Pelvic Floor Research Group (PFRG) Day 2011

Improving prevention and treatment of women’s pelvic floor disorders.

Sponsored by grants from NIH SCOR (P50 HD44406), Office of the Vice President for Research, The Department of Obstetrics and Gynecology, and The Institute for Research on Women and Gender at the University of Michigan.
The Pelvic Floor Research Group at the University of Michigan Health System is an internationally recognized research group working to improve the understanding and treatment of women’s pelvic floor disorders (e.g., incontinence and prolapse). Our interdisciplinary assemblage of University of Michigan health care providers and researchers have two major areas of focus:

- discovering the basic mechanism underlying the problem of pelvic floor disorders (i.e., exactly what has gone wrong to cause pelvic floor problems) and
- putting the knowledge into practice with cutting-edge strategies for prevention and treatment of these common and distressing conditions

We approach these lines of investigation through four areas of research:

- using computer modeling to study injuries to the pelvic floor that occur during childbirth
- using advanced magnetic resonance imaging of the pelvic floor to study the details of pelvic floor injury in women with incontinence and prolapse
- developing innovative technologies for improving the assessment of pelvic floor muscle strength and urethral function
- using the detailed information from the studies to improve selection of patients for proper treatment

For more information visit our website: [www.med.umich.edu/pfrg](http://www.med.umich.edu/pfrg)
For pictures of our group visit us as: [www.pfrg.smugmug.com](http://www.pfrg.smugmug.com)
John R.G. Gosling Lectureship

Dr. John R. G. Gosling, M.D. was an associate professor of Obstetrics and Gynecology. He received many honors and awards during his lifelong career at the University, including the Markle Foundation Scholar Award, the University of Michigan Distinguished Service Award, and the prestigious Henry Russell Award. He published important and original works concerning gynecologic malignancy and medical education and held prominent positions in the Medical School. In 1991, in recognition of his many contributions, the physicians he trained established the John R.G. Gosling Lectureship in Obstetrics and Gynecology.

PFRG Day 2011 Key Note Speaker

“Obstetrical Anal Sphincter Injuries: What is the bottom line?”

Abdul H Sultan MB.ChB, MD, FRCOG
Department of Obstetrics and Gynecology
Croydon (Mayday) University Hospital, Surrey, UK
Honorary Reader, St. Georges University of London
www.perineum.net

Abdul Sultan is a Consultant Obstetrician and Gynecologist with a special interest in urogynecology at Croydon University Hospital, Surrey, UK. He has also been appointed an honorary Reader at St George’s University of London. He completed his basic medical training (MB.ChB) in South Africa prior to moving to the United Kingdom in 1984 and obtained the MRCOG degree in 1990. He did his post graduate training at the North Middlesex Hospital, Whips Cross Hospital and finally at St George’s Hospital with Professor Stuart Stanton. He conducted research under the supervision of Professor Chris Hudson at St Bartholomews and Homerton Hospitals and Professors Clive Bartram and Mike Kamm at St Mark’s Hospital. The research involved studying the effects of childbirth on the pelvic floor and anal sphincters. This led to a landmark paper published in the New England Journal of Medicine and to a Doctorate (MD). His pioneering work highlighted the deficiencies in training of doctors and midwives in detecting and repairing injuries to the perineum and anal sphincter after childbirth.

He has served on the Wellbeing of Women Committee (RCOG), the Scientific Advisory Committee (RCOG), the International Consultation on Incontinence and was a founder member of the British Society of Urogynecology. He is currently the treasurer of the obstetrics and gynaecology section of the Royal Society of Medicine and on the scientific committee of the International Urogynecological Association.
He is currently a consultant in a busy tertiary referral urogynecology department at Croydon University Hospital, with a large clinical workload, dealing with complex urogynaecological problems, teaching medical students, training junior doctors and undertaking clinical research. The program directors (Ranee Thakar and Abdul Sultan) conduct a subspecialty training program in urogynecology and in addition supervise four to six research fellows. The Croydon continence team was recently awarded the hospital doctor award for "The Continence Team of the year (2005)". In addition, Abdul Sultan was awarded the prestigious UK overall Hospital Doctor of the Year award. Along with Ranee Thakar, he runs the popular perineal repair courses at Croydon University Hospital. His has numerous publications in peer reviewed journals and many contributions to book chapters. He has also co-edited the first comprehensive book on perineal and anal sphincter trauma.

**Department of Obstetrics & Gynecology**

**Grand Rounds**

“Sex After Childbirth: Will it ever be the same again?”

RANEE THAKAR MD MRCOG

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Honorary Reader, St. Georges University of London

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Ranee Thakar is a Subspecialist in Urogynaecology and Consultant Obstetrician and Gynaecologist at Mayday University Hospital, Croydon as well as an honorary senior lecturer at St George’s University of London. She is the Honorary Secretary of the British Society of Urogynaecology (BSUG) and has just completed her three year term as the chair of the education committee of the International Urogynecological Association.

She is a consultant in a busy tertiary referral urogynaecology department at Mayday University Hospital, with a large clinical workload, dealing with complex urogynaecological problems, teaching medical students, training junior doctors and undertaking clinical research. Her publications include many original papers in peer review journals and chapters in books. She is the co-editor of the first comprehensive textbook on perineal and anal sphincter trauma. Along with Abdul Sultan she runs the popular perineal repair courses at Croydon University Hospital The unit is recognised for subspecialty training in urogynaecology and runs an active research programme. The Croydon continence team was awarded The UK Continence Team of the year in 2005.
Abernethy-Smith
MORBIDITY ASSOCIATED WITH THROMBOPROPHYLACTIC HEPARIN ADMINISTRATION IN THE SETTING OF VAGINAL SURGERY

Brincat, C
ASSESSMENT OF PELVIC FLOOR SYMPTOMS AND RECOVERY AFTER PRIMIPAROUS VAGINAL DELIVERIES WITH KNOWN RISK FACTORS FOR LEVATOR ANI INJURY

Berger, MB
CERVICAL ELONGATION IN PELVIC ORGAN PROLAPSE

Berger, MB
RACIAL DIFFERENCES IN HEALTHCARE SEEKING AND TREATMENT FOR URINARY INCONTINENCE

DeLancey, JOL
J. STRUCTURAL ALTERATIONS SEEN IN PELVIC FLOOR “ARCHITECTURAL DISTORTION”.

Fitzgerald, CM
PREGNANCY-RELATED PELVIC GIRDLE PAIN IS ASSOCIATED WITH DEEP PELVIC FLOOR MUSCLE TENDERNESS

Johnson, P
SELF-REPORTED EXPERIENCES OF RECURRENT PROLAPSE

Kim, J
AN ANATOMICAL AND HISTOLOGICAL STUDY OF THE HUMAN PUBOVISCERAL MUSCLE ORIGIN

Larson, K
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Luo, J
INTERACTIVE 3D MODEL OF MR-BASED PELVIC SUPPORT ANATOMY OF NORMAL WOMEN IN PDF FORMAT

Miller, JM
DIARY DATA SUBJECTED TO CLUSTER ANALYSIS OF INTAKE/OUTPUT/VOID HABITS WITH RESULTING CLUSTERS COMPARED BY CONTINENCE STATUS, AGE, RACE

Miller, JM
ON THE RELATIONSHIP BETWEEN OBJECTIVE MEASURES OF URINARY INCONTINENCE AND PHYSICAL ACTIVITY IN OLDER WOMEN

Miller, JM
SUSTAINABILITY OF RESPONSE TO THE KNACK MANEUVER FOR URINARY INCONTINENCE AT 1 YEAR.
Zielinski, RE
THE RELATIONSHIP BETWEEN PELVIC ORGAN PROLAPSE, GENITAL BODY IMAGE AND SEXUAL HEALTH

Zielinski, RE
VALIDITY AND RELIABILITY OF THE GENITAL SELF IMAGE SCALE
What is SCOR?
(cited from http://www.niams.nih.gov/funding/Funded_Research/orwh_scor.asp)

Specialized Centers of Research on Sex and Gender Factors Affecting Women’s Health

The Office of Research on Women’s Health (ORWH) serves as a focal point to promote, stimulate, and support efforts to improve the health of women through biomedical and behavioral research at the National Institutes of Health (NIH). ORWH works in partnership with the NIH institutes and centers, and other federal agencies to ensure that women's health research is part of the scientific framework at NIH and throughout the scientific community. Through this partnership, the ORWH established eleven SCORs to promote institutional interdisciplinary research in an area important to women's health. The specialized centers are co-funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), the National Institutes on Drug Abuse (NIDA), the National Institute of Mental Health (NIMH), and the National Institute of Environmental Health Sciences (NIEHS), and the Food and Drug Administration (FDA). The NIAMS provides administrative oversight for the centers.

Currently Funded SCOR Grants

Brigham and Women's Hospital
Fetal antecedents to sex differences in depression: a translational approach. Jill Goldstein, Ph.D., is the center director.

Medical University of South Carolina
Role of sex and gender differences in substance abuse relapse. Kathleen Brady, M. D., Ph.D., is the center director.

Northwestern University
Excess male hormones (androgens) as the key to explaining polycystic ovarian syndrome (PCOS). Andrea Dunaif, M.D., is the center director.

University of California, Los Angeles
A coordinated study of stress, pain, emotion, and sexual factors underlying the pelvic visceral disorders of irritable bowel disorder and interstitial cystitis. Emeran Mayer, M.D., is the center director.

University of California, San Francisco
Lower urinary tract function in women. Jeanette Brown, M.D., is center director.

University of Chicago
Sex steroids, sleep, and metabolic dysfunction in women. David Ehrmann, M.D., is the center director.

University of Miami
Sex and gender influences on addition and health: a developmental perspective. Emmalee Bandstra, M.D., is the center director.

University of Michigan, Ann Arbor
Birth, muscle injury, and pelvic floor dysfunction. John DeLancey, M.D., is the center director.

University of Missouri, Kansas City
Identifying the genes that put women at risk for osteoporosis. Hong-Wen Den, Ph.D., is the center director.
The molecular and epidemiologic basis of acute and recurrent urinary tract infections (UTI’s) in women. Scott Hultgren, Ph.D., is the center director.

Sex, stress, and substance use disorders. Rajita Sinha, Ph.D. is the center director.
Project Descriptions
This proposal seeks to improve care for the women who suffer the priority health conditions of pelvic floor dysfunction; problems that arise due to women’s unique role in giving birth. It addresses the sex disparities that exist in these problems. Each year 3 million women deliver babies and 300,000 women need surgery for pelvic floor dysfunction. A lack of basic understanding of the mechanisms of birth-related injury and recovery during reproductive years and mechanisms of prolapse later in life block efforts to prevent damage, improve recovery, or improve treatment. We seek continued support for a broadly interdisciplinary group of researchers from 4 schools and 2 institutes to that has expedited development of new knowledge needed to improve treatment and prevention.

Project 1: “Birth Biomechanics” will test hypotheses concerning basic mechanisms of pelvic floor injury during vaginal birth; the single largest factor in causing pelvic floor dysfunction to identify specific situations may increase or decrease injury risk.

Project 2: “Injury Recovery” will identify risk factors associated with levator injury, test the hypothesis that these injuries are, in fact, related to vaginal delivery and determine early predictors of eventual recovery.

Project 3, “Mechanisms of Posterior Vaginal Prolapse” will use advanced imaging and deformation analysis to test hypotheses concerning the basic disease mechanisms responsible for posterior vaginal wall prolapse, one of the most common and strongly birth-associated pelvic floor dysfunction.

Core A: Administrative / Human Subjects / Biostatistics core provides project support by recruiting subjects, compiling and analyzing data and protecting subject safety. In Core A, two study groups will be formed concerning 1) Gender Impact and 2) Basic Science Futures to discuss expanding the issues raised by this research.

Core B: Measurement and Imaging core will provide technical support for the projects along with integrated analysis for 2 and 3 dimensional spatial data gathered across projects. This research will produce insights to address the women’s health problem of pelvic floor dysfunction.
The overall goal of this research is to better understand the mechanisms of maternal vaginal birth related injury at the end of the second stage of labor. The main factor affecting the resistance of the pelvic floor muscles to stretch as they resist the downward descent of the fetal head is their viscoelastic material properties. The effect of term pregnancy on these properties has never been documented, partly due to the difficulty of obtaining sample of undamaged human pelvic floor tissues during birth.

In AIM 1, therefore, we will use equi-biaxial testing and stepwise stress relaxation assays to characterize the effect of term pregnancy on the constitutive law and mechanical behavior of mammalian pelvic floor tissues in rat and squirrel monkey. Uniaxial failure tests will also be conducted to determine the effect of pregnancy and test direction on the ultimate tensile stress in these tissues.

In AIM 2.1 we will develop a subject-specific, 3-D finite element biomechanical model of the second stage of labor from Station +2 on with representations of the fetal head, five major pelvic floor muscles and related soft tissues, as well as the time-varying maternal expulsive force. In AIM 2.2 we will validate the model predictions by comparing them against the results of in vivo experiments in pregnant women. These involve the measured temporal displacement of a posterior weighted speculum at C-section, and the time course of the increase in vaginal diameter upon fetal head crowning.

