# VALIDATION OF SOFTWARES USED FOR DOSIMETRY OF PATIENTS SUBMITTED TO CHEST CT EXAMINATIONS

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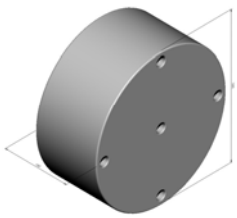
## INTRODUCTION

Aiming the protection of patients, diagnostic reference levels (DRL) for computed tomography (CT) were recommended in terms of in air or in phantom related dosimetric quantities like the CT air kerma-length product ($P_{K,L}$), the weighted CT air kerma index ($C_w$), the volumetric weighted CT air kerma index ($C_{vol}$) and dose effective (E). The aim of this work was to validate some computational programs used for CT patient dosimetry through comparison against experimental measurements in antropormorphic and standard body phantoms under routine CT chest protocols in Belo Horizonte, Brazil.

## MATERIALS AND METHODS

CT Expo and ImpactDose softwares were used for available for dose assessments in patient dosimetry. Organ absorbed dose measurements were done with TLD-100H thermoluminescent dosimeters in an Alderson phantom. CT dosimetric quantities were also measured by a calibrated pencil ionization chamber and the standard body CT PMMA phantom.


Windows of the CT Expo (left)) and ImpactDose (right) softwares used for dose assessments in patient dosimetry



Antropomorphic Alderson phantom , thermoluminescent dosimeters (*left*), standard body CT PMMA phantom and pencil CT ionization chamber (*right)* used for CT dose measurements.

Measurements were done in model Brigth Speed 4 channels, GE unit for an adult routine chest protocol: 120kV, 230mA, 0,8s, 1,5 picth, 4x2,5mm collimation, 27cm length and dosimetric quantities were calculated by simulating the examination with the two mentioned programs.

## RESULTS AND DISCUSSIONS

Results showed that both the CT Expo and ImpactDose underestimated the dose equivalents in selected organs from 63% up to 97% and 10% to 95% , respectively, in the range 1.1 - 20.4 mSv, in comparison to the experimental measurements with the anthropomorphic phantom.

**Equivalent doses in selected organs calculated by CT Expo and ImpactDose and experimentally measured in an anthropomorphic phantom.**

| Dose | Phantom | CT Expo | Ratio (CT Expo/Phantom) | ImpactDose | Ratio (ImpactDose/Phantom) |
|---|---|---|---|---|---|
| Large intestine | 5,4 | 0,2 | **0,04** | 0,3 | **0,06** |
| Kidneys | 7,6 | 1,1 | **0,15** | 2,9 | **0,38** |
| Pancreas | 8,6 | 3,9 | **0,45** | 5,1 | **0,59** |
| Liver | 11,3 | 5,3 | **0,47** | 7,3 | **0,64** |
| Stomach | 9,2 | 3,3 | **0,36** | 5,1 | **0,55** |
| Lung | 9,0 | 20,4 | **2,26** | 12,4 | **1,38** |

In comparison to the experimental measurements in the standard body CT PMMA phantom, CT Expo calculations showed an acceptable underestimation of the CT dosimetric quantities: 23% for the $C_{vol}$ and $C_w$ , 16% for the $P_{K,L}$.
Acceptable agreement was also observed for both CT Expo (1%) and ImpactDose (13%) for E assessment in comparison to E value derived from $P_{K,L}$ measurements.

**CT dosimetric quantities calculated by CT Expo and ImpactDose and measured in the standard body CT PMMA phantom**

| Dosimetry quantities | Phantom | CT Expo | ImpactDose | Ratio (CT Expo/Phantom) | Ratio (ImpactDose/Phantom) |
|---|---|---|---|---|---|
| $C_{vol}$ (mGy) | 17,39 | 13,45 | ... | **0,77** | ... |
| $C_w$ (mGy) | 26,08 | 20,18 | ... | **0,77** | ... |
| $P_{K,L}$ (mGy.cm) | 469,50 | 392,74 | ... | **0,84** | ... |
| E (mSv) | 5,44 | 5,35 | 4,75 | **0,98** | 0,87 |

$C_W$ and $P_{K,L}$ values were lower than the recommended diagnostic reference levels (DRLs) of 30 mGy and 650 mGy.cm, respectively.

## CONCLUSION

Both CTExpo and ImpactDose softwares were not validated for equivalent doses in selected organs; it suggest that mathematical and physical phantoms might be significantly different.

CT Expo was validated for the assessment of CT dosimetric quantities within an acceptable uncertainty.

As far as DRLs, results show suggest there is still a room for seeking values representative to the Brazilian CT examination conditions.

## ACKNOWLEDGMENT

The authors are thankful to the National Commission of Nuclear Energy - CNEN for providing a master fellowship for Natalia Gonzaga. This work is part of the project of the Brazilian Institute of Science and Technology (INCT) Radiation Metrology in Medicine .