Excessive Radiation Dose or Inadequate Image Quality for Diagnostic Computed Tomography (CT) in Adults

Frequently.Asked.Questions.(FAQs)

Question 1: Which computed tomography (CT) studies are included in the Excessive Radiation Dose or Inadequate Image Quality measure, and how should facilities account for variations in study types, naming conventions, and exclusions (e.g., screening studies)?

Response 1:

The Excessive Radiation Dose or Inadequate Image Quality for Diagnostic Computed Tomography (CT) in Adults measure (ExRad measure) applies to diagnostic CT studies performed on adults (age 18 and older), including screening studies such as lung and colon cancer screening, as well as CT angiography (CTA) studies. Studies that are not diagnostic. CT.scans.(ultrasound, MRI, PET, radiography, fluoroscopy, angiography, invasive procedures/biopsies) are not included in the measure. In other words, only diagnostic CT. studies.are included in the measure denominator. Studies that are a combination of a non-diagnostic CT (e.g., PET-CT where the CT is used for attenuation correction) are not included in the measure denominator.

Eligible studies are identified using standardized Current Procedural Terminology (CPT) codes rather than local study names. This approach supports consistent identification of included studies across facilities and clinicians and minimizes variation due to differences in naming conventions.

The exclusion criteria available at the eCQI Resource Center specifies which diagnostic.CT. study.types are excluded from the measure denominator. Exclusion criteria are specified in the value sets available on the eCQI Resource Center.

Question 2: Under what circumstances should CT studies be excluded from the measure denominator due to missing, incomplete, or non-calculable intermediate variables?

Response 2:

Exclusion criteria are specified in the value sets available on the eCQI Resource Center. Diagnostic.CT.studies.are excluded from the denominator when required data elements are missing, when intermediate variables cannot be reliably calculated, or when the CT category reflects combined body regions not covered by the measure.

Examples of scenarios for which a diagnostic CT study would be excluded from the denominator are: a CT study with missing patient age, a CT study that does not have all three intermediate variables (a CT Dose and Image Quality Category, a Calculated Global Noise value, and a Calculated CT Size-Adjusted Dose value), or an assignment to the full body CT Dose and Image Quality Category.

The measure steward's translation software calculates the intermediate variables and automatically determines whether the study falls into one of the measure's denominator exclusions.

Question 3: How are CT "scans" and "studies" defined in the measure specifications, and are these terms intended to be used interchangeably?

Response 3:

The measure developer acknowledges that terms such as "scan," "exam," and "study" are used inconsistently across clinical practice. The measure does not define these terms as part of the measure specifications. For example, the measure specifications recognize that a single irradiation event may be represented by multiple DICOM Study Instance UIDs, or multiple irradiation events may be grouped under a single Study UID. Current CT systems also do not uniformly support metadata that consistently identifies irradiation events.

To address the limitation posed by inconsistent use of these terms, the measure developer established the concept of a CT category, defined using combinations of Current Procedural Terminology (CPT) and ICD-10 codes. The CT category provides a reliable method for identifying CT studies for measure calculation, reducing ambiguity associated with variable terminology and imaging workflows. There are 19 CT categories, each defined by body region and dose range. For example, head, chest, abdomen, and cardiac CTs each have low, medium, and high dose subcategories, while regions such as the extremities and neck have a single dose range.

Question 4: How are CT studies mapped to CT Dose and Image Quality Categories within the measure?

Response 4:

CT studies are mapped to CT Dose and Image Quality Categories using defined combinations of Current Procedural Terminology (CPT) and ICD-10 codes.

Question 5: How does this measure's approach to measuring patient size compare to existing standards such as water-equivalent diameter (WED)?

Response 5:

The measure accounts for patient size by applying size-adjusted dose thresholds within each CT category. These thresholds are specific to both the clinical indication for the study and body region, which allows the measure to account for differences in patient size without requiring a separate calculation of water-equivalent diameter (WED).

The measure developer identified effective diameter as the best approach for measuring patient size. Effective diameter is used because it can be derived consistently and automatically from data that are routinely available for all CT studies, such as the mid-scan axial image or CT localizer (scout) image. This supports automated calculation using standardized DICOM data and enables implementation across a wide range of clinical settings without requiring additional data elements or manual input. Effective diameter is also a genuine measure of patient size.

