

DICOM Correction Item

Correction Number: CP 156	
Log Summary: Clarify Image Pixel Attributes for Compressed Transfer Syntaxes	
Type of Modification Clarification	Name of Standard DICOM Standard - 1999
Rationale for Correction: <p>The existing DICOM Standard states that for compressed image data the image object's "Data Elements ... shall contain values which are consistent with the characteristics of the uncompressed pixel data ..." (PS3.5 8.2.1 and 8.2.2 – 1999). This makes it vague for cases where image data are converted from one photometric interpretation to another prior to the compression step in order to enhance the compression ratio. For example, in the case where RGB data is converted to YBR FULL 422 data prior to JPEG compression should the Data Elements indicate the state of the RGB data or of the YBR FULL 422 data?</p> <p>The correct approach should be that the Data Elements indicate the actual state of the compressed data stream. This will allow proper decompression and interpretation of the decompressed output in cases where only the DICOM Data Elements indicate the state of the compressed image data.</p>	
Sections of document affected: PS3.3 - 1999 PS3.5 - 1999	

Correction Wording:

Amend the last paragraph of PS3.5 Section 8.2.1 JPEG IMAGE COMPRESSION as follows:

The use of the DICOM Encapsulated Format to support JPEG Compressed Pixel Data ~~implies~~ **requires** that the Data Elements which are related to the ~~Native Format~~ Pixel Data encoding (e.g. **Photometric Interpretation, Samples per Pixel, Planar Configuration**, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values which are consistent with the characteristics of the ~~uncompressed pixel data from which the~~ compressed Data Stream ~~was derived~~. The Pixel Data characteristics included in the JPEG Interchange Format shall be used to decode the compressed data stream.

Notes: 1. These requirements were formerly specified in terms of the "uncompressed pixel data from which the compressed Data Stream was derived". However, since the form of the "original" uncompressed data stream could vary between different implementations, this requirement is now specified in terms of consistency with what is encapsulated.

When decompressing, should the characteristics explicitly specified in the compressed data stream (e.g. spatial subsampling or number of components or planar configuration) be inconsistent with those specified in the DICOM Data Elements, those explicitly specified in the compressed data stream should be used to control the decompression. The DICOM data elements, if inconsistent, can be regarded as suggestions as to the form in which an uncompressed data set might be encoded.

2. Those characteristics not explicitly specified in the compressed data stream (e.g. color space which is not specified in the JPEG Interchange Format), or implied by the definition of the compression scheme (e.g. always unsigned in JPEG), can therefore be determined from the DICOM Data Element in the enclosing data set. For example a Photometric Interpretation of "YBR FULL 422" would describe the color space that is commonly used to lossy compress images using JPEG. It is unusual to use an RGB color space for lossy compression, since no advantage is taken of correlation between the red, green and blue components (e.g. of luminance), and poor compression is achieved.

3. Should the compression process be incapable of encoding a particular form of pixel data representation (e.g. JPEG cannot encode signed integers, only unsigned integers), then ideally only the appropriate form should be "fed" into the compression process. However, for certain characteristics described in DICOM Data Elements but not explicitly described in the compressed Data Stream (such as Pixel Representation), then the DICOM Data Element should be considered to describe what has been compressed (e.g. the pixel data really is to be interpreted as signed if Pixel Representation so specifies).

4. DICOM Data Elements should not describe characteristics that are beyond the capability of the compression scheme used. For example, JPEG lossy processes are limited to 12 bits, hence the value of Bits Stored should be 12 or less. Bits Allocated is irrelevant, and is likely to be constrained by the Information Object Definition in PS 3.3 to values of 8 or 16. Also, JPEG compressed data streams are always color-by-pixel and should be specified as such (a decoder can essentially ignore this element however as the value for JPEG compressed data is already known).

Amend the last paragraph of PS3.5 Section 8.2.2 RUN LENGTH ENCODING COMPRESSION as follows:

The use of the DICOM Encapsulated Format to support RLE Compressed Pixel Data **implies requires** that the Data Elements which are related to the ~~Native Format~~ Pixel Data encoding (e.g. **Photometric Interpretation, Samples per Pixel, Planar Configuration**, Bits Allocated, Bits Stored, High Bit, Pixel Representation, Rows, Columns, etc.) shall contain values which are consistent with the characteristics of the ~~uncompressed pixel data from which the~~ compressed Data Stream ~~was derived~~.

- Notes:**
1. These requirements were formerly specified in terms of the "uncompressed pixel data from which the compressed Data Stream was derived". However, since the form of the "original" uncompressed data stream could vary between different implementations, this requirement is now specified in terms of consistency with what is encapsulated.
 2. Those characteristics not implied by the definition of the compression scheme (e.g. always color-by-plane in RLE), can therefore be determined from the DICOM Data Element in the enclosing data set. For example a Photometric Interpretation of "YBR FULL" would describe the color space that is commonly used to losslessly compress images using RLE. It is unusual to use an RGB color space for RLE compression, since no advantage is taken of correlation between the red, green and blue components (e.g. of luminance), and poor compression is achieved (note however that the conversion from RGB to YBR FULL is itself lossy. A new photometric interpretation may be proposed in the future which allows lossless conversion from RGB and also results in better RLE compression ratios).
 3. DICOM Data Elements should not describe characteristics that are beyond the capability of the compression scheme used. For example, RLE compressed data streams (using the algorithm mandated in the DICOM Standard) are always color-by-plane.

Add this to PS3.3 Sections C.7.6.3.1.2 and C.8.5.6.1.2 Photometric Interpretation:

See PS3.5 section 8.2 for restrictions imposed by the Transfer Syntax.