Guidebook for Prospective Students
WHAT IS CARDIOVASCULAR IMAGING?

Cardiovascular sonography refers to noninvasive testing of the heart and blood vessels via ultrasound technology and physiologic testing. Although ultrasound testing is safe, cost-effective, and easily reproducible, it is extremely operator dependent. The Clemson Cardiovascular Imaging Leadership Concentration teaches students the art and science of obtaining and evaluating both echocardiography and vascular sonography images necessary to diagnose cardiovascular disease.

The Career of a Cardiovascular Sonographer

A diagnostic medical sonographer is a highly-skilled professional who uses specialized equipment to create images of structures inside the human body that are used by physicians to make a medical diagnosis. The process involves placing a small device called a transducer against the patient’s skin near the body area to be imaged. The transducer works like a loudspeaker and microphone because it can transmit and receive sound. The transducer sends a stream of high frequency sound waves into the body that bounce off the structures inside. Different structures in the body reflect these sound waves differently. A computer monitor is used to display images of the cardiovascular structures, which are recorded digitally.

Sonographers have extensive, direct patient contact that may include performing some invasive procedures. They must be able to interact compassionately and effectively with people who range from healthy to critically ill. Many sonographers also assist in electronic and clerical scheduling, record keeping, lab accreditation preparation, quality assurance and computerized image archiving. Sonographers may also have managerial or supervisory responsibilities.

The sonography work environment varies between in-patient and out-patient settings, often requiring evening, weekend and overnight call shifts as well as holiday coverage. Some of these settings involve working independently, demanding the sonographer exhibits excellent time management and organizational skills.

In conclusion, the role of the cardiovascular sonographer is increasingly complex and demanding. The sonographer must be capable of performing the approved clinical protocols for each type of examination ordered by the patient’s physician. The sonographer must analyze the patient’s clinical history to identify the purpose of the examination, frame the clinical questions the examination is intended to answer, and expand the examination as necessary to answer those clinical questions.
Cardiovascular Imaging Leadership Concentration Details

On July 31, 2014, the Clemson Cardiovascular Imaging Leadership Concentration received initial Commission on Accreditation for Allied Health Education Programs (CAAHEP) accreditation for education in Adult Echocardiography and Noninvasive Vascular Study. We joined a small nationwide group of accredited undergrad programs and are the only CAAHEP-accredited program to offer cardiovascular sonography training simultaneously within the framework of a baccalaureate degree in public health science. CAAHEP programmatic accreditation ensures a rigorous and dynamic program in full compliance of the standards set by the Joint Review Committee for Cardiovascular Technology (JRC-CVT). To learn more about CAAHEP and JRC-CVT, visit the following sites:

www.caahep.org
www.jrccvt.org

Students are required to meet the requirements set by Clemson’s Department of Public Health Sciences. Cardiovascular Technology (CVT)-specific courses begin sophomore year. During the junior year of the concentration, CVT classes are held at the Greenville Health System’s (GHS) Patewood campus on Tuesdays and Thursdays. Patewood’s Bioimaging lab mimics the clinical area and allows for junior-level students to learn ultrasound scanning techniques they will use during senior year. During the senior year, students rotate through a variety of clinical rotations throughout various GHS medical campuses. Credentialed preceptors mentor students in various settings providing them with enriching, real world experiences and the framework of support and clinical expertise necessary to become proficient in noninvasive vascular testing and echocardiography. Clinical experiences include rotations to the special procedures lab, cath lab, electrophysiology lab and the operating room as well as in-patient and out-patient scanning environments. By the end of the program, students are not only prepared to enter the workforce, they are also able to comprehend the full continuum of care for cardiovascular patients.

