**Figure Legends**

**Yao, Please edit the legend of Figure 1**

**Figure 1.** **Distribution of cellular DNA contents in exfoliative cytology (A)** Selected cells with abnormally high DNA contents above D.I. value > 2.3. **(B)** Scatter plots of cells in the in exfoliative cytology study, y-axis indicates the area of captured nucleus image and x-axis indicates the corresponding DNA Index (D.I.) values. **(C)** Distribution histogram of D.I. values of all captured nucleus image. **(D)** Distribution histogram of D.I. values of simulated three cell populations and mixture of three. Red density was simulated from normal distribution (µ=1.001, σ=0.19); green density was simulated from normal distribution (µ=2.002, σ=0.25); blue density was simulated from normal distribution (µ=2.300, σ=0.5); black density was the mixture of three populations at ratio: 0.893:0.092:0.05.

**Figure 2. Work flow of expert-guided data transformation and reconstruction (EdTAR).** Starting with DI values as the raw day, EdTAR first identified candidate peaks of cell populations. Diploid cell population was extracted and further filtered if more than one population is detected. The same procedure was applied to extract the tetraploid cell population and thus the aneuploid cell population was isolated. Data of these three cell populations were reconstructed across a wide rage [0 – 8] using the discrete density at each interval. The newly constructed data was used for training the statistical model and calculation of the Oral Cancer Risk Index (OCRI).

**Figure 3. Application of EdTAR in processing data of three samples with pathological diagnosis of normal (A-C), OLK (D-F), and OSCC (G-I).** All density plots have x-axis as DI value and y-axis as density. Panel A, D and G showed density plots before data processing by EdTAR. In Panel A, a major peek with a DI of 0.995 represents the diploid cell population, where another small peaks (D.I. = 0.594) was a minor population possibly due to image processing. In Panel D, a major peek with a DI of 0.798 represents the diploid cell population (3,590 cells). Other than this peak, four peaks with DI values of 1.25, 1.75, 2.22, and 2.74, were present. In Panel G, a major peek with a DI of 1.02 represents the diploid cell population, and a second peak with a DI of 1.79 represents the tetraploid cell population. Other than these two peaks, three peaks with DI values of 3.25, 3.57, and 3.99 were present, and were believed to represent the aneuploidy cell population. Panel B, E and H corresponding with Panel A, D and G respectively were three plots showing the net results of data processing by EdTAR. Signals of the aneuploidy cell populations were amplified in Panel E and H. Panel C, F and I showed boxplots of newly constructed variables after data processing with EdTAR. The x-axis indicated the new variables along a range of DI [0 – 8] and y-axis the boxplot of available values for each variable.

**Figure 4. Assessment of statistical models.** Seven models (SVM, RRF, PLR, NNET, KNN, and CART) were tested for their performance using three parameters, ROC, sensitivity and specificity. Each model was trained on the training data and tested on the testing data. Each boxplot showed the distribution of these three parameters (R caret package <http://cran.r-project.org/web/packages/caret/index.html>).

**Figure 5. Calculation of Oral Cancer Risk Index (OCRI).** OCRI was calculated for each case with known pathology. The y-axis showed the ORCI between 0 and 1, where 0 indicates the lowest risk of OSCC and 1 indicates the highest risk of OSCC.

**Figure 6. Application of EdTAR in follow-up of one patient (Case 128141).** Exfoliative cytology was performed on WHEN. (A) Data plot of exfoliative cytology before EdTAR; (B) Data plot of exfoliative cytology after EdTAR with an OCRI of 0.884358882; (C) Homogeneous OLK at the time of cytology; (D) Mild dysplasia on histopathology at the time of cytology; (E) A tumor was observed on WHEN (xxx months after cytology); (F) Histopathology of resected tumor confirmed the diagnosis of squamous cell carcinoma.