During measure development, the measure developer considered alternatives to measuring patient size other than effective diameter, including WED. The measure developer also considered that the purpose of WED is to compare dose across body regions of differing tissue density, and determined that because this measure does not make that comparison, WED is a less preferable approach to measuring patient size.

Question 6: Is the measure's approach to measuring patient size using effective diameter able to properly characterize size in the thorax and head?

Response 6:

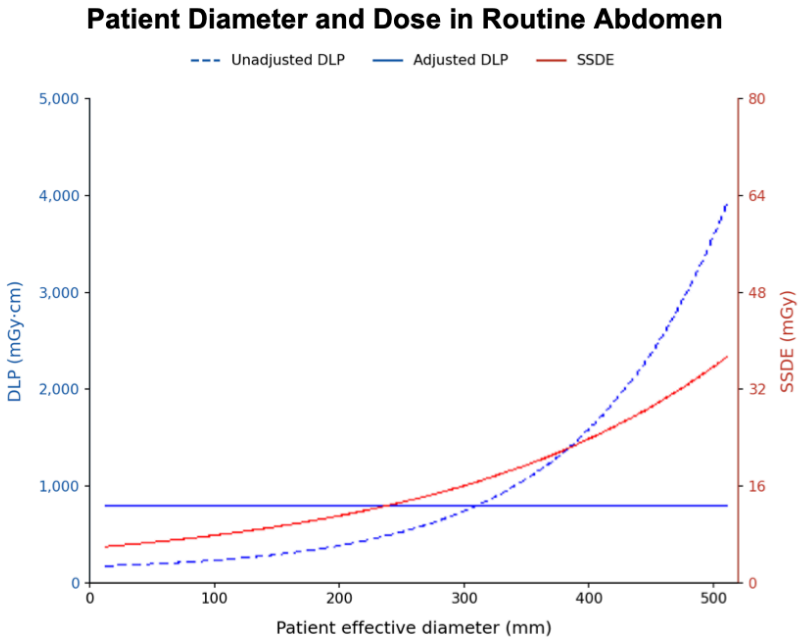
Yes, the approach to measuring patient size using effective diameter has been validated across all body regions.

Question 7: Is CT Size-Adjusted Dose (size-adjusted dose length product [DLP]) an adequate approach for determining radiation dose appropriateness? What about Size-Specific Dose Estimate (SSDE) as an alternative?

Response 7:

First, the measure is designed to evaluate the total radiation dose delivered during a CT study. Size-adjusted DLP captures cumulative exposure across the entire study, including all scan phases. In contrast, Size-Specific Dose Estimate (SSDE) represents the average dose per slice and does not account for the scan length or total number of scan phases, which are important contributors to total radiation dose. As a result, SSDE values may appear acceptable even when the overall radiation dose is elevated due to excessive scan length, or for multiphase scanning. Multiphase scanning is a key contributor to excessive radiation exposure. Roughly one quarter of all CT studies are multiphase and occur more frequently for abdomen and pelvis imaging.

Second, as shown in the figure below, size-adjusted DLP supports case-mix adjustment across patient populations. The graph shows that both unadjusted DLP and SSDE increase with patient effective diameter, while size-adjusted DLP is linear and flat. SSDE does not adequately account for the variation in patient size and if used in the measure, hospitals and clinicians that have a higher than average number of large patients would do worse on the measure. The size-adjusted DLP approach is designed to account for differences in patient size, and differences in practice patterns related to size, enabling more accurate side-by-side comparisons across hospitals and clinicians regardless of the population served.



Finally, there are practical implementation considerations, as SSDE is not consistently reported across CT systems from different manufacturers. Broad adoption of an SSDE-based approach could require significant equipment upgrades, whereas DLP is widely available in current systems.

For these reasons, size-adjusted DLP was selected as the most appropriate and feasible approach for this measure.

Question 8: How is Calculated CT Global Noise measured for this measure, and which approach is used given the different methods described in the literature (e.g., measurements in soft tissue versus air)?

