated cancer of the paranasal sinuses or nasal cavity. Surveillance imaging or follow-up imaging for suspected or known recurrence.
[. US neck

US coupled with fine-needle aspiration and/or core-needle biopsy can be a useful tool in regional nodal evaluation following treatment of head and neck cancer [140]. A range of sensitivities and specificities for detection of nodal disease are found in the literature, likely reflecting the highly operator-dependent nature of this technique. US alone has been shown to very sensitive (77.8%-96.8%) and specific (68.75%-97%) in detecting cervical nodal metastases [47,63-65]. In the presence of bulky nodal disease in squamous cell carcinoma, US combined with FDG-PET/CT was found to be a reliable strategy to identify patients with complete nodal response to therapy, with a higher combined NPV [65].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.

Physical examination and imaging surveillance following treatment of malignant neoplasms of the major salivary glands may be obscured or impeded by postoperative scarring and anatomic distortion. Furthermore, deep local recurrences and perineural tumor spread can be inaccessible to clinical assessment and may go overlooked, particularly in early stages [108]. Delayed diagnosis of tumor recurrence portends a poor prognosis and a decrease in long-term survival, independent of histologic type [108,152]. Because perineural tumor spread is common in malignant salivary gland tumors, in particular in adenoid cystic carcinoma, a complete radical resection may not always be feasible and postoperative radiotherapy may be indicated [152].

Regular follow-up is recommended following treatment of malignant salivary gland neoplasms [152]. The majority, approximately 70%, of recurrences of high-grade malignant salivary gland tumors occur in the first 3 years following treatment [108], and these can be subclassified into local, regional, and distant. In a large cohort of 565 patients with salivary gland tumors followed over a 10 year period, local recurrence was reported in 13% of the cases, regional recurrence was seen in 22% of the cases, and distant metastases were documented in 33% of the patients [108]. Other studies reported distant disease in >50% of patients, with adenoid cystic carcinoma, adenocarcinoma, and carcinoma ex pleomorphic adenoma accounting for the majority of the cases [108]. The most common site of metastatic involvement beyond the head and neck in up to 90% of cases is the lungs. A distant second are the bones followed by the liver, brain, and other sites [108].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. A. CT chest with IV contrast

CT chest with IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Pulmonary metastatic disease is the single most common site of metastatic disease beyond the head and neck in suspected or confirmed metastatic disease at follow-up. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy by distinguishing the nodes from mediastinal vessels. There is a paucity of relevant supportive literature specifically comparing the diagnostic performance of CT chest with IV contrast and CT chest without IV contrast.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. B. CT chest without and with IV contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the evaluation of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. C. CT chest without IV contrast

CT chest without IV contrast can accurately identify pulmonary metastasis and be used to detect thoracic nodal and skeletal metastases to the ribs or vertebrae. Pulmonary metastatic disease is the single most common site of metastatic disease beyond the head and neck in suspected or confirmed metastatic disease at follow-up. CT chest confers superior spatial localization and contrast resolution compared to radiography, allowing for the detection of small pulmonary nodules [15]. The use of IV contrast may improve detection of mediastinal and hilar adenopathy by distinguishing the nodes from mediastinal vessels. Noncontrast CT chest may be considered as an alternative and is part of routine clinical practice, although there is paucity of relevant supportive literature evaluating the use of CT chest without IV contrast.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. D. CT head with IV contrast

There is no relevant literature to support the routine use of CT of the head with IV contrast in

follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. E. CT head without and with IV contrast

There is no relevant literature to support the routine use of CT of the head without and with IV contrast in follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. F. CT head without IV contrast

There is no relevant literature to support the routine use of CT of the head without IV contrast in follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. G. CT maxillofacial with IV contrast

There is no relevant literature to support the routine use of CT maxillofacial with IV contrast in follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland. CT of the maxillofacial region may provide sufficient coverage for the anatomic evaluation of the primary tumor site. However, CT maxillofacial will typically not include evaluation of the neck and would therefore be inadequate for the staging of regional lymphadenopathy.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. H. CT maxillofacial without and with IV contrast

There is no relevant literature to support the routine use of CT maxillofacial without and with IV contrast in follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. I. CT maxillofacial without IV contrast

There is no relevant literature to support the routine use of CT maxillofacial without IV contrast in follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. J. CT neck with IV contrast

Although protocols vary across institutions, for the purposes of this document, CT of the neck includes coverage from the top of the frontal sinuses down to the level of the aortic arch, with thin slices, multiplanar reformats, and both soft tissue and bony algorithms. CECT of the neck allows for the detection and localization of recurrent tumor and the evaluation of regional nodal disease. CT is also used to monitor treatment changes and assess for treatment complications such as infection or osteoradionecrosis. Evaluation of the treated neck is very often complicated by

significant treatment related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. Soft tissue resolution of CT is considered inferior to that of MRI [108], and certain cancers such as adenoid cystic carcinoma, mucoepidermoid carcinoma, and acinic cell carcinomas may lack significant contrast enhancement on CT, rendering the detection of recurrence difficult by this modality [111]. Furthermore, MRI is considered superior in the detection of perineural spread and the soft tissue extent of disease [107,108]. Generally, CT is reserved for the evaluation of treatment complications or when there are indeterminate findings regarding osseous invasion [107,108]. CT may prove to be especially useful in the setting of suspected bone involvement because of its improved detection of cortical erosion [112]. The use of IV contrast is recommended to better outline the extent of the primary site.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.
K. CT neck without and with IV contrast

There is no relevant literature to support the routine use of CT neck without and with IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.
L. CT neck without IV contrast

There is no relevant literature to support the routine use of CT neck without IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland. Contrast enhancement is imperative in order to correctly identify and delineate recurrence, distinguishing it from treatment changes.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.
M. CTA neck with IV contrast

There is no relevant literature to support the routine use of CTA of the neck with IV contrast in the follow-up imaging or evaluation of known or suspected recurrence of treated cancer of a major salivary gland. In the case of recurrent disease encroaching on the carotid arteries, CTA of the neck can be used to identify patients at high risk of bleeding [41].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence.
N. FDG-PET/CT skull base to mid-thigh

FDG-PET/CT allows for the assessment of treatment response and detection and localization of recurrence, regional nodal disease, and distant metastases. The utility of FDG-PET/CT depends on the tumor grade, because low-grade salivary gland tumors tend to have relatively low metabolism and may be occult on FDG-PET/imaging. FDG-PET/CT is therefore not routinely recommended for follow-up of low-grade salivary gland tumors [108]. The presence of posttreatment inflammatory change decreases the specificity of findings on FDG-PET/CT. For this reason, imaging with FDG-PET/CT should be delayed at least 8 weeks following therapy and is preferred to occur at a minimum of 12 weeks after completion of therapy to allow for treatment effects to subside [110]. Concurrent infection can similarity give false positive findings. The use of FDG-PET/CT to evaluate for local recurrence may not confer benefit over CECT and MRI [153] but may have benefit in follow-up imaging of high-grade salivary gland tumors because of the increased frequency of distant metastases [108,114].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. O. FDG-PET/MRI skull base to mid-thigh

