



IN VIVO

The Publication of the Metropolitan Association of College and University Biologists

Fall 2017

Volume 39, Issue 1

2017 MACUB CONFERENCE Our 50th Year Celebration



New Jersey City University
Saturday, October 28th

Mosquitos as Vectors - Zika and Malaria

Invited Speakers

Vincent Racaniello, Ph.D.

**Higgins Professor, Department of Microbiology and Immunology
Columbia University College of Physicians and Surgeons**

and

Ana Rodriguez, Ph.D.

**Associate Professor, Department of Microbiology
Co-Director, Anopheles Insectary
New York University Medical Center**

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Articles can be submitted electronically to invivo@mec.cuny.edu or mailed as a printed copy (preferably with a diskette that contains the file) to the Editorial Board at Medgar Evers College. All submissions should be formatted double spaced with 1 inch margins. The title of the article, the full names of each author, their academic affiliations and addresses, and the name of the person to whom correspondence should be sent must be given. As a rule, full length articles should include a brief abstract and be divided into the following sections: introduction, materials and methods, results, discussion, acknowledgments and references. Reviews and short communications can be arranged differently. References should be identified in the text by using numerical superscripts in consecutive order. In the reference section, references should be arranged in the order that they appeared in the text using the following format: last name, initials., year of publication. title of article, journal volume number: page numbers. (eg. - ¹Hassan, M. and V. Herbert, 2000. Colon Cancer. *In Vivo* **32**: 3 - 8). For books the order should be last name, initial, year of publication, title of book in italics, publisher and city, and page number referred to. (eg. - Prosser, C.L., 1973. *Comparative Animal Physiology*, Saunders Co., Philadelphia, p 59.). Abbreviations and technical jargon should be avoided. Tables and figures should be submitted on separate pages with the desired locations in the text indicated in the margins.

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In This Issue:

MACUB 2017-2018 Executive Board	inside cover
Welcome from New Jersey City University	2
2917 Conference Speakers	3
Chronic Traumatic Encephalopathy: A Mini-Review by Chu-Kan, Alfred Romito, Guomei Tang and Rujin Tian	4
The Vascular Flora of Pea Island, Long Island Sound, New York, Eleven Months After a Millennial Storm, Hurricane Sandy by Richard Stalter, Amira El Jebbari, Jasmine Burkett, Louis Bryan, Eleni Frenxhi, Sachvinder Kaur and Yu Hao Zhong	9
Transitioning from a Biology Major to a Career in Nursing by Eleanor Kehoe, Dana LaVecchia, Allen Burdowski and Kathleen A. Nolan	15
Conference Registration Information	29
Affiliate Members	inside back cover

Save the Date
The 2017 MACUB Conference will be at
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Welcome from New Jersey City University

New Jersey City University welcomes the members and guests of the Metropolitan Association of College and University Biologists to MACUB's 50th Annual Conference. NJCU's Biology Department is proud to serve as the host of MACUB's Golden Anniversary Conference. Please join me in congratulating the present and past leaders and members of MACUB in sustaining a vibrant organization dedicated to collegiate education and research in the biological sciences.

NJCU's mission is to provide a diverse student population with an excellent education. NJCU is committed to the improvement of the educational, intellectual, cultural, socioeconomic, and physical environment of the surrounding urban region and beyond. Established in 1927 as a training school for teachers, NJCU is among the most comprehensive universities in the state of New Jersey. NJCU's fully accredited Colleges of Arts and Sciences, Education, and Professional Studies, and School of Business offer 43 undergraduate programs, 28 master's programs, and 3 professional doctoral programs. NJCU operates three campus sites—the main campus in Jersey City, the School of Business in Jersey City's financial district, and NJCU at Brookdale in Wall Township.

NJCU is a vibrant place to live and learn, with students and faculty from around the world; a welcoming campus; a wide variety of student organizations, including Biology and Chemistry Clubs and the *Nu Pi* chapter of the *Beta Beta Beta* Biological National Honor Society; and learner support services that address individual student needs. NJCU students engage in rigorous applied-learning experiences that include research internships, international study, and cooperative education placements. 38 Biology majors participated in mentored research internships and courses in 2016, several of whom were recognized for excellence at regional undergraduate research conferences.

NJCU's Biology Department is one of NJCU's largest departments, with nearly 600 declared and intended majors. It recently became the first NJCU department to receive 1000 applicants in a single year. The Department offers a range of programs that lead to baccalaureate degrees in Biology, Medical Imaging Science, and Medical Lab Science, as well as dual-degree programs in Biology with Biomedical Engineering, Dentistry, Podiatry, or Biomedical Sciences. Through these programs, NJCU's Biology Department propels students to careers in health care, government, research, education and more.

The Biology Department's scholarly and supportive culture creates the optimal environment for scientific learning and exploration. The faculty is student-focused and committed to offering outstanding learning experiences along with individualized attention. Faculty members are very successful in grant-seeking to support a variety of student-support initiatives, including mentored research, Supplemental Instruction, personal and professional development activities, curricular innovation, and infrastructure development. The faculty provide personal mentoring and advisement to guide students in selecting coursework and career plans that fit their interests and life goals.

NJCU is completing an \$42 million expansion and wholesale renovation of its Science Building that will be finished in 2018. The new facility will house the Biology, Chemistry, Geoscience and Physics Departments, and will include imaging, spectroscopy, GIS and other core facilities, as well as up-to-date classrooms, teaching and research labs, educational technology, and numerous spaces for student interaction. Please feel free to tour the 4th and 5th floors of our new home!

Once again, and on behalf of New Jersey City University's Biology Department, I welcome you to NJCU for our annual get-together with our MACUB friends. We have a stimulating program of events and renowned speakers will share their work on vector-borne diseases with us. I hope that you enjoy our hospitality and the Gilligan Student Union Building. Have a great conference and a great day!

John Grew, Ph.D.
Professor and Chairman of Biology

Mosquitos as Vectors



Zika and Malaria



Vincent Racaniello, Ph.D.

Higgins Professor, Department of Microbiology and Immunology
Columbia University College of Physicians and Surgeons



Vincent Racaniello today (left) and as a Ph.D. student in the laboratory of Peter Palese, Mt.

Dr. Racaniello studies the infection of humans with viruses ranging from Zika to the common cold. Dr. Racaniello completed both his undergraduate and his Ph.D. studies at Cornell University where he studied genetic reassortment of influenza virus. As a post-doctoral fellow in David Baltimore's laboratory at MIT (1979–1982), Racaniello used recombinant DNA technology to clone and sequence the genome of the small RNA animal virus poliovirus. He produced the first infectious clone of an animal RNA virus, which helped to greatly advance the field of modern virology.

With the global decline of poliovirus, Racaniello's lab has taken a particular interest in Zika virus. Racaniello's virology blog and podcasts *This Week in Virology*, help scientists and non-scientists alike learn more about viruses. He is a co-author of *Principles of Virology*, a textbook used by many students.

Ana Rodriguez, Ph.D.

Associate Professor, Department of Microbiology
Co-Director, Anopheles Insectary
New York University Medical Center



Dish of cultured female *Anopheles stephensi*

Dr. Rodriguez's lab studies two different parasites, *Plasmodium*, which causes Malaria, and *Trypanosoma cruzi*, which causes Chagas disease. Malaria is a devastating disease that causes about 400,000 deaths per year, mainly among children in Africa. There is an urgent need for new strategies to control malaria, but there is a lack of detailed knowledge of the basic biological processes of *Plasmodium*, that would allow faster development of anti-malaria drugs and vaccines. A main interest of her laboratory is the study of malaria-induced inflammatory pathology and its implications in the pathology of disease, including cerebral malaria and severe anemia. The laboratory is attempting to develop effective drugs against Chagas Disease. In collaboration with GSK, her lab team has performed high through-put screenings of intracellular *Trypanosoma cruzi*, to find compounds with anti-trypanosomal activities. Selected compounds are now being tested for efficacy in mice.

Chronic Traumatic Encephalopathy: A Mini-Review

Chu-Kan¹, Alfred Romito¹, Guomei Tang¹ and Rujin Tian²

¹Bronx Community College, CUNY Bronx, NY

²Columbia University, New York, NY

Abstract

Chronic traumatic encephalopathy (CTE) is a neurodegenerative brain disease resulting from repetitive brain trauma. The initial discovery can be dated to the 1920s from boxers who sustained repeated blows to the head. Dr. Harrison Stanford Martland was the first to introduce symptoms associated with the disease. Recently CTE has gained prominence due to a number of retired NFL football players who have displayed symptoms, or died from complications of traumatic brain injuries. Due to limited research in this field, a cure is still ongoing. Currently, the only conclusive diagnosis for CTE can be assessed with a post-mortem pathological analysis. The future will depend heavily on the discovery of biochemical markers to determine the early onset of the disease pre-mortem.

History and Prevalence of CTE

The history of chronic traumatic encephalopathy (CTE) can be traced back to the 1920s. It was originally diagnosed as a condition experienced mainly by boxers who suffered significant head trauma from repeated blows to the head. Harrison Stanford Martland was the first to describe the symptoms associated with CTE in 1928¹. The symptoms of cognitive impairment, behavioral and mood changes, Parkinsonism, and memory disturbances led Dr. Martland to introduce the phrase “punch drunk” to the medical vernacular. In 1937, J. A. Millspaugh coined the term “dementia pugilistica” due to the mental confusion and motor deficits seen in professional boxers².

Currently traumatic brain injuries have gained widespread attention in part to a number of athletes who have died from complications of CTE. The prevalence of CTE in athletes is caused by the frequent occurrence of concussions in contact sports. Annually, 1.6 to 3.8 million sport-related concussions occur in the United States³. Sports such as boxing, football, basketball, wrestling, rugby, soccer, hockey, volleyball, and lacrosse produce similarly high rates. A vast number of sport-related head injury is minor with the athlete recovering in a few days or weeks.

However, a small number do develop long term symptoms. In cases of repetitive concussions or traumatic brain injury, seventeen percent develop CTE. Female high school athletes are found to be at double the risk of suffering concussions than their male counterparts. A National Football League study reported 1.9 percent of players aged 30 to 49 have experienced some level of cognitive impairment, emotional liability, dementia, and depression⁴. This represents an occurrence of twenty times greater compared to the same age group of the general public.

