

# Supplementary Materials: Multi-View Data Integration Methods for Radiotherapy Structure Name Standardization

Khajamoinuddin Syed<sup>1</sup>, William C. Sleeman IV<sup>1,2</sup>, Michael Hagan<sup>2,3</sup>, Jatinder Palta<sup>2,3</sup>, Rishabh Kapoor<sup>2,3</sup>, and Preetam Ghosh<sup>1</sup>

**Table 1.** Single-View with Image Features Model Results for VA-ROQS, Lung Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset | Disease | Image Features Type | Image Feature Size | Algorithm  | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|---------|---------|---------------------|--------------------|------------|-----------|--------|-----------------------|-------|---------|
| VA      | lung    | BonesSeparate       | 50                 | RF         | 0.765     | 0.673  | 0.681                 | 0.914 | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | LR         | 0.751     | 0.628  | 0.646                 | 0.888 | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | SVM_Linear | 0.63      | 0.598  | 0.595                 | 0.89  | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | SVM_RBF    | 0.598     | 0.635  | 0.616                 | 0.911 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | RF         | 0.825     | 0.694  | 0.708                 | 0.916 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | LR         | 0.729     | 0.69   | 0.693                 | 0.887 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | SVM_Linear | 0.654     | 0.658  | 0.651                 | 0.888 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | SVM_RBF    | 0.725     | 0.717  | 0.716                 | 0.911 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | RF         | 0.91      | 0.667  | 0.693                 | 0.91  | 2564    |
| VA      | lung    | BonesSeparate       | 250                | LR         | 0.73      | 0.723  | 0.719                 | 0.887 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | SVM_Linear | 0.66      | 0.704  | 0.68                  | 0.896 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | SVM_RBF    | 0.716     | 0.713  | 0.711                 | 0.91  | 2564    |
| VA      | lung    | BonesSeparate       | 500                | RF         | 0.708     | 0.625  | 0.651                 | 0.904 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | LR         | 0.657     | 0.732  | 0.682                 | 0.864 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | SVM_Linear | 0.634     | 0.743  | 0.663                 | 0.879 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | SVM_RBF    | 0.719     | 0.705  | 0.709                 | 0.908 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | RF         | 0.783     | 0.572  | 0.602                 | 0.897 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | LR         | 0.605     | 0.734  | 0.657                 | 0.831 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | SVM_Linear | 0.603     | 0.722  | 0.645                 | 0.826 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | SVM_RBF    | 0.725     | 0.693  | 0.705                 | 0.907 | 2564    |
| VA      | lung    | NoBones             | 50                 | LR         | 0.544     | 0.487  | 0.491                 | 0.844 | 2564    |
| VA      | lung    | NoBones             | 50                 | SVM_Linear | 0.372     | 0.415  | 0.392                 | 0.835 | 2564    |
| VA      | lung    | NoBones             | 50                 | SVM_RBF    | 0.547     | 0.578  | 0.562                 | 0.892 | 2564    |
| VA      | lung    | NoBones             | 100                | RF         | 0.703     | 0.644  | 0.658                 | 0.904 | 2564    |
| VA      | lung    | NoBones             | 100                | LR         | 0.566     | 0.548  | 0.544                 | 0.854 | 2564    |
| VA      | lung    | NoBones             | 100                | SVM_Linear | 0.518     | 0.534  | 0.525                 | 0.862 | 2564    |
| VA      | lung    | NoBones             | 100                | SVM_RBF    | 0.56      | 0.578  | 0.567                 | 0.894 | 2564    |
| VA      | lung    | NoBones             | 250                | RF         | 0.729     | 0.646  | 0.666                 | 0.905 | 2564    |
| VA      | lung    | NoBones             | 250                | LR         | 0.608     | 0.618  | 0.605                 | 0.86  | 2564    |
| VA      | lung    | NoBones             | 250                | SVM_Linear | 0.54      | 0.584  | 0.561                 | 0.875 | 2564    |
| VA      | lung    | NoBones             | 250                | SVM_RBF    | 0.573     | 0.59   | 0.58                  | 0.895 | 2564    |
| VA      | lung    | NoBones             | 500                | RF         | 0.749     | 0.605  | 0.626                 | 0.9   | 2564    |
| VA      | lung    | NoBones             | 500                | LR         | 0.591     | 0.628  | 0.604                 | 0.844 | 2564    |
| VA      | lung    | NoBones             | 500                | SVM_Linear | 0.592     | 0.594  | 0.572                 | 0.862 | 2564    |
| VA      | lung    | NoBones             | 500                | SVM_RBF    | 0.578     | 0.58   | 0.578                 | 0.894 | 2564    |
| VA      | lung    | NoBones             | 1000               | RF         | 0.754     | 0.573  | 0.591                 | 0.896 | 2564    |
| VA      | lung    | NoBones             | 1000               | LR         | 0.536     | 0.618  | 0.564                 | 0.797 | 2564    |
| VA      | lung    | NoBones             | 1000               | SVM_Linear | 0.543     | 0.634  | 0.563                 | 0.781 | 2564    |
| VA      | lung    | NoBones             | 1000               | SVM_RBF    | 0.594     | 0.564  | 0.577                 | 0.894 | 2564    |

**Table 2.** Single-View with Image Features Model Results for VA-ROQS, Prostate Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset   | Disease         | Image Features Type  | Image Feature Size | Algorithm  | Precision    | Recall       | F <sub>1</sub> -Score | Acc   | Support |
|-----------|-----------------|----------------------|--------------------|------------|--------------|--------------|-----------------------|-------|---------|
| VA        | prostate        | BonesSeparate        | 50                 | RF         | 0.747        | 0.608        | 0.645                 | 0.858 | 4020    |
| VA        | prostate        | BonesSeparate        | 50                 | LR         | 0.701        | 0.632        | 0.65                  | 0.852 | 4020    |
| VA        | prostate        | BonesSeparate        | 50                 | SVM_Linear | 0.64         | 0.653        | 0.642                 | 0.855 | 4020    |
| VA        | prostate        | BonesSeparate        | 50                 | SVM_RBF    | 0.681        | 0.722        | 0.697                 | 0.874 | 4020    |
| <b>VA</b> | <b>prostate</b> | <b>BonesSeparate</b> | <b>100</b>         | <b>RF</b>  | <b>0.758</b> | <b>0.579</b> | <b>0.619</b>          | 0.856 | 4020    |
| VA        | prostate        | BonesSeparate        | 100                | LR         | 0.721        | 0.674        | 0.686                 | 0.861 | 4020    |
| VA        | prostate        | BonesSeparate        | 100                | SVM_Linear | 0.671        | 0.676        | 0.67                  | 0.866 | 4020    |
| VA        | prostate        | BonesSeparate        | 100                | SVM_RBF    | 0.705        | 0.709        | 0.703                 | 0.879 | 4020    |
| VA        | prostate        | BonesSeparate        | 250                | RF         | 0.68         | 0.509        | 0.547                 | 0.85  | 4020    |
| VA        | prostate        | BonesSeparate        | 250                | LR         | 0.654        | 0.671        | 0.657                 | 0.832 | 4020    |
| VA        | prostate        | BonesSeparate        | 250                | SVM_Linear | 0.632        | 0.686        | 0.654                 | 0.85  | 4020    |
| VA        | prostate        | BonesSeparate        | 250                | SVM_RBF    | 0.708        | 0.669        | 0.684                 | 0.874 | 4020    |
| VA        | prostate        | BonesSeparate        | 500                | RF         | 0.718        | 0.46         | 0.502                 | 0.841 | 4020    |
| VA        | prostate        | BonesSeparate        | 500                | LR         | 0.592        | 0.657        | 0.618                 | 0.795 | 4020    |
| VA        | prostate        | BonesSeparate        | 500                | SVM_Linear | 0.615        | 0.681        | 0.64                  | 0.803 | 4020    |
| VA        | prostate        | BonesSeparate        | 500                | SVM_RBF    | 0.725        | 0.605        | 0.646                 | 0.868 | 4020    |
| VA        | prostate        | BonesSeparate        | 1000               | RF         | 0.642        | 0.402        | 0.44                  | 0.828 | 4020    |
| VA        | prostate        | BonesSeparate        | 1000               | LR         | 0.572        | 0.626        | 0.591                 | 0.775 | 4020    |
| VA        | prostate        | BonesSeparate        | 1000               | SVM_Linear | 0.601        | 0.667        | 0.623                 | 0.781 | 4020    |
| VA        | prostate        | BonesSeparate        | 1000               | SVM_RBF    | 0.758        | 0.507        | 0.565                 | 0.855 | 4020    |
| VA        | prostate        | NoBones              | 50                 | RF         | 0.73         | 0.55         | 0.6                   | 0.845 | 4020    |
| VA        | prostate        | NoBones              | 50                 | LR         | 0.694        | 0.545        | 0.59                  | 0.834 | 4020    |
| VA        | prostate        | NoBones              | 50                 | SVM_Linear | 0.651        | 0.515        | 0.542                 | 0.834 | 4020    |
| VA        | prostate        | NoBones              | 50                 | SVM_RBF    | 0.672        | 0.566        | 0.591                 | 0.854 | 4020    |
| VA        | prostate        | NoBones              | 100                | RF         | 0.739        | 0.539        | 0.59                  | 0.847 | 4020    |
| VA        | prostate        | NoBones              | 100                | LR         | 0.688        | 0.606        | 0.631                 | 0.846 | 4020    |
| VA        | prostate        | NoBones              | 100                | SVM_Linear | 0.644        | 0.574        | 0.597                 | 0.841 | 4020    |
| VA        | prostate        | NoBones              | 100                | SVM_RBF    | 0.718        | 0.566        | 0.6                   | 0.858 | 4020    |
| VA        | prostate        | NoBones              | 250                | RF         | 0.705        | 0.499        | 0.555                 | 0.841 | 4020    |
| VA        | prostate        | NoBones              | 250                | LR         | 0.65         | 0.628        | 0.63                  | 0.832 | 4020    |
| VA        | prostate        | NoBones              | 250                | SVM_Linear | 0.595        | 0.602        | 0.595                 | 0.843 | 4020    |
| VA        | prostate        | NoBones              | 250                | SVM_RBF    | 0.729        | 0.55         | 0.591                 | 0.855 | 4020    |
| VA        | prostate        | NoBones              | 500                | RF         | 0.723        | 0.448        | 0.507                 | 0.833 | 4020    |
| VA        | prostate        | NoBones              | 500                | LR         | 0.618        | 0.619        | 0.612                 | 0.812 | 4020    |
| VA        | prostate        | NoBones              | 500                | SVM_Linear | 0.602        | 0.6          | 0.594                 | 0.808 | 4020    |
| VA        | prostate        | NoBones              | 500                | SVM_RBF    | 0.646        | 0.504        | 0.549                 | 0.845 | 4020    |
| VA        | prostate        | NoBones              | 1000               | RF         | 0.695        | 0.409        | 0.468                 | 0.823 | 4020    |
| VA        | prostate        | NoBones              | 1000               | LR         | 0.574        | 0.59         | 0.578                 | 0.786 | 4020    |
| VA        | prostate        | NoBones              | 1000               | SVM_Linear | 0.542        | 0.579        | 0.557                 | 0.776 | 4020    |
| VA        | prostate        | NoBones              | 1000               | SVM_RBF    | 0.651        | 0.453        | 0.511                 | 0.834 | 4020    |

