KNOWLEDGE RETENTION ACROSS CURRICULAR MODELS

AN INTERNATIONAL COLLABORATION

The Department of Anatomy and Regenerative Biology and the SMHS Center for Faculty Excellence

The George Washington University School of Medicine and Health Sciences

THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

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Introduction by Rosalyn A. Jurjus, MD, PhD

In the anatomical disciplines, the knowledge retained from the preclinical courses decreases with time, which creates a significant gap in knowledge between the preclinical and clinical years of medical school. However, with the proper introduction of refreshers or modules before basic surgical specialties, the information recalled and retained can improve to reach appropriate levels. These refreshers, using multiple learning strategies, have proven to be effective in filling the gaps identified in the obstetrics and gynecology specialty.

I started research collaborations with various departments at the George Washington University (GW) School of Medicine and Health Sciences (SMHS), particularly the departments of surgery, and OB/GYN. With the support of a grant I received from the GW Office of the Vice Provost for Teaching and Learning as part of the Spring 2013 Grants for High-Impact Teaching and Learning Practices, I was able to conduct a study on retention of anatomical knowledge in the clinical years and build a trial integrated curriculum for both OB/GYN and surgery. This approach required significant cooperation between the clinical and basic science faculties and the flexibility of the curriculum committee. I detailed this work in a recent interview with *Anatomy Now*, the official newsletter of the American Association of Anatomists. The work is continuing, and two articles from this project have already been published. Currently, I am working on the third and fourth phases of the project in an international comparative study on curricula and retention. We received a GW SMHS Medical and Health Science Education Research Grant that helped make this symposium and its proceedings possible.

I am testing the hypothesis that **integration across the curriculum will improve the anatomical knowledge of medical students entering surgical rotations.** The goal of the new phase of the study is to evaluate the impact of anatomical knowledge retention in different curricular models. This is a **comparative analysis using quantitative methods that evaluate student outcomes as well as student self-efficacy and confidence in applying anatomical knowledge to the clinic.** This study will provide additional quantification and assist in establishing the generalizability of findings, which thus far have only been measured at one institution. We started measuring outcomes at four other institutions and we hope to expand in the future. The research will help address knowledge gaps during clinical years. It also promises to have widespread implications for medical school curriculum reform, with data possibly affecting decisions about basic science nesting in clinical rotations in various curricular models.

This symposium features research that has been on-going for the past six years to understand and enhance medical students' retention of anatomical knowledge. The work to date has included a cross-disciplinary team of six faculty and eight students, and produced two published papers, one interview media article, 16 abstracts (five platform oral presentations, 16 poster presentations, and four awards) and two websites of learning modules. Colleagues from Australia, Ireland, Italy, and Lebanon

who are joining the exploration of the knowledge retention strategies in their varied curricula will discuss their models and retention issues.

Learning Objectives: *By the end of this symposium, attendees should be able to*:

- recognize how a research agenda is initiated and develops over time;
- discuss different curricular models and the general implications for knowledge retention;
- discuss different models of teaching the anatomical disciplines and the specific implications for knowledge retention; and,
- describe key features important to building international education research collaborations.

Presenters

Rosalyn Jurjus, MD, PhD

Department of Anatomy and Regenerative Biology, SMHS, Chair

Rosalyn Jurjus, MD, PhD, is an associate professor of the anatomy and regenerative biology at the George Washington University (GW) School of Medicine and health Sciences (SMHS). She earned her MD from the American University of Beirut and her PhD from the GW. She teaches three anatomical disciplines (gross anatomy, histology, and embryology). She serves as director of the GI/liver block, director of the histology and embryology disciplines, and assistant director of the Pre-Medicine Graduate Programs in Anatomical and Translational Sciences (GCATS and MATS). She shifted her main research focus over the last six years towards outcome investigations of medical education.

Abdo R. Jurjus, PhD

Department of Anatomy, Cell Biology, and Physiology, The American University of Beirut, Lebanon

Abdo Jurjus, PhD, has served as a professor of anatomical sciences at the American University of Beirut for almost four decades. He has served as an professor of anatomy and regenerative biology at the George Washington University School of Medicine and Health Sciences for 20 years, and as adjunct professor at the University of Palermo for almost a decade. His main research interests include inflammation, burn wound healing, colorectal cancer, IBD, cardiovascular diseases and HIV/AIDS. Jurjus is a member of many professional societies (including the American Association of Clinical Anatomists, the American Society for Cell Biology, and the New York Academic Sciences). He is also the founder of many professional NGOs, such as the Lebanese Health Society, Lebanese AIDS Society, Lebanese Hypertension League, and the Lebanese Association for the Advancement of Science. Jurjus is also the author of more than 100 peer-reviewed journal articles and a number of books. He is well cited in the literature. He has deep interest in medical education and in the history of medicine.

Jihad Hawi, PhD

Faculty of Medicine and Medical Sciences, Department of Biomedical Sciences University of Balamand, Lebanon

Jihad Hawi, PhD, serves as assistant professor at the University of Balamand Faculty of Medicine, Lebanon. He received the bachelor's and master's degrees from the American University of Beirut, and earned a PhD in cardiac anatomy and physiology from Bristol Cardiovascular, University of Bristol, United Kingdom. Hawi worked as human gross anatomy lab supervisor in the Human Morphology Department, at the American University of Beirut from 1984 to 2001. In 2001, he joined the Faculty of Medicine and Medical Sciences at the University of Balamand, where he serves as a course director of human gross anatomy. His research interests include characteristics and protection of hearts and myocytes isolated from mice fed a high-fat diet, as well as the effect of pravastatin on these mice. Hawi is interested in human anatomic variations where he has several publications. He is a member of the American Association of Anatomists and the American Association of Clinical Anatomists.

Angelo Leone, PhD

Department of Experimental Biomedicine and Clinical Neurosciences, Section of Anatomy, BIONEC, University of Palermo, Italy

Angelo Leone, PhD, has served as professor of histology and embryology at the Medical and Dental School in Palermo – Italy since 2001. In 2009, he served as visiting professor in the Craniofacial Department of King's College, London, and is a member of the International Scientific Associations and fellow of the British Academy of Higher Education. His research centers on the effects of orthodontic traction on human dental pulp; expression of some odontogenic genes in stem cells, salivary glands, teaching histology, and embryology in modern time; and online teaching.

Mutahira Lone, MDPH, MFD, BDS

Department of Anatomy and Neuroscience, University College Cork, College Road, Cork, Ireland

Dr. Mutahira Lone is currently a lecturer at University College Cork (UCC) and teaches several modules to Graduate Entry Medical students and Dental students. These include gross anatomy, neuroanatomy, histology, embryology, oral anatomy and oral histology. She received her dental bachelor degree from Karachi University, Pakistan with honors. After moving to Ireland, she completed all required examinations and became a member of the Royal College of Surgeons and Physicians, Ireland.

After several years of practicing dentistry in private clinics and the dental hospitals, she started teaching anatomy after which she completed a Masters in Dental Public health at UCC. Dr Lone has been involved in teaching in the anatomy department, UCC since 2004 to a wide cohort of students. In 2014, she joined the department as a Senior Medical Demonstrator and started investigating innovative ways to teach anatomy to dental students which she compiled into a PhD.

Gisela Butera, MLIS, MEd

Reference Instructional Librarian

Gisela Butera, is a reference and instructional librarian at Himmelfarb Health Sciences Library and an adjunct instructor of medicine at George Washington University (GW) School of Medicine and Health Sciences. She began working at SMHS in 2007 and currently teaches first- and second-year medical students in the clinical skills and reasoning course. She serves as a liaison to the Milken Institute School of Public Health at GW and is embedded in the master's and doctoral online nursing programs at the GW School of Nursing. Her research interests include medical curriculum, adult learning, distance learning, evidence-based practice, social media, e-professionalism, and public health. She received her Master of Library and Information Science degree from the University of Pittsburgh and a Master of Arts in Education and Human Development in Organizational Leadership and Learning from the George Washington University. She also holds a certificate from the GW Graduate School of Education and Human Development's Master Teacher Leadership Development Program.

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Articles

Participating in Interdisciplinary Research:

The Role of a Librarian

Gisela Butera, MLIS, MA

Reference Instructional Librarian
Himmelfarb Health Sciences Library, The George Washington University

The Strengths of an Interdisciplinary research team - *The librarian role*

Background

Opportunities to share knowledge, information and expertise across disciplines are one of the primary incentives researchers engage in an interdisciplinary research team. The benefit of interdisciplinary research allows groups to move away from working in silos within their field and toward a collaborative integrative working model (Goodman, 2006; Lakhani, Benzies, and Hayden, 2012). Working in teams of diverse subject fields helps to address knowledge gaps and allows for different perspective of interpretation and analysis of findings.(Doherty, 2013).

The Integrative Curriculum of Anatomical Sciences IRB study intended to address medical students' gaps in retention of anatomy during their obstetrics and gynecology (OB/GYN) and surgical clerkship rotations. The study created interactive e-modules to help students review and test their anatomical knowledge. Students also participated in a hands-on laboratory session to strengthen and reinforce the content of the e-modules.

Interdisciplinary Research Teams:

The study was developed with the strong collaboration from several disciplines of faculty from a variety of departments within The George Washington (GW) School of Medicine. In addition to faculty from the departments of anatomy, OB/GYN, and surgery the research team also included the expertise of a medical health science librarian. Studies have shown that the role a librarian working jointly with the research team adds not only research support conducting literature reviews but specialized technical expertise and best practices (Garca-Milian et al., 2013; Lorenzetti and Rutherford, 2012).

Role of the Librarian – *Technical and Research Support*

In 2013, the principal investigator (PI), reached out to GW Himmelfarb Health Sciences Library inquiring on technical assistance with creating modules. The PI also asked for assistance into exploring if the modules could be hosted online for easy access to medical students. As a medical librarian I joined the research team and worked closely with the PI to help provide technical and research support to try to address some of the issues.

Creating Interactive e-Modules

To help create the modules, the suggestion was to use Camtasia. Camtasia is a fairly user-friendly software, produced by TechSmith allowing users to create and record video tutorials using screencast and a plugin for Microsoft PowerPoint. Camtasia is a software the library owned and both faculty and students are permitted to checkout laptops with the software to work on projects. The library also provides technical training and support of the software to each research team member tasked with creating and editing the e-modules. The software is ideal for producing educational learning e-modules, where the research team could customize the modules, upload anatomical images and insert labels. An important feature Camtasia delivered was the ability to created quizzes at different intervals of the modules. The study required following the principles of adult learning and the interactive quiz feature allowed for students to engage in a self-study using the modules to reinforce or learn clinical anatomy material. Camtasia also could generate reports of users responses and the data collected was emailed to the PI to help provide analysis on the effectiveness of the modules.

Creating a Private Research Study Webpage

The IRB study demanded that the data collected was to be limited to only those medical students who were in their OB/GYN and surgical rotations. Therefore, one of the key dilemmas the research team encountered was how to make the e-modules easily available online while keeping the site closed to only the medical student participants. The library has access to LibGuides a content management and multi-media information sharing system produced by Springshare. The LibGuide platform allows you to create a webpage and easily organize content as well as upload video, audio, and links. The librarian created and maintained the site working closely with the PI and research team in the design and content. The end result was the creation of portal that was easy for users to navigate and where all of the e-modules were hosted and accessible to the study's participants (Jurjus and Krapf, 2014; Jurjus and Lee, 2014).

What made it ideal for the study is that a LibGuide webpage can be published to a "private" setting. This limited access to the site through invitation only when shared privately via a link. Once the e-modules were created, the librarian uploaded each onto the LibGuide web page. The Integrated Curriculum: Anatomy OB/GYN site included nine e-modules and the Integrated Curriculum: Anatomy Surgery site had a total of six e-modules.

The librarian worked with the research team to brand the site creating an "Integrated Curriculum Anatomical Sciences" logo for the surgical and OB/GYN websites. The site included a table of content of all of the e-modules along with acknowledgement of the grant funding received for the research.

Navigating Copyright

A great deal of hard work went into producing the e-modules. The e-modules relied heavily on anatomical images and the librarian was responsible in working with the researches helping them navigate copyright to ensure that the images used were properly cited and free to use for educational purposes. The web site also included a "creative commons" copyright license statement providing clear restrictions on the usage of the content of the site. The copyright prohibited non-commercial use, no derivatives (no modification or distribution of the material) of the web site. It also demanded that if used or linked to the site attribution must be included providing appropriate credit to the creators.

Conclusion

Medicine is a team sport, and research teams benefit from engaging in a culture of diverse disciplines. Librarians who have experience engaging in scientific research can play a major role as information specialist providing literature reviews, publishing support as well as technical expertise to the team.(Lorenzetti and Rutherford, 2012). The research team librarian played an integral role in helping the study from the onset with the technical and logistical support of creating the e-modules and web site. The initial study results was published in 2016 and, after publication, the decision of the PI was to allow the e-modules site to be open to the public allowing access to all of the materials (Jurjus et al., 2016).

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Eye Witness for Half a Century of Anatomy at the American University of Beirut: *The Oldest and Permanent Science*

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Establishment of the School of Medicine at the American University of Beirut

Since its inception in 1867, one year after the establishment of the "college', the AUB in 1866, the school of medicine (SOM) started teaching in Arabic until 1883, when English became the main language of instruction. In this pre-Flexner's Era, the medical program, a 4-year program, was shaped very closely according to Harvard medical program in the USA. The basic medical sciences (anatomy, histology, biochemistry, physiology and pharmacology) were taught as courses by professors from other schools in the university or by practicing physicians in various clinical disciplines, until 1925, with cadaveric dissection. For example, John Wortabet, an American missionary and a trained pathologist, was the professor of Anatomy and Physiology (1867-1882). He wrote an Arabic version of Gray's Anatomy and adopted it in his teaching (Khouri, 2010; Jurjus, 2013; Kronfol, 2017).

The courses followed the standards of the Council on Medical Education of the American Medical Association, whereby, the above disciplines constituted the essence of the teaching of medicine since 1867. In 1926 these disciplines were first organized, in line with Flexner's report 1905, into the three departments of: (1) Anatomy, (2) Histology, and Neuroanatomy, and (3) Physiology. In 1967, the departments of Anatomy and Histology were merged together into the Department of Human Morphology until 2010 where the name was changed one more time into Anatomy, Cell Biology and Physiological Sciences to include: Anatomy, Embryology, Histology, Neuroanatomy, Cell biology and Physiology. Al through these changes Anatomy has retained its prominent value and its identity for 150 years, so far, in the school of medicine. It has been and still is a corner stone in the medical curriculum (Flexner, 1910; Kronfol, 2017).

In 2012, almost a hundred years after Flexner's report, reforms were introduced to the medical curriculum which was transformed from a discipline based into an integrated organ-system based curriculum. Amidst these reforms, Anatomy now called "Clinical Anatomy" maintained its integrity as a single course of 165 hours with cadaveric dissection being considered as the main source of information along with an array of adjunct resources including radiographic anatomy, with more stress on competencies to be acquired by students.

Hereby, is a description of the various major developments regarding the teaching of Anatomy at the AUB with a focus on the present status.

Eye Witnessed Changes

The teaching of Anatomical Sciences at the American university of Beirut followed grossly the major trends adopted in the American medical schools. For almost half a century at the AUB, since my first Embryology and Comparative Anatomy courses in 1971-72 and my Human Anatomy course in 1973, I eye witnessed major changes in the teaching of Anatomy at the SOM. They were tailored to a great extent by the professor/ director of the course, but the essentials remained compatible with the major trends in the USA.

Pre Flexner Era: *Chaos*

It is well documented that, medical education in the US started in 1765 in Pennsylvania almost a hundred years before the AUB. Then, in the US, medical programs proliferated and mushroomed in a chaotic fashion. Despite the chaotic situation in the US, the teaching at the AUB School of Medicine was already organized into disciplines along the Harvard model. During this period of early medical education in the US, Anatomy by itself constituted most of the preclinical education

(Bardeen, 1905; Flexner, 1910; Neame, 1984; Rappleye, 1932). The same applies to the AUB, about 1000 hours, on the average, for Anatomy.

Flexner Era: *Order*

At the introduction of Flexner's reforms, early in the 20th century, major changes took place by implementing the Flexner's recommendations. Starting 1910; the preclinical and clinical studies were separated into 2 preclinical and one clinical years plus one year internship. Other basic science disciplines were given more space in the preclinical curriculum at the expense of Anatomy which was reduced in time. A report by the AAMC in 1909, Anatomy occupied about 20% of the medical curriculum: About 800 hours of lectures and laboratories on the average. Some schools had 1000 hours of Anatomy Instruction (Bardeen, 1909).

Another report by the AAMC in 1923 recommended that the time devoted to Anatomy should be restricted to an average range of 471-814 hours (Reid, 1931). Moreover, in 1927, a proposition came out to integrate the curriculum which the AUB did not adopt then. In this integration, anatomy teaching was suggested to be vertically integrated in all 4 years of medical curriculum and restricted to 566 hours. Such integration included: Gross and microscopic anatomy in year one, Topographic anatomy in year two, and Clinical anatomy in years three and four; incorporated into Medicine and Surgery Clerkships. This innovative proposition was not widely accepted and had no real impact on the teaching of other basic sciences (Zapffe, 1927; Moxham, Plaisant, Smith, Pawlina, & McHanwell, 2014) . In 1931, another report was published showing that the average time allocated to teaching Anatomy was about 780 hours with a range of 480-1185 hours. During this period, in 1926, the School of Medicine at the AUB continued to follow the same discipline based pattern by forming 3 departments of basic sciences and divided clearly the program into 2 preclinical and 3 clinical years, the last year being a year of internship in compatibility with the Lebanese Law.

Later on, in the late sixties and early seventies, the teaching of anatomy remained discipline based in most medical schools in the US and Canada, with a handful of schools that started pilot case-based curricula. They introduced early clinical exposures with case-based integrated basic and clinical sciences teaching (e.g. McMaster and others). The average anatomical teaching hours, was then about 465 hours for the Gross Anatomy.

During that period, I was a student taking the Anatomy course the AUB. Then the course consisted of 300 hours, almost 100 hours of lectures and 200 hours of dissection.

The 80s

With the great expansion in medical science research in the seventies, more space was needed in the curriculum for the various mushrooming sub disciplines of: Cell Biology, Molecular Biology and Biochemistry, Immunology and more Physiology and Pharmacology, in addition to a vast array of microbiological sub disciplines. At the same time, new public health concepts emerged including the Alma Ata declaration of 1978 on primary health care by the WHO, which deviated the focus on the medical graduate to be an undifferentiated primary care physician (Carraccio, Wolfsthal, Englander, Ferentz, & Martin, 2002; Sugand, Abrahams, & Khurana, 2010).

During this time, the teaching hours of Anatomy at the AUB, gradually decreased. Except for the introduction of some clinically oriented lectures, x-ray readings, and case discussion in the early eighties, traditional teaching methods prevailed. In the US and the AUB, complete separation between the various disciplines was strongly maintained through the restructuring of departments and divisions within the Medical School. The average teaching hours for Anatomy during this period, in the US, reached the average of 320 hours. Anatomy lectures were still going to the greatest possible details using text books like Gray's Anatomy with a supporting dissection laboratory and a locally made detailed comprehensive dissector guide.

In the late eighties and early nineties , the transitional period in the US continued with the same trend of decreasing Anatomy teaching hours; less lectures which became more clinically oriented, and less voluminous textbooks were used like: The Clinically Oriented Anatomy of

K.L. Moore, Kraft or Grant's & Snell and other similar books. Dissection of the cadavers continued with more questions about the need to focus on the essentials and on the more clinically relevant structures.

Transitional Period: *The wake of the new century*

During the transitional era, any integration with clinical instruction was not favored among preclinical teachers and even sometimes students (McLaren, 1980). However, such an attitude changed with time, despite the fact that classically trained anatomists felt uncomfortable trying to put their teaching into clinical contexts (McCrorie, 2000). I believe that such a transition has discouraged many faculty members from going through this change. Consequently, there were much less anatomists. The size of the anatomy course shrunk more to reach the average of 210 hours by early nineties. The AUB maintained this decrease trend with a course of 242 hours (32 lectures and 210 laboratory dissection)

In the mid 90s, I had the chance to do a sabbatical year and teach Anatomy in the USA. I got more exposed to the curricular changes taking place then. During that period, Medical Curricula began a wave to change from a conventional, discipline-based approach to an integrated organ-system multidisciplinary approach (Ling, Swanson, Holtzman, & Bucak, 2008; Schmidt, 1998). During the late nineties and on, more clinical relevance and clinical correlations as well as radiographic anatomy were introduced into the teaching of anatomical sciences. Such a move is well documented by the contemporary editions of anatomy resources: books and atlases. They included a large share of clinical scenarios and clinical correlation in addition to radiographic anatomy stressing the normal. Radiology started being part and parcel of the anatomy teaching and it invaded stepwise the textbooks and atlases at the turn of the new millennium. Some schools even opted to teach fully integrated Anatomy without a structured separate course. Other schools opted to maintain a stand-alone separate course of Anatomy while integrating the various organ systems. Still others opted to have the two options by teaching a separate course for parts of anatomy (Upper Limb, Lower Limb, back and Head + Neck) and integrate the rest in the organ systems courses. At the AUB, since1997, radiology was introduced in a well-structured regional approach through a complete interactive computerized program in addition to radiology regional lectures and reading of x-ray films.

The New Millennium: *First decade*

In the US, the introduced curricular changes raised concern by the AAMC in 2001, particularly over the decrease in teaching time dedicated to basic biomedical sciences, including Anatomy. At the same time, professional anatomical societies in the USA (AAA and AACA) suggested the contents in Anatomy for an optimal modern curriculum. It included clinical lectures and case discussions in addition to a thorough regional dissection of the essentials including common anatomical variations. Their aim was to maximize learning from a compact course within the recommended framework of 4 years. Similarly, the Anatomical Society of Great Britain and Ireland suggested similar recommendations. They all stressed the need to involve cadaveric dissections and/or prosections preferably guided by demonstrators. They also recommended optimal contents including clinical and radiologic components. They also agreed on a series of recommendations including: active observation and participation in cadaveric dissection, understanding of 3-D structures, curiosity for self-exploration, promotion of psychological development and attitudes towards professionalism and ethics, promotion of teamwork and skills. They consequently defined competencies required for an MD graduate.

Moreover, the societies recognized the educational use and value of other adjunct resources like: Plastinated Specimens, Interactive Media, Medical Imaging, Surface and Clinical Anatomy, Virtual Simulation, and Plastic Models…

However, In 2009, the AAMC, looking into the scientific foundations for future Physicians, continued to voice concern that basic science education needed to be up to date and stronger. They advocated movement from a stationary list of courses to a fluid set of scientific competencies centered on learner performance and meeting society's health needs (Association of American Medical Colleges, 2009).

Toward the end of the first decade of the 21st century, the status of Anatomy teaching can be summarized as follows: the largest number of medical schools maintained Anatomy as a standalone course, most of them use the regional approach, the average length of the course was about 150 hours with a range between 56-231, the average lecture hours was 43±19 (range 0-78) and the average number of laboratory hours was 94±29 with a range of (20-160).

During this period, at the AUB we followed the same trend with a total of 220-240 hours of teaching including about 40 lectures hours.

The New Millennium: *After the first decade*

By the end of the first decade of the 21st Century, there were again many driving forces behind curricular reforms in the direction to decrease weekly contact hours, giving more time for self-learning; increase subject matter integration; increase clinical exposure in the early years of medical school; make use of the large array of information technology resources and technological advances. In brief Anatomy time, contents, and strategies changed to accommodate such reforms.