Clinical Manifestations of CTE (with MRI and CT Imaging)

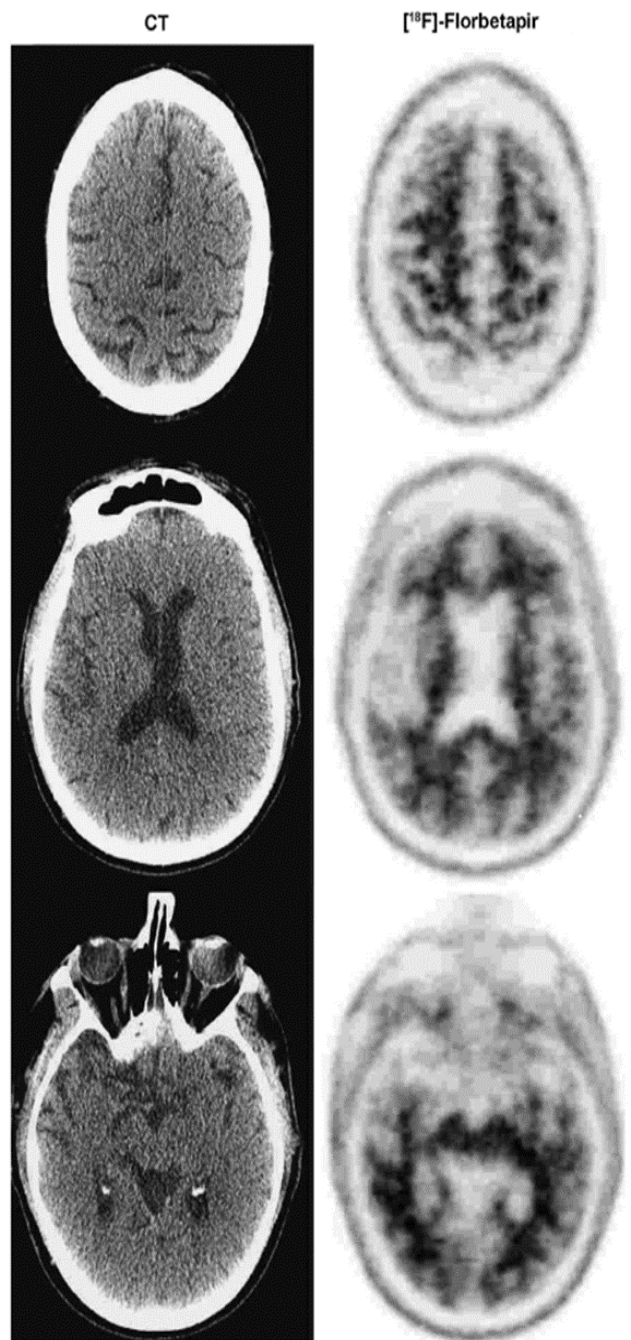
Based on current findings, clinical manifestations of CTE resemble neurodegenerative diseases and are progressive. It is usually present in individuals during midlife, years after the exposure to repeated head trauma. Initial symptoms include deteriorations in cognition, behavior, short term memory, depression, suicidal thoughts, and emotional stability. This will progressively lead to later manifestations such as motor impairment,

speech and gait abnormalities, Parkinsonism, Alzheimer's dementia, and Lou Gehrig's disease (ALS). Although there is no present biochemical marker or imaging modality to accurately detect the early development of CTE, imaging studies can help determine the extent of brain damage (Figures 1 and 2). Functional magnetic resonance imaging (fMRI) can provide further insight into functional alterations, specifically structural changes and working memory⁵. It can help differentiate CTE from other neurodegenerative diseases. fMRI can also provide a real time assessment of brain function and activity. Susceptibility weighted MRI can detect micro hemorrhages, which are secondary injuries following traumatic brain injuries. Single photon emission computer tomography (SPECT) can be used to measure cerebral perfusion⁵. It has been effective in detecting abnormalities in boxers with repeated head trauma.

Differential Diagnosis of CTE

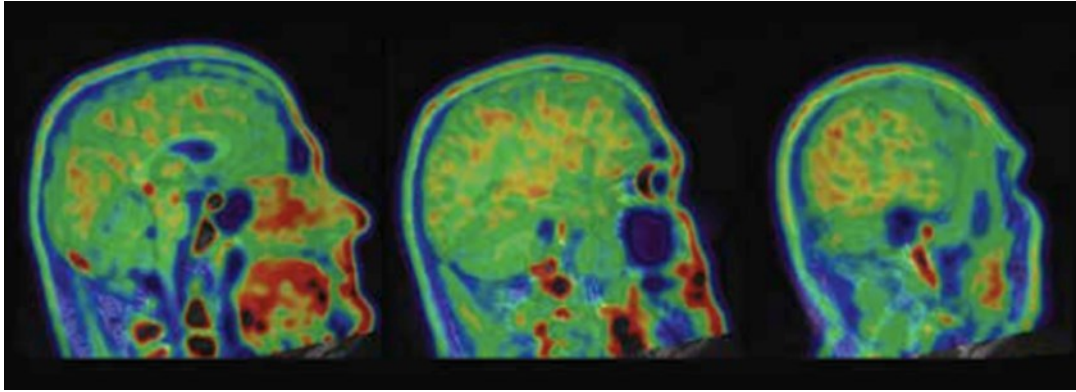
The correct diagnosis of CTE may be difficult at times due to its similarity to other neurodegenerative diseases. Because there is limited research in this field, a combination of standard clinical and laboratory evaluation criteria is used only to arrive at a mere prognostication. An accurate diagnosis requires evidence of tau protein deposits and degenerative brain tissue that can only be detected in the brain post-mortem (Figures 3 and 4). Nonetheless, the diagnosis of CTE remains controversial because it represents a pathological diagnosis. There is no present general consensus on a clinical diagnosis. Cognitive and behavioral symptoms such as memory loss, emotional stability, depression, and dementia is similar to Alzheimer's and bipolar disorder. Motor impairments such as gait difficulties, speech abnormalities, and Parkinsonism would suggest Parkinson's disease or ALS. Since awareness of CTE became recently prominent from retired NFL football players, research for an accurate diagnosis is still ongoing.

Figure 1. Imaging from a 71-year-old retired NFL player⁴



Left panel is CT image and right panel is [18F]-Florbetapir PET imaging, which was negative for amyloid accumulation. CT, computed tomography; NFL, National Football League; PET, positron emission tomography.

Figure 4 Tau protein deposits in the brain⁶



Yellow-red splotches in the brain of a former NFL player (seen from three different angles) may indicate the presence of the tau protein thought to be important in the development of CTE.

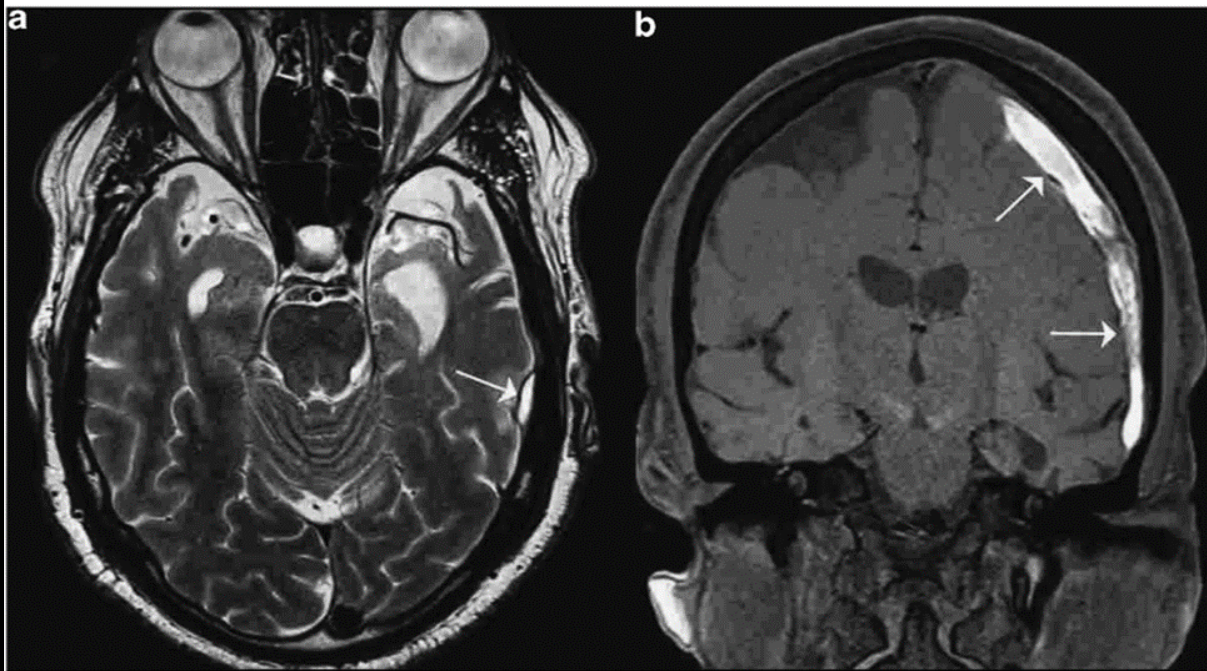
Pathological Implications and Continuing Research

Gross pathological findings uncovered a number of neuropathological features associated with CTE. The most common characteristics include a reduction in brain weight, enlargement of the lateral and third ventricles, a fenestrated cavum septum pellucidum, thinning of the corpus callosum, and scarring with neuronal loss of the cerebellar tonsils³. The brain weight reduction is mild in nature. It is usually associated with atrophy in the frontal, temporal, and parietal lobes. As the disease progresses with increasing severity, atrophy of the hippocampus, amygdala, and entorhinal cortex may occur as well. The lateral and third ventricles will dilate causing an increase in size. Finally, pallor of the substantia nigra and locus ceruleus is evident in some cases resembling Parkinson's and Alzheimer's respectively⁴.