Learn more about the Clemson Public Health Department and CV Imaging Leadership Concentration by visiting:

-OR-
http://hsc.ghs.org/cvt/
# Bachelor of Science in Health Science
## Cardiovascular Imaging Leadership Concentration

### 2017_18

Clemson University ● Department of Public Health Sciences

501 Edwards Hall ● Clemson, South Carolina 29634-0745 ● FAX (864) 656-6227 ● (864) 656-5502

## Freshmen Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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<tbody>
<tr>
<td>BIOL 1030 &amp; 1050 General Biology I &amp; Lab I or BIOL 1100 Principles of Biology I</td>
<td>BIOL 1040 &amp; 1060 General Biology II &amp; Lab II or BIOL 1110 Principles of Biology II</td>
</tr>
<tr>
<td>CH 1010 General Chemistry I</td>
<td>CH 1020 General Chemistry II</td>
</tr>
<tr>
<td>HLTH 2020 Introduction to Public Health</td>
<td>ENGL 1030 Accelerated Composition</td>
</tr>
<tr>
<td>Social Science Requirement</td>
<td>HLTH 2030 Overview of Health Care Systems</td>
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## Sophomore Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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<tbody>
<tr>
<td>BIOL 2220 Human Anatomy &amp; Physiology I</td>
<td>BIOL 2230 Human Anatomy &amp; Physiology II</td>
</tr>
<tr>
<td>HLTH 2980 Human Health &amp; Disease</td>
<td>HLTH 2400 Determinants of Health Behavior</td>
</tr>
<tr>
<td>CVT 2260 Intro to Cardiovascular Sonography</td>
<td>COMM 2500 Public Speaking or COMM 1500 Intro to Human Communication</td>
</tr>
<tr>
<td>Statistics Requirement</td>
<td>HLTH Requirement</td>
</tr>
<tr>
<td>PHYS 2070 General Physics I</td>
<td>CVT 2250 Ultrasound Physics</td>
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<tr>
<td>PHYS 2090 General Physics I Laboratory</td>
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## Junior Year

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<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
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</thead>
<tbody>
<tr>
<td>Arts &amp; Humanities (Literature) Requirement</td>
<td>Social Science Requirement</td>
</tr>
<tr>
<td>HLTH 3800 Epidemiology</td>
<td>HLTH 4900 Research &amp; Eval Strategies for Pub Health</td>
</tr>
<tr>
<td>CVT 3250 Echocardiography Principles</td>
<td>HEHD Leadership Course Requirement</td>
</tr>
<tr>
<td>CVT 3251 Echo Prin Lab</td>
<td>CVT 3260 Echocardiography Methods</td>
</tr>
<tr>
<td>CVT 3350 Vascular Sonography Principles</td>
<td>CVT 3261 Echo Methods Lab</td>
</tr>
<tr>
<td>CVT 3351 Vascular Sono Lab</td>
<td>CVT 3360 Vascular Sonography Methods</td>
</tr>
<tr>
<td>CVT 3351 Vascular Sono Lab</td>
<td>CVT 3361 Vascular Methods Lab</td>
</tr>
</tbody>
</table>

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## Summer

| CVT 4240 CVT Intro to Field Experience | 3 |

## Senior Year

<table>
<thead>
<tr>
<th>First Semester</th>
<th>Second Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts &amp; Humanities (Non-Lit) Requirement</td>
<td>CVT 4260 CVS Field Experience III</td>
</tr>
<tr>
<td>CVT 4250 CVS Field Experiences II</td>
<td>HLTH Requirement</td>
</tr>
<tr>
<td>HLTH 4180 CVT Professional Development</td>
<td>HEHD Leadership Course Requirement</td>
</tr>
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Total Semester Hours = **122-125**

1. See General Education Requirements. Six of these credit hours must also satisfy the Cross-Cultural Awareness and Science & Technology in Society Requirements.
2. MATH 1020 or 1060
3. STAT 2100 or 3090
4. Any HLTH course not otherwise required.
5. Students are required to take at least two courses from the HEHD Leadership course offerings: HEHD 4000, HEHD 4100 and HEHD 4200.
6. Notes:
   1. A minimum grade-point ratio of 2.0 is required for registration in all HLTH courses.
   2. CVT-designated classes require a $200/credit hour differential.
   3. Student must meet progression guidelines for each CVT course to remain eligible for next sequential CVT class.
   4. All CVT-designated classes (except CVT2260) are taught at Greenville Health System facilities off-campus.
Student Progression Guidelines

