Digital Imaging and Communications in Medicine (DICOM)

Supplement 227: Ultrasound Elastography Structured Report

DICOM Standards Committee

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#  Scope and Field

This supplement to the DICOM Standard introduces an SR section template for Ultrasound Elastography results and a General Ultrasound Report within which it can be used.

Ultrasound elastography is used on tissues including liver, breast, prostate, and tendon. In shear wave elastography (SWE), the ultrasound system measures shear wave speed (SWS) and derives a value for elasticity (in kPa) from that. Some systems also assess viscosity (which can be correlated to inflammation) by generating a value such as shear wave dispersion slope. In strain elastography (SE), elasticity/stiffness is assessed qualitatively by comparing the compression of tissue in a target region to that of tissue in a nearby reference region.

*References:*

[*https://doi.org/10.1148/radiol.2020192437*](https://doi.org/10.1148/radiol.2020192437) *Update to the Society of Radiologists in Ultrasound Liver Elastography Consensus Statement – Jun 2020 – Full Text*

[*https://pubs.rsna.org/doi/full/10.1148/rg.2017160116*](https://pubs.rsna.org/doi/full/10.1148/rg.2017160116) *SWE Basic Physics and Musculoskeletal Applications*

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5720889/>

*2015 EASL-ALEH Clinical Practice Guidelines: Non-invasive tests for evaluation of liver disease severity and prognosis* [*https://www.journal-of-hepatology.eu/article/S0168-8278(15)00259-7/fulltext*](https://www.journal-of-hepatology.eu/article/S0168-8278%2815%2900259-7/fulltext)

*Guidelines from WFUMB (World Federation for Ultrasound in Medicine and Biology) and EFSUMB (European Federation of Societies for Ultrasound in Medicine and Biology)*

* *EFSUMB Guidelines and Recs on the Clinical Use of* ***Liver*** *Ultrasound Elastography, Update 2017 (Long Version), Dietrich CF et al., Ultraschall Med.* [*https://www.thieme-connect.com/products/ejournals/pdf/10.1055/s-0043-103952.pdf*](https://www.thieme-connect.com/products/ejournals/pdf/10.1055/s-0043-103952.pdf)
* *WFUMB guidelines and recs for clinical use of ultrasound elastography: Part 3:* ***liver****, Ferraioli G et al., Ultrasound Med Biol. 2015 May;41(5):1161-79;*
* *EFSUMB guidelines and recs for the clinical practice of Elastography in Non-Hepatic Application: Update 2018, Săftoiu A, et al., Ultraschall Med. 2019 Aug;40(4):425-453.; Section 5* ***Breast***
* *WFUMB guidelines and recs for clinical use of ultrasound elastography: Part 2:* ***breast****, Barr RG et al., Ultrasound Med Biol. 2015 May;41(5):1148-60;*
* *EFSUMB guidelines and recs for the clinical practice of Elastography in Non-Hepatic Application: Update 2018, Săftoiu A, et al., Ultraschall Med. 2019 Aug;40(4):425-453.; Section 7* ***Thyroid***
* *WFUMB Guidelines and Recs on the Clinical Use of Ultrasound Elastography: Part 4.* ***Thyroid****, Cosgrove D et al., Ultrasound Med Biol. 2016 Aug 25;*
* *EFSUMB guidelines and recs for the clinical practice of Elastography in Non-Hepatic Application: Update 2018, Săftoiu A, et al., Ultraschall Med. 2019 Aug;40(4):425-453.; Section 6* ***Prostate***
* *WFUMB Guidelines and Recs on the Clinical Use of Ultrasound Elastography: Part 5.* ***Prostate****, Barr RG et. Al, Ultrasound Med Biol. 2016 Aug 23*

*The following are currently less consolidated in the daily clinical practice or, like the vascular applications, are still areas of active research*

* *EFSUMB guidelines and recs for the clinical practice of Elastography in Non-Hepatic Application: Update 2018, Săftoiu A, et al., Ultraschall Med. 2019 Aug;40(4):425-453.; Section 8* ***Pancreas****, Section 9* ***GastroIntestinal Tract****, Section 10* ***Spleen****, Section 11* ***Kidney****, Section 12* ***Lymph nodes****, Section 13* ***MusculoSkeletal****, Section 14* ***Testis****, Section 14* ***Vascular***

# OPEN ISSUES

|  |
| --- |
|  Q. Are there additional "confounding details" that should be captured in Patient Characteristics?For example, some guidelines have noted elevated liver function results, non-fasting (postprandial hyperemia), intense physical exercise, and vascular congestion could elevate liver stiffness readings. Other confounding factors might include, but are not limited to, acute hepatitis, liver inflammation, transaminitis flares with alanine aminotransferase value more than five times the upper limit of normal, obstructive cholestasis, hepatic congestion, and infiltrative liver diseases such as amyloidosis, lymphoma, or extramedullary hematopoiesis. In all these conditions, however, stiffness values within the normal range exclude significant liver fibrosis.Patient Orientation can already be included to track deviation from supine or slight (<30°) left decubitus which can result in measurement variability. Details like suspended tidal respiration and transducer make/model could also be captured elsewhere.  |
| Q. Should Ultrasound Strain Elastography (SE) be addressed in this supplement?The supplement text has been driven mostly by Ultrasound Shear Wave Speed Elastography (SWE). |
| Q. Is adequate information captured for assessing repeated measurements over time (months, years)?The equipment module captures the make/model of the ultrasound system as a whole.Should recording of transducer make/model be highlighted, or made mandatory?Are there calibration values that would be useful/important? |

# CLOSED ISSUES

|  |
| --- |
| Q. Make a SOP Class or just a TID? A: TID It’s the precedent for Ultrasound SRs. Make a General Ultrasound Report TID that includes an Elastography section. |

# Changes to NEMA Standards Publication PS3.16

**Digital Imaging and Communications in Medicine (DICOM)**

Part 16: Content Mapping Resource

*Add a General Ultrasound Report root template as shown*

**TID newTID1 General Ultrasound Report​**

This is the Template for the root of the content tree for a general ultrasound procedure report.

**Type: Extensible
Order: Significant
Root: Yes**

Table TID newTID1. General Ultrasound Report

|  | **NL** | **Rel with Parent** | **VT** | **Concept Name** | **VM** | **Req Type** | **Condition** | **Value Set Constraint** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  | CONTAINER | BCID newCID0 "General Ultrasound Report Document Titles" | 1 | M |  |  |
| 2 | > | HAS CONCEPT MOD | INCLUDE | DTID 1204 “Language of Content Item and Descendants” | 1 | U |  |  |
| 3 | > | HAS OBS CONTEXT | INCLUDE | DTID 1001 “Observation Context” | 1 | M |  |  |
| 4 | > | CONTAINS | INCLUDE | DTID newTID2 "Ultrasound Patient Characteristics" | 1 | U |  |  |
| 5 | > | CONTAINS | CONTAINER | DT (55111-9, LN, "Current Procedure Descriptions") | 1 | U |  |  |
| 6 | >> | CONTAINS | CODE | DT (125203, DCM, "Acquisition Protocol") | 1-n | M |  | BCID 12001 “Ultrasound Protocol Types” |
| 7 | >> | CONTAINS | CODE | DT (113743, DCM, "Patient Orientation") | 1 | U |  | DCID 19 “Patient Orientation” |
| 8 | >>> | HAS CONCEPT MOD | CODE | EV (113744, DCM, "Patient Orientation Modifier") | 1 | U |  | DCID 20 “Patient Orientation Modifier” |
| 9 | > | CONTAINS | CONTAINER | EV (18785-6, LN, "Indications for Procedure") | 1 | U |  |  |
| 10 | > | CONTAINS | CONTAINER | EV (111028, DCM, "Image Library") | 1 | U |  |  |
| 11 | >> | CONTAINS | IMAGE |  | 1-n | M |  |  |
| 12 | > | CONTAINS | CONTAINER | DT (59776-5, LN, "Findings") | 1-n | U |  |  |
| 13 | >> | CONTAINS | INCLUDE | DTID 300 “Measurement” | 1-n | U |  |  |
| 14 | >> | CONTAINS | TEXT | EV (121071, DCM, "Finding") | 1-n | U |  |  |
| 15 | > | CONTAINS | INCLUDE | DTID 5X01 “Ultrasound Elastography Section” | 1-n | U |  |  |

**Content Item Descriptions**

|  |  |
| --- | --- |
| Row 10 | The Image Library provides potentially relevant characteristics of images associated with the measurements. There is no requirement to include all, or any, of the images referenced in the ROIs and measurements elsewhere in this template. The template may also include images that are associated with, but not directly referenced in, the ROIs and measurements.The Image Library is not replicating the content of the SOP Instance Reference Sequence.  |
| Row 11 | No purpose of reference is specified. |

