DEEPHEALTH

Hackathon - Course 3

De-identification in DICOM metainformation

The project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825111.

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De-identificaton in DICOM metainformation

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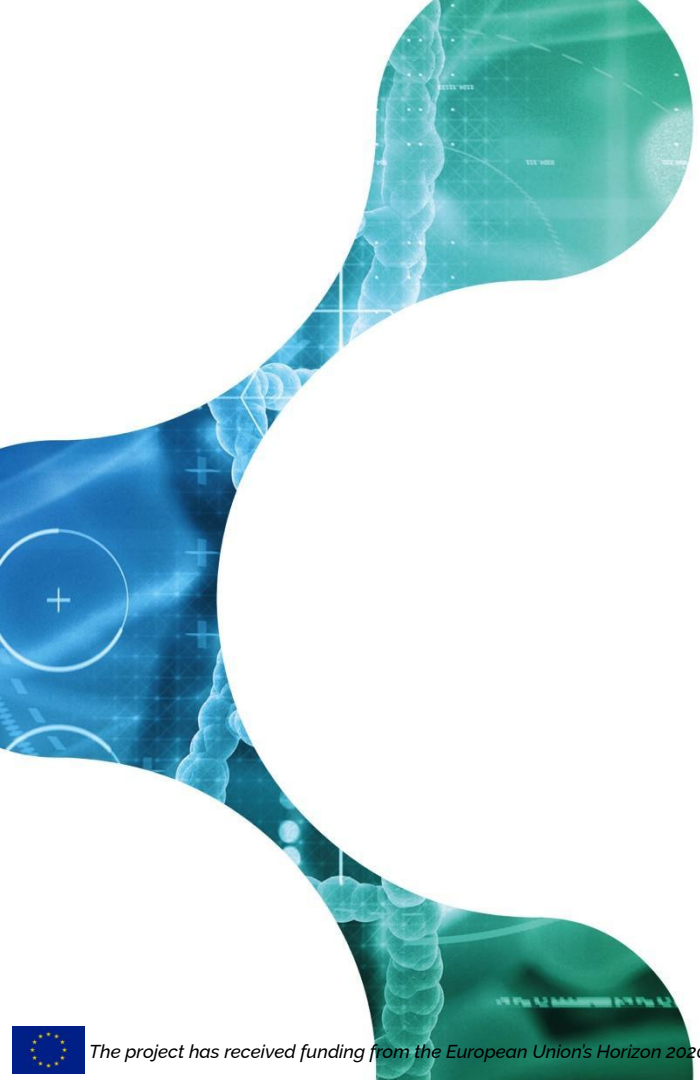

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Introduction

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De-identification of Medical Images

All the institutions are responsible for de-identifying imaging examinations and associated clinical information for pseudonymised storages.

To achieve this, DICOM proposal:

- Regulation
- Best practices

DICOM
Digital Imaging and Communications in Medicine

RSNA + DICOM experts

Data De-identification Guidelines and Protocol

Open-Source Software Tool Clinical Trial Processor

CTP
Clinical Trial Processor

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DICOM Standard

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DICOM: Definition

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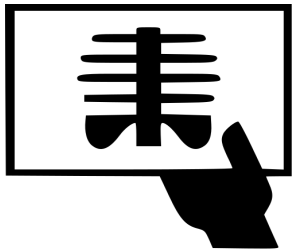
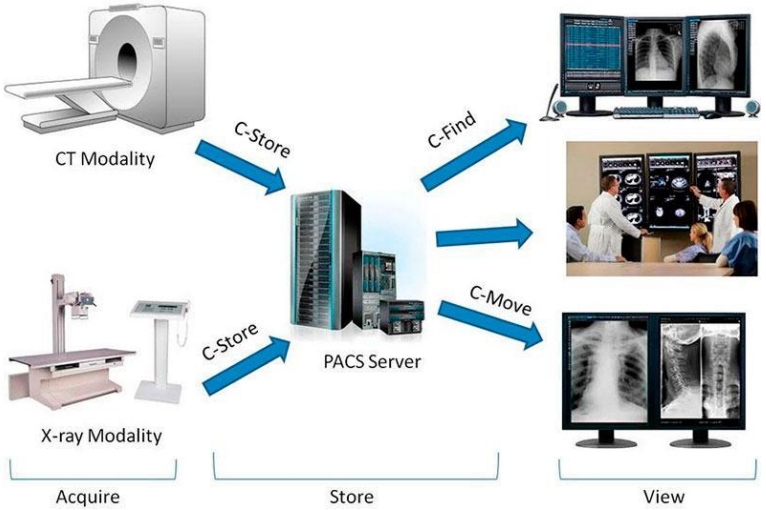
DICOM (Digital Imaging and Communications in Medicine): Standard in Medical Imaging to ensure interoperability between equipment and systems.

DICOM℠
Digital Imaging and Communications in Medicine





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DICOM: Performance

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DICOM Standard controls the handing of Image-related Information

- Rules for transfering safely in ISO-OSI and TCP/IP
- Only one Digital Image Format defined
- File structure for Biomedical Image and related Information

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DICOM: Data format

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A DICOM File groups images of a session and their related attributes into DICOM tags (metainformation).

Tags types:
Patient, Session, Modality, Hospital, Machine, Image Acquisition, Image Quality...

They can contain Personal Health Information (PHI).

For pseudo-anon, it is needed to add an Unique Identifier (UID).

Name	DICOM Tag	Description
Modality	(0008,0060)	Equipment type
Station Name	(0008,1010)	Equipment identifier
Patient ID	(0010,0020)	Patient hospital identification number
Study Instance UID	(0020,000D)	Study identifier
Study Date	(0008,0020)	Date the study started
Study Description	(0008,1030)	Examination description (from the RIS)
Protocol Name	(0018,1030)	Protocol description (from the imager)
Series Instance UID	(0020,000E)	Series identifier
Series Description	(0008,103E)	Series description
SOP Instance UID	(0008,0018)	Image identifier
Acquisition Time	(0008,0032)	Image start time
Image Type	(0008,0008)	Original or derived
Acquisition Duration	(0019,105A)	Length of a series with one vendor's MR imager
X-ray On Time	(0043,104E)	Length of a series with one vendor's CT scanner

Figure Source: https://pubs.rsna.org/doi/10.1148/rg.312105714

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DICOM Confidentiality Profiles

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10 Confidentiality Profiles

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De-identification rules from DICOM Standard table PS 3.15 Appendix E

1. Basic profile
2. Keep safe private information
3. Keep UIDs
4. Keep patient characteristics
5. Keep device identity
6. Keep complete dates
7. Keep complete modified dates
8. Clean descriptors
9. Clean structured content
10. Clean graphics

PHI is removed expect some part according to several cases of interest.

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Nº 1 Basic Profile

De-identificaton in DICOM metainformation

All PHI is removed. Other profiles are the modification of this one.

- Identity Patient (Demographics, Characteristics)
- Identity Authors or Family Members
- Identity of Staff
- Identity of Organizations
- Any other useful information to find the patient (date & time, UIDs,..)
- Private Attributes outside the DICOM standard

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Nº 2 Keep secure private info

De-identificaton in DICOM metainformation

Retained private secure attributes that doesn't allow identification of the patient

- Private Attributes outside the DICOM standard
- Usually, only vendor can understand this information
- Sometime, there are interesting technique attributes and they are kept.

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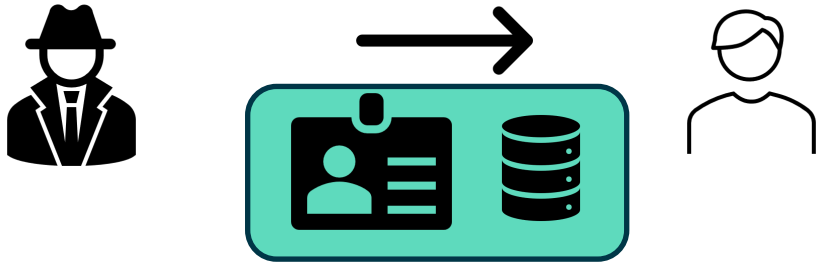
Nº 3 Preserve UIDs

De-identificaton in DICOM metainformation

Unique Identifiers (UIDs) are assigned **globally** to patients, studies, series, agencies or other entities within Standard DICOM.

If access to original images + UIDs ⟶ identity of individual

Use when small risk for having access to the original information.



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Nº 4 Retain patient characteristics

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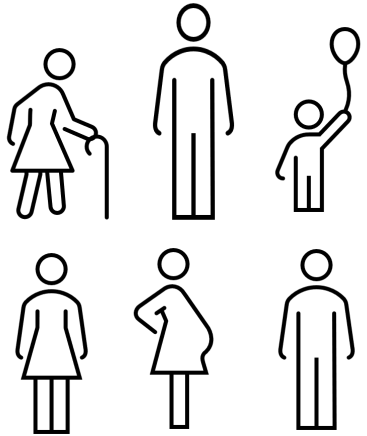
When some researches require physical characteristics to achieve the objectives of the study.

