

## Diagnostic Medical Sonography (DMSI) Program Mapping

### **Program Outcome #1 - Utilize oral and written communication.**

- Maintain clinical records;
- Interact with the interpreting physician or other designated physicians with oral or written summary of findings as permitted by employer policy and procedure
- Recognize significant clinical information and historical facts from the patient and the medical records, which may impact the diagnostic examination;
- Comprehend and employ appropriate medical terminology, abbreviations, symbols, terms, and phrases; and
- Educate other health care providers and the public in the appropriate applications of ultrasound and other diagnostic vascular evaluation, including the following:
  - Medical terminology
  - Sonographic/other vascular terminology
  - Pertinent clinical signs, symptoms, and laboratory tests
  - Pertinent legal principles

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

### **Program Outcome #2 – Provide basic patient care and comfort.**

- Maintain infection control and utilize standard precautions;
- Anticipate and be able to respond to the needs of the patient;
- Demonstrate age related competency (i.e., neonates, pediatric patients, adolescents, adults, and Obstetric patients)
- Respond appropriately to parental needs
- Recognize when sedation may be appropriate
- Demonstrate appropriate care in nursery and intensive care environments (ancillary equipment, thermal, central venous lines, ET tubes, respiratory needs)
- Identify life-threatening situations and implement emergency care as permitted by employer procedure, including the following:
  - Pertinent patient care procedures
  - Principles of psychological support
  - Emergency conditions and procedures
  - First aid and resuscitation techniques
- Proper patient positioning

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #3 - Demonstrate knowledge and understanding of human gross anatomy and sectional anatomy.**

- Evaluate anatomic structures in the region of interest; and
- Recognize the sonographic appearance of normal tissue structures, including the following:
  - Sectional anatomy
  - Embryology
  - Normal sonographic patterns

**Courses:** DMSI 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #4 - Demonstrate knowledge and understanding of physiology, pathology, and pathophysiology.**

- Obtain and evaluate pertinent patient history and physical findings;
- Extend standard diagnostic testing protocol as required by patient history or initial findings;
- Review data from current and previous examinations to produce a written/oral summary of technical findings, including relevant interval changes, for the interpreting physician's reference and
- Recognize examination findings that require immediate clinical response and notify the interpreting physician of such findings, including the following:
  - Patient interview and examination techniques
  - Chart and referral evaluation
  - Diagnostic testing protocols related to specific disease conditions
  - Physiology including blood flow dynamics
  - Pertinent pathology and pathophysiology
  - Pertinent legal issues

**Courses:** DMSI 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #5 - Demonstrate knowledge and understanding of acoustic physics, Doppler ultrasound principles, and ultrasound instrumentation.**

- Select the appropriate technique(s) for examination(s) being performed;
- Adjust instrument controls to optimize image quality;
- Perform linear, area, circumference, and other related measurements from sonographic images or data;
- Recognize and compensate for acoustical artifacts
- Utilize appropriate devices to obtain pertinent documentation
- Minimize patient exposure to acoustic energy
- Apply basic concepts of acoustic physics which include the following:
  - Sound production and propagation
  - Interaction of sound and matter
  - Instrument options and transducer selection
  - Principles of ultrasound instruments and modes of operation
  - Operator control options
  - Physics of Doppler
  - Principles of Doppler techniques
  - Methods of Doppler flow analysis
  - Recording techniques
  - Acoustic artifacts
- Emerging Technologies

**Courses:** DMSI 101 and 102

**Assessments:** Assessed through lab training, lab assignments, written tests, clinical evaluations, and clinical competencies.

**Program Outcome #6 - Demonstrate knowledge and understanding of the interaction between ultrasound and tissue and the probability of biological effects in clinical examinations, including the following:**

- Biologic effects
- Pertinent in-vitro and in-vivo studies
- Exposure display indices
- Generally accepted maximum safe exposure levels
- ALARA principle

**Courses:** DMSI 101 and 102

**Assessments:** Assessed through lab training, lab assignments, written tests, clinical evaluations, and clinical competencies.