FDG-PET/MRI is new imaging modality with a growing body of evidence demonstrating the feasibility of use for routine clinical imaging, including the initial staging of major salivary gland tumor, with FDG-PET/MRI performing similarly to FDG-PET/CT. A study comparing FDG-PET/MRI to MRI concluded that FDG-PET/MRI is superior to MRI alone in the detection of local disease recurrence and locoregional nodal metastases in patients with adenoid cystic carcinoma [152]. Also, hybrid FDG-PET/MRI was found to be superior to conventional MRI in its NPV [137]. A separate study suggests FDG-PET/MRI is superior to PET/CT in the setting of salivary gland tumors because of its improved characterization of internal tumor features and because of the propensity of these malignancies to present with perineural tumor spread [154].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. P. MRA neck with IV contrast

There is no relevant literature to support the routine use of MRA of the neck with IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. Q. MRA neck without and with IV contrast

There is no relevant literature to support the routine use of MRA of the neck with and without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. R. MRA neck without IV contrast

There is no relevant literature to support the routine use of MRA of the neck without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. S. MRI head with IV contrast

There is no relevant literature to support the routine use of MRI of the head with IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. T. MRI head without and with IV contrast

There is no relevant literature to support the routine use of MRI of the head with and without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual

glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. U. MRI head without IV contrast

There is no relevant literature to support the routine use of MRI of the head without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. V. MRI orbits face neck with IV contrast

There is no relevant literature to support the routine use of MRI orbits, face, and neck with IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. W. MRI orbits face neck without and with IV contrast

MRI orbits, face, and neck without and with IV contrast has superior soft tissue contrast resolution, which facilitates assessment of local recurrence and can be helpful in distinguishing from treatment-related changes and evaluating local tumor response. Evaluation of the treated neck is very often complicated by significant treatment-related changes that can be difficult to differentiate from persistent disease after therapy or recurrence. Because of the superior soft tissue contrast resolution of MRI, it is considered the modality of choice over CECT for imaging of suspected locoregional tumor recurrence. MRI better delineates the soft tissue extension of tumor, including perineural spread of disease. The use of advanced MRI techniques such as diffusion-weighted imaging may provide further information and increase sensitivity of identifying the recurrent tumor [108]. Combined pre- and postcontrast imaging provides the best opportunity to correctly identify and delineate recurrence and distinguish that from treatment change.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. X. MRI orbits face neck without IV contrast

There is no relevant literature to support the routine use of MRI orbits, face, and neck without IV contrast in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland. Combined pre- and postcontrast imaging provides the best opportunity to identify and delineate local tumor recurrence, distinguishing it from treatment-related change, and in evaluating local tumor response. The absence of IV contrast limits the ability to accurately delineate the margins and the soft tissue extent of the tumor. However, noncontrast MR sequences are routinely used to identify tumor recurrence and can define tumor extent, in particular marrow involvement, and are used in nodal assessment.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. Y. Radiography chest

CXR is not considered the imaging modality of choice for the evaluation of pulmonary metastatic disease in treated cancer of a major salivary gland. Chest CT is far more sensitive in detecting pulmonary metastatic disease compared to radiography [15], with the sensitivity of CXR to detect pulmonary metastatic disease reported as low as 28% compared to chest CT [11]. The low sensitivity may in part be due to the small size of pulmonary nodules at presentation or peripheral

location, in which CXR tends to be less reliable [11]. The use of CXR for detection of metastases has not been shown to improve prognosis because pulmonary metastatic disease detected on CXR tends to be diagnosed at a late stage when it is not as amenable to treatment [18].

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. Z. Radiography paranasal sinuses

There is no relevant literature to support the use of radiography of the paranasal sinuses in the follow-up imaging or the evaluation of known or suspected recurrence of treated cancer of a major salivary gland.

Variant 8: Treated cancer of a major salivary gland (parotid, submandibular, and sublingual glands). Surveillance imaging or follow-up imaging for suspected or known recurrence. [. US neck

US allows for the detection and localization of recurrence following treatment of major salivary gland tumors as well as regional nodal staging. US can additionally serve as guidance for fine-needle aspiration for diagnosis of recurrent disease [108]. Evaluation of the treated neck is complicated by significant treatment-related changes that can be difficult to distinguish from persistent disease after therapy or recurrence. Furthermore, US has limited performance in the deep spaces of the neck and is insufficient in diagnosing deep compartment extension, perineural tumor spread, bone invasion, and oropharyngeal/retropharyngeal nodal involvement [112].

Summary of Highlights

- **Variants 1 and 5:** For initial staging and imaging of treated oral cavity, oropharynx, hypopharynx, or larynx cancer or head and neck cancer of unknown primary, CT neck with IV contrast, MRI orbits, face, and neck without and with IV contrast, and FDG-PET/CT are recommended studies in order to stage the tumor, evaluate for recurrence at the primary site, and assess for nodal disease in the neck. MRI and CT are alternative studies, which provide anatomic delineation of primary site and nodal disease. FDG-PET/CT is complementary and is performed in combination with diagnostic CT or MRI to provide metabolic information and to map systemic involvement. CT chest either with IV contrast or without IV contrast may be appropriate in the event of advanced-stage cancer or in the context of a smoking history in which screening for pulmonary metastatic disease would be appropriate. US of the neck may be appropriate and used to delineate specific features of the primary site or for the evaluation of nodal disease and as guidance for biopsy.
- **Variants 2 and 6:** For initial staging and imaging of treated nasopharynx and EBV-associated head and neck cancer of unknown primary, CT neck with IV contrast, MRI orbits, face, and neck without and with IV contrast, FDG-PET/CT or FDG-PET/MRI are recommended studies in order to stage the tumor, evaluate for recurrence at the primary site, and assess for nodal disease in the neck. Either CT or MRI can be performed, but they are often obtained in combination because they are complementary. MRI provides detailed anatomic delineation of the soft tissue extent of disease and skull-base marrow involvement, whereas CT allows for superior evaluation of osseus anatomy. FDG-PET can be performed as PET/CT or as PET/MRI and is performed in combination with diagnostic CT or MRI to provide metabolic information and to map systemic involvement. CT maxillofacial either without IV contrast or with IV contrast may be appropriate when further osseous detail is needed. CT chest either with IV

contrast or without IV contrast may be appropriate in the event of advanced stage cancer or in the context of a smoking history in which screening for pulmonary metastatic disease would be appropriate. US of the neck may be appropriate for the evaluation of nodal disease, often performed as an adjunct to one of the primary imaging modalities and as guidance for biopsy.