**Table 3.** Single-View with Image Features Model Results for VCU data Lung Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset    | Disease     | Image Features Type  | Image Feature Size | Algorithm  | Precision   | Recall       | F <sub>1</sub> -Score | Acc   | Support |
|------------|-------------|----------------------|--------------------|------------|-------------|--------------|-----------------------|-------|---------|
| VCU        | lung        | BonesSeparate        | 50                 | RF         | 0.635       | 0.598        | 0.614                 | 0.932 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | LR         | 0.543       | 0.55         | 0.538                 | 0.866 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | SVM_Linear | 0.519       | 0.524        | 0.519                 | 0.874 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | SVM_RBF    | 0.565       | 0.61         | 0.584                 | 0.908 | 955     |
| <b>VCU</b> | <b>lung</b> | <b>BonesSeparate</b> | <b>100</b>         | <b>RF</b>  | <b>0.61</b> | <b>0.565</b> | <b>0.585</b>          | 0.918 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | LR         | 0.587       | 0.579        | 0.568                 | 0.871 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | SVM_Linear | 0.526       | 0.587        | 0.548                 | 0.865 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | SVM_RBF    | 0.604       | 0.647        | 0.621                 | 0.904 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | RF         | 0.629       | 0.552        | 0.583                 | 0.919 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | LR         | 0.573       | 0.643        | 0.584                 | 0.857 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | SVM_Linear | 0.552       | 0.619        | 0.573                 | 0.88  | 955     |
| VCU        | lung        | BonesSeparate        | 250                | SVM_RBF    | 0.583       | 0.626        | 0.599                 | 0.895 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | RF         | 0.633       | 0.541        | 0.579                 | 0.917 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | LR         | 0.518       | 0.63         | 0.546                 | 0.807 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | SVM_Linear | 0.521       | 0.636        | 0.542                 | 0.838 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | SVM_RBF    | 0.595       | 0.613        | 0.598                 | 0.895 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | RF         | 0.621       | 0.494        | 0.542                 | 0.903 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | LR         | 0.499       | 0.624        | 0.542                 | 0.791 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | SVM_Linear | 0.529       | 0.662        | 0.552                 | 0.792 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | SVM_RBF    | 0.566       | 0.565        | 0.559                 | 0.896 | 955     |
| VCU        | lung        | NoBones              | 50                 | RF         | 0.713       | 0.569        | 0.603                 | 0.913 | 955     |
| VCU        | lung        | NoBones              | 50                 | LR         | 0.474       | 0.448        | 0.448                 | 0.836 | 955     |
| VCU        | lung        | NoBones              | 50                 | SVM_Linear | 0.342       | 0.381        | 0.358                 | 0.816 | 955     |
| VCU        | lung        | NoBones              | 50                 | SVM_RBF    | 0.539       | 0.547        | 0.542                 | 0.907 | 955     |
| VCU        | lung        | NoBones              | 100                | RF         | 0.563       | 0.528        | 0.543                 | 0.914 | 955     |
| VCU        | lung        | NoBones              | 100                | LR         | 0.5         | 0.5          | 0.491                 | 0.845 | 955     |
| VCU        | lung        | NoBones              | 100                | SVM_Linear | 0.471       | 0.51         | 0.487                 | 0.855 | 955     |
| VCU        | lung        | NoBones              | 100                | SVM_RBF    | 0.534       | 0.539        | 0.533                 | 0.897 | 955     |
| VCU        | lung        | NoBones              | 250                | RF         | 0.582       | 0.531        | 0.553                 | 0.915 | 955     |
| VCU        | lung        | NoBones              | 250                | LR         | 0.489       | 0.511        | 0.497                 | 0.832 | 955     |
| VCU        | lung        | NoBones              | 250                | SVM_Linear | 0.485       | 0.518        | 0.499                 | 0.844 | 955     |
| VCU        | lung        | NoBones              | 250                | SVM_RBF    | 0.525       | 0.533        | 0.527                 | 0.888 | 955     |
| VCU        | lung        | NoBones              | 500                | RF         | 0.595       | 0.537        | 0.562                 | 0.917 | 955     |
| VCU        | lung        | NoBones              | 500                | LR         | 0.483       | 0.496        | 0.488                 | 0.815 | 955     |
| VCU        | lung        | NoBones              | 500                | SVM_Linear | 0.477       | 0.513        | 0.491                 | 0.825 | 955     |
| VCU        | lung        | NoBones              | 500                | SVM_RBF    | 0.524       | 0.515        | 0.517                 | 0.885 | 955     |
| VCU        | lung        | NoBones              | 1000               | RF         | 0.609       | 0.523        | 0.557                 | 0.914 | 955     |
| VCU        | lung        | NoBones              | 1000               | LR         | 0.453       | 0.519        | 0.478                 | 0.773 | 955     |
| VCU        | lung        | NoBones              | 1000               | SVM_Linear | 0.492       | 0.529        | 0.498                 | 0.758 | 955     |
| VCU        | lung        | NoBones              | 1000               | SVM_RBF    | 0.53        | 0.509        | 0.517                 | 0.887 | 955     |

