

Purpose: In many of brachytherapy procedures, a large amount of radioactive sources are used to deliver desired doses to target volume. Source strength assay is usually performed to independently verify the sources' strength. Though the reports of AAPM Task Group 40 and 56 have made specific recommendations on the assay of brachytherapy sources, the relevant statistical significance of the recommendations remain unanswered. This study was conducted to use statistical theories to quantify the assay process.

Method and Materials: Based on statistical theories, Student T Distribution was used to analyze the statistical distribution of a pool of sources used for a brachytherapy procedure. The analysis was based on the assayed source strength and the assayed strength distribution. The probability distribution was determined for the percent difference between the expected and the assayed source mean strength, so were the confidence intervals for this percent difference. The statistical analysis was also conducted for the confidence intervals of using manufacturer's provided source strength.

Results: It was found, as expected, that the 95% confidence interval increased with number of assayed sources, and decreased with strength deviation. Therefore the quality of an assay process was really dependent on the combination of the number and strength distribution of assayed sources. Tables and Figures of this combination were generated for reference use to meet various recommended criteria. It was found that without careful consideration the use of manufacturer's provided strength instead of assayed strength may potentially lead to larger statistical deviation.

Conclusions: The assay process can be determined by the obtained assay information, instead of a preset percentage of total sources. It was further found that the use of manufacturer's stated strength value may possibly lead to bigger uncertainty in source strength accuracy, unless the manufacturer's stated strength is the measured mean value of all the ordered sources.