



Data de-identification made simple

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Introduction

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Basic idea

- PhUSE: De-Identification Standard for CDISC SDTM 3.2
 - Small set of well defined rules
 - Exhaustive list of rules per variable
- Metadata extract from trial data
- Match trial data and definition metadata
- Determine order of operations
- One operation => one macro
- Execute and report



De-Identification Standard

Rules

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- Recode subject ID (key across domains)
- Recode ID variable (independent)
- Offset (dates as if all begins on the same date)
- Remove (variables)
- Keep (no action)
- No further de-identification (no action)
- Elevate to continent (simple mapping)
- Derive Age (handle few very old subjects)
- Aggregate Age (manual assessment)
- Review and only redact values with personal information (manual)
- Remove dataset (always CO, maybe SU and others)

- Remove observation (not in standard)



De-Identification Standard

SDTM Implementation Guide definitions

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- Small excerpt of interesting columns

Domain	Variable_Name	DI_Primary_Rule
	STUDYID	
	DOMAIN	
	USUBJID	Recode subject ID
	POOLID	
	SPDEVID	Remove
	--SEQ	
	--GRPID	
	--REFID	Recode ID variable
	--SPID	Recode ID variable
	--TRT	Remove
	--TERM	Remove
DM	INVID	Remove
DM	INVNAM	Remove
DM	BRTHDTC	Remove
DM	AGE	Derive Age
DM	AGEU	
DM	SEX	Keep
DM	RACE	Keep
DM	ETHNIC	Keep
DM	ARMCD	
DM	ARM	

Metadata

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Mapping rules to macros

```
proc format;  
  value $rules  
    'Remove dataset'          = '%di_remove_dsn'  
    'Derive Age'              = '%di_derive_age'  
    'Offset'                  = '%di_offset'  
    'Elevate to continent'    = '%di_continent'  
    'Recode subject ID'      = '%di_recode_subject'  
    'Recode ID variable'     = '%di_recode_id'  
    'Remove'                  = '%di_remove_var'  
    'Keep'                    = '%di_keep'  
    'No further de-identification' = '%di_no_further'  
    'Review and only redact values with personal information' = '%di_manual'  
    other                     = '';  
;
```



Metadata

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Prioritize operations

```
proc format;  
  invalue rules  
    '%di_remove_dsn'      = 1  
    '%di_derive_age'      = 2  
    '%di_offset'          = 3  
    '%di_continent'       = 4  
    '%di_recode_subject'  = 5  
    '%di_recode_id'       = 6  
    '%di_remove_var'      = 7  
    '%di_keep'            = 9  
    '%di_no_further'      = 8  
    '%di_manual'          = 10  
  other                   = 99;  
;
```



Metadata

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Mapping countries to continents

- Obtaining metadata apparently difficult
- SAS maps data always at hand
 - maps.names, maps.metamaps
- Merge by name and isoname
 - Slightly different results. Use both and merge
- Russia and Mexico(?) also in Europe!
 - Data needs to be fixed; duplicates removed
- Once per new SAS version/maps update

Metadata

Study metadata

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- Strictly SDTM domains and variables
- Global variables across domains
 - Without -- prefix; USUBJID, VISITNUM
- Domain specific variables
 - Without -- prefix; AETERM, EXROUTE
- List of domains from study datasets
 - Excluding SUPP-- domains
- Other variables
 - With -- prefix, replaced with domain code
- All variables
 - Merge and remove duplicates

Metadata

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Study metadata principles

- Merge enriched specification variable list with variables in study data
- Add rules to each variable
- Leave out all variables not in specification
- Assign priority to each variable and sort

Operations

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Preparing operations

- Calculate offset per subject
 - Earliest of
 - RFSTDTC (first reference)
 - SVSTDTC (visit 1)
 - DSSTDTC (date of informed consent)
 - ...as study start date
 - Each subject have individual offset relative to study start date
- Create USUBJID look-up table
 - USUBJID must be consistent across domains

Operations macros

Common structure

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- Validate arguments
 - Derive any support values
- Register operation
 - Categorize operation by importance
- Perform operation
 - Update study data
- Debugging comments
 - Stand alone test data

Operations

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1. Remove dataset

- Avoid superfluous work
 - Update metadata, remove as well!

2. Derive age

- Age is expected in DM
 - May be empty; calculate
 - May need redaction
 - If any subject > 89 years old
- Age unit may vary
 - Days, hours, weeks, months, years
- Create plots of age distribution

3. Offset dates

- Simple subtraction of offset from date
- Handling of partial dates
 - Impute date to mid month/year as needed
 - Subtract offset from imputed date
 - Remove imputed date parts

Operations

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4. Elevate to continent

- Convert continent dataset to format
- Create variable REGIONDI containing continent
- Ensure REGIONDI has sufficient length

Operations

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5. Recode subject identifier

- All identifiers are recoded using the same algorithm
- Recoding USUBJID requires re-sorting of the dataset

Operations

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6. Recoding

- Calculate max recoded value
- Obfuscate variable (by un-sorting)
 - Sort by some quazi-random sequence
- Calculate new monotonic value from next multiple of 10 of max recoded value
 - 215, 101, 147... becomes 1001, 1002, 1003...
- Update values in situ



7. Remove variable

- Delay dropping variables until after dependent values are calculated
 - Age depends on date of birth

