OPTIMAL ASSAY SIZES FOR INTRAOPERATIVELY PLANNED ^{125}I BRACHYTHERAPY

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BACKGROUND

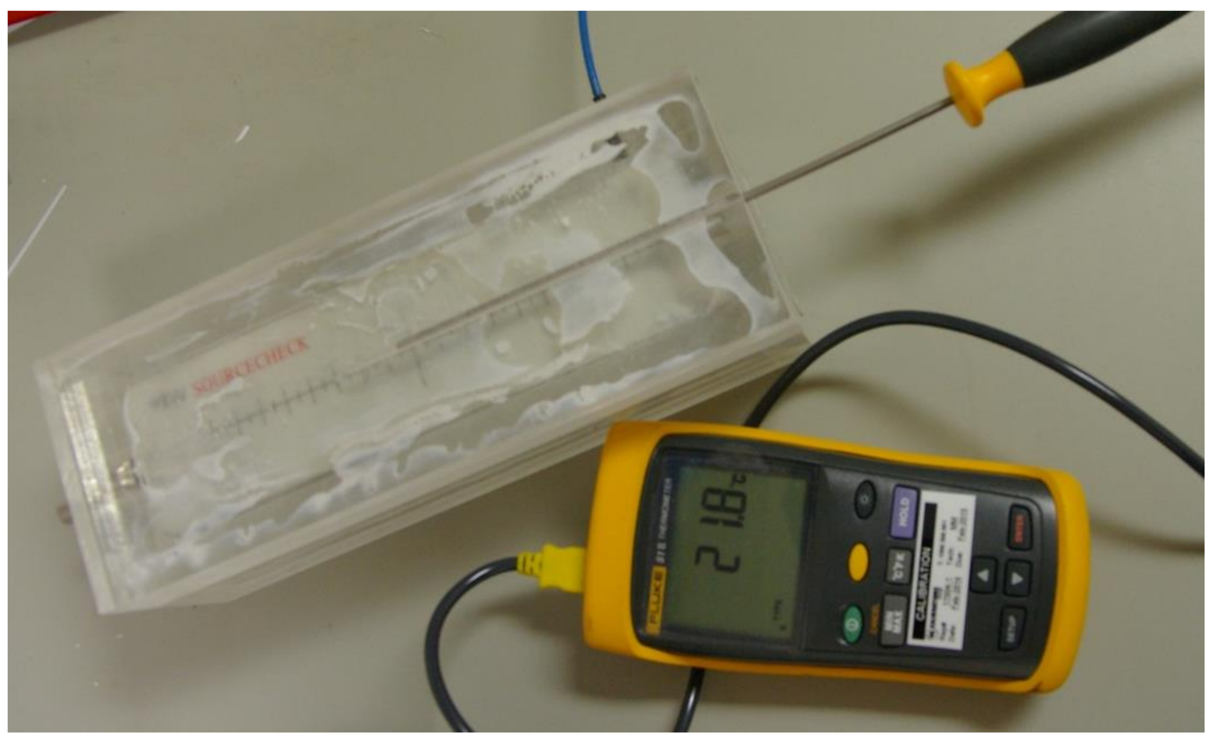
- Implanted ^{125}I seeds can be effectively used for LDR treatments for localised adenocarcinoma of the prostate.
- Technique requires that the air-kerma strength of seeds be checked against the vendor calibration certificate.
- Checks of multiple sources are difficult to achieve when seeds are packaged in a sterile cartridge: seeds must be extracted at the beginning of the surgical procedure.
- AAPM report 98 recommends testing of 5% of the seeds or 5 seeds, whichever number is smaller; and specifically recommends against the use of statistical methods described elsewhere in the literature.
- The Nucletron Seed-Selectron system contains an array of diodes that assay all seeds as the implant is delivered.
- Nucletron claim that only one seed from each batch needs to be assayed before the implantation procedure commences; but the literature suggests that this is not sufficiently precise to meet AAPM recommendations.

OBJECTIVE

- The aim of this study was to identify optimal assay sizes to achieve the 3% tolerance recommended by the AAPM, by experimental measurements to investigate the consistency of the strength of ^{125}I seeds.

METHOD

- Study investigated 3 small batches of N=10, 19 and 30, to identify the optimal assay size, *n*, required to achieve the AAPM recommended tolerance of 3% uncertainty.
- Seeds were extracted from cartridges, and air kerma (S_K) measured using calibrated PTW SourceCheck chamber.



