ALMA COLLEGE

Policies and procedures for body composition testing using a Dual-Energy X-ray Absorptiometer

Overview

In 2023, Alma College purchased a Hologic Horizon W dual-energy x-ray absorptiometer (DEXA) system for the purposes of aiding in teaching, research, athlete testing, and community outreach efforts at the college. This document covers the policies and procedures for how the DEXA will be used and safeguards to protect test administrators and individuals being tested.

DEXA systems are capable of measuring body composition, which is important in health and athletic performance contexts. The DEXA uses low doses of x-rays (see Appendix A) to differentiate the body composition of humans and animals into three tissue types: 1) bone mass,

2) fat mass, and 3) non-bone fat-free mass (e.g., muscle, organs). These tissue types are assessed at the whole-body level as well as regionally (e.g., left vs. right, arms vs. legs). When operated correctly, the DEXA system has accuracy to within 2-3% of true values of each of these tissue types, making it the most accurate non-invasive laboratory method available for assessing body composition.

A DEXA scan involves lying supine on the scanning bed in light clothing, while a mechanical arm makes one to seven passes above the body, depending on the specific type of scan (bone density or whole body composition). The scan itself takes up to six minutes, and with setup and calibration the total test time is 10-15 minutes. The results can be viewed instantaneously, but for regional scans it is recommended that a trained technician check the regions approximated by the computer as part of the data analysis.

There are many important applications for body composition assessment. Body fat assessment (both total fat and fat distribution) is important for understanding health risk. Assessment of bone mass is important for determining risk of stress fracture in athletes as well as in older individuals with osteopenia/osteoporosis. Additionally, assessment of muscle mass is important for athletes looking to optimize training and performance and for individuals looking to see positive change following adoption of dietary modifications or exercise training.

However, there are risks associated with DEXA body composition testing. Such risks include 1) x-ray exposure, which is minimal but could theoretically accumulate if a person does enough tests or potentially pose a bigger threat for pregnant individuals, and 2) anxiety/mood effects associated with weight status, especially in groups vulnerable to body image issues or disordered eating. Therefore, proper use of the DEXA machine, as laid out in these policies and procedures, will help to maximize the utility and benefits of DEXA testing while mitigating risks to the extent possible.

The DEXA emits radiation. However, the dose is so low that there is a specific exception to the Michigan Radiation Safety rules for DEXA machines (see Appendix B). No special room is needed, and dosimeter monitoring of x-ray exposures is not required. Even though not required, we have installed the DEXA in its own room for privacy in testing and will place a dosimeter badge on the computer where the technicians run the scans to ensure ambient radiation levels are sufficiently low. Patients getting scanned will receive a radiation dose of approximately 0.01 millisieverts (mSv), which is the equivalent of ~1 day of natural radiation exposure from the natural environment, or ~10% of the radiation exposure from a round-trip flight across the United States (see appendix A). Stated another way, a single round-trip flight across the US would expose a person to the equivalent of ~10 DEXA scans. The only contraindication to getting a DEXA scan is being pregnant due to potential for harm to the unborn child, so females will be required to sign a statement confirming that they are not pregnant before getting scanned.

Oversight of DEXA Use

There is a DEXA oversight committee (DOC), which will confirm adherence to these policies and procedures. Members of the DOC will include two members from the academics sector (at least one of whom will be a faculty member in the IPHS Department), two members from the athletics sector, and an individual, internal or external, who is an expert in radiation use and safety.

Uses of the DEXA will comply with the policies laid out in the following sections. These include teaching, research, athlete testing, and community testing. If any planned uses of the DEXA fall outside of these testing parameters, the DOC must approve of an exception to the policies.

Teaching

The DEXA system has appeal for teaching across a number of courses in IPHS, Nursing, and Biology. All individuals who get a DEXA scan as part of a course must sign an informed consent form prior to testing. The number of scans will be limited to two per class per semester. Additional scans would need to be approved by the DOC and the instructor of the class.

For the purposes of teaching, DEXA scans would not be considered research data and, therefore, a protocol would not need to be submitted to Alma's Institutional Review Board (IRB) for approval. Additionally, the consent form will make clear that the data collected by the DEXA scan are not being evaluated by a medical provider and, therefore, cannot be used to diagnose or treat health conditions. Students in these classes will be provided with the data from the scans, which they can use for whatever purposes they desire. Instructors will not share student scan data with anyone except the student being tested.

For some classes, it may be the case that animals will be scanned rather than humans. In such cases, a protocol must be submitted to and approved by Alma's Institutional

Animal Care and Use Committee (IACUC) prior to testing even if the scans are only used for teaching purposes. The numbers and types of scans conducted will be described in the IACUC submission.