Characteristics example:

- Age
- Sex
- Height
- Weight
- Ethnic group

Putting together can reduce the number of people possibly related to an image.



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Nº 5 Retain device identity

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Device information can limit the number of posible subjects for an image.

However, this information is relevant in some studies to improve analysis or interpretation like Deep Learning where image quality is crucial.

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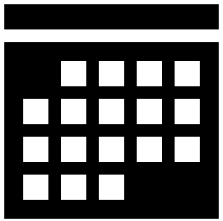
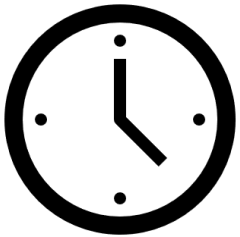
Nº 6 Retain complete dates

De-identificaton in DICOM metainformation

A big risk to keep the dates but necessary in some studies.

If Date or Time preserved ⟶ label (0028,0303) added with text 'UNMODIFIED'





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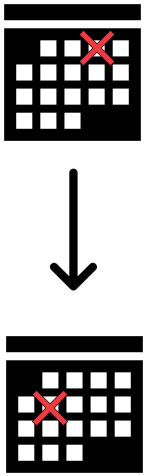
Nº 7 Keep complete modified dates

De-identificaton in DICOM metainformation

Date or Time type attributes are modified.

Criteria:

- Change date to reduce identification.
- Preserve longitudinal temporal relationships among images
- Preserve precise timing relationships among images and events needed for analysis



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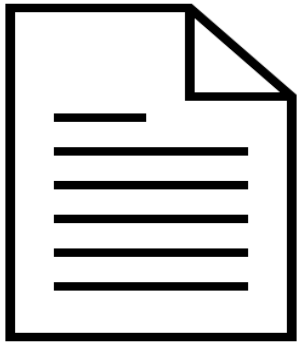
Nº 8 Clean descriptors

De-identificaton in DICOM metainformation

In free text DICOM attributes, PHI could be added. This should be deleted.

Looking for any information added in text strings or not corresponding to the attribute itself.



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Nº 9 Clean structured content

De-identificaton in DICOM metainformation

Structural Reports and the Acquisition Context information can contain PHI.

For example, the "observer" responsible for a diagnostic imaging report may be explicitly identified in Observation Content in a SR.

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Nº 10 Clean graphics

De-identificaton in DICOM metainformation

Delete PHI from layers and graphical annotations superimposed to the image or printed in the image itself.

Need methods of digital imaging processing.

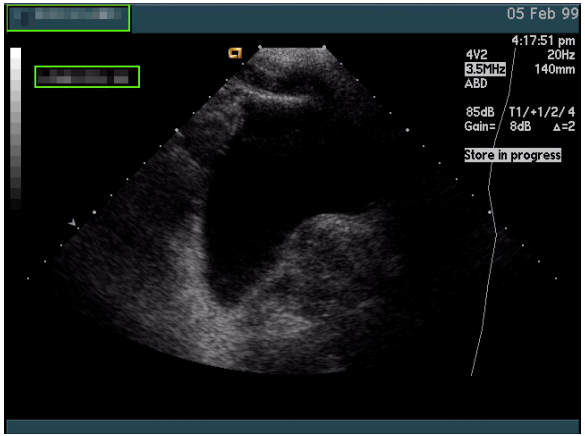

Figure Source: http://www.dclunie.com/pixelmed/software/webstart/DicomCleanerUsage.html