- **Variants 3 and 7:** For initial staging and imaging of treated cancer of the paranasal sinuses or nasal cavity, CT neck with IV contrast, MRI orbits, face, and neck without and with IV contrast, and FDG-PET/CT are recommended studies in order to stage the tumor, evaluate for recurrence at the primary site, and assess for nodal disease in the neck. MRI provides detailed anatomic delineation of the soft tissue extent of disease, whereas CT neck allows for superior evaluation of osseus anatomy. FDG-PET/CT is complementary and is performed in combination with diagnostic CT and MRI to provide metabolic information and to map systemic involvement. CT maxillofacial either without IV contrast or with IV contrast may be appropriate when further osseous detail is needed. CT chest either with IV contrast or without IV contrast may be appropriate in the event of advanced stage cancer or in the context of a smoking history in which screening for pulmonary metastatic disease would be appropriate. US of the neck may be appropriate for the evaluation of nodal disease, often performed as an adjunct to one of the primary imaging modalities and as guidance for biopsy.
- **Variants 4 and 8:** For initial staging and imaging of treated of cancer of a major salivary gland, CT neck with IV contrast, MRI orbits, face, and neck without and with IV contrast, and FDG-PET/CT are recommended studies in order to stage the tumor, evaluate for recurrence at the primary site, and assess for nodal disease in the neck. MRI and CT may be alternative or complementary procedures because both provide detailed anatomic delineation of the primary site; MRI is the procedure of choice when perineural spread is suspected whereas CT provides superior delineation of osseus anatomy. FDG-PET/CT is complementary and is performed in combination with diagnostic CT and MRI to provide metabolic information and to map systemic involvement. CT chest either with IV contrast or without IV contrast may be appropriate in the event of advanced-stage cancer or in the context of a smoking history, in which screening for pulmonary metastatic disease would be appropriate. US of the neck may be appropriate for the evaluation of nodal disease and primary site, often performed as an adjunct to one of the primary imaging modalities and as guidance for biopsy.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Gender Equality and Inclusivity Clause

The ACR acknowledges the limitations in applying inclusive language when citing research studies that predates the use of the current understanding of language inclusive of diversity in sex, intersex, gender, and gender-diverse people. The data variables regarding sex and gender used in

the cited literature will not be changed. However, this guideline will use the terminology and definitions as proposed by the National Institutes of Health.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

References

1. Rettig EM, D'Souza G. Epidemiology of head and neck cancer. [Review]. Surgical Oncology Clinics of North America. 24(3):379-96, 2015 Jul.
2. NCCN Clinical Practice Guidelines in Oncology. Head and Neck Cancers. Version 1.2022. Available at: https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf.
3. Amin MB, Edge S, Greene F, et al. AJCC Cancer Staging Manual. 8th ed. New York, NY: Springer; 2017.
4. Hoang JK, Oldan JD, Mandel SJ, et al. ACR Appropriateness Criteria® Thyroid Disease. J Am Coll Radiol 2019;16:S300-S14.
5. Policeni B, Corey AS, Burns J, et al. ACR Appropriateness Criteria® Cranial Neuropathy. J Am Coll Radiol 2017;14:S406-S20.
6. Aulino JM, Kirsch CFE, Burns J, et al. ACR Appropriateness Criteria® Neck Mass-Adenopathy. J Am Coll Radiol 2019;16:S150-S60.
7. American College of Radiology. ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA). Available at: https://gravitas.acr.org/PPTS/GetDocumentView?docId=164+&releaseId=2.
8. Prasad R, Chen B. Imaging Evaluation of the Head and Neck Oncology Patient. Cancer Treat Res. 174:59-86, 2018.
9. Sanli Y, Zukotynski K, Mittra E, et al. Update 2018: 18F-FDG PET/CT and PET/MRI in Head and Neck Cancer. [Review]. Clin Nucl Med. 43(12):e439-e452, 2018 Dec.
10. Rohde M, Nielsen AL, Johansen J, et al. Head-to-Head Comparison of Chest X-Ray/Head and Neck MRI, Chest CT/Head and Neck MRI, and 18F-FDG PET/CT for Detection of Distant Metastases and Synchronous Cancer in Oral, Pharyngeal, and Laryngeal Cancer. J Nucl Med. 58(12):1919-1924, 2017 12.
11. de Bree R, Deurloo EE, Snow GB, Leemans CR. Screening for distant metastases in patients with head and neck cancer. Laryngoscope. 110(3 Pt 1):397-401, 2000 Mar.
12. de Bree R, Ljumanovic R, Hazewinkel MJ, Witte BI, Castelijns JA. Radiologic extranodal spread and matted nodes: Important predictive factors for development of distant metastases in patients with high-risk head and neck cancer. Head Neck. 38 Suppl 1:E1452-8, 2016 04.
13. Senft A, Hoekstra OS, Castelijns JA, Leemans CR, de Bree R. Pretreatment screening for distant metastases in the Dutch head and neck centers: 10 years later. European Archives of Oto-Rhino-Laryngology. 273(10):3287-91, 2016 Oct.
14. Jackel MC, Reischl A, Huppert P. Efficacy of radiologic screening for distant metastases and second primaries in newly diagnosed patients with head and neck cancer. Laryngoscope. 117(2):242-7, 2007 Feb.
15. Fukuhara T, Fujiwara K, Fujii T, et al. Usefulness of chest CT scan for head and neck cancer. Auris Nasus Larynx. 42(1):49-52, 2015 Feb.

16. Halimi C, Barry B, De Raucourt D, et al. Guidelines of the French Society of Otorhinolaryngology (SFORL), short version. Diagnosis of local recurrence and metachronous locations in head and neck oncology. Eur Ann Otorhinolaryngol Head Neck Dis. 132(5):287-90, 2015 Nov.

17. Lee JR, Kim JS, Roh JL, et al. Detection of occult primary tumors in patients with cervical metastases of unknown primary tumors: comparison of (18)F FDG PET/CT with contrast-enhanced CT or CT/MR imaging-prospective study. Radiology. 274(3):764-71, 2015 Mar.

18. Ong TK, Kerawala CJ, Martin IC, Stafford FW. The role of thorax imaging in staging head and neck squamous cell carcinoma. Journal of Cranio-Maxillo-Facial Surgery. 27(6):339-44, 1999 Dec.

19. Senft A, Hoekstra OS, Witte BI, Leemans CR, de Bree R. Screening for distant metastases in head and neck cancer patients using FDG-PET and chest CT: validation of an algorithm. European Archives of Oto-Rhino-Laryngology. 273(9):2643-50, 2016 Sep.

20. Piersiala K, Akst LM, Hillel AT, Best SR. Clinical practice patterns in laryngeal cancer and introduction of CT lung screening. Am J Otolaryngol. 40(4):520-524, 2019 Jul - Aug.

21. Jaspers GW, Witjes MJ, Groen HJ, Groen H, Rodiger LA, Roodenburg JL. Strategies for patients with newly diagnosed oral squamous cell carcinoma and a positive chest CT. A cohort study on the effects on treatment planning and incidence. Eur J Surg Oncol. 37(3):272-7, 2011 Mar.

22. Locatello LG, Bruno C, Pietragalla M, et al. A critical evaluation of computed tomography-derived depth of invasion in the preoperative assessment of oral cancer staging. Oral Oncol. 107:104749, 2020 08.

23. Madana J, Laliberte F, Morand GB, et al. Computerized tomography based tumor-thickness measurement is useful to predict postoperative pathological tumor thickness in oral tongue squamous cell carcinoma. J Otolaryngol Head Neck Surg. 44:49, 2015 Nov 16.

24. Yoon BC, Buch K, Cunnane ME, Sadow PM, Varvares MA, Juliano AF. Comparison between computed tomography and ultrasound for presurgical evaluation of oral tongue squamous cell carcinoma tumor thickness. American Journal of Otolaryngology. 42(6):103089, 2021 Nov-Dec.