Response 8:

This measure uses a noise-in-air method for calculating CT Global Noise. Calculated CT Global Noise is included in the measure as a balancing metric to ensure that efforts to reduce radiation dose do not result in image quality falling below levels necessary for accurate diagnosis.

For each CT study, noise is calculated for each slice, and then averaged at the series level. The measure selects the lowest average noise-in-air value across all series within the study, reflecting the series with the highest image quality. This approach of using the lowest value ensures that the best available image quality from any series within the examination is represented and avoids penalizing studies that may include some higher-noise series.

In certain situations—such as studies involving bariatric patients or studies with a small field of view such as a cardiac study—there may be insufficient air within the image to support noise measurement using this method. In these cases, the measure steward's translation software does not generate a noise value. Because the electronic clinical quality measure (eCQM) denominator is defined as studies where all three intermediate variables (CT Dose and Image Quality Category, Calculated CT Size-Adjusted Dose, Calculated CT Global Noise) are present, these studies, for which a noise value cannot be accurately generated, are excluded from the measure.

Prior to selecting the noise-in-air method for calculating CT Global Noise, the measure developer considered a range of alternative noise-measurement methods, including several soft-tissue-based approaches, which had high sensitivity but low specificity for determinations of abnormal noise. The measure developer ultimately selected the noise-in-air method because it was found to have the highest predictive value (highest specificity) of the methods evaluated.

Question 9: How should combination CT studies (e.g., examinations spanning multiple body regions) be handled for purposes of measure calculation and reporting?

Response 9:

The measure logic has two approaches for combination studies: simultaneous CT categories with size-adjusted dose and image noise thresholds that are specific for common combinations, and the full-body category.

Combination CT categories (LOINC 96914-7):

- Simultaneous Chest and Abdomen and Pelvis (LA31768-7)
- Simultaneous Thoracic and Lumbar Spine (LA31851-1)
- Simultaneous Head and Neck Routine Dose (LA31769-5)
- Simultaneous Head and Neck High Dose (LA31770-3)

Simultaneous CT categories are used for studies where irradiation events covering more than one body region are imaged in a single session. If the collection of body parts does not match or exceeds one of the simultaneous categories, studies are assigned a CT category of Full Body (LA3177-1) which is excluded from the measure denominator.

Question 10: Is an HL7® or Fast Healthcare Interoperability Resources (FHIR®) interface with the electronic health record (EHR) required to report this measure, and how are CPT and ICD-10 codes used to support measure calculation and submission of supplemental data elements?

Response 10:

The measure does not prescribe specific technical requirements for system integration (e.g., use of an HL7 or FHIR interface) due to variation in health information system architectures across hospitals and clinician practices. Instead, the measure is designed to use universally available data elements (CPT and ICD-10 codes) that are widely available across ONC-certified health IT systems. Because this is a radiology-focused measure, implementation also requires access to imaging-related data from systems such as Picture Archiving and Communication Systems (PACS) and Radiology Information Systems (RIS), including radiation dose structured reports and DICOM metadata. The measure integrates these radiology data with clinical data (e.g., CPT and ICD-10 codes) to support accurate CT categorization and measure performance calculation.

Question 11: What benchmarks are used to evaluate performance on this measure, and how can hospitals and clinicians understand or anticipate their performance relative to these benchmarks?

Response 11:

The overall performance rate of this measure is the percentage of CT studies 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 study. The performance rate reflects all diagnostic CT studies performed in the applicable hospital or clinician/group practice location during the reporting period of the measure. There are no pre-established performance benchmarks for this measure. Lower percentages reflect better performance.

As part of assessing performance on this measure, each CT study is evaluated using predefined thresholds for size-adjusted radiation dose and image noise, specific to each CT category. A study is classified as “out of range” if either the dose or noise value exceeds the established threshold.

These thresholds are specified in the electronic clinical quality measure (eCQM) and are publicly available on eCQI Resource Center. Hospitals and clinicians can use these specifications to understand how individual studies are assessed and to calculate the proportion of studies that fall outside the acceptable range.

Question 12: Are the dose and image noise thresholds applied uniformly to all studies within a given CT Dose and Image Quality Category, and how do these thresholds account for clinical variations (e.g., cardiac gating or contrast use)?