**Program Outcome #7 - Employ professional judgment and discretion.**

- Protect the patient's right to privacy based on current federal standards and regulations;
- Maintain confidentiality; and

- Adhere to the professional codes of conduct/ethics through the following:
  - Medical ethics
  - Pertinent legal principles
  - Professional interaction skills
  - Professional scopes of practice

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #8 - Understand the fundamental elements for implementing a quality assurance and improvement program, and the policies, protocols, and procedures for the general function of the ultrasound laboratory, including the following:**

- Administrative procedures
- Quality control procedures
- Elements of quality assurance program
- Records maintenance
- Personnel and fiscal management
- Trends in health care systems

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #9 - Recognize the importance of continuing education, through the following:**

- Professional journals
- Conferences
- Lectures
- In-house educational offerings
- Professional organizations and resources
- Recent developments in sonography
- Research statistics and design

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**Program Outcome #10 - Recognize the importance of, and employ, ergonomically correct scanning techniques:**

- Personal fitness
- Supports, tools, and devices
- Equipment adjustments
- Patient positioning

**Courses:** DMSI 111

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, peer observations, written tests, clinical evaluations, and clinical competencies.

**General Learning Concentrations**

- A. Outcome:** Demonstrate the ability to perform sonographic examinations of the abdomen, superficial structures, non-cardiac chest, and the gravid and nongravid pelvis according to protocol guidelines established by national professional organizations and the protocol of the employing institution utilizing real-time equipment with both transabdominal and endocavitary transducers, and Doppler display modes.

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

- B. Outcome:** Recognize and identify the sonographic appearance of normal anatomic structures, including anatomic variants and normal Doppler patterns:

- Liver
- Biliary system
- Pancreas
- Urinary tract
- Adrenal glands
- Spleen
- Prevertebral vessels
- Peritoneal cavity, including potential spaces
- Gastrointestinal tract
- Noncardiac chest
- Neck
- Breast
- Scrotum
- Prostate
- Anterior abdominal wall
- Extremities

- Brain and spinal cord
- Musculoskeletal

**Courses:** DMSI 102 and 202

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**C. Outcome:** Recognize, identify, and appropriately document the abnormal sonographic and Doppler patterns of disease processes, pathology, and pathophysiology of the following structures:

- Liver
- Biliary system
- Pancreas
- Urinary tract
- Adrenal glands
- Spleen
- Prevertebral vessels
- Peritoneal cavity, including potential spaces
- Gastrointestinal tract
- Noncardiac chest
- Neck
- Breast
- Scrotum
- Prostate
- Anterior abdominal wall
- Extremities
- Brain and spinal cord
- Musculoskeletal

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**D. Outcome:** Modify the scanning protocol based on the sonographic findings and the differential diagnosis:

- History and physical examination
- Related imaging, laboratory, and functional testing procedures
- Clinical differential diagnosis
- Role of ultrasound in patient management
- Sonographic and Doppler patterns in clinical diseases that may occur in the following categories:
  - Iatrogenic
  - Degenerative
  - Inflammatory

- Traumatic
- Neoplastic
- Infectious
- Obstructive
- Congenital
- Metabolic
- Immunologic

**Courses:** DMSI 101, 102, 103, 105, 107, 110, 111, 113, 114, 116, 117, 119, 160, 190, 201, 202, 203, 205, 206, 210, 214, 216, 217, 219, 220, 295

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**E. Outcome:** Recognize and identify the sonographic appearance of normal anatomic structures of the female pelvis, including anatomic variants and normal Doppler patterns:

- Reproductive system
- Pelvic muscles
- Suspensory ligaments
- Peritoneal spaces
- Pelvic vasculature

**Courses:** DMSI 103 and 203

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**F. Outcome:** Recognize and identify the sonographic appearance of normal maternal, embryonic, and fetal anatomic structures during the first, second, and third trimesters:

- Sectional anatomy
- Pertinent measurement techniques
- Doppler applications

**Courses:** DMSI 103, 111, and 203

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**G. Outcome:** Recognize, identify, and appropriately document the sonographic appearance of gynecologic disease processes, pathology, and pathophysiology:

- History and physical examination
- Related imaging, laboratory, and functional testing procedures
- Differential diagnosis
- Role of ultrasound in patient management
- Abnormal sonographic patterns:
  - Iatrogenic
  - Degenerative
  - Inflammatory
  - Traumatic
  - Neoplastic
  - Infectious
  - Obstructive

- Congenital
- Metabolic
- Immunologic
- Contraceptive devices
- Infertility procedures
- Doppler applications

