HDR GYN dose statistics script, *doseStats*, user guide
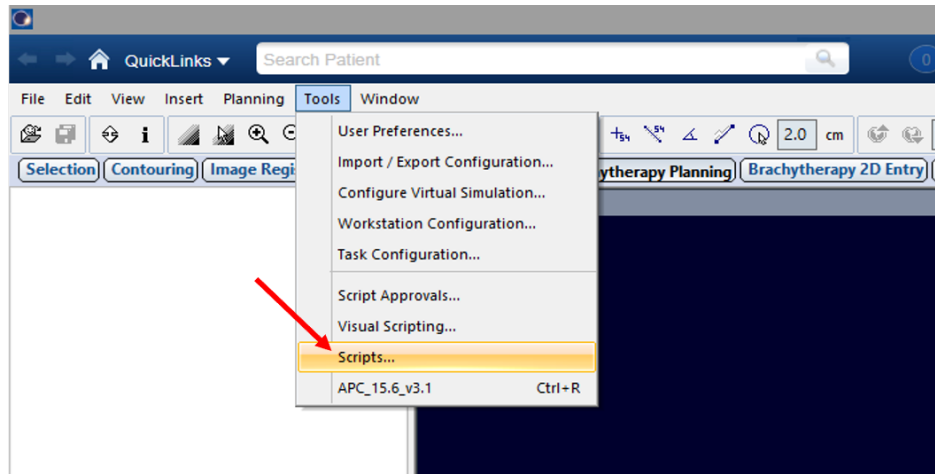
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(Revised May 22, 2022)

Contents

Figure 1: How to access scripts within the Eclipse treatment planning system.

1 Current script version

The below guide is valid and accurate for the for the script version:
doseStats_v0.7
Eclipse v16.1

2 Introduction

The purpose of this document is to provide guidance for the *doseStats* script used to increase planning efficiency and safety in HDR brachytherapy. This script focuses on automating the extraction of the EQD2 data from GYN HDR brachytherapy fractions and eliminating manual data entry. Furthermore, the default metrics that are retrived from the current and previous fractions can be modified in the GUI or in a configuration file that is read by *doseStats* upon launch. The results of the EQD2 values can easily be written to an excel file for record keeping. As many clinics manually enter the physical doses into a spreadsheet to calculate the EQD2, I imagine the preferred option would be to calculate the EQD2 using the script and then write the physical doses to the appropriate locations in the clinic's current EQD2 spreadsheet for an independent calculation of the EQD2. This functionality is included with *doseStats*.

A second dose calculation check is provided with *doseStats*, which uses the exposure rate constant for Ir-192 (from AAPM TG43) along with the point-source approximation. The results of this second dose calculation can also be written to an excel spreadsheet. The existing algorithm will be replaced in the future with a TG43 calculation.

3 How to run the script

- To run the script (or any script within Eclipse), go to Tools –> Scripts in Brachytherapy Planning or External Beam Planning (Figure 1)

- Select 'Folder' and 'Change Folder ...' (Figure 2)

- Navigate to and select the folder where the compiled script was placed (i.e., the .dll file)

    - E.g., \\vfs0006\RadData\oncology\ESimiele\HDR\ESAPI\release_versions\
    - **Don't worry if the folder is empty. The file browser doesn't display script files by default**

- Run the script 'doseStats_vXX.dll'

    - The 'XX' corresponds to the current version number

- The user interface for the script is shown in Figure 3

- By default, user specified metrics (see Section 5.1 for configuring the default metrics) are obtained from the open plan and the previously treated fractions (determined by the plan treatment approval status)

    - **NOTE: THE SCRIPT MAY TAKE A FEW SECONDS TO CALCU-LATE AND GRAB THE METRICS THE FIRST TIME YOU RUN THE SCRIPT!**
    - **THIS IS BECAUSE THE SCRIPT NEEDS TO CALCULATE THE DVH FOR THE RELEVANT STRUCTURES IN THIS PLAN AND THE PREVIOUS PLANS.**
    - After the first execution, the script should launch instantaneously

- By default, the patient is assumed to have a prior external beam treatment of 4500 cGy in 25 fractions. This information is used in the calculation of the EQD2 to the target and OAR volumes from the external beam course, which is subseqently added to the HDR EQD2

    - The default dose per fraction and number of fractions from the EBRT course can be adjsuted in the GUI (Figure 3) or on the configuration .ini file (Section 5.1)

- EQD2 is calculated as:

$$EQD2 = nd * \left(\frac{d + \frac{\alpha}{\beta}}{2.0 + \frac{\alpha}{\beta}} \right) \tag{1}$$

- n = number of fractions, d = dose per fraction, and $\frac{\alpha}{\beta}$ is defined for each tissue