*Add TID for Ultrasound Patient Characteristics as shown*

**TID newTID2 Ultrasound Patient Characteristics**

**Type: Extensible
Order: Significant
Root: No**

Table TID newTID2. Ultrasound Patient Characteristics

|  | **NL** | **Rel with Parent** | **VT** | **Concept Name** | **VM** | **Req Type** | **Condition** | **Value Set Constraint** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | CONTAINER | NUM | EV (121118, DCM, "Patient Characteristics") | 1 | M |  |  |
| 2 | > | CONTAINS | NUM | EV (113550, DCM, "Fasting Duration") | 1 | U |  | UNITS= EV (h, UCUM, "hours") |
| 3 | > | CONTAINS | TEXT | EV (113552, DCM, "Recent Physical Activity") | 1 | U |  |  |
| 4 | > | CONTAINS | NUM | EV (271649006, SCT, "Systolic Blood Pressure") | 1 | U |  | UNITS= EV (mm[Hg], UCUM, "mmHg") |
| 5 | > | CONTAINS | NUM | EV (271650006, SCT, "Diastolic Blood Pressure") | 1 | U |  | UNITS= EV (mm[Hg], UCUM, "mmHg") |
| 6 | > | CONTAINS | CODE | EV (newcode04, DCM, "Relevant Patient Conditions") | 1-n | U |  |  |
| 7 | > | CONTAINS | TEXT | EV (121106, DCM, "Comment") | 1 | U |  |  |

**Content Item Descriptions**

|  |  |
| --- | --- |
| Row 6 | Currently present patient conditions that may affect, or are otherwise relevant to, the capture or interpretation of the findings in this report. |
| Row 7 | General comments which may also include relevant patient conditions that would otherwise be recorded in Row 6 if appropriate codes were available. |

*Add Elastography Section TID 5X01 as shown*

**TID 5X01 Ultrasound Elastography Section​**

This section template incorporates a set of measurements for assessing tissue elasticity characteristics.

**Type: Extensible
Order: Significant
Root: No**

Table TID 5X01. Ultrasound Elastography Section

|  | **NL** | **Rel with Parent** | **VT** | **Concept Name** | **VM** | **Req Type** | **Condition** | **Value Set Constraint** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  |  | CONTAINER | DT (59776-5, LN, "Findings") | 1 | M |  |  |
| 2 | > | HAS CONCEPT MOD | CODE | EV (121058, DCM, "Procedure Reported" | 1 | M |  | DT (448764002, SCT, "Ultrasound elastography (procedure)" |
| 3 | > | HAS CONCEPT MOD | CODE | EV (363698007, SCT, "Finding Site" | 1 | M |  | BCID NewCID1 "Elastography Sites" |
| 4 | >> | HAS CONCEPT MOD | CODE | EV (272741003, SCT, "Laterality") | 1 | U |  | DCID 244 “Laterality” |
| 5 | > | HAS ACQ CONTEXT | CODE | EV (399264008, SCT, "Image Mode") | 1 | U |  | BCID 12224 “Ultrasound Image Modes” |
| 5a | > | HAS ACQ CONTEXT | CODE | EV (111031, DCM, "Image View") | 1 | U |  | BCID 5 "Transducer Approach" |
| 5b | >> | HAS ACQ CONTEXT | CODE | EV (111032, DCM, "Image View Modifier") | 1-n | U |  | BCID 6 "Transducer Orientation"BCID 7 "Ultrasound Beam Path" |
| 6 | > | CONTAINS | CONTAINER | DT (55112-7, LN, "Summary") | 1 | M |  |  |
| 7 | >> | CONTAINS | NUM | EV (130611, DCM, "Shear Wave Speed") | 1 | M |  |  |
| 7b | >>> | HAS PROPERTIES | NUM | EV (386136009, SCT, "Standard deviation") | 1 | U |  |  |
| 7c | >>> | HAS PROPERTIES | NUM | EV (373099004, SCT, "Median") | 1 | U |  |  |
| 7d | >>> | HAS PROPERTIES | NUM | EV (130614, DCM, "Interquartile Range of population") | 1 | U |  |  |
| 7e | >>> | HAS PROPERTIES | NUM | EV (130615, DCM, "Interquartile Range to Median Ratio of population") | 1 | M |  |  |
| 8 | >> | CONTAINS | NUM | EV (110830, DCM, "Elasticity") | 1 | M |  |  |
| 8b | >>> | HAS PROPERTIES | NUM | EV (386136009, SCT, "Standard deviation") | 1 | U |  |  |
| 8c | >>> | HAS PROPERTIES | NUM | EV (373099004, SCT, "Median") | 1 | U |  |  |
| 8d | >>> | HAS PROPERTIES | NUM | EV (130614, DCM, "Interquartile Range of population") | 1 | U |  |  |
| 8e | >>> | HAS PROPERTIES | NUM | EV (130615, DCM, "Interquartile Range to Median Ratio of population") | 1 | M |  |  |
| 9 | >> | CONTAINS | NUM | EV (130612, DCM, "Shear Wave Dispersion Slope") | 1 | U |  |  |
| 9b | >>> | HAS PROPERTIES | NUM | EV (386136009, SCT, "Standard deviation") | 1 | U |  |  |
| 9c | >>> | HAS PROPERTIES | NUM | EV (373099004, SCT, "Median") | 1 | U |  |  |
| 9d | >>> | HAS PROPERTIES | NUM | EV (130614, DCM, "Interquartile Range of population") | 1 | U |  |  |
| 9e | >>> | HAS PROPERTIES | NUM | EV (130615, DCM, "Interquartile Range to Median Ratio of population") | 1 | M |  |  |
| 10 | > | CONTAINS | CONTAINER | DT (125007, DCM, "Measurement Group" | 1-n | M |  |  |
| 11 | >> | HAS OBS CONTEXT | TEXT | EV (125010, DCM, "Identifier”) ​ | 1 | M |  |  |
| 12 | >> | CONTAINS | INCLUDE | DTID 5X02 “Shear Wave Elastography Measurement” | 1 | M |  |  |
| 13 | > | CONTAINS | CONTAINER | DT (Newcode01, DCM, "Reference Measurement Group") | 1 | M |  |  |
| 14 | >> | CONTAINS | INCLUDE | DTID 5X02 “Shear Wave Elastography Measurement” | 1 | M |  |  |