Operations

8 & 9. Do nothing

- Keep variable
- No further action

Operations

10. Manual handling

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- Review and only redact values with personal information

Operations

Addendum to specification

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- Remove observation
 - Qval in SUPP-- may contain names and dates etc.
 - Subject initials
 - Investigators names and/or initials
- Country should be removed after elevation to continent

Reporting

Messages collected

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- HTML output
- Resorting messages
 - Operation 10, manual processing, is highlighted at the top of the list
- Age distribution is plotted

Reporting

Example of messages

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Issues handled during DE-identification

Category=1

Action taken

Variable AEACNOTH in dataset AE must be handled manually
Variable CMDOSFRQ in dataset CM must be handled manually
Variable CMDOSU in dataset CM must be handled manually

Issues handled during DE-identification

Category=6

Action taken

Removing observations in dataset SUPPDM where SUBSTR(QVAL,1,5)='EARLY'

Issues handled during DE-identification

Category=9

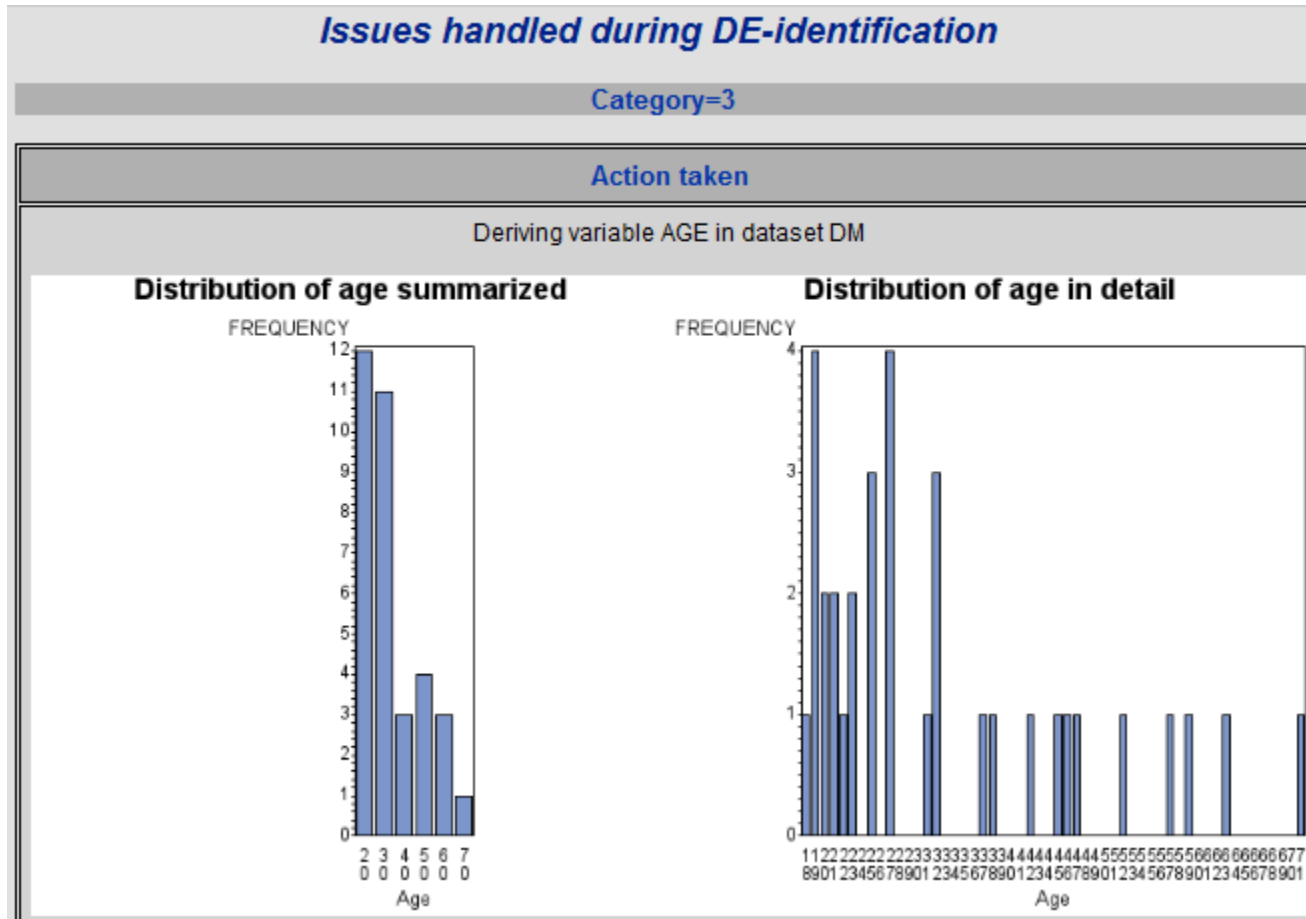
Action taken

Dataset AE re-sorted by USUBJID
Dataset CM re-sorted by USUBJID
Dataset DM re-sorted by USUBJID
Dataset DS re-sorted by USUBJID
Dataset EX re-sorted by USUBJID

Example of age distribution

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Process

Always several iterations

- Setup and run the program suite
- Inspect the report for manual operations and age distribution
- Inspect all domains for dates, names, initials etc. not mentioned
- Insert study specific operations
- Run again
- Repeat

Questions

...and hopefully answers

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