In AIM 2.3 we will investigate the effect of (a) fetal head orientation, (b) cephalopelvic disproportion, (c) maternal sub-pubic arch angle, (d) epidural, (3) forceps use, and (f) episiotomy of the magnitude, direction and location of a maximum pelvic floor muscle tissue stress. The ration of that stress to the ultimate tensile stress I taken as a measure of the risk of tissue injury, and should lead to better methods of preventing these injuries.
Magnetic resonance imaging data suggest a strong relationship between childbirth and structural pelvic floor injury, likely originating from stretch or crush of maternal tissues during the expulsive phase of labor. The pelvic floor muscle most vulnerable to injury is the striated pubovisceral muscle (PVM); 11-20% of parous women demonstrate a muscle defect at a year postpartum. A link between this defect and pelvic floor disorders has been found in our preliminary studies; women with prolapse and incontinence have a 4 fold- and 2 fold- higher rate of PVM defects respectively. This finding offers a plausible causal link between pelvic floor disorders and a structural injury that occurs at childbirth. The cause of the defect is not yet known; nerve or muscle injury might be the underlying mechanism. Serial MRI offers the ability to observe PVM defects over time and differentiate: 1) neurogenic injury (degeneration over time), 2) myogenic injury (early and permanent avulsion), or 3) fully recoverable injury. Injury type can then be correlated with obstetric risk factors and functional recovery. This study’s aims are to: 1) Establish the validity of factors used to identify women with greatest likelihood of PVM injury by estimating the probability of each injury outcome classified at 6 months postpartum in a sample (n=125) enriched for risk factors of long duration of 2nd stage, instrumented delivery, 3rd or 4th degree perineal lacerations, macrosomic infant. 2) Establish that PVM injuries are associated with vaginal births vs. pregnancy by comparing our 125 women who birthed vaginally to 50 women who birthed by elective Caesarean. 3) Determine the extent to which an array of clinical parameters observed at 6 weeks postpartum will predict long term (6 months) muscle outcomes. To do so, we will obtain MRI’s at 2 weeks and 6 months postpartum and perform functional PVM testing at the standard 6-week postpartum evaluation. We will classify putative injury types and correlate with risk factors and functional parameters. We will try to address the knowledge gaps identified at the March 2006 NIH convened State-of-the-Science Conference: Cesarean Delivery on Maternal Request, which highlighted the need for understanding the mechanisms and risk factors for PVM injury. The short-term goal is new insights on injury mechanism. The long-term goal is prevention of and better treatment for pelvic floor disorders.
Mechanisms of Posterior Vaginal Prolapse  
(SCOR2 Project 3)  
Principal Investigator: John O.L. DeLancey, M.D.  
August 1, 2007 – August 31, 2012  

Posterior vaginal wall prolapse (PVP), including enterocele and rectocele, is an enigmatic condition whose pathophysiology is poorly understood. ORWH, NICHD and NIDDK have each identified that female pelvic floor disorders such as PVP are in critical need of pathophysiology research. Competing hypotheses have been proposed relating to the causal roles of endopelvic fascia or levator ani muscle failure. However, data to resolve these conflicts are not available and are needed to establish the relative contributions of fascial and muscular abnormalities to PVP. This study will test the mechanistic hypothesis that the occurrence of PVP is not explained by a single mechanism but involves the interaction between fascial and muscle abnormalities. To test these hypotheses, we will recruit 75 cases with PVP and 75 controls of similar age and race.  

**Aim 1, “Fascia”**, we will use mid-sagittal MR images made during maximal Valsalva to document the posterior wall location and morphology in 4 regions influenced by fascial support: 1) location of the posterior vaginal apex, 2) length of the posterior vaginal wall, 3) changes in the inclination of the distal vaginal wall, and 4) location of the perineal body. By comparing measurements between cases and controls, we will determine the contributions of abnormalities in each region to the occurrence and size of PVP.  

**Aim 2, “Muscle”**, we will use multiplanar proton density MR scans to compare 1) presence of visible defects in the levator ani muscles, 2) cross sectional areas of the muscle, as well as measuring and 3) pelvic muscle contraction force during a maximal contraction. Using these data we will determine the contribution of muscular abnormalities. We will then use statistical modeling to determine the relative contributions of fascial versus muscular abnormalities.  

**Aim 3, “Rectocele vs. Enterocele”**, we will test the strength of association between the 4 fascial and 3 muscle abnormalities and the two types of PVP using general linear modeling.  

**Aim 4, “Biomechanical Modeling”**, we will use biomechanical analyses of fascia and muscle interactions in computer-based models to investigate patterns of muscle and connective tissue support site failures that lead to PVP. These insights are needed to advance our understanding of disease mechanisms so that we can reduce the 30% recurrence rate of prolapse after surgery, and develop preventative strategies to reduce the need for surgery in 200,000 women each year.
Core A - Administrative, Human Subjects, Biostatistics
(SCOR2)
Principal Investigator: John O.L. DeLancey, M.D.
August 1, 2007 – August 31, 2012

Core A will be responsible for the following four services to unify, support, and coordinate the 3 projects in this SCOR. Aim 1 Administration: Core A will provide administrative support to Projects 1, 2 and 3 for recruitment, subject scheduling, forms generation, IRB issues, organization and confidential filing. In addition, it will file group renewal reports, generate, manage and plan project budgets, schedule group meetings, discussion groups, and seminars. Aim 2: Fostering Sex and Gender Research: Core A will seek to stimulate further research with the following activities 2a) Gender Impact Studies Group discussion to consider the personal and societal impact of these problems unique to women, 2b) Support, maintain and expand the SCOR Pelvic Floor Disorders Databank of over 12,000 images of over 600 research subjects from prior and ongoing projects 2c) convene an annual campus wide SCOR sponsored Pelvic Floor Research Day to foster interdisciplinary discussion 2d) Sponsor a National Workshop in Future Directions in Pelvic Floor Basic Science Research at the American Urogynecologic Society meeting. Aim 3 Biostatistics: Core A will manage data and work with project investigators to properly test study hypotheses. This will include overseeing data forms, data entry and management, biostatistical analysis and data quality control. Aim 4 Human Subjects: The core will assure Human Subject safety through active involvement with our IRB committee. This involvement will assure compliance with institutional and national regulations, tracking and assessing subject safety by monitoring adverse events, providing information to our outside subject safety committee as necessary. Core A will prepare regular reports from centralized logs concerning adverse events across all projects to increase detection of infrequent events that may occur in different projects.

Core B – Measurement and Imaging
(SCOR2)
Principal Investigator: James A. Ashton-Miller, Ph.D.
August 1, 2007 – August 31, 2012

The Measurement and Imaging Core will assist with measurements of perineal geometry during the late second stage of labor in 50 women, and of pelvic floor load-displacement behavior in 32 women using a posterior weighted speculum at the time of pelvic surgery. The Core will assist with clinical measurements and standardized data sets from magnetic resonance (MR) imaging to be made on the 175 and 150 women completing Projects 2 and 3, respectively. In Projects 2 & 3, subject-specific pelvic floor model geometries will be developed from reconstructing the magnetic resonance (MR) images. Additionally, in Project 2 the post natal recovery of normal MR signal intensity will be tracked over time in the pubovisceral muscles. In Project 3, MR measurements of posterior vaginal wall geometry will be made. Lastly, the Core will provide bioengineering and technical support to each project. For Projects 2 & 3 it will provide technical support for all urethral pressure measurements (MUCPR R and MUCPMVC) to be made using 8F catheter, maintain the hardware and software of the instrumented speculum used to measure levator ani contractile properties (LA R and LA MVC), and analyze and provide cleaned data sets to Core A for statistical analysis.
Mechanisms of Anterior Wall Support Failure
(OPAL3)
Sponsor: NIH
Principal Investigator: John O.L. DeLancey, M.D.
August 10, 2010 – March 31, 2015

Anterior vaginal wall prolapse (AVP), clinically known as cystocele, is the most common type of pelvic organ prolapse. It is also the most common site of recurrent prolapse after surgery. The goal of this ongoing grant is to further our understanding of its basic mechanics and to seek insights that will improve prevention and cure of this condition; an effort identified by the NIH as a priority women’s health issue. We have discovered a pattern of soft tissue distortion where the lateral vaginal wall extends beyond its normal location and comes into contact with the obturator internus muscle; a pattern we have termed architectural distortion (AD). AD occurs in a structurally important region of the AVW support system where interconnections between three key support structures exist: 1) the arcus tendineus fascia pelvis (ATFP); 2) arcus tendineus levator ani (ATLA); and 3) the pubic portion of the levator ani muscle (LAP). While women with prolapse have an increased occurrence of AD there is an important knowledge gap concerning the structural changes in the fascia and muscles that link AD to prolapse. In addition, the biomechanical factors that cause an increase in anterior vaginal descent with AD are not known. We will make and measure complex MR-based volumetric pelvic floor models including the key support structures based on our existing MR scans from at least 504 subjects (276 cases and 228 controls) acquired during our ongoing NIH funded investigations to test the following mechanistic hypotheses in Aim 1 and 2.

Aim 1: What structural changes are present in AD? Using scans from 26 subjects with unilateral AD (in whom a normal side can be compared), we will test structural hypotheses concerning differences between the three key structures in AD and normal sides. To confirm that unilateral AD is similar to bilateral AD, we will also compare the normal and AD sides of women with unilateral AD, to bilateral AD and to normal women.

Aim 2: Relative contributions of AD and LAP cross sectional area to AVW prolapse. Using the geometric and structural data we will collect from 232 cases and 186 matched asymptomatic controls, we will use general linear statistical models to determine how fascial and muscle status interact with AD to explain the occurrence and size of anterior vaginal wall prolapse. In Aim 3: Biomechanical Modeling of AVW prolapse and AD we will develop, refine, and validate a 3rd generation 3-D finite element biomechanical model and use it to test hypotheses concerning the structural effects of the alterations found in Aims 1 and 2 on the basic mechanics of anterior vaginal wall prolapse. We will then use this model to examine specific mechanistic hypotheses concerning the interaction between changes in connective tissue material properties and the development of prolapse in a repetitively loaded system. These insights are needed so that advances in basic pathomechanics of anterior vaginal wall prolapse can be used to improve treatment by identifying mechanisms associated with treatment failure and opportunities for injury prevention at birth.
Defining Measures and Events of Normal Delivery to Predict Pelvic Floor Damage (DiMEND)

Sponsor: MICHRYR
Principal Investigator: Lisa Kane Low, PhD, CNM, FACNM

Over 200,000 women require surgery annually for prolapse, making it the most common pelvic floor dysfunction requiring surgery. Despite compelling evidence that vaginal birth is the most important modifiable etiologic factor for prolapse, potentially causal events have not been identified to explain the 4- to 11-fold increase in prolapse after vaginal birth.

Two factors have impeded the research into potentially causal events for prolapse. The first factor was the long lag time between exposure to events during vaginal birth and symptoms of prolapse later in life. Recent research using magnetic resonance imaging (MRI) has partially resolved the first factor by providing evidence of the type of muscle defect that occurs to the support muscles of the pelvic organs, specifically the levator ani, that results from vaginal birth. Birth induced damage to the levator ani muscle is a primary cause of prolapse 60% of the time later in life. With this surrogate marker, it is now feasible to study contemporaneously the potential birth events underlying the injury that are associated with the expected later development of prolapse.

A second factor impeding the research: the paucity of detail about the events of second stage when levator damage occurs. At the bedside, nurses and other health care providers make multiple clinical assessments of the progress that a woman is making in 2nd stage. Yet the details of these physical events and care responses largely go undocumented. The dynamics of the 2nd stage are typically summed up as a length of time. Without detailed documentation of 2nd stage events, it is not possible to determine the specifics of when and how injury occurred. Thus, the specific aim of this study is to:

AIM 1: Develop a set of precise measures for 2nd stage labor events and
   1.a Determine the reliability of the measures and validity of a subset of measures.

A prospective, observational, clinical investigation will be conducted, recruiting 25 primigravida women at 36 weeks gestation, to achieve a planned final sample size of 20 women after vaginal birth. The events of second stage will be quantified and characterized using observational techniques and reliability of the measures and validity of selected measures will be confirmed.