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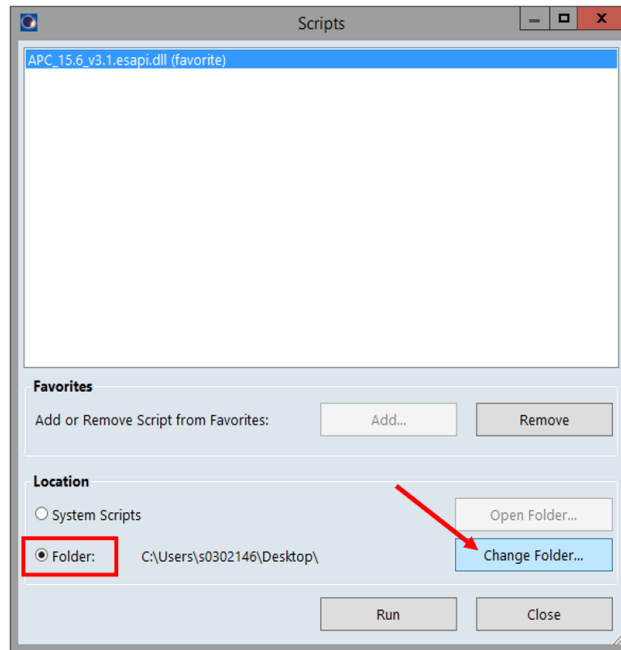
Figure 2: How to change the location of the folder used to load scripts (.dll files).
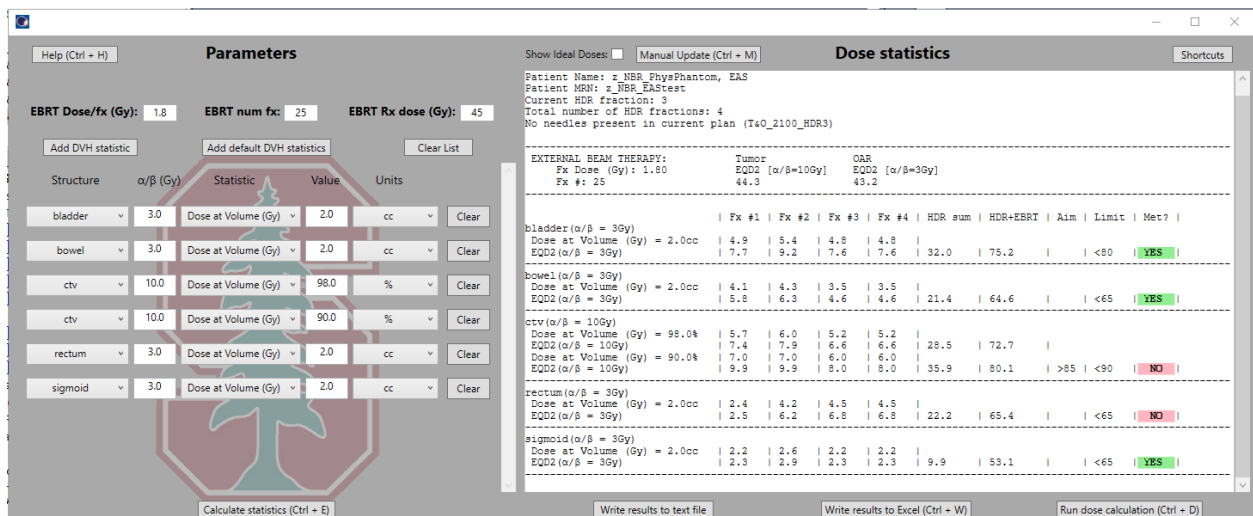
Figure 3: The user interface when the script is first launched. By default (see Section 5.1), several metrics are obtained from the current plan and the previously treated plans for this patient.
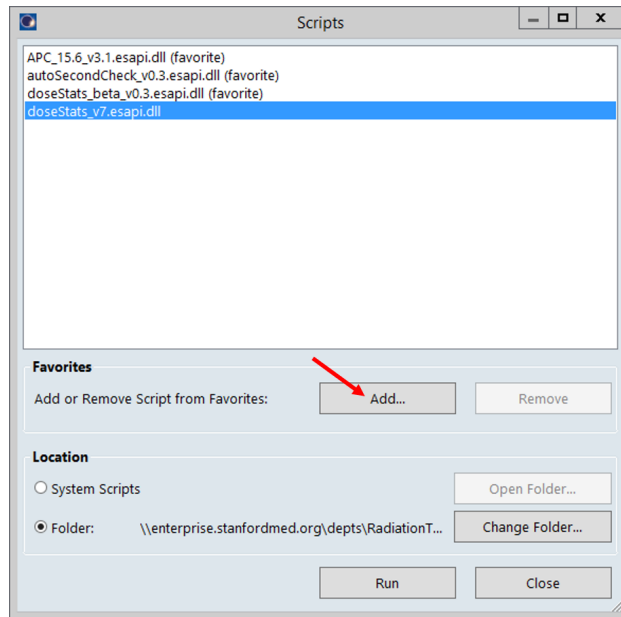
Figure 4: How to add a script to favorites (i.e., how to macro a script to your keyboard).

3.1 How to launch the script with a keyboard shortcut

- The instructions in the previous section explain how to launch scripts within Eclipse. However, using that methodology you will need to manually go to Tools –> Scripts, select the script you want, and hit Run

- This time consuming process can be costly, especially in brachytherapy. To expedite the process of launching scripts, you can 'macro' favorite scripts to your keyboard

  - By macro, I mean using a keyboard shortcut (e.g., Ctrl + E) to launch the desired script

- To add a favorite script, go to Tools –> Scripts

- In the Scripts window, highlight the script you want to macro to your keyboard, and add the script as a favorite (Figure 4)

- In the window that pops up, assign this script to a keyboard shortcut of your choice (I recommend Ctrl + E)

- With the script macro-ed to your keyboard, you should be able to open the brachytherapy plan of interest, select one of the viewing plans, and use your macro to launch the script

Table I: Available shortcuts in the script.