**Courses:** DMSI 103, 111, 203, 295 and general concentration clinical courses

**Assessments:** Assessed through lab training, lab assignments, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**H. Outcome:** Recognize, identify, and appropriately document the sonographic appearance of obstetric abnormalities, disease, pathology, and pathophysiology:

- History and physical examination
- Related imaging, laboratory, and functional testing procedures
- Differential diagnosis
- Role of ultrasound in patient management
- Use of three-dimensional obstetric sonography Abnormal sonographic characteristics in pregnancy:
  - Placenta
  - Congenital/genetic anomalies
  - Growth abnormalities
  - Amniotic fluid
  - Viability
  - Multiple gestation
  - Fetal monitoring
  - Maternal factors
  - Postpartum
  - Fetal therapy

**Courses:** DMSI 103, 111, 203, 295 and general concentration clinical courses

**Assessments:** Assessed through lab training, lab assignments, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**I. Outcome:** Demonstrate knowledge and understanding of the role of the sonographer in performing interventional/invasive procedures.

**Courses:** DMSI 103, 111, 203, 295 and general concentration clinical courses

**Assessments:** Assessed through lab training, lab assignments, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**J. Outcome:** Demonstrate knowledge of normal and abnormal cardiac anatomy:

- Embryology and fetal cardiac development
- Cardiac chambers and septation
- Valve anatomy and dynamics
- Coronary artery anatomy
- Relationships of cardiac chambers and great vessels

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, written tests, case studies, clinical evaluations, and clinical competencies.

**K. Outcome:** Demonstrate knowledge of normal cardiovascular physiology:

- Hemodynamics
- Ventricular function, including influence of loading conditions and measurement of cardiac output
- Exercise physiology
- Electrophysiology and conduction system
- Pulmonary vascular disease

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, written tests, case studies, clinical evaluations, and clinical competencies.

**L. Outcome:** Demonstrate knowledge and understanding of cardiac pathology, pathophysiology, and hemodynamics in different types of cardiac disease:

- Valvular heart disease
- Ischemic cardiac disease
- Cardiomyopathy
- Pericardial disease
- Congenital heart disease
- Cardiac neoplasms and masses
- Cardiac trauma
- Pulmonary vascular disease
- Diseases of the aorta and great vessels

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, written tests, case studies, clinical evaluations, and clinical competencies.

**M. Outcome: Demonstrate knowledge and understanding of clinical cardiology:**

- Relationship of echocardiography to history and physical examination (including indications for echocardiography)
- Differential diagnosis as it relates to the echocardiographic examination
- Cardiovascular surgery and interventional cardiology
- Effect of systemic diseases on cardiovascular anatomy and physiology

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, written tests, case studies, clinical evaluations, and clinical competencies.

**N. Outcome:** Demonstrate knowledge of other cardiac procedures emphasizing indications, utility, and limitations of these procedures:

- Angiography and cardiac catheterization
- Electrocardiography, electrophysiologic studies, Holter monitoring
- Stress testing

- Radionuclide studies
- Other tomographic imaging procedures
- Phonocardiography and external pulse recording

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, written tests, case studies, clinical evaluations, and clinical competencies.

- O. Outcome:** Demonstrate proficiency in the performance of M-mode, two-dimensional, and Doppler (pulsed wave, continuous wave, color flow and power) echocardiographic studies.

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

- P. Outcome:** Recognize, identify, and appropriately document the abnormal echocardiographic and Doppler patterns of disease, pathology, and pathophysiology for the disease categories listed.

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through written tests, case studies, clinical evaluations, and clinical competencies.

- Q. Outcome:** Demonstrate knowledge and understanding of the indications, utility, limitations, and technical procedures for related echocardiographic studies:

- Stress echocardiography
- Transesophageal echocardiography
- Intraoperative echocardiography
- Contrast echocardiography
- Three-dimensional echocardiography
- Echo-guided procedures

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through discussion boards, written tests, case studies, clinical evaluations, clinical competencies, and journal article synopsis.

- R. Outcome:** Demonstrate knowledge and understanding of clinical pharmacology as it relates to echocardiography and provocative maneuvers:

- Cardiovascular pharmacology
- Theory and use of provocative stress agents
- Non-pharmacologic stress
- Potential effects of cardiac medications on echocardiographic findings

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through discussion boards, written tests, case studies, clinical evaluations, clinical competencies, and journal article synopsis.

