During the 2014-15 academic year the Healthcare Genetics (HCG) program continued its successful progression with a total of 21 enrolled doctoral students. All of the first cohort of doctoral students have now graduated and have jobs in academia, one is part-time.

The next wave of students have started to plan the schedule for their comprehensive exams with implementation of the dissertation research study once the exams are successfully completed. This cohort of approximately ten students includes both multidisciplinary and nursing students. One is an Internal Medicine physician from China (interested in pharmacogenomics), four master’s prepared nurses interested in an academic career (interested in genetics education in practice, genetics of obesity, genetics associated with nutrition after brain injury, and elder knowledge ethical issues of consent associated with genetics policy), a student originally from Iran but now a U.S. citizen (interested in breast cancer research), a nurse from India (interested in the epidemiology of Indian-Asian incidence of breast cancer) and three multidisciplinary students with undergraduate degrees in Psychology (one already has worked with a mouse model and an educational study for staff working with children) and two in Biology (interested in working with cell free DNA to answer her research question and the other is focused on leukemia and cytogenetic variants). Many of these students plan to graduate by December, 2016.

The "youngest cohort of doctoral students" are all multidisciplinary with degrees in bioinformatics, biology, bioengineering and nutrition.

Of the students enrolled in the HCG interdisciplinary doctorate (iPhD) three are internationals, two are males and 12 are from disciplines other than nursing. In addition, three of the students are of minority designation. Four Nursing students have completed the master’s level portion of the BS-PhD option designed for nurse educators with one completing as a family nurse practitioner. Two students from outside of South Carolina are taking online program courses to enhance their coursework.

Program recruitment, admissions and progression
Statistics are kept regarding inquiries, accepted versus enrolled students and those continuing in the program. (See the Healthcare Genetics Program Recruitment and Admissions table directly below.) Evaluation and outcome criteria have been established for the HCG program. (See the Healthcare Genetics Program Scholarly Outcomes table below.)

<table>
<thead>
<tr>
<th>Cohorts</th>
<th>Inquiries</th>
<th>Accepted</th>
<th>Enrolled</th>
<th>Continuing Enrollment</th>
<th>Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 08-09</td>
<td>44</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 09-10</td>
<td>16</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year 10-11</td>
<td>18</td>
<td>5</td>
<td>14</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Year 11-12</td>
<td>44</td>
<td>7</td>
<td>21</td>
<td>21</td>
<td>2</td>
</tr>
<tr>
<td>Year 12-13</td>
<td>10</td>
<td>3</td>
<td>21</td>
<td>18</td>
<td>0</td>
</tr>
</tbody>
</table>
To address recruitment, the Student Services Coordinator and HCG faculty plan to meet with various healthcare institutions, schools with Master's degrees, especially those with diverse populations of students. The website is undergoing revision to enhance visibility of the interdisciplinary faculty and partnerships available for doctoral student research.

A new Student Advisory group was developed to provide feedback to faculty about courses, concerns of the students and suggestions to promote the continued recruitment, growth and progression through the program. Based on this feedback the doctoral student handbook was revised to more specifically address needs of students as they move through the program.

The Healthcare Genetics Society (HCGS) is a Clemson University-sponsored student organization that was established in 2011 by Interdisciplinary PhD in Healthcare Genetics (HCG) students. Mary Beth Steck, PhD, APRN, BC is the faculty advisor of this organization. The HCGS, made up of 17 students, meets twice a semester in the evening either at the main Clemson campus or at the University Center Greenville. HCG students that reside outside the Clemson area can access the meetings via Adobe Connect. Each meeting includes a business meeting, followed by an educational program. Additionally, the HCGS meets to plan and implement a seminar on an annual basis.

The 2013-14 annual HCGS seminar held on November 1, 2014 was entitled, "Pharmacogenomics: A key to personalized medicine." Learning objectives for the targeted seminar participants included:

1. Explain the foundation of pharmacogenetics and its relationship to personalized medicine through metabolic pathways and drug metabolism.
2. Describe the future effects of personalized medicine on patient care.
3. Discuss rationale for the use of GINA in clinical practice.