Action	Keyboard shortcut
Close the script	Ctrl + Q
Calculate metrics	Ctrl + E
Write the obtained metrics to the Excel template	Ctrl + W
Run the second dose calculation check in a new window	Ctrl + D
Open this help guide	Ctrl + H
Toggle displaying the ideal/achieved doses	Ctrl + A
Open the manual dose adjustment window	Ctrl + M

3.2   How to use keyboard shortcuts or macros within the script

- To improve the efficiency of using the script, default metrics (see Section 5.1) are automatically retrieved upon execution

- In addition, it is recognized that having to manually click the various buttons in the UI (Figure 3) can slow down the treatment planner

- Therefore, keyboard shortcuts or macros were implemented to improve the efficiency of performing functions within the script. A list of the functions is shown in Table I

- I find it particularly useful to bounce in and out of the script using the keyboard shortcuts

  - E.g., I will make a change to the dose distribution in the plan, launch the script to evaluate where I am with respect to the dose limits, then hit Ctrl + Q to close the script. Rinse and repeat

  - This way, you don't need to waste time using your mouse to close the script

- These shortcuts are also useful if you are too lazy to click on the buttons

3.3   How to modify the requested statistics

- The requested statistics can easily be changed by hitting the 'Add DVH statistic' button

- A new row will be added to the requested statistics. You will need to select a structure

  - The available structures are: bladder, bowel, rectum, sigmoid, ctv, and pt A

  - Additional structures can be added by modifying the configuration .ini file (Section 5.1)

- Upon selecting a structure, the accompanying $\frac{\alpha}{\beta}$ ratio will be updated (this field is read-only)

- The $\frac{\alpha}{\beta}$ value is hard-coded into the script. A value of 10 is used for targets (CTV, GTV, pt A) and a value of 3 is used for all other tissues

- Select a statistic

  - The available statistics are: Dose at Volume (Gy), Dose at Volume (%), Dmean (Gy), Dmean (%), Volume at Dose (cc), Volume at Dose (%), and Volume (cc)

- For the Dose at Volume (Gy), Dose at Volume (%), Volume at Dose (cc), and Volume at Dose (%) metrics, you will be prompted to enter a query value and the associated units with the query (either cc, Gy, or %)

- Individual rows in the requested statistics can be removed by hitting the 'Clear' button

- The entire set of requested statistics can be cleared by hitting the 'Clear List'

- The statistics can then be re-added one at a time with the 'Add DVH statistic' button or the default parameters can be added by hitting the 'Add default DVH statistics' button (these are the same statistics that are retrieved when the script is initially launched)

- The EQD2 from the external beam course can modified by changing the values in the EBRT Dose/fx (Gy) and EBRT num fx text boxes (the value in EBRT Rx dose (Gy) text box is read-only)

3.4 How to write dose statistics to excel and txt

Table II: Default statistics that are written to the EQD2 Excel spreadsheet.

Structure	Metric
Bladder	D2cc (Gy)
Bowel	D2cc (Gy)
Rectum	D2cc (Gy)
CTV	D98% (Gy)
CTV	D90% (Gy)
CTV	V100% (%)
CTV	V200% (%)
CTV	Volume (cc)
pt A	Dmean (Gy)
N/A	Needle dwell time contribution (%)

- The relevant metrics listed in Table II can be written to the specified excel template by hitting the 'Write results to Excel' button (or using the associated macro)
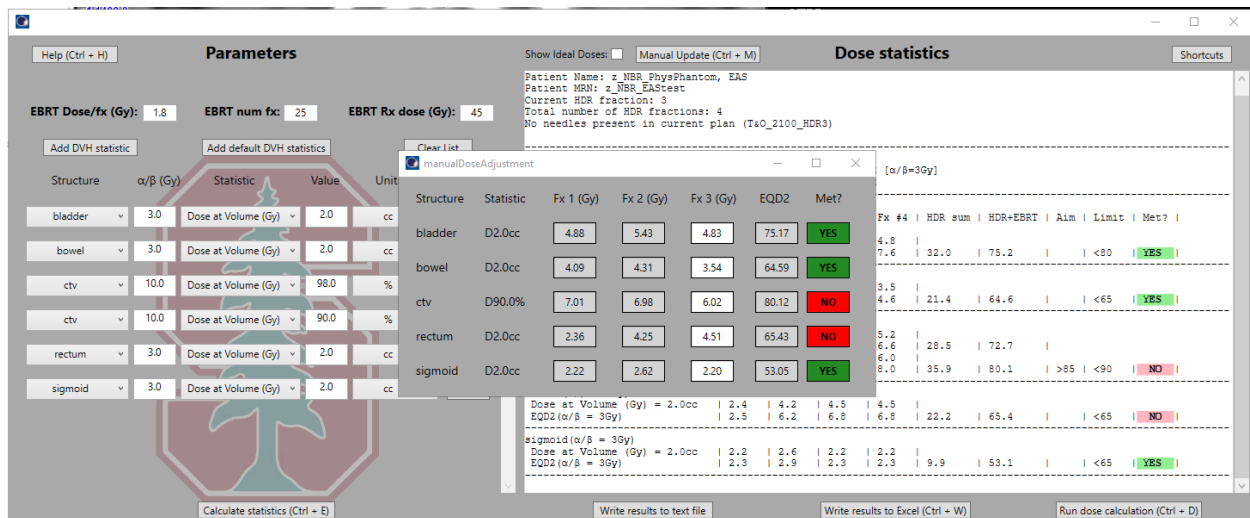
Figure 5: The manual dose adjustment window show the achieved physical dose for the previous fractions, the current fraction dose, the current EQD2, and if the EQD2 constraint is met for each tissue. All text boxes are read-only except for the current fraction physical dose. The EQD2 and Met textboxes are automatically updated when the dose in the current fraction is modified.