These guidelines provide the framework for students to progress through the CVT Imaging Leadership Concentration. Each area is divided by academic year and shows both co-/pre-requisite as well as course completion requirements. NOTE: Many courses, including all CVT-specific courses, are offered only once per year during specific semesters. All CVT-courses are offered in sequential order.

In addition to the academic criteria detailed below, all CVT-designated courses require a $200/credit hour differential. Additionally, all 3000- and 4000-level courses are taught in a variety of Greenville Health System (GHS) settings requiring personal transportation for the three senior fieldwork courses. Due to the limited availability of clinical sites and the rigors of providing high quality healthcare services, CVT progression is competitive, requiring a student’s best effort at all times.

Freshman Year

In order to qualify for enrollment in CVT2260, student must obtain a cumulative GPA of 3.0 or higher, with a science GPA of 3.0 or higher during freshman year. Student must meet with the CVT academic advisor prior to enrolling in CVT 2260. NOTE: BIOL 1030/1050 or 1100 is offered in the FALL ONLY and BIOL 1040/1060 or 1110 is offered in the SPRING semesters only.

Sophomore Year

Fall Semester: Student must: 1) earn a CVT2260 class grade of 80% or higher, 2) earn a 75% or higher on the CVT2260 final exam, 3) earn a C grade (or higher) in BIOL 2220 and 4) finish in the top 12 of CVT2260 to progress. Should more than 12 candidates meet this threshold, overall numeric course grade in CVT2260 and overall GPA for coursework completed at Clemson University determines progression.

Spring Semester: Student must: 1) earn a CVT2250 course grade of 80% or higher, 2) earn a 75% or higher on the CVT2250 final exam, 3) pass ARDMS SPI credentialing exam*, and 4) finish in the top 8 of CVT2250 to be considered eligible to progress. Should more than 8 candidates meet this threshold, overall numeric course grade in CVT2250 and overall GPA for coursework completed at Clemson University determines progression.

Junior Year

Fall Semester: Student must: 1) earn course grades 85% or higher in both CVT3250 and CVT3350, 2) earn a 75% or higher on the CVT3250 and CVT 3350 final exams, and 3) complete both CVT3251 and CVT3351 scan lab sections with an 80% or higher.

Spring Semester: Student must: 1) earn course grades 85% or higher in both CVT3260 and CVT3360, 2) earn a 75% or higher on the CVT3260 and CVT 3360 final exams, and 3) complete both CVT3261 and CVT3361 scan lab sections with an 80% or higher.

Senior Year

Summer Semester: Student must complete CVT4240 with a score of 80% or higher to be eligible for progression.

Fall Semester: Student must complete CVT4250 AND its associated clinical competencies – ABI w/wo Exercise, Bilateral LE Venous Duplex and Carotid Duplex – with a score of 80% or higher to be eligible for progression.

Spring Semester: Student must complete CVT4260 AND its associated clinical competencies –Bilateral LE Arterial Duplex, Abdominal Vasculature Duplex and Transthoracic Echocardiogram – with a score of 80% or higher to be eligible for progression.

