

ABSTRAK

Latar Belakang : *Cross-calibration* atau kalibrasi silang merupakan prosedur standar fisika medis untuk menetapkan faktor kalibrasi dosis air ($N_{D,w}$) suatu detektor lapangann (*Field Detector*) relatif terhadap detektor referensi yang telah dikalibrasi oleh Laboratorium Standar Dosis Sekunder (SSDL). Prosedur ini mengikuti Protokol IAEA TRS-398 yang diakui secara internasional.

Metode: Penelitian ini melaksanakan kalibrasi silang terhadap tiga detektor ionisasi, Iba CC04 (S/N 8821), Iba CC13 (S/N 7632), dan Exradin A12 (S/N 4417), terhadap detektor referensi PTW FC65-G (S/N 2345). Pengujian dilakukan pada tiga kualitas berkas radiasi: Cobalt-60, Linac Vitalbeam 6 MV, dan Linac Vitalbeam 10 MV menggunakan factor k_Q berbasis nilai baseline komisioning pesawat. Pengukuran dilaksanakan di RSUD Dr. Moewardi Surakarta pada periode bulan April 2026.

Hasil : Analisis ketidakpastian mengikuti panduan GUM ISO/IEC Guide 98-3 dengan sembilan sumber ketidakpastian yang diidentifikasi. Hasil menunjukkan ketidakpastian diperluas $U = 1,227\%$ ($k = 2$, $\sim 95\%$), memenuhi persyaratan klinis $\leq 1,5\%$. Deviasi seluruh detektor terhadap data historis SSDL berada di bawah $2,0\%$, dikategorikan **Sangat Baik** sesuai kriteria penerimaan. Efisiensi biaya kalibrasi mencapai penghematan sebesar 68% dibandingkan kalibrasi individual ke SSDL.

Kata kunci: *cross-calibration*, dosimetri ionisasi, IAEA TRS-398, faktor kalibrasi, ketidakpastian pengukuran, Cobalt-60, Linac Vitalbeam.

ABSTRACT

Background: Cross-calibration is a standard medical physics procedure to determine the absorbed dose-to-water calibration factor ($N_{D,w}$) of a field detector relative to a reference detector that has been calibrated by a Secondary Standard Dosimetry Laboratory (SSDL). This procedure follows the internationally recognized IAEA TRS-398 protocol. **Methods:** This study performed cross-calibration on three field detectors, IBA CC04 (S/N 8821), IBA CC13 (S/N 7632), and Exradin A12 (S/N 4417), against a PTW FC65-G reference detector (S/N 2345). The evaluation was carried out across three radiation beam qualities: Cobalt-60, Linac VitalBeam 6 MV, and Linac VitalBeam 10 MV, utilizing beam quality correction factors (k_Q) derived from the machine's commissioning baseline values. Measurements were conducted at Dr. Moewardi Regional General Hospital, Surakarta, during April 2026. **Results:** Uncertainty analysis followed the GUM ISO/IEC Guide 98-3 guidelines, identifying nine sources of uncertainty. The results demonstrated an expanded uncertainty of $U = 1.227\%$ ($k = 2$, $\sim 95\%$), which fulfills the clinical requirement of $\leq 1.5\%$. The deviations of all three field detectors relative to historical SSDL data were below 2.0% across all energy levels, categorizing them as "Excellent" according to the acceptance criteria. **Conclusion:** Furthermore, the implementation of this local method achieved calibration cost efficiency, saving up to 68% compared to individual calibrations performed directly at the SSDL.

Keywords: cross-calibration, ionization dosimetry, IAEA TRS-398, calibration factor, measurement uncertainty, Cobalt-60, Linac VitalBeam.