The future of CTE research will center around the development of a clinically accepted process to provide an accurate pre-mortem diagnosis. A post-mortem pathological analysis is the only current method for a conclusive diagnosis. With the advancement in imaging technologies, there are more opportunities to understand the

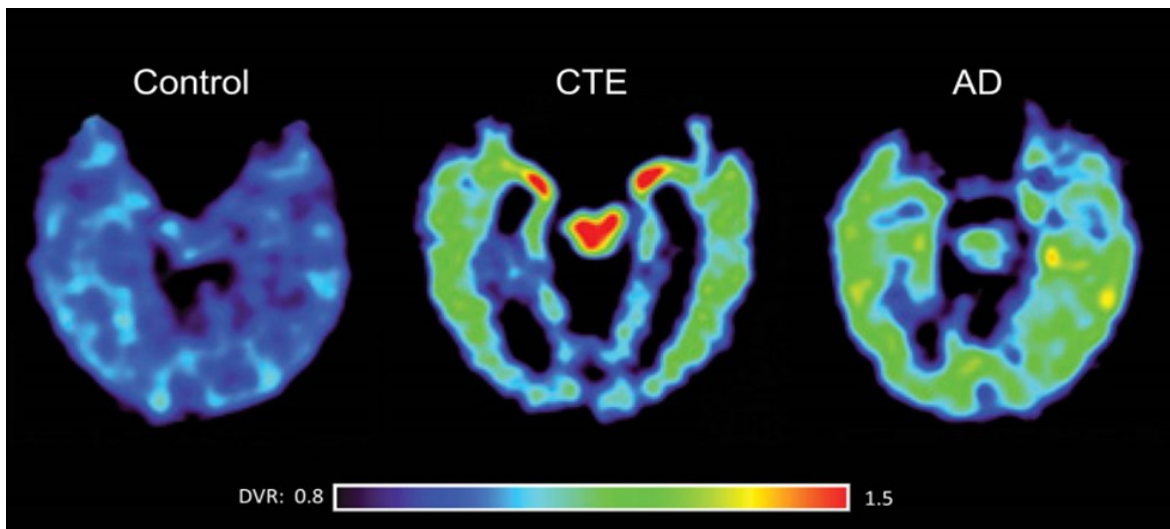
pathophysiology and diagnosis of this disease. One of the main obstacles is to define the role subconcussive injuries have on the development of CTE. Biomarkers represent one way CTE may ultimately be diagnosed. It would allow the severity and progression of the disease to be tracked in a patient. Boston University's Center for the Study of CTE will also play a vital role. The center is one of the largest resources available for research on the anatomy and pathophysiology of CTE. Their brain and spinal cord donation registry contains more than 500 registered former affected athletes⁴. Researchers at Mount Sinai are also pioneering the use of a PET imaging agent [¹⁸F]-T807, a newly developed tau tracer, to detect and track the progression of CTE in living patients. This is particularly significant because CTE diagnosis has only been possible by evaluating post-mortem brain tissue⁹. Continuing studies on surviving athletes may help in discovering biochemical markers, as well as other physiological testing to determine the early onset of CTE. It can also help to determine whether any therapeutic intervention aimed to curtail head injury exposure might arrest the progression or modify the tauopathy of CTE.

Figure 2. Imaging from a 59-year-old, physician with a sports-related injury⁴



Magnetic resonance imaging showing atrophy of the frontal poles of the frontal and temporal lobes bilaterally. (a) and (b) Arrows indicate a subdural hematoma (SDH).

Figure 3 Tau protein deposits in the brain⁶



Yellow-red splotches in the brain of a former NFL player (seen from three different angles) may indicate the presence of the tau protein thought to be important in the development of CTE.

Acknowledgments

We thank Dr. Peter Canoll (Department of Neurosurgery, Columbia Medical Center) for his valuable assistance in explaining medical images. Chu-Kan Chen is currently a CUNY research Scholar.

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The Vascular Flora of Pea Island, Long Island Sound, New York, Eleven Months After a Millennial Storm, Hurricane Sandy

Richard Stalter, Amira El Jebbari, Jasmine Burkett, Louis Bryan,
Eleni Frenxhi, Sachvinder Kaur and Yu Hao Zhong
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Abstract

The vegetation at Pea Island, New York, was sampled on 30 September 2013, eleven months after a millennial storm, Hurricane Sandy. The sampling procedure involved collecting all vascular plant species by walking the island along belt transects spaced ten meters apart that completely covered the island. Fifty six taxa in fifty genera in 23 families were identified in the survey. Thirty taxa, 54% of the flora were not native to the island. The Asteraceae and Rosaceae were the largest families in the flora with ten and five species respectively. Birds were the most likely source of seed introduction to the island. Two plant communities, a large

Introduction

The objective was to document Pea Island's vascular plant species eleven months after a millennial storm, Hurricane Sandy. Pea Island is within the city limits of New Rochelle, Westchester County NY. It lies along the southern terminus of the rocky intertidal zone, located in western Long Island Sound at 40.877N, 73.762W (Figure 1). The 0.81 hectare island is owned by the Huguenot Yacht Club which developed the site as a marina in the 1930s.

The savage 1992 December nor'easter destroyed the marina. Because of catastrophic damage, the Yacht Club chose not to rebuild (Figure 2). Since then Pea Island has seen little human activity with the exception of the occasional boater or fisherman.

While powerful nor'easters can wreak havoc on small islands, hurricanes such as Hurricane Sandy may pose a greater threat to the vascular plant species that grow there. Hurricanes generally occur during the growing season while nor'easters typically occur in late fall and winter when plants are dormant. Powerful Hurricane Sandy struck New York



Figure 1. Pea Island, 2013 (from Wikimapia.org)

City on 29 October, 2012 causing extensive damage to the New Jersey and New York coastal zone¹. Much of the damage was caused by the storm surge that inundated Pea Island, flooded downtown Manhattan's subways and caused massive destruction to the region's coastal dunes. New York City has experienced stronger winds than those of Hurricane Sandy. Of the memorable hurricanes to strike the vicinity of New York, only two follow. The fiercest storm to strike

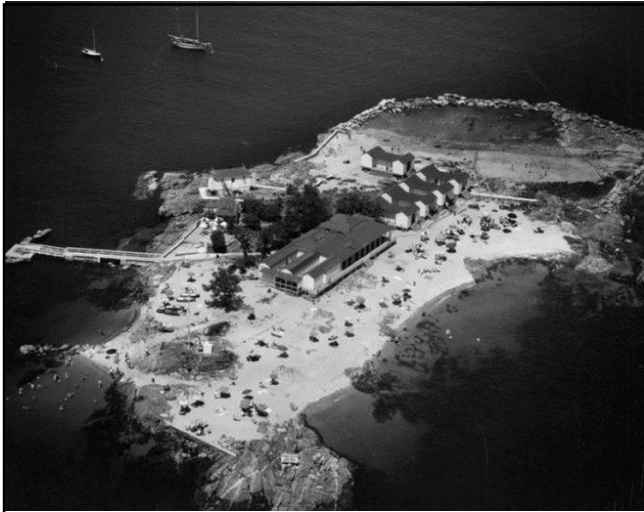


Figure 2. The Huguenot Yacht Club on Pea Island prior to the December 92' nor-easter (from Wikimapia.org)

Long Island was the un-named September hurricane of 1938 which brought a 298 Kph (186 mph) wind gust to the West Hampton Air Port, the highest wind ever recorded for Long Island. Hurricane Hazel October, 1954, is notable for its wind gust of 182 Kph (114 mph), the highest ever recorded at New York City where continuous weather records have been kept since 1869. Yet the storm surge of these two hurricanes was not as high as Sandy's recorded on October 30, 2012, at 3.61 m (14.2 feet), the highest ever recorded at the Battery at the tip of Manhattan Island where tide records date back to 1821. Low-lying Pea Island was inundated by this storm, yet resilient woody taxa, notably *Toxicodendron radicans* (poison ivy), *Pyrus caleriana* (Callery pear), *Quercus palustris* (pin oak) and more survived.

Climate

The nearest weather station to Pea Island is at LaGuardia Airport, New York. The climate is mild with a growing season of 189 days². January is the coldest month with a mean temperature of -0.2 C (31.7 F), while July averages 25 C (76.9 F). July averages 6 days above 32.2 C (90 F) or above. January generally does not experience days when the low temperature falls below -17.6 C (0 F). Rainfall is evenly distributed throughout the

year. February is the driest month with 70 mm (2.74 in) of rain. July is the wettest month averaging 104 mm (4.10 in). Yearly rainfall averages 1086 mm (42.74 in).

Materials and Methods

The vegetation was sampled on September 30, 2013, eleven months after Hurricane Sandy. Sampling of the vascular plant species followed the procedure used by the senior author for the past 50 years, walking the island along belt transects spaced ten meters apart that completely covered the island. All plants observed along the belt transects were collected and identified. Voucher specimens were collected for each species and deposited in the A. C. Moore Herbarium at the University of South Carolina. Taxonomically problematic species were sent to experts to confirm identification. Nomenclature follows Haines³. Native and invasive status follows Gleason and Cronquist⁴.

Results and Discussion

Fifty six taxa in fifty55 genera in 23 families were identified in the 30 September 2013 survey Table 1). No spore plants or gymnosperms were observed. The Asteraceae (10 taxa) and Rosaceae 5 taxa) were the largest families in the flora. *Rhus* (sumac) was the largest genus with 3 taxa. *Anagalis arvensis* (pimpernel) was the most common taxon on the island. *Toxicodendron radicans* was also abundant. *Spartina alterniflora* (tall marsh cord grass) was the most common salt marsh associate. Thirty taxa, 54% of the flora are not native to the island. Non-native taxa are significantly higher on several of New-York's coastal islands botanized by the author: Great Gull⁵ Ellis⁶ Liberty⁷, and Hoffman and Swinburne islands⁸ (Table 2). Pea Island's non-native taxa, 54%, is higher than that of New York State (35%).