* Students are required to present their ARDMS SPI testing results to the program director prior to attending CVT3250/3251 and CVT3350/3351 in the fall semester of junior year.
CVT Technical Standards

The cardiovascular sonographer is a crucial member of the healthcare team. Their responsibilities are representative of this. Students interested in the CVT Imaging Leadership Concentration must be able to perform certain physical and critical thinking skills. Some items of the listed below, such as CPR, patient assessment, etc., are taught during the concentration whereas physical requirements must be demonstrated by students prior to entering the junior level of the concentration. These professional responsibilities include, but are not limited to:

**Cognitive (Knowledge) Domain:**
- Well-versed in medical terminology
- Possess basic computer skills including data entry, word processing, etc.
- Understand basic mathematical formulas
- Mastery of circulatory anatomy and hemodynamic effects throughout the human body
- Able to obtain and record an accurate patient history
- Organize and accurately perform the individual steps required in a sonographic procedure by following the proper sequence (protocol) within a specified amount of time
- Acquire and analyze technical data obtained using ultrasound and related diagnostic technologies
- Demonstrate independent judgment by recognizing the need to extend the scope of the procedure according to the diagnostic findings during each patient encounter
- Provide an oral or written summary of the technical findings to the physician to aid in patient diagnosis and management

**Psychomotor (Skills) Domain:**
- Lift more than 50 pounds routinely
- Push and pull routinely
- Bend and stoop routinely
- Have full use of both hands, wrists and shoulders
- Work standing on their feet 80% of the time
- Distinguish audible sounds
- Perform patient assessments, i.e. blood pressure measurements, palpate peripheral pulses, etc.
- Adequately view sonograms, including color distinctions and shades of grey
- Assist patients on and off examination tables, in and out of wheelchairs, etc.
- Competent in first aid and certified in Basic Life Support (CPR)
- Competent in obtaining IV access and administration of ultrasound contrast
- Participation in special procedures that require ultrasound guidance such as thrombin injections, pericardiocentesis and other sterile procedures

**Affective (Behavior) Domain:**
- Provide quality patient care
- Interact compassionately and effectively with the sick or injured
- Capable of explaining the purpose of the sonographic examination to the patient and answering patients’ questions (within scope of practice)
- Routinely demonstrate independent judgment and systematic problem solving methods
- Adjust and optimize image settings to produce high quality diagnostic information for the reading/interpreting physician
- Collaborate – both orally and in writing – with healthcare providers, including other sonographers, physicians, nurses, etc.
- Adapt to changes within the clinical setting
- Understand exposure to and involvement in operative procedures
- Practice proper infection control, including precautionary procedures to prevent possible contamination from blood and body fluids
- Remain in compliance of relevant laws regarding patient confidentiality and privacy

Updated February 2017
The content within the CVT Technical Standards was compiled via several professional societies (see list below) and has been reviewed and edited, where necessary, by Greenville Health System clinical personnel (December 2013).

- The Society of Diagnostic Medical Sonographers (SDMS): http://www.sdms.org/career/career.asp

**Tips for Success**

The comments below come directly from recent graduates of the Cardiovascular Imaging Leadership Concentration. They make these recommendations from a place of experience with the intent of assisting new students within our concentration.

- Take as many general education classes as possible before you begin your junior year clinical courses. Save the classes that you can take online, late in the afternoon or evenings for your senior year. See the CVT advisor for class examples.

- Be as involved as possible on campus while you are underclassmen. Try not to take any leadership positions during senior year because you will rarely be on campus.

- The CVT material during the junior year classes may feel challenging, but grads have reported that the subject matter makes more sense once clinicals begin during the senior year.

- Get to know your fellow CVT students and exchange contact information. It can be helpful to carpool during senior and junior year, if clinical rotations allow.

- It is very important to have a car to drive to clinicals during senior year. You can carpool during your junior year, but you will often have rotations by yourself senior year and it is imperative to have a reliable car of your own.

- If possible, set aside money ahead of time to use for gas while driving to clinicals. Students are responsible for their own transportation and gas funds.

- Remember that there is a tuition differential fee for each credit hour for CVT-designated classes. Therefore, be prepared for the additional fees on the tuition bill.

- If at all possible, limit your outside work hours as much as possible. It is hard to do all of the clinical hours and work a part time job. If it were necessary for a student to work, a part-time evening job would be most fitting as clinicals consume 32 hours per week (8:00 am to 4:00 pm Monday through Thursday during the summer, fall and spring semesters of senior year).