In Parallel, new teaching strategies were available and judged to be useful in replacing the classical lecture based presentation. Such new trends promoted interactive and small group learning. Small group interactive sessions were encouraged and favored to acquire the competencies indicated: e.g. Case-based discussions, Problem-based learning, Team-based learning as well as others.

In the US, laboratory experience remained the major component in at least 63% of the schools. Regional approach is followed in 94% of courses, with Anatomy as a separate course in 71%, and Cadaveric experience in almost all schools (65%student dissection, 25% combined dissection and prosection). The average course length including student dissection was about 150 hours (Drake, 2014; Hirt & Shiozawa, 2013).

In brief, there was a progressive change from 1955 to 2009 over a period of 50 years. Actually, there was more than 55% decrease in total course hours used to teach gross anatomy. However, it is now plateauing. It would appear that any further significant reductions in course hours will probably come at the expense of students' dissection experience.

In 2016, the AAMC reported that out of a total of 136 Medical schools participating (US and Canada), 132 Medical schools use cadaveric dissection for gross anatomy Instruction. In addition, 119 (88%) use Prosection, 68 (50%) use Plastinated Specimens, 104 (76%) use Anatomic models or simulators and 109 (80%) use virtual and online programs [12, 13].

The present status of anatomy teaching at the AUB - *Faculty of medicine (AUB-FM)*

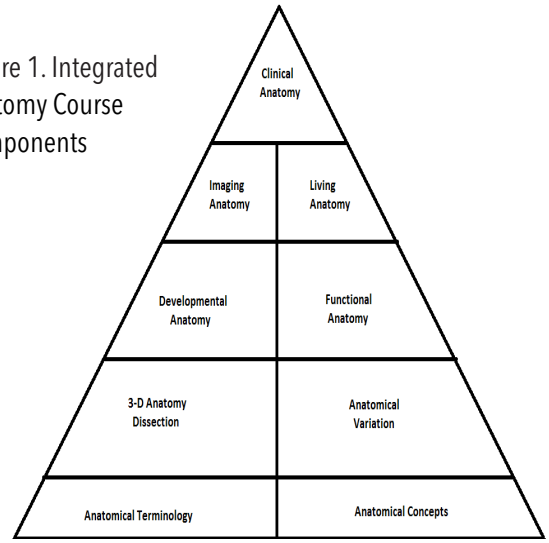
In 2013-2014, the AUBFM started implementing a new curriculum, the Impact Curriculum(IC), gradually starting with medicine one. It was a major restructuring of the medical program since the 1970's. The IC was conceived as a dynamic entity subject to regular evaluation. It is a student centered, competency-based, integrated curriculum that emphasizes active self-learning, teamwork, critical thinking and problem solving with leadership skills. One of its pillars in the science of medicine is anatomy, now called clinical anatomy. It preserved its separate entity, as the only course maintained as a standalone course in the IC. Actually, the design of the curriculum reflects that science-based clinical education is the driving force throughout the medical program with emphasis placed on developing the student's life-long learning skills in alignment with the required competencies.

Years 1 and 2 are conceived as a continuum whereby, clinical material is presented in the context of basic scientific, social, ethical and public health principles and perspectives. The first year is composed of two broad sections:

1- An initial foundation block including topics in the science of medicine such as: clinical anatomy, histology, biochemistry, genetics in health and disease, cell physiology, basic pathology, principles of drug action, microbiology and immunology.

2- A second organ-system series of blocks, covering all aspects of each system in a very comprehensive approach.

Figure 1. Integrated Anatomy Course Components



The syllabus of the course covers all aspects related to the course: description, competencies required, learning objectives to be acquired in knowledge, attitudes, skills and professionalism. Various strategies are being applied in the implementation of the various aspects of the course; however, whole body dissection remains the main source of information (Syllabus is distributed on day 1).

Whole body detailed regional objectives are annexed to the syllabus. They are covered through110 hours of dissection divided into 43 lab sessions [back (3), upper limb (8), head & neck (13), thorax (4), abdomen (7), pelvis (4), lower limb (4)]. In addition, there are 40 prelab sessions of 30 min each, 13 clinical lectures and 7 radiology lectures covering all regions dissected, 18 embryology lectures and 4 TBL'S(2 hours each) covering selected topic difficult to cover by other means. A detailed daily schedule is distributed to students on the first day.

Other resources are also being used as adjunct teaching material like: an interactive, comprehensive, and computer based program covering anatomy and radiology of the body; a complete series of plastinated specimens; a series of skeleton, plastic models and anatomical charts.

Assessment of performance in the course is a continuous process. It includes both formative and summative assessments with fast feedbacks. Both in-house local board type and NBME exams are administered. There are 3 theoretical, 3 radiology and 3 on the cadaver exams, in addition to an NBME final exam and TBL's grades. All exams are on-line (except the practicals and TBL's). The students have an immediate feedback after each exam with the possibility to discuss performance by appointment. Weak students are closely monitored and counselled if needed.

The overall performance of the students in the course is reported as: Pass or Fail, however, numerical grades are available for the students with about 8% of the grade on the professionalism whose grade will be the average of multiple grades from five lab instructors put twice during the course (mid-course and end of the course), and based on clear criteria (team work, punctuality, attendance and preparedness…). This teaching approach proved to be, after 5 years of its implementation, fulfilling its objectives according to the students' evaluations and improved performance year after year.

Refreshers in Medicine II

In parallel with the implementation of the Impact curriculum, 4 "Refresher sessions" for anatomical sciences were introduced, at a rate of 3 hr. sessions per each organ system given to Med II students.

Each session included: One short review lecture, bird's-eye view of the topic, preceded by a pre-test of 10 questions and followed by a lab review/cadaver, prosected specimens, and ending with a post test.

There was a marked and consistent improvement between the pre and post-tests, from an average of 70±10 to 90±10.

In the previous years, the MED I average for the anatomy course was 78±8 and a high percentage was retained from year 1 to year 2. However, this retention improved by about 20% after the refreshers. The refreshers were very well received and highly evaluated by students.

Concluding Remarks

The American University of Beirut since its start, in 1866, adopted the USA model of education.
Now, after 151 years, we are still following the same trend, programs and criteria, leaving a space for adaptation to the specificities of Lebanon and the Region. The university is accredited by American standards.

The same applies for the 150 years medical School and medical programs which are accredited by the US medical Education Commission and for the teaching Medical Center, accredited by the Joint Commission International for Hospitals (JCI).

In brief, what applied to most USA medical schools, in general, applied to our medical school at the AUB, of which I am an eye witness for almost half a century. During this period, I Witnessed so many changes, so many winds blowing from the West and from the East; The Americans, the French, The Ottoman's, who ruled Lebanon for almost 500 years, as well as others.. All these blowing winds affected, to various extents, medical education in Lebanon, including anatomy teaching, sometimes making drastic changes

It is very clear that the history of the teaching of Anatomy at the AUB SOM still follows the US pattern and passed through similar stages since 1867. From the beginning, Gross Anatomy stands as a separate comprehensive course depending mostly on dissection by students of a whole body by a regional approach.

General Comments:

There may have been a trend several years ago to discontinue cadaveric dissection, most if not all schools reverted to using cadavers given a decrease in learning outcomes and student preference. It should not be surprising that cadaveric dissection remains almost universal at US medical Schools. Even with curricular revision, in most medical schools, including ours, this time honored tradition is maintained whereby, the cadaver is a new student's first patient. Despite all advances in visualization technologies, nothing could replace the visual and tactical experience of seeing an organ in its anatomical location, holding it after dissection and comparing pathologic to normal findings side by side.

Administrators in all medical schools should recognize the relevance and importance of Anatomy in medical education and act accordingly.

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Has the Integrated Modular System in Medical Curriculum Improved Anatomical Knowledge Retention by Medical Students in Preclinical and Clinical Years?