**Table 4.** Single-View with Image Features Model Results for VCU data Prostate Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset    | Disease         | Image Features Type  | Image Feature Size | Algorithm  | Precision   | Recall       | F <sub>1</sub> -Score | Acc   | Support |
|------------|-----------------|----------------------|--------------------|------------|-------------|--------------|-----------------------|-------|---------|
| VCU        | prostate        | BonesSeparate        | 50                 | RF         | 0.73        | 0.508        | 0.552                 | 0.878 | 1225    |
| VCU        | prostate        | BonesSeparate        | 50                 | LR         | 0.675       | 0.528        | 0.557                 | 0.869 | 1225    |
| VCU        | prostate        | BonesSeparate        | 50                 | SVM_Linear | 0.662       | 0.51         | 0.528                 | 0.868 | 1225    |
| VCU        | prostate        | BonesSeparate        | 50                 | SVM_RBF    | 0.691       | 0.516        | 0.548                 | 0.878 | 1225    |
| <b>VCU</b> | <b>prostate</b> | <b>BonesSeparate</b> | <b>100</b>         | <b>RF</b>  | <b>0.71</b> | <b>0.476</b> | <b>0.519</b>          | 0.87  | 1225    |
| VCU        | prostate        | BonesSeparate        | 100                | LR         | 0.672       | 0.538        | 0.565                 | 0.866 | 1225    |
| VCU        | prostate        | BonesSeparate        | 100                | SVM_Linear | 0.663       | 0.525        | 0.542                 | 0.871 | 1225    |
| VCU        | prostate        | BonesSeparate        | 100                | SVM_RBF    | 0.692       | 0.519        | 0.545                 | 0.877 | 1225    |
| VCU        | prostate        | BonesSeparate        | 250                | RF         | 0.711       | 0.455        | 0.498                 | 0.869 | 1225    |
| VCU        | prostate        | BonesSeparate        | 250                | LR         | 0.651       | 0.564        | 0.591                 | 0.86  | 1225    |
| VCU        | prostate        | BonesSeparate        | 250                | SVM_Linear | 0.589       | 0.532        | 0.537                 | 0.851 | 1225    |
| VCU        | prostate        | BonesSeparate        | 250                | SVM_RBF    | 0.693       | 0.506        | 0.532                 | 0.874 | 1225    |
| VCU        | prostate        | BonesSeparate        | 500                | RF         | 0.693       | 0.435        | 0.463                 | 0.864 | 1225    |
| VCU        | prostate        | BonesSeparate        | 500                | LR         | 0.6         | 0.534        | 0.554                 | 0.839 | 1225    |
| VCU        | prostate        | BonesSeparate        | 500                | SVM_Linear | 0.635       | 0.581        | 0.593                 | 0.842 | 1225    |
| VCU        | prostate        | BonesSeparate        | 500                | SVM_RBF    | 0.689       | 0.494        | 0.517                 | 0.872 | 1225    |
| VCU        | prostate        | BonesSeparate        | 1000               | RF         | 0.667       | 0.429        | 0.456                 | 0.849 | 1225    |
| VCU        | prostate        | BonesSeparate        | 1000               | LR         | 0.526       | 0.482        | 0.497                 | 0.797 | 1225    |
| VCU        | prostate        | BonesSeparate        | 1000               | SVM_Linear | 0.629       | 0.52         | 0.555                 | 0.807 | 1225    |
| VCU        | prostate        | BonesSeparate        | 1000               | SVM_RBF    | 0.704       | 0.466        | 0.494                 | 0.869 | 1225    |
| VCU        | prostate        | NoBones              | 50                 | RF         | 0.69        | 0.441        | 0.493                 | 0.857 | 1225    |
| VCU        | prostate        | NoBones              | 50                 | LR         | 0.639       | 0.442        | 0.49                  | 0.851 | 1225    |
| VCU        | prostate        | NoBones              | 50                 | SVM_Linear | 0.633       | 0.432        | 0.482                 | 0.863 | 1225    |
| VCU        | prostate        | NoBones              | 50                 | SVM_RBF    | 0.675       | 0.435        | 0.484                 | 0.867 | 1225    |
| VCU        | prostate        | NoBones              | 100                | RF         | 0.679       | 0.431        | 0.479                 | 0.86  | 1225    |
| VCU        | prostate        | NoBones              | 100                | LR         | 0.635       | 0.493        | 0.543                 | 0.844 | 1225    |
| VCU        | prostate        | NoBones              | 100                | SVM_Linear | 0.596       | 0.461        | 0.506                 | 0.86  | 1225    |
| VCU        | prostate        | NoBones              | 100                | SVM_RBF    | 0.675       | 0.437        | 0.487                 | 0.866 | 1225    |
| VCU        | prostate        | NoBones              | 250                | RF         | 0.68        | 0.398        | 0.447                 | 0.853 | 1225    |
| VCU        | prostate        | NoBones              | 250                | LR         | 0.561       | 0.489        | 0.509                 | 0.827 | 1225    |
| VCU        | prostate        | NoBones              | 250                | SVM_Linear | 0.557       | 0.48         | 0.5                   | 0.841 | 1225    |
| VCU        | prostate        | NoBones              | 250                | SVM_RBF    | 0.674       | 0.429        | 0.472                 | 0.863 | 1225    |
| VCU        | prostate        | NoBones              | 500                | RF         | 0.71        | 0.399        | 0.45                  | 0.854 | 1225    |
| VCU        | prostate        | NoBones              | 500                | LR         | 0.5         | 0.464        | 0.475                 | 0.795 | 1225    |
| VCU        | prostate        | NoBones              | 500                | SVM_Linear | 0.514       | 0.482        | 0.489                 | 0.789 | 1225    |
| VCU        | prostate        | NoBones              | 500                | SVM_RBF    | 0.669       | 0.406        | 0.452                 | 0.857 | 1225    |
| VCU        | prostate        | NoBones              | 1000               | RF         | 0.583       | 0.362        | 0.414                 | 0.85  | 1225    |
| VCU        | prostate        | NoBones              | 1000               | LR         | 0.442       | 0.464        | 0.44                  | 0.76  | 1225    |
| VCU        | prostate        | NoBones              | 1000               | SVM_Linear | 0.472       | 0.471        | 0.451                 | 0.757 | 1225    |
| VCU        | prostate        | NoBones              | 1000               | SVM_RBF    | 0.543       | 0.364        | 0.412                 | 0.848 | 1225    |