- You will get ample time with different preceptors and even physicians. Take advantage of that time. You can learn something different from every single person.

- View clinical rotations as a job interview and remember that the people you are working with could potentially be future employers or references.
I was given the opportunity to enter the Cardiovascular Imaging Leadership (CVT) program my sophomore year. Initially, I viewed the CVT program as an avenue to find my place in the medical field. Through the CVT program, I was given the opportunity to witness and experience aspects of health care that would have otherwise been unattainable as an undergraduate. I was able to spend eight hours a day, four days a week performing echocardiograms and a variety of vascular tests with patients. The CVT program provided me with more hands-on patient care than I could have ever imagined. I remember discovering a vascularized thyroid mass in an asymptomatic patient while performing a carotid duplex and discovering a thrombus in a patient's left atrial appendage while performing a transesophageal echocardiogram, preventing his scheduled cardioversion. Perhaps one of the most inspiring experiences was my senior project. While performing an echocardiogram, I discovered a severely sclerotic aortic valve and possible coronary artery disease. My project permitted me to follow the patient from start to finish—attending every doctor’s visit, heart catheterization, and eventually open heart surgery. I remember entering the OR early in the morning and finding myself a spot at the head of the table for the duration of the surgery, eager to absorb every detail of the CABG and aortic valve replacement surgery. This was the moment I realized my strong interest in medicine became a passion.

These experiences are unique to Clemson’s CVT program. The lessons learned surpass those in a textbook. Through the CVT program I was able to establish a foundation of perspective, respect for others, and work ethic that I will continue to build on each day as I journey to become a physician.

Sarah Taylor, BS, RDCS, RVT – CVT Class of 2014
2nd year medical student, University of South Carolina, School of Medicine, Greenville, SC

This program provided tremendous opportunities for a successful future in the medical field. We were held accountable to give informative presentations based on peer-reviewed journal articles to the Vascular and Cardiology departments, develop teamwork and effective communication skills by performing group-led training programs for the Medical Academy (MedEx) students, as well as establish essential skills needed to determine disease pathology and perform various sonography examinations. We were able to follow-up pathologic findings in a surgical setting and interact with various members of the health care team enabling us to see the critical role each member plays. I am currently in a Physician Assistant program and my professors are amazed at the amount of clinical knowledge I am able to contribute as well as my ability to interact confidently with [patients].

Katie Armstrong, BS – CVT Class of 2015
2nd year student, Physician’s Assistant Program, Georgia Regents, Augusta, GA

Being that Clemson is one of very few schools in the nation to offer a Bachelor’s degree in dual modality ultrasound, I was given a unique opportunity as a student. Rather than sitting in an auditorium-styled classroom and listening to lectures, we were able to have hands-on learning opportunities in a small group setting with one-on-one attention. The partnership that Clemson has with the Greenville Health System (GHS) allowed us the opportunity to work closely with sonographers, lab managers, doctors, and surgeons through clinical experience and surgical shadowing opportunities. The critical thinking skills and work experience that I gained throughout this program prepared me to enter the field of sonography with confidence and all of the tools required to be a successful, healthcare employee.

Courtney Johnson, BS, RDCS, RVT – CVT Class of 2016,
Echocardiographer, St. Francis Hospital, Greenville, SC

The Clemson CVT program played a major part in preparing me for my current position as a Cardiac Sonographer in a busy lab that serves the #1 ranked academic hospital in the state of Illinois and #8 in the nation. Joining such a large, academic hospital as a recent graduate can be very overwhelming. However, my training in the Clemson CVT program more than prepared me for the challenge. One aspect of the program that helped me was the instructors always challenged me to use critical thinking skills to solve problems. There was always the expectation we would not only master the anatomy and pathophysiology related to the cardiovascular system, but also actively
apply that knowledge when working with patients in clinicals. Reading about a disease process is one thing, but actually seeing the disease in clinicals really reinforces the concept.