If the incidence of prolapse can be prevented by even 20%, that would reduce the number of women who experience surgery by 25,000 annually, thereby sparing women the pain and health systems the significant costs.
Despite compelling evidence that pelvic floor muscle training (PFMT) reduces childbearing women’s risk of urinary incontinence (UI) by up to 39-59% 1;2;3, too few childbearing women adopt and sustain this practice. Recent review reaffirms PFMT as recommended practice during pregnancy/postpartum 4, but only 20-52% of childbearing women report its use 5;3;6. Moreover, virtually all previous trials of self-care to prevent UI have been with Caucasian women. Our RCT with older women testing the UI prevention efficacy of a combined PFMT and bladder training (BT) self-management program applied Bandura’s 7 self-efficacy theory: the intervention was taught in an intensive class and demonstrated a two-fold preventive effect 8. Furthermore, adherence to PFMT was high (82% at 3 months post instruction) and sustained (68% at 12 months) 9. These results encourage us to extend our current study (NIH R01 NR07618, PI C. Sampselle) with this competing continuation. To assure adequate racial/ethnic representation, we will over sample African American and Hispanic women using community-based sites that serve diverse patients. Aim 1 will determine the efficacy of an intensive antenatal Bladder Health Class to prevent UI at 12 months postpartum in a diverse sample of African American, Caucasian, and Hispanic childbearing women. Aim 2 will examine the capacity of adherence to mediate the association of self-efficacy with UI incidence. Aim 3 will explore the attitudes and strategies among 3 racial/ethnic groups that facilitate or deter adherence. Aim 4 will explore the efficacy of the Bladder Health class at 3 years post index birth. To accomplish Aims 1 and 4, we will conduct a single-blind RCT following intention-to-treat assumptions taking race/ethnicity into account. To accomplish Aim 2, we will assess the role of adherence as a mediator of the relationship between self-efficacy and UI. If Aim 1 hypotheses are supported, an intensive Bladder Health Class could become the standard of care for maternity patients. Aim 2 & 3 results will provide insights re: the mediating role of adherence and about facilitators/barriers to self-management. Aim 4 results will yield much needed long term data regarding the potential benefit of these UI preventive self-care practices. Ultimately we intend to mount an effectiveness RCT, which will be informed by the results of the study proposed here.
More than one in three US women suffers from the distressing, embarrassing, and often unreported problem of urinary incontinence (UI).\(^1\)\(^2\) UI severity increases with age and the financial cost exceeds $19 billion per year.\(^3\) Based on level A evidence, the Adult Conservative Management Committee of the 2008 International Consultation on Incontinence concluded that “pelvic floor muscle training (PFMT) should be offered as first line therapy to all women with stress, urge, or mixed UI;” and that bladder training (BT) may be preferred to drug therapy.\(^4\) Conservative strategies are low risk and differ from other forms of UI management in that they do not prejudice future treatments. We reasoned that such self-management practices should also prevent UI and conducted a RCT to test a prevention behavior modification program, called the Bladder Health Class. This group teaching session presented an array of conservative self-management practices—PFMT, BT and the Knack Maneuver, which is a preemptive contraction to decrease stress UI and/or suppress urge UI.\(^11\) At 12-months post-intervention we found a two-fold UI prevention effect.\(^12\) Moreover, we found high and sustained adherence: 82% at 3 months post intervention and 68% at 12 months.\(^13\) At four years follow-up, we found sustained adherence of 70% that was predicted by early self-efficacy.\(^14\) This intervention is novel because it enables women to adopt and sustain efficacious bladder health practices for incontinence prevention, whereas to date conservative management approaches have focused on treatment. Based on what we now know, these practices should be part of standard well woman care, but it is not realistic to expect busy clinicians to provide this information within the confines of a brief encounter. We have developed a DVD that is a condensed version of the group session; it is culturally sensitive and has yielded comparable levels of knowledge and self-efficacy. We aim to compare the efficacy and cost-effectiveness of the group session to the DVD version by randomizing 600 women aged 55 years and older to a two-armed RCT with follow-up points at 3-months, 12-months, and 24-months post-intervention. Controlling for age and BMI, we will test the hypotheses:

HO1: There will be no difference in incidence of UI demonstrated by each group (PRIMARY AIM)

HO2: There will be no group difference in self-management knowledge immediately post intervention

HO3: There will be no group difference in level of self-efficacy immediately post intervention

Further, we will conduct an economic analysis comparing the two-hour session with the DVD version. Describing the costs and analyzing the willingness to pay and employment data will be the primary focus of this study in order to create the foundation for a future cost-effectiveness analysis, should trial hypotheses be confirmed. Finally, we will conduct interviews at 36 months post intervention to explore characteristics of the intervention that contribute to long-term sustainability. Our long-range objective is to provide an intervention suitable for wide-spread translation into standard well woman care to advance UI prevention.
Poster Abstracts
MORBIDITY ASSOCIATED WITH THROMBOPROPHYLACTIC HEPARIN ADMINISTRATION IN THE SETTING OF VAGINAL SURGERY
Abernethy-Smith M, Larson K, Berger MB, Fenner DE, DeLancey JOL, Morgan DM.

Objectives: Current guidelines recommend the use of subcutaneously injected unfractionated heparin for at-risk patients; however, complications associated with heparin-thromboprophylaxis for gynecologic surgeries are not well described. The objective of this study was to describe among women undergoing vaginal surgery for pelvic organ prolapse the morbidity associated with unfractionated heparin to prevent venous thromboembolic events.

Methods: A retrospective chart review was undertaken of 454 patients identified by billing records as having undergone a sacrospinous ligament suspension at a tertiary care center between 1998 and 2003. Heparin administration was abstracted from inpatient pharmacy records. Transfusion was confirmed through blood bank records and verified as necessary due to excessive blood loss related to the initial surgical procedure. Complication rates were compared using chi square analysis and comparisons in hematologic parameters calculated with two sample t-tests (Stata v9.2).

Results: Prophylactic unfractionated heparin was administered subcutaneously twice daily to 330 (73%) women. The rate of postoperative symptomatic anemia leading to blood transfusion was higher women who received heparin compared with those who did not (2.4% v 0%, p=0.08). There was no difference between those who did and did not receive heparin in mean (± SD) percent hematocrit preoperatively (39.1 ± 2.8 v 39.5 ± 3.1, p=.227), postoperatively (32.3 ± 3.0 v 32.8 ± 3.4, p=.153) or in the change between pre and post operative values (6.8 ± 2.6 v 6.8 ± 3.0, p=.998). One woman who received heparin developed a large hematoma that required transfusion during her initial post operative course and then a second surgery for irrigation and drainage when it became infected. The number of patients who developed a venous thromboembolic event did not differ between those who did and did not receive heparin (0% v 0.30%, p=.533).

Conclusions: Among women undergoing vaginal prolapse surgery, administration of prophylactic doses of unfractionated heparin is associated with a marginally increased risk of postoperative anemia requiring blood transfusion. The lack of a difference in any hematologic parameters suggests that there may be a small number of patients who are at higher risk for hemorrhagic events but whose risk factors for such an event have not been identified. Thromboembolic events appear to be rare among patients having vaginal surgery for prolapse.
Hypothesis / aims of study: The aim of our descriptive study was to investigate if primiparous women showed different patterns of pelvic floor disorder symptoms and recovery when differentiated prospectively by levator ani (LA) status. Cross-sectional studies show that women with pelvic floor dysfunction postpartum have higher odds of demonstrating a levator ani tear. Yet, it is not known if women with levator ani injuries are more likely to have pelvic floor dysfunction.

Study design, materials and methods: This analysis examined clinical data from a pilot study of nineteen primiparas. Inclusion criteria was based on having obstetric risk factors associated with LA tears: second stage greater than 150 minutes, instrumented delivery, and/or anal sphincter tears as identified by chart review [1]. The longitudinal study design included investigation by MRI and clinical examinations performed “early” and “late” in the first half year postpartum. The early time point was on average 29.4 +/- 8.7 days and the late time point was on average 207.9 +/- 14.3 days postpartum. Immediately after the early postpartum time point we grouped the women according to whether their LA muscles were fully intact (Controls) or showed any tear (Cases) on MRI [2].

Clinical measures included: standing stress test-to assess demonstrable SUI, quantification of leakage with the Antonakos leakage index questionnaire, severity of fecal incontinence with the Wexner questionnaire, quantification of pelvic organ prolapse with the POP-Q, and functional strength of the LA muscles as quantified by instrumented speculum. Mean urethral closure was measured as maximal urethral closure pressure at rest and during a pelvic muscle contraction (Kegel urethral closure pressure - KUCP) using an 8F Gaeltec (Medical Measurements Incorporated, Hackensack, NJ) urodynamic catheter.

At the early clinic visits, all participants were instructed in pelvic floor muscle identification and contraction control and were assigned home practice of graduated strength training [3].

Results: Nine women were classified as Cases and 10 as Controls, based on their initial MRI findings. The mean age of the sample was 28 years (SD=3.91), and the mean BMI was 25.08 (SD=3.97). Cases and controls did not differ significantly on age or BMI. Three of the 19 women were unable to return for the late MRI. For the clinical outcomes data, missing data was due to any or a combination of the following factors: attrition, discomfort during the exam such that the clinician investigator chose to defer examination, or instrument failure.

In assessing the distribution of symptoms by early and late time points and by MRI status, no clear pattern emerged to differentiate cases from controls according to clinical symptoms. Likewise, there were no statistically significant differences between any of the clinical symptoms by MRI status groups (Table 1).

Table 1: Clinical outcomes of LA injury at the early and Late postpartum time points.

<table>
<thead>
<tr>
<th></th>
<th>EARLY No injury</th>
<th>EARLY Any Injury</th>
<th>LATE No injury</th>
<th>LATE Any Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrable SUI *</td>
<td>0/10</td>
<td>2/6</td>
<td>1/8</td>
<td>1/6</td>
</tr>
<tr>
<td>Antonakos ≥ 2</td>
<td>4/10</td>
<td>4/6</td>
<td>3/8</td>
<td>4/6</td>
</tr>
<tr>
<td>Wexner ≥ 6</td>
<td>0/7</td>
<td>0/5</td>
<td>1/8</td>
<td>0/6</td>
</tr>
<tr>
<td>POP-Q: Ba ≥ -1</td>
<td>0/10</td>
<td>0/6</td>
<td>1/7</td>
<td>0/6</td>
</tr>
<tr>
<td>MUCP &lt;40 mmHg</td>
<td>**</td>
<td>**</td>
<td>0/7</td>
<td>2/6</td>
</tr>
<tr>
<td>KUCP &lt;50 mmHg</td>
<td>**</td>
<td>**</td>
<td>1/7</td>
<td>1/6</td>
</tr>
<tr>
<td>Strength per speculum &lt; 4 Newtons</td>
<td>2/10</td>
<td>0/5</td>
<td>0/7</td>
<td>0/6</td>
</tr>
</tbody>
</table>

*Results reported as number affected over sample size
**Not performed early due to study design and concern for patient discomfort
To further explore the data and to assess recovery potential, we computed the change scores between the clinical variables at the early versus late time point. There was a trend in the expected direction of slightly worse recovery rates in cases (Table 2).

Table 2: Change in clinical outcomes

<table>
<thead>
<tr>
<th></th>
<th>LATE n=16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No injury</td>
</tr>
<tr>
<td>Demonstrable SUI *</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>1/8</td>
</tr>
<tr>
<td>Worsened</td>
<td>0/8</td>
</tr>
<tr>
<td>No change</td>
<td>7/8</td>
</tr>
<tr>
<td>Antonakas</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>2/8</td>
</tr>
<tr>
<td>Worsened</td>
<td>3/8</td>
</tr>
<tr>
<td>No Change</td>
<td>4/8</td>
</tr>
<tr>
<td>Wexner</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>1/5</td>
</tr>
<tr>
<td>Worsened</td>
<td>3/5</td>
</tr>
<tr>
<td>No Change</td>
<td>1/5</td>
</tr>
<tr>
<td>POP-Q: Ba</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>1/7</td>
</tr>
<tr>
<td>Worsened</td>
<td>2/7</td>
</tr>
<tr>
<td>No Change</td>
<td>4/7</td>
</tr>
<tr>
<td>Strength per speculum</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>6/7</td>
</tr>
<tr>
<td>Worsened</td>
<td>0/7</td>
</tr>
<tr>
<td>No Change &gt; 1 Newton</td>
<td>1/7</td>
</tr>
</tbody>
</table>

*Results reported as number affected over sample size in those with data on both variables

Interpretation of results. In these 19 women recruited based on obstetric risk factors for LA tear at first birth, there was not a clear pattern of symptoms or recovery from symptoms based on the presence or absence of LA injury early postpartum. This differs from previous research that recruited based on symptoms, and established that symptoms are associated with rates of increased LA damage. Whether or not these findings would be maintained for the women with LA injury is unclear as pelvic floor disorders such as prolapse and fecal incontinence have a later onset than the timeframe of this study. Although not a powered analysis, this data has not been previously reported and is difficult to obtain. Further, in obtaining the data, we learned valuable lessons that will inform future investigation, including the ability to case-find women early with LA injury based on previously identified risk factors. This is complicated, since knowledge gained from too early clinical exams was selective, since women were sometimes too tender to tolerate the clinical exam portion of the study.
CERVICAL ELONGATION IN PELVIC ORGAN PROLAPSE
Berger MB, Ramanah R, DeLancey JOL

To examine the prevalence and extent of cervical elongation in women with pelvic organ prolapse and assess factors associated with its occurrence.

Measurements of cervical and uterine size at maximal Valsalva were made on 3T sagittal MRI images of 51 women with clinically-identified prolapse below the hymen (cases) and 46 controls with normal support acquired as part of an IRB-approved study of anterior/apical prolapse. The groups were matched for age, BMI, gravidity and parity. Exclusion criteria include prior hysterectomy, anatomically-distorting fibroids, women with posterior vaginal wall-predominant prolapse or subjects for whom image quality precluded accurate measurements. Measurements were determined independently by 2 authors using ImageJ software for MRI analysis, with the average used for final calculations. Statistical analyses were performed with the independent t-test.

Prolapse is associated with elongation of both the uterus and cervix (Table 1). The cervix measures 8.6 mm (36.4%) longer in cases than controls, whereas the uterus measures 13.5 mm (20.2%) longer in cases, suggesting that the cervix elongates proportionately more than the uterine corpus in women with prolapse, as demonstrated by the increase in the ratio of the cervical length to uterine length in cases.

We next determined a normal range of cervical length based on measurements of control subjects, with the upper limit of normal (mean + 1.96 standard deviations) found to be 34 mm. Cases were then stratified into women with and without normal cervical elongation based on this value. Among cases 39.2% had cervical elongation. Cases with cervical elongation have a greater degree of uterine prolapse based on Point C below the hymen in clinical POP-Q evaluation were younger and premenopausal (Table 2). By contrast, no statistically-significant difference in Point D was found.