**Table 5.** Intermediate Integration Results - VA-ROQS data Lung Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset | Disease | Image Features Type | Image Feature Size | Algorithm  | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|---------|---------|---------------------|--------------------|------------|-----------|--------|-----------------------|-------|---------|
| VA      | lung    | BonesSeparate       | 50                 | RF         | 0.896     | 0.873  | 0.882                 | 0.946 | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | LR         | 0.896     | 0.807  | 0.84                  | 0.945 | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | SVM_Linear | 0.939     | 0.741  | 0.778                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 50                 | SVM_RBF    | 0.889     | 0.87   | 0.871                 | 0.946 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | RF         | 0.885     | 0.867  | 0.873                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | LR         | 0.9       | 0.828  | 0.856                 | 0.946 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | SVM_Linear | 0.893     | 0.758  | 0.797                 | 0.944 | 2564    |
| VA      | lung    | BonesSeparate       | 100                | SVM_RBF    | 0.885     | 0.804  | 0.834                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | RF         | 0.892     | 0.869  | 0.878                 | 0.946 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | LR         | 0.899     | 0.826  | 0.854                 | 0.945 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | SVM_Linear | 0.902     | 0.801  | 0.836                 | 0.945 | 2564    |
| VA      | lung    | BonesSeparate       | 250                | SVM_RBF    | 0.885     | 0.766  | 0.803                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | RF         | 0.887     | 0.869  | 0.876                 | 0.944 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | LR         | 0.883     | 0.825  | 0.849                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | SVM_Linear | 0.897     | 0.834  | 0.857                 | 0.946 | 2564    |
| VA      | lung    | BonesSeparate       | 500                | SVM_RBF    | 0.881     | 0.764  | 0.801                 | 0.942 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | RF         | 0.886     | 0.868  | 0.874                 | 0.944 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | LR         | 0.861     | 0.844  | 0.85                  | 0.938 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | SVM_Linear | 0.881     | 0.833  | 0.851                 | 0.943 | 2564    |
| VA      | lung    | BonesSeparate       | 1000               | SVM_RBF    | 0.878     | 0.756  | 0.792                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 50                 | RF         | 0.884     | 0.872  | 0.875                 | 0.946 | 2564    |
| VA      | lung    | NoBones             | 50                 | LR         | 0.916     | 0.813  | 0.85                  | 0.944 | 2564    |
| VA      | lung    | NoBones             | 50                 | SVM_Linear | 0.774     | 0.715  | 0.733                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 50                 | SVM_RBF    | 0.889     | 0.859  | 0.868                 | 0.945 | 2564    |
| VA      | lung    | NoBones             | 100                | RF         | 0.884     | 0.876  | 0.878                 | 0.946 | 2564    |
| VA      | lung    | NoBones             | 100                | LR         | 0.917     | 0.815  | 0.852                 | 0.945 | 2564    |
| VA      | lung    | NoBones             | 100                | SVM_Linear | 0.774     | 0.715  | 0.733                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 100                | SVM_RBF    | 0.911     | 0.777  | 0.818                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 250                | RF         | 0.888     | 0.883  | 0.882                 | 0.947 | 2564    |
| VA      | lung    | NoBones             | 250                | LR         | 0.901     | 0.815  | 0.847                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 250                | SVM_Linear | 0.774     | 0.715  | 0.733                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 250                | SVM_RBF    | 0.773     | 0.714  | 0.732                 | 0.942 | 2564    |
| VA      | lung    | NoBones             | 500                | RF         | 0.885     | 0.868  | 0.874                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 500                | LR         | 0.884     | 0.821  | 0.846                 | 0.942 | 2564    |
| VA      | lung    | NoBones             | 500                | SVM_Linear | 0.937     | 0.723  | 0.749                 | 0.942 | 2564    |
| VA      | lung    | NoBones             | 500                | SVM_RBF    | 0.774     | 0.712  | 0.73                  | 0.942 | 2564    |
| VA      | lung    | NoBones             | 1000               | RF         | 0.881     | 0.871  | 0.874                 | 0.944 | 2564    |
| VA      | lung    | NoBones             | 1000               | LR         | 0.885     | 0.824  | 0.849                 | 0.943 | 2564    |
| VA      | lung    | NoBones             | 1000               | SVM_Linear | 0.937     | 0.725  | 0.75                  | 0.943 | 2564    |
| VA      | lung    | NoBones             | 1000               | SVM_RBF    | 0.773     | 0.71   | 0.728                 | 0.941 | 2564    |

**Table 6.** Intermediate Integration Results - VA-ROQS dataset Prostate Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset | Disease  | Image Features Type | Image Feature Size | Algorithm  | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|---------|----------|---------------------|--------------------|------------|-----------|--------|-----------------------|-------|---------|
| VA      | prostate | BonesSeparate       | 50                 | RF         | 0.874     | 0.895  | 0.879                 | 0.936 | 4020    |
| VA      | prostate | BonesSeparate       | 50                 | LR         | 0.85      | 0.873  | 0.854                 | 0.931 | 4020    |
| VA      | prostate | BonesSeparate       | 50                 | SVM_Linear | 0.848     | 0.897  | 0.864                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 50                 | SVM_RBF    | 0.863     | 0.908  | 0.878                 | 0.938 | 4020    |
| VA      | prostate | BonesSeparate       | 100                | RF         | 0.875     | 0.893  | 0.879                 | 0.935 | 4020    |
| VA      | prostate | BonesSeparate       | 100                | LR         | 0.855     | 0.873  | 0.856                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 100                | SVM_Linear | 0.849     | 0.903  | 0.867                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 100                | SVM_RBF    | 0.86      | 0.907  | 0.875                 | 0.937 | 4020    |
| VA      | prostate | BonesSeparate       | 250                | RF         | 0.867     | 0.896  | 0.875                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 250                | LR         | 0.861     | 0.877  | 0.86                  | 0.933 | 4020    |
| VA      | prostate | BonesSeparate       | 250                | SVM_Linear | 0.852     | 0.903  | 0.868                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 250                | SVM_RBF    | 0.853     | 0.897  | 0.867                 | 0.933 | 4020    |
| VA      | prostate | BonesSeparate       | 500                | RF         | 0.86      | 0.903  | 0.875                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 500                | LR         | 0.864     | 0.875  | 0.861                 | 0.932 | 4020    |
| VA      | prostate | BonesSeparate       | 500                | SVM_Linear | 0.846     | 0.899  | 0.864                 | 0.931 | 4020    |
| VA      | prostate | BonesSeparate       | 500                | SVM_RBF    | 0.853     | 0.902  | 0.867                 | 0.933 | 4020    |
| VA      | prostate | BonesSeparate       | 1000               | RF         | 0.866     | 0.903  | 0.877                 | 0.934 | 4020    |
| VA      | prostate | BonesSeparate       | 1000               | LR         | 0.852     | 0.847  | 0.842                 | 0.926 | 4020    |
| VA      | prostate | BonesSeparate       | 1000               | SVM_Linear | 0.847     | 0.888  | 0.859                 | 0.929 | 4020    |
| VA      | prostate | BonesSeparate       | 1000               | SVM_RBF    | 0.847     | 0.862  | 0.845                 | 0.928 | 4020    |
| VA      | prostate | NoBones             | 50                 | RF         | 0.871     | 0.893  | 0.878                 | 0.933 | 4020    |
| VA      | prostate | NoBones             | 50                 | LR         | 0.842     | 0.877  | 0.852                 | 0.929 | 4020    |
| VA      | prostate | NoBones             | 50                 | SVM_Linear | 0.846     | 0.898  | 0.863                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 50                 | SVM_RBF    | 0.859     | 0.91   | 0.876                 | 0.937 | 4020    |
| VA      | prostate | NoBones             | 100                | RF         | 0.87      | 0.891  | 0.876                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 100                | LR         | 0.851     | 0.883  | 0.859                 | 0.931 | 4020    |
| VA      | prostate | NoBones             | 100                | SVM_Linear | 0.848     | 0.896  | 0.864                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 100                | SVM_RBF    | 0.857     | 0.903  | 0.873                 | 0.936 | 4020    |
| VA      | prostate | NoBones             | 250                | RF         | 0.868     | 0.895  | 0.875                 | 0.932 | 4020    |
| VA      | prostate | NoBones             | 250                | LR         | 0.846     | 0.874  | 0.853                 | 0.927 | 4020    |
| VA      | prostate | NoBones             | 250                | SVM_Linear | 0.848     | 0.902  | 0.865                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 250                | SVM_RBF    | 0.847     | 0.899  | 0.863                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 500                | RF         | 0.873     | 0.892  | 0.877                 | 0.93  | 4020    |
| VA      | prostate | NoBones             | 500                | LR         | 0.845     | 0.857  | 0.844                 | 0.926 | 4020    |
| VA      | prostate | NoBones             | 500                | SVM_Linear | 0.841     | 0.891  | 0.858                 | 0.928 | 4020    |
| VA      | prostate | NoBones             | 500                | SVM_RBF    | 0.843     | 0.886  | 0.856                 | 0.928 | 4020    |
| VA      | prostate | NoBones             | 1000               | RF         | 0.868     | 0.896  | 0.876                 | 0.934 | 4020    |
| VA      | prostate | NoBones             | 1000               | LR         | 0.839     | 0.836  | 0.83                  | 0.922 | 4020    |
| VA      | prostate | NoBones             | 1000               | SVM_Linear | 0.842     | 0.881  | 0.854                 | 0.924 | 4020    |
| VA      | prostate | NoBones             | 1000               | SVM_RBF    | 0.836     | 0.844  | 0.833                 | 0.921 | 4020    |

**Table 7.** Intermediate Integration Results - VCU dataset Lung Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset    | Disease     | Image Features Type  | Image Feature Size | Algorithm  | Precision    | Recall       | F <sub>1</sub> -Score | Acc   | Support |
|------------|-------------|----------------------|--------------------|------------|--------------|--------------|-----------------------|-------|---------|
| <b>VCU</b> | <b>lung</b> | <b>BonesSeparate</b> | <b>50</b>          | <b>RF</b>  | <b>0.821</b> | <b>0.976</b> | <b>0.86</b>           | 0.964 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | LR         | 0.832        | 0.977        | 0.874                 | 0.968 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | SVM_Linear | 0.855        | 0.895        | 0.872                 | 0.971 | 955     |
| VCU        | lung        | BonesSeparate        | 50                 | SVM_RBF    | 0.817        | 0.981        | 0.861                 | 0.964 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | RF         | 0.82         | 0.985        | 0.865                 | 0.966 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | LR         | 0.811        | 0.939        | 0.853                 | 0.964 | 955     |
| VCU        | lung        | BonesSeparate        | 100                | SVM_Linear | 0.838        | 0.894        | 0.863                 | 0.97  | 955     |
| VCU        | lung        | BonesSeparate        | 100                | SVM_RBF    | 0.818        | 0.935        | 0.858                 | 0.965 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | RF         | 0.823        | 0.986        | 0.869                 | 0.968 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | LR         | 0.802        | 0.943        | 0.85                  | 0.962 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | SVM_Linear | 0.823        | 0.894        | 0.853                 | 0.968 | 955     |
| VCU        | lung        | BonesSeparate        | 250                | SVM_RBF    | 0.838        | 0.894        | 0.863                 | 0.97  | 955     |
| VCU        | lung        | BonesSeparate        | 500                | RF         | 0.817        | 0.981        | 0.861                 | 0.964 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | LR         | 0.811        | 0.939        | 0.858                 | 0.963 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | SVM_Linear | 0.801        | 0.893        | 0.834                 | 0.963 | 955     |
| VCU        | lung        | BonesSeparate        | 500                | SVM_RBF    | 0.817        | 0.852        | 0.831                 | 0.966 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | RF         | 0.825        | 0.986        | 0.872                 | 0.968 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | LR         | 0.799        | 0.92         | 0.846                 | 0.956 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | SVM_Linear | 0.799        | 0.934        | 0.847                 | 0.959 | 955     |
| VCU        | lung        | BonesSeparate        | 1000               | SVM_RBF    | 0.795        | 0.851        | 0.818                 | 0.958 | 955     |
| VCU        | lung        | NoBones              | 50                 | RF         | 0.819        | 0.976        | 0.86                  | 0.964 | 955     |
| VCU        | lung        | NoBones              | 50                 | LR         | 0.824        | 0.981        | 0.869                 | 0.966 | 955     |
| VCU        | lung        | NoBones              | 50                 | SVM_Linear | 0.827        | 0.853        | 0.836                 | 0.97  | 955     |
| VCU        | lung        | NoBones              | 50                 | SVM_RBF    | 0.817        | 0.981        | 0.861                 | 0.964 | 955     |
| VCU        | lung        | NoBones              | 100                | RF         | 0.819        | 0.985        | 0.867                 | 0.966 | 955     |
| VCU        | lung        | NoBones              | 100                | LR         | 0.82         | 0.981        | 0.867                 | 0.965 | 955     |
| VCU        | lung        | NoBones              | 100                | SVM_Linear | 0.827        | 0.853        | 0.836                 | 0.97  | 955     |
| VCU        | lung        | NoBones              | 100                | SVM_RBF    | 0.839        | 0.977        | 0.887                 | 0.968 | 955     |
| VCU        | lung        | NoBones              | 250                | RF         | 0.814        | 0.985        | 0.861                 | 0.964 | 955     |
| VCU        | lung        | NoBones              | 250                | LR         | 0.804        | 0.984        | 0.857                 | 0.961 | 955     |
| VCU        | lung        | NoBones              | 250                | SVM_Linear | 0.823        | 0.853        | 0.834                 | 0.969 | 955     |
| VCU        | lung        | NoBones              | 250                | SVM_RBF    | 0.827        | 0.853        | 0.836                 | 0.97  | 955     |
| VCU        | lung        | NoBones              | 500                | RF         | 0.811        | 0.985        | 0.859                 | 0.963 | 955     |
| VCU        | lung        | NoBones              | 500                | LR         | 0.801        | 0.984        | 0.853                 | 0.96  | 955     |
| VCU        | lung        | NoBones              | 500                | SVM_Linear | 0.827        | 0.853        | 0.836                 | 0.97  | 955     |
| VCU        | lung        | NoBones              | 500                | SVM_RBF    | 0.771        | 0.812        | 0.789                 | 0.971 | 955     |
| VCU        | lung        | NoBones              | 1000               | RF         | 0.82         | 0.985        | 0.865                 | 0.966 | 955     |
| VCU        | lung        | NoBones              | 1000               | LR         | 0.806        | 0.98         | 0.854                 | 0.961 | 955     |
| VCU        | lung        | NoBones              | 1000               | SVM_Linear | 0.819        | 0.852        | 0.832                 | 0.968 | 955     |
| VCU        | lung        | NoBones              | 1000               | SVM_RBF    | 0.764        | 0.811        | 0.785                 | 0.969 | 955     |



**Table 8.** Intermediate Integration Results- VCU dataset Prostate Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Dataset | Disease  | Image Features Type | Image Feature Size | Algorithm  | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|---------|----------|---------------------|--------------------|------------|-----------|--------|-----------------------|-------|---------|
| VCU     | prostate | BonesSeparate       | 50                 | RF         | 0.781     | 0.747  | 0.754                 | 0.93  | 1225    |
| VCU     | prostate | BonesSeparate       | 50                 | LR         | 0.780     | 0.772  | 0.771                 | 0.939 | 1225    |
| VCU     | prostate | BonesSeparate       | 50                 | SVM_Linear | 0.778     | 0.792  | 0.782                 | 0.941 | 1225    |
| VCU     | prostate | BonesSeparate       | 50                 | SVM_RBF    | 0.779     | 0.771  | 0.769                 | 0.934 | 1225    |
| VCU     | prostate | BonesSeparate       | 100                | RF         | 0.789     | 0.777  | 0.775                 | 0.938 | 1225    |
| VCU     | prostate | BonesSeparate       | 100                | LR         | 0.776     | 0.762  | 0.761                 | 0.934 | 1225    |
| VCU     | prostate | BonesSeparate       | 100                | SVM_Linear | 0.772     | 0.779  | 0.77                  | 0.935 | 1225    |
| VCU     | prostate | BonesSeparate       | 100                | SVM_RBF    | 0.78      | 0.774  | 0.771                 | 0.936 | 1225    |
| VCU     | prostate | BonesSeparate       | 250                | RF         | 0.78      | 0.770  | 0.767                 | 0.934 | 1225    |
| VCU     | prostate | BonesSeparate       | 250                | LR         | 0.774     | 0.749  | 0.751                 | 0.927 | 1225    |
| VCU     | prostate | BonesSeparate       | 250                | SVM_Linear | 0.773     | 0.767  | 0.762                 | 0.931 | 1225    |
| VCU     | prostate | BonesSeparate       | 250                | SVM_RBF    | 0.773     | 0.769  | 0.764                 | 0.931 | 1225    |
| VCU     | prostate | BonesSeparate       | 500                | RF         | 0.784     | 0.782  | 0.775                 | 0.936 | 1225    |
| VCU     | prostate | BonesSeparate       | 500                | LR         | 0.781     | 0.74   | 0.75                  | 0.928 | 1225    |
| VCU     | prostate | BonesSeparate       | 500                | SVM_Linear | 0.775     | 0.764  | 0.76                  | 0.929 | 1225    |
| VCU     | prostate | BonesSeparate       | 500                | SVM_RBF    | 0.773     | 0.766  | 0.762                 | 0.931 | 1225    |
| VCU     | prostate | BonesSeparate       | 1000               | RF         | 0.78      | 0.775  | 0.769                 | 0.933 | 1225    |
| VCU     | prostate | BonesSeparate       | 1000               | LR         | 0.781     | 0.736  | 0.749                 | 0.93  | 1225    |
| VCU     | prostate | BonesSeparate       | 1000               | SVM_Linear | 0.775     | 0.763  | 0.758                 | 0.93  | 1225    |
| VCU     | prostate | BonesSeparate       | 1000               | SVM_RBF    | 0.773     | 0.753  | 0.752                 | 0.927 | 1225    |
| VCU     | prostate | NoBones             | 50                 | RF         | 0.782     | 0.751  | 0.756                 | 0.93  | 1225    |
| VCU     | prostate | NoBones             | 50                 | LR         | 0.779     | 0.767  | 0.766                 | 0.936 | 1225    |
| VCU     | prostate | NoBones             | 50                 | SVM_Linear | 0.778     | 0.792  | 0.781                 | 0.94  | 1225    |
| VCU     | prostate | NoBones             | 50                 | SVM_RBF    | 0.786     | 0.78   | 0.778                 | 0.94  | 1225    |
| VCU     | prostate | NoBones             | 100                | RF         | 0.782     | 0.751  | 0.758                 | 0.931 | 1225    |
| VCU     | prostate | NoBones             | 100                | LR         | 0.78      | 0.775  | 0.772                 | 0.938 | 1225    |
| VCU     | prostate | NoBones             | 100                | SVM_Linear | 0.777     | 0.789  | 0.78                  | 0.94  | 1225    |
| VCU     | prostate | NoBones             | 100                | SVM_RBF    | 0.785     | 0.787  | 0.782                 | 0.94  | 1225    |
| VCU     | prostate | NoBones             | 250                | RF         | 0.784     | 0.756  | 0.76                  | 0.932 | 1225    |
| VCU     | prostate | NoBones             | 250                | LR         | 0.771     | 0.752  | 0.75                  | 0.928 | 1225    |
| VCU     | prostate | NoBones             | 250                | SVM_Linear | 0.776     | 0.774  | 0.769                 | 0.935 | 1225    |
| VCU     | prostate | NoBones             | 250                | SVM_RBF    | 0.778     | 0.779  | 0.774                 | 0.937 | 1225    |
| VCU     | prostate | NoBones             | 500                | RF         | 0.782     | 0.756  | 0.76                  | 0.932 | 1225    |
| VCU     | prostate | NoBones             | 500                | LR         | 0.771     | 0.742  | 0.743                 | 0.925 | 1225    |
| VCU     | prostate | NoBones             | 500                | SVM_Linear | 0.77      | 0.771  | 0.764                 | 0.931 | 1225    |
| VCU     | prostate | NoBones             | 500                | SVM_RBF    | 0.777     | 0.777  | 0.772                 | 0.936 | 1225    |
| VCU     | prostate | NoBones             | 1000               | RF         | 0.78      | 0.769  | 0.768                 | 0.938 | 1225    |
| VCU     | prostate | NoBones             | 1000               | LR         | 0.774     | 0.737  | 0.741                 | 0.925 | 1225    |
| VCU     | prostate | NoBones             | 1000               | SVM_Linear | 0.775     | 0.778  | 0.77                  | 0.934 | 1225    |
| VCU     | prostate | NoBones             | 1000               | SVM_RBF    | 0.777     | 0.764  | 0.763                 | 0.932 | 1225    |



