South African Health Products
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GUIDELINE FOR BONE DENSITOMETER – SHIELDING, MONITORING AND POSITIONING OF OPERATORS

The following recommendations serve as guidelines for shielding, monitoring, and positioning of operators during dual-energy X-Ray absorptiometry (DXA).

Document History

Final Version	Reason for Amendment	Effective Date
0	First issue and published for implementation	Oct 2009
1	– Content structured on the new SAHPRA Guideline Template – A unique document number SAHPGL-RDN-XR-07 allocated to this Guideline	August 2022

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Glossary

Abbreviation/ Term	Meaning
BMD	Bone Mineral Density
ISCD	International Society for Clinical Densitometry
DEXA/DXA	Dual Energy X-Ray Absorptiometry
mSv	millisievert
Absorptiometry	Means of measuring bone mineral density
Act	Hazardous Substances Act, 1973 (Act 15 of 1973)
Regulations	Regulations relating to the Control of Electronic Products (No R1332 of 3 August 1973)
SAHPRA	South African Health Product Regulatory Authority

1. INTRODUCTION

Dual-energy X-Ray absorptiometry (DXA, or formerly DEXA) is a technique used to measure bone mineral density (BMD). The preferred regions for BMD measurement are lumbar spine, proximal femur, and whole body. The technique relies on transmission measurements made at two photon energies to allow calcium, and thereby bone mineral, to be assessed.

The abbreviation “DXA” was proposed by the International Society for Clinical Densitometry (ISCD) in 2003, as an alternative to “DEXA”.

1.1 Purpose

This guideline document is intended to ensure that license holders and users of bone densitometer are updated with the requirements of the Act and Regulations.

1.2 Scope

The guideline outlines the requirements and recommendations for shielding, monitoring, and positioning of operators during dual-energy X-Ray absorptiometry (DXA).

2. LEGAL PROVISION

The Hazardous Substances Act, 1973 (Act 15 of 1973) and Regulations (No R1332 of 3 August 1973) govern the safe use of X-Ray equipment in South Africa.

3. Guideline Recommendations

3.1 Background

The patient dose from a DXA examination is determined by system dependent parameters such as source spectra, source-detector geometry, beam collimation, beam filters, beam filtration, tube current and scan speed.

These factors vary significantly between systems made by different manufacturers. Broadly similar levels of dose are achieved when the radionuclide source is replaced by an X-Ray tube. The dose depends on the precision of the BMD measurement as well as the site of investigation. This is commonly the spine, femur, hip, or whole body.

The latest DXA scanners with fan beams provide improved images that approach diagnostic radiographic quality. However, this increases the patient dose. Pencil beam scanners give lower doses than fan beam

systems. So far, there have been few investigations of cone-beam and C-arm systems, but initial reports indicate the dose is higher than that from typical fan-beam systems.

3.2 Shielding requirements

I. Walls - dry walls should provide sufficient shielding with a workload of less than 7500 examinations per year (20 examinations / day)

II. Protective screen (preferably transparent lead-acrylic shielding).

III. Only required if the distances below are not kept by the operator or the workload is more than 20 examinations / day.

3.1 Operator: Positioning

I. Pencil beam densitometers:

- The operator shall be positioned at least 1 metre from the edge of the scan table.

II. Fan beam densitometers:

- The operator shall be positioned at least 2 metres from the edge of the scan table.

3.2 Personal Monitoring

Personnel are required to wear personal dosimeters if the distances above are not kept, and a protective screen not used.

- The dose to staff in DXA facilities is generally small. However, new developments in DXA imaging technology (fan beam, cone beam, C-arm configurations) can result in larger scattered exposure levels.

- In some examinations the operator may be present in the scanning room; thus, the scattered radiation from the total annual patient workload must be considered when assessing occupational dose levels.

- The reported scatter dose rates at 1m from the central axis of the patient table range from few tenths of a µSv/h to 5 µSv/h, depending on the scanner model.

- From these values, recent calculations and measurements indicate that the annual dose for an average workload (20 patients/day) at 1m from the scanner will be between 0.1 and 1.5 mSv depending on the model of the scanner.

- These figures assume that staff do not comfort or hold children during examinations, and that this is done by parents or other comforters/careers.

4. REFERENCES

The following related documents are referenced:

4.1 CRCPD Publication E-06-05 (October 2006) – Technical White Paper: Bone Densitometry

4.2 https://www.iaea.org/resources/rpop/health-professionals/other-specialities-and-imaging-modalities/dxa-bone-mineral-densitometry

4.3 BOUDOUSQ, V., KOTZKI, P.O., DINTEN, J.M., BARRAU, C., ROBERT-COUTANT, C., THOMAS, E., GOULART, D.M., Total Dose incurred by patients and staff from BMD measurement using a new 2D digital bone densitometer, Osteoporos. Int. 14 3 (May 2003) 263-269.

4.4 EUROPEAN COMMISSION, Council Directive 97/43/ EURATOM on Health Protection of Individuals against the Dangers of Ionising Radiation in relation to Medical Exposure. Official Journal of the European Communities, Luxembourg (1996).

4.5 EU 2000; Publication 118: Referral Guidelines.

4.6 EU 1998; Research Guidelines, Publication 99.

4.7 HUDA, W., MORIN, R.L., Patient doses in bone mineral densitometry, Br. J. Radiol. 69 821 (May 1996) 422-425.

4.8 LARKIN, A., SHEAHAN, N., GRAY, L., O'CONNOR, U., DOWLING, A., VANO, E., TORBICA, P., SALAT, D., SCHREINER, A., NEOFOTISTOU, V., MALONE, J.F., Commissioning and Quality Assurance of Dual Energy X-Ray Absorptiometry (DEXA) systems, Rad. Prot. Dosim. 2008 (in press).

4.9 LEWIS, M.K., BLAKE, G.M., FOGELMAN, I., Patient dose in dual X-Ray absorptiometry, Osteoporos. Int. 4 1 (Jan.1994) 11-15.

4.10 SHEAHAN, N.F., DOWLING, A., O'REILLY, G., MALONE, J.F., Commissioning and quality assurance protocol for dual energy X-Ray absorptiometry systems, Rad. Prot. Dosim. 117 (2005) 288-290.

5. VALIDITY

This guideline is valid for a period of 5 years from the effective date of revision and replaces the old guideline for Bone Densitometer – Shielding, Monitoring and Positioning of Operators, revised October 2009. It will be reviewed on this timeframe or as and when required.