The flora of 0.8 ha Pea Island, 56 taxa, is larger than 1.0 ha Swinburne Island (38 taxa), but smaller than that of larger 4.0 ha Hoffman Island (87 taxa) and 4.9 ha Liberty Island (97

Table 1. A summary of the vascular flora at Pea Island, Long Island Sound, New York

	Spore Plants	Conifers	Dicots	Monocots	Total
Families	0	0	21	2	23
Genera	0	0	50	4	45
Species	0	0	52	4	56
Native Species	0	0	24	2	26
Introduced Species	0	0	28	2	30

Table 2. Frequencies of native versus non-native plants at New York State, Pea Island, Liberty Island, Ellis Island, Swinburne Island, Hoffman Island, and Great Gull Island

	New York State	Pea Island, NY	Liberty Island, NY	Ellis Island, NY	Hoffman Island, NY	Swinburne Island, NY	Great Gull Island, NY
Native species	2078	26	34	98	31	14	73
Non-native species	1117	30	63	149	56	24	115
% Non-native species	35	54	65	60.3	62	63	57
Total	3195	56	97	247	87	38	203

Table 3. Island Size – A comparison

Island	Size (ha)
Great Gull	6.9
Ellis Island	11.1
Liberty Island	4.9
Hoffman Island	4.0
Swinburne Island	1.0
Pea Island	0.82

Table 4. Species richness (diversity/ha) and size in six New York coastal islands

Island	Size (ha)	# of Taxa	Species Richness
Great Gull	6.9	203	29.4
Ellis Island	11.1	247	23.6
Liberty Island	4.9	97	19.8
Hoffman Island	4.0	87	21.8
Swinburne Island	1.0	38	38
Pea Island	0.82	56	68.3

Table 5. Possible mode of invasion of vascular plant species. The four taxa persistent after cultivation may have been planted

Mode of Invasion	Number of Taxa
Birds	40
Water	25
Wind	15
Persistent after Cultivation	4

taxa (Table 3). Hoffman and Swinburne are uninhabited man-made islands while Pea Island is a natural granite island with a rocky intertidal zone. Species richness at Pea Island, defined here as number of taxa/hectare, is higher than that of Great Gull, Ellis, Hoffman, and Swinburne (Table 4).

The possible mode of invasion of vascular plant species at Pea Island is presented in Table 5. Many taxa have multiple modes of invasion so the total number of taxa in the table exceeds 56, the current number of vascular plant species at Pea Island. Birds are most likely responsible for the introducing of the greatest number of taxa, 40. Birds may carry seeds to the island in soil on their feet and feathers. In addition, bird feces deposited on the island may also contain seeds from fruit eaten by birds. For example, seeds of the sumacs, *Rhus*, and poison ivy, *Toxicodendron*, are a favorite food of many bird species. Fruits containing the seeds of these two taxa and others were likely brought to the island in the guts of birds. Water was the most likely source of *Anagalis arvensis* seeds brought to the island during Sandy's storm surge. *Baccharis halimifolia* (silverling) seeds were blown to Pea Island by the wind. *Albizia* (mimosa) may have been planted by the Huguenot Yacht Club.

Summary

In summary, Pea Island is an excellent plant ecology laboratory. The island is uninhabited and the Huguenot Yacht Club has no plans to rebuild the marina at the present time. Pea Island like its island neighbors Columbia and David's Island flourished botanically, in the past and are devoid of human habitation and influence and at the present time. Thus Pea Island may serve as a site where botanists can continue to monitor changes in the vascular vegetation. In the face of the future perturbations as global warming proceeds and sea level rises in Long Island Sound.

Acknowledgments

We wish to thank Eric Lamont for identifying the Asteraceae, Gordon Tucker for identifying the Cyperaceae, Dwight Kincaid for reviewing the paper and St. John's University for purchasing herbarium supplies.

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- ⁷Stalter R. and N. Tang, 2001. The vascular flora of Statue of Liberty National Monument, New York City, New York. *Bartonia* **61**: 123-130.
- ⁸Stalter R. and A. Munir, 2002. The vascular flora of Hoffman and Swinburne Islands, New York Harbor, New York. *Journal of the Torrey Botanical. Society.* **129**: 77-82.

Appendix

Annotated checklist of species, Pea Island, Long Island Sound, New York. The vascular plant taxa are arranged according to the categories: spore plants, gymnosperms, dicots, monocots. Families and lower taxa are arranged alphabetically. Nomenclature primarily follows Haines (2011); older synonyms listed in Gleason and Cronquist (1971) follow. Each entry includes the following information sequence: scientific name; pertinent synonym, enclosed in brackets; frequency relative to the study area, using categories: rare (scarce, less than 5 populations), infrequent (uncommon, occasional, 5 to 20 populations), frequent (common, more than 20 populations). Non-native taxa are followed with an asterisk (*).

Spore Plants

DICOTYLEDONEAE

AIZOACEAE

Mollugo verticillata L.*; infreq.

ANACARDIACEAE

Rhus copallina L.; infreq.

Rhus glabra L.; rare

Rhus typhina L.; infreq.

Toxicodendron radicans (L.) Kuntze [*Rhus radicans*]; freq.

ASTERACEAE

Ambrosia artemisiifolia L.; rare

Artemisia vulgaris L.*; freq.

Baccharis halimifolia L.; infreq.

Cirsium.vulgare (Savi) Tenore;* infreq.

Eclipta prostrata L.*; infreq.

Eupatorium hyssopifolium L. freq. (L.) Hilliard and B.L. Burt spp. *obtusifolium*;

Iva frutescens L.; rare

Senecio vulgaris L.*; rare

Solidago sempervirens L.; freq.

Taraxicum officinale F.H. Wiggs*; infreq..

BRASSICACEAE

Brassica nigra (L.) W.D.J. Koch*; rare

Lepidium virginicum L.; infreq.

CAPRIFOLIACEAE

Celastrus orbiculatus Thunb.*; infreq.

Lonicera japonica Thunb.*; infreq.

8; infreq.

CHENOPODICEAE

Atriplex prostrata Bouchér ex DC.; infreq.

Chenopodium album L.*; infreq.

Dysphania ambrosioides (L.) Musyakin and Clemants* [*Chenopodium Ambrosioides*]; infreq.

CONVOLVULACEAE

Calystegia sepium (L.) R. Br.*; infreq.

Cuscuta sp.; rare

EUPHORBIACEAE

Acalypha rhomboidea Raf.; freq.

Euphorbia maculata L.; freq.

Euphorbia supina Raf.; freq.

FABACEAE

Amorpha fruticosa L.; rare

Medicago lupulina L.*; infreq.

Strophostyles helvola L.; infreq.

Trifolium repens L.*; rare

FAGACEAE

Quercus palustris Muench; rare

MALVACEAE

Abutilon theophrasti Medik*; infreq.

Malva neglecta Wallr.*; infreq.

ONAGRACEAE

Oenothera biennis L.; infreq.

OXALIDACEAE

Oxalis stricta L.*; rare

POLYGONACEAE

Polygonum cuspidatum Siebold and Zucc.*; infreq.

Polygonum pensylvanicum L. [*Persicaria pensylvanica* (L.) Maza. var. *nesophilum* Fern.]; rare

PORTULACACEAE

Portulaca oleracea L.*; infreq.

PRIMULACEAE

Anagalis arvensis L.*; abundant

ROSACEAE

Prunus maritima Marshall var. *maritima*; infreq.

Prunus serotina Ehrh. var. *serotina*; infreq.

Pyrus calleryana Decne.*; rare

Rosa multiflora Thunb.*; rare

Rosa rugosa Thunb.*; infreq.

SALICACEAE

Populus deltoides Bart. ex Marsh.; rare

SCROPHULARIACEAE

Paulownia tomentosa (Thun.) Siebold and Zucc. ex. Steud.*; rare

Verbascum thapsus L.*; infreq.

SOLANACEAE

Datura stramonium L.*; infreq.

Solanum nigrum L.*; infreq.

VITACEAE

Ampelopsis glandulosa var. *brevipedunculata* (Maxim.) Momig. infreq.

Parthenocissus quinquefolia (L.) Planch.; rare

MONOCOTYLEDONAE

LILIACEAE

Allium vineale L.*; infreq.

POACEAE

Digitaria sanguinalis (L.) Scop.*; rare

Distichlis spicata (L.) Greene; infreq.

Spartina alterniflora Loisel.; abundant

Transitioning from a Biology Major to a Career in Nursing

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Abstract

Seventeen St. Francis College students or alumni (ten women and seven men) participated in oral interviews about their reasons why they transitioned from biology majors into nursing careers. Additional questions such as who influenced them, what they like about nursing, particular areas in which they are interested, their desire to pursue further education, and gender issues were posed. Biology majors enter our programs for a variety of reasons. Students aspire to become professionals such as: medical doctors, physician assistants, dentists, physical therapists, occupational therapists, radiologic technologists/medical sonographers, pharmacists, Ph.D. and Masters degree researchers, public health workers, teachers, and nurses. St. Francis College graduated its first class of nurses in May 2015 (we also have a nursing completion program in which students come to us with an RN and then obtain their BSN). Several of our students have decided to become double majors in biology and nursing, others have started out as biology majors and have switched to major in nursing, and still others are graduates with a biology degree who decided to go into either an accelerated or regular nursing program. We do have a former student who switched from medicine into nursing, and students that have had interesting nurse-related careers such as nurse midwifery. We have presented our students with information over the years about careers in nursing, and what it would be like to become a nurse practitioner, in an attempt to expand their knowledge about various nursing careers. These interviews allowed us a window

Introduction

We have begun a new four-year Bachelors of Science with a Major in Nursing program at St. Francis College (SFC) that had its first graduating class in May 2015. SFC also has what is called a nursing completion program in which students who are already registered nurses can come to SFC and finish the Bachelors degree (RN->BSN program). Some of those students in the first graduating cohort were biology majors and we have continued to recruit a few biology majors each year into the program. Some have completed their bachelor's degree in biology, and some started in biology and switched to nursing. We decided to personally interview some of these students, in addition to some bio degree holders who went on to or who are entering accelerated nursing programs. Our goals were to get a glimpse into the

background of these students, and to ascertain their motivation and interests in nursing. We looked to the literature to see what type of research has already been conducted in this area, and to help us shape ideas for interview questions. We were interested in: career choice and what influences it, the psychological implications of switching from biology to nursing and any gender issues.

Boughn¹ examined data sets from the 1980's and 1990's and found that caring, power, and practicality were three factors that emerged that influenced both sexes' choices in nursing. Lang² noted there were five reasons why students change majors. Interestingly, science majors score higher on #5. These are: 1) personal enjoyment or interest; 2) own talent in the field; 3) importance of the field as preparation for intended profession or career; 4) previous high school courses; 5) the influence of a

family member; and 6) a strong background in the field. Maldoon and Reilly³ found through surveys that certain professions, such as nursing, are more “gender-typed”. They used the terms gender neutral (GN), female sex-typed (F) or highly female sex-typed (HF) in their survey. Hoke⁴ suggests that attitudes toward nursing are formed by middle school, and that there was a 48% increase in interest in nursing after students viewed a video about nursing careers. Turner⁵ found similar results with fifth grade students among both males and females. Filman⁶ also suggests the use of early education for nursing recruitment. The difference based on gender was significantly different in only two of six middle school classes tested⁴. It would be interesting to see if perhaps there were cultural or even time differences between the two groups of students in Hoke’s⁴ and Maldoon and Reilly’s³ studies. Also, Maldoon and Reilly queried older, college-aged students, whereas the younger students in Hoke’s study may have not yet formed as many gender biases.

Price *et al.*⁷ noted that historically nurses and physicians have often had adversarial roles. There is “nurse is inferior” attitude of some in which the doctor provides all the answers and the nurse is the subservient follower, and the “nurse is superior” attitude in which the nurse monopolizes all the caring. We sensed in our interviews of students that they had a more collaborative attitude toward solving the patient’s problems and that they sense that this teamwork is preferential to the adversarial one.

Methods

Students and alumni were interviewed either face-to-face (11) or over the phone (6). Interviewees are listed in the order interviewed—their answers are summarized in Table 1 but grouped by gender.

Questions asked in oral interviews

Name (ethnicity was optional)
Age
Gender
Name of high school (some students preferred us not to record the name of the H.S.)
Were you always interested in nursing?
If not, which area were you interested in?
Did anyone influence you in your choice to go into nursing?
What do you like about the profession?
Which areas in nursing interest you?
Do you plan on additional education beyond the B.S. in Nursing?
Do you have gender issues?

Results

Interview 1. D.L. Female student, age 21, first generation college, Italian, will graduate January, 2018. Senior Biology major. All girls’ Catholic school, Brooklyn, NY. Entered St. Francis in Fall 2013, with an interest in Physician Assistant (PA). She changed her mind in 2016, after talking to two friends and two professors who suggested that she might be interested in becoming a nurse practitioner. They stated that in this career the nurse practitioner (NP) had more independence than a PA, which appealed to her. She also had a positive interactive with a nurse while her grandmother was sick in the hospital. The nurse demonstrated venipuncture of her grandmother’s leg. She will apply to accelerated nursing programs. She feels that, “It is important to have that four-year biology degree; the science will definitely help.”

Interview 2. A.P. Female student, age 26, born and raised in NYC, St. John Villa Academy H.S., in accelerated 15-month nursing program at NYU. Currently an Anatomy and Physiology laboratory instructor, graduated in 2012 with a B.S. in Biology. She thinks that nursing is a great alternative to becoming a doctor. She did take the MCAT and scored fairly well, but did not want to put in the time required for medical school. She was attracted to the 15-month program and job prospects, and might go on to become an NP or even a Doctorate of Nursing Practice (DNP). She has found that working in a hospital, her group has truly worked as a team, and each member is really not superior to the others. “There is a lot of responsibility in any area, be it home care or hospital, or any setting. What I really love about

nursing is how we really work closely with the patients. If I become an NP, it will be in the area of pediatric oncology. What influenced me is a close family member who had cancer and died at 21 at Sloan Kettering". She felt that the nurses were very caring there. "My perspective in life has changed, my health is better, I eat less salt and sugar. Nursing helps you want to take care of your health and others." When queried about the number of males in the program, A. P. said the ratio is about 7 to 1 or 2. "It is good to have males on the floor. They can especially help with the lifting of heavy patients."

Interview 3. S.P. Female student, age 22. Guyanese descent, born in NYC, went to public H.S. in Queens. Double major, Biology and Health Care Management (HCM), will graduate in 5 years. Initially interested in PA, but took some HCM courses as a "backup" if she did not get into PA school. Really likes HCM, thinks she will be good in it. "It looks like there is a lot of room for growth, and one can branch out into different areas, such as NP, Nurse anesthetist, What I like the most about it is the ability to move up. I will work a year after graduation in the place I am doing my internship---Long Island Jewish Hospital. They have offered me a full-time job in employee health services. Besides an MBA, I am really interested in the accelerated nursing program, labor and delivery is the area I am most interested in. I did not want to become a doctor because I don't feel committed enough to the amount of time and studying involved."

Interview 4. A.P. Male student, age 21. Catholic H.S. from Brooklyn. He also did not want to spend the time it takes to become a doctor. He has become an EMT, and he sees how hard and how long the doctors work---many are 35 and still in residencies. He talks to nurses and finds that they are very happy and less stressed, compensated well, and they have flexibility. His mother has been a nurse for years, and has recently become a school nurse. She also works per diem with the Visiting Nurses Association (VNA). He graduated with a B.S. in Biology in May 2017. He just got into SUNY Downstate's Accelerated Nursing Program, and started in June 2017. He is undecided as to which field he would like to enter in nursing, but he is interested in medical surgery, and might also like to work per diem for the VNA. He has an EMT colleague whose sister has an NP and now runs a nursing home, which he found interesting and a testament to the variety that exists in the field.

Interview 5. G.G. Male student, 22. He is in the B.S. in Nursing program at SFC. He has a B.S. in Biology. He is from Brooklyn, and went to high school in Manhattan at the High School for Health Professions and Human Services. "I was first interested in medical school. Nursing was my second choice. I realized that my family had financial limitations and that it would be very expensive to go to medical school". He wants to start his career in nursing and possibly become a nurse practitioner or nurse anesthetist. When asked what he might like most about nursing, he noted that it was a "hands-on profession. The doctors go from patient to patient. The nurses spend more time with the patient." When asked how he felt about the gender of nurses, he said, "I might have a hard time. It is very female-oriented as it is a very caring profession. There might be lots of adapting."

Interview 6. K.C., Female student, age 21. She was a Bio major, and she wanted to be a pediatrician or pediatric oncologist. She is from Brooklyn, went to St. Mary's H.S. in Long Island (Manhasset). The reason why she switched is that she found it to be a faster route with decent money. She plans to graduate with a B.S. in Health Promotion, and plans to apply to accelerated nursing programs. Several people in her family are pediatricians, which originally influenced her to want to become a pediatrician. When asked if she foresaw any gender issues in nursing, "I see mostly females in nursing. I believe that men like to go into something else---management, accounting, business, or even become doctors."

Interview 7. D.E. Male student, age 23. He was born and grew up in Latin America, and went to Spanish-speaking H.S. there in Spanish. He did learn English there, but did not have an opportunity to practice until he came to the U.S. He finished his B.S. in Biology, but originally wanted to go to medical school. He also thought about PA. However, he realized it would cost a lot of money. He felt that nursing would be a quicker, perhaps less-competitive career path, that would lead to greater independence than a PA if he became a nurse practitioner. No one in his family was a nurse; he likes the holistic approach to nursing in which one integrates philosophy, spirituality, mental and physical parameters of health into the treatment of the patient. When asked, "How do you feel about gender in nursing?", he pronounced that there is an even greater difference in Columbia than in the U.S. and is encouraged by how in the U.S. many are at least striving for equality with their fairer treatment of LGBT. He knows that nursing has traditionally been a more female profession, as many of the original nurses

were nuns, but that he is all right with that. He feels he will be able to integrate into nursing just fine. D.E.'s family suffered through a tragedy (one of his brother's died of leukemia at the age of 4) but he feels that, since we are all mortal, we cannot dwell on aspects of our health that are negative. He tries to encourage all of his patients (he has started clinicals).

Interview 8. E.F. Female student, age 22, large public school in Brooklyn. She knew that she wanted to go into some area of the health field, but was not sure of which area. No one in her family is in the nursing field, she is "Pushed by her father and supported by her mother." She wants to go into pediatrics and labor and delivery. She really loves kids. They make her happy. When told that these kids most likely would be sick, she said, "I want to be the one to make them feel better." Nursing is much more hands-on. There is more interaction of patients with nurses than there is with doctors. Patients will know you better and might tell you more than they would tell a doctor." About gender? "There might be an issue in labor and delivery, perhaps women would want to have other women around when they were delivering a baby." E. F. graduated with a B.S. in Biology in May 2017, and will enter the SFC nursing program in the fall, and spend two years to receive her B.S. in Nursing. Maybe in the future she would do an NP.

Interview 9: G.P. Female student, age 21, Catholic H.S. in Queens. She did not initially want to go into nursing; she loves children and was thinking of becoming a pediatrician. She graduated in May 2017 with a B.S. in Biology and will take some pre-requisite classes such as Anatomy and Physiology, and then apply for accelerated nursing programs in Spring 2018. She said she finds it difficult to describe the atmosphere around nursing, "very hands-on". Her mother is a lab technologist in a hospital, so she has had exposure to hospitals over the years. "I do see stereotypes here in the U.S., but in Greece there are more male nurses than female nurses!" (at least in the hospital she was in in the summer of 2017).

Interview 10. T.P. Female student, age 25. Public school in Queens. She initially wanted to go to medical school. What made her change her mind? She volunteered in a hospital, and observed the roles of the doctors and nurses. "Nursing was more who I wanted to see myself as, helping rather than diagnosing." She graduated from SFC with a B.S. in Biology, and has just finished her first year in the accelerated (15 month) program at NYU. She said it is hard, "Time is condensed, not the materials." When asked about gender, she said, "There are a greater number of females, but there

are a lot of males surprisingly, the field is becoming more diverse in that sense. Many also want to become practitioners." "I like nursing---there is a lot you can go into, education, health promotion. You can become an NP or a DNP."