25. Yoon BC, Bulbul MD, Sadow PM, et al. Comparison of Intraoperative Sonography and Histopathologic Evaluation of Tumor Thickness and Depth of Invasion in Oral Tongue Cancer: A Pilot Study. Ajnr: American Journal of Neuroradiology. 41(7):1245-1250, 2020 07.

26. Waech T, Pazahr S, Guarda V, Rupp NJ, Broglie MA, Morand GB. Measurement variations of MRI and CT in the assessment of tumor depth of invasion in oral cancer: A retrospective study. Eur J Radiol. 135:109480, 2021 Feb.

27. Handschel J, Naujoks C, Depprich RA, et al. CT-scan is a valuable tool to detect mandibular involvement in oral cancer patients. Oral Oncol. 48(4):361-6, 2012 Apr.

28. Naz N, Sattar J, Ashrafi SK. Diagnostic Accuracy of Computed Tomography in Detecting Bone Invasion due to Squamous Cell Carcinoma of Buccal Mucosa. J Coll Physicians Surg Pak. 28(11):829-833, 2018 Nov.

29. Slieker FJB, Dankbaar JW, de Bree R, Van Cann EM. Detecting Bone Invasion of the Maxilla by Oral Squamous Cell Carcinoma: Diagnostic Accuracy of Preoperative Computed

Tomography Versus Magnetic Resonance Imaging. J Oral Maxillofac Surg. 78(9):1645-1652, 2020 Sep.

30. Adolphs AP, Boersma NA, Diemel BD, et al. A systematic review of computed tomography detection of cartilage invasion in laryngeal carcinoma. [Review]. Laryngoscope. 125(7):1650-5, 2015 Jul.

31. Farrow ES, Boulanger T, Wojcik T, Lemaire AS, Raoul G, Julieron M. Magnetic resonance imaging and computed tomography in the assessment of mandibular invasion by squamous cell carcinoma of the oral cavity. Influence on surgical management and post-operative course. Rev Stomatol Chir Maxillofac Chir Orale. 117(5):311-321, 2016 Nov.

32. Suzuki N, Kuribayashi A, Sakamoto K, et al. Diagnostic abilities of 3T MRI for assessing mandibular invasion of squamous cell carcinoma in the oral cavity: comparison with 64-row multidetector CT. Dentomaxillofac Radiol. 48(4):20180311, 2019 May.

33. Cho SJ, Lee JH, Suh CH, et al. Comparison of diagnostic performance between CT and MRI for detection of cartilage invasion for primary tumor staging in patients with laryngo-hypopharyngeal cancer: a systematic review and meta-analysis. Eur Radiol. 30(7):3803-3812, 2020 Jul.

34. Wu JH, Zhao J, Li ZH, et al. Comparison of CT and MRI in Diagnosis of Laryngeal Carcinoma with Anterior Vocal Commissure Involvement. Sci. rep.. 6:30353, 2016 08 02.

35. Bae MR, Roh JL, Kim JS, et al. 18F-FDG PET/CT versus CT/MR imaging for detection of neck lymph node metastasis in palpably node-negative oral cavity cancer. J Cancer Res Clin Oncol. 146(1):237-244, 2020 Jan.

36. Cho JK, Ow TJ, Lee AY, et al. Preoperative 18F-FDG-PET/CT vs Contrast-Enhanced CT to Identify Regional Nodal Metastasis among Patients with Head and Neck Squamous Cell Carcinoma. Otolaryngol Head Neck Surg. 157(3):439-447, 2017 09.

37. Kim SJ, Pak K, Kim K. Diagnostic accuracy of F-18 FDG PET or PET/CT for detection of lymph node metastasis in clinically node negative head and neck cancer patients; A systematic review and meta-analysis. Am J Otolaryngol. 40(2):297-305, 2019 Mar - Apr.

38. Lee HJ, Kim J, Woo HY, Kang WJ, Lee JH, Koh YW. 18F-FDG PET-CT as a supplement to CT/MRI for detection of nodal metastasis in hypopharyngeal SCC with palpably negative neck. Laryngoscope. 125(7):1607-12, 2015 Jul.

39. Sohn B, Koh YW, Kang WJ, Lee JH, Shin NY, Kim J. Is there an additive value of 18 F-FDG PET-CT to CT/MRI for detecting nodal metastasis in oropharyngeal squamous cell carcinoma patients with palpably negative neck?. Acta Radiol. 57(11):1352-1359, 2016 Nov.

40. Erdogan N, Bulbul E, Songu M, et al. Puffed-cheek computed tomography: a dynamic maneuver for imaging oral cavity tumors. Ear Nose Throat J. 91(9):383-4, 386, 2012 Sep.

41. Cannavale A, Corona M, Nardis P, et al. Computed Tomography Angiography findings can predict massive bleeding in head and neck tumours. Eur J Radiol. 125:108910, 2020 Apr.

42. Ryan JL, Aaron VD, Sims JB. PET/MRI vs PET/CT in Head and Neck Imaging: When, Why, and How?. [Review]. Semin Ultrasound CT MR. 40(5):376-390, 2019 Oct.

43. Ghanooni R, Delpierre I, Magremanne M, et al. 18F-FDG PET/CT and MRI in the follow-up of head and neck squamous cell carcinoma. Contrast Media Mol Imaging. 6(4):260-6, 2011 Jul-Aug.

44. Huang SH, Chien CY, Lin WC, et al. A comparative study of fused FDG PET/MRI, PET/CT, MRI, and CT imaging for assessing surrounding tissue invasion of advanced buccal squamous cell carcinoma. Clin Nucl Med. 36(7):518-25, 2011 Jul.

45. Kim SY, Kim JS, Doo H, et al. Combined [18F]fluorodeoxyglucose positron emission tomography and computed tomography for detecting contralateral neck metastases in patients with head and neck squamous cell carcinoma. Oral Oncol. 47(5):376-80, 2011 May.

46. Yongkui L, Jian L, Wanghan, Jingui L. 18FDG-PET/CT for the detection of regional nodal metastasis in patients with primary head and neck cancer before treatment: a meta-analysis. [Review]. Surg Oncol. 22(2):e11-6, 2013 Jun.

47. Chaukar D, Dandekar M, Kane S, et al. Relative value of ultrasound, computed tomography and positron emission tomography imaging in the clinically node-negative neck in oral cancer. Asia Pac J Clin Oncol. 12(2):e332-8, 2016 Jun.

48. Qualliotine JR, Mydlarz WK, Chan JY, Zhou X, Wang H, Agrawal N. Comparing staging by positron emission tomography with contrast-enhanced computed tomography and by pathology in head and neck squamous cell carcinoma. J Laryngol Otol. 129(12):1213-9, 2015 Dec.

49. Lowe VJ, Duan F, Subramaniam RM, et al. Multicenter Trial of [18F]fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Staging of Head and Neck Cancer and Negative Predictive Value and Surgical Impact in the N0 Neck: Results From ACRIN 6685. J Clin Oncol. 37(20):1704-1712, 2019 07 10.

