Summary

Radioactive material can enter to the human body via inhalation, ingestion, or through intact or wounded skin. Although the committed effective dose cannot be measured directly, it can be estimated using mathematical models once the quantity of radioactive isotopes in the body has been determined through measurement. The level of intake depends on various factors, including the physico-chemical form of the radioactive material, as well as the time, mode and route of intake.

In developing methods suitable for internal dose assessment, special attention must be paid to the optimisation of the measurement methods and the investigation of the uncertainties of the parameters used for dose estimation.

The determination of the quantity and quality of radioisotopes in the human body using *in vivo* methods, primarily γ-spectrometry, is not fundamentally different from other measurements performed on prepared samples. The generally unfavourable and individually variable measurement geometry and the limited measurement time often lead to a greater measurement uncertainty compared to that of inanimate samples. Despite these challenges, appropriate measurement of radioisotopes in the human body requires careful consideration of differences in body sizes and the location of internal organs of individuals, especially for low-energy γ-rays. In addition, age-dependent characteristics such as organ size and metabolic behavior may also be important.

In my PhD thesis, I have shown in detail that to improve the accuracy of in vivo measurements for determining internal doses, calibration procedures must be developed that take into account several factors: the specific isotopes to be measured, the measurement geometry, the characteristics of the measurement device, the organs to be measured, and the age of the individual.

In *in vitro* measurements of internal dosimetry involve the analysis of biological samples, such as excreta (urine, faeces), blood or nasal secretions, to determine the concentration of radioactive material present in the body, allowing the, thereby estimating the committed effective dose. These measurements are either complementary to the results of whole-body or are necessary because, in the case of when dealing with short-range radionuclides for direct quantification it is not possible in the body feasible by other means.

In my thesis, I investigated the effectiveness of different calibration methods aimed at eliminating or accounting for the quench effect without the need for time-consuming sample preparation of urine samples. My aim was to develop a method that would remain accurate in the presence of the quench effect, even for complex samples, thus improving the reliability and efficiency of measurement.

In the calculation of the committed effective dose, the uncertainties are due to the shortcomings of the biokinetic models, the model parameter uncertainties and individual variability. One source of uncertainties is that these models are developed for a *Reference Humans* whose physical characteristics may differ substantially from those of the person being measured. In addition, the uncertainty is increased by other characteristics of the individual, such as the amount of urine or faeces excreted, may change over time. The usefulness of the measurement data for dose estimation may also be affected by a decorporation treatment that is used after exposure to accelerate the elimination of radioactive material from the body. The treatment alters the retention function of the radioactive material in the body consequently the standard biokinetic models cannot be applied directly.

In my research, I have examined the used to determine internal doyimetry, including the various measurement techniques employed and the key aspects of dose estimation. My objective is to enhance the measurement methods and models currently in use. By implementing these improvements, I aim to enhance the sensitivity of measurements, reduce measurement uncertainties, and improve the accuracy and reliability of dose estimates.