The speakers for this seminar included:

1. Christopher Farrell, PhD, assistant professor, School of Pharmacy at Presbyterian College
2. Mark Watson, MD, PhD, Chief Operating Officer, Gibbs Health Institute at Spartanburg Regional Healthcare System
3. Stephen Dyar, MD, oncology specialist, Upstate Oncology Associates in Greenville, SC
4. Elizabeth Chismark, PhD, RN, CCRC, manager of nursing education, St. Jude Children’s Research Hospital in Memphis, TN
5. Dennis Peffley, PhD, JD, professor of biochemistry, USC School of Medicine in Greenville, SC
6. Barbara Gordon, MD, MS, FACMG, assistant clinical geneticist, Greenwood Genetic Center in Greenwood, SC.
7. Mary Beth Steck, PhD, APRN, BC, assistant professor, School of Nursing at Clemson University.
8. Rebecca Myers, BS, HCG doctoral student at Clemson University
9. Matthew Tedder, BS, HCG doctoral student at Clemson University
10. Anna Chassevent, BA, HCG doctoral student at Clemson University

Attendance was lower than anticipated, perhaps due to the unseasonal snowfall that occurred the night before the seminar. Seminar participants indicated on the evaluation form that the seminar’s

| Year 13-14 | 22 | 2 | 19 | 15 | 4 |
| Year 14-15 | 27 | 5 | 21 | 16 | 0 |
educational goals were satisfactorily met. Ratings and comments included:

1. “Thought speakers were excellent! Seminar was very informative and educational; learned a lot.”
2. “The information presented is/was useful. Unfortunately, the majority of patients who could conceivably benefit from specialized testing are unable to afford genetic testing that insurance is unwilling to pay for.”

Dr. Christopher Farrell speaking with HCG director Dr. Julie Eggert during a break.
HCG doctoral student Matthew Tedder served as the seminar moderator.

Dr. Dennis Peffley describes the applications of PGx testing.
Dr. Elizabeth Chismark discussed the clinical utility of PGx testing for sickle-cell anemia

The 2015-16 HCG annual seminar is scheduled for August 28 and is entitled, "How can I apply genetics in my nursing practice?" A multidisciplinary group of expert speakers and vendors have been invited and confirmed for this seminar. Speakers include:

1. Kathleen Calzone, PhD, RN, APNG, FAAN, Senior Nurse Specialist for the National Cancer Institute at the National Institutes of Health will present on the impact of genetics for nurses.
2. F. Alex Feltus, PhD, associate professor, Department of Genetics and Biochemistry at Clemson University will discuss systems genetics and big data bioinformatics.
3. Human Genetics and Pharmacogenomics will be the focus of Christopher Farrell, PhD, assistant professor, School of Pharmacy at Presbyterian College, presentation.
4. Stephen Dyar, MD, oncology specialist with Upstate Oncology Associates in Greenville will focus on the use of genetics to prevent, detect and target a variety of cancer types.
5. Kevin Busby, Director of Nursing Services at Patrick B. Harris Psychiatric Hospital in Anderson, SC and Clemson School of Nursing Instructor will discuss the genomics of treating mental illness.
6. R. Curtis Rogers, MD, Director of Greenwood Genetic Center in Greenville, SC will speak on the topic of genomics and behavioral pediatrics.

Objectives for this year's seminar include:

1. Understand how genomics and pharmacogenomics impact clinical practice
2. Describe the use of genetic databases in clinical practice
3. Recognize uses of genetics in oncology and mental health.
As this conference grows the HCGs aspires to use the revenue to establish a fund to support student travel and attendance at national conferences. Another goal is to connect students with career opportunities through the HCGs and include more students across disciplines in its membership.

*The Healthcare Genetics Laboratory* in 105 Edwards Hall has been active under the direction of Research Scientist Dr. Pattilee Tate. Multiple research studies using immortalized cell lines have been conducted by doctoral students. Nutraceuticals such as raspberries and saffron are demonstrating the ability to limit cancer cell growth. Another student is using an anti-malarial agent with interesting results. One industrial grant is being finalized for implementation in August, 2015. This will add two research assistant positions for students, providing tuition and a stipend, plus the use of an additional lab in Jordan Hall.

The 105 laboratory is equipped with a BSL-2 laminar flow hood, two double water-jacketed CO2 incubators, Beckman Coulter Allegra refrigerated centrifuge, inverted microscope, refrigerator, -20°C and -80°C freezer, autoclave and Nanopure™ water system. Instrumentation includes Tecan Infinite® M200 series microplate reader, Accuri C6 flow cytometer, BioRad CX96 real-time PCR instrument, pco.Pixelfly digital fluorescent camera, Nikon Eclipse C1 confocal microscope with EZ-C1image acquisition and analysis software. All computers in the laboratory are password protected and assessable by the PI and students. The laboratory is locked at all times and entrance is controlled by badge access.

**Instruction**

Two HCG courses were taught during the 2014-15 academic year plus two electives. These electives (Grant submission taught by Dr. Sara Sarasoa and Pharmacogenomics taught by Dr. Chris Farrell) enhanced the HCG curriculum. All students were required to write a grant proposal and prepare it for submission in August, 2015. The funds from the grants would assist the students to complete their dissertation projects.