Response 12:

The measure applies CT Dose and Image Quality Category-specific thresholds for radiation dose and image noise, grouping together clinically similar CT studies with comparable dose distributions and image quality requirements. Variation in dose across different CT categories is substantially greater than variation within a single category, reflecting differences in clinical purpose. Within a category, some variability is expected; however, this variation is generally modest and does not support the use of separate thresholds for every clinical indication. Whether cardiac gating or intravenous contrast is used does not impact the thresholds that are applied.

Establishing indication-specific thresholds, or thresholds that account for contrast or gating, is not feasible due to the large number of potential clinical scenarios and the lack of a reliable method to consistently assign individual studies to highly granular categories. In addition, much of the variation in dose within a category is driven by technical and protocol decisions (e.g., use of contrast, cardiac gating, multiphase imaging, scan length, and pitch), which are under the control of the ordering or interpreting clinician. Applying different thresholds based on these factors could obscure opportunities to optimize radiation dose, which is a primary goal of the measure.

We note that the measure is intended for population-level assessment, and not every individual examination is expected to fall below the threshold. Clinicians should continue to apply appropriate clinical judgment to ensure that radiation dose is sufficient to answer the clinical question for each patient. During testing, approximately 30% of studies exceeded established thresholds.

Question 13: How do the dose and image noise thresholds established for each CT Dose and Image Quality Category account for variation in clinical practice across different types of CT examinations?

Response 13:

Dose and image noise thresholds are specific to each CT Dose and Image Quality Category and are designed to reflect the different dose requirements associated with distinct clinical indications. For example, abdomen CT examinations intended for low-dose indications (e.g., renal stone evaluation) have a lower dose threshold and a higher image noise threshold, than abdomen examinations that may require higher image quality and

radiation exposure (e.g., liver cancer evaluation). This approach aligns with how radiologists tailor imaging protocols based on the clinical question for the patient.

Variation in thresholds across CT Dose and Image Quality Category accounts for differences in clinical purpose and supports appropriate dose optimization based on the specific diagnostic context.

Question 14: What options are available to hospitals and clinicians that believe their measure results are inaccurate, and is there a process to request review or correction of reported scores?

Response 14:

Hospitals can review their measure results through CMS' Hospital Quality Reporting (HQR) system eCQM user interface during both testing and production submission periods.

MIPS eligible clinicians and group practices can review their measure results through CMS' Quality Payment Program (QPP) system eCQM user interface during the submission period. They can also contact the QPP Service Center any time by calling 1-866-288-8292 (TRS: 711) or emailing QPP@cms.hhs.gov.

In addition, hospitals and clinicians have the opportunity to review their results during the public reporting preview period, prior to public display on CMS' Provider Compare Tool on Medicare.gov. This preview period allows hospitals and clinicians to assess reported data and identify any potential concerns before results are finalized for public reporting.

In addition, the measure steward's translation software provides the intermediate variable results for every CT study. For each study, hospitals and clinicians can see the assigned CT Dose and Image Quality Category along with the Calculated CT Size-Adjusted Dose and the Calculated CT Global Noise. Hospitals and clinicians can also see whether that study falls out of range on either the size-adjusted dose threshold or the Global Noise threshold for its category.

Beyond the individual study level, results can be aggregated on the measure steward's platform within the provider's own network. This would allow a hospital or clinician to see which types of studies are most frequently out of range and how they are performing on the measure, all before any data are transmitted to CMS. Because this review happens inside the provider's environment, it supports internal quality review without exposing data externally.

Similar information may be provided to hospitals and clinicians by vendors providing an alternative to the measure steward's translation software.

Question 15: To what extent can hospitals and clinicians including hospitals and radiologists independently understand, implement, and validate results for the Excessive Radiation Dose or Inadequate Image Quality (ExRad) measure? Are additional resources, such as CPT/ICD-to-category lookup tables, intermediate variable outputs, or detailed calculation logic, necessary for implementation and verification?

Response 15:

CMS designs quality measures to support standardized, reliable, and scalable implementation, and must sometimes balance full transparency with the practical realities of complex data sources and calculation methods.