Interview 11. K.C. Male student, age 25. Public high school in upstate NY. Initially wanted to go to medical school or become a PA. He has a B.S. in Biology. He was worried about his prospects as a PA, so he looked into the nursing school at SFC. He is finding it to be enjoyable. What he likes about the profession is the caring for people and working with people. His future goals are to definitely pursue more education, and maybe go into research. When queried as to what area of research he would like to go into, he said, "We will see where it goes." And, "I do like pediatrics." There are no family members that are nurses, but his mother is a doctor. When asked about gender, he said, "It is a little bit difficult and different, to be a caregiver."

Interview 12. M.R. Male, age 31. Catholic Archbishop Molloy H.S., no one in his family is in health care. "My family wanted me to be a doctor, but, when a junior in H.S., I was leaning toward nursing. And, in college, when I did volunteer work at St. Vincent's, I found the nursing rotation really fascinating". He graduated with a B.S. in Biology. "I did attend two years of medical school, but found that physicians did not spend as much time with their patients as nurses did. I wanted to build relationships with people. To me, that is the most important thing about nursing. I have worked in a neonatal ICU and have found it to be very fulfilling. I have also achieved a Masters in Nursing Education, and might pursue my Ph.D. in the future". When asked if gender was an issue for him, he responded in an optimistic way and noted that the number of males in the last few years' nursing classes had increased. He said he thinks that this might be difficult, especially in a neonatal unit, but that the young mothers have been very accepting of the males in their roles as nurses.

Interview 13. K. L. Female student, age 22. This student went to the public Tottenville H.S. She originally thought she wanted to become a radiographer, but realized that she could do more. She has also looked into PA. She thinks that she always wanted to be a nurse, but that it seemed like, "everyone else was going into it, and she wanted to be different". Her mother was a nurse in China, but is not certified here. She feels that in nursing one can get "intimate or closer to the patient and establish a relationship." She is interested in either neonatal or geriatrics Gender issues? "Anyone can become a nurse and males

can do the same things in nursing as females can". She is in pre-nursing at SFC.

Interview 14. A. C. Female student, age 25. Went to a Catholic H.S. She always wanted to go into the medical field, she just wasn't sure about which area. She has a distant cousin who is an NP, and has influenced her to become interested in starting her own business. She is going into nursing, as she is "giving back" to others who have helped her (she has lupus). She is interested in becoming an NP as well, and going into "medical aesthetics" such as using Botox for migraines. She sees no gender issues. She holds a B.S. in both Biology and Nursing.

Interview 15. I. R. Male student, age 21. Catholic Archbishop Molloy H.S. He is from England originally. He wanted to do something medical. He is now a paramedic. He wanted to become a doctor but due to money and family responsibilities decided not to. He feels that nurses help patients more, "there is a certain level of comfort that only nurses can achieve. Doctors see a patient as a puzzle to be solved. Nurses provide care plans. It is a more holistic style of medicine." He sees his career as proceeding in this manner: will spend two-three years as a floor nurse and venture into critical care and ER, and then eventually become a certified nurse anesthetist. He sees gender as sometimes being a problem from the women patients, who might feel uncomfortable around men with personal areas (body). Stereotypes exist, people back "home" say, it is a "women's field". His advice for others that want to go into this field is that "you have to work hard and be dedicated and want to really work to help people holistically." Now in SFC nursing program.

Interview 16. M.M. Male student, age 29. Public, Fort Hamilton H.S. Graduated with a B.S. in Biology. Married and has two children. "I originally wanted to be a pharmacist (well, there was family pressure to do so).

Then I wanted to be a doctor or a PA. I did get into a Caribbean medical school, but I did not want to leave the area." He did start a career in research, but could not picture himself in a lab all day with bacteria or cells. He wanted to "be with people and see the outside world." He was originally ignorant about what nursing was all about. What he likes the best about nursing is, "the opportunity to grow in an area". "I like the flexibility of the schedule (I can work three long days, and spend more time with my family, and/or take on some additional part-time work, such as substitute teaching (which I've been doing). I had recently been married and my wife brought up nursing and how it would suit me well." He is now in the SFC nursing program. He is also a member of the NY Chapter of Men in Nursing. He does see stereotyping, but "Men can give care to the patient. It might be different, but just as well as women can." (A brief review of the NYC Chapter of the American Assembly of Men's Nursing, formed in 2013, reveals information about a male nurse's interests in topics that range from bullying in the workplace to male perspectives of caring.)

Interview 17. A.B. Female student, Age 23. H.S. for Construction. "I was not initially interested in nursing. I wanted to go to medical school. However, I decided that I did not want to commit to the education involved. What I like the best about nursing is we have the most interaction with the patients. Dr. Burdowski influenced me to go into nursing. I am not sure I want to go further than the B.S. degree. The responsibility of prescribing medication as an NP scares me a bit. I see no gender issues for females in nursing: if I was a male I might feel funny, but there are many different areas that one can go into. I am interested in neonatal and the ER. I also am happy that I have the Biology degree for the extra background it has afforded me."

Table 1. Answers to first 10 questions of the interviews (answers to Questions 5 and 6 were combined)

Student	Gender & age	High school	Always interested in nursing?	Have you been influenced by anyone?	Like about the profession?	Which areas interest you?	Do you plan more education?	
1	DL	F, 21	Catholic	First interest was PA	Two students and two professors—also a nurse who demonstrated venipuncture on her grandmother's leg	More independence of a nurse (NP) than PA	General	"It is important to have that four-year biology degree---the science will definitely help." Wants to go on to NP

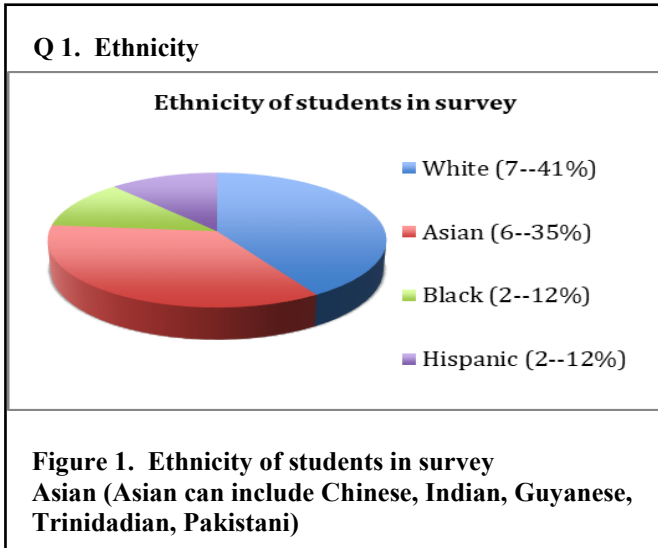
Table 1, continued

2	AP	F, 26	Catholic	Thinks that nursing is a great alternative to becoming a doctor—she did take the MCAT and scored fairly well, but did not want to put in the time required for medical school—she was attracted to the 15-month program job prospects	A close family member who had cancer and died at 21 at Sloan Kettering. She felt that the nurses were very caring there. “My perspective in life has changed---my health is better—I eat less salt and sugar.”	“How we really work closely with the patients.”	Pediatric oncology	might go on to become an NP or even a DNP.
3	SP	F, 22	Public	Initially interested in PA, but took some HCM courses as a “backup” “I did not want to become a doctor because I don’t feel committed enough to the amount of time and studying involved.”	Nurses I met over the years.	“Lot of room for growth, and one can branch out into different areas, such as NP, Nurse anesthetist, What I like the most about it is the ability to move up.”	Labor and delivery	“Besides an MBA, I am really interested in the accelerated nursing program”
4	KC	F, 21	Catholic	She was a Bio major, and she wanted to be a pediatrician or pediatric oncologist. She switched because she found it to be a faster route with decent money.	Pediatricians in her family	Caring for people	Pediatrics; pediatric oncology	Will earn bachelors in Health Promotion, and plans to apply to accelerated nursing programs.
5	EF	F, 22	Public	She wanted to go into some area of the health field, but was not sure of which area.	“Pushed by her father and supported by her mother.”	“I want to be the one to make them (sick kids) feel better.” “Nursing is much more hands-on—there is more interaction of patients with nurses than there is with doctors. Patients will know you better and might tell you more than they would tell a doctor.”	pediatrics and labor and delivery	B.S. in Biology---will earn B.S. in Nursing---maybe NP in the future
6	GP	F, 21	Catholic	She did not initially want to go into nursing; she loves children and was thinking of becoming a pediatrician	Her mother is a lab technologist in a hospital, so she has had exposure to hospitals over the years	“Very hands-on”	pediatrics	B.S. in Biology, will take pre-reqs and apply for accelerated nursing programs
7	TP	F, 25	Public	She initially wanted to go to medical school. What made her change her mind? She volunteered in a hospital, and observed the roles of the doctors and nurses.	Nurses and doctors in the hospital where she volunteered	“Nursing was more who I wanted to see myself as--- helping rather than diagnosing.”	“I like nursing--- there is a lot you can go into--- education, health promotion—you can become an NP or a DNP.”	B.S. in Biology--- am in accelerated nursing program at NYU/ I might go on to become an NP or DNP.