**Table 9.** Late Integration Results - VA-ROQS dataset Lung Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Disease | Image Features Type  | Image Feature Size | Integration Type | Precision    | Recall      | F <sub>1</sub> -Score | Acc   | Support |
|---------|----------------------|--------------------|------------------|--------------|-------------|-----------------------|-------|---------|
| lung    | BonesSeparate        | 50                 | AVG              | 0.918        | 0.824       | 0.857                 | 0.946 | 2564    |
| lung    | BonesSeparate        | 50                 | MAX              | 0.916        | 0.825       | 0.858                 | 0.946 | 2564    |
| lung    | BonesSeparate        | 100                | AVG              | 0.918        | 0.84        | 0.868                 | 0.946 | 2564    |
| lung    | <b>BonesSeparate</b> | <b>100</b>         | <b>MAX</b>       | <b>0.916</b> | <b>0.84</b> | <b>0.867</b>          | 0.945 | 2564    |
| lung    | BonesSeparate        | 250                | AVG              | 0.924        | 0.84        | 0.869                 | 0.947 | 2564    |
| lung    | BonesSeparate        | 250                | MAX              | 0.921        | 0.842       | 0.87                  | 0.947 | 2564    |
| lung    | BonesSeparate        | 500                | AVG              | 0.918        | 0.811       | 0.849                 | 0.945 | 2564    |
| lung    | BonesSeparate        | 500                | MAX              | 0.919        | 0.821       | 0.856                 | 0.945 | 2564    |
| lung    | BonesSeparate        | 1000               | AVG              | 0.923        | 0.797       | 0.839                 | 0.943 | 2564    |
| lung    | BonesSeparate        | 1000               | MAX              | 0.924        | 0.811       | 0.852                 | 0.944 | 2564    |
| lung    | NoBones              | 50                 | AVG              | 0.93         | 0.842       | 0.874                 | 0.947 | 2564    |
| lung    | NoBones              | 50                 | MAX              | 0.932        | 0.86        | 0.884                 | 0.948 | 2564    |
| lung    | NoBones              | 100                | AVG              | 0.933        | 0.859       | 0.884                 | 0.948 | 2564    |
| lung    | NoBones              | 100                | MAX              | 0.927        | 0.859       | 0.882                 | 0.947 | 2564    |
| lung    | NoBones              | 250                | AVG              | 0.929        | 0.805       | 0.848                 | 0.946 | 2564    |
| lung    | NoBones              | 250                | MAX              | 0.928        | 0.822       | 0.861                 | 0.946 | 2564    |
| lung    | NoBones              | 500                | AVG              | 0.924        | 0.822       | 0.86                  | 0.945 | 2564    |
| lung    | NoBones              | 500                | MAX              | 0.928        | 0.843       | 0.875                 | 0.947 | 2564    |
| lung    | NoBones              | 1000               | AVG              | 0.929        | 0.812       | 0.853                 | 0.945 | 2564    |
| lung    | NoBones              | 1000               | MAX              | 0.927        | 0.817       | 0.857                 | 0.946 | 2564    |

**Table 10.** Late Integration Results - VA-ROQS dataset Prostate Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Disease  | Image Features Type  | Image Feature Size | Integration Type | Precision    | Recall       | F <sub>1</sub> -Score | Acc   | Support |
|----------|----------------------|--------------------|------------------|--------------|--------------|-----------------------|-------|---------|
| prostate | BonesSeparate        | 50                 | AVG              | 0.896        | 0.836        | 0.856                 | 0.929 | 4020    |
| prostate | BonesSeparate        | 50                 | MAX              | 0.898        | 0.85         | 0.866                 | 0.932 | 4020    |
| prostate | BonesSeparate        | 100                | AVG              | 0.897        | 0.836        | 0.857                 | 0.93  | 4020    |
| prostate | <b>BonesSeparate</b> | <b>100</b>         | <b>MAX</b>       | <b>0.897</b> | <b>0.848</b> | <b>0.864</b>          | 0.93  | 4020    |
| prostate | BonesSeparate        | 250                | AVG              | 0.898        | 0.829        | 0.851                 | 0.926 | 4020    |
| prostate | BonesSeparate        | 250                | MAX              | 0.9          | 0.841        | 0.86                  | 0.928 | 4020    |
| prostate | BonesSeparate        | 500                | AVG              | 0.904        | 0.819        | 0.847                 | 0.926 | 4020    |
| prostate | BonesSeparate        | 500                | MAX              | 0.9          | 0.831        | 0.853                 | 0.926 | 4020    |
| prostate | BonesSeparate        | 1000               | AVG              | 0.9          | 0.803        | 0.833                 | 0.922 | 4020    |
| prostate | BonesSeparate        | 1000               | MAX              | 0.899        | 0.829        | 0.852                 | 0.926 | 4020    |
| prostate | NoBones              | 50                 | AVG              | 0.903        | 0.825        | 0.851                 | 0.929 | 4020    |
| prostate | NoBones              | 50                 | MAX              | 0.906        | 0.829        | 0.855                 | 0.929 | 4020    |
| prostate | NoBones              | 100                | AVG              | 0.906        | 0.818        | 0.848                 | 0.928 | 4020    |
| prostate | NoBones              | 100                | MAX              | 0.905        | 0.826        | 0.853                 | 0.929 | 4020    |
| prostate | NoBones              | 250                | AVG              | 0.907        | 0.821        | 0.85                  | 0.928 | 4020    |
| prostate | NoBones              | 250                | MAX              | 0.904        | 0.827        | 0.853                 | 0.929 | 4020    |
| prostate | NoBones              | 500                | AVG              | 0.908        | 0.819        | 0.849                 | 0.927 | 4020    |
| prostate | NoBones              | 500                | MAX              | 0.904        | 0.826        | 0.853                 | 0.928 | 4020    |
| prostate | NoBones              | 1000               | AVG              | 0.91         | 0.813        | 0.846                 | 0.927 | 4020    |
| prostate | NoBones              | 1000               | MAX              | 0.897        | 0.824        | 0.848                 | 0.925 | 4020    |

