Purpose: To investigate analytic and numerical strategies involved in permanent prostate implant planning. The goal is to find optimal seeding plan to achieve a homogeneous dose distribution within the PTV.

Method: The PTV is simplified as a sphere - a first order approximation of prostate PTV. I-125 seeds with equal activities are modeled as TG43U1 Amersham 6711 point sources. The distribution of the seeds is represented by seed density function with spherical symmetry. No seeds are placed outside the PTV. The dose at any point inside the PTV is obtained by the integral of dose contribution over the PTV volume. A solution of the seed distribution is sought to achieve a homogeneous prescription dose throughout the PTV.

Results: The analytical expression representing the dose distribution inside the PTV was found to be the sum of two simple integrals involving seed density function and radial dose function. The treatment planning is turned into a mathematical problem of finding the seed density function given the prescribed dose and the seed properties such as air kerma strength and radial dose function. Analytic solution of the seed density function remains unsolved in this study. Nevertheless, a feasible approach through numerical integration has been described.

Conclusions: This study successfully identified the analytical representation for the simplified prostate seed implant treatment planning. A straightforward numerical solution to the homogeneous dose equation is presented. More study is needed to use the same strategy to handle practical prostate implant treatment planning.