Another aspect of the program that helped me was the wide variety of clinical sites we trained at (outpatient, inpatient, large hospital, small community hospital, etc). These sites exposed me to many different healthcare professionals in various fields. Being able to interact with pharmacists, respiratory therapists, nurse practitioners, physician assistants, nurses, and doctors demonstrated to me how high quality healthcare requires a team approach. I also saw how my role as a cardiovascular sonographer fit into the healthcare of a patient: it is our diagnostic study that allows the provider to make decisions regarding the care of the patient. If we don’t capture the whole story accurately for that patient, then a diagnosis may be missed resulting in poor quality care.

A final aspect of the CVT program that prepared me for post-graduation employment was mock interviewing and résumé workshops during our final semester. The resume workshops taught me how to craft a resume that grabs the attention of hiring managers. The mock interviews helped me hone my interviewing skills and prepared me to answer questions asked of me when trying to land my first job. Because of the professional development that the CVT program incorporates into its curriculum, I felt confident during every single interview experience I have had received since graduation. As a matter of fact, every interview I have had has resulted in an employment offer. I can only attribute that kind of interviewing success to the training I received from the Clemson CVT program.

*Jarobvey Matthews, BS, RDCS, RVT – CVT Class of 2016
Echocardiographer, Northwestern Medicine, Chicago, IL*
Cardiovascular Imaging Leadership Concentration Disclosures

- Although Clemson University has policies in place for advanced placement and credit by examination for some elementary classes, the Cardiovascular Imaging Leadership Concentration does not offer advanced placement for any of the CVT-designated courses. The lone exception to this rule is credit for CVT2250 if a student has completed (and supplies proof of) the ARDMS SPI exam. SPI exam results must remain valid through expected graduation from the concentration (i.e. ARDMS grants a five year period from the date of SPI exam to take additional technology exams).

- While clinical experience is the cornerstone of cardiovascular sonography, the Cardiovascular Imaging Leadership Concentration does not award experiential credit for any of the CVT courses.

- In addition to Clemson University tuition, each CVT credit hour has an additional $200 tuition differential fee. (For example, a 4.0 CVT course has an additional $800 fee.)

- Scrubs are required by the program and are purchased at the student’s expense.

- Students are expected to have a reliable mode of transportation to attend clinical sites throughout the upstate. Students are responsible for their own gas to these sites. Carpooling with classmates is recommended, but is not always an option due to clinical rotation assignments.

- Once enrolled in the CVT program, students will have opportunities to go to symposiums, conferences, and meetings that may cost an additional amount. (Although these are not mandatory, they are highly recommended for your success in the program and future career in Cardiovascular Ultrasound.)

- The Greenville Health System (GHS) requires all students to complete a background check and computer-based training via HealthStream in addition to providing current proof of certain vaccinations (see vaccination list below) prior to rotating within GHS clinical areas. Typically, the background check costs $35 and the HealthStream set up fee is $15.00. (Fees are reviewed periodically and are subject to change.) HealthStream training covers such topics as blood-borne pathogens, hand hygiene, workplace safety, fire safety, etc. The background check is required for working bedside with patients throughout the system. These activities and fees are due prior to the beginning of the fall term junior CVT courses.

- GHS is accredited by Joint Commission on Accreditation of Healthcare Organizations (JCAHO). In order to fully comply with accreditation standards, GHS requires all students rotating through our system show evidence of the following vaccines:
  - Annual PPD (2-Step if student has not completed this test before)
  - Annual flu shot, due by November 1st each year
  - MMR
  - Varicella vaccine or titer (we cannot accept “history of having the disease”)
  - Hepatitis B series is strongly encouraged, but not required. Please understand you will be exposed to some invasive procedures in the cath lab and operating room during senior year clinical rotations. Since Hepatitis B is a blood-borne pathogen, it is highly recommended CVT students receive the Hepatitis B vaccine.
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Instructor of Record for CVT2250-Ultrasound Physics