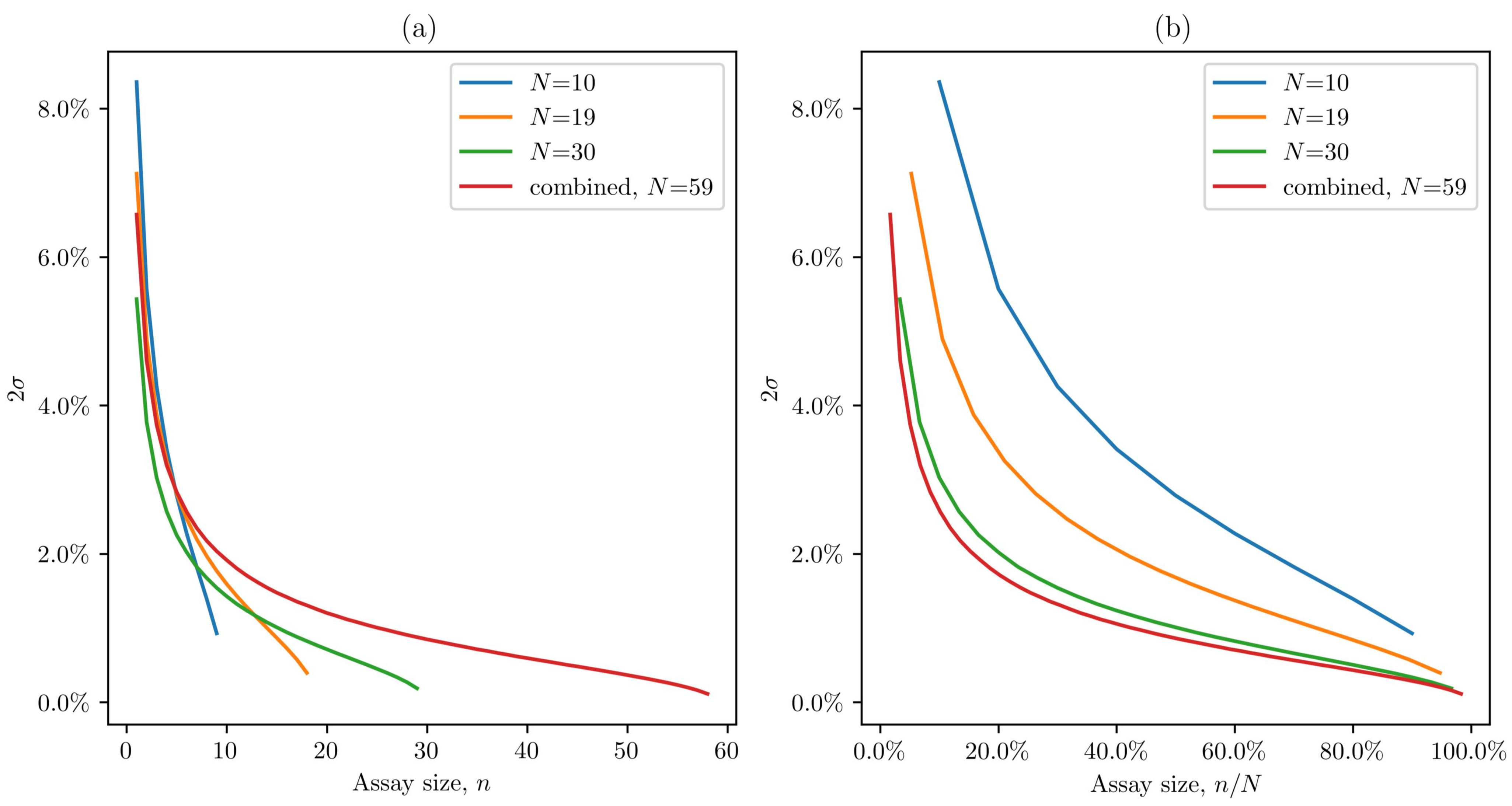
- The differences between measured S_K for each seed and corrected certificate S_K were calculated.
- Statistical sampling methods were used to characterise 2σ standard deviations in mean differences between the mean S_K of assays of size *n*, (1<*n*<N-1), and the mean S_K of the batch (N=10,19,30 or 59), of all combinations *S*:

$$\delta(n) = \sqrt{\frac{\sum_{i \epsilon S}\left(\bar{S}_{K,i} - \bar{S}_K\right)^2}{n-1}} \times 2$$

- Three 60 s readings were used for each measurement, which were adjusted for decay.

FINDINGS

- For three batches, N=10,19,30; 80%, 53% and 17% of seeds disagreed with vendor calibration certificate by >3%, respectively.
- S_K within 3% of batch mean was achieved with random assays of 5 seeds. S_K within 1% of batch mean was achieved with random assays of 7-9 seeds. See figures.
- >30% chance of random single seed S_K differing from batch mean by >3%.
- Findings support recommendations of the AAPM, and agree with observations in the literature concerning distribution of S_K.
- Findings don't support practice of single seed assay in surgical setting.



Acknowledgements
This work was made possible by the thoughtful ordering and preservation of seed cartridges that was provided by Candice Deans, Mark West and George Warr.

For more information, see S. B. Crowe, T. Kairn, "Calibration seed sampling for iodine-125 prostate brachytherapy", IFMBE Proceedings 68(3): 459-462, 2019