- - The metrics in Table II represent the defaults, but these can be adjusted in the configuration .ini file

- A copy of the excel template file will be taken from the specified patient database folder folder, the data will be written to the file, and the file will then be written to the patient folder. If the patient folder isn't found, you will be prompted to select a folder to write the resulting file

- If the excel file is open, the script can't access the patient folder, etc. the script will not be able to save the file

  - - The script should recognize the issue and inform you that there was a problem writing the file. It will then ask if you want to write the excel data to another location with another file name

- Upon writing the results to the patient folder, a pop-up window will appear and ask if you want to launch the newly-created excel file

- The individual metrics listed in Table II (or in the configuration .ini file) will only be written to the excel file only if you originally requested them

- The user also has the option to write the text in the output window to a simple .txt file by hitting the 'Write results to text file' (sorry, no macro). Upon hitting this button, you will be requested to select a folder and filename for the text file

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3.5 How to show the ideal doses and manually adjust the current dose

3.5.1 How to show the ideal doses in the dose statistics window

- The doses required to just meet the aims/limits can also be displayed in the dose statistics window by checking the 'Show Ideal Doses' checkbox

  - The required doses will be calculated and displayed for all EQD2 values that have an associated aim/limit AND are not currently meeting the constraint

  - The macro, Ctrl + A can also be used to show the ideal doses

- Upon showing the ideal doses, a warning message will appear at the bottom of the dose statistics window stating that the displayed dose values DO NOT reflect the delivered doses in the current plan

  - **NOTE: YOU WILL NOT BE ABLE TO WRITE THE DOSE STATISTICS RESULTS TO EXCEL WHEN THE IDEAL DOSES ARE DISPLAYED IN THE DOSE STATISTICS WINDOW**

- Note: the aim/limit constraint that is used to calculate the physical dose is selected by first checking if the constraint has an aim. If so, the aim is used to calculate the physical dose. If not, the limit is used to calculate the physical dose

3.5.2 Manual dose adjustment and EQD2 evaluation

- The achieved dose per fraction for each tissue can also be manually adjusted and the impact on the EQD2 can be evaluated by hitting the 'Manual Update' button (Ctrl + M)

- The window can also be opened by double clicking in the dose statistics output window

- A new window will open displaying the achieved physical dose for the previous fractions, the current fraction dose, the current EQD2, and if the EQD2 constraint is met for each tissue (Figure 5)

- All textboxes are read-only except for the current fraction physical dose

- The EQD2 and Met textboxes update automatically as the current fraction physical dose is modified