**Table 11.** Late Integration Results - VCU dataset Prostate - Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Disease  | Image Features Type | Image Feature Size | Integration Type | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|----------|---------------------|--------------------|------------------|-----------|--------|-----------------------|-------|---------|
| prostate | BonesSeparate       | 50                 | AVG              | 0.799     | 0.688  | 0.719                 | 0.927 | 1225    |
| prostate | BonesSeparate       | 50                 | MAX              | 0.8       | 0.713  | 0.738                 | 0.935 | 1225    |
| prostate | BonesSeparate       | 100                | AVG              | 0.802     | 0.685  | 0.719                 | 0.929 | 1225    |
| prostate | BonesSeparate       | 100                | MAX              | 0.801     | 0.708  | 0.739                 | 0.936 | 1225    |
| prostate | BonesSeparate       | 250                | AVG              | 0.804     | 0.672  | 0.705                 | 0.927 | 1225    |
| prostate | BonesSeparate       | 250                | MAX              | 0.799     | 0.703  | 0.731                 | 0.932 | 1225    |
| prostate | BonesSeparate       | 500                | AVG              | 0.802     | 0.673  | 0.709                 | 0.928 | 1225    |
| prostate | BonesSeparate       | 500                | MAX              | 0.795     | 0.703  | 0.733                 | 0.935 | 1225    |
| prostate | BonesSeparate       | 1000               | AVG              | 0.805     | 0.675  | 0.71                  | 0.931 | 1225    |
| prostate | BonesSeparate       | 1000               | MAX              | 0.807     | 0.715  | 0.746                 | 0.94  | 1225    |
| prostate | NoBones             | 50                 | AVG              | 0.786     | 0.657  | 0.7                   | 0.92  | 1225    |
| prostate | NoBones             | 50                 | MAX              | 0.792     | 0.707  | 0.734                 | 0.933 | 1225    |
| prostate | NoBones             | 100                | AVG              | 0.791     | 0.68   | 0.713                 | 0.922 | 1225    |
| prostate | NoBones             | 100                | MAX              | 0.791     | 0.711  | 0.734                 | 0.931 | 1225    |
| prostate | NoBones             | 250                | AVG              | 0.794     | 0.683  | 0.716                 | 0.925 | 1225    |
| prostate | NoBones             | 250                | MAX              | 0.793     | 0.718  | 0.741                 | 0.933 | 1225    |
| prostate | NoBones             | 500                | AVG              | 0.795     | 0.683  | 0.718                 | 0.927 | 1225    |
| prostate | NoBones             | 500                | MAX              | 0.791     | 0.713  | 0.737                 | 0.932 | 1225    |
| prostate | NoBones             | 1000               | AVG              | 0.803     | 0.684  | 0.725                 | 0.932 | 1225    |
| prostate | NoBones             | 1000               | MAX              | 0.792     | 0.704  | 0.734                 | 0.931 | 1225    |

**Table 12.** Late Integration Results - VCU dataset Lung - Disease specific macro-averaged Precision, Recall, F<sub>1</sub>-Score, and Overall Accuracy.

| Disease | Image Features Type | Image Feature Size | Integration Type | Precision | Recall | F <sub>1</sub> -Score | Acc   | Support |
|---------|---------------------|--------------------|------------------|-----------|--------|-----------------------|-------|---------|
| lung    | BonesSeparate       | 50                 | AVG              | 0.858     | 0.807  | 0.811                 | 0.964 | 955     |
| lung    | BonesSeparate       | 50                 | MAX              | 0.853     | 0.812  | 0.810                 | 0.964 | 955     |
| lung    | BonesSeparate       | 100                | AVG              | 0.858     | 0.807  | 0.811                 | 0.964 | 955     |
| lung    | BonesSeparate       | 100                | MAX              | 0.849     | 0.81   | 0.806                 | 0.963 | 955     |
| lung    | BonesSeparate       | 250                | AVG              | 0.867     | 0.812  | 0.822                 | 0.966 | 955     |
| lung    | BonesSeparate       | 250                | MAX              | 0.867     | 0.812  | 0.822                 | 0.966 | 955     |
| lung    | BonesSeparate       | 500                | AVG              | 0.879     | 0.835  | 0.827                 | 0.963 | 955     |
| lung    | BonesSeparate       | 500                | MAX              | 0.883     | 0.854  | 0.846                 | 0.968 | 955     |
| lung    | BonesSeparate       | 1000               | AVG              | 0.866     | 0.804  | 0.815                 | 0.964 | 955     |
| lung    | BonesSeparate       | 1000               | MAX              | 0.885     | 0.868  | 0.859                 | 0.971 | 955     |
| lung    | NoBones             | 50                 | AVG              | 0.866     | 0.811  | 0.819                 | 0.966 | 955     |
| lung    | NoBones             | 50                 | MAX              | 0.867     | 0.816  | 0.824                 | 0.968 | 955     |
| lung    | NoBones             | 100                | AVG              | 0.877     | 0.816  | 0.826                 | 0.969 | 955     |
| lung    | NoBones             | 100                | MAX              | 0.893     | 0.858  | 0.85                  | 0.97  | 955     |
| lung    | NoBones             | 250                | AVG              | 0.881     | 0.844  | 0.837                 | 0.965 | 955     |
| lung    | NoBones             | 250                | MAX              | 0.882     | 0.853  | 0.843                 | 0.968 | 955     |
| lung    | NoBones             | 500                | AVG              | 0.876     | 0.797  | 0.806                 | 0.964 | 955     |
| lung    | NoBones             | 500                | MAX              | 0.873     | 0.848  | 0.831                 | 0.965 | 955     |
| lung    | NoBones             | 1000               | AVG              | 0.875     | 0.798  | 0.815                 | 0.964 | 955     |
| lung    | NoBones             | 1000               | MAX              | 0.877     | 0.808  | 0.825                 | 0.966 | 955     |

**Table 13.** Single-View Label wise results - VA-ROQS dataset Lung, BonesSeparate, with 100 Image Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 0.78      | 0.37   | 0.50    | 19      |
| Esophagus      | 0.92      | 0.87   | 0.89    | 126     |
| Heart          | 0.87      | 0.99   | 0.92    | 134     |
| Other          | 0.92      | 0.98   | 0.95    | 1998    |
| PTV            | 0.50      | 0.01   | 0.03    | 143     |
| SpinalCord     | 0.97      | 0.95   | 0.96    | 144     |
| accuracy       | 0.92      | 0.92   | 0.92    | 2564    |
| macro avg      | 0.83      | 0.69   | 0.71    | 2564    |
| weighted avg   | 0.89      | 0.92   | 0.89    | 2564    |

**Table 14.** Single-View Label wise results - VA-ROQS dataset Prostate, BonesSeparate, with 100 Image Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 0.60      | 0.65   | 0.62    | 146     |
| Femur_L        | 0.97      | 0.92   | 0.95    | 190     |
| Femur_R        | 0.98      | 0.93   | 0.95    | 191     |
| LargeBowel     | 0.72      | 0.27   | 0.39    | 105     |
| Other          | 0.86      | 0.96   | 0.91    | 2954    |
| PTV            | 0.58      | 0.08   | 0.13    | 185     |
| Rectum         | 0.78      | 0.61   | 0.69    | 189     |
| SmallBowel     | 0.57      | 0.22   | 0.31    | 60      |
| accuracy       | 0.86      | 0.86   | 0.86    | 4020    |
| macro avg      | 0.76      | 0.58   | 0.62    | 4020    |
| weighted avg   | 0.84      | 0.86   | 0.83    | 4020    |

**Table 15.** Single-View Label wise results - VCU dataset Lung, BonesSeparate, with 100 Image Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 0.00      | 0.00   | 0.00    | 4       |
| Esophagus      | 0.82      | 0.66   | 0.73    | 47      |
| Heart          | 0.98      | 0.91   | 0.94    | 45      |
| Other          | 0.92      | 0.99   | 0.95    | 775     |
| PTV            | 0.00      | 0.00   | 0.00    | 36      |
| SpinalCord     | 0.95      | 0.83   | 0.89    | 48      |
| accuracy       | 0.92      | 0.92   | 0.92    | 955     |
| macro avg      | 0.61      | 0.57   | 0.59    | 955     |
| weighted avg   | 0.88      | 0.92   | 0.90    | 955     |