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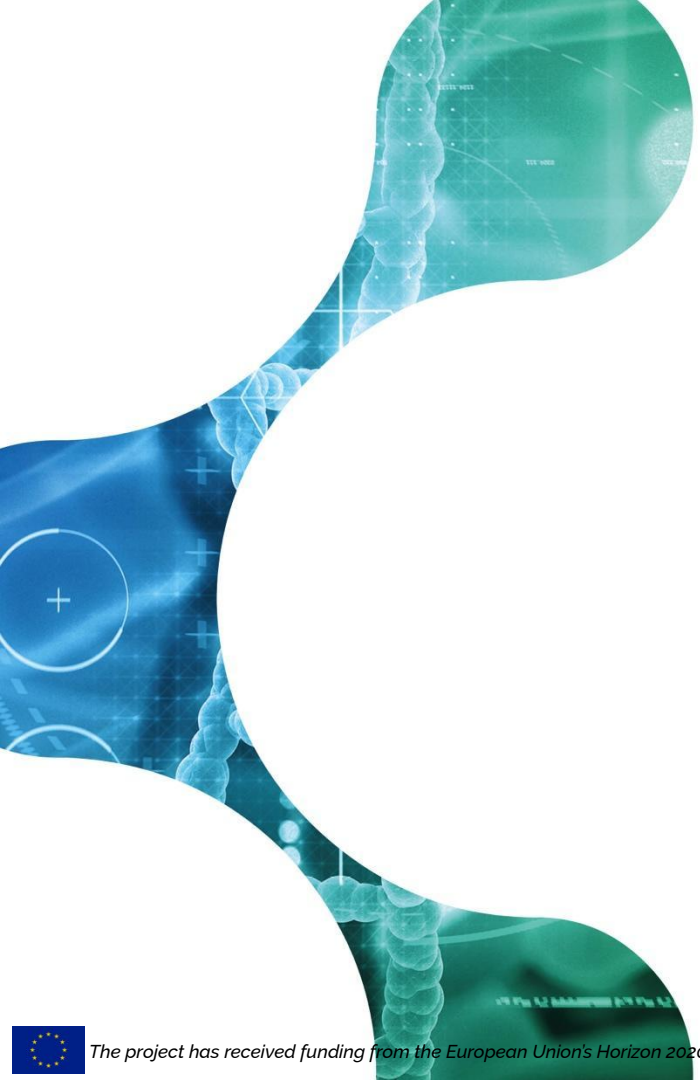

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Methodology

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DICOM tags to anonymise

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Main DICOM tags to be modified or anonymised according to DICOM PS 3.16 (table CID 7050) Guideline.

0008,0020 StudyDate	0008,0090 ReferringPhysiciansName	0010,0030 PatientsBirthDate
0008,0021 SeriesDate	0008,0092 ReferringPhysiciansAddress	0010,0032 PatientsBirthTime
0008,0022 AcquisitionDate	0008,0094 Ref. PhysiciansTelephoneNumber	0010,0040 PatientsSex
0008,0023 ContentDate	0008,0096 ReferringPhysicianIDSequence	0010,1000 OtherPatientIDs
0008,0024 OverlayDate	0008,1040 InstitutionalDepartmentName	0010,1001 OtherPatientNames
0008,0025 CurveDate	0008,1048 PhysicianOfRecord	0010,1005 PatientsBirthName
0008,002A AcquisitionDatetime	0008,1049 PhysicianOfRecordIDSequence	0010,1010 PatientsAge
0008,0030 StudyTime	0008,1050 PerformingPhysiciansName	0010,1040 PatientsAddress
0008,0031 SeriesTime	0008,1052 PerformingPhysicianIDSequence	0010,1060 PatientsMothersBirthName
0008,0032 AcquisitionTime	0008,1060 NameOfPhysicianReadingStudy	0010,2150 CountryOfResidence
0008,0033 ContentTime	0008,1062 PhysicianReadingStudyIDSequence	0010,2152 RegionOfResidence
0008,0034 OverlayTime	0008,1070 OperatorsName	0010,2154 PatientsTelephoneNumbers
0008,0035 CurveTime	0010,0010 PatientsName (M)	0020,0010 StudyID
0008,0050 AccessionNumber	0010,0020 PatientID (M)	0038,0300 CurrentPatientLocation
0008,0080 InstitutionName	0010,0021 IssuerOfPatientID	0038,0400 PatientsInstitutionResidence
0008,0081 InstitutionAddress		0040, A120 DateTime
		0040, A121 Date
		0040, A122 Time
		0040, A123 PersonName

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Methodology: De-identification

De-identificaton in DICOM metainformation

DICOM Standard:
Part 1: Introduction and Overview
National Electrical Manufactures Association PS. 3.1-3.18, 2009

Performance of the de-identification in Digital Imaging and Communications in Medicine