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Importance of Anatomy Within the New Medical Technology

The major advances in medical imaging, surgical techniques, laparoscopy and robotic surgery resulted in a better appreciation of important surgical anatomical features that were once of dissection interest only. During surgery, there are structures neglected by the surgeon in different body regions. Now, with new medical technology, some of neglected structures are highly considered due to laparoscopy and endoscopy techniques. However, for hundreds of years, some schools have been teaching medical students detailed anatomy that is useless and difficult to remember, or that offers little help in the clinical context. Therefore, the advent of new medical devices and instruments has resulted in reconsideration of the anatomy teaching curriculum, which should be in conjunction with the clinicians in various specialties, to better understand anatomy in the clinical setting. This will enhance the retention of anatomy in preclinical and clinical years. Moreover, anatomy that is useful for the physician is emphasized.

The Medicine 1 Semi-Integrated Curriculum at the Faculty of Medicine and Medical Sciences at the University of Balamand, Lebanon

The Faculty of Medicine and Medical Sciences at the University of Balamand, Lebanon, started in 2001-2002 following the American model of education with two years of basic medical sciences and two years of clinical sciences after receiving a bachelor's degree. Twenty five students were enrolled in 2001-2002. The number increased throughout the years. In 2017-2018, the number reached 80. Students are admitted to the medical degree program after a selection process including the GPA, MCAT, and an interview, as well as research. The first quarter of the first year, foundation courses are offered in a discipline based approach. The gross anatomy course (7 credits) following the traditional system is given as a block course that consists of 34 anatomy lecture hours, 32 clinical lecture hours, 16 radiology lecture hours and 151 lab hours. However, for the past two years gross anatomy has been incorporated in the semi-integrated modular system, which includes anatomy, physiology, histology and embryology of the body systems. The course proceeds by dissecting first the pectoral region, axilla, upper and lower limbs, back, head and neck, thorax, abdomen and reproductive systems. Moreover, in the academic year 2015-2016 the anatomy, physiology, histology and embryology courses were modified and integrated in a modular system and were divided into several courses:

1. The Musculoskeletal System: Structure and Function
2. The Head, Neck, and Brain: Structure and Function
3. The Cardiovascular System: Structure and Function
4. The Respiratory System: Structure and Function
5. The Digestive System: Structure and Function
6. The Renal System: Structure and Function
7. The Endocrine System: Structure and Function (which includes the Male and Female Reproductive Systems)

The current anatomy course is divided into lectures and laboratory regional dissections. There are 56 lectures in all modules. They highlight the anatomical perspective given by a basic anatomist. In addition, there are 42 clinical lectures in all modules given by a clinical specialist to stress applied anatomy in the clinical setting. The laboratory sessions consist of 118 hours and include surgical demonstrations throughout. The course emphasizes the importance of anatomy in the interpretation of radiographs, MRI,

CT and ultrasound of the region under dissection, and consists of 16 radiology lecture hours and 12 ultrasound lecture hours with hands-on demonstration. The laboratory sessions are cadaver-based dissections. Great emphasis is on individual dissections done by students, studying skeletal material on display, anatomical charts and videos. In the laboratory, the 80 students are divided into two sections. In each section, there is one anatomist and two general surgeons at a time to guide, explain and help students during dissections. Evaluation of student academic performance is done through seven written multiple-choice exams and NBMEs exams, with seven hands-on practical exams. The second year foundation follows the modular system and is not yet integrated with first year.

Pitfalls of the Traditional System

The question is why do students not seem to have enough anatomical knowledge in the clinical years to practice safely. There are various answers to that in the traditional system. In the traditional system, the preclinical students have minimal exposure to clinical cases. The anatomy, embryology, histology and neuroscience courses are given as block courses with detailed information not needed in the clinical years. Therefore, most of the students study anatomy using short term memory to pass exams. Moreover, the amount of information given and the clinical correlation of body structures are grasped differently in the minds of students and compulsory dissection is not included. Almost 25% of students do not participate in actual dissections for different purposes. The different teaching methods and the evaluation of student performance, applied in various medical schools, play an important role in the lack of retention of anatomical information in clinical years. Moreover, teaching objectives and methods are applied differently among medical schools. The importance of anatomy and other morphological disciplines is not appreciated by some groups of students until they join surgical rotations in clinical years, where they regret what they missed in preclinical years. Moreover, the written exams, which were partially clinically oriented. Last, there is no feedback from physicians on student retention of anatomical information in surgical rotations, a point that requires further investigations.

The Integrated Modular System

The medical committee at the Faculty of Medicine (Balamand) started the integrated modular system two years ago, where the body systems were divided into seven courses. The musculoskeletal system course is the only exception which is given as a separate unintegrated system. The anatomy part includes the pectoral region, axilla, upper and lower limbs and the back. The embryology part includes the first eight weeks of development, and the histology part includes the skeletal muscle, blood and lymphoid tissue. Moreover, this course also focuses on skeletal muscle physiology and the mechanisms of neural control of skeletal muscle function. The course format includes lectures, laboratory sessions and a series of clinical correlations for students to develop a functional understanding of bones, tendons, joints, muscles, their innervation and mechanisms of action in health, injuries, and disease. The anatomy course was integrated with other disciplines and illustrated with cadaver-based learning (CBL) sessions dispersed throughout the first year. The teaching objectives of the human gross anatomy discipline follow the objectives of the American Association of Clinical Anatomists (AACA).

Due to shortage of time in the new integrated system, a thorough study and review of the anatomy curriculum was done to adjust the lecture and lab hours among other disciplines and try to help students to retain as much anatomy knowledge as possible in their clinical years. After revising the anatomy curriculum with the clinicians and surgeons of various specialties, we agreed to teach students the structures and organs that they will operate on and need to know in the operating room. Almost half of the anatomy materials that depend on rote memorization and will not be seen in the operating room were omitted. The concentration was on the various body systems and the related organs, major vessels, nerves and lymphatics needed to know in surgery. They were supplemented by radiographs, MRI, CT scans and ultrasounds, as well as clinical demonstrations in the laboratory sessions. More-

over, the written exams include clinical case-based questions and the laboratory exams are cadaver-based hands-on questions.

Retention Issues Between the Two Systems Among Students in the Pre-clinical and Clinical Years

Since we have no data related to the traditional system adopted 14 years ago, personal conversations with students in the clinical years revealed that anatomy retention varied among students in OBS-GYN and surgical rotations from poor to good to excellent depending on the region the student likes. But definitely students who lacked the proper retention, make up almost half of the class; they regret the teaching methods they followed during the preclinical years. It is probably due to either their approach to studying or to the adopted system applied before. Moreover, some of students said they studied anatomy to pass exams based on short-term memory. Others regret that they did not perform dissections the way it should be to enhance the proper skill and imprint in their minds' eye the locations and relationships of body parts. Fortunately, students of Balamand have the opportunity to review in medicine two and clinical years the preclinical and clinical courses to sit for the USMLE exams. Nevertheless, retention of anatomical sciences is reported. In 2016-2017, the semi-modular integrated system adopted revealed better retention of anatomical information in the medicine two class. In the NBME neuropathology exam, about 80% of students answered 50 questions related to anatomy of head, neck and brain successfully, and the overall average was 70%. This is an example of the success in the retention of anatomy information of the integrated system. The qualitative data will be collected starting 2017-2018 to better evaluate the new system.

How to Move With the Data Collection in the New Modular System?

Data collection in the new modular system is essential to target the gap in anatomical knowledge of medical students needed to identify the baseline areas of strength and weakness in surgical anatomy knowledge prior to joining surgical rotations (Jurjus et al., 2014). However, in our university, we have no collected data neither for the traditional curriculum, since the beginning of the Faculty of Medicine, nor for the new curriculum that started three years ago. Our objective is to start data collection for medicine two students at the beginning of the academic year 2017-2018. We will give a written exam composed of 70 multiple choice clinical anatomy questions representing the seven modules studied in medicine 1. Similar exams will be given at the beginning of Medicine 3 and 4 prepared by surgeons stressing the surgical anatomical knowledge retention essential for students entering surgical rotations. Hopefully, this will enhance to bridge the anatomy knowledge gap needed in the operating room. This will bring the operating room to the anatomy laboratory. In addition, longitudinal integration with the academic committee combining preclinical and clinical faculty responsible for continuous anatomy teaching tailored by a specialty is recommended. At the University of Balamand, we will try to implement the nesting approach and hopefully include, in addition to gross anatomy, other anatomical sciences such as radiographic anatomy, histology, and embryology in the near future.