For the ExRad measure, we acknowledge requests for additional transparency related to this measure, particularly CPT/ICD-to-category lookup tables, access to intermediate variables, and more detailed methodological documentation. These requests reflect a desire for greater visibility into how results are generated, particularly given that the measure relies on calculated intermediate variables and specialized processing of radiology data. While we are not able to provide information that is proprietary to the measure steward, CMS provides publicly available specifications, including measure logic, value sets, and data element definitions through the eCQI Resource Center. These materials are sufficient to support implementation within certified health IT systems, and hospitals and clinicians can review their results through submission systems and during public reporting preview periods regardless of which software they use for the measure.

Direct, identical replication of the full calculation is not required for hospitals and radiologists to optimize imaging protocols because the measure provides actionable outputs such as CT category assignment, dose and noise comparisons to established thresholds, and identification of out-of-range examinations that are sufficient to guide clinical decision-making and quality improvement without needing to reproduce the underlying algorithms.

We note that similar limitations on independent replication exist across other CMS quality measures. For example, claims-based outcome measures, such as the 30-day risk-standardized unplanned readmission measures in the Hospital Readmissions Reduction Program rely on Medicare claims data across multiple care settings and incorporate risk adjustment methodologies that are operationalized by CMS. As a result, these measures cannot be completely reproduced at the facility level. Similarly, the Hospital-Medicare Spending per Beneficiary measure uses complex episode-based cost attribution and

national benchmarking that depend on CMS data and grouping logic not available to individual hospitals.

Similarly, hospitals and clinicians do not need full access to all underlying calculation components to implement the measure, interpret results, or participate in quality improvement activities. The ExRad measure follows the same general approach as other CMS quality measures, in which implementation is based on standardized specifications and certified systems, full independent replication is not required, and hospitals and clinicians are able to review, interpret, and act on their results.

Question 16: What type of support is available to help hospitals and clinicians implement the ExRad measure with the measure steward's translation software? How can hospitals and clinicians be sure that security protocols will be followed?

Response 16: The measure steward provides support to hospitals and clinicians who choose to use their translation software for free, pursuant to the steward's standard license agreement. Interested hospitals and clinicians can begin the onboarding process at https://www.alaragateway.com/contact. Hospitals and clinicians will then need to identify one IT contact and one contact with EHR access.

Intermediate variables can be integrated with electronic health records and dose management platforms using a variety of commonly available transmission standards (FHIR, HL7v2, flat files). The transmission standard used depends on the reporting entity's EHR vendor and local implementation decisions.

In addition, the translation software is designed to meet established security and compliance standards. It is HIPAA-compliant and certified under SOC 2 and HITRUST frameworks. The translation software can be deployed on-premises within a facility's existing infrastructure, supporting alignment with local security policies and minimizing data security risks.

Question 17: What implementation support is available to hospitals and clinicians who choose to use a translation software offered by a different vendor than the measure steward?

Response 17:

CMS encourages hospitals and clinicians interested in using translation software offered by a different vendor than the measure steward to discuss these questions with those vendors.

Question 18: Where should hospitals and clinicians direct any additional questions to CMS?

Response 18:

We recommend submission of eCQM-related questions to the eCQM Issue Tracker on Jira. Submitting questions via the eCQM Issue Tracker is valuable for CMS, as it allows us to receive questions and concerns related to the measures. Responses to questions provided through the eCQM Issue Tracker are also publicly available for reference.

For assistance with the Merit-based Incentive Payment System (MIPS) eCQM, contact the Quality Payment Program (QPP) Service Center by email at QPP@cms.hhs.gov, by creating a QPP Service Center ticket, or by phone at 1-866-288-8292 (Monday – Friday, 8 a.m. – 8 p.m. ET). To receive assistance more quickly, please consider calling during non-peak hours (before 10 a.m. and after 2 p.m. ET). People who are deaf or hard of hearing can dial 711 to be connected to a TRS Communications Assistant.

For assistance with the Hospital Inpatient Quality Reporting Program or Hospital Outpatient Quality Reporting Program, please contact the Inpatient & Outpatient Healthcare Quality Systems Development & Program Support Team at https://cmsqualitysupport.servicenowservices.com/qnet_qa?id=ask_a_question or (844) 472-4477.