eCQM Title	**Excessive Radiation Dose or Inadequate Image Quality for Diagnostic Computed Tomography (CT) in Adults (Clinician Level)**		
eCQM Identifier (Measure Authoring Tool)	1056	eCQM Version Number	2.2.000
CBE Number	3633e	GUID	3ef4413e-dc67-41bc-bbdb-862815354e34
Measurement Period	January 1, 20XX through December 31, 20XX		
Measure Steward	Alara Imaging, Inc.		
Measure Developer	University of California San Francisco		
Endorsed By	CMS Consensus Based Entity		
Description	This measure provides a standardized method for monitoring the performance of diagnostic CT to discourage unnecessarily high radiation doses, a risk factor for cancer, while preserving image quality. It is expressed as a percentage of patients with CT exams that are out-of-range based on having either excessive radiation dose or inadequate image quality relative to evidence-based thresholds based on the clinical indication for the exam. All diagnostic CT exams of specified anatomic sites performed in inpatient, outpatient and ambulatory care settings are eligible. This measure is not telehealth eligible. This eCQM requires the use of additional software to access primary data elements stored within radiology electronic health records and translate them into data elements that can be ingested by this eCQM. Additional details are included in the Guidance field. The translation software was written and will be updated and maintained by Alara Imaging and will be accessible by creating a secure account through Alara's website.		
Copyright			
Disclaimer	The Measure is not a clinical guideline, does not establish a standard of medical care, and has not been tested for all potential applications. Alara Imaging, Inc., the University of California San Francisco, and its members and users shall not be responsible for any use or accuracy of the Measure or any code contained within the Measure. THE MEASURE AND SPECIFICATIONS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND. Limited proprietary coding is contained in the Measure specifications for convenience. Users of the proprietary code sets should obtain all necessary licenses from the owners of these code sets. Alara Imaging, Inc. disclaims all liability for use or accuracy of any third-party code contained in the specifications. CPT(R) contained in the Measure specifications is copyright 2004-2023 American Medical Association. LOINC(R) is copyright 2004-2023 Regenstrief Institute, Inc. SNOMED Clinical Terms(R) (SNOMED CT[R]) is copyright 2004-2023 International Health Terminology Standards Development Organisation. ICD-10 is copyright 2023 World Health Organization. All Rights Reserved. Due to technical limitations, registered trademarks are indicated by (R) or [R].		
Measure Scoring	Proportion		
Measure Type	Intermediate Clinical Outcome		
Stratification	None		
Risk Adjustment	None		
Rate Aggregation	None		
Rationale	Diagnostic imaging using CT occurs in more than a third of acute care hospitalizations in the U.S. (Vance, 2013) and greater than 90 million scans are performed annually in the U.S. (IMV, 2019). There is marked observed variation in the radiation doses used to perform these exams (Smith-Bindman, 2019). The inconsistency in how CT exams are performed represents a significant, unnecessary, and modifiable iatrogenic health risk, as there is extensive epidemiological and biological evidence that suggests exposure to radiation in the same range as that routinely delivered by CT increases a person's risk of developing cancer (Board of Radiation Effects, 2006; Grant, 2017; Hong, 2019; Sakata, 2019; Sadakane, 2019a, and Sadakane, 2019b; Bernier, 2019; Meulepas, 2019; Brenner, 2020; Berrington de Gonzalez, 2020; Sugiyama, 2020; Hauptmann, 2020; Huang, 2020; Abalo, 2021; Cao, 2022; Hauptmann, 2023). It is estimated that 2% (37,000) of the 1.8 million cancers diagnosed annually in the U.S. are caused by CT exams (Berrington de Gonzalez, 2009; NCI Cancer Statistics, 2020). The measure focuses on reducing radiation dose in CT, an intermediate outcome directly and proportionally related to cancer prevention. As radiation dose is known to be directly related and proportional to future cancer risk (Board of Radiation Effects, 2006; Berrington de Gonzalez, 2009), any reduction in radiation exposure would be expected to lead to a proportional reduction in cancers. Research suggests that when healthcare organizations and clinicians are provided with a summary of their CT radiation doses, their subsequent doses can be reduced without changing the usefulness of these tests (Smith-Bindman, 2020). On the basis of the current estimated number of CT scans performed annually in the U.S. (IMV, 2019), distribution in scan types and observed doses (Demb, 2017; Smith-Bindman, 2019), modeling of the cancer risk associated with CT at different ages of exposure (Berrington de Gonzalez, 2009), and costs of cancer care (Dieguez, 2017; Mariotto, 2011), an estimated 13,982 cancers could be prevented among Medicare beneficiaries annually, resulting in $1.86 billion to $5.21 billion annual cost savings. These cost calculations were supported by more recent data on cancer survivorship and costs, which yielded an estimated $3.04 billion dollars in annual costs savings to Medicare. (Mariotto, 2020; NCI Office of Cancer Survivorship, 2022).		
Clinical Recommendation Statement	The measure aligns with numerous evidence- and consensus-based clinical guidelines asking radiologists to track, optimize, and lower CT radiation doses, guidelines that have been written by the American College of Radiology (Kanal, 2017), cardiovascular imaging societies (Hirshfeld, 2018a, Hirshfeld, 2018b, Hirshfeld, 2018c), Image Gently Alliance, an initiative begun by the American College of Radiology, the Radiological Society of North America, American Society of Radiologic Technologists, the American Association of Physicists in Medicine, and the Society of Pediatric Radiology, which dozens of U.S. and international organizations have joined as recently as 2020 (Image Gently Alliance, 2022), and the US Food and Drug Administration (FDA, 2019). This measure has been strongly supported by a Technical Expert Panel (TEP) comprising a diverse group of clinicians, patient advocates, and leaders of medical specialty societies, payers, and healthcare safety and accrediting organizations, all of whom were engaged through every stage of measure conceptualization, development, and testing. In assessing the face validity of the measure, 100% of TEP members agreed radiation dose and global noise are relevant metrics of CT quality, that size is an appropriate method of risk adjustment, and that performance on this measure of radiation dose and image quality as specified is a representation of quality.		
Improvement Notation	Lower score indicates higher quality, and a decreased score over time indicates improvement		
Reference	Reference Type: CITATION Reference Text: 'Berrington de González, A., Mahesh, M., Kim, K. P., Bhargavan, M., Lewis, R., Mettler, F., & Land, C. (2009). Projected cancer risks from computed tomographic scans performed in the United States in 2007. Archives of internal medicine, 169(22), 2071–2077. https://doi.org/10.1001/archinternmed.2009.440'		
Reference	Reference Type: CITATION Reference Text: 'Board of Radiation Effects Research Division on Earth and Life Sciences National Research Council of the National Academies. (2006). Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2, Washington, D.C.: The National Academies Press.'		

Reference Type: CITATION

Reference | Reference Text: 'Demb, J., Chu, P., Nelson, T., Hall, D., Seibert, A., Lamba, R., … Smith-Bindman, R. (2017). Optimizing radiation doses for computed tomography across institutions: dose auditing and best practices. JAMA internal medicine, 177(6), 810–817. https://doi.org/10.1001/jamainternmed.2017.0445'

Reference Type: CITATION

Reference | Reference Text: 'Dieguez, G., Ferro, C., & Pyenson, B. (2017, April 10). Milliman Research Report: A Multi-Year Look at the Cost Burden of Cancer Care. Milliman. Retrieved from https://www.milliman.com/en/insight/2017/a-multi-year-look-at-the-cost-burden-of-cancer-care'

Reference Type: CITATION

Reference | Reference Text: 'Hong, J. Y., Han, K., Jung, J. H., & Kim, J. S. (2019). Association of exposure to diagnostic low-dose ionizing radiation with risk of cancer among youths in South Korea. JAMA network open, 2(9), e1910584. https://doi.org/10.1001/jamanetworkopen.2019.10584'

Reference Type: CITATION

Reference | Reference Text: 'IMV 2019 CT Market Outlook Report. (2019). Retrieved from https://imvinfo.com/product/2019-ct-market-outlook-report/'

Reference Type: CITATION

Reference | Reference Text: 'Kanal, K. M., Butler, P. F., Sengupta, D., Bhargavan-Chatfield, M., Coombs, L. P., & Morin, R. L. (2017). U.S. diagnostic reference levels and achievable doses for 10 adult CT examinations. Radiology, 284(1), 120–133. https://doi.org/10.1148/radiol.2017161911'

Reference Type: CITATION

Reference | Reference Text: 'Mariotto, A. B., Yabroff, K. R., Shao, Y., Feuer, E. J., & Brown, M. L. (2011). Projections of the cost of cancer care in the United States: 2010-2020. Journal of the National Cancer Institute, 103(2), 117–128. https://doi.org/10.1093/jnci/djq495'

Reference Type: CITATION

Reference | Reference Text: 'National Cancer Institute. (2020, September 25). Cancer Statistics. Retrieved from https://www.cancer.gov/about-cancer/understanding/statistics'

Reference Type: CITATION

Reference | Reference Text: 'Smith-Bindman, R., Wang, Y., Chu, P., Chung, R., Einstein, A. J., Balcombe, J., … Miglioretti, D. L. (2019). International variation in radiation dose for computed tomography examinations: prospective cohort study. BMJ (Clinical research ed.), 364, k4931. https://doi.org/10.1136/bmj.k4931'

Reference Type: CITATION

Reference | Reference Text: 'Smith-Bindman, R., Chu, P., Wang, Y., Chung, R., Lopez-Solano, N., Einstein, A. J., … Miglioretti, D. L. (2020). Comparison of the effectiveness of single-Ccomponent and multicomponent interventions for reducing radiation doses in patients undergoing computed tomography: a randomized clinical trial. JAMA internal medicine, 180(5), 666–675. https://doi.org/10.1001/jamainternmed.2020.0064'

Reference Type: CITATION

Reference | Reference Text: 'U.S. Food and Drug Administration. (2019, June 14) White Paper: Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging. Retrieved from https://www.fda.gov/radiation-emitting-products/initiative-reduce-unnecessary-radiation-exposure-medical-imaging/white-paper-initiative-reduce-unnecessary-radiation-exposure-medical-imaging'

Reference Type: CITATION

Reference | Reference Text: 'Vance, E. A., Xie, X., Henry, A., Wernz, C., & Slonim, A. D. (2013). Computed tomography scan use variation: patient, hospital, and geographic factors. The American journal of managed care, 19(3), e93–e99.'

Reference Type: CITATION

Reference | Reference Text: 'Hirshfeld, J. W. (a), Jr, Ferrari, V. A., Bengel, F. M., Bergersen, L., Chambers, C. E., Einstein, A. J., … Wiggins, B. S. (2018). 2018 ACC/HRS/NASCI/SCAI/SCCT Expert consensus document on optimal use of ionizing radiation in cardiovascular imaging-best practices for safety and effectiveness, part 2: radiological equipment operation, dose-sparing methodologies, patient and medical personnel protection. Catheterization and cardiovascular interventions: official journal of the Society for Cardiac Angiography & Interventions, 92(2), 222–246. https://doi.org/10.1002/ccd.27661'

Reference Type: CITATION

Reference | Reference Text: 'Hirshfeld, J. W. (b), Jr, Ferrari, V. A., Bengel, F. M., Bergersen, L., Chambers, C. E., Einstein, A. J., … Wann, L. S. (2018). 2018 ACC/HRS/NASCI/SCAI/SCCT Expert consensus document on optimal use of ionizing radiation in cardiovascular imaging: best practices for safety and effectiveness: a report of the American College of Cardiology task force on expert consensus decision pathways. Journal of the American College of Cardiology, 71(24), e283–e351. https://doi.org/10.1016/j.jacc.2018.02.016'

Reference Type: CITATION

Reference | Reference Text: 'Hirshfeld, J. W. (c), Jr, Ferrari, V. A., Bengel, F. M., Bergersen, L., Chambers, C. E., Einstein, A. J., … Wann, L. S. (2018). 2018 ACC/HRS/NASCI/SCAI/SCCT Expert consensus document on optimal use of ionizing radiation in cardiovascular imaging-best practices for safety and effectiveness, part 1: radiation physics and radiation biology: a report of the American College of Cardiology task force on expert consensus decision Ppathways. Journal of the American College of Cardiology, 71(24), 2811–2828. https://doi.org/10.1016/j.jacc.2018.02.017'

Reference Type: CITATION

Reference | Reference Text: 'Abalo, K. D., Rage, E., Leuraud, K., Richardson, D. B., Le Pointe, H. D., Laurier, D., & Bernier, M. O. (2021). Early life ionizing radiation exposure and cancer risks: systematic review and meta-analysis. Pediatric radiology, 51(1), 45–56. https://doi.org/10.1007/s00247-020-04803-0'

Reference Type: CITATION

Reference | Reference Text: 'Bernier, M. O., Baysson, H., Pearce, M. S., Moissonnier, M., Cardis, E., Hauptmann, M., … Kesminiene, A. (2019). Cohort Profile: the EPI-CT study: a European pooled epidemiological study to quantify the risk of radiation-induced cancer from paediatric CT. International journal of epidemiology, 48(2), 379–381g. https://doi.org/10.1093/ije/dyy231'

Reference Type: CITATION

Reference | Reference Text: 'Berrington de Gonzalez, A., Daniels, R. D., Cardis, E., Cullings, H. M., Gilbert, E., Hauptmann, M., … Schubauer-Berigan, M. K. (2020). Epidemiological studies of low-dose ionizing radiation and cancer: rationale and framework for the monograph and overview of eligible studies. Journal of the National Cancer Institute. Monographs, 2020(56), 97–113. https://doi.org/10.1093/jncimonographs/lgaa009'

Reference Type: CITATION

Reference | Reference Text: 'Brenner, A. V., Sugiyama, H., Preston, D. L., Sakata, R., French, B., Sadakane, A., … Ozasa, K. (2020). Radiation risk of central nervous system tumors in the Life Span Study of atomic bomb survivors, 1958-2009. European journal of epidemiology, 35(6), 591–600. https://doi.org/10.1007/s10654-019-00599-y'

Reference Type: CITATION

Reference | Reference Text: 'Cao, C. F., Ma, K. L., Shan, H., Liu, T. F., Zhao, S. Q., Wan, Y., … Wang, H. Q. (2022). CT scans and cancer risks: a systematic review and dose-response meta-analysis. BMC cancer, 22(1), 1238. https://doi.org/10.1186/s12885-022-10310-2'

Reference Type: CITATION

Reference

Reference Text: 'Grant, E. J., Brenner, A., Sugiyama, H., Sakata, R., Sadakane, A., Utada, M., … Ozasa, K. (2017). Solid cancer incidence among the Life Span Study of Atomic Bomb Survivors: 1958-2009. Radiation research, 187(5), 513–537. https://doi.org/10.1667/RR14492.1'

Reference Type: CITATION

Reference

Reference Text: 'Hauptmann, M., Daniels, R. D., Cardis, E., Cullings, H. M., Kendall, G., Laurier, D., … Berrington de Gonzalez, A. (2020). Epidemiological studies of low-dose ionizing radiation and cancer: summary bias assessment and meta-analysis. Journal of the National Cancer Institute. Monographs, 2020(56), 188–200. https://doi.org/10.1093/jncimonographs/lgaa010'

Reference Type: CITATION

Reference

Reference Text: 'Hauptmann, M., Byrnes, G., Cardis, E., Bernier, M. O., Blettner, M., Dabin, J., … Kesminiene, A. (2023). Brain cancer after radiation exposure from CT examinations of children and young adults: results from the EPI-CT cohort study. The Lancet. Oncology, 24(1), 45–53. https://doi.org/10.1016/S1470-2045(22)00655-6'

Reference Type: CITATION

Reference

Reference Text: 'Huang, R., Liu, X., He, L., & Zhou, P. K. (2020). Radiation exposure associated with computed tomography in childhood and the subsequent risk of cancer: a meta-analysis of cohort studies. Dose-response: a publication of International Hormesis Society, 18(2), 1559325820923828. https://doi.org/10.1177/1559325820923828'

Reference Type: CITATION

Reference

Reference Text: 'Mariotto, A. B., Enewold, L., Zhao, J., Zeruto, C. A., & Yabroff, K. R. (2020). Medical care costs associated with cancer survivorship in the United States. Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology, 29(7), 1304–1312. https://doi.org/10.1158/1055-9965.EPI-19-1534'

Reference Type: CITATION

Reference

Reference Text: 'Meulepas, J. M., Ronckers, C. M., Smets, A. M. J. B., Nievelstein, R. A. J., Gradowska, P., Lee, C., … Hauptmann, M. (2019). Radiation exposure from pediatric CT scans and subsequent cancer risk in the Netherlands. Journal of the National Cancer Institute, 111(3), 256–263. https://doi.org/10.1093/jnci/djy104'