Future Directions

a. The anatomy teaching methodology is dynamic and needs constant follow up through regular feedback.
b. Longitudinal integration with an academic committee responsible for continuous anatomy teaching for residents tailored by specialty.
c. Undergraduate courses in anatomy during bachelor's degree study.
d. A day review session in the anatomy lab for medicine 2, 3, and 4 before the beginning of modules and surgery rotations.
e. A general anatomy exam at the end of every academic year (assessment).
f. Feedback from residents and students at the affiliated hospitals, which will improve the teaching methodology, the content of the lectures, as well as what should be stressed upon and what needs to be explained further.

g. We should create an assessment score and follow it continuously.

h. Closing the knowledge loop (Fig. 1) to prepare students to assimilate the knowledge they acquire and use it in clinical practice.

i. A Simulation Lab is recommended.

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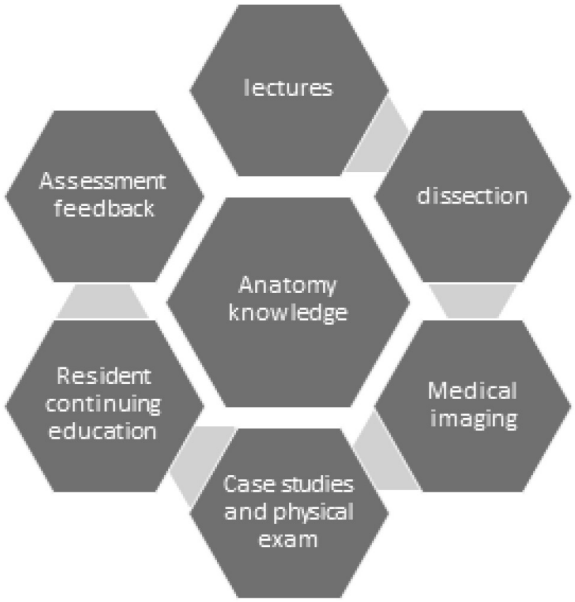

Figure 1. Closing the knowledge loop

Anatomy in the Irish Medical Education -

The Land of Saints and Scholars

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1- History of Medicine in Ireland

Several civilizations colonized Ireland before the arrival of the Celts from the European Mainland 350 years before Christ. The Tuath-de-Dannan were one of these civilizations, with their priestly Druid race being the earliest physicians mentioned in history. In the year 432, St. Patrick, as a young boy, was brought to Ireland as a hostage. He is referred to as the "Apostle of Ireland" and, with Christianity, Ireland experienced three hundred years of peace known as its "golden age." Medicine was closely linked to monasteries in Ireland with Christian hospitals attached to them (Woods, 1982).

Prior to the 18th century, Ireland's physicians had trained in Europe – in France, Belgium, Italy, Holland or England. Many Irish medical student, especially from Ulster province, studied medicine in Scotland after the establishment of medicine. On June 28, 1667, the College of Physicians in Dublin was established by Royal Charter granted by King Charles II. Under the charter no person could practice medicine within a 7-mile radius of Dublin unless licensed by the college. The charter named the first 14 Fellows of the College, and confirmed Dr. John Stearne as president for life (Woods, 1982).

2- Current Medical Schools in Ireland

There are six medical schools in Ireland: University College Cork (UCC); University College Dublin (UCD); National University of Ireland, Galway (NUIG); The University of Dublin, Trinity College (TCD); Royal College of Surgeons in Ireland (RCSI); and the University of Limerick (UL).

UCC, UCD, NUIG, TCD, and UL are all university-based medical schools, which are state-funded. University College Cork, University College Dublin, and National University of Ireland, Galway, are constituent colleges of the National University of Ireland. The Royal College of Surgeons in Ireland is an independent institution (Medical Council Republic of Ireland, 2007).

3- Entry to Medical School in Ireland

Medical schools in Ireland use the Central Applications Office points score, along with the Health Professions Admissions Test (HPAT) for school leaver entry. School leavers obtaining high points in the Leaving Certificate examination along with high HPAT scores are the typical entrants to medical school, despite the introduction of graduate entry programs. Traditionally, an Irish student enters university to study medicine at the age of 18 or 19. Access programs for (socially and educationally) disadvantaged students permit admission at a lower Leaving Certificate point and HPAT score.

Entry to the four-year Graduate Entry Medicine programme for EU applicants is through the CAO, applicants must obtain a minimum of an upper second class honours, (2H:1 or equivalent) in their first honours (Level 8) degree and complete a Graduate Medical School Admissions Test (GAMSAT). Non-EU applicants must achieve a competitive cumulative GPA and complete the Medical College Admission Test (MCAT). Non-EU, predominantly North Americans make up 50% of the yearly intake to the GEM programme (University of College Cork, School of Medicine, 2016a).

There has been a significant increase in recent years in the number of female applicants and entrants into medicine. Women now form the majority of the annual intake to medical schools in Ireland.

4- Medical Programs in Ireland

Programs that are primarily for school leavers, and are of five years' duration, are offered at Uni-

versity College Cork; University College Dublin; National University of Ireland, Galway; University of Dublin, Trinity College; and the Royal College of Surgeons in Ireland. These programs also have a minority of students who are mature and/or already have a non-medical degree. The graduate entry programs, of four years' duration, are offered at UCC, UCD, RCSI and UL.

The curriculum is delivered through an integrated teaching approach. Different teaching methods are integrated where medical students not only attend lectures but are also required to participate in group work, tutorials, small group teaching, practical classes, seminars and clinical teaching, in addition to private study and electives during summer vacation. After graduating from medical school, they complete a one-year internship before becoming fully registered medical practitioners in Ireland. They then enter a period of post-graduate training.

5- Medicine at University College Cork (UCC)

Since 1849, the School of Medicine at University College Cork has taught the art and science of medicine to students from all over the world. The Medicine Program at UCC is a student-centred learning program with students at UCC having early clinical experience in both hospital and community settings. Modern medical school facilities combined with a large network of teaching hospitals provide our students with a high quality educational experience. Both five-year and four-year degree program are available to Irish and international students, with students graduating with an MB BCh BAO Degree (Bachelor of Medicine, Bachelor of Surgery, and Bachelor in the Art of Obstetrics).

The medical curriculum at UCC reflects best practice in medical education and is under constant review (University of College Cork, School of Medicine, 2016b). From the beginning of the course, students learn clinical skills and professionalism alongside basic medical sciences so that knowledge is acquired in an integrated, patient-centred and holistic way. The curriculum is further enhanced by a wide range of elective modules ranging from library projects to the humanities. Research is a key element of UCC medical education, and all students receive structured teaching in research methodologies and complete a research project in the final two years of the program.

The curriculum is horizontally and vertically integrated. The integrated curriculum means that students learn life sciences and clinical practice together. In the last two years of the program, students spend most of their time in our teaching hospitals and family practices, where teaching is mainly bedside learning in small groups. Students also have the opportunity to undertake international electives.

5.1- Direct Entry to Medicine (DEM) - Curriculum at a Glance

The direct entry medical curriculum is a vertically and horizontally integrated program with various components introduced in each year of the program.

Year 1: Foundations of Medical Science (Anatomy, Physiology, Biochemistry); Clinical Science and Practice; Professional Development; Behavioural Science and Communication Skills; Epidemiology and Public Health; Student-selected module.

Year 2: Foundations of Medical Science; Clinical Science and Practice (including Family Practice attachment); Professional Development; Behavioural Science and Communication Skills; Epidemiology and Public Health; Student-selected module.

Year 3: Pathology; Pharmacology; Medical Ethics; Public Health and Epidemiology; Clinical Placements; Professional Development; Procedural skills.

Year 4: Clinical Practice and the Fundamentals of Adult Disease; Psychiatry and Behavioural Medicine; Reproduction, Pregnancy, Child Health and Development; Forensic Medicine; Research and Professionalism in Medicine; Clinical Electives.