Table 1, continued								
8	KL	F, 22	Public	At SFC, she originally studied to become a radiographer, but realized that she could do more. She has also looked into PA. She thinks that she always wanted to be a nurse, but that it seemed like, "everyone else was going into it, and she wanted to be different".	Her mother was a nurse.	She feels that in nursing one can get "intimate or closer to the patient and establish a relationship."	Neonatal or geriatrics	B. S. in Nursing
9	AC	F, 25	Catholic	She always wanted to go into the medical field, she just wasn't sure about which area.	She has a distant cousin who is an NP, and has influenced her to become interested in starting her own business.	She is going into nursing, as she is "giving back" to others who have helped her (she has lupus).	"medical aesthetics" such as using Botox for migraines.	B. S. in Biology and B.S. in Nursing--NP
10	AB	F, 23	Public	"I was not initially interested in nursing---I wanted to go to medical school. However, I decided that I did not want to commit to the education involved".	Dr. Burdowski (a professor and a dean)	"We have the most interaction with the patients."	Neonatal and ER	B.S. Biology and B.S. Nursing "I am not sure I want to go further than the BS degree---the responsibility of prescribing medication as an NP scares me a bit".
11	AP	M, 21	Catholic	He also did not want to spend the time it takes to become a doctor. He has become an EMT, and he sees how hard and how long the doctors work---many are 35 and still in residencies.	His mother has been a nurse for years, and has recently become a school nurse. She also works per diem with the Visiting Nurses Association (VNA).	He talks to nurses and finds that they are very happy and less stressed, compensated well, and they have flexibility.	medical surgery, per diem for the VNA, run a nursing home (?)	Downstate's Accelerated Nursing Program, and started in June 2017, maybe NP
12	GG	M, 22	Public	"I was first interested in medical school---nursing was my second choice. I realized that my family had financial limitations and that it would be very expensive to go to medical school."	Medical personnel he met over the years.	"hands-on profession--the doctors go from patient to patient---the nurses spend more time with the patient."	NP, nurse anesthetist	He has a BS in Biology; He wants to start his career in nursing and possibly become a nurse practitioner or nurse anesthetist.

Table 1, continued

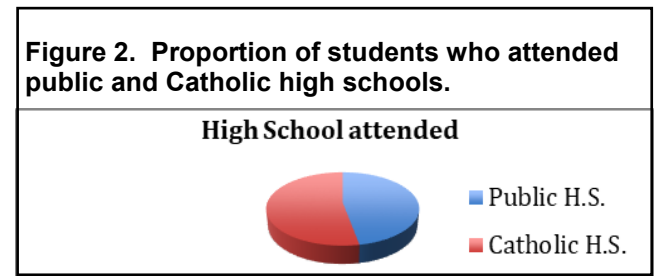
13	DE	M, 23	Catholic	He finished his Bio degree, but originally wanted to go to medical school. He also thought about PA. However, he realized it would be a lot of money. He felt that nursing would be a quicker, perhaps less competitive career path, that would lead to greater independence than a PA if he became a nurse practitioner.	His little brother who died of leukemia when he was four.	"I like the holistic approach to nursing in which one integrates philosophy, spirituality, mental and physical parameters of health into the treatment of the patient."		B.S. in Biology and a B.S. in Nursing
14	KC	M, 25	Public	Initially wanted to go to medical school or become a PA, was worried about his prospects as a PA, so he looked into the nursing school at SFC.	His mother is a doctor.	What he likes about the profession is the caring for people and working with people.	Pursue more education, and maybe go into research. What area of research would he like to go into? "We will see where it goes. I do like pediatrics."	B.S. in Biology and a B.S. in Nursing
15	MR	M, 31	Catholic	He started out pre-med, and even finished 2 yrs. of medical school! Always wanted to be a nurse!	He was influenced by the nurses at St. Vincent's Hospital	"I wanted to build relationships with people. To me, that is the most important thing about nursing. "	Neonatal ICU and Nursing education	B.S. Biology, B.S. Nursing, Masters in Nursing Education— might pursue Ph.D. in Nursing.
16	IR	M, 21	Catholic	He wanted to do something medical--he is now a paramedic. He wanted to become a doctor but due to money and family responsibilities decided not to.	Medical personnel he met over the years.	He feels that nurses help patients more---"there is a certain level of comfort that only nurses can achieve. Doctors see a patient as a puzzle to be solved. Nurses provide care plans---it is a more holistic style of medicine."	Critical care, ER	2-3 years as a floor nurse and venture into critical care and ER. And then eventually become a CNRA
17	M M	M, 29	Public	"I originally wanted to be a pharmacist (well, there was family pressure to do so). Then I wanted to be a doctor of a PA---I did get into a Caribbean medical school, but I did not want to leave the area."	"I had recently been married and my wife brought up nursing and how it would suit me well."	"the opportunity to grow in an area and the flexibility"	general	B.S. in Biology B.S. in Nursing



Q's 2 and 3. The ages of the ten females ranged from 21 to 29; the age of the seven males ranged from 21-31.

Q 4. Table 2. Number of males and females that attended Catholic and public high schools.

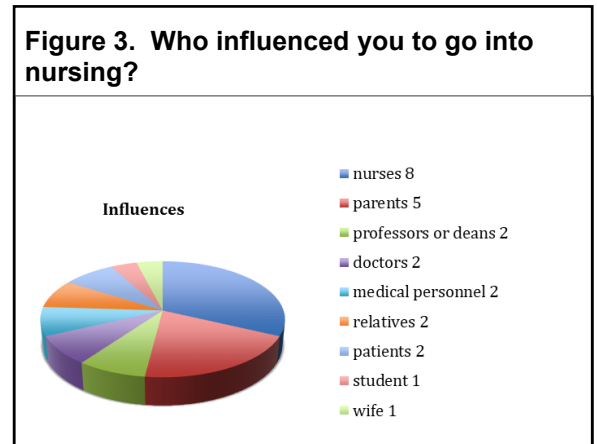
Gender	Catholic H.S.	Public H.S.
Female	5	5
Male	4	3



Some, but not all, initially wanted to become medical doctors or physician assistants, but changed their minds. Thirteen wanted to be medical doctors or physician assistants, two were not sure but wanted something medically related, one wanted to become a radiographer, and one wanted to become a pharmacist. Their reasons were a mix: economic—meaning that they could get their degree faster and have less debt. One got into a Caribbean medical school, but did not want to leave the area. One said that she did not want to put in the work required.

Q 7. Who influenced the respondents to go into nursing?

Nurses themselves would be the most obvious influence, but other medical personnel and doctors had an influence as well. Parents, a wife, and relatives also had influence---in two cases the nurses were also mothers of the students. One mother was a medical technologist, and another was a doctor. Two patients that died influenced two of the students to go into nursing, in one case, the patient was a relative. A student influenced one of our biology majors to go into nursing; professors had a slight influence. (One professor is also the pre-med advisor.)



Q 8. Why the respondents like nursing.

The number one reason that students liked nursing is that the profession gave them the opportunity to work closely with patients. Nine out of 17 or 53% gave this as their top answer. Some said it was “hands-on”, and others said it allowed them to “build relationships” with the patients. Two (a male and a female) noted that nursing was a “helping” rather than a “diagnosing” type profession. One student mentioned that for physicians it was like solving a puzzle, whereas nursing is more about caring for the patient. Two males mentioned that it was a “holistic” profession that treated the whole person. Six or 35% of the students noted that nursing was a faster route to a good-paying career. One male was disturbed that

establishing oneself as a doctor could take a long time; others mentioned that they did not want to take the time to study so hard and for so long to become a doctor. Three saw nursing as having a high potential for growth, two males liked the flexible schedules, one who suffers from lupus likes the idea of giving back, and two stated that an NP has more independence than a PA.

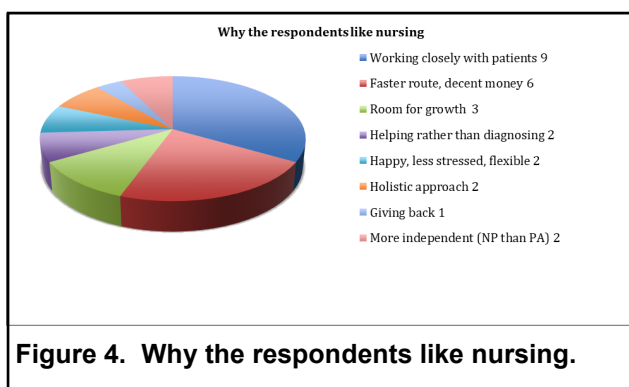


Figure 4. Why the respondents like nursing.

Q 9. Areas in nursing that respondents are interested in.

Areas respondents aspire to go into are varied: general, pediatric oncology, labor and delivery, pediatrics, pediatric oncology, labor and delivery, pediatrics, education, health promotion, general, neonatal, geriatrics, medical aesthetics (run own business), neonatal, ER, medical surgery, visiting nursing, administration (run a nursing home), anesthesia, research, pediatrics, neonatal ICU, nursing education, critical care, ER—25

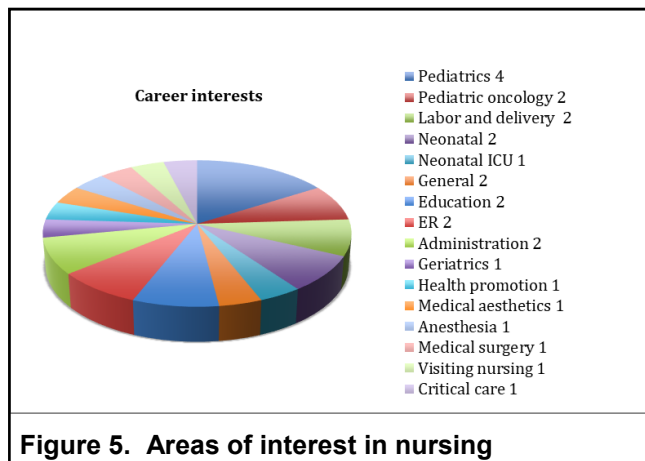


Figure 5. Areas of interest in nursing

interests in all of 16 unique choices.

Forty-four percent of the possible choices in nursing related to children or newborns. It is interesting that only one person mentioned geriatrics as a field of nursing to enter, considering that that is where 60% of the jobs in nursing will be in five years!

Q 10. Educational background and additional education to which respondents might aspire.

Fourteen out of the 17 (82%) hold a B.S. in Biology (one will graduate in January, 2018.). Out of that group seven are in or have completed an additional two years at SFC to obtain their B.S. in Nursing. Out of the remaining seven biology degree holders, three are in accelerated nursing programs, three want to apply to accelerated nursing programs, and one has graduated with an accelerated B.S. in nursing plus a masters degree in nursing education. Two of the 17 started out as bio majors but have switched to the SFC Nursing program. One started out in bio but has switched to the Health Promotion major and will apply to accelerated nursing programs. Nine respondents expressed an interest in possibly furthering their education and becoming either NP's, DNP's, nurse anesthetists, or Ph.D.'s.