Reference Type: CITATION

Reference

Reference Text: 'National Cancer Institute Office of Cancer Survivorship. Statistics and Graphs. (2022, November 17). Retrieved from https://cancercontrol.cancer.gov/ocs/statistics#stats'

Reference Type: CITATION

Reference

Reference Text: 'Sugiyama, H., Misumi, M., Brenner, A., Grant, E. J., Sakata, R., Sadakane, A., … Ozasa, K. (2020). Radiation risk of incident colorectal cancer by anatomical site among atomic bomb survivors: 1958-2009. International Journal of Cancer, 146(3), 635–645. https://doi.org/10.1002/ijc.32275'

Reference Type: CITATION

Reference

Reference Text: 'Image Gently Alliance, Strategic Agenda 2022-2027. (2022).
Retrieved from http://www.imagegently.org/Portals/6/IGA%20Strategic%20Plan%201_10_22.pdf'

Reference Type: CITATION

Reference

Reference Text: 'Sadakane, A. (a), French B., Brenner A.V., Preston, D. L., Sugiyama, H., Grant, E. J., … Ozasa, K. (2019) Radiation and risk of liver, biliary tract, and pancreatic cancers among atomic bomb survivors in Hiroshima and Nagasaki: 1958-2009. Radiat Res 192:299-310. https://doi.org/10.1667/RR15341.1'

Reference Type: CITATION

Reference

Reference Text: 'Sadakane, A. (b), Landes, R.D., Sakata, R., Nagano, J., Shore, R.E., & Ozasa, K. (2019) Medical radiation exposure among atomic bomb survivors: understanding its impact on risk estimates of atomic bomb radiation. Radiat Res 191:507-517. https://doi.org/10.1667/RR15054.1'

Reference Type: CITATION

Reference

Reference Text: 'Sakata, R., Preston, D.L., Brenner, A.V., Sugiyama, H., Grant, E. J., Rajaraman, P., … Ozasa, K. (2019) Radiation-related risk of cancers of the upper digestive tract among Japanese atomic bomb Ssurvivors. Radiat Res 192:331-344. https://doi.org/10.1667/RR15386.1.'

Definition

CT Dose and Image Quality Category: reflects the type of exam performed based on body region and clinical indication. Each CT Dose and Image Quality Category has a specific set of dose and image quality (global noise) thresholds.

Calculated CT Size-Adjusted Dose: reflects the total radiation dose received during CT, risk-adjusted by patient size. The Calculated CT Size-Adjusted Dose thresholds vary by the CT Dose and Image Quality Category.

Calculated CT Global Noise: reflects the image quality of the CT. The Calculated CT Global Noise thresholds vary by the CT Dose and Image Quality Category.

Guidance

This is an inverse measure; as such the higher the value the worse the performance.

The level of aggregation for this eCQM is the clinician. Parallel eCQMs report CT exams performed in inpatient and outpatient hospital settings and is aggregated on the facility level. A single CT exam may be simultaneously measured in both the MIPS and one of the hospital reporting programs (inpatient or outpatient); however, a single exam cannot be measured in both the inpatient and outpatient hospital quality reporting programs.

TRANSLATION SOFTWARE

As a radiology measure, the measure derives standardized data elements from structured fields within both the electronic health record (EHR) and the radiology electronic clinical data systems, including the Radiology Information System (RIS) and the Picture Archiving and Communication System (PACS). Primary imaging data including Radiation Dose Structured Reports and image pixel data are stored in the PACS in Digital Imaging and Communications in Medicine (DICOM) format, a universally adopted standard for medical imaging information. Because of limitations in their specifications and format, eCQMs cannot currently access and consume elements from these radiology sources in their original DICOM formats. Thus, translation software was developed to transform primary data into a format that the eCQM can consume. This eCQM requires the use of additional software (translation software) to access the primary data elements that are required for measure computation and translate them into data elements that can be ingested by this eCQM. The purpose of this translation software is to access and link these primary data elements with minimal site burden, assess each CT exam for eligibility based on initial population criteria, and generate the three data elements mapped to a clinical terminology for eCQM consumption: CT Dose and Image Quality Category, Calculated CT Size-Adjusted Dose, and Calculated CT Global Noise. The translation software necessary to use this eCQM is written and maintained by Alara Imaging, Inc.