Year 5: Principles and Practice of Surgery; Principles and Practice of Internal Medicine and General; Practice Principles and Practice of Paediatrics and Child Health; Principles and Practice of Obstetrics and Gynaecology; Research and Professionalism in Medicine (Final Year Project).

5.2- Graduate Entry to Medicine (GEM) - Curriculum at a Glance

Similar to the direct entry curriculum, the graduate entry medical curriculum is a condensed program allowing vertical and horizontal integration throughout the program.

Year 1: Foundations of Medical Science (Anatomy, Biochemistry, Pathology, Pharmacology and Therapeutics, Physiology); Clinical Science and Practice; Professional Development; Behavioural Science and Communication Skills; Epidemiology and Public Health.

Year 2: Foundations of Medical Sciences; Clinical Science and Practice (including Family Practice attachments); Clinical Elective; Epidemiology and Public Health; Student Selected Module.

Year 3: Clinical Practice and the Fundamentals of Adult Disease; Psychiatry and Behavioural Medicine; Reproduction, Pregnancy, Child Health and Development; Forensic Medicine; Research and Professionalism in Medicine; Clinical Elective.

Year 4: Principles and Practice of Surgery; Principles and Practice of Internal Medicine and General Practice; Principles and Practice of Paediatrics and Child; Health Principles and Practice of Obstetrics and Gynaecology; Research and Professionalism in Medicine (Final Year Project).

5.3- Anatomy Education in the Medical Curriculum

The anatomy for the DEM program is spread among Year 1 and Year 2. In Year 1, there are four Foundation of Medicine modules that integrate gross anatomy, histology and radiology, along with other basic medical sciences. The first module covers the musculoskeletal system followed by cardiovascular, respiratory and gastrointestinal. Neuroanatomy is covered in Year 2 and is then followed by the last gross anatomy component – the genitourinary system.

Meanwhile, the gross anatomy on the GEM program is covered in Year 1 and the first semester of Year 2, across four integrated modules that cover anatomy, biochemistry, pathology (including microbiology), pharmacology and physiology. The first module covers the musculoskeletal system followed by cardiovascular, respiratory, genitourinary and the last module of Year 1 is gastrointestinal system. Neuroanatomy is covered in the first semester of Year 2.

5.4- Anatomy Teaching Methods

Gross anatomy in UCC is taught using different modalities to provide an enhanced learning experience for students with different intelligences. Interactive lectures are utilized to introduce anatomical principles integrating gross anatomy, histology and radiology. This is followed up by practicals, where medical demonstrators use prosections of human cadavers to deliver clinically based tutorials. Moreover, students have the opportunity to dissect cadaveric specimen in different aspects of the course.

While cadaveric specimens are considered the primary teaching tool, other resources are used to assist in student learning. Different online resources, such as virtual dissections and dissection videos, are available in the anatomy laboratory for student learning. Moreover, students can avail myriad plastic models and plastinated specimens that help them in appreciating the three dimensional aspect of anatomy.

5.5- Design of the Study

To assess the students' memory retention, a cross-sectional questionnaire-based study will be conducted on both programs. Ethical approval for the study will be sought from the Social Research Ethical Committee at University College Cork.

The first set of data will be collected from DEM students after completing the genitourinary system in Year 2. The second set of data will be collected at the start of Year 3, when the students start their clinical rotations. As for the GEM students, the first set of data will be collected after completing the gastrointestinal system at the end of Year 1. The second set of data will be collected at the start of Year 2.

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The Morphological Teaching In Palermo Medical School

Past And Present

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For centuries, the University of Palermo has occupied a famous and historical position in the advancement of anatomy. Many pioneer discoveries were recorded in the name of its pioneer professers, who made significant leaps in the field.

Ilustrious Places and People of the Human Anatomy School in Palermo

1.1 Giovan Filippo Ingrassia (Regalbuto, 1510/12 – Palermo, 1580) was the founder of the School of Anatomy Palermo, and can therefore be considered the first Professor of Anatomy in Palermo. He studied medicine in Padua under Giovanni Battista De Petra, where his distinguished and historic teachers and colleagues included Vesalio and Falloppio. Remembered as the "new Galen" or "Sicilian Hippocrates," he made a fundamental contribution to medical sciences in the 1500s. In particular, he revolutionized the study of the human skeleton, with the introduction of the description of the individual bone segments, instead of the skeleton as a whole. He discovered a small bone inside the ear which he called *"staffa"* (stapes) and he also identified, for the first time, many of structures of the head and the reproductive system, one of which still bears the name he gave it in Italian (*piccole ali dello sfenoide*, the lesser wings of the sphenoid). Furthermore, after being appointed by King Philip II of Spain as the prestigious *Protomedico* of Sicily, he worked to curb the spread of malaria and the plague epidemic that struck Palermo in 1575. Giovan Filippo Ingrassia created the first *"Gabinetto di Anatomia"* (Anatomy Dissection Laboratory) in the Chapel of Santa Barbara at the Cloister of the San Domenico Convent in Palermo, where he wanted to be buried and where he held public dissections open to doctors. His most important publications include: *Jatropologia* (1547), *De tumoribus praeter naturam* (1552), *Galeni Ars medica* (1574), *Informatione del pestifero, et contagioso morbo* (1576), *Methodus dandi relationes per mutilatis torquendis* (1578), and, *posthumously, Galeni Librum de ossibus* (1603). Among his students was Baldassarre Grassia, who formed the "*Accademia di Anatomia*," which was followed by the "*Accademia dei Jatrofisici e di Medicina*," the current Academy of Medical Sciences, which formed the basis of the Medical Faculty when the University of Palermo was established in 1806.

1.2 Giovanni Gorgone (San Piero Patti, 1801 – Palermo, 1868) was the first official lecturer in human anatomy after the establishment of the University of Palermo, where he taught starting in 1826, and was renowned for his remarkable commitment to the discipline through both theoretical lessons and demonstrations with anatomical models. His openness and devotion to providing anatomical knowledge aroused the interest of many students, even from other universities. Gorgone was also responsible for the construction of the first Anatomical Amphitheatre in the city (which still exists at the current Department of Law in via Maqueda in Palermo), the foundation of an anatomical library, the purchase of wax models and a large assortment of anatomical and surgical instruments, as well as a vast collection of anatomical and pathological sections which formed the basis for the establishment of a "*Gabinetto di Anatomia Patologica*" (Pathological Anatomy Laboratory) in 1830. He created the School of anatomy that trained some illustrious students (including Giambattista Gallo). He is remembered for his contributions to the study of blood vessel structure, the jaw, the masseter muscle and, above all, human teeth. He was the first scholar to establish that the various tissues and organs of both humans and animals deteriorate within different time frames. Among

the Sicilian Doctors and Scientists of the 1800s, Giovanni Gorgone is remembered for his devotion to the study of anatomy, pathological anatomy and surgery, as well as for being a balanced and sensible clinician. In his memory, a marble half bust is displayed at the current Faculty of Law in Palermo and, according to the wishes of his family, his tombstone is located in the Church of San Domenico.

1.3 Francesco Randacio (Cagliari, 1821 – Palermo, 1903), was a professor of human anatomy and Dean of the Faculty of Medicine from 1884 to 1885. He obtained a grant from the Ministry of Education which enabled him to build, at the *Ospedale della Concezione* on the ramparts of Porta Carini (which no longer exists as it was demolished to build the current courthouse), the first Anatomy Institute, inaugurated on Oct. 27, 1884. He was a professional dedicated to professional training and the stimulation of curiosity and capacity for debates with his students. He also set up a museum of anatomy with wax models by skilled and well-known wax modellers, inspired by the masterful works of Zumbo, such as Ferrini and Graffeo. His research was mainly focused on the cardiovascular system and osteology.