**Table 16.** Single-View Label wise results - VCU dataset Prostate, BonesSeparate, with 100 Image Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 0.83      | 0.30   | 0.44    | 50      |
| Femur_L        | 0.96      | 0.90   | 0.93    | 29      |
| Femur_R        | 0.93      | 0.90   | 0.91    | 29      |
| LargeBowel     | 0.00      | 0.00   | 0.00    | 0       |
| Other          | 0.87      | 0.98   | 0.92    | 980     |
| PTV            | 0.20      | 0.03   | 0.05    | 38      |
| Rectum         | 0.88      | 0.60   | 0.71    | 50      |
| SmallBowel     | 1.00      | 0.10   | 0.19    | 49      |
| accuracy       | 0.87      | 0.87   | 0.87    | 1225    |
| macro avg      | 0.71      | 0.48   | 0.52    | 1225    |
| weighted avg   | 0.86      | 0.87   | 0.84    | 1225    |

**Table 17.** Intermediate Integration Label wise results - VA-ROQS dataset Lung, BonesSeparate, 50 Image Features, 200 Text Features, with Random Forest Algorithm

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 1.00      | 0.16   | 0.27    | 19      |
| Esophagus      | 0.95      | 1.00   | 0.97    | 126     |
| Heart          | 0.97      | 1.00   | 0.99    | 134     |
| Other          | 0.94      | 0.99   | 0.96    | 1998    |
| PTV            | 0.79      | 0.41   | 0.54    | 143     |
| SpinalCord     | 0.98      | 0.90   | 0.93    | 144     |
| accuracy       | 0.94      | 0.94   | 0.94    | 2564    |
| macro avg      | 0.94      | 0.74   | 0.78    | 2564    |
| weighted avg   | 0.94      | 0.94   | 0.94    | 2564    |

**Table 18.** Intermediate Integration Label wise results - VCU dataset Lung, BonesSeparate,, 50 Image Features, 200 Text Features, with Random Forest Algorithm

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 0.50      | 0.50   | 0.50    | 4       |
| Esophagus      | 1.00      | 1.00   | 1.00    | 47      |
| Heart          | 1.00      | 1.00   | 1.00    | 45      |
| Other          | 0.99      | 0.97   | 0.98    | 775     |
| PTV            | 0.89      | 0.92   | 0.90    | 36      |
| SpinalCord     | 0.75      | 0.98   | 0.85    | 48      |
| accuracy       | 0.97      | 0.97   | 0.97    | 955     |
| macro avg      | 0.86      | 0.89   | 0.87    | 955     |
| weighted avg   | 0.97      | 0.97   | 0.97    | 955     |

**Table 19.** Intermediate Integration Label wise results - VA-ROQS dataset Prostate, BonesSeparate, 50 Image Features, 200 Text Features, with Random Forest Algorithm

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 0.75      | 1.00   | 0.86    | 146     |
| Femur_L        | 0.86      | 0.98   | 0.92    | 190     |
| Femur_R        | 0.86      | 0.99   | 0.92    | 191     |
| LargeBowel     | 0.96      | 0.83   | 0.89    | 105     |
| Other          | 0.97      | 0.94   | 0.95    | 2954    |
| PTV            | 0.78      | 0.58   | 0.66    | 185     |
| Rectum         | 0.98      | 0.97   | 0.97    | 189     |
| SmallBowel     | 0.62      | 0.88   | 0.73    | 60      |
| accuracy       | 0.93      | 0.93   | 0.93    | 4020    |
| macro avg      | 0.85      | 0.90   | 0.86    | 4020    |
| weighted avg   | 0.93      | 0.93   | 0.93    | 4020    |

**Table 20.** Intermediate Integration Label wise results - VCU dataset Prostate, BonesSeparate, 50 Image Features, 200 Text Features, with Random Forest Algorithm

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 1.00      | 1.00   | 1.00    | 50      |
| Femur_L        | 0.94      | 1.00   | 0.97    | 29      |
| Femur_R        | 0.97      | 1.00   | 0.98    | 29      |
| LargeBowel     | 0.00      | 0.00   | 0.00    | 0       |
| Other          | 0.97      | 0.95   | 0.96    | 980     |
| PTV            | 0.34      | 0.53   | 0.42    | 38      |
| Rectum         | 1.00      | 1.00   | 1.00    | 50      |
| SmallBowel     | 1.00      | 0.86   | 0.92    | 49      |
| accuracy       | 0.94      | 0.94   | 0.94    | 1225    |
| macro avg      | 0.78      | 0.79   | 0.78    | 1225    |
| weighted avg   | 0.96      | 0.94   | 0.95    | 1225    |

**Table 21.** Late Integration Label wise results - VA-ROQS dataset Lung, 100 Image Features, 200 Text Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 0.88      | 0.79   | 0.83    | 19      |
| Esophagus      | 0.97      | 0.98   | 0.98    | 126     |
| Heart          | 0.96      | 1.00   | 0.98    | 134     |
| Other          | 0.95      | 0.98   | 0.97    | 1998    |
| PTV            | 0.76      | 0.38   | 0.51    | 143     |
| SpinalCord     | 0.98      | 0.90   | 0.93    | 144     |
| accuracy       | 0.95      | 0.95   | 0.95    | 2564    |
| macro avg      | 0.92      | 0.84   | 0.87    | 2564    |
| weighted avg   | 0.94      | 0.95   | 0.94    | 2564    |

**Table 22.** Late Integration Label wise results - VCU dataset Lung, BonesSeparate, 100 Image Features, 200 Text Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| BrachialPlexus | 0.25      | 0.50   | 0.33    | 4       |
| Esophagus      | 1.00      | 0.98   | 0.99    | 47      |
| Heart          | 1.00      | 1.00   | 1.00    | 45      |
| Other          | 0.97      | 0.99   | 0.98    | 775     |
| PTV            | 0.94      | 0.42   | 0.58    | 36      |
| SpinalCord     | 0.94      | 0.98   | 0.96    | 48      |
| accuracy       | 0.96      | 0.96   | 0.96    | 955     |
| macro avg      | 0.85      | 0.81   | 0.81    | 955     |
| weighted avg   | 0.97      | 0.96   | 0.96    | 955     |

**Table 23.** Late Integration Label wise results - VA-ROQS dataset Prostate, BonesSeparate, 100 Image Features, 200 Text Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 0.76      | 1.00   | 0.86    | 146     |
| Femur_L        | 0.90      | 0.92   | 0.91    | 190     |
| Femur_R        | 0.92      | 0.92   | 0.92    | 191     |
| LargeBowel     | 0.97      | 0.83   | 0.89    | 105     |
| Other          | 0.95      | 0.96   | 0.95    | 2954    |
| PTV            | 0.80      | 0.51   | 0.62    | 185     |
| Rectum         | 0.98      | 0.96   | 0.97    | 189     |
| SmallBowel     | 0.91      | 0.68   | 0.78    | 60      |
| accuracy       | 0.96      | 0.93   | 0.93    | 4020    |
| macro avg      | 0.90      | 0.85   | 0.86    | 4020    |
| weighted avg   | 0.93      | 0.93   | 0.93    | 4020    |

**Table 24.** Late Integration Label wise results - VCU dataset Prostate, BonesSeparate, 100 Image Features, 200 Text Features

| Structure Name | Precision | Recall | F-Score | Support |
|----------------|-----------|--------|---------|---------|
| Bladder        | 1.00      | 0.92   | 0.96    | 50      |
| Femur_L        | 0.97      | 0.97   | 0.97    | 29      |
| Femur_R        | 1.00      | 0.97   | 0.98    | 29      |
| LargeBowel     | 0.00      | 0.00   | 0.00    | 0       |
| Other          | 0.94      | 0.98   | 0.96    | 980     |
| PTV            | 0.50      | 0.45   | 0.47    | 38      |
| Rectum         | 1.00      | 0.98   | 0.99    | 50      |
| SmallBowel     | 1.00      | 0.41   | 0.58    | 49      |
| accuracy       | 0.94      | 0.94   | 0.94    | 1225    |
| macro avg      | 0.80      | 0.71   | 0.74    | 1225    |
| weighted avg   | 0.94      | 0.94   | 0.93    | 1225    |