CODING

The translation software will create three variables required for measure computation including the CT Dose and Image Quality Category (LOINC(R) Code 96914-7), the Calculated CT Global Noise (LOINC(R) Code 96912-1) and the Calculated CT Size-Adjusted Dose (LOINC(R) Code 96913-9). These variables are defined in the Definition field above. These transformed data elements can be stored in the EHR.

MEASURE CALCULATION

The measure will evaluate each included CT exam for a patient based on allowable thresholds that are specified by the CT Dose and Image Quality Category. An exam is considered out of range if either the Calculated CT Global Noise or the Calculated CT Size-Adjusted Dose is out of range for the CT Dose and Image Quality Category. Exams will be evaluated against their corresponding threshold, shown below with the following format: [Category shorthand (=CT Dose and Image Quality Category), threshold for the Calculated CT Global Noise in Hounsfield units, threshold for the

	Calculated CT Size-Adjusted Dose in dose length product]. [LA31752-1 (=Abdomen and Pelvis, Low Dose), 64, 598]; [LA31753-9 (=Abdomen and Pelvis, Routine Dose), 29, 644]; [LA31754-7 (=Abdomen and Pelvis, High Dose), 29, 1260]; [LA31755-4 (=Cardiac Low Dose), 55, 93]; [LA31756-2 (=Cardiac Routine Dose), 32, 576]; [LA31758-8 (=Chest Low Dose), 55, 377]; [LA31759-6 (=Chest Routine Dose), 49, 377]; [LA31761-2 (=Chest High Dose or Cardiac High Dose), 49, 1282]; [LA31762-0 (=Head Low Dose), 115, 582]; [LA31763-8 (=Head Routine Dose), 115, 1025]; [LA31764-6 (=Head High Dose), 115, 1832]; [LA31765-3 (=Upper or Lower Extremity), 73, 320]; [LA31766-1 (=Neck or Cervical Spine), 25, 1260]; [LA31767-9 (=Thoracic or Lumbar Spine), 25, 1260]; [LA31768-7 (=Combined Chest, Abdomen and Pelvis), 29, 1637]; [LA31851-1 (=Combined Thoracic and Lumbar Spine), 25, 2520]; [LA31769-5 (=Combined Head and Neck, Routine Dose), 25, 2285]; [LA31770-3 (=Combined Head and Neck, High Dose), 25, 3092] EXCLUSIONS CT scans with missing patient age or missing CT Dose and Image Quality Category (LOINC(R) 96914-7) are excluded from the initial population. CT scans with a missing Calculated Global Noise value or a missing Calculated CT Size-Adjusted Dose value are not included in the denominator. Patients that have one or more CT scans assigned a CT Dose and Image Quality Category (LOINC(R) 96914-7) value using the LOINC(R) answer list (LL5824-9) of full body (LA31771-1) during the measurement period are excluded from the denominator. These exams are included in the initial population because they have a non-missing CT Dose and Image Quality Category but are then removed as a Denominator Exclusion in the eCQM because the value is full body, which reflects CT exams that cannot be categorized by anatomical area or by clinical indication, either because they are simultaneous exams of multiple body regions outside of four commonly encountered multiple region groupings, or because there is insufficient data for their classification based on the given diagnosis and procedure codes. This eCQM is a patient-based measure and should report the percentage of patients that had an eligible CT scan performed during the measurement period that had either a size adjusted dose or noise level out of range. Telehealth encounters are not eligible for this measure because the measure does not contain telehealth-eligible encounter codes. This version of the eCQM uses QDM version 5.6. Please refer to the eCQI resource center (https://ecqi.healthit.gov/qdm) for more information on the QDM.
Transmission Format	TBD
Initial Population	Patients aged 18 years and older at the start of the measurement period that have an eligible CT scan with Dose and Image Quality Category performed during the measurement period
Denominator	Equals Initial Population where an eligible CT scan has a Calculated Global Noise value and a Calculated CT Size-Adjusted Dose value
Denominator Exclusions	Patients with one or more eligible CT scans that has a CT Dose and Image Quality Category = full body
Numerator	Patients with one or more eligible CT scans with calculated CT Size-Adjusted Dose greater than or equal to a threshold specific to the CT Dose and Image Quality Category, or Calculated CT Global Noise value greater than or equal to a threshold specific to the CT Dose and Image Quality Category
Numerator Exclusions	Not Applicable
Denominator Exceptions	None
Supplemental Data Elements	For every patient evaluated by this measure also identify payer, race, ethnicity and sex

Table of Contents

Population Criteria

◢ Initial Population

exists ("Patients with Qualifying CTScan")

◢ Denominator

exists ("Patients with Qualifying CTScan with Values")

◢ Denominator Exclusions

```
exists ( "Patients with Qualifying CTScan with Values" CTScan
   where CTScan.result ~ "Full Body"
)
```

◢ Numerator

```
exists ( "Patients with Qualifying CTScan with Values" CTScan
   where AlaraCommon."CT Scan Qualifies" ( CTScan )
)
```

◢ Numerator Exclusions

None

◢ Denominator Exceptions

None

◢ Stratification

None

Definitions

◢ Denominator

```
exists ( "Patients with Qualifying CTScan with Values" )
```

◢ Denominator Exclusion

```
exists ( "Patients with Qualifying CTScan with Values" CTScan
    where CTScan.result ~ "Full Body"
)
```

◢ Initial Population

```
exists ( "Patients with Qualifying CTScan" )
```

◢ Numerator

```
exists ( "Patients with Qualifying CTScan with Values" CTScan
    where AlaraCommon."CT Scan Qualifies" ( CTScan )
)
```

◢ Patients with Qualifying CTScan

```
["Diagnostic Study, Performed": "CT dose and image quality category"] CTScanResult
  where Global."NormalizeInterval" ( CTScanResult.relevantDatetime, CTScanResult.relevantPeriod ) ends during day of "Measurement Period"
    and ( AgeInYearsAt(start of "Measurement Period") >= 18 )
```

◢ Patients with Qualifying CTScan with Values

```
"Patients with Qualifying CTScan" QualifyingCTScan
  where AlaraCommon."Global Noise Value" ( QualifyingCTScan ) is not null
    and AlaraCommon."Size Adjusted Value" ( QualifyingCTScan ) is not null
    and QualifyingCTScan.result is not null
```

◢ SDE Ethnicity

```
["Patient Characteristic Ethnicity": "Ethnicity"]
```

◢ SDE Payer

```
["Patient Characteristic Payer": "Payer Type"]
```

◢ SDE Race

```
["Patient Characteristic Race": "Race"]
```

◢ SDE Sex

```
["Patient Characteristic Sex": "ONC Administrative Sex"]
```

Functions

◢ AlaraCommon.CT Scan Qualifies(Study "Diagnostic Study, Performed")

```
"Qualifies"(Study, "Abdomen and Pelvis Low Dose", 64, 598)
  or "Qualifies"(Study, "Abdomen and Pelvis Routine Dose", 29, 644)
  or "Qualifies"(Study, "Abdomen and Pelvis High Dose", 29, 1260)
  or "Qualifies"(Study, "Cardiac Low Dose", 55, 93)
  or "Qualifies"(Study, "Cardiac Routine Dose", 32, 576)
  or "Qualifies"(Study, "Chest Low Dose", 55, 377)
  or "Qualifies"(Study, "Chest Routine Dose", 49, 377)
  or "Qualifies"(Study, "Cardiac High Dose or Chest High Dose", 49, 1282)
  or "Qualifies"(Study, "Head Low Dose", 115, 582)
  or "Qualifies"(Study, "Head Routine Dose", 115, 1025)
  or "Qualifies"(Study, "Head High Dose", 115, 1832)
  or "Qualifies"(Study, "Extremity", 73, 320)
  or "Qualifies"(Study, "Neck or Cervical Spine", 25, 1260)
  or "Qualifies"(Study, "Thoracic or Lumbar Spine", 25, 1260)
  or "Qualifies"(Study, "Simultaneous Chest and Abdomen and Pelvis", 29, 1637)
  or "Qualifies"(Study, "Simultaneous Thoracic and Lumbar Spine", 25, 2520)
  or "Qualifies"(Study, "Simultaneous Head and Neck Routine Dose", 25, 2285)
  or "Qualifies"(Study, "Simultaneous Head and Neck High Dose", 25, 3092)
```