**Content Item Descriptions**

|  |  |
| --- | --- |
| Row 7 | The nominal Shear Wave Speed for the tissue of interest. |
| Rows 7b-7e | These values are a statistical description of Shear Wave Speed measurements in Row 10 from which the value in Row 7 was derived. |
| Row 11 | The identifier is used to distinguish the different measurement ROIs. For example, the identifier might be used as a column header when displaying the measurements from all the ROIs in a table.  |

**TID 5X02 Shear Wave Elastography Measurement**

A shear wave elastography measurement, and related values, associated with a point or region in an ultrasound image.

**Type: Extensible
Order: Significant
Root: No**

Table TID 5X02. Shear Wave Elastography Measurement

|  | **NL** | **Rel with Parent** | **VT** | **Concept Name** | **VM** | **Req Type** | **Condition** | **Value Set Constraint** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 |  | HAS CONCEPT MOD | NUM | EV (130613, DCM, “ROI Depth”) | 1 | M |  | UNITS= EV (cm, UCUM, "cm") |
| 2 |  | HAS CONCEPT MOD | NUM | EV (131184002, SCT, "Area of defined region") | 1 | U |  | UNITS= EV (cm2, UCUM, "cm2”) ​ |
| 3 |  | INFERRED FROM | SCOORD | EV (111030, DCM, "Image Region") | 1 | U |  | GRAPHIC TYPE = not {MULTIPOINT} |
| 4 |  | CONTAINS | NUM | EV (130611, DCM, "Shear Wave Speed" | 1 | M |  | UNITS= EV (m/s, UCUM, "m/s") |
| 5 | > | HAS CONCEPT MOD | NUM | EV (386136009, SCT, "Standard deviation") | 1 | M |  | UNITS= EV (m/s, UCUM, "m/s") |
| 6 |  | CONTAINS | NUM | EV (110830, DCM, "Elasticity") | 1 | M |  | UNITS= EV (kPa, UCUM, "kPa") |
| 7 | > | HAS CONCEPT MOD | NUM | EV (386136009, SCT, "Standard deviation") | 1 | M |  | UNITS= EV (kPa, UCUM, "kPa") |
| 8 |  | CONTAINS | NUM | EV (130612, DCM, "Shear Wave Dispersion Slope") | 1 | U |  | UNITS= EV (m/s/kHz, UCUM, "m/s/kHz") |
| 9 | > | HAS CONCEPT MOD | NUM | EV (386136009, SCT, "Standard deviation") | 1 | M |  | UNITS= EV (m/s/kHz, UCUM, "m/s/kHz") |

**Content Item Descriptions**

|  |  |
| --- | --- |
| Row 3 | The ROI is typically a circle or square, although other shapes are not prohibited. |
| Rows 4, 6, 8 | The value represents the mean value of the pixels contained in the ROI. |
| Rows 5, 7, 9 | The value represents the standard deviation of the values of the pixels contained in the ROI. |