- This window provides a simple method to see how different physical doses translate to EQD2 values, which is a common part of plan review (e.g., we are achieving this dose and this EQD2, what will be the impact on the EQD2 if we lower the dose by 0.4 Gy?).

```
doseCalc                                                               —   □   ×

3/11/2022 9:45:46 AM
Patient: z_NBR_PhysPhantom, EAS (z_NBR_EAStest)
Plan: T&O_700_HDR1

Ir-192 planned activity: 10.00 Ci
Ir-192 current activity: 5.38 Ci

Use current activity for second dose calculation check: False

QA reference pt: RadCalc_HDR
QA reference location (x,y,z): (-1.65 cm, -4.41 cm, 20.46 cm)

Ir-192 T-constant: 4.69 R-cm2/mCi-hr
R->cGy in air conversion: 0.876 cGy/R
cGy in air->cGy in tissue conversion: 1.1 cGy/cGy
Ir-192 dose-rate constant: 0.00126 cGy-cm2/mCi-sec

NOTE: THIS CALCULATION USES THE POINT-SOURCE APPROXIMATION!

Catheter #3
------------------------------------------------------------------------------------------------
| Position (cm) | Planned Dt (sec) | x (cm) | y (cm) | z (cm) | r (cm) | Dose (cGy) | Tx day Dt (sec) |
| 149.90        | 16.9             | -4.40  | -4.05  | 19.17  | 3.06   | 22.72      | 31.4            |
| 149.40        | 12.8             | -4.40  | -4.45  | 18.86  | 3.18   | 15.85      | 23.8            |
| 148.90        | 8.9              | -4.41  | -4.84  | 18.56  | 3.38   | 9.77       | 16.5            |
| 148.40        | 0.0              | -4.42  | -5.24  | 18.25  | 3.64   | 0.00       | 0.0             |

Catheter #2
------------------------------------------------------------------------------------------------
| Position (cm) | Planned Dt (sec) | x (cm) | y (cm) | z (cm) | r (cm) | Dose (cGy) | Tx day Dt (sec) |
| 149.90        | 14.1             | -2.24  | -3.99  | 19.03  | 1.60   | 68.91      | 26.2            |
| 149.40        | 12.5             | -2.26  | -4.38  | 18.73  | 1.84   | 46.39      | 23.2            |
| 148.90        | 10.6             | -2.27  | -4.77  | 18.42  | 2.17   | 28.33      | 19.7            |
| 148.40        | 8.3              | -2.29  | -5.17  | 18.11  | 2.55   | 16.00      | 15.4            |

Catheter #1
------------------------------------------------------------------------------------------------
| Position (cm) | Planned Dt (sec) | x (cm) | y (cm) | z (cm) | r (cm) | Dose (cGy) | Tx day Dt (sec) |
| 149.90        | 0.0              | -2.67  | -6.12  | 23.56  | 3.68   | 0.00       | 0.0             |
| 149.40        | 1.0              | -2.73  | -5.93  | 23.10  | 3.23   | 1.20       | 1.9             |
| 148.90        | 7.1              | -2.80  | -5.74  | 22.64  | 2.81   | 11.33      | 13.2            |
| 148.40        | 5.4              | -2.87  | -5.54  | 22.19  | 2.40   | 11.74      | 10.0            |
| 147.90        | 20.3             | -2.94  | -5.35  | 21.73  | 2.04   | 61.00      | 37.7            |
| 147.40        | 14.2             | -3.01  | -5.16  | 21.28  | 1.76   | 57.83      | 26.4            |
| 146.90        | 7.6              | -3.08  | -4.96  | 20.82  | 1.58   | 38.37      | 14.1            |
| 146.40        | 16.7             | -3.15  | -4.77  | 20.36  | 1.55   | 87.70      | 31.0            |
| 145.90        | 27.3             | -3.21  | -4.62  | 19.89  | 1.67   | 122.45     | 50.7            |
| 145.40        | 23.8             | -3.26  | -4.51  | 19.41  | 1.93   | 80.61      | 44.2            |

Summary
------------------------------------------------------------------------------------------------
Planned treatment time: 207.50 seconds
Treatment time corrected for decay: 385.59 seconds
Dose at Reference Point: 692.68 cGy
Hand calculation (A = 10.00 Ci): 680.20 cGy
Percent Difference: -1.8%
Tolerance: 2%
Within tolerance?: YES

        Write to text (Ctrl + T)              Write to Excel (Ctrl + W)
```
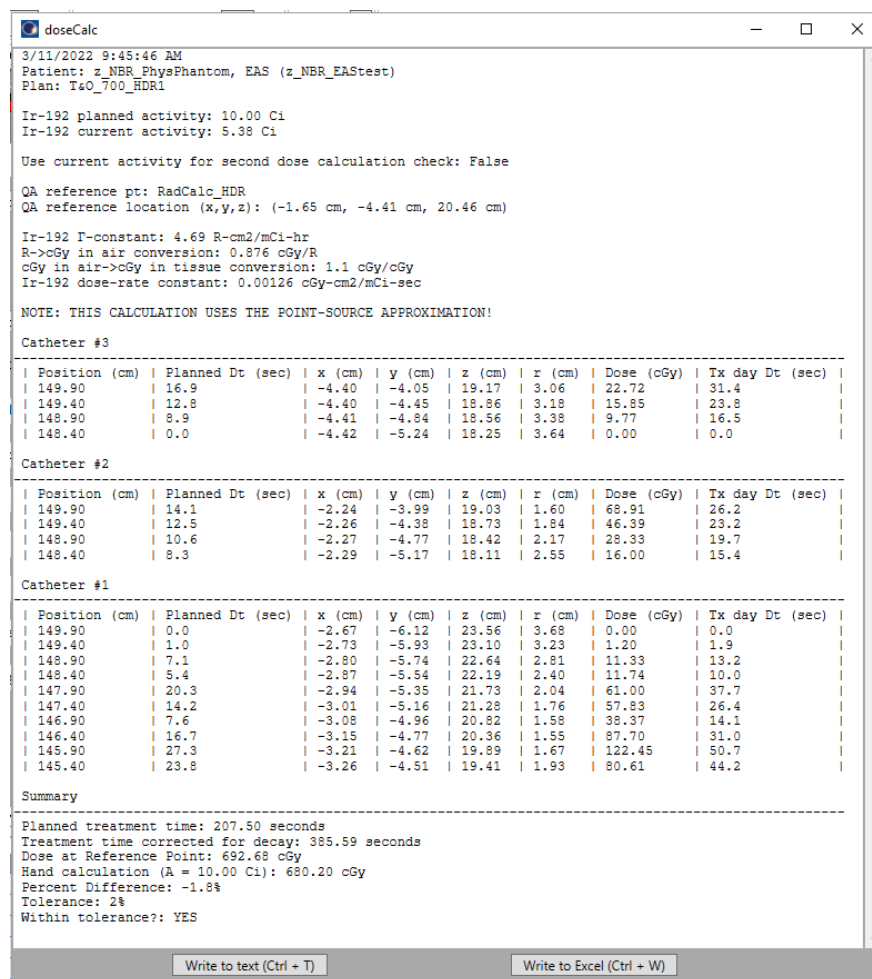
Figure 6: The second dose calculation window for a T&O plan. Doses are calculated using the point source approximation and are compared to the planned dose at a reference point location (one point of a reference line or a reference point).