**S. Outcome:** Demonstrate knowledge, understanding, and proficiency in the use of quantitation principles applied to echocardiographic images and flow data:

- Standard M-mode, two-dimensional, and Doppler measurements and calculations
- Knowledge and understanding of normal and abnormal values for M-mode, two-dimensional and Doppler echocardiography
- Evaluation of normal and abnormal ventricular function
- Evaluation of the severity of valve stenosis and regurgitation
- Knowledge of normal and abnormal cardiovascular hemodynamics and flow patterns

**Courses:** DMSI 107, 117, 119, 160, 217, 219, and 220

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**T. Outcome: Demonstrate knowledge of normal and abnormal vascular anatomy:**

- Extremity Arterial (upper and lower)
- Extremity Venous (upper and lower)
- Cerebrovascular: extracranial and intracranial
- Abdominal Vasculature: arterial and venous
- Special circulations: arterial and venous

**Courses:** DMSI 110, 111, 150, 210, and 295

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies.

**U. Outcome: Demonstrate knowledge of normal and abnormal vascular physiology:**

- Normal and Abnormal Arterial and Venous Hemodynamics: Flow physics
- Exercise physiology
- Effects of collateralization on Hemodynamics

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**V. Outcome:** Demonstrate knowledge and understanding of vascular physiology, pathophysiology, and hemodynamics in the different types of vascular disease/dysfunction:

- Iatrogenic
- Degenerative
- Inflammatory
- Traumatic
- Neoplastic
- Infectious
- Obstructive
- Congenital
- Metabolic

- Immunologic
- Flow changes secondary to other states, e.g., cardiac diseases, pulmonary diseases, pregnancy, inflammatory diseases, intracranial and extracranial disease, anemia
- Pharmacology

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**W. Outcome: Demonstrate knowledge and understanding of clinical vascular diagnostic procedures:**

- Relationship of vascular diagnostic techniques to patient history and physical examination
- Knowledge of appropriate indications for vascular examination
- Differential diagnosis as it relates to vascular testing and examination
- Vascular surgery and interventional vascular procedures including intravascular ultrasound, angiography, transluminal angioplasty with and without stenting, atherectomy, endarterectomy, patch graft endarterectomy, vein and synthetic vascular bypass procedures as well as embolectomy and thrombectomy, radio-frequency and laser vein ablation, endovascular repair

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**X. Outcome: Demonstrate knowledge of other vascular procedures emphasizing indications, utility, and limitations of these procedures:**

- Angiography
- Venography
- Magnetic resonance angiogram
- Magnetic resonance flow meters
- Computed tomography
- Nuclear medicine vascular procedures

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through discussion boards, written tests, case studies, clinical evaluations, and clinical competencies.

**Y. Outcome: Knowledge of importance and impact of other laboratory values and invasive and non-invasive testing/imaging modalities.**

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, role playing scenarios, discussion boards, peer observations, volunteer evaluation of student lab performance, written tests, case studies, clinical evaluations, and clinical competencies

**Z. Outcome:** Demonstrate proficiency in the performance of physiologic testing (including volume pulse recording, pressure measurements, plethysmography, and stress testing), real-time ultrasound imaging, and Doppler evaluation (pulsed and continuous wave, color and power flow) as relates to the vasculature. Vascular testing proficiency must be demonstrated in the following areas:

- Extracranial Cerebrovascular
- Intracranial Cerebrovascular (transcranial Doppler)
- Extremity Arterial (upper and lower)
- Extremity Venous (upper and lower)
- Visceral Vascular (renal artery, mesenteric/splanchnic, hepatoportal)

**Courses:** DMSI 110, 150, 210, 114, 116, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.

**AA. Outcome:** Demonstrate knowledge and understanding of clinical pharmacology as it relates to vascular evaluation and stress testing:

- Ankle/brachial pressure ratios
- Segmental pressures
- Aorta/renal ratios
- Resistive index
- Pulsatility index
- Internal carotid artery to common carotid artery ratio
- Percentage velocity change across stenosis for grading arterial lesions
- Area and diameter reduction measurements
- Knowledge of normal and abnormal vascular flow patterns and waveform morphology

**Courses:** DMSI 110, 114, 116, 150, 210, 214, and 216

**Assessments:** Assessed through lab training, lab assignments, simulations, written tests, case studies, clinical evaluations, and clinical competencies.