**Add the following UID Values to Part 6 Annex A Table A-3:**

**Table A-3 CONTEXT GROUP UID VALUES**

|  |  |  |
| --- | --- | --- |
| **Context UID**  | **Context Identifier** | **Context Group Name** |
| ... | ... | … |
| **1.2.840.10008.6.1.zzcid0** | **newcid0** | **General Ultrasound Report Document Titles** |
| **1.2.840.10008.6.1.zzcid1** | **newcid1** | **Elastography Sites** |

Add the following codes to the following CIDs in Part 16 Annex B:

### CID 5 Transducer Approach

**Type: Extensible
Version: yyyymmdd**

Table CID 5. Ultrasound Approach

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Coding Scheme Designator** | **Code Value** | **Code Meaning**  | **SNOMED-RT ID** | **UMLS Concept Unique ID** |
| SCT | 24028007 | Right | G-A100 | C0205090 |
| SCT | 7771000 | Left | G-A101 | C0205091 |
| SCT | 49370004 | Lateral | G-A104 | C0205093 |
| … |  |  |  |  |
| **DCM** | **newcode02** | **Intercostal** |  |  |
| **DCM** | **newcode03** | **Subcostal** |  |  |

Add the new General Ultrasound Report Document Titles to CID 7000 in Part 16 Annex B:

### CID 7000 Diagnostic Imaging Report Document Titles

**Type: Extensible
Version: yyyymmdd**

Table CID 7000. Diagnostic Imaging Report Document Titles

|  |  |  |  |
| --- | --- | --- | --- |
| **Coding Scheme Designator** | **Code Value** | **Code Meaning**  | **UMLS Concept Unique ID** |
| … |  |  |  |
| LN | 47048-4 | Diagnostic Interventional Radiology Report | C1831148 |
| *Include CID 12100 “Vascular Ultrasound Report Document Titles”* |
| ***Include CID newCID0 “General Ultrasound Report Document Titles”*** |

Add the following CIDs to Part 16 Annex B:

### CID newcid0 General Ultrasound Report Document Titles

**Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Type: Extensible
Version: yyyymmdd
UID: 1.2.840.10008.6.1.zzcid0**

Table CID newcid0. General Ultrasound Report Document Titles

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Coding Scheme Designator** | **Code Value** | **Code Meaning**  | **SNOMED-RT ID** | **UMLS Concept Unique ID** |
| LN | 25061-3 | Ultrasound Report |  | C0882213 |
| LN | 39453-6 | US Tendon Report |  |  |
| LN | 24601-7 | US Breast Report |  |  |
| LN | 38036-0 | US Kidney Report |  |  |
| LN | 28614-6 | US Liver Report |  |  |
| LN | 24884-9 | US Prostate (transrectal) Report |  |  |
| LN | 24859-1 | US Pancreas Report |  |  |
| LN | 24990-4 | US Spleen Report |  |  |
| LN | 24907-8 | US Shoulder Report |  |  |
| LN | 25002-7 | US Scrotum and Testicle Report |  |  |
| LN | 25010-0 | US Thyroid Report |  |  |

### CID newcid1 Elastography Sites

**Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML
Type: Extensible
Version: yyyymmdd
UID: 1.2.840.10008.6.1.zzcid1**

Table CID newcid1. Elastography Sites

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Coding Scheme Designator** | **Code Value** | **Code Meaning**  | **SNOMED-RT ID** | **UMLS Concept Unique ID** |
| SCT | 61352006 | Achilles Tendon |  |  |
| SCT | 76752008 | Breast | T-04000 | C0006141 |
| SCT | 64033007 | Kidney | T-71000 | C0022646 |
| SCT | 10200004 | Liver | T-62000 | C0023884 |
| SCT | 41216001 | Prostate | T-92000 | C0033572 |
| SCT | 15776009 | Pancreas | T-65000 | C0030274 |
| SCT | 18033002 | Patellar Tendon |  |  |
| SCT | 78961009 | Spleen | T-C3000 | C0037993 |
| SCT | 245100002 | Tendon of Rotator Cuff of Shoulder |  |  |
| SCT | 40689003 | Testis | T-94000 | C0039597 |
| SCT | 69748006 | Thyroid | T-B6000 | C0040132 |

Add the following Definitions to Annex D

DICOM Code Definitions (Coding Scheme Designator “DCM” Coding Scheme Version “01”)

|  |  |  |
| --- | --- | --- |
| Code Value | Code Meaning | Definition |
| newcode01 | Reference Measurement Group | A grouping of related measurements and calculations that share a common context and that serves as a reference against which similar measurement groups are compared. |
| newcode02 | Intercostal | Between adjacent ribs |
| newcode03 | Subcostal | Below the ribs |
| newcode04 | Relevant Patient Conditions | Currently present patient conditions which might be relevant to the current context. |