The ROYAL MARSDEN
NHS Foundation Trust

Developing a CT scan protocol comparison tool

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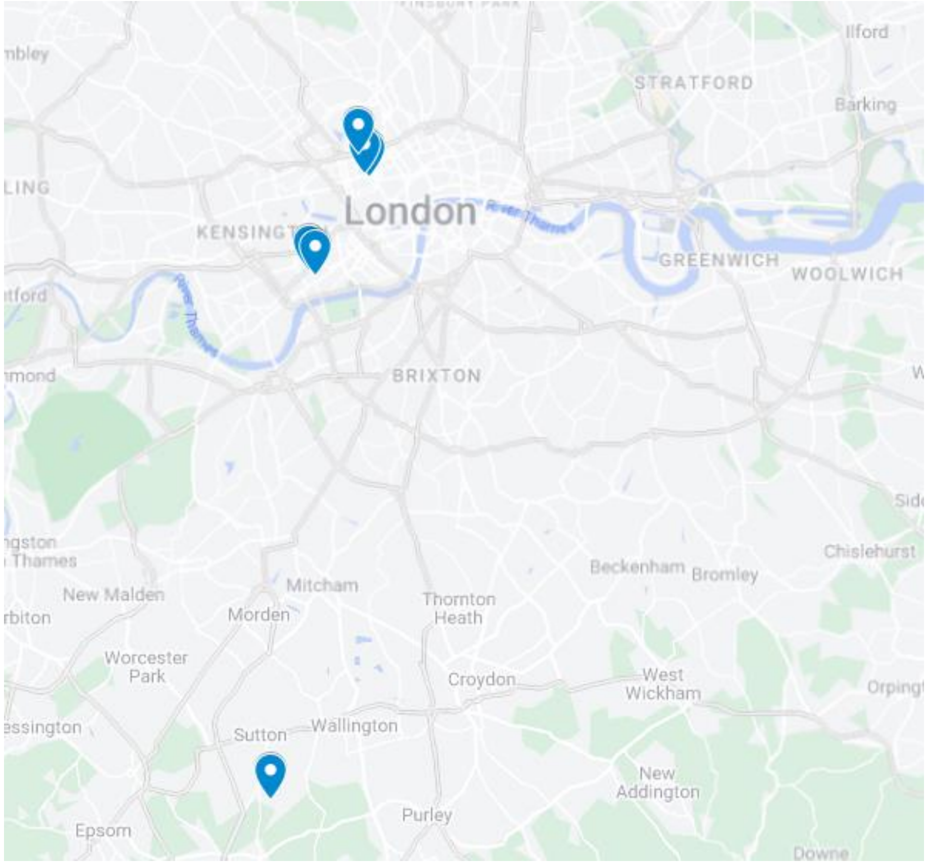
NHS

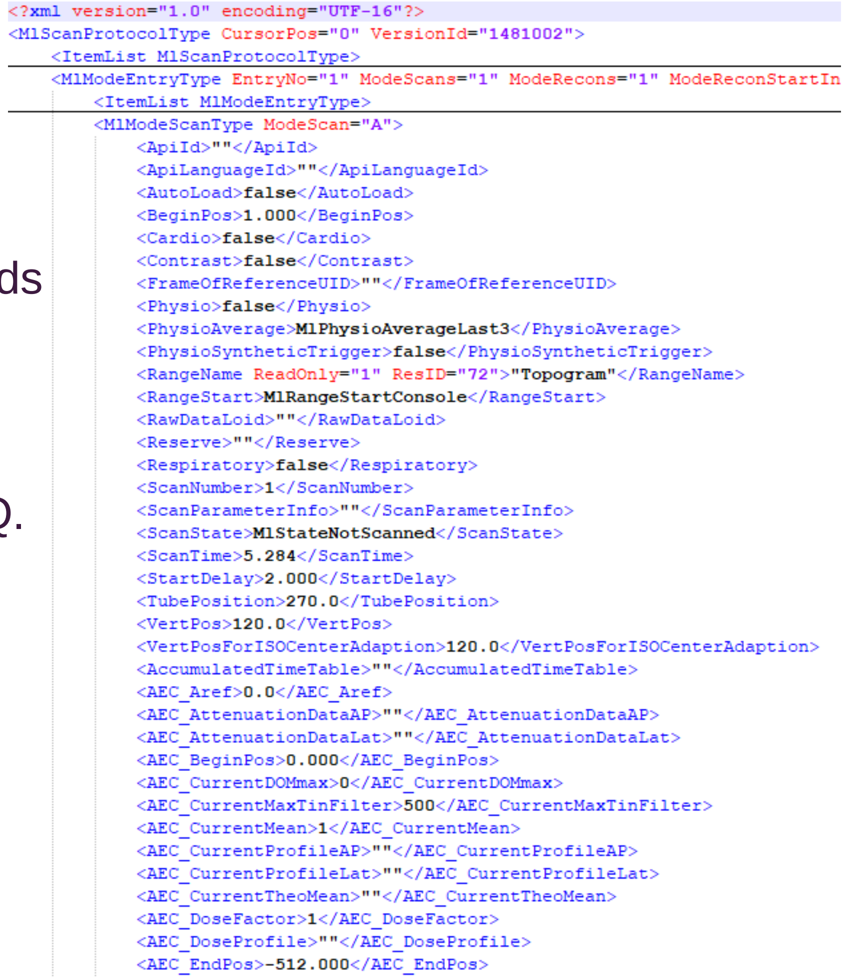
RMH DR Physics: CT

- 19 CT scanners across 6 sites (including PET/SPECT-CT)
    - 15 of 19 are Siemens units
- 4 x Clinical scientists (3 x MPEs) + 1 x 0.2 WTE
- 2 x Route 2 trainees



CT Protocols

- Depending on clinical workload, one unit will have dozens of protocols.
- Each protocol is defined using hundreds of parameters.
- Only a small subset of these parameters directly affect dosimetry/IQ.
- Large numbers of parameters can change from seemingly small adjustments.
- New parameters are regularly added during software upgrades.



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<?xml version="1.0" encoding="UTF-16"?>
<MlScanProtocolType CursorPos="0" VersionId="1481002">
    <ItemList MlScanProtocolType>
    <MlModeEntryType EntryNo="1" ModeScans="1" ModeRecons="1" ModeReconStartIn
        <ItemList MlModeEntryType>
        <MlModeScanType ModeScan="A">
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            <ApiLanguageId>""</ApiLanguageId>
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            <PhysioAverage>MlPhysioAverageLast3</PhysioAverage>
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```

CT Protocol Management

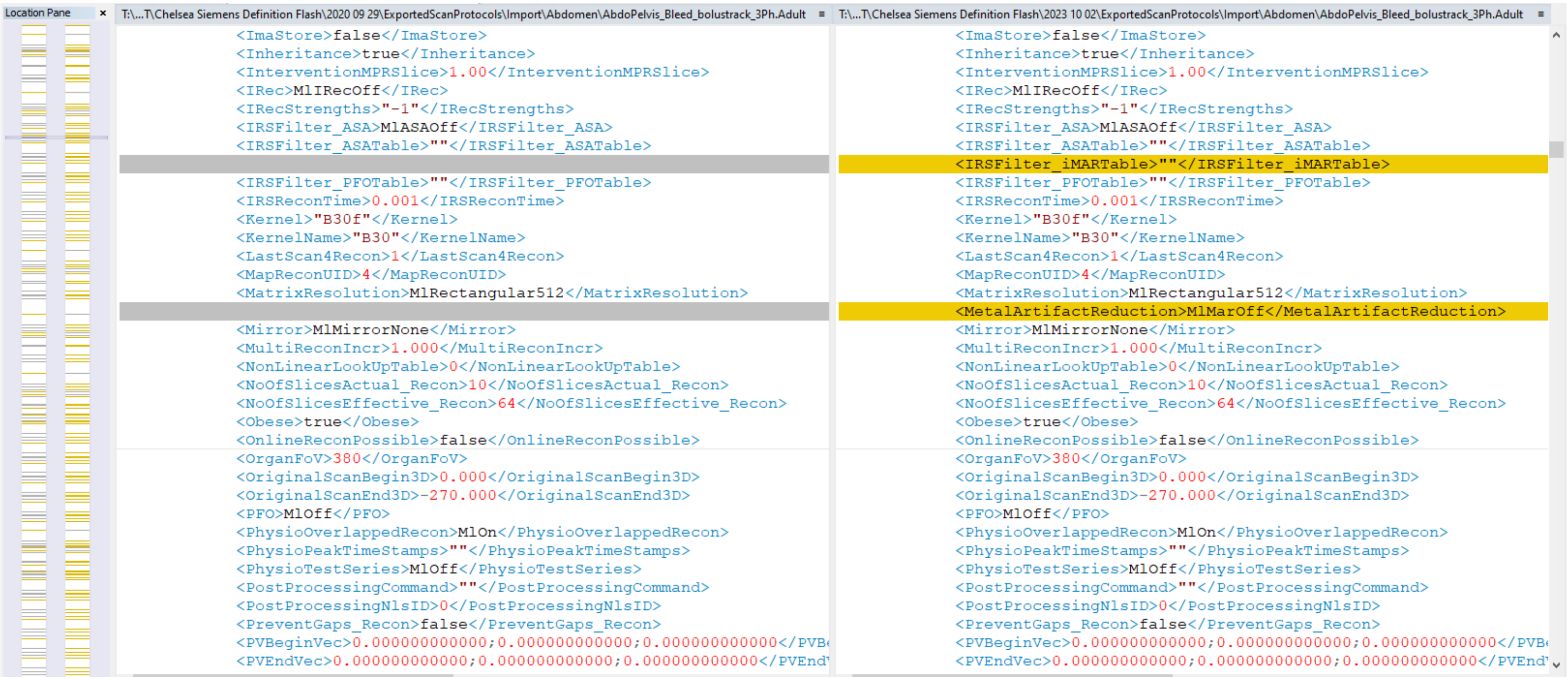
- Export CT protocols at each routine QA visit and before and after any protocol changes.