50. Chaput A, Robin P, Podeur F, et al. Diagnostic performance of 18 fluorodesoxyglucose positron emission/computed tomography and magnetic resonance imaging in detecting T1-T2 head and neck squamous cell carcinoma. Laryngoscope. 128(2):378-385, 2018 02.

51. Lang Kuhs KA, Wood CB, Wiggleton J, et al. Transcervical sonography and human papillomavirus 16 E6 antibodies are sensitive for the detection of oropharyngeal cancer. Cancer. 126(11):2658-2665, 2020 06 01.

52. Becker M, Zaidi H. Imaging in head and neck squamous cell carcinoma: the potential role of PET/MRI. [Review]. Br J Radiol. 87(1036):20130677, 2014 Apr.

53. Partovi S, Kohan A, Vercher-Conejero JL, et al. Qualitative and quantitative performance of 18F-FDG-PET/MRI versus 18F-FDG-PET/CT in patients with head and neck cancer. AJNR Am J Neuroradiol. 35(10):1970-5, 2014 Oct.

54. Schaarschmidt BM, Heusch P, Buchbender C, et al. Locoregional tumour evaluation of squamous cell carcinoma in the head and neck area: a comparison between MRI, PET/CT and integrated PET/MRI. Eur J Nucl Med Mol Imaging. 43(1):92-102, 2016 Jan.

55. Schlittenbauer T, Zeilinger M, Nkenke E, et al. Positron emission tomography-computed tomography versus positron emission tomography-magnetic resonance imaging for diagnosis of oral squamous cell carcinoma: A pilot study. J Craniomaxillofac Surg. 43(10):2129-35, 2015 Dec.

56. Sekine T, de Galiza Barbosa F, Kuhn FP, et al. PET+MR versus PET/CT in the initial staging of head and neck cancer, using a trimodality PET/CT+MR system. Clin Imaging. 42:232-239, 2017 Mar - Apr.

57. Chen J, Hagiwara M, Givi B, et al. Assessment of metastatic lymph nodes in head and neck squamous cell carcinomas using simultaneous 18F-FDG-PET and MRI. Sci. rep.. 10(1):20764, 2020 11 27.

58. Sekine T, Barbosa FG, Sah BR, et al. PET/MR Outperforms PET/CT in Suspected Occult Tumors. Clin Nucl Med. 42(2):e88-e95, 2017 Feb.

59. Park SI, Guenette JP, Suh CH, et al. The diagnostic performance of CT and MRI for detecting extranodal extension in patients with head and neck squamous cell carcinoma: a systematic review and diagnostic meta-analysis. Eur Radiol. 31(4):2048-2061, 2021 Apr.

60. Allegra E, Ferrise P, Trapasso S, et al. Early glottic cancer: role of MRI in the preoperative staging. Biomed Res Int. 2014:890385, 2014.

61. Hagiwara M, Nusbaum A, Schmidt BL. MR assessment of oral cavity carcinomas. [Review]. Magn Reson Imaging Clin N Am. 20(3):473-94, 2012 Aug.

62. Stoeckli SJ, Haerle SK, Strobel K, Haile SR, Hany TF, Schuknecht B. Initial staging of the neck in head and neck squamous cell carcinoma: a comparison of CT, PET/CT, and ultrasound-guided fine-needle aspiration cytology. Head Neck. 34(4):469-76, 2012 Apr.

63. Hwang HS, Perez DA, Orloff LA. Comparison of positron emission tomography/computed tomography imaging and ultrasound in staging and surveillance of head and neck and thyroid cancer. Laryngoscope. 119(10):1958-65, 2009 Oct.

64. Ashraf M, Biswas J, Jha J, et al. Clinical utility and prospective comparison of ultrasonography and computed tomography imaging in staging of neck metastases in head and neck squamous cell cancer in an Indian setup. Int J Clin Oncol. 16(6):686-93, 2011 Dec.

65. Pellini R, Manciocco V, Turri-Zanoni M, et al. Planned neck dissection after chemoradiotherapy in advanced oropharyngeal squamous cell cancer: the role of US, MRI and FDG-PET/TC scans to assess residual neck disease. J Craniomaxillofac Surg. 42(8):1834-9, 2014 Dec.

66. Faraji F, Coquia SF, Wenderoth MB, et al. Evaluating oropharyngeal carcinoma with transcervical ultrasound, CT, and MRI. Oral Oncol. 78:177-185, 2018 03.

67. Klein Nulent TJW, Noorlag R, Van Cann EM, et al. Intraoral ultrasonography to measure tumor thickness of oral cancer: A systematic review and meta-analysis. Oral Oncol. 77:29-36, 2018 02.

68. Rocchetti F, Tenore G, Montori A, et al. Preoperative evaluation of tumor depth of invasion in oral squamous cell carcinoma with intraoral ultrasonography: a retrospective study. Oral Surg Oral Med Oral Pathol Oral Radiol. 131(1):130-138, 2021 Jan.

69. Smiley N, Anzai Y, Foster S, Dillon J. Is Ultrasound a Useful Adjunct in the Management of Oral Squamous Cell Carcinoma?. J Oral Maxillofac Surg. 77(1):204-217, 2019 Jan.

70. Dhoot NM, Singh S, Choudhury B, et al. Evaluation of hypopharyngeal carcinoma using high-resolution ultrasound: comparison with CT. J Clin Ultrasound. 42(3):143-9, 2014 Mar-Apr.

71. Hu Q, Zhu SY, Zhang Z, Luo F, Mao YP, Guan XH. Assessment of glottic squamous cell carcinoma: comparison of sonography and non-contrast-enhanced magnetic resonance imaging. J Ultrasound Med. 30(11):1467-74, 2011 Nov.

72. Hu Q, Luo F, Zhu SY, Zhang Z, Mao YP, Hui Guan X. Staging of laryngeal carcinoma: comparison of high-frequency sonography and contrast-enhanced computed tomography. Clin Radiol. 67(2):140-7, 2012 Feb.

73. Rzepakowska A, Osuch-Wojcikiewicz E, Bruzgielewicz A, Niemczyk K. How useful is ultrasound in the assessment of local advancement of laryngeal cancer?. Otolaryngol Pol. 69(2):21-6, 2015.

74. Xiao BB, Chen QY, Sun XS, et al. Low value of whole-body dual-modality [18f]fluorodeoxyglucose positron emission tomography/computed tomography in primary staging of stage I-II nasopharyngeal carcinoma: a nest case-control study. Eur Radiol. 31(7):5222-5233, 2021 Jul.

75. Mohandas A, Marcus C, Kang H, Truong MT, Subramaniam RM. FDG PET/CT in the management of nasopharyngeal carcinoma. [Review]. AJR Am J Roentgenol. 203(2):W146-57, 2014 Aug.

76. Juliano A, Moonis G. Computed Tomography Versus Magnetic Resonance in Head and Neck Cancer: When to Use What and Image Optimization Strategies. [Review]. Magn Reson Imaging Clin N Am. 26(1):63-84, 2018 Feb.