Post-hoc secondary analysis with age-matching of the cases with and without cervical elongation was then performed and showed that both cervical and uterine elongation findings persisted.

Cervical elongation occurs in approximately 40% of women with anterior/apical prolapse. In these women, cervical elongation is associated with greater degrees of uterine descent and younger age, but Point D is not lower.

Table 1 – Pelvic Measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Controls Mean±SD</th>
<th>Cases Mean±SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical Length (mm)</td>
<td>23.6±5.2</td>
<td>32.2±11.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Uterine Length (mm)</td>
<td>67.1±13.6</td>
<td>80.6±17.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ratio Cervix:Uterus Length</td>
<td>0.35±0.05</td>
<td>0.39±0.08</td>
<td>0.004</td>
</tr>
</tbody>
</table>

Table 2 – Cases With and Without Cervical Elongation

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases with Normal Cervix Mean±SD</th>
<th>Cases with Elongated Cervix Mean±SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>57.7±10.1</td>
<td>50.5±10.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Proportion Postmenopausal</td>
<td>0.8±0.4</td>
<td>0.4±0.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Point C (cm)</td>
<td>-2.1±3.5</td>
<td>0.7±4.7</td>
<td>0.03</td>
</tr>
<tr>
<td>Point D (cm)</td>
<td>-5.9±2.7</td>
<td>-5.2±3.1</td>
<td>0.34</td>
</tr>
</tbody>
</table>
Hypothesis / aims of study

Epidemiological studies suggest that although urinary incontinence (UI) affects large numbers of women, many of the affected individuals do not seek care or treatment. The aims of this study are 1) to examine the prevalence of healthcare seeking amongst a population-based sample of black and white community-dwelling women with self-reported UI, 2) to examine barriers to treatment faced by women with UI, and 3) to investigate utilization of commonly used therapeutic modalities for incontinence.

Study design, materials and methods

This is a planned secondary analysis of a cross-sectional population-based epidemiological study of racial differences in the prevalence of urinary incontinence in community-dwelling women aged 35-64 years [1]. 2814 women were interviewed by telephone, of whom 571 (278 black and 293 white) self-identified as having urinary incontinence, defined as at least 12 episodes of involuntary urine loss within the prior 12 months, and were included in this study. Type of incontinence (stress, urge, mixed or below threshold) was based on a 10-item questionnaire modified from the MESA questionnaire. The subjects were asked if they had ever spoken with a healthcare provider about their UI. All subjects that had not spoken to a provider were queried about specific reasons for not doing so. The subjects were also asked about specific measures being used to manage their UI. All statistical analyses were performed with SAS software (version 9.1; SAS Institute, Cary, NC). Data reflect values weighted to represent the population from which the sample was taken, as previously described [1].

Results

Of the 571 women with self-reported UI, 51% responded that they had sought care from a healthcare provider. There was no statistically significant difference when comparing the percentages of black and white women seeking care for their incontinence (53% black, 51% white, p=0.64). The subjects that complained of having bothersome UI but who did not seek care were asked about specific reasons for not talking to a provider (Table 1). No statistically significant differences were noted between black and white respondents. By far the most common reason identified was the belief that nothing could be done for their UI.

<table>
<thead>
<tr>
<th>Reason For Not Seeking Care</th>
<th>Total % (N=258)</th>
<th>Black % (N=127)</th>
<th>White % (N=131)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctor Never Asked</td>
<td>9.1</td>
<td>6.5</td>
<td>9.7</td>
<td>0.47</td>
</tr>
<tr>
<td>Too Embarrassed</td>
<td>8.8</td>
<td>9.2</td>
<td>8.6</td>
<td>0.89</td>
</tr>
<tr>
<td>Didn’t Think Anything Could Be Done</td>
<td>94.2</td>
<td>93.7</td>
<td>94.4</td>
<td>0.85</td>
</tr>
<tr>
<td>Can’t Afford Doctor/No Health Insurance</td>
<td>7.6</td>
<td>4.3</td>
<td>8.4</td>
<td>0.32</td>
</tr>
<tr>
<td>Afraid of Doctors, Surgery, Medications, etc.</td>
<td>2.8</td>
<td>2.5</td>
<td>2.9</td>
<td>0.88</td>
</tr>
<tr>
<td>Other</td>
<td>81.7</td>
<td>87.1</td>
<td>80.9</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Of the incontinence management strategies presented to the subjects, multiple approaches were identified as being used by the respondents (Table 2). The only coping method for which there was a statistically-significant difference noted between the black and white respondents was fluid restriction (18.7% black, 10.3% white, p=0.01). In the subset of women who talked to a healthcare provider about their incontinence (not shown in table), similar percentages of black and white subjects reported that something was recommended or prescribed for incontinence (55.1% black, 65.8% white, p=0.12). Racial differences in management were noted in usage of Kegels (20.7% black,
32.7% white, p=0.02), fluid restriction (21.7% black, 10.7% white, p=0.007), and avoidance of provocational activities (5.4% black, 0.5% white, p=0.002).

Table 2 – Incontinence coping strategies utilized by all women with self-reported UI, regardless of health seeking behavior.

<table>
<thead>
<tr>
<th>Management Strategy</th>
<th>Total % (N=571)</th>
<th>Black % (N=278)</th>
<th>White % (N=293)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take Medications</td>
<td>8.5</td>
<td>9.0</td>
<td>8.4</td>
<td>0.84</td>
</tr>
<tr>
<td>Do Kegels</td>
<td>21.2</td>
<td>14.9</td>
<td>22.8</td>
<td>0.07</td>
</tr>
<tr>
<td>Locate Bathroom Immediately</td>
<td>12.3</td>
<td>14.3</td>
<td>11.8</td>
<td>0.47</td>
</tr>
<tr>
<td>Toilet Regularly</td>
<td>39.1</td>
<td>38.1</td>
<td>39.3</td>
<td>0.82</td>
</tr>
<tr>
<td>Restrict Fluids</td>
<td>12.0</td>
<td>18.7</td>
<td>10.3</td>
<td>0.01</td>
</tr>
<tr>
<td>Avoid Certain Foods or Beverages</td>
<td>5.8</td>
<td>8.6</td>
<td>5.1</td>
<td>0.15</td>
</tr>
<tr>
<td>Avoid Certain Exercises or Physical Activities</td>
<td>2.7</td>
<td>4.9</td>
<td>2.1</td>
<td>0.10</td>
</tr>
<tr>
<td>Wear Pads or Other Protection</td>
<td>59.2</td>
<td>60.8</td>
<td>58.8</td>
<td>0.70</td>
</tr>
<tr>
<td>Other</td>
<td>21.0</td>
<td>23.7</td>
<td>20.4</td>
<td>0.44</td>
</tr>
<tr>
<td>Do Nothing</td>
<td>8.7</td>
<td>8.3</td>
<td>8.8</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Interpretation of results

In this study, approximately one-half of the adult female population with self-reported urinary incontinence sought care from a healthcare provider. Similar percentages of black and white women sought care from a provider, and no major differences were noted between the racial groups in identifying demographic characteristics of those who seek care for incontinence (data not shown). Almost all of the subjects reported that they had not seen a healthcare provider regarding their incontinence, at least in part, due to a belief that nothing could be done for their problem. Black and white women largely use similar coping strategies to manage their UI. However, women who have sought care for their UI, black women are more likely to restrict fluid intake and avoid certain activities or exercises, whereas white women are more likely to perform Kegel exercises. These patterns of incontinence management are consistent with our previous finding that black women are more likely to suffer from urge UI, whereas white women are more likely to have stress urinary incontinence [1].

Few studies have examined care seeking behavior for UI in racially diverse groups. Like our study, the Boston Area Community Health (BACH) Survey is a cross-sectional examination of a community-based population, although its subjects were enrolled from a more urban population in a different geographic region [2]. A similarly low level of healthcare seeking behavior was noted in BACH, but the women who received care in Boston were noted to use medications and pelvic floor exercises at seemingly higher proportions than the women in our study. The Reproductive Risks of Incontinence (RRISK) Study from the Kaiser Permanente Medical Care Program of Northern California also examined care seeking in women of different racial backgrounds [3]. While the subjects in the RRISK Study were drawn from one integrated healthcare organization, were more ethnically diverse, and lived in a geographically and culturally different locale than the women in our study, similar behaviors were noted regarding seeking care and usage of different strategies for management of UI.

Concluding message

Despite its high prevalence and bother, only about half of women seek care from health providers for UI. Black and white women discuss incontinence with providers at similar frequencies, but there are significant differences between the groups regarding how they manage their UI. A better understanding of these differences may be useful for improving incontinence care. While no significant differences were noted between the groups regarding reasons for not seeking care, the vast majority of the women surveyed admitted that they did not discuss UI with a provider as they felt that it could not be treated. This suggests that targeted education about UI and its treatment are critical for improving women’s health.
STRUCTURAL ALTERATIONS SEEN IN PELVIC FLOOR “ARCHITECTURAL DISTORTION”.
DeLancey, J, Larson K.

Aim: Pelvic floor injuries due to women’s unique role in childbirth which result in pelvic organ prolapse are poorly understood. Recently an area of pelvic floor “architectural distortion” was discovered that is associated with prolapse. This study examines anatomical abnormalities involved in this injury to clarify mechanical factors responsible for prolapse.

Methods: MRI scans were examined from 14 women with unilateral architectural distortion where a normal side can be compared with an abnormal side in the same individual: ten women had pelvic floor disorders and four were normal. Detailed analysis of pelvic floor structures was carried out to identify injury-associated structural alterations. 3D models were made using 3D Slicer (Version 3.41.0) to investigate structural interactions.

Results: Mean age was 48.1 years (SD 12.6) and parity was 2.8 (SD 2.5). MR images reveal that the levator ani muscle’s pubic origin avulses from the superior pubic ramus on the pelvic sidewall with unilateral distortion. This results in downward displacement of the levator’s fascial arch from which the iliococcygeal muscle arises. Absence of the ventrally directed levator muscle attachment transferred tension from the anterior fascial arch to the posterior fascial arch lowering its location on the pelvic sidewall resulting in a lateral rather than a ventral direction of muscle action. This places the remaining levator in an unfavorable location from which to provide pelvic organ support.

Conclusion: Loss of the levator’s ventral attachment from the pubic bone results in dorsal movement of pelvic floor fascial structures placing them in unfavorable locations for support.
PREGNANCY-RELATED PELVIC GIRDLE PAIN IS ASSOCIATED WITH DEEP PELVIC FLOOR MUSCLE TENDERNESST
Fitzgerald, Colleen M, Mallinson, Trudy
Northwestern University Feinberg School of Medicine, Department of Physical Medicine and Rehabilitation, Chicago, IL and University of Southern California Division of Occupational Science and Occupational Therapy

Background: Pregnancy-related pelvic girdle pain (PGP) is common and can be disabling. Pelvic floor muscle dysfunction (abnormal motor control activation patterns) in pregnancy-related PGP has been previously described. The association of PFM tenderness and PGP in pregnancy has not been reported.

Objective: To determine if patients with PGP in pregnancy, defined by positive external musculoskeletal pain provocation tests, have associated vaginal PFM tenderness as compared with pregnant patients without PGP.

Methods: 47 pregnant women with and without PGP were recruited in the second trimester. Patients had to have at least 3/10 pain intensity or higher on self report and 2/4 positive PGP tests to be included in the pain cohort. External tests included the long dorsal ligament palpation test, the pubic symphysis palpation test, the posterior pelvic pain provocation test and the active straight leg raise test. An external and internal vaginal examination was then performed including right and left PFM tenderness defined as tender yes or no. 4 women (3 PGP and 1 no pain) were not included in the analysis because the vaginal exam was unable to be completed (refused or medically prohibited).

Results: 43 patients (19 with PGP and 24 without) were included in the analysis. Most patients in the PGP group had levator ani (17/19) and obturator internus (18/19) tenderness compared with few (4/24) in the no pain group (Fishers Exact Test (FET) P < .001). Neither the PGP group nor the no pain group had tenderness in the superficial muscles.

Conclusion: There is an association with PGP and deep but not superficial PFM tenderness in pregnancy. Whether deep PFM tenderness is the primary pain generator or a compensatory response to external musculoskeletal (pelvic joint) pain is yet unclear.
SELF-REPORTED EXPERIENCES OF RECURRENT PROLAPSE

Hypothesis / aims of study
The purpose of the study was to describe the characteristics and history of recurrent prolapse among women seeking Urogynecologic evaluation at a tertiary care center.

Study design, materials and methods
A convenience sampling of patients presenting to our Urogynecology clinic or undergoing surgical intervention at our center for recurrent pelvic organ prolapse (POP) between January 1998 and January 2010 were asked to complete a questionnaire. Individuals may have had more than one episode of recurrent POP. The recurrent POP at the time of presentation was regarded as the index prolapse. Patients were asked to characterize the index POP as well as reflect on past recurrences. The survey focused on information related to timing of their recurrence(s), symptoms of their index POP recurrence, and demographic characteristics (BMI, parity, hysterectomy and menopause status). Further characterization of the patient’s POP and the timeline of recurrence was accomplished by evaluation of the physician notes and medical records. Data were evaluated using descriptive statistics.