- Compare old and new exports using WinMerge.

- Record changes found, follow up on unexpected findings with superintendents.

- Manufacturer solutions exist but typically require a subscription per scanner.

CT Protocol Management: Old system



T:\...T\Chelsea Siemens Definition Flash\2020 09 29\ExportedScanProtocols\Import\Abdomen\AbdoPelvis_Bleed_bolustrack_3Ph.Adult

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<Inheritance>true</Inheritance>
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<ImaStore>false</ImaStore>
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<IRec>MlIRecOff</IRec>
<IRecStrengths>"-1"</IRecStrengths>
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<IRSFilter_PFOTable>""</IRSFilter_PFOTable>
<IRSReconTime>0.001</IRSReconTime>
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<PVBeginVec>0.000000000000;0.000000000000;0.000000000000</PVB
<PVEndVec>0.000000000000;0.000000000000;0.000000000000</PVEnd
```
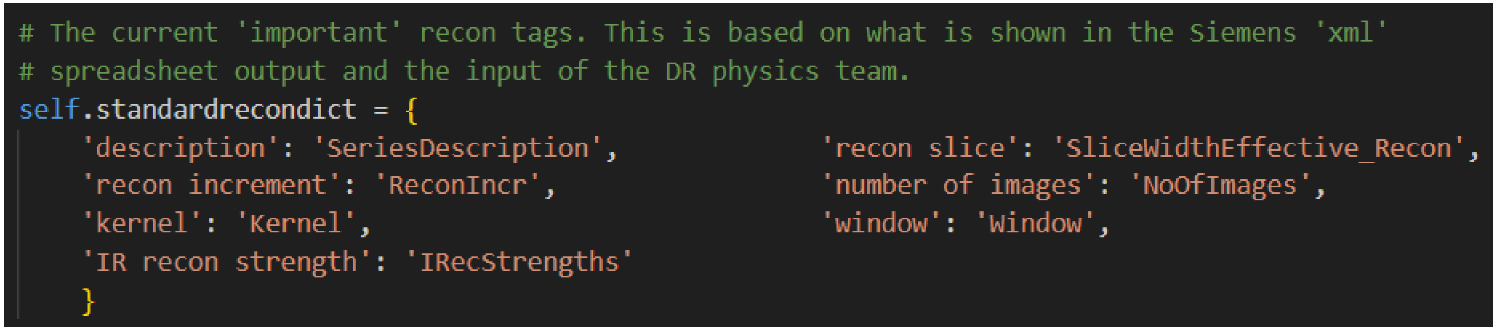

CT Protocol Comparison Tool: Specifications

- Project managed using Redmine and Git.
- Developed using Python.
- “This software will accept as input two folder locations containing the .Adult and .Child xml files extracted from the UserProtocols.ar files exported from a Siemens CT scanner. It will then process all the files and perform a comparison of the pertinent contents of the files and presenting these changes in an understandable way to the user. In this way, changes to the protocol files that are due to file format changes or similar that do not reflect clinical changes to the protocols can be safely disregarded, whilst clinical changes to the protocols can be easily highlighted.”

CT Protocol Comparison Tool: Design

- filecmp package used to compare file/folder structures.
- Xml tags in changed files parsed using lxml package.
- Defined list of ‘important’ tags compared between files.

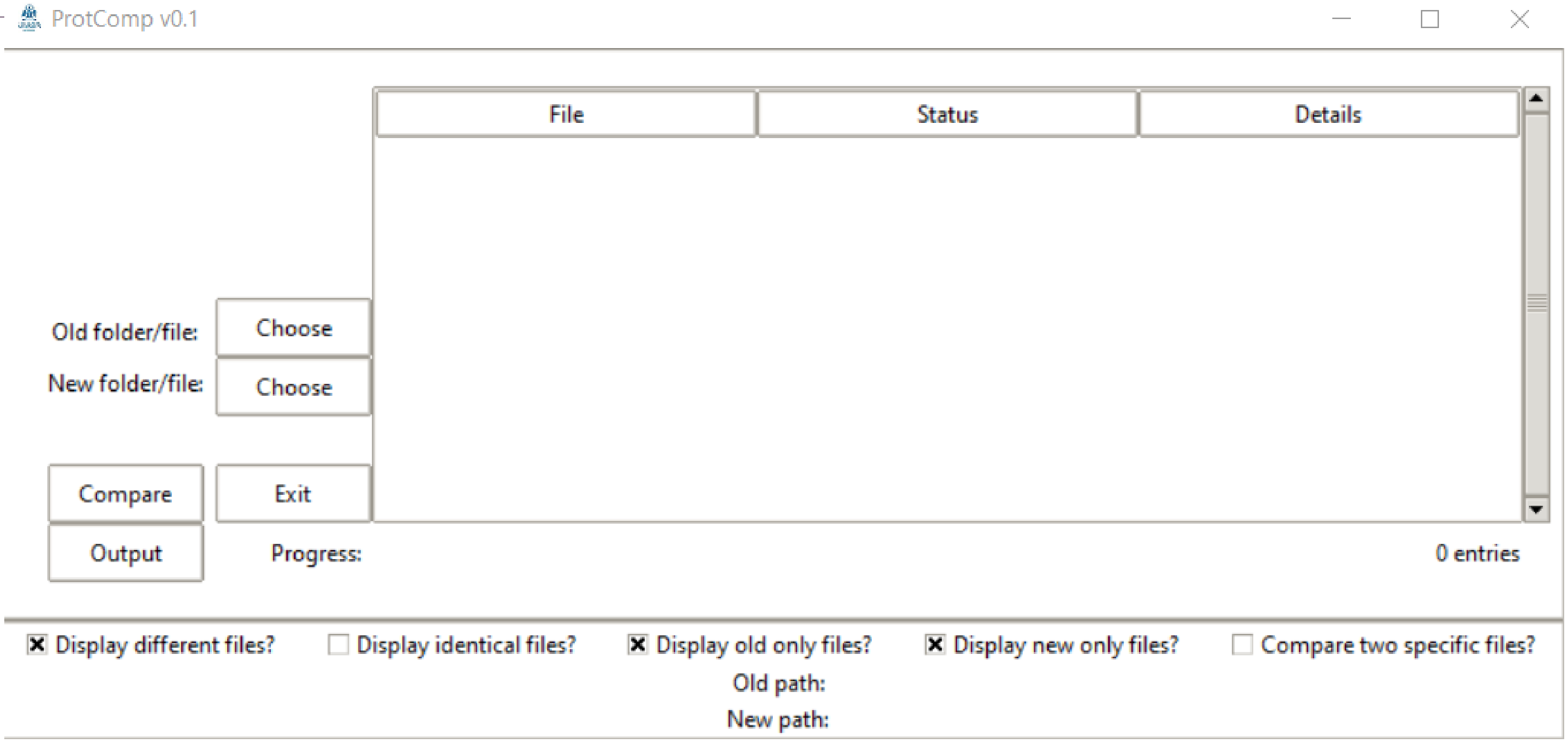