77. Hu YC, Chang CH, Chen CH, et al. Impact of intracranial extension on survival in stage IV nasopharyngeal carcinoma: identification of a subset of patients with better prognosis. Jpn J Clin Oncol. 41(1):95-102, 2011 Jan.

78. King AD, Ahuja AT, Leung SF, et al. Neck node metastases from nasopharyngeal carcinoma: MR imaging of patterns of disease. Head & Neck. 22(3):275-81, 2000 May.

79. Al Tamimi AS, Zaheer S, Ng DC, Osmany S. The incidence and sites of Nasopharyngeal carcinoma (NPC) metastases on FDG PET/CT scans. Oral Oncol. 51(11):1047-1050, 2015 Nov.

80. Dumrongpisutikul N, Luangcharuthorn K. Imaging characteristics of nasopharyngeal carcinoma for predicting distant metastasis. Clin Radiol. 74(10):818.e9-818.e15, 2019 Oct.

81. King AD, Woo JKS, Ai QY, et al. Complementary roles of MRI and endoscopic examination in the early detection of nasopharyngeal carcinoma. Ann Oncol. 30(6):977-982, 2019 06 01.

82. Ng SH, Chan SC, Yen TC, et al. Staging of untreated nasopharyngeal carcinoma with PET/CT: comparison with conventional imaging work-up. European Journal of Nuclear Medicine & Molecular Imaging. 36(1):12-22, 2009 Jan.

83. Shen G, Zhang W, Jia Z, Li J, Wang Q, Deng H. Meta-analysis of diagnostic value of 18F-FDG PET or PET/CT for detecting lymph node and distant metastases in patients with nasopharyngeal carcinoma. [Review]. Br J Radiol. 87(1044):20140296, 2014 Dec.

84. Kao CH, Hsieh JF, Tsai SC, et al. Comparison of 18-fluoro-2-deoxyglucose positron emission tomography and computed tomography in detection of cervical lymph node metastases of nasopharyngeal carcinoma. Annals of Otology, Rhinology & Laryngology. 109(12 Pt 1):1130-4, 2000 Dec.

85. Traylor KS, Koontz N, Mosier K. Squamous Cell Carcinoma: PET/CT and PET/MRI of the Pretreatment and Post-Treatment Neck. [Review]. Semin Ultrasound CT MR. 40(5):400-413, 2019 Oct.

86. Cheng Y, Bai L, Shang J, et al. Preliminary clinical results for PET/MR compared with PET/CT

in patients with nasopharyngeal carcinoma. Oncol Rep. 43(1):177-187, 2020 Jan.

87. Liu FY, Lin CY, Chang JT, et al. 18F-FDG PET can replace conventional work-up in primary M staging of nonkeratinizing nasopharyngeal carcinoma. Journal of Nuclear Medicine. 48(10):1614-9, 2007 Oct.

88. Yi X, Fan M, Liu Y, Zhang H, Liu S. 18 FDG PET and PET-CT for the detection of bone metastases in patients with head and neck cancer. A meta-analysis. J Med Imaging Radiat Oncol. 57(6):674-9, 2013 Dec.

89. Chan SC, Yeh CH, Yen TC, et al. Clinical utility of simultaneous whole-body 18F-FDG PET/MRI as a single-step imaging modality in the staging of primary nasopharyngeal carcinoma. European Journal of Nuclear Medicine & Molecular Imaging. 45(8):1297-1308, 2018 07.

90. Lai V, Khong PL. Updates on MR imaging and 18F-FDG PET/CT imaging in nasopharyngeal carcinoma. Oral Oncol. 50(6):539-48, 2014 Jun.

91. Zhang SX, Han PH, Zhang GQ, et al. Comparison of SPECT/CT, MRI and CT in diagnosis of skull base bone invasion in nasopharyngeal carcinoma. Biomed Mater Eng. 24(1):1117-24, 2014.

92. King AD, Vlantis AC, Yuen TW, et al. Detection of Nasopharyngeal Carcinoma by MR Imaging: Diagnostic Accuracy of MRI Compared with Endoscopy and Endoscopic Biopsy Based on Long-Term Follow-Up. AJNR Am J Neuroradiol. 36(12):2380-5, 2015 Dec.

93. Gao Y, Zhu SY, Dai Y, Lu BF, Lu L. Diagnostic accuracy of sonography versus magnetic resonance imaging for primary nasopharyngeal carcinoma. J Ultrasound Med. 33(5):827-34, 2014 May.

94. Dulguerov P, Jacobsen MS, Allal AS, Lehmann W, Calcaterra T. Nasal and paranasal sinus carcinoma: are we making progress? A series of 220 patients and a systematic review. Cancer. 92(12):3012-29, 2001 Dec 15.

95. Kim SH, Mun SJ, Kim HJ, Kim SL, Kim SD, Cho KS. Differential Diagnosis of Sinonasal Lymphoma and Squamous Cell Carcinoma on CT, MRI, and PET/CT. Otolaryngol Head Neck Surg. 159(3):494-500, 2018 09.

96. Sen S, Chandra A, Mukhopadhyay S, Ghosh P. Imaging Approach to Sinonasal Neoplasms. [Review]. Neuroimaging Clin N Am. 25(4):577-93, 2015 Nov.

97. Sen S, Chandra A, Mukhopadhyay S, Ghosh P. Sinonasal Tumors: Computed Tomography and MR Imaging Features. [Review]. Neuroimaging Clin N Am. 25(4):595-618, 2015 Nov.

98. Jegoux F, Metreau A, Louvel G, Bedfert C. Paranasal sinus cancer. [Review]. Eur Ann Otorhinolaryngol Head Neck Dis. 130(6):327-35, 2013 Dec.

99. Koeller KK. Radiologic Features of Sinonasal Tumors. [Review]. Head Neck Pathol. 10(1):1-12, 2016 Mar.

100. Haerle SK, Soyka MB, Fischer DR, et al. The value of 18F-FDG-PET/CT imaging for sinonasal malignant melanoma. European Archives of Oto-Rhino-Laryngology. 269(1):127-33, 2012 Jan.

101. Laubenbacher C, Saumweber D, Wagner-Manslau C, et al. Comparison of fluorine-18-fluorodeoxyglucose PET, MRI and endoscopy for staging head and neck squamous-cell carcinomas. Journal of Nuclear Medicine. 36(10):1747-57, 1995 Oct.

102. Wild D, Eyrich GK, Ciernik IF, Stoeckli SJ, Schuknecht B, Goerres GW. In-line (18)F-fluorodeoxyglucose positron emission tomography with computed tomography (PET/CT) in patients with carcinoma of the sinus/nasal area and orbit. Journal of Cranio-Maxillo-Facial Surgery. 34(1):9-16, 2006 Jan.

103. Ogawa T, Kojima I, Wakamori S, et al. Clinical utility of apparent diffusion coefficient and diffusion-weighted magnetic resonance imaging for resectability assessment of head and neck tumors with skull base invasion. Head Neck. 42(10):2896-2904, 2020 10.

104. Touska P, Connor SEJ. Recent advances in MRI of the head and neck, skull base and cranial nerves: new and evolving sequences, analyses and clinical applications. [Review]. Br J Radiol. 92(1104):20190513, 2019 Dec.