1.4 Emerico Luna (Palermo, 1882 – 1963) was was an advocate and the administrator of the transfer, in the 1930s, of the Institute of Anatomy to the present location at the *Policlinico* University Hospital. He was also one of the founders of the Italian Society of Anatomy, in 1929, together with Nello Beccari (Florence) and Luigi Castaldi (Cagliari). He was a popular doctor, a sensitive man, a passionate intellectual, a professor loved and respected by his students. He succeeded Giuseppe Levi as the Director of the Anatomical Institute in the immediate post-war period. He was a staunch advocate of the educational and scientific revival. His studies were mainly focused on the vast fields of histology and histogenesis, cytology, human and comparative morphology, organogenesis, physiology and comparative embryology. His observations on the morphology, histology and development of the nervous system, including, among others, the projection on the surface of the cerebellum by the cerebellar nuclei, the development and morphology of the intercalated Staderini nucleus, the connections of the encephalic nerve nuclei in Chiroptera, are particularly noteworthy. Furthermore, Emerico Luna was the first to introduce radiological anatomy teaching (anatomy of the living) in Italy. At the end of his career, he was assigned the title of Professor Emeritus of the University of Palermo. His *Volume di Neurologia* from 1932, part of the *Trattato di Anatomia Umana* published by Dante Bertelli, is still of a considerable importance today.

The Modern Era of Palermo Medical School

2.1 The school of medicine, established more than two centuries ago, consists of five schools and twenty departments with professors, administrative and support staff, specialists, research fellows, research grant holders and trained students, divided into faculty and non-faculty members. The medical school's curriculum is structured in one-cycle courses of six years, both for medicine and for odontology degrees. The first two years in the curriculum are devoted to basic sciences, including morphological sciences. In addition, there are master's degree courses for graduates, and Bachelor of Science, (short) three-year programs in nursing, dental hygiene, physiotherapy, and so on. After graduation, PhD international programs are also available for distinguished students.

As a whole, the School of Medicine and Surgery of the University of Palermo aims to meet the needs of those who intend to pursue a medical career or undertake a research path.

Every year, more than 500 students are admitted to the medical school, divided into three majors: medical, dental and a number of other healthcare professions. All degrees start with a period of basic science studies before clinical activities. Morphological sciences play a considerable role. In medicine, there are 80 hours of histology (cytology, histology and embryology) and 150 hours of gross anatomy.

In the last 20 years, the Faculty of Medicine and Surgery has been revolutionized both in its formal and educational settings. With regard to Medicine, the numerical ratio teacher/student improved. In fact, the classes in medicine today con-

sist of 150 students, whereas for the three-year degrees the range is 15 to 40 students. In this way, it would be expected that the quality of teaching has been significantly improved, but is it so?

Of course, if we only consider the numbers, the answer is yes, but if we analyze the issue in more details, we realize that apparent improvements took place. In fact, the decrease in the number of students wanted by the morphologists is based on the need for teachers to improve the teacher/student relationships with the absolute urgency to use non-classical teaching strategies and materials such as slides, light boards, etc., and to gain practical experiences in the field, like dissection of corpses and histology exercises (microscopes, microtomes, etc.).

The improvement happened only on paper, because of the lack of university funds. Consequently, the way to teach remained *ex-cattedra* as in the '70s.

Knowing that, morphology cannot be a fictional tale; it is a visual science that needs images, direct experiences, understanding the structures and ultrastructures. In addition, faculty members struggled with personal motivation to adapt the interactive teaching. In such cases, the students would not be just listeners but active participants both in discussion and the direct use of advanced technical means, such as optical and electronic microscopy. Meanwhile, the use of online information has been widely disseminated over the years; surely the online teaching was taken into account to great extent.

As for the future of morphology teaching, we believe that all modifications that have been made, and all old and new teaching materials, have a fundamental utility: to make sure that the teaching of morphological sciences does not remain a mere passage of information between teachers and students. On the other hand, this basic teaching would be the true foundation of a cultural construction that can lead to self-learning and to a conscious and moral professionalism.

It is true, at this time, that the teacher-student ratio is very low, and one may wish to have a teacher for every 10 students. At the same time, we must not neglect the possibility to show all microscopic and macroscopic aspects in morphological sciences using animated tools through videos and again through the three-dimensionality; they are of fundamental importance in this kind of studies. Throughout the use of advanced technology, it would appear that the teacher's function has diminished. Even though in one of our studies (Leone, et al.), which needs to be further investigated, we have shown that among all the teaching strategies, perhaps the role of teacher can be even eliminated. We remain of the idea that the function of the teacher is mainly to help students avoid losing the focal points, a function that is not only educational but also moral.

2.2 Human Anatomy

Today, the teaching of human anatomy in Palermo is imparted into a total of 150 hours of lectures. It is taught with a topographic clinical approach (human anatomy of the living body): After an introduction (8 hours) on the history of human anatomy and the terminology that is used to describe the human body, the program includes the study of the head (8 hours), neck (8 hours), chest (18 hours), abdomen (30 hours), pelvis (12 hours), upper limb (8 hours), lower limb (8 hours) and neuroanatomy (50 hours).

Each part of the human body is covered by describing its location, shape, relationships, and structure. The first three (location, morphology, and relationship) should serve students to learn the basics of physical diagnosis. The study of the structure is essential to understand the physiology of the organs, the pathophysiology of diseases and pharmacology.

Small group practical work covers the study of natural skeletal segments by using animals (e.g. a pig), which have similarities with human, mannequins (through a simulation lab for learning simple mini invasive procedures such as intubations, catheterizations, arterial and venous drawings, sutures, etc.) and plastic models to help students understand the 3-D relationships of all organs in the various anatomic regions. For the past few years, we have been trying to activate a donation program, as there is an adequate dissection room in our department, but the Italian legislation and the widespread influence of religious authority have so far made this project very difficult to be realized.

2.3 Histology

Histology teaching consists of an 80 hour course including 60 hours of theoretical lectures and 20 hours of histology laboratory work. The course covers the following subtopics:

introduction to morphological sciences (3 hours),
histology techniques (6 hours),
cytology (8 hours) ,
epithelial tissue (8 hours),
connective tissues (8 hours),
muscular tissue (6 hours),
nervous tissue (11 hours), and
embryology (10 hours).

Students are also encouraged to study anatomy or histology subjects online.

In each part, the student will get sufficient knowledge about the embryogenesis of tissues and their microscopic structures. Thus, students are ready to be assessed once the whole program of both anatomy and histology is acquired.

In histology, assessment and feedback to and from the students is acquired through forms, face to face discussion, oral exams, as well as National Board of Medical Examiners (NBME). In the future, our plan is to add more elements of assessment and feedback, such as: assessing whether online learners can align learning objectives with real-life applications better than paper-based or face-to-face approaches; adopting strategies for creating better and validated multiple-choice tests with online assessment and feedback like NBME; using self-check exercises to assess online learning; and measuring the effectiveness of an online learning community.

Conclusion

It is believed that designing and developing online assessment and feedback strategies would lead better documented findings. In the end, the goal of learning assessments should be to measure whether actual learning outcomes match desired learning outcomes. The gold standard of assessment of quality is therefore validity. A valid assessment should measure what it claims to measure. However, inadequate learning assessments can be frustrating. At worst, they can prevent the students and institutions from reaching their goals.

Up to now there has not been enough evidence whether online-only learning by students can be considered sufficient to acquire the core and essential knowledge. For this reason, we think it is best to use the advantages that both the classical method and the online method offer to the fullest extent. It would be also wise to consider a combination of online and classroom learning to convey the subject matter to students, this hybrid or "blended" teaching would probably be the best teaching method. Our experience showed that students who are part of a blended education model performed better that those who exclusively followed one or the other.

We can say according to some reports that well-defined online instructional and learning techniques are making teaching more effective. Such techniques can be introduced slowly and methodically with the online assessment and feedback mechanism without compromising coverage of the syllabus, thereby, promoting the learning process. These activities are more economic and require less money, time, and effort. Most importantly, online learning, assessment and feedback have been validated by documented and repeatable research and, as such, their effectiveness is not simply a matter of opinion, they contribute to maintain a high educational standard.

In brief, the teaching of anatomical sciences in the University of Palermo is deeply rooted in the history of medicine. Pioneers in the field were universally recognized. Our role is to consolidate, improve and keep up with this glorious heritage.

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Notes

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