Research

The DEXA system will provide valuable data on body composition for human and animal research subjects. In order to use the DEXA for research use, human subjects research protocols must be submitted to and approved by Alma College's IRB, which will consult with the DOC on any projects seeking to use the DEXA system before offering study approval. All studies with animal subjects must be submitted to and approved by Alma College's IACUC, which will consult with the DOC before offering approval. The number of scans to be conducted on each subject will depend on the study purpose, duration of subject involvement, and other factors.

Alma College Athlete Testing

Body composition is helpful for athletes for a number of reasons. First, getting a baseline DEXA scan allows for assessment of changes over time, whether that be due to training, dietary changes, or injury. Regional scans (e.g., left vs. right) can detect underlying asymmetries, which may be expected due to the nature of the sport (e.g., larger lean mass in throwing arm of a pitcher) or may reflect underlying injury or poor recovery from injury. Results from the DEXA may also help to inform potential dietary strategies which may help athletes optimize performance and recovery.

Despite the potential value of body composition testing in athletes, body composition data can cause psychological harm if misused. An example from late 2021 showcases body image issues and eating disorders that were introduced by improper use of DEXA data in University of Oregon track and field athletes, where too much emphasis was placed on achieving certain body weights and body percent fat levels (https://www.opb.org/article/2021/10/26/track-team-members-accuse-uo-program-of-body-shaming/). In order to minimize the risk of such events, we propose a hierarchy of data availability such that not all data are shared with coaches, trainers, or even the athletes themselves. Specifically, testing will be conducted only by approved staff (e.g., head or assistant coach, athletic trainer, strength and conditioning coach, faculty), not by students. For each team, a single person will be designated to analyze and interpret the scans. Once data are analyzed, fat mass data will not be shared, and only whole body and/or regional lean mass (bone mass and non-bone fat-free mass) data will be shared with team coaches, athletic training staff, strength and conditioning coaches, and the athletes themselves.

The only possible exception for which fat mass data would be shareable is for the men's and women's wrestling teams. Wrestling has minimum body fat percentages that athletes can attain and still be eligible to compete, so the body fat information would aid the athletes and staff on appropriate weight classes for the athletes.

The number of scans athletes could get would be limited to 10 per year. Additional scans would need to be approved by the DOC.

Community Member Testing

Body composition testing in community members also has potential benefits such as understanding health risks associated with low bone mass, excess fat mass, or unfavorable fat mass distribution as well as understanding changes in body composition over time, for example with exercise training or dietary modification. Alma College is not a medical institution nor are staff medically trained, so data from DEXA scans will not be used for the diagnosis or treatment of disease. Rather, results will be given to community members with a general interpretation, and they will be encouraged to seek guidance from a healthcare professional for further information or interpretation of the results.

Training Required to Conduct DEXA Scans

There are no state regulations on who can conduct DEXA scans. However, Alma College will require a ~1 hour training administered by a member of the DOC, which includes demonstrations of how to complete quality control checks and whole body scans. There will also be a Collaborative Institutional Training Initiative (CITI) training module focused on radiation safety, rights of human subjects, and information privacy (e.g., HIPPA) that needs to be completed. Finally, the person being trained must conduct at least one whole body scan under supervision from a member of the DOC to confirm competence in operating the equipment.

Data Storage and Security

The DEXA machine is located in McIntyre Center for Health Science (MCE) 113, a small room within the main MCE 111 laboratory in the Integrative Physiology and Health Science (IPHS) Department. The room is rarely used for any purpose other than body composition testing, has no windows, and is lockable. The computer that runs the DEXA machine is located in the MCE 113 lab, and it also stores the data files from the DEXA scans. The computer is not connected to the internet, so the only way to view files is on the computer itself. Files will be backed up weekly to an external hard drive and writeable DVD, both of which will be stored in locked IPHS offices or laboratories. DEXA files have a special file type that allows them to be opened only on the DEXA computer. Data exports for athletics teams, research, etc. will be stored only in electronic format (.csv files) on password-protected computers or in Alma's secure OneDrive storage. Additionally, a paper log of scan dates, participant names, and technician names will be kept for record keeping.

Fees for Testing

The DOC will determine a fee schedule for DEXA scans to cover costs of consumables, maintenance, and other items related to DEXA operation. The fee schedule may include

discounts for local teams, Stone Recreation Center members, etc. Additionally, some groups may receive scans free of charge, such as Alma College students within a class setting, research participants, and Alma College athletes if conducted as part of team-planned testing.

Uses for Funds Raised Through Testing

There are costs to operating the DEXA, with examples of such costs listed below. We plan to set up a roll-over account at the college, to which funds raised from DEXA scans will be deposited. This budget can only be used to cover DEXA-related expenses.