105. Wang XY, Yan F, Hao H, Wu JX, Chen QH, Xian JF. Improved performance in differentiating benign from malignant sinonasal tumors using diffusion-weighted combined with dynamic contrast-enhanced magnetic resonance imaging. Chin Med J. 128(5):586-92, 2015 Mar 05.

106. Kong X, Li H, Han Z. The diagnostic role of ultrasonography, computed tomography, magnetic resonance imaging, positron emission tomography/computed tomography, and real-time elastography in the differentiation of benign and malignant salivary gland tumors: a meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol. 128(4):431-443.e1, 2019 Oct.

107. Maraghelli D, Pietragalla M, Cordopatri C, et al. Magnetic resonance imaging of salivary gland tumours: Key findings for imaging characterisation. [Review]. European Journal of Radiology. 139:109716, 2021 Jun.

108. Freling N, Crippa F, Maroldi R. Staging and follow-up of high-grade malignant salivary gland tumours: The role of traditional versus functional imaging approaches - A review. [Review]. Oral Oncol. 60:157-66, 2016 09.

109. Thoeny HC. Imaging of salivary gland tumours. [Review] [38 refs]. Cancer Imaging. 7:52-62, 2007 Apr 30.

110. Larson CR, Wiggins RH. FDG-PET Imaging of Salivary Gland Tumors. [Review]. Semin Ultrasound CT MR. 40(5):391-399, 2019 Oct.

111. Ettl T, Schwarz-Furlan S, Gosau M, Reichert TE. Salivary gland carcinomas. [Review]. Oral Maxillofac Surg. 16(3):267-83, 2012 Sep.

112. Lee YY, Wong KT, King AD, Ahuja AT. Imaging of salivary gland tumours. [Review] [44 refs]. European Journal of Radiology. 66(3):419-36, 2008 Jun.

113. Liu Y, Li J, Tan YR, Xiong P, Zhong LP. Accuracy of diagnosis of salivary gland tumors with the use of ultrasonography, computed tomography, and magnetic resonance imaging: a meta-analysis. Oral Surg Oral Med Oral Pathol Oral Radiol. 119(2):238-245.e2, 2015 Feb.

114. Westergaard-Nielsen M, Rohde M, Godballe C, et al. Up-front F18-FDG PET/CT in suspected salivary gland carcinoma. Ann Nucl Med. 33(8):554-563, 2019 Aug.

115. Badger D, Aygun N. Imaging of Perineural Spread in Head and Neck Cancer. [Review]. Radiol Clin North Am. 55(1):139-149, 2017 Jan.

116. Gerwel A, Kosik K, Jurkiewicz D. US in preoperative evaluation of parotid gland neoplasms. Otolaryngol Pol. 69(2):27-33, 2015.

117. Kim JW, Roh JL, Kim JS, et al. (18)F-FDG PET/CT surveillance at 3-6 and 12 months for

detection of recurrence and second primary cancer in patients with head and neck squamous cell carcinoma. Br J Cancer. 109(12):2973-9, 2013 Dec 10.

118. Cheung PK, Chin RY, Eslick GD. Detecting Residual/Recurrent Head Neck Squamous Cell Carcinomas Using PET or PET/CT: Systematic Review and Meta-analysis. [Review]. Otolaryngol Head Neck Surg. 154(3):421-32, 2016 Mar.

119. Suenaga Y, Kitajima K, Ishihara T, et al. FDG-PET/contrast-enhanced CT as a post-treatment tool in head and neck squamous cell carcinoma: comparison with FDG-PET/non-contrast-enhanced CT and contrast-enhanced CT. Eur Radiol. 26(4):1018-30, 2016 Apr.

120. Zammit-Maempel I, Kurien R, Paleri V. Outcomes of synchronous pulmonary nodules detected on computed tomography in head and neck cancer patients: 12-year retrospective review of a consecutive cohort. J Laryngol Otol. 130(6):575-80, 2016 Jun.

121. Iovoli AJ, Platek AJ, Degraaff L, et al. Routine surveillance scanning in HNSCC: Lung screening CT scans have value but head and neck scans do not. Oral Oncol. 86:273-277, 2018 11.

122. Fakhry N, Michel J, Colavolpe C, Varoquaux A, Dessi P, Giovanni A. Screening for distant metastases before salvage surgery in patients with recurrent head and neck squamous cell carcinoma: a retrospective case series comparing thoraco-abdominal CT, positron emission tomography and abdominal ultrasound. Clinical Otolaryngology. 37(3):197-206, 2012 Jun.

123. Sullivan BP, Parks KA, Dean NR, Rosenthal EL, Carroll WR, Magnuson JS. Utility of CT surveillance for primary site recurrence of squamous cell carcinoma of the head and neck. Head & Neck. 33(11):1547-50, 2011 Nov.

124. Hermans R, Pameijer FA, Mancuso AA, Parsons JT, Mendenhall WM. Laryngeal or hypopharyngeal squamous cell carcinoma: can follow-up CT after definitive radiation therapy be used to detect local failure earlier than clinical examination alone?. Radiology. 214(3):683-7, 2000 Mar.

125. Rivelli V, Luebbers HT, Weber FE, Cordella C, Gratz KW, Kruse AL. Screening recurrence and lymph node metastases in head and neck cancer: the role of computer tomography in follow-up. Head Neck Oncol. 3:18, 2011 Mar 25.

126. Sheikhbahaei S, Marcus C, Subramaniam RM. 18F FDG PET/CT and Head and Neck Cancer: Patient Management and Outcomes. [Review]. PET clinics. 10(2):125-45, 2015 Apr.

127. Muller J, Hullner M, Strobel K, Huber GF, Burger IA, Haerle SK. The value of (18) F-FDG-PET/CT imaging in oral cavity cancer patients following surgical reconstruction. Laryngoscope. 125(8):1861-8, 2015 Aug.

128. Kim ES, Yoon DY, Moon JY, et al. Detection of loco-regional recurrence in malignant head and neck tumors: a comparison of CT, MRI, and FDG PET-CT. Acta Radiol. 60(2):186-195, 2019 Feb.

129. Helsen N, Van den Wyngaert T, Carp L, Stroobants S. 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. 45(6):1063-1071, 2018 06.

130. McDermott M, Hughes M, Rath T, et al. Negative predictive value of surveillance PET/CT in head and neck squamous cell cancer. AJNR Am J Neuroradiol. 34(8):1632-6, 2013 Aug.

131. Sagardoy T, Fernandez P, Ghafouri A, et al. Accuracy of (18) FDG PET-CT for treatment evaluation 3 months after completion of chemoradiotherapy for head and neck squamous cell carcinoma: 2-year minimum follow-up. Head Neck. 38 Suppl 1:E1271-6, 2016 04.

132. Dunsky KA, Wehrmann DJ, Osman MM, Thornberry BM, Varvares MA. PET-CT and the detection of the asymptomatic recurrence or second primary lesions in the treated head and neck cancer patient. Laryngoscope. 123(9):2161-4, 2013 Sep.

133. Robin P, Abgral R, Valette G, et al. Diagnostic performance of FDG PET/CT to detect subclinical HNSCC recurrence 6 months after the end of treatment. Eur J Nucl Med Mol Imaging. 42(1):72-8, 2015 Jan.