```
# The current 'important' recon tags. This is based on what is shown in the Siemens 'xml'
# spreadsheet output and the input of the DR physics team.
self.standardrecondict = {
    'description': 'SeriesDescription',             'recon slice': 'SliceWidthEffective_Recon',
    'recon increment': 'ReconIncr',                 'number of images': 'NoOfImages',
    'kernel': 'Kernel',                             'window': 'Window',
    'IR recon strength': 'IRecStrengths'
    }
```

- Tkinter package used to create GUI.
- Pyinstaller used to create .exe.

- Protocols where filenames have been changed are found by calculating the percentage of identical tags between them – if >95% of tags match, protocols are assumed to be the same.

Live Demonstration



Is it worth comparing protocols?

- Cardiac CT scanner protocol Quality Reference mAs was reduced by RMH Physics as part of an optimisation project.

- Issues with the scanner the following weekend, manufacturer used remote diagnostics to reset scanner to their backup state. No AxREM form, Physics not informed.

- Dose audit a few weeks later showed no reduction in dose indicators. Protocols exported and compared, no change to Q. Ref. mAs! ~25 patients inadvertently scanned with higher mAs.

- Incident reported to CQC, root cause found. Protocols now exported/compared on a monthly basis. Following discussions with Siemens, systems will be backed up before software updates.

Future Development

- Tool currently used exclusively by DR Physics. Further documentation required to support use by radiographers.
- Still requires comparison to be manually processed, potential for automating process.
- Tool can only be used with Siemens CT scanners. Siemens SPECT/PET-CT and other manufacturers use different protocol formats, development required.
- Changes to formatting in the future may require further development to maintain functionality.

Acknowledgements

Ed McDonagh

RMH DR Physics