Purpose:
Patients receive radiotherapy composed of different modalities. For example, EBRT followed by HDR brachytherapy boost or mixed photon and particle therapies. For such cases, where different fractionation schemes or modalities with different RBEs are used, generation of a 3D composite equivalent biological dose distribution in 2 Gy fractions (EQD2) is desirable. Currently this function is unavailable in commercial planning platforms. The goal of this work was to develop a software tool capable of creating the 3D composite EQD2 dose distribution for multiple modalities.

Methods:
Matlab-based software was developed. DICOM-RT files exported from different planning systems were imported into the software. The physical dose distribution is converted to an EQD2 distribution at voxel levels using the linear-quadratic model or induced-repair model. Radiobiological parameters such as alpha/beta ratio and RBE for each structure are changable by the user. Dose matrices from different modalities are aligned and a composite EQD2 dose matrix is generated. This matrix is written back into DICOM format for import into a commercial planning system or in-house software for plan evaluation. As a demonstration, two cervical cancer test cases were planned with both EBRT in Eclipse and HDR brachytherapy in Oncentra MasterPlan and evaluated.

Results:
The software provides the 3D composite EQD2 distribution. This simplifies the evaluation of multi-modality treatments with different fractionation schemes for clinicians. For the two test cases, the D90 for targets and D2cc for the organs-at-risk were evaluated. These results were able to be directly interpreted according to published guidelines. The composite plan can also be evaluated in in-house software using published data of tumor control and normal tissue complication probabilities.

Conclusions:
The software provides 3D composite biological dose from multiple modalites. This information can help in the evaluation of treatments, assist in creating optimal treatment plans and predict the overall treatment outcome.