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Methodology: Smart-Upload

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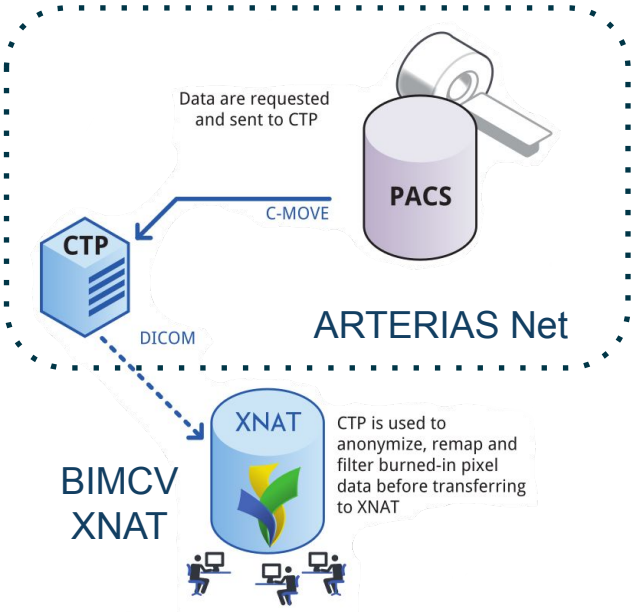
BIMCV Anon and Pseudoanonymisation Performance



Steps

1. Download DICOM files from PACS to CTP Server.
2. Clean and decompress images
3. Anonymise with CTP
4. Upload to XNAT

Non-anon Images operations within Secure Network ARTERIAS

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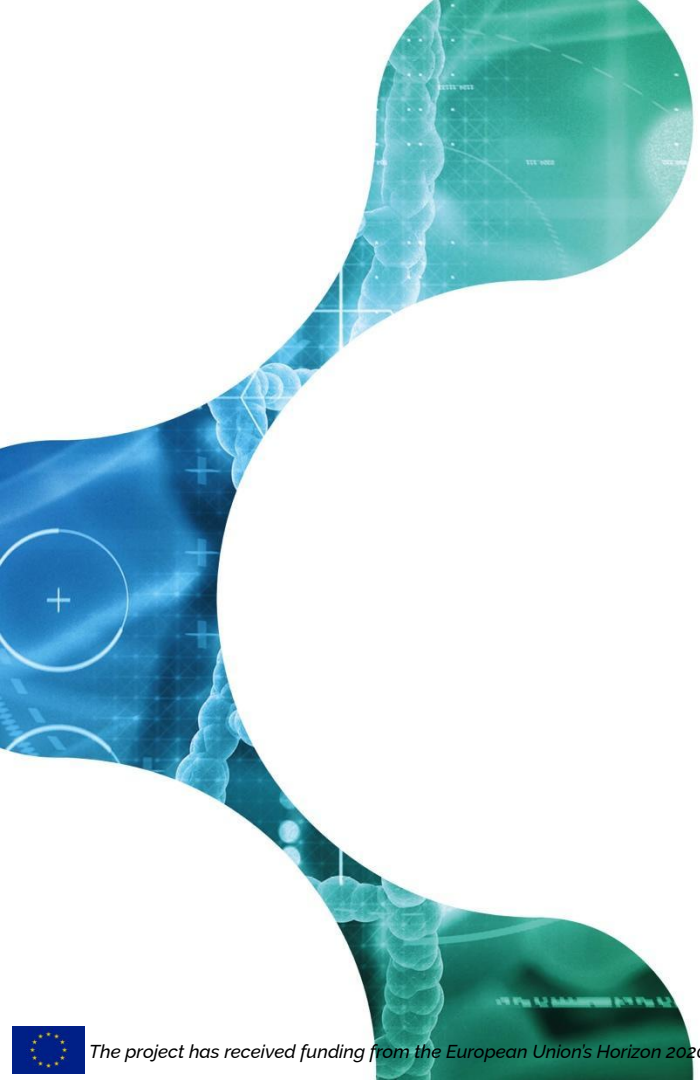

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- Reference DICOM Table Profiles: https://dicom.nema.org/medical/dicom/current/output/chtml/part15/chapter_E.html
- Reference DICOM Tags to anonymise: http://dicom.nema.org/dicom/2013/output/chtml/part16/sect_CID_7050.html
- Reference CTP: https://mircwiki.rsna.org/index.php?title=MIRC_CTP&redirect=no
- Reference BIMCV Smart-Upload: https://github.com/BIMCV-CSUSP-Smart-Upload
- Reference XNAT: https://www.xnat.org/about/
- Extra: Programming libraries
  Pydicom: https://pydicom.github.io/
  Gdcm: http://gdcm.sourceforge.net/wiki/index.php/General_questions

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Thanks for the attention

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