- The manual adjust window can also be launched after displaying the ideal doses in the dose statistics window (Section 3.5.1), which shows the doses required to achieve the EQD2 aims/limits

3.6 How to run the second dose calculation check

- Similar to the previous subsection, the user has the option to run the physics second dose calculation check using the point source approximation (Ctril + D)

- A new window will appear with the results of the second dose calculation. An example window is shown in Figure 6

- The second dose calculation calculates dose at a reference point location. This reference

point could be one point of a reference line (must be named 'pt A', not case sensitive) or a reference point (name must contain either 'qa' or 'radcalc', not case sensitive)

- If a reference line is selected for calculation, the point that is used for evaluation is determined by grabbing all of the available reference line points and ordering them based on the square of the dose difference between the dose at the point and the prescription dose. The first item in the list is selected for QA

- The results of the second dose calculation can be written to a template excel file for second checks (not provided with the code)

- Similar to Section 3.3, the script will automatically write the results to the appropriate patient folder (and will prompt you to select a folder if the patient folder isn't found)

- Upon writing the results to the patient folder, a pop-up window will appear and ask if you want to launch the newly-created excel file

- At this point, you just need to enter the relevant information for the physician, the planner, and the physicist checking the plan. The spreadsheet is now ready for review by the physicist

- All the information written to the cells is simply taken from the dwell time and position information for each applicator

- The Ir-192 source activity reported in Eclipse is the CALIBRATION activity. Therefore, this activity is retrieved and decayed to the current DAY

- The user has the option to use the calibration acitivity or decayed activity for dose calculation with the second dose calculation check

4   How it works and assumptions in the script

4.1   Number of fractions

- The number of HDR fractions for a given patient is determined from the primary reference point

- The reason is this methodology is used is because the number of fractions assigned to the plan will generally be one, which is incorrect

- However, the reference point total dose limit and session dose limit are typically assigned to the overall dose fractionation intent for the HDR course. Therefore the number of fractions is calculated as the ratio of the reference point total dose limit to the session dose limit **CAST AS AN INT TYPE!**

– By casting to an int, we are assuming the ratio is an integer value with no remainder. If this is not the case, by casting to an int, we drop the remainder entirely (i.e., the number of fractions will be rounded down)

- **If the dose fractionation intent for the HDR course is NOT assigned to the primary reference point, THE SCRIPT WILL NOT WORK CORRECTLY!**

4.2   Current and previous plan sorting

- When the script is launched, it will grab all treatment approved brachytherapy plans in the open course

- If the open plan/plan in focus is NOT treatment approved, the script will still add it to the list of plans

- When ESAPI grabs multiple objects from Eclipse and places them in a list, there's no guarantee the list will be in chronological order

- There are two methods available for sorting the plans and they both rely on information in the plan ID

- Method 1: the list of plans is sorted according to the character immediately following the string 'HDR', which must be in the plan Id

  – E.g., the plan Id's will contain HDR1, HDR2, etc.
  – Additional information may be added to the plan Id, but the character following the 'HDR' string will denote the fraction number

- Method 2: the current cumulative delivered dose is specified between two underscore characters

  – E.g., the plan Id's can be VBT_600_3cm, T&O_1200_fx2, etc.
  – Here, the number between the two underscores denotes the current delivered dose in cGy

- If the plan Id's do not conform to this naming convention, the script will throw an error and inform you that only the second dose calculation check is possible (and automatically launch the second dose calculation window)

4.3   Structure determination from each fraction

- With the list of plans sorted, we can start pulling the requested information from each plan

- You'll notice the structure names in the drop-down list under Structure in the requested statistics are generic names

- The script was written this way due to the heterogeneity in structure naming from fraction-to-fraction, particularly for the target volumes

- As the script iterates through the list of plans, the structure of interest is determined by finding all structures that contain the generic structure name and are NOT empty

    - For example, if bladder D2cc is requested, all structures containing 'bladder' and are not empty are added to the list
    - NOTE: THE SCRIPT IS NOT SENSITIVE TO THE STRUCTURE ID CASE

- The CTV structure is a special case because the structure Id for the CTV of interest can changee for each fraction

- At Stanford, the target structure of interest for a given fraction is named (if an MRI is obtained on tx day): ctv_mri<fx #> where fx # is the current fraction number

- In addition, the target structures from the previous fractions might be propagated to all subsequent fractions

- To determine the appropriate structure for the CTV for a given fraction, the script finds all structures that contain ctv_mri<fx #> and are NOT empty

    - If the list of CTV structures is empty, the script will grab all structures that contain ctv and are NOT empty