134. Mori M, Tsukuda M, Horiuchi C, et al. Efficacy of fluoro-2-deoxy-D-glucose positron emission tomography to evaluate responses to concurrent chemoradiotherapy for head and neck squamous cell carcinoma. Auris Nasus Larynx. 38(6):724-9, 2011 Dec.

135. Sjovall J, Wahlberg P, Almquist H, Kjellen E, Brun E. A prospective study of positron emission tomography for evaluation of neck node response 6 weeks after radiotherapy in patients with head and neck squamous cell carcinoma. Head Neck. 38 Suppl 1:E473-9, 2016 04.

136. Leung AS, Rath TJ, Hughes MA, Kim S, Branstetter BF 4th. Optimal timing of first posttreatment FDG PET/CT in head and neck squamous cell carcinoma. Head Neck. 38 Suppl 1:E853-8, 2016 04.

137. Covello M, Cavaliere C, Aiello M, et al. Simultaneous PET/MR head-neck cancer imaging: Preliminary clinical experience and multiparametric evaluation. Eur J Radiol. 84(7):1269-76, 2015 Jul.

138. Romeo V, Iorio B, Mesolella M, et al. Simultaneous PET/MRI in assessing the response to chemo/radiotherapy in head and neck carcinoma: initial experience. Med Oncol. 35(7):112, 2018 Jun 19.

139. Kangelaris GT, Yom SS, Huang K, Wang SJ. Limited utility of routine surveillance MRI following chemoradiation for advanced-stage oropharynx carcinoma. International journal of otolaryngology. 2010, 2010.

140. Lin CM, Wang CP, Chen CN, et al. The application of ultrasound in detecting lymph nodal recurrence in the treated neck of head and neck cancer patients. Sci. rep.. 7(1):3958, 2017 06 21.

141. Park JJ, Emmerling O, Westhofen M. Role of neck ultrasound during follow-up care of head and neck squamous cell carcinomas. Acta Oto-Laryngologica. 132(2):218-24, 2012 Feb.

142. Teo PT, Tan NC, Khoo JB. Imaging appearances for recurrent nasopharyngeal carcinoma and post-salvage nasopharyngectomy. [Review]. Clin Radiol. 68(11):e629-38, 2013 Nov.

143. Wei J, Pei S, Zhu X. Comparison of 18F-FDG PET/CT, MRI and SPECT in the diagnosis of local residual/recurrent nasopharyngeal carcinoma: A meta-analysis. [Review]. Oral Oncol. 52:11-7, 2016 Jan.

144. Xie CM, Liu XW, Li H, et al. Computed tomographic findings of skull base bony changes after radiotherapy for nasopharyngeal carcinoma: implications for local recurrence. J Otolaryngol Head Neck Surg. 40(4):300-10, 2011 Aug.

145. Chan SC, Ng SH, Chang JT, et al. Advantages and pitfalls of 18F-fluoro-2-deoxy-D-glucose

positron emission tomography in detecting locally residual or recurrent nasopharyngeal carcinoma: comparison with magnetic resonance imaging. European Journal of Nuclear Medicine & Molecular Imaging. 33(9):1032-40, 2006 Sep.

146. Chan SC, Yen TC, Ng SH, et al. Differential roles of 18F-FDG PET in patients with locoregional advanced nasopharyngeal carcinoma after primary curative therapy: response evaluation and impact on management. Journal of Nuclear Medicine. 47(9):1447-54, 2006 Sep.

147. Yakoob MY, Theodoratou E, Jabeen A, et al. Preventive zinc supplementation in developing countries: impact on mortality and morbidity due to diarrhea, pneumonia and malaria. [Review]. BMC Public Health. 11 Suppl 3:S23, 2011 Apr 13.

148. Li Z, Li Y, Li N, Shen L. Positron emission tomography/computed tomography outperforms MRI in the diagnosis of local recurrence and residue of nasopharyngeal carcinoma: An update evidence from 44 studies. Cancer Med. 8(1):67-79, 2019 01.

149. Chan SC, Kuo WH, Wang HM, et al. Prognostic implications of post-therapy (18)F-FDG PET in patients with locoregionally advanced nasopharyngeal carcinoma treated with chemoradiotherapy. Ann Nucl Med. 27(8):710-9, 2013 Oct.

150. Lamarre ED, Batra PS, Lorenz RR, et al. Role of positron emission tomography in management of sinonasal neoplasms--a single institution's experience. Am J Otolaryngol. 33(3):289-95, 2012 May-Jun.

151. Argiris A, Karamouzis MV, Raben D, Ferris RL. Head and neck cancer. [Review] [153 refs]. Lancet. 371(9625):1695-709, 2008 May 17.

152. Kirchner J, Schaarschmidt BM, Sauerwein W, et al. 18 F-FDG PET/MRI vs MRI in patients with recurrent adenoid cystic carcinoma. Head Neck. 41(1):170-176, 2019 01.

153. Park HL, Yoo IeR, Lee N, et al. The Value of F-18 FDG PET for Planning Treatment and Detecting Recurrence in Malignant Salivary Gland Tumors: Comparison with Conventional Imaging Studies. Nuclear Medicine & Molecular Imaging. 47(4):242-8, 2013 Dec.

154. Queiroz MA, Huellner MW. PET/MR in cancers of the head and neck. [Review]. Semin Nucl Med. 45(3):248-65, 2015 May.

155. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: https://edge.sitecorecloud.io/americancoldf5f-acrorgf92a-productioncb02-3650/media/ACR/Files/Clinical/Appropriateness-Criteria/ACR-Appropriateness-Criteria-Radiation-Dose-Assessment-Introduction.pdf.

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[a]The University of Texas MD Anderson Cancer Center, Houston, Texas. [b]Research Author, The University of Texas MD Anderson Cancer Center, Houston, Texas. [c]Panel Chair, University of Iowa Hospitals and Clinics, Iowa City, Iowa. [d]Panel Vice-Chair, Massachusetts Eye and Ear, Harvard Medical School, Boston, Massachusetts. [e]Froedtert Memorial Lutheran Hospital Medical College of Wisconsin, Milwaukee, Wisconsin. [f]University of Texas at Austin, Dell Medical School, Austin, Texas; American Society of Clinical Oncology. [g]Houston Methodist Hospital, Houston, Texas. [h]Houston Methodist Hospital, Houston, Texas. [i]New York University Langone Health, New York, New York. [j]University of Iowa Hospital, Iowa City, Iowa, Primary care physician. [k]MetroHealth Medical Center, Cleveland, Ohio. [l]Mayo Clinic Arizona, Phoenix, Arizona. [m]Baptist Medical Center, Jacksonville, Florida; American Academy of Otolaryngology-Head and Neck Surgery. [n]University of Otago, Dunedin, Otepoti, New Zealand; Commission on Nuclear Medicine and Molecular Imaging. [o]George Washington University Hospital, Washington, District of Columbia. [p]University of California San Francisco, San Francisco, California. [q]University of Colorado Denver, Denver, Colorado. [r]Specialty Chair, Montefiore Medical Center, Bronx, New York.