◢ AlaraCommon.Global Noise Value(Study "Diagnostic Study, Performed")

```
singleton from ( Study.components C
    where C.code ~ "Calculated CT global noise"
      and C.result.unit = '[hnsf\'U]'
    return C.result.value as Decimal
)
```

◢ AlaraCommon.Qualifies(Study "Diagnostic Study, Performed", code System.Code, noiseThreshold Decimal, sizeDoseThreshold Decimal)

```
Study.result ~ code
  and ( "Global Noise Value"(Study) >= noiseThreshold
      or "Size Adjusted Value"(Study) >= sizeDoseThreshold
  )
```

◢ AlaraCommon.Size Adjusted Value(Study "Diagnostic Study, Performed")

```
singleton from ( Study.components C
    where C.code ~ "Calculated CT size-adjusted dose"
      and C.result.unit = 'mGy.cm'
    return C.result.value as Decimal
)
```

◢ Global.NormalizeInterval(pointInTime DateTime, period Interval<DateTime>)

```
if pointInTime is not null then Interval[pointInTime, pointInTime]
  else if period is not null then period
  else null as Interval<DateTime>
```

Terminology

- code "Abdomen and Pelvis High Dose" ("LOINC Code (LA31754-7)")
- code "Abdomen and Pelvis Low Dose" ("LOINC Code (LA31752-1)")
- code "Abdomen and Pelvis Routine Dose" ("LOINC Code (LA31753-9)")
- code "Calculated CT global noise" ("LOINC Code (96912-1)")
- code "Calculated CT size-adjusted dose" ("LOINC Code (96913-9)")
- code "Cardiac High Dose or Chest High Dose" ("LOINC Code (LA31761-2)")
- code "Cardiac Low Dose" ("LOINC Code (LA31755-4)")

- code "Cardiac Routine Dose" ("LOINC Code (LA31756-2)")
- code "Chest Low Dose" ("LOINC Code (LA31758-8)")
- code "Chest Routine Dose" ("LOINC Code (LA31759-6)")
- code "CT dose and image quality category" ("LOINC Code (96914-7)")
- code "Extremity" ("LOINC Code (LA31765-3)")
- code "Full Body" ("LOINC Code (LA31771-1)")
- code "Head High Dose" ("LOINC Code (LA31764-6)")
- code "Head Low Dose" ("LOINC Code (LA31762-0)")
- code "Head Routine Dose" ("LOINC Code (LA31763-8)")
- code "Neck or Cervical Spine" ("LOINC Code (LA31766-1)")
- code "Simultaneous Chest and Abdomen and Pelvis" ("LOINC Code (LA31768-7)")
- code "Simultaneous Head and Neck High Dose" ("LOINC Code (LA31770-3)")
- code "Simultaneous Head and Neck Routine Dose" ("LOINC Code (LA31769-5)")
- code "Simultaneous Thoracic and Lumbar Spine" ("LOINC Code (LA31851-1)")
- code "Thoracic or Lumbar Spine" ("LOINC Code (LA31767-9)")
- valueset "Ethnicity" (2.16.840.1.114222.4.11.837)
- valueset "ONC Administrative Sex" (2.16.840.1.113762.1.4.1)
- valueset "Payer Type" (2.16.840.1.114222.4.11.3591)
- valueset "Race" (2.16.840.1.114222.4.11.836)

Data Criteria (QDM Data Elements)

- "Diagnostic Study, Performed: CT dose and image quality category" using "CT dose and image quality category (LOINC Code 96914-7)"
- "Patient Characteristic Ethnicity: Ethnicity" using "Ethnicity (2.16.840.1.114222.4.11.837)"
- "Patient Characteristic Payer: Payer Type" using "Payer Type (2.16.840.1.114222.4.11.3591)"
- "Patient Characteristic Race: Race" using "Race (2.16.840.1.114222.4.11.836)"
- "Patient Characteristic Sex: ONC Administrative Sex" using "ONC Administrative Sex (2.16.840.1.113762.1.4.1)"

Supplemental Data Elements

◢ SDE Ethnicity

["Patient Characteristic Ethnicity": "Ethnicity"]

◢ SDE Payer

["Patient Characteristic Payer": "Payer Type"]

◢ SDE Race

["Patient Characteristic Race": "Race"]

◢ SDE Sex

["Patient Characteristic Sex": "ONC Administrative Sex"]

Risk Adjustment Variables

None

Measure Set	None