Results
Ninety-eight subjects completed the questionnaire regarding their recurrent POP, of which ninety-three had sufficient data for analysis. The participating women had a mean age of 62.9 ± 9.7 years, BMI of 27.9 ± 5.2 kg/m², and parity of 2.8 ± 1.2. Ninety-six percent were Caucasian, 3.0% African American, and 1.0% Asian. A majority were postmenopausal (91.2%) and had prior hysterectomy (95.7%, 69% of whom were for prolapse). Prior to presentation at our facility, all subjects had at least one surgical treatment for prolapse, and 46.2% had undergone multiple prior treatments (34.4% had two, 8.6% had three, and 3.2% had four or more).

Eighty-four percent of subjects (76/90) reported that they self-discovered the prolapse, while the remaining 16% (14/90) were diagnosed by their physician. Regardless of who discovered the prolapse, 31% of subjects reported that they had not informed their prior surgeon of their recurrence. The most common symptoms subjects associated with return of their prolapse were incomplete emptying of bowel (56.5%), urinary incontinence (55.3%), low back pain (51.8%), constipation (42.4%), and dyspareunia (40.0%). Thirty-four subjects, or 43% (n=79), reported their index symptoms were consistent with their prior POP symptoms. Fifty-six reflected on the severity of their symptoms, of which 46% (26/56) said that they were the same, while 38% (22/56) said they were more severe.

Subjects were stratified as having persistent prolapse if return of symptoms occurred within 3 months of prior surgery, and recurrent prolapse if they had relief of symptoms for at least 3 months after surgery. Patient recall of the return of symptoms showed that after the primary surgery for POP, 36% fell in the persistent category, while 64% (48/75) had recurrent POP with a mean 72.0 months of relief. After the second and third treatments, similar percentages were seen regarding persistence and recurrence (62.5% (15/24) had recurrent POP with a mean 38.6 months of relief, and 66.7% (4/6) had recurrent POP with a mean 22 months of relief, respectively). These proportions are not dependent on number of prior surgeries (p=0.98). Figure 1 illustrates these findings. The time intervals in months between successive treatments were as follows: after the first surgery, 89.5 ± 106.9; after the second surgery, 71.7 ± 77.9; and after the third surgery, 29.9 ± 25.2. Table 1 summarizes these findings.

Interpretation of results
From the convenience sampling of patients presenting to our institution with recurrent prolapse, most subjects discovered their prolapse themselves. One-third of patients reported they had not informed their prior surgeon of their recurrence. A majority of women felt that their symptoms were either the same or worse than prior to treatment. Regardless of the number of prior treatment failures,
approximately 40% of the time symptoms recurred within 3 months suggesting persistence of prolapse or failure of prior operative approach to achieve even short-term success. Approximately 60% had a longer interval to return of symptoms. While it appears that the mean time to return of symptoms and time to the next treatment decreases with each successive operation, there was too much variability within the data to be statistically significant (p=.31, p=.21, respectively).

Table 1. Patient Recall of Symptom Return and Treatment Timeline

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Return of symptoms*</th>
<th>Interval to next surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Surgery</td>
<td>72.0 ± 103.0 (n=48)</td>
<td>89.5 ± 106.9 (n=92)</td>
</tr>
<tr>
<td>Secondary Surgery</td>
<td>38.6 ± 40.7 (n=15)</td>
<td>71.7 ± 77.9 (n=31)</td>
</tr>
<tr>
<td>Tertiary Surgery</td>
<td>22 ± 8.8 (n=4)</td>
<td>29.9 ± 25.2 (n=8)</td>
</tr>
</tbody>
</table>

* among women in “recurrent population” with return of symptoms > 3 months

Figure 1. Percent of Persistent and Recurrent POPs with Each Successive Surgery

Concluding message
In this population, forty percent of patients have early recurrence, independent of the number of previous operative treatments, and most women report that their symptoms are the same or worse than prior episodes of prolapse. One-third of patients had not informed their surgeon of their recurrence suggesting that, as gynecologists, we may not have an accurate assessment of our outcomes.
AN ANATOMICAL AND HISTOLOGICAL STUDY OF THE HUMAN PUBOVISCERAL MUSCLE ORIGIN
Jinyong Kim, James Ashton-Miller, John DeLancey

OBJECTIVE: Avulsion of the pubovisceral muscle (PVM) from its pubic origin occurs in 15% of nullipara during vaginal birth and is associated with prolapse later in life. The nature of the PVM attachment to the pubic bone (the enthesis) that is subject to failure has not been examined. This study seeks to classify the PVM enthesis according to a formal classification system.

METHODS: Parasagittal sections of the pubic ramus, including the enthesis, parallel to PVM fiber direction were harvested from five female cadavers, 51 to 98 years of age, in the area of known PVM injury. Histological sections were prepared with Masson’s trichrome stains. Specimens were analyzed using software written in Matlab® to determine cross-sectional area and composition of muscle and connective tissue. Bands of 1 mm width located at 2 mm intervals along the PVM were used to collect image data so color-based segmentation could be performed.

RESULTS: The PVM enthesis is consistent with it being a fibrous rather than a fibrocartilaginous enthesis, because of an absence of fibrocartilaginous zones and tidemarks (Figure 1-A). PVM muscle fibers terminated in collagenous structures whose fibers inserted tangentially onto the periosteum of the posteroinferior pubic rami. The PVM enthesis was bounded by a collagenous fascia on both its ventral and dorsal surfaces until each merged with the periosteum 5 to 10 mm apart. The areas of connective tissue and muscle become equal approximately 7 mm from the pubic bone (Figure 1-B). Systematic thickening of the periosteum was not observed in the enthesial region, neither were Sharpey’s fibers observed. The enthesis extends from about 1 cm outside the pubic symphysis to about less than 1 cm lateral to where the superior pubic ramus extends out of the body of the pubic bone. The superficial and lateral region of the PVM takes origin from the arcus tendineus fascia pelvis.

CONCLUSION: The PVM enthesis is a fibrous enthesis arising tangentially from the periosteum of the pubic ramus. Because highly aligned Type 1 collagenous tissues, like tendon, are known to be two orders stronger than striated muscle, we conclude failure is likely to occur in the muscular portion of the enthesis.

Figure 1. (A) Parasagittal section through the PVM enthesis (red bracket) with Masson’s trichrome stain. (PVM = pubovisceral muscle; OIM = obturator internus muscle; PB = pubic bone; Scale bar = 2 mm). (B) Longitudinal distribution of muscle and connective tissue along the PVM enthesis. Values are mean (SD) areas within 1 mm-wide sampling bands taken normal to the enthesial line-of-action. The table shows the composition of muscle and connective tissue in each band at 2 mm intervals from the enthesial origin.
MICHIGAN FOUR WALL SACROSPINOUS LIGAMENT SUSPENSION: >5 YEAR SYMPTOMATIC OUTCOMES
Larson KA, Berger MB, Abernethy-Smith M, Fenner DE, DeLancey JOL, Morgan DM

Objectives: Describe long-term symptomatic outcomes of women who underwent Michigan four wall sacrospinous ligament suspension (SSLS) for the treatment of prolapse.

Methods: After IRB approval, 459 patients were identified by billing records as having undergone a SSLS at our tertiary care center between 1998-2003. Subjects were asked to complete a mailed questionnaire, including short forms of the Pelvic Floor Impact Questionnaire (PFIQ) and Pelvic Floor Distress Inventory (PFDI), and general questions regarding their health and satisfaction with the surgical results. Subjects rated their satisfaction on a continuous scale between 0-100% with anchors of 0, 25, 50, 75, and 100 indicating "not at all," "minimally," "moderately," "very," and "completely" satisfied. Women indicating >75% satisfaction or "very" satisfied were considered "Satisfied" while those indicating ≤75% were considered "Not satisfied." If subjects elected not to return the questionnaire, they had an option to sign a "Do not participate" form with 3 satisfaction questions. Of the original 459 subjects, 86 were deceased, "undeliverable," or later identified not having undergone a SSLS.

Results: Our response rate was 69% (257/373): 190 women completed the questionnaire, and 67 completed the "Do Not Participate" form which included three satisfaction questions. Mean time since surgery among these women was 8.4 ± 1.7 years. Mean age, vaginal parity, and BMI of those who answered the questionnaire were 64 ± 9 years, 3.2 ± 1.5 children, and 27.7 ± 5.1 kg/m2 respectively. Among women who completed the questionnaire, 78% (142/182) reported being "very" or "completely" satisfied with their surgery (score >75% satisfaction). Ninety-one percent (159/175) reported they would make the decision to have surgery again, and 85% (158/184) would recommend it to family or friends. Mean responses to validated questionnaires were the following: mean PFDI 48.9 ± 24.2 (with prolapse, colorectal and urinary subscale means of 6.7 ± 15, 41.7 ± 6.7, and 3.3 ± 11.6 respectively) and mean PFIQ 33.5 ± 57.2 (with prolapse, colorectal and urinary subscale means of 8.5 ± 19.8, 11.0 ± 21.3, and 15.1 ± 23.4 respectively). Within these PFIQ subscales, only impact of bladder symptoms (UIQ) are greater among those women who are "Not satisfied." There was a small, statistically significant but clinically insignificant difference in PFDI colorectal anal dysfunction subscale (CRADI) scores between the "Satisfied" and "Not satisfied women." Mean subscale scores for prolapse (POPDI) and urogenital symptoms measured (UDI-6) did not differ. Satisfaction responses among those who signed the "do not participate form" did not differ significantly from those who completed the questionnaire.

Conclusions: An average of 8.4 years after Michigan four wall sacrospinous suspension, over three quarters of women are very or completely satisfied with their results. Nine out of 10 would choose to undergo the surgery again or recommend it to a friend. Urinary symptoms were more common in those “Not satisfied.”
INTERACTIVE 3D MODEL OF MR-BASED PELVIC SUPPORT ANATOMY OF NORMAL WOMEN IN PDF FORMAT
Luo J, Ramanah T, Larson KA, Chen L, Ashton-Miller JA, DeLancey JOL.

Hypothesis / aims of study
Anatomical errors are often found in drawings that are not based directly on actual dissections. The same can be true for 3D models used for education. Most of the available pelvic floor models are based on demonstrating concepts of anatomy and are not taken directly from data acquired from living women whose pelvic floor status is known.

The aim of this study is to present detailed 3D models in a widely useable PDF interface made directly from high resolution MR scans of one nulliparous and one multiparous woman with proven normal support. These models include all 23 structures involved in pelvic organ support based on published descriptions of anatomical features as seen in MR images.

Study design, materials and methods
3D volumetric models were created from 1) the MR images of a 50th percentile 51 year-old healthy nulliparous woman and 2) a 50th percentile 45 year-old healthy multiparous woman recruited as normal controls in an IRB approved study. Multi-planar, two-dimensional, fast spin, proton density MR images were obtained using a 3 T superconducting magnet (Philips Medical Systems Inc, Bothell, WA) with version 2.5.1.0 software. The axial, sagittal and coronal fields of view were 20x20 cm, with slice thicknesses of 4 mm and a 1 mm gap between slices.

MR images from all three planes were imported into 3D Slicer 3.4.2009-10-15 (Brigham and Women’s Hospital, Boston, MA) [1] and aligned using auto registration and fixed landmarks. Each pelvic floor structure was traced from one most clearly visible axial or coronal plane and corresponding model was created. The degree of smoothing was adjusted to avoid artefacts. The models were compared to the original tracing to confirm fidelity to original scan.

The 3D models generated by 3D Slicer were first imported into Adobe 3D Reviewer 9.0 (Adobe Systems Incorporated, San Jose, CA) [2] or Pro/Engineer Wildfire 4.0 (Parametric Technology Corporation, Needham, MA) and then exported as universal 3D file (U3D) after setting up the properties of the model. The saved U3D was then inserted into Adobe Acrobat 9 Pro (Adobe Systems Incorporated, San Jose, CA) with 3D tool under Tools menu. After activating the 3D model by clicking the picture, the 3D PDF was customized to set up a preview and several optional views for readers.

Results
Figure 1 shows the 3D pelvic supports PDF model of the 50th percentile 45 year-old healthy multiparous woman.

Figure 1. Interactive 3D PDF model of pelvic supports. The left side shows the model tree through which readers can hide or isolate parts, or make parts transparent, or choose custom view. Structures can be grouped by system (e.g. bones, muscles, organs). The right top side
shows the 3D toolbar through which readers can zoom in and out, rotate, and pan across the object, make 3D measurements, or cut a cross section of the model. The PDF file can be downloaded from the internet (Download link, Open Password:ics2010) which has no any identification info.

The following manipulations can be performed after clicking the picture to activate the 3D model: 1) Display different combinations of structures, 2) Render any structure transparent, 3) Zoom in and out, rotate, and pan across the object, and 4) Cut model in any plane and at any level. Figure 2 shows 4 views of the 3D model.

Figure 2. A. 3D model is shown without bone to illustrate selected features. B. Transparencies of bladder and urethra to show the underlying structures. C. Middle sagittal cross section. D. Axial cross section. The bladder (B) and urethra (Ura) are yellow, the uterus (Ut) and vagina (V) are blue, the rectum (R) is dark brown, the cardinal ligament (CL) is light brown, the uterosacral ligament (USL) is light green, the perineal body (PeB) is green, the Levator Ani (LA) is purple, the external anal sphincter (EAS) and coccygeus (C) are red.

Interpretation of results
This study presents the interactive 3D models of pelvic supports based on real anatomy seen in MR scans of living women. These models were made using published descriptions of anatomical features as seen in MR images, to create the key structures involved pelvic organ disorders. It can be used as accurate examples to teach structural relationships in pelvic anatomy from 3D visualization. The ability to interact with the different structures facilitates learning complex anatomical relationships. Having models that are anatomically accurate is critical to avoiding errors in understanding that can arise from models conceptually based anatomy.

Embedding the 3D models into PDF has advantages over the limited views of 2D images in printed publication [3]. After activating the 3D model by clicking the image, readers can manipulate the 3D model to look into the details within the models, which is especially useful for the anatomy study of spatial relationships of complicated structures. These files can be read with the standard Adobe Reader from 7.0 and higher available as a free download (get.adobe.com/reader/) that is on most computers making it readily available to all learners. We believe this will become the new publication standard for information of this type.

Concluding message
Our study demonstrated that 3D PDF can present the interactive 3D detailed models of pelvic supports which can be viewed and manipulated by readers without any specialized visualization software.
DIARY DATA SUBJECTED TO CLUSTER ANALYSIS OF INTAKE/OUTPUT/VOID HABITS WITH RESULTING CLUSTERS COMPARED BY CONTINENCE STATUS, AGE, RACE
Miller JM, Gao Y, Becker Rodseth S, Fenner DE, DeLancey JO

Hypothesis / aims of study
Clinicians attempt to reduce and interpret the multi-factorial information contained on a voiding diary by subjectively reducing the differing aspects into a single, unified pattern presumed to be associated with a particular bladder health state. This process, however, has relied on subjective rather than objectively driven analysis. We analyzed diary data, from both continent and incontinent women, to identify simple, discrete, patterns that emerge from the full spectrum of intake/output variables when subjected to a statistical data-driven process. We: 1) used cluster analysis to look for naturally occurring groupings, 2) described and labelled the resulting clusters, and 3) profiled the clusters by comparing them across variables commonly associated with bladder health but external to the cluster analysis variables.

Study design, materials and methods
Participants included 352 community dwelling women of Black (n = 196) and White (n = 156) race who agreed to participate in the clinical portion of a parent population-based study on prevalence of urinary incontinence [1, 2]. The clinical portion of the study oversampled for incontinence. All interpretable 3-day intake/output/continence status diaries were evaluated. Six variables (void frequency during daytime hours, void frequency during night-time hours, modal output, total output, beverage intake, and BMI) were used for the cluster analyses. Cluster analysis requires the investigator to specify the number of clusters to extract. We selected to evaluate 3, 4, and 5 cluster models to compare classification results for best fit (most parsimonious yet distinct) using the six variables subjected to the analysis. The hierarchical tree clustering statistical technique is designed to identify homogenous groups within sets of data [3]. Once cluster groupings were revealed, we compared other diary variables of interest including proportion and amount of beverage “irritants” (coffee, tea, colas, alcohol, and juice), continence status, incontinence episodes; we also compared clusters by race (Black/White), education, and age.

Results
The 3 clusters model demonstrated best fit as compared to the 4 or 5 clusters models. Each of the three clusters that emerged differed significantly (p < .001) on all of the 6 variables used to construct them except BMI, as shown in Table 1. We descriptively labelled the three clusters “Conventional,” “Benchmark,” and “Supersize.”
Table 1 shows descriptive results of all clustering variables for all subjects. Results are expressed as Mean ± standard error; P values are computed by ANOVA test. Cluster comparison significance at 0.05 level is indicated by *. Bonferroni correction is used to adjust for multiple comparisons among the clusters.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total intake per Daytime (ml)</td>
<td>1320 ±375</td>
<td>2444 ±542</td>
<td>3773 ±912</td>
<td>&lt;0.001</td>
<td>0.626</td>
<td>3-2* 2-1* 1-3*</td>
</tr>
<tr>
<td>Total output during 24 Hr (ml)</td>
<td>1068 ±434</td>
<td>1907 ±437</td>
<td>3280 ±1066</td>
<td>&lt;0.001</td>
<td>0.689</td>
<td>3-2* 2-1* 1-3*</td>
</tr>
<tr>
<td>Modal output at daytime (ml)</td>
<td>289 ±143</td>
<td>444 ±201</td>
<td>646 ±209</td>
<td>&lt;0.001</td>
<td>0.278</td>
<td>3-2* 2-1* 1-3*</td>
</tr>
<tr>
<td>Num of voids daytime (count)</td>
<td>5.2 ±1.8</td>
<td>6.9 ±2.3</td>
<td>10.5 ±5.3</td>
<td>&lt;0.001</td>
<td>0.270</td>
<td>3-2* 2-1* 1-3*</td>
</tr>
<tr>
<td>Num of voids at night-time (count)</td>
<td>1.1 ±0.8</td>
<td>1.4 ±0.9</td>
<td>1.9 ±1.2</td>
<td>&lt;0.001</td>
<td>0.056</td>
<td>3-2* 2-1* 1-3*</td>
</tr>
<tr>
<td>BMI (points)</td>
<td>30.3 ±7.1</td>
<td>30.7 ±7.6</td>
<td>30.0 ±9.3</td>
<td>0.81</td>
<td>0.001</td>
<td>3-2 2-1 1-3</td>
</tr>
</tbody>
</table>

Table 2 shows comparison by clusters of clinical and demographic variables external to those used for the cluster analysis. For continuous variables (i.e., age), p values were computed by ANOVA test. Results are expressed as mean ± standard error; for categorical variables (i.e., race), P values were computed by chi-square test and results are expressed as numbers (percentages).

<table>
<thead>
<tr>
<th></th>
<th>Conventional (N=233)</th>
<th>Benchmark (N=96)</th>
<th>Supersize (N=23)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of Bladder irritants intake (ml)</td>
<td>1310 ±373</td>
<td>2417 ±559</td>
<td>3318 ±110</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Proportion of bladder irritants</td>
<td>0.64 ±0.3</td>
<td>0.58 ±0.3</td>
<td>0.65 ±0.3</td>
<td>0.27</td>
</tr>
<tr>
<td>Incontinence episodes/day (average)</td>
<td>0.9 ±1</td>
<td>1.2 ±2</td>
<td>2.0 ±3</td>
<td>0.02</td>
</tr>
<tr>
<td>Incontinence episodes/day (n &amp; %)</td>
<td></td>
<td></td>
<td></td>
<td>0.05</td>
</tr>
<tr>
<td>0 leakages (n=164)</td>
<td>114 (41.7%)</td>
<td>40 (48.9%)</td>
<td>10 (43.5%)</td>
<td></td>
</tr>
<tr>
<td>0&lt; leakages = 1 (n=97)</td>
<td>66 (30.2%)</td>
<td>29 (28.3%)</td>
<td>2 (8.7%)</td>
<td></td>
</tr>
<tr>
<td>leakages &gt; 1 (n=91)</td>
<td>53 (28.1%)</td>
<td>27 (22.8%)</td>
<td>11 (47.8%)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>White</td>
<td>82 (35.2%)</td>
<td>58 (60.4%)</td>
<td>16 (69.6%)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>151 (64.8%)</td>
<td>38 (39.6%)</td>
<td>7 (30.4%)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>49.7 ±8.1</td>
<td>49.2 ±7.7</td>
<td>53.3 ±7.4</td>
<td>0.08</td>
</tr>
<tr>
<td>Education (years)</td>
<td>14.2 ±2.0</td>
<td>14.4 ±2.1</td>
<td>14.0 ±2.2</td>
<td>0.60</td>
</tr>
</tbody>
</table>
Table 2 shows that the proportion of beverage irritant to non-irritant intake did not differ significantly by clusters, but the absolute amount of irritants did differ with the Benchmark cluster nearly double, and Supersize cluster nearly triple, compared with the Conventional cluster (p<.001). The Supersize cluster had greatest incontinence severity and was predominantly of White race. Age and education did not differ across the clusters.

**Interpretation of results**
There is no agreed-upon standard, simple, yet comprehensive classification system for voiding diaries. Our results offer an objective and data-derived 3-cluster schema with labels of “Conventional,” “Benchmark,” and “Supersize” paralleling the descriptive parameters that emerged. This 3-cluster categorization schema solves a difficult data management issue for both clinicians and researchers, and opens the door to scrutiny of whether pre-conceived notions of “healthy bladder behaviors” are supported by actual data. For instance, the advice to drink at least 8 glasses of water per day does not appear to be protective against leakage.

**Concluding message**
Identification of three discrete clusters of diary data provides a parsimonious but data-driven means of classifying individuals for additional epidemiological or clinical study. The research and clinical utility rests with the simplicity of classification, and the potential for intervening to move an individual from high risk to low risk cluster with regards to incontinence.
ON THE RELATIONSHIP BETWEEN OBJECTIVE MEASURES OF URINARY INCONTINENCE AND PHYSICAL ACTIVITY IN OLDER WOMEN
Miller J, McConnachie H, Ashton-Miller J, Sampselle C

Hypothesis / Aims of study
Urinary incontinence is known to be inversely related to activity levels when studied by population-based, self-report, mailed survey data ([1] [2]. But the relationship between objective measures of urinary incontinence and physical activity in clinically studied, well-characterized incontinent women has not been documented. We therefore studied incontinent women in the clinic to test the following hypothesis: H1) those who leaked urine on an objective standing stress test will have significantly lower physical activity scores compared to those with a dry standing stress test, and H2) in the subset of women who do leak on standing stress test, there will be a positive correlation between self-reported frequency of that leakage and physical activity scores.

Study Design, Materials and Methods
Baseline data were available from 52 women enrolled in a parent prospective clinical trial. Criteria were: female, 60 years or older, ambulatory, mentally intact with Mini-Mental State scores above 23, community dwelling, and self-reported history of leakage with coughing. Exclusion criteria included prior urethral or bladder surgery, current urinary tract infection, or prolapse below the level of the hymenal ring. Women with symptoms of urge incontinence in addition to stress urinary incontinence were permitted to participate. Presence of objectively tested stress-related urine loss was demonstrated by a paper towel standing stress test using 3 hard coughs (designated the ‘SST’).

Frequency of stress-related urine loss was determined by questionnaire prior to the standing stress test using the following question: “Do you ever leak urine or lose control of urination during physical activity?”; response categories were: ‘never’, ‘few times per year’, ‘few times per month’, ‘few times per week’, or ‘daily’. Physical activity was measured via the Yale Physical Activity Survey (YPAS), a reliable and well-validated interview instrument specific to older adults [3] with two components: the YPAS I elicits information about very specific physical activities and the YPAS II is calculated for general activity categories and includes a seasonal adjustment.

Results
Of the n=46 participants who had complete data including subjective report of UI with cough, 67% demonstrated stress incontinence as positive for leakage on the SST. An independent-samples t-test was conducted to compare the YPAS scores for SST negative (n=15) and SST positive (n=31) women, using both YPAS I and YPAS II scores independently for analysis. For YPAS I scores, no statistical difference was found between groups. For YPAS II, higher physical activity scores were found for SST negative women (mean [SD]: 125.70 [70.12] points) compared to SST positive women (77.56 [57.79] points, P < .05. The magnitude of the differences in the means was large (eta squared = 0.12), indicating that women with demonstrable stress incontinence participate less in physical activity.

To further explore the data, the YPAS II scores were
analyzed in a subset of participants with positive SST and positive response to the questionnaire item regarding leakage during physical activity (n=25). A positive correlation between the YPAS II score and the frequency of leakage experienced (R=0.446, p=0.025) was demonstrated, indicating that when women with demonstrable SUI do participate in greater activity levels it is indeed associated with greater frequency of leakage. Figure 2 portrays the Yale II data and questionnaire item data graded leakage few/year (coded 1) few/mo (coded 2) few/wk (coded 3), or daily (coded 4).

**Interpretation of Results**

Of the women who reported leakage on coughing, those with demonstrable leakage showed curtailed physical activity levels compared to those who were dry on SST. These findings are further strengthened by the fact that reported leakage frequency with physical activity was positively correlated with the YPAS II score. These findings are consistent with our hypotheses and support prior work from survey data, while adding specificity of incontinence type through objective demonstration of stress-type leakage. Although our study design cannot speak to cause and effect, our data suggest that SUI is a barrier to physical activity because as an incontinent older woman increases her physical activity she experiences the negative feedback of increased frequency of urinary leakage. We speculate that the YPAS I did not show differences between women with and without positive standing stress test because of its focus on very specific activities, such as childcare, golfing, or home repair, which study participants may or may not be engaged in due to person preference, income, or social situation.

Study Limitations: Our sample size was small, however adequate power was indicated by the large effect size demonstrated in the analysis using the YPAS II scores. A larger sample may offer more insight into the YPAS I score analysis. Use of longitudinal data would permit determination of whether the onset of stress incontinence predicts a decrease in physical activity in women or, alternatively, if lower activity levels predates stress incontinence onset.

**Concluding Message**

This study underscores and adds to the accumulating body of evidence on the potential negative effect that objectively demonstrable stress incontinence can have on the physical activity of older women. Clinical implications of the findings point to use of pessaries or other forms of treatment for exercise-related exacerbation of symptoms, a component that should not be overlooked in a population of older clinical patients with mixed urinary incontinence.
SUSTAINABILITY OF RESPONSE TO THE KNACK MANEUVER FOR URINARY INCONTINENCE AT 1 YEAR.
Miller J, Parks L, Misiunas R, Tolbert M, Ashton-Miller JA, DeLancey JOL.

Aims: The Knack maneuver is a simple treatment for incontinence that teaches women the habit of activating their pelvic floor muscles at the moment of expected incontinence (e.g. cough). It is known to help 60% of women 1-3 months after intervention. This study evaluates sustainability of positive response at 12 months.

Methods: Of the 97 women who were early short term responders (one to three months) in studies treating stress or mixed incontinence, 57 volunteered to return for 1-year follow-up. Positive response was defined as improvement of 50% or more on at least 2 of 3 outcome variables: 1) incontinence episodes on a three-day diary, 2) measured leakage during stress maneuvers in clinic at a standardized bladder volume of 250ml and 3) self-reported improvement on a visual analogue scale from 0 – 100%.

Results: At 12 months 45 of 57 women (79%) continued to experience positive response. Average leaks on diary were reduced compared to baseline from a mean (SD) of 3.5 (2.9) to 1.5 (2.0) leaks per day (p < .0005). Wetted area on the paper towel reduced, from 48.4 cm² to 12.9 cm², (p < .006). Median subjective improvement on visual analogue was 75%.

Conclusion: Five out of six women that respond to Knack training after short-term treatment continue to demonstrate more than 50% reduction in incontinence at 12 months despite not performing any muscle strengthening exercises or having contact with study personnel.
THE RELATIONSHIP BETWEEN PELVIC ORGAN PROLAPSE, GENITAL BODY IMAGE AND SEXUAL HEALTH
Zielinski RE, Miller JM, Kane-Low L

Aims of study:
Because prolapse can present as a bulge outside of the body we wondered about its affect on women’s genital body image. While body image in general has been well studied, providing evidence that body image dissatisfaction is increasing in women [1], scant data exists on the relationship between prolapse and body image specific to women’s genitals. Sampling from both women with and without prolapse, the purpose of this study was to test the following hypotheses:

H1. Women with pelvic organ prolapse will have significantly greater genital body image dissatisfaction than age matched control participants.

H2. There will be a significant correlation between severity of prolapse and genital body image dissatisfaction.

H3. In both women with and without prolapse there will be a significant correlation between genital body image and sexual function,

H4. There will be a significant correlation between genital body image and overall body image

Study design, materials and methods:
Women who had participated in a previous study of pelvic floor disorders [2] who indicated they were willing to be recruited for future studies were the population used in this study. In the initial study (enrollment occurred between 2000 and 2004) POPQ examinations were performed and the participants were dichotomized into prolapse (POP-Q point at least 1 cm below the hymen) or controls (no POP-Q point lower than -1). The remainder of the data was collected via survey methodology. Women who indicated they were willing to be recruited for future studies (N = 123) were first sent an introductory letter, then unless they opted out they were sent questionnaires two weeks later by postal mail. The Genital Self Image Scale was administered, a 20 item (0-40 range) scale with higher scores indicating more positive genital body image. Additionally, overall body image was assessed using the Body Esteem Scale which includes three subscales, Weight, Appearance and Attributes. Sexual health was assessed using the Female Sexual Function Index which includes 6 subscales, Desire, Lubrication, Arousal, Orgasm, Satisfaction and Pain. Analysis included descriptive statistics, correlations between genital body image and overall body image, partial correlations between genital body image and sexual health (to control for overall body image) and independent T-tests to compare groups.

Results:
Survey response rate was 78% (Prolapse = 50, Controls = 46). Mean age (sd) for the women with prolapse was 60.3, and mean age for the control participants was 58.1, and 37 from each group indicated that they were sexually active.

Women with pelvic organ prolapse exhibited significantly lower genital body image scores (M = 29.15) than the age matched control women (M = 32.63, p < .05). However, H4 was not supported in that there was not a significant correlation between severity of prolapse and genital body image (r = .152).

For both participants with prolapse as well as the age matched controls (who indicated that they were sexually active) there was a significant positive correlation between genital body image and overall sexual function as well as several of the sexual health subscales, (See Table 1),
TABLE 1

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Prolapse Group (N = 37)</th>
<th>Control group (N = 37)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GENITAL SELF IMAGE SCALE</td>
<td>GENITAL SELF IMAGE SCALE</td>
</tr>
<tr>
<td>Female Sexual Function</td>
<td>.430*</td>
<td>.463**</td>
</tr>
<tr>
<td>Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual Desire</td>
<td>.332</td>
<td>.379*</td>
</tr>
<tr>
<td>Lubrication</td>
<td>.243</td>
<td>.376*</td>
</tr>
<tr>
<td>Sexual Arousal</td>
<td>.319</td>
<td>.323</td>
</tr>
<tr>
<td>Orgasm</td>
<td>.404*</td>
<td>.324</td>
</tr>
<tr>
<td>Sexual Satisfaction</td>
<td>.556*</td>
<td>.409*</td>
</tr>
<tr>
<td>Pain with intercourse</td>
<td>.189</td>
<td>.344*</td>
</tr>
</tbody>
</table>

** p < .01 (2 tailed) * p < .05 (2 tailed)

In both women with pelvic organ prolapse and those without prolapse there were significant partial correlations between genital body image and overall body image (See Table 2).

TABLE 2

<table>
<thead>
<tr>
<th>PARTICIPANT GROUP</th>
<th>Participants with Prolapse (N = 37, mean age = 60.3 years)</th>
<th>Age matched controls (N = 37, mean age = 58.1 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Genital Self Image Scale</td>
<td>Genital Self Image Scale</td>
</tr>
<tr>
<td>Body Esteem Scale - Total</td>
<td>.423*</td>
<td>.443*</td>
</tr>
<tr>
<td>Weight Subscale</td>
<td>.339</td>
<td>.281</td>
</tr>
<tr>
<td>Appearance Subscale</td>
<td>.553**</td>
<td>.504**</td>
</tr>
<tr>
<td>Attributes Subscale</td>
<td>.237</td>
<td>.476*</td>
</tr>
</tbody>
</table>

** p<.01 (2 tailed) * p< .05 (2 tailed)

Interpretation of results:

Our study was designed to overcome some of the limitations of previous studies by using an age matched control group and a measure of body image specific to the genital area. The results provide preliminary evidence that women with pelvic organ prolapse experience more genital body image dissatisfaction than women of the same age that do not have prolapse.

There are limitations associated with these findings. The majority of the women in this study were Caucasian, educated, and heterosexual, limiting the generalizability to other populations. In addition, clinic data was collected several years prior to this study, for this reason women who indicated they had undergone surgery for their prolapse were excluded from the analysis of the relationship between severity of prolapse and genital body image.

Concluding message:

Women with pelvic organ prolapse demonstrate significantly more genital body image dissatisfaction that does not seem to be dependent on the severity of the prolapse. This initial pilot work provides a foundation for future investigation between the relationships between prolapse and genital body image and how these relationships may influence decisions regarding treatment (i.e. watchful waiting vs. surgical correction).
VALIDITY AND RELIABILITY OF THE GENITAL SELF IMAGE SCALE
Zielinski RE, Kane-Low L, Miller JM

Aims of study:
Body image dissatisfaction is increasing in women [1]. Also increasing is the numbers of women undergoing genital cosmetic surgery [2], suggesting that for some women body image dissatisfaction may extend to those parts of their bodies that are usually hidden from view, their genitals. Anecdotally, woman’s genital body image is purported to be affected by vaginal childbirth and pelvic organ prolapse. Yet, data to support these relationships and relate genital body image to a broad variety of clinical phenomena is limited by lack of adequate assessment tools. The Genital Self Image Scale (GSIS) [3] is a 29 item previously published scale designed to measure genital body image, limited by the lack of established reliability and validity. This study’s purpose was to establish reliability and validity of the GSIS.

Study design, materials and methods
To test the GSIS, we used a study design following standard procedures for validity and reliability testing of psychometric scales. For content validity, 5 experts assessed the content representativeness of the items within the scale. The experts used were two urogynecologists, one OB/GYN, and two sex therapists. The experts were asked to rate the relevance of each item and to indicate if they felt content was missing from the scale. Individual items in the scale were assessed; if an item in the scale was rated relevant/very relevant by at least four of the five experts was considered valid. A content validity index was created for the entire scale by quantifying the extent of agreement between experts using the alpha coefficient.

For the next portion of validity and reliability testing study participants were recruited using purposeful sampling to provide variance by including women with and without life events associated with genital changes. Nulliparous women were recruited from an undergraduate Women’s Studies course, women with prolapse as well as age matched controls were participants from a previous study, and a limited chart review was performed to identify women after vaginal birth with significant genital tract trauma (forceps, vacuum, 3rd and 4th degree lacerations. We used exploratory and confirmatory factor analysis to determine if the scale adequately measures and reflects the desired constructs. Internal reliability (the extent to which the items are all measuring the same construct) was assessed for each group using Cronbach’s Alpha. Test-retest reliability was determined using a subpopulation of 20 participants surveyed twice; at baseline and three weeks post baseline. Correlations between responses and limits of agreement for the two time points were also assessed.

Results:
Content Validity: Seven items were determined to be content invalid and were removed from the scale. With these items removed the content validity index for the entire scale was α = .83, indicating excellent content validity. In response to expert’s suggestions two items were added to the original scale (bolded items in Table 1).

Factor Analysis: Included in the total sample were 192 nulliparas, 47 with prolapse, 45 age matched controls, and 56 post vaginal childbirth. Initial exploratory factor analysis using SPSS was undertaken separately for each participant group. Because the factors were similar for all groups it was determined that the data could be merged, yielding a total sample size of 277, sufficient for a 20 item factor analysis. During exploratory factor analysis four additional items that either did not correlate or exhibited multicollinearity with other items were removed. Four factors, or subscales were identified: Genital Confidence, Appeal, Function, and Comfort. The four subscale, 20 item confirmatory factor analysis explained 58.9% of the variance. Table 1 shows the subscales, factor loadings and communalities. Negatively worded items were reverse coded.

Internal and Test-retest Reliability: The final 20 item scale exhibited good to excellent internal reliability across all sample groups (α = .79 - .89). Pearson’s correlation between the test-retest scores was r = .85 indicating excellent test-retest reliability. Additionally, the limits of agreement between the two time period scores demonstrated that the scores would be repeatable within 2.5 points for 95% of the participants on this final 20 point scale.
Interpretation of results:
Currently there are no published studies that provide validity and reliability for measures of genital body image. This study determined that results of a revised and reduced previously published scale [3] shows both reliability and validity. Generalizability of these results is limited due to the sample demographics; for instance, the majority of the participants were Caucasian and heterosexual. Nevertheless, to our knowledge this is the first scale validated to explore whether genital body image dissatisfaction may influence women’s decisions to seek surgery such as genital cosmetic procedures but also surgeries not specifically viewed as cosmetic such as those for pelvic organ prolapse.

Concluding message:
The revised Genital Self Image Scale (the GSIS-20) provides a twenty question scale that demonstrates reliability and validity across several populations of women. This scale offers opportunity to advance understandings about the influence of genital body image on women’s emotional and sexual health, and on decisions about surgery for pelvic floor disorders and genital cosmetic surgery. Additional research is needed to provide data regarding psychometric testing of the GSIS-20 within more ethnically diverse populations of women.

Table 1

<table>
<thead>
<tr>
<th>Item</th>
<th>Genital Confidence</th>
<th>Genital Appeal</th>
<th>Genital Function</th>
<th>Genital Comfort</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel ashamed about the shape of my genitals</td>
<td>.852</td>
<td></td>
<td></td>
<td></td>
<td>.690</td>
</tr>
<tr>
<td>When I think about my genitals, I feel ashamed</td>
<td>.668</td>
<td>.690</td>
<td></td>
<td></td>
<td>.585</td>
</tr>
<tr>
<td>My genitals are embarrassing</td>
<td>.620</td>
<td></td>
<td></td>
<td></td>
<td>.558</td>
</tr>
<tr>
<td>My genitals are unattractive</td>
<td>.615</td>
<td></td>
<td></td>
<td></td>
<td>.533</td>
</tr>
<tr>
<td>I feel sad when I think about my genitals</td>
<td>.570</td>
<td></td>
<td></td>
<td></td>
<td>.529</td>
</tr>
<tr>
<td>I feel my genitals are desirable</td>
<td>.807</td>
<td>.690</td>
<td></td>
<td></td>
<td>.639</td>
</tr>
<tr>
<td>I feel that my genitals would arouse my partner</td>
<td>.784</td>
<td></td>
<td></td>
<td></td>
<td>.632</td>
</tr>
<tr>
<td>My genitals are attractive</td>
<td>.707</td>
<td></td>
<td></td>
<td></td>
<td>.538</td>
</tr>
<tr>
<td>I enjoy my genitals</td>
<td>.650</td>
<td></td>
<td></td>
<td></td>
<td>.554</td>
</tr>
<tr>
<td>I feel comfortable about my partner seeing my genitals</td>
<td>.605</td>
<td></td>
<td></td>
<td></td>
<td>.456</td>
</tr>
<tr>
<td>My genitals are well-shaped</td>
<td>.575</td>
<td></td>
<td></td>
<td></td>
<td>.494</td>
</tr>
<tr>
<td>My genitals are functional</td>
<td>.771</td>
<td></td>
<td></td>
<td></td>
<td>.578</td>
</tr>
<tr>
<td>I feel like my genitals are healthy</td>
<td>.701</td>
<td></td>
<td></td>
<td></td>
<td>.496</td>
</tr>
<tr>
<td>I feel my genitals work/function as they should</td>
<td>.592</td>
<td></td>
<td></td>
<td></td>
<td>.395</td>
</tr>
<tr>
<td>I feel my genitals are like other</td>
<td>.511</td>
<td></td>
<td></td>
<td></td>
<td>.574</td>
</tr>
<tr>
<td>I worry when I think about how my genitals function</td>
<td>.503</td>
<td>.690</td>
<td></td>
<td></td>
<td>.465</td>
</tr>
<tr>
<td>My genitals are malodorous</td>
<td></td>
<td>.712</td>
<td></td>
<td></td>
<td>.555</td>
</tr>
<tr>
<td>My genitals are offensive</td>
<td></td>
<td>.673</td>
<td></td>
<td></td>
<td>.492</td>
</tr>
<tr>
<td>I feel my genitals are inadequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.628</td>
</tr>
<tr>
<td>I feel ashamed about the odor of my genitals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.581</td>
</tr>
</tbody>
</table>

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The Pelvic Floor Research Group 2011 Index
Keynote Speaker

Abdul Sultan, MD, FRGOC
Dr. Sultan is a Consultant Obstetrician and Gynecologist with a special interest in urogynecology at Croydon University Hospital, Surrey, UK. He has also been appointed a honorary Reader at St George's University of London. He completed his basic medical training (MB.ChB) in South Africa prior to moving to the United Kingdom in 1984 and obtained the MRCOG degree in 1990. He did his post graduate training at the North Middlesex Hospital, Whipps Cross Hospital and finally at St George’s Hospital with Professor Stuart Stanton. He conducted research under the supervision of Professor Chris Hudson at St Bartholomews and Homerton Hospitals and Professors Clive Bartram and Mike Kamm at St Mark's Hospital. The research involved studying the effects of childbirth on the pelvic floor and anal sphincters. This led to a landmark paper published in the New England Journal of Medicine and to a Doctorate (MD). His pioneering work highlighted the deficiencies in training of doctors and midwives in detecting and repairing injuries to the perineum and anal sphincter after childbirth.

Ranee Thakar, MD, MRCOG
Dr. Thakar is a Subspecialist in Urogynaecology and Consultant Obstetrician and Gynaecologist at Mayday University Hospital, Croydon as well as a honorary senior lecturer at St George's University of London. She is the Honorary Secretary of the British Society of Urogynaecology (BSUG) and has just completed her three year term as the chair of the education committee of the International Urogynaecological Association.

Presenters

James A. Ashton-Miller, PhD
Dr. Ashton-Miller received his Bachelor of Science in Mechanical Engineering in 1972 from the University of Newcastle-Upon-Tyne. He received his Master of Science in Mechanical Engineering from the Massachusetts Institute of Technology in 1974 and his PhD in Biomechanics from the University of Oslo in 1982. Currently, he is the Director of the Biomechanics Research Laboratories in the Department of Mechanical Engineering at the University of Michigan. He is also a Senior Research Scientist at the Institute of Gerontology at the University of Michigan. His research interests include: the biomechanics, functional anatomy and aging of the female pelvic floor structures including muscle, fascia, tendons, nerves, urethra, vagina, and rectum; experimental and computer simulation approaches; instrumentation design & development, and measurement systems. Dr. Ashton-Miller functions in the PFRG as a Co-Investigator on the OPALII and SCOR2 projects. He is the Project Leader of Project 1 and Core B (Imaging) of the SCOR2. jaam@umich.edu

Catherine Brandon, MD
Dr. Brandon received her Bachelor of Arts in Anthropology from University of Arizona in 1976 and a Masters in Arts in Anthropology from University of California, Berkeley in 1977. She went on to receive her Medical Degree from the University of California, Irvine in 1985. She completed her residency in Diagnostic Radiology from University of Michigan in 1989 with Fellowships in Mammography and Ultrasound from Henry Ford Hospital, Detroit, MI in 1990. She then received a Masters in Science in Medical Management from the joint program at University of Texas School of Management and University of Texas Southwest Medical Center, Dallas, TX in 2000. She completed a fellowship in Musculoskeletal Imaging at Henry Ford Hospital, Detroit, MI in 2005. Currently she is an Assistant Professor in Radiology, Musculoskeletal Division with research interests in muscle imaging, musculoskeletal ultrasound and 3T MRI musculoskeletal imaging. Her role in the PFRG is Co-Investigator for the SCOR 2 project in CORE B to study 3T MRI of pelvic floor muscles to determine patterns of injury and to distinguish between muscle injuries secondary to structural disruption verse neuropathy changes. catbrand@med.umich.edu
Cynthia Brincat, MD, PhD
Dr. Brincat is a third year fellow in Female Pelvic Medicine and Reconstructive Surgery. She completed her residency at the University of Michigan. She is a graduate of Smith College and completed her PhD in philosophy with a concentration in ethics at Loyola University, Chicago. She taught philosophy and medical ethics for several years, then returned to Loyola for her MD. Dr. Brincat is involved in the research efforts of all PFRG projects. cbrincat@umich.edu

J. Quentin Clemens, MD, MSCI
Dr. Clemens received his Medical Degree from Johns Hopkins in 1993 and completed his residency in 1999 at Northwestern University in Chicago. He currently is Associate Professor in the Department of Urology. He is the head of Neuourology & Pelvic Reconstructive Surgery Division in Urology. Dr. Clemens is the second Glagher Scholar, a competitive award given by the AUA to create a small cohort of urologists who are experts on national health policy issues. qclemens@med.umich.edu

John O.L. DeLancey, MD
Dr. DeLancey received his Bachelor of Science in Biology from Oberlin College in 1973 and received his Medical Degree from the University of Michigan in 1977. He completed his residency in 1981 at the University of Michigan in Obstetrics and Gynecology. Currently, he is a Norman F. Miller Professor for the Department of Obstetrics and Gynecology at the University of Michigan Medical Center. His research interests include: the anatomy of the pelvic floor, pelvic floor biomechanics, vaginal birth and pelvic floor injury. Dr. DeLancey functions in the PFRG as the Principal Investigator of the OPALII and SCOR2 projects. delancey@umich.edu

Dee E. Fenner, MD
Dr. Fenner received a Medical Degree from the University of Missouri-Columbia in 1985 and completed residency in Obstetrics and Gynecology at the University of Michigan in 1989. Currently, she is an Associate Professor and Director of the Division of Gynecology in the Department of Obstetrics and Gynecology at the University of Michigan. Her research interests include: anal incontinence and defecation disorders; depression and its impact on urge incontinence. Dr. Fenner functions in the PFRG as a Co-Investigator on the SCOR2 projects. deef@med.umich.edu

Timothy R Johnson, MD
Dr. Johnson received his Medical Degree from University of Virginia in 1975 and completed his residency in Obstetrics and Gynecology at the University of Michigan in 1979. He went on to complete a fellowship in Maternal & Fetal Medicine at Johns Hopkins University in 1981. Currently he is the Department Chair of Obstetrics and Gynecology, Research Professor for the Center for Human Growth and Development, Professor in Women’s Studies and the Arthur F Thurnau Professor, as well as the Bates Professor of the Diseases of Women and Children. His clinical interests include active involvement in teaching activities in Africa with numerous visits to Ghana to assist in the training of physicians and midwives in the areas of fetal assessment, perinatal asphyxia, clinical aspects of fetal behavior and maternal mortality. Other clinical interests include prenatal care and women’s health. His research interests include fetal behavior and international women’s health issues. trbj@med.umich.edu

Lisa Kane Low, PhD, CNM, FACNM
Dr. Low received a Bachelor of Science in Nursing from the University of Michigan, a Master of Science in Nurse Midwifery from the University of Illinois at Chicago and PhD in Nursing and Graduate Certificate in Women's Studies from University of Michigan in 2001. Dr. Low was a BIRCWH Scholar from 2001-2003. Currently, Dr. Low is an Assistant Professor in the School of Nursing and Women's Studies Department in the College of LS&A at University of Michigan and is a member of the midwifery service and lecturer in the Department of Obstetrics and Gynecology. Her research interests include care practices during childbirth with an emphasis on the association of processes of care and social support on health outcomes postpartum. Within the PFRG she focuses on the management of second stage and associated risks for pelvic floor damage. She has other grants focusing on the role of stress and trauma on childbearing outcomes and the role of social
support in reducing risks for post partum depression. She has an ongoing project in Honduras focused on care practices during labor in low resources settings. Dr. Low functions in the PFRG as a Co-Investigator on SCOR2. kanelow@med.umich.edu

Janis M. Miller, PhD, ANP-BC
Dr. Miller received a Bachelor of Science in Nursing from Goshen College in 1981 and her Master of Science in Nursing from Loyola University of Chicago in 1987. She went on to receive Certification in Gerontology in 1999, a PhD in Nursing in 1996, and Adult Nurse Practitioner Certification in 2000. Currently, Dr. Miller serves as a faculty member in the Department of Obstetrics and Gynecology and in the School of Nursing at the University of Michigan. Her research interests focus on understanding the etiology of urinary incontinence and other pelvic floor disorders in order to provide the most effective prevention strategies and conservative treatment interventions. Dr. Miller functions in the PFRG as a Principal Investigator for Project 2 of SCOR2 and the University of Michigan branch of BRIDGES. She is also a Co-Investigator on OPAL II. janismm@umich.edu

Carolyn M. Sampselle, PhD, RNC
Dr. Sampselle received a Bachelor of Science in Nursing with honors from Ohio State University in 1965. She went on to receive a Master of Science in Nursing from Ohio State University in 1968. In 1985, she received her PhD in Clinical Nursing Research from the University of Michigan. Currently, she is the Carolyne K. Davis Collegiate Chair, Professor of Nursing at the University of Michigan. She has joint appointments in the Department of Obstetrics and Gynecology and Women’s Studies. Her research interests focus on self-care strategies to treat and prevent urinary incontinence. She recently received the Pathfinder Award for distinguished service from the Friends of the National Institute for Nursing Research. Dr. Sampselle functions in the PFRG as a consultant on the SCOR2 Project. csampsll@umich.edu

John T. Wei, MD, MS
John T. Wei, MD, MS, Associate Professor of Urology and the Associate Chair for Research in the Department of Urology at the University of Michigan, Ann Arbor, Michigan, graduated from the Honors Program in Medical Education 6-year BS-MD program at Northwestern University, Evanston, Illinois. He completed his urology training at the New York Hospital–Cornell Medical Center in New York City. Dr. Wei's research work involves the NIH funded EDRN CEVC that seeks to develop and validate novel markers for the early detection of prostate cancer. His other research interests include pelvic floor disorders, evaluation of clinical practice guidelines, quality of life for patients with urologic conditions, and quality of care for prostate cancer. Dr. Wei and colleagues expanded the popular Prostate Cancer Index to include items for assessing irritative and hormonal symptoms, now referred to as the Expanded Prostate cancer Index Composite (EPIC). jtwei@umich.edu

Team Members

Mitch Berger, MD
Dr. Berger is currently the second year fellow in Female Pelvic Medicine and Reconstructive Surgery. He graduated from the University of Pennsylvania where he double majored in Biochemistry and Economics, then entered the combined MD/PhD program at the University of Pennsylvania, working in the laboratory of Mark Lemmon PhD. His PhD thesis was on Mechanisms of ErbB Receptor Oligomerization, for which he received the Saul Winegrad, MD, Award for Outstanding Dissertation. He was awarded his PhD degree in 2004, and received his MD in 2005 from the University of Pennsylvania School of Medicine. Dr. Berger then completed a residency in Obstetrics and Gynecology at the University of Michigan prior to starting his fellowship here in Female Pelvic Medicine/Reconstructive Surgery. mitcberg@med.umich.edu

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Dr. Chen received her bachelor and master of science in Engineering, majoring in precision instrumentation from Tsinghua University in 2001. She received her Master's in electrical engineering system in 2006 and applied statistics in 2007 and Ph.D in Biomedical Engineering in 2008 from University of Michigan. She worked as Research Scientist in Xoran technologies Inc, a startup CT medical imaging company in Ann Arbor for two years. Currently she is a research fellow in Biomechanics Research Lab, interested in pelvic floor functional anatomy and modeling.
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Alessandra Jannette
Ms. Jannette is a freshman in the LSA Honors Program at the University of Michigan. She is expected to graduate in May 2014. She is currently undecided about a major but considering neuroscience with minors in women’s studies or philosophy. After college she plans to pursue a dual MD/PhD in the hopes of becoming an orthopedic surgeon. She currently works with the PFRG as a student research assistant helping with MRI and data management. amja@umich.edu

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Mr. Kim received a Bachelor of Science in mechanical and aerospace engineering from Seoul National University in Korea in 2006. He then came to the University of Michigan to pursue a Ph.D. degree in mechanical engineering. Currently Mr. Kim is currently enrolled in the mechanical engineering PhD program at the University of Michigan and is a graduate student research assistant for Project 1: Measurement rate of fetal head descent of the SCOR2 grant. jinyongk@umich.edu

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Julie Tumbarello, MA
Ms. Tumbarello received a Bachelor of Arts degree in Anthropology with minors in Southeast Asian Studies and Women's Studies from Northern Illinois University in 1993. She went on to receive a Master of Arts in Anthropology from Northern Illinois University in 1996 and continued for 2 years in Medical Anthropology at the University of California, San Francisco. Ms. Tumbarello splits her time between the PFRG as the Project Manager and the Department of OB/GYN as the Department Research Manager. jtumbare@umich.edu

*Please submit changes to Julie Tumbarello: jtumbare@umich.edu