- Disinfectant wipes used every scan.
- Tape used every scan.
- Dosimeter badges, replaced every year.
- Annual state radiation licensing fee.
- Dehumidifier for room, planned replacement every two-to-three years.
- Printer ink and paper.
- Maintenance and repair on DEXA and computer.

Handling Violations of DEXA Use

In addition to needing to follow these policies and procedures, the following items are considered violations of acceptable DEXA use. Such actions may result in an individual becoming ineligible to operate the DEXA system or perform or analyze any further DEXA scans.

- Operating the machine for scans without completing the appropriate training and approval process from the DOC.
- Scanning individuals without obtaining informed consent beforehand.
- Analyzing the results of DEXA scans without approval from the DOC.
- Printing the results of DEXA scans without approval from the DOC.
- Providing interpretation of DEXA scans with approval from the DOC.

Policy and Planning approval November 2023

Appendices

Appendix A. X-ray emissions from Hologic DEXA scanner.

Radiation Dose from Common Imaging Examinations

HOLOGIC

Procedure		Approximate effective radiation dose	Comparable to natural background radiation for:	Comparable to natural background radiation for:
ABDOMINAL REGION	Computed Tomography (CT) — Abdomen and Pelvis	10 mSV	3 years	Low
	Computed Tomography (CT) — Abdomen and Pelvis, repeated with and without contrast material	20 mSV	7 years	Moderate
	Computed Tomography (CT) — Colonography 6	6 mSv	2 years	Low
	Intravenous Pyelogram (IVP)	3mSv	1 year	Low
	Radiography (X-ray) — Lower GI Tract	8 m Sv	3 years	Low
	Radiography (X-ray) — Upper GI Tract	6mSv	2 years	Low
BONE	Radiography (X-ray) — Spine	1.5mSv	6 months	Very Low
	Radiography (X-ray) — Extremity s	0.001mSv	3 hours	Negligible
CENTRAL NERVOUS SYSTEM	Computed Tomography (CT) — Head	2 mSv	8 months	
	Computed Tomography (CT) — Head, repeated with and without contrast material	4 mSv	16 months	Low
	Computed Tomography (CT) — Spine	6mSv	2 years	Low
CHEST	Computed Tomography (CT) — Chest	7 mSv	2 years	Low
	Computed Tomography (CT) — Lung Cancer Screening	1.5 mSv	6 months	Very Low
	Radiography — Chest	0.1 mSv	10 days	Minimal
DENTAL	Intraoral X-ray	0.005 mSv	1 day	Negligible
HEART	Coronary Computed Tomography Angiography (CTA)	12 mSv	4 years	Low
	Cardiac CT for Calcium Scoring	3mSv	1 year	Low
MEN'S IMAGING	**Bone Densitometry (DXA)**	**0.001 mSv**	**3 hours**	**Negligible**
NUCLEAR MEDICINE	Positron Emission Tomography — Computed Tomography (PET/CT)	25mSv	8 year	Moderate
WOMEN'S IMAGING	Mammography	0.4 mSv	7 weeks	Very Low
BODY COMPOSITION	**Whole Body Scan (DXA)**	**0.01m Sv**	**1 day**	**Negligible**

Note: This chart simplifies a highly complex topic for patients' informational use. The effective doses are typical values for an average-sized adult. The actual dose can vary substantially, depending on a person's size as well as on differences in imaging practices. It is also important to note that doses given to pediatric patients will vary significantly from those given to adults, since children vary in size. Patients with radiation dose questions should consult with their radiation physicists and/or radiologists as part of a larger discussion on the benefits and risks of radiologic care.

For detailed recommendations visit radiologyinfo.org

Appendix B. Michigan regulations for DEXA dosimetry monitoring.

Michigan Department of Licensing and Regulatory Affairs
Radiation Safety Section

LARA
LICENSING AND REGULATORY AFFAIRS
CUSTOMER DRIVEN. BUSINESS MINDED.

Dosimetry for Bone Densitometry X-ray Machines

Type of Machine	Policy	Rationale
Bone densitometry equipment	A dosimeter is not required. Facilities using these units should ensure that the operator remains at least one meter from the bone densitometer and patient while x-rays are being produced.	Only low levels of scatter radiation are detectable in the vicinity of bone densitometer machines. R 333.5064 requires that individuals likely to exceed 10% of the annual occupational limit shall be provided with dosimeters to monitor their radiation exposure. Our experience surveying these units indicates the exposure to the operator is not likely to exceed 10% of the annual occupational limit. Studies performed by other radiation protection agencies confirm this finding.

MIOSHA-RSS-113 (5/16)
Authority: 1978 PA 368, as amended