- If the retrieved structure list contains zero items, the requested dose statistic for that structure is skipped for that particular fraction

- If the retrieved structure list contains multiple items, a popup window will appear asking you to select the structure you want to use for analysis

4.4 Data reporting

- The achieved dose statistics in the current and previous fractions are reported to the user

- If additional fractions need to be delivered beyond the current plan:

    - For all dose metrics where a dose value is requested, the achieved dose statistics from the current plan are propagated to the total number of fractions (Section 2.1)
    - For all dose metrics where a volume is requested, 0.0 is reported for all subsequent fractions

- Propagating the achieved dose values in the current fraction to all subsequent fractions is useful in the determination of meeting dose constraints

- Propagating volume or achieved volume values doesn't provide much useful information and is a bit nonsensical, therefore, 0.0 is reported for these metrics for all subsequent fractions

- For all metrics that request an absolute dose value:

  - the EQD2 will be calculated for that metric for each fraction
  - the sum of the EQD2 values from the HDR treatments will be calculated
  - the sum of the EQD2 values from the HDR treatments and the external beam course will be calculated

4.5 Aims and limits

Table III: Example default aim and limit values for the metrics of interest.

Metic	Aim	Limit
Bladder D2cc EQD2 (Gy)	< 80 Gy	< 90 Gy
Bowel D2cc EQD2 (Gy)	< 70 Gy	< 75 Gy
Rectum D2cc EQD2 (Gy)	< 65 Gy	< 75 Gy
CTV D98% EQD2 (Gy)	> 75 Gy	
CTV D90% EQD2 (Gy)	> 85 Gy	< 95 Gy

- Example default dosimetric aims and limits of interest are shown in Table III

- The default aims and limits can be configured in the configuration .ini file (Section 5.1)

  - NOTE: currently, the aims and limits can only be configured for dose statistics as we are evaluating if a single value (i.e., total EQD2) is acceptable. Additional logic is needed for evaluating volumetric statistics because we are evaluating if multiple values are acceptable

- If both an aim and limit are present for a particular metric, the constraint is considered to be met if either the aim or limit is met

- If the inequality operator is different between the aim and limit (e.g., CTV D90% in Table III), the constraint is considered to be met if BOTH the aim and limit are met

4.6 Needle dwell time contribution

- If needles are present in the plan, it is of interest to determine their overall dosimetric contribution in the plan

- Per the ABS guidelines for HDR treatment of advanced carcinoma of the cervix, no more of the 10-20% of the total dwell time should be linked to the needles

- The script automatically calculates the needle dwell time contribution and reports it to the user for the open plan if needles are present in the current plan

- The total dwell time in the plan is calculated by summing the total dwell times from each catheter

- The needle dwell times are calculated by summing the total dwell times from each RELEVANT catheter

- The needle catheters are determined by grabbing all catheters where the catheter Id does NOT contain (not case sensitive): 'tandem', 'ring', 'ovoid', or 'cylinder'

- If the plan protocol Id contains 'T&0' or 'TO' (indicating that the plan is a tandem and ovoid or tandem and ring), the size of the needle catheter list is evaluated

  - If the total number of catheters minus the number of needle catheters is equal to one, the first catheter in the needle catheter list is removed

  - This logic is used for the situation where the patient is treated with a tandem and ring, but the treatment planner digitized the ring with a normal applicator (i.e., not a solid applicator) and did not set the ring catheter Id to include 'ring'

5 FYI for physics

5.1 Configuring the script

5.1.1 Introduction, general commands, and requesting default statistics

- To reduce the number of changes to the underlying code, the script was modified so the script loads a configuration file to define the relevant paths and default statistics

- **The configuration file MUST be named HDR_doseStats_config.ini and MUST be placed in a folder named 'configuration' that is located in the same directory as the compiled script .dll**

- Comments in the HDR_doseStats_config.ini file can be added by placing a '%' character at the beginning of a line

- The patient database (keyword: patient database) path and excel template (keyword: excel template) can be specified as options

  - Syntax: patient database=<path>

  - Syntax: excel template=<file with extension, no path>

  - **NOTE: THE SCRIPT ASSUMES THE EXCEL TEMPLATE FILE RESIDES IN THE PATIENT DATABASE FOLDER!**

  - Checks are performed to ensure the entered path and excel template file exist

- The second check excel file can be specified in a similar manner to the EQD2 excel file

- Regarding the second dose calculation, the current or calibration source activity can be specified (keyword='use current activity for second dose calc')

- The tolerance for agreement between the Eclipse-calculated and script-calculated dose at the reference point can also be specified (keyword=tolerance). The tolerance value is assumed to be a percentage

- ESAPI generally does not have access to physician names, which can make it a bit annoying when writing any data to an excel file as the user will have to manually enter the physician name/initials. The physician name and ID can be specified in the configuration file as a lookup table to replace the physician ID with an acutal name. Syntax

- Default structures that can be used for DVH analysis can be added/modified in the configuration file

  - Syntax:

  add physician id{<id in Aria>,<physician name>}

  - Syntax:

  add structure{<structure name>}

- Default requested statistics can also be added to the configuration file

  - Syntax:

  add default statistic{<structure>,<alpha/beta>,<statistic>,<query value>,<query value units>}

  - E.g., add default statistic{bladder,3.0,Dose at Volume (Gy),2.0,cc}
  - The structure names for this command should exactly match the entered structure names with the 'add structure' command above!