The Adobe Connect® technology continues to be utilized as the online format for class. Students access the course from home via computer or mobile technology (or anywhere) and interact synchronously while viewing lectures or making their presentations to classmates and faculty. Break-out sessions are available online where the faculty can move between the groups to facilitate discussions and respond to questions without leaving the virtual classroom though private sessions are also accessible for individual questions. Other internet resources such as You Tube are incorporated to engage a variety of learning styles.
A whiteboard is available for students or faculty to make notes and develop directions for student to follow during the weekly class time. Some classes have been recorded and available for download to MP3 players, iPods, iPads or home computers. Pre-course preparation is completed following a typical syllabus outline with expanded discussion of technological requirements and accessibility instructions. The goal is for all courses in the HCG program to be available via all or a portion of the noted technology so students from other states and internationally can participate in this original doctoral program.

Innovation and Collaboration

The HCG faculty have been working closely with the Greenwood Genetic Center (GGC), Upstate Oncology Associates with St Francis Health System, Greenville Hospital System (GHS) faculty and staff to collaborate in courses, research, clinics and innovative projects that will offer better health to the people of SC. This academic year, two courses (Advances in Healthcare Genetics and Applications of HCG to Medical Genetics) were taught in conjunction with faculty from these institutions.

Drs. DeLuca and Eggert work in clinics (Metabolic and Inherited Cancer Genetics, respectively) to provide examples of cases that can be reviewed (without identifiers) to facilitate the understanding of genetics in the healthcare setting. The new inherited genetics clinic has opened over the Summer, 2015 in the Sullivan Center in Edwards Hall. Students work with the faculty to analyze family history of cancer, learn focused assessment and provide education to the patients in order to help prevent or access early detection of cancer for the patients and/or their loved ones.

Scholarship

During 2014-15 doctoral students provided peer-reviewed presentations including national/international podium with poster presentation at the international, national and regional/local levels. See the Appendix for a detailed list.

Dr. Eggert was recently funded to implement the second year of the research study with GGC faculty. Drs. Chaubey and Friez to develop Next Generation Sequencing targeting specific high risk cancer susceptibility genes. One outcome for the information obtained will be to answer questions regarding breast cancer and leukemia in diverse populations of women in SC. Two doctoral students have been funded as research assistants to help collect data and learn the research process. Another student will use some of the data for her dissertation.

<table>
<thead>
<tr>
<th>Year</th>
<th>Publications</th>
<th>Posters</th>
<th>Podia</th>
<th>Scholarships</th>
<th>GTA/RA</th>
<th>Creative</th>
<th>Grant Funding*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 08-09</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 09-10</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 10-11</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>1 (3)</td>
<td></td>
</tr>
<tr>
<td>Year 11-12</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 12-13</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>1</td>
<td>6</td>
<td>2 (4)</td>
<td></td>
</tr>
<tr>
<td>Year 13-14</td>
<td>14</td>
<td>11</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>1 (3)</td>
<td></td>
</tr>
<tr>
<td>Year 14-15*</td>
<td>10</td>
<td>17</td>
<td>6</td>
<td>5</td>
<td>/2</td>
<td>4</td>
<td>2* (1)</td>
</tr>
</tbody>
</table>

*Please see Appendix for a detailed list of 2014-15 outcomes.
Four groups of *Creative Inquiry* (CI) research projects in the HCG program incorporated direction from doctoral students. This unique approach to research utilizes a path to academic and personal discovery. It’s small group learning for all students with the unique combination of engaged learning and undergraduate research with the addition of doctoral students as members of the CI team. This enhances the doctoral student’s research and teaching experience while working with undergraduates from multiple disciplines. This multidisciplinary approach is now encouraged by the National Institutes of Health and other funding agencies in order to answer research questions that require knowledge from more than one specialty.

The CI topics were identified through discussion with a professor and the doctoral students to create a challenge or from the pressing concerns associated with breast cancer and leukemia incidence in SC. These team-based investigations were supervised by a faculty mentor with leadership from the doctoral students. The projects ranged from two to four semesters. The students took ownership of these projects and will participate with retrospective chart review and some laboratory research in order to solve the specific aims of their research.

Three CI groups had posters accepted for presentation at the undergraduate conference. The undergraduate students under direction of the doctoral students are finalizing their manuscripts for publication. (See the Appendix)

**Awards and Recognition**

The 2014-15 HEHD Outstanding Doctoral Student was awarded to **Sourat Darabi**. Ms. Darabi is a PhD candidate for December graduation.

**Katie Andrews and Elizabeth Hassen** received recognition as second year recipients of the Jonas Nurse Leader Scholars awards to support educational development a potential new nursing faculty and to learn to stimulate models for joint faculty appointments between schools of nursing and clinical affiliates. The grants, made through institutional awards, also prepare doctoral candidates to help students address the needs of future patients – from dealing with comorbidities and chronic illnesses to providing culturally competent care. Less than 300 doctoral students received this award nationally.

**Scott E. Moore** was named a Fellow with the Geriatric Nursing Leadership Academy (GNLA) Cohort IV. Funded by the Hearst Foundations and Hill-Rom, Inc., the GNLA is the premier leadership development opportunity for nurses with a dedication to work with elders in order to improve their health outcomes. The GNLA Fellowship offers grantees a stimulating, intense and professional life-changing experience. The purpose of the academy is to prepare emerging nurse leaders, through individualized leadership development, to lead and motivate multi-professional teams in order to improve health care quality for older adults and their families. Mr. Moore’s focus is on elder decision-making in the ever changing world of genomics in medicine.
In addition, Mr. Moore continues as the 2013-1017 the Betty Cecil Family scholarship recipient for incorporating genetics into the advancement of healthcare for older adults.

**Angela Wu and Matt Tedder** presented their research topics at the “3MFlash Talk” during the HEHD spring research forum. **Matt** received the 2nd place designation. They both did an excellent job!

The HCG doctoral program has continued to educate the students to become providers, educators and researchers through the application of genomics into healthcare. This year the new inherited cancer clinic was added through the Sullivan Center in Edwards Hall to enhance the education of the HCG students via the Interventionist pathway. Four students utilized the bench laboratory experience to answer their research questions at the molecular level. At least two of the studies suggest promise for application into “clinical practice.” All students incorporate their genetics knowledge in their discussions and education of patients, students and lay persons.

Finally, three students have taken their Comprehensive Exams over the past 12 months. The topics of their research will focus on “Correlation of genetic variants of breast cancer with the aggressive markers of tumors”, “considering cell free fetal DNA testing: Decision making processes of women” and, “Phenylalanine hydroxylase deficiency: The effects of Kuvan treatment on body mass index and biochemical measures.” All three hope to complete their dissertation research and graduate by May, 2016.

Submitted by Dr. Julie Eggert, PhD, GNP-BC, AGN-BC, AOCN, Professor and Coordinator of Doctoral Program

FOR THE APPENDIX:

Research:
Externally funded project:

Darabi, S., Tedder, M., Chaubey, A., Friez, M. & Eggert, J. Collaborative Oncology Testing: A New Model for South Carolina. Second year funding by Self Regional Hospital ($200,000/year).

Creative Inquiry:

Chassevent, A., Darabi, S. & Eggert, J. Breast cancer and ethnicity. (Fall, 2014-Spring, 2016)
Undergraduate Students: Coggins, K., Few, A., Kalley, C., Wingo, C.

Darabi, S., Chassevent, A., & Eggert, J. Breast cancer and Mammography (Fall, 2014-Spring, 2016)
Undergraduate Students: Sloger, H., Geer, W., Powell, C, Inglesby, D., Peterson, M., Erickson, S., Thomas, S., Tyler, L.

Creative Inquiry:

Moore, S.

Undergraduate Students: Jackson, M., O’Brien, M., Reiner, B.

Publications:


Chassavent, A., & Chismark, E. Implementing genetics into primary care through the Patient Protection and Affordable Care act. Policy, Politics, & Nursing Practice. Submitted for publication, pending review.


Wu, B., Eggert, J., & Alexov, E. [Accepted]. Molecular mechanisms underlying pathogenic missense mutations. eLS.

**Podium Presentation:**


**Tedder, M.** (November 1, 2014) Pharmacogenomics in Cardiology. Healthcare Genetics seminar, “Pharmacogenomics: A key to personalized medicine.” Greenville, SC


**Wu, B.** (April 23, 2015) Translating individual differences to personalized medicine in Hydrocodone use. Three minute Flash Talk, HEHD Spring Research Forum, Clemson University, Clemson, SC.

**Poster Presentation:**


Comment [JAE7]: Waiting on confirmation and formal reference.


Darabi, S., Tedder, M., Chaubey, A., Basehore, M., Abidi, F., Friez, M., Eggert, J., (June 22, 2015). Collaborative Oncology Testing: Development of an Interdisciplinary Team to Create a Tool for Precision Medicine in South Carolina. Festival of Genomics, Boston, MA.


Hassen, E., Lowe, T., & Eggert, J. (November 7, 2014) Assessment of Faculty Genetics Knowledge. 2014 International Society of Nurses in Genetics (ISONG), Scottsdale, AZ.


Myers, R.L. & Eggert, JA. (March 24, 2015). Clinical relevance of consumption of artificial
sweeteners on obesity and type 2 diabetes. Poster session presented at the American College of Medical Genetics conference, Salt Lake City, UT.

Myers, R.L. & Tate, P. (April 23, 2015). The effect of aloe emodin on the growth of two breast cancer cell lines. Poster session presented at the Clemson University HEHD spring research forum, Clemson, SC.