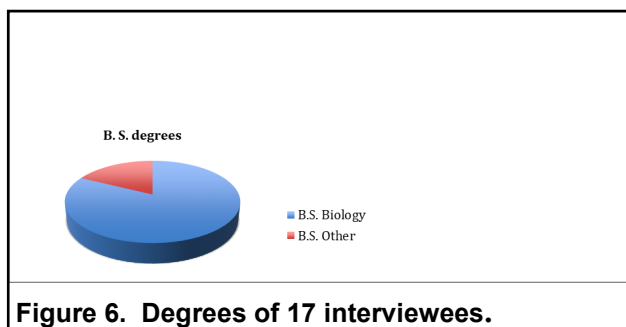


Figure 6. Degrees of 17 interviewees.

Table 3. Comments about gender issues in nursing.	
	Comments about gender—Question 11.
DL, F	No gender issues
SP, F	No gender issues
AP, F	“The ratio is about 7 females to 1 or 2 males. It is good to have males on the floor---they can especially help with the lifting of heavy patients.
KC, F	“I see mostly females in nursing---I believe that men like to go into something else---management, accounting, business, or even become doctors.”
EF, F	“There might be an issue in labor and delivery---perhaps women would want to have other women around when they were delivering a baby.”
GP, F	No gender issues---more male doctors in Greece than female doctors!
TP, F	“There are a greater number of females, but there are a lot of males surprisingly---the field is becoming more diverse in that sense---many also want to become practitioners.”
KL, F	“Anyone can become a nurse and males can do same things in nursing as females can. “
AC, F	“I see no gender issues.”
AB, F	“I see no gender issues for females in nursing: if I was a male I might feel funny---but there are many different areas that one can go into.“
AP, M	Doesn't have any issues with gender in nursing. Opportunities exist for everyone.
GG, M	“I might have a hard time---it is very female-oriented as it is a very caring profession. There might be lots of adapting.”
DE, M	“There is an even greater difference in Columbia than in the U.S. and I am encouraged by how in the U.S. many are at least striving for equality with their fairer treatment of LGBT. I know nursing has traditionally been a more female profession, as many of the original nurses were nuns, but I am all right with that. I will be able to integrate into nursing just fine.”
KC, M	“It is a little bit difficult---different---to be a caregiver.”
MR, M	“This might be difficult, especially in a neonatal unit, but that the young mothers have been very accepting of the males in their roles as nurses.”
IR, M	“Gender is sometimes seen as a problem from the women patients, who might feel uncomfortable around men with personal areas. Also, stereotypes exist, people back “home” say, it is a “women’s field”.
MM, M	“Men can give care to the patient—it might be different--- just as well as women can.”

.Q 11. Do you have any issues with gender?

Six out of 17 felt that there might be gender issues in nursing (one was an observation that more women than men go into nursing). One student did note that there were more male than female nurses in a hospital she went to in Greece (e-mail dated 7/14/17). Four of the seven men acknowledged that it might be difficult for two reasons: two men found that the caring aspects might be difficult---and two men felt (in addition to one woman) that the patients themselves might have difficulty accepting male nurses as their health facilitators. One

female and one male noted that stereotypes exist—the male said this existed especially among his friends and family who call nursing “women’s work”.

Discussion

Interviewees were diverse ethnically, and about the same percentage came from public (8) and Catholic (9) high schools. Information gleaned from interviewees depicted optimistic attitudes toward nursing. It appears that with more men entering the field, the roles may become more egalitarian. Some, but not all, initially wanted to become medical doctors or

physician assistants, but changed their minds. Thirteen wanted to be medical doctors or physician assistants, two were not sure but wanted something medically related, one wanted to become a radiographer, and one wanted to become a pharmacist. Their reasons were a mix: economic—meaning that that could get their degree faster and have less debt. One got into a Caribbean medical school, but did not want to leave the area. One said that she did not want to put in the work required. The respondents also did not dwell on their GPA or how difficult it is to study and take the MCAT.

Nurses, doctors, medical personnel, parents and relatives, spouses, patients, professors and administrators, and students influenced students to go into nursing. From looking at our data, we feel that professors could have a greater role in educating our students about what the possibilities in this field are. Also, since only one student was influenced by another student, we realize we could institute a peer-mentoring program with students and alumni from our nursing program. Some had health workers in their families, others did not.

Fifty-three percent chose caring as their top reason for going into nursing, with others going beyond this theme by discussing how physicians diagnose and nurses provide more hands-on care and that nurses take a holistic approach, including spiritual or mental well-being as well as physical aspects of care, and some saw nursing as developing a relationship with the person. Six or 35% of the students noted that nursing was a faster route to a good-paying career. This seems to be especially important to the SFC student. Our mission says: "...the College provides a quality, accessibly-priced education to students from the five boroughs of New York City..." Our students are not usually in the higher-earning echelons of NYC and most need to work for a living. One male noted that friends of his were still in a residency at 35 and others mentioned that they did not want to take the time to study so hard and for so long to become a doctor. Three liked that a nursing career had room for growth:

educationally, monetarily, and through opportunity. Two males liked the flexible schedules, especially one that has a young family, one who suffers from lupus likes the idea of giving back, and two stated that an NP has more independence than a PA. We feel that the professors and peer-student groups could also help make this latter fact better known to the students. Somers *et al.*⁸ define the caring group as "traditionalists" and the students interested in variety, mobility, and compensation as "instrumentals". They suggest that different marketing strategies could be utilized to attract additional potential nursing students.

We believe that student expectations match existing trends. For example, Curtis⁹ shows that salaries range from \$76 - \$80,000 for nurses in the Northeast. Salaries are slightly higher in the west, and 9.3% of nurses are male. Interestingly, our random survey was able to include 41% males. (Only 18% are interested in leaving their current positions, and 62% are expecting a salary raise.) When people do leave, it appears they do so to get better opportunities. However, even though the students chose 16 different areas in which they were interested in, forty-four percent chose fields that serve babies and children rather than our elderly. Only one out of 17 even mentioned geriatrics as a possible field. With a fast-paced growth rate of our elderly population, more might want to consider going into geriatrics. Since half of the patients admitted are over the age of 65 and only 1% of nurses have geriatric training, this might be a growth area for our students in the future (<https://www.bls.gov/ooh/health-care/registered-nurses.htm>). Giving our students articles about nursing, showing them videos, and having them talk to nursing students might open their minds to areas they may not have considered. For example, this is a quote from a nursing student at Fairfield University in Campbell¹⁰: "I know already that I want to work in the field of geriatrics. I have volunteered at a nursing home in my town at home for the past two summers, and I will be returning there this summer. Once I have clinical experience, I can actually do some of

the medical work at the nursing home." Haron¹¹ found that in a survey of students studying nursing, 61% had no intention of going into geriatrics, whereas when queried if training was provided, 27% of them would consider doing so in Israel. Cox *et al.*¹² did find that course work influenced students in their areas of choice in nursing. Coster *et al.*¹³ found that an interprofessional course introduced at the beginning of post-secondary education of students in a cross-section of health areas was the most effective in nursing majors. We at SFC are exploring such a course to be given to all incoming freshmen who express an interest in health careers.

Gender issues appeared to be difficult for some, but they were optimistic about surmounting them. This was more of an issue with the males than the females. One female observed that men did not seem to go into nursing, but did not really explore why that might be. One mentioned that even though nurses were originally nuns, he had no problem with becoming a nurse. One male and one female felt it might be difficult for female patients to accept male nurses, One male nurse already in the field said that women were usually accepting of male nurses, even in neonatal. One male has joined the NYC Chapter of the American Assembly for Men in Nursing (AAMN) that was founded in 2013. (The AAMN was founded nationally in 1971 <http://www.aamn.org> /.) Acquainting our male students with this organization might improve their recruitment into nursing. Evans and Frank¹⁴ note that, back in the early 2000's only 5% of nurses in the U.S. and Canada were men. Now it is up to 9.3%. They list reasons why men do not go into nursing and explore stereotypes. However, 13 years later in 2016, Twoney and Meadus¹⁵ found that despite stereotypes, 87% of the men interviewed were satisfied or highly satisfied with their career choice, and 81% would recommend nursing to a male colleague. We feel that in at least the seven males that we interviewed that there has been an attitude shift and the men seem more comfortable and

positive about their career choice than the eight men interviewed in Evans and Frank¹⁴. Liaw *et al.*¹⁶ suggest that students be reached earlier and that we also educate the parents in an effort to dispel gender stereotypes.

In the future we would like to expand our sample of interviewees as we found the information to be valuable in helping us shape further education of our biology and nursing majors. We did find that Price *et al.*¹⁷ found similar responses to ours in millennial nurses that they interviewed. Perhaps we will do comparisons of our 17 interviewees with additional students/alumni from SFC and other area colleges along with studies such as that done by Price¹⁷. Another area to research would be a survey of psychometric factors that may be influencing career choices, especially in nursing. Such an analysis was conducted by Shahhosseini¹⁸. In all cases, it is important to provide as much knowledge in many different ways (invited speakers, informational videos, articles, peer-mentoring groups) as possible to inform student choice, and, ultimately their happiness and satisfaction with a career. We are happy that our biology majors seem to be succeeding in finishing their nursing programs, which appears to be in contrast with the Salamonson *et al.*¹⁹ study that found that students who first began in nursing had more successful completion rates.

Acknowledgments

We would like to thank all of our students and alumni for participating in this project, and Kathleen Boyd for identifying some of the students for us.

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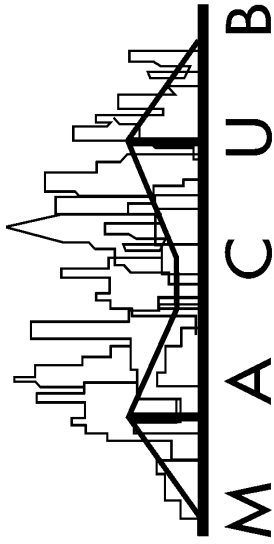
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