- **NOTE: THE SCRIPT IS CASE SENSITIVE TO THE ENTERED PA-RAMETERS!**

- **NOTE: THE SCRIPT IS SENSITIVE TO SPACES BEFORE/AFTER THE ENTERED VALUE(S)!**

  - E.g., add default statistic{bladder ,3.0, Dose at Volume (Gy),2.0,cc} will cause problems with the script

- Logic was added to the script to ensure basic fidelity of the added parameters, but is by no means comprehensive

5.1.2 Requesting default aims and limits

- The default aims and limits (Table III) can be modified in the HDR_doseStats_config.ini file using the 'add limit' command

- As mentioned previously, aims in limits in this script only apply to requested statistics that retrieve an absolute dose value

- Syntax:

add limit{<structure>,<statistic>,<query value>,<query value units>,<aim>,<limit>}

- **NOTE: THE ONLY ACCEPTABLE INEQUALITY OPERATORS FOR THE AIM AND LIMIT ARE '<' OR '>'**

- A request statistic can have an aim, a limit, or both

- If a requested statistic only has one constraint (i.e., an aim or a limit), YOU STILL MUST INCLUDE AN EMPTY SPACE WHERE THE MISSING CONSTRAINT WOULD GO!

  - E.g., we want the limit for Bladder D2cc to be less than 80 Gy and there is no aim for this constraint. Therefore, the syntax is:
    add limit{bladder,Dose at Volume (Gy),2.0,cc,,<80}

- If an aim/limit is added for a requested statistic that DOES NOT retrieve an absolute dose value, it is ignored and will not show up in the statistics window

5.1.3 Writing data to the EQD2 Excel sheet

- The data that should be written to the excel file can also be specified in the HDR_doseStats_config.ini file

- Header information for the excel file (e.g., patient name, MRN, date, etc.) can be specified using the parameter=value syntax discussed in the previous section

  - For these items, the value will consist of an array where the first element is the row and the second element is the column (e.g., excel patient name={2,B})

  - This syntax is also used to indicate if the needle contribution and number of needles in each plan should be written to the excel file

- Relevant statistics that should be written to the Excel file can be specified using the following syntax:

add excel statistic{<structure>,<statistic>,<query value>,<query value units>,<row>,<column>}

where <row> and <column> correspond to a starting location in the Excel file

- NOTE: all of these statistics will be written to the FIRST sheet in the Excel file

- Again, the requested excel statistics will only be written to the excel file IF they were requested from the plans (e.g., 'add default statistic')

  - I.e., if the data wasn't retrieved from the plans, then there is nothing to write to the excel file

- Since each requested statistic essentially represents a data vector, you need to specify if the data should be written across columns (columnwise) or across rows (i.e., rowwise)

  - **NOTE: If 'excel write format' is not set correctly (i.e., does not match the format of the excel file), then the output to the excel will look very strange**

5.2 Vector formats in the code

Requested statistics vector format:

List<structure id, $\frac{\alpha}{\beta}$, List<statistic requested, query value, volume presentation, dose presentation>>

An example list of requested statistics using the above format is shown in Table IV.

Table IV: Example set of requested statistics.

Entry #	Static		Dynamic			
Entry 1	bladder	3.0	Dose at Volume (Gy)	2.0	absolute volume	absolute dose
Entry 2	bowel	3.0	Dose at Volume (Gy)	2.0	absolute volume	absolute dose
			Volume (cc)	0.0	absolute volume	absolute dose
Entry 3	ctv	10.0	Dose at Volume (Gy)	98.0	relative volume	absolute dose
			Dose at Volume (Gy)	90.0	relative volume	absolute dose
			Volume at Dose (%)	100.0	relative volume	relative dose
			Volume at Dose (%)	200.0	relative volume	relative dose

Variables using this format: defaultStats, statsRequest

Retrieved statistics vector format:

List<structure id, $\frac{\alpha}{\beta}$, List<statistic requested, query value, units on query value,List<result>>>

An example for a 4 fraction TnO with 3 fractions completed is shown Table V.
NOTE: THE RETRIEVED STATISTICS ARE **<u>NOT</u>** PROPAGATED FORWARD FOR ALL FRACTIONS IN THE ABOVE VECTOR! That process takes place in the updateStats method of the stats class.

Table V: Example set of requested statistics.

Entry #	Static		Dynamic			
Entry 1	bladder	3.0	Dose at Volume (Gy)	2.0	cc	5.0
						5.6
						5.3
Entry 2	bowel	3.0	Dose at Volume (Gy)	2.0	cc	4.6
						4.3
						4.8
Entry 3	ctv	10.0	Dose at Volume (Gy)	98.0	%	6.0
						5.9
						5.7
			Dose at Volume (Gy)	90.0	%	7.0
						7.0
						6.8
			Volume at Dose (%)	100.0	%	90.0
						90.1
						87.9
			Volume at Dose (%)	200.0	%	25.3
						22.8
						17.7

Variables using this format: statsResults