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## A paradigm shift in progress: The impact of work hour reform on the operative volume of surgical residents

Kathryn A. Mendoza  
*William & Mary - School of Education*

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**A Paradigm Shift in Progress:  
The Impact of Work Hour Reform on the Operative Volume  
of Surgical Residents**

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A Dissertation

Presented to

The Faculty of the School of Education  
The College of William and Mary in Virginia

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In Partial Fulfillment  
Of the Requirements for the Degree  
Doctor of Education

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by  
Kathryn A. Mendoza  
February 12, 2004

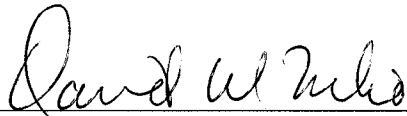
**A Paradigm Shift in Progress:**  
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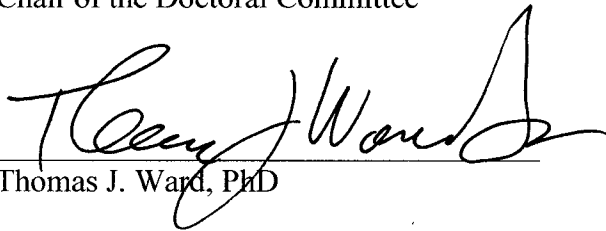
**Kathryn A. Mendoza, PhD**

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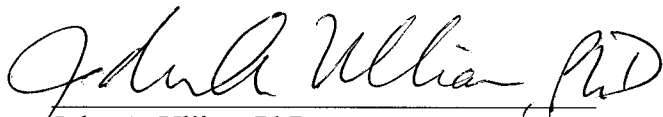
**Approved February 2004 by**



David W. Leslie, EdD  
Chair of the Doctoral Committee



Thomas J. Ward, PhD



John A. Ullian, PhD

## Dedication

This dissertation is dedicated first and foremost to my husband, Bernardo Mendoza, MD, who has been my strength and support for 15 years. His unrelenting desire and dedication to become a surgeon has shown me that anything is possible, even if you must travel down many different paths to get to your final destination. I am blessed to travel down this road with him, a path that continues to strengthen me while also enabling me to find my niche in the world.

This work is also dedicated to Mom and Dad for their continued emotional support and commitment to understanding the sacrifices Bernardo and I must make in pursuing our paths. (Dad – while in high school in 1980, I disappointed you by explaining that I was never planning to go to college, instead choosing to enter the secretarial workforce. Hopefully, my PhD makes up for that disappointment and demonstrates that perhaps taking the road less traveled may really be the better way!) ☺

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## Abstract

### **A Paradigm Shift in Progress: The Impact of Work Hour Reform on the Operative Volume of Surgical Residents**

Student: Kathryn A. Mendoza, PhD, The College of William and Mary, 2004. 82 pp.  
Chair: David W. Leslie, EdD

The purpose of this study was to explore how work hour models impact the operative volume of Chief residents immediately prior to the official transition to national work hour reform.

This study sample comprised all accredited General Surgery programs in the United States. Program Directors were sent a letter inviting participation in this study. Inclusion criteria required the operative data from Chief residents graduating in 2002 and 2003 and completion of a self-designed survey. Fifteen Program Directors were randomly selected to participate in a telephone interview to review these findings.

Of the 80 programs that responded, statistical analyses revealed the following findings:

1) there were no significant differences in the operative volume of Chief residents based on work hour model, program setting, or graduating class; 2) there was no significant difference of Chiefs' operative volume between programs that experimented with work hour reform and programs that did not experiment with work hour reform during 2002-03; 3) there was no relationship found between work hours and volume of operative cases; and 4) there was an inverse relationship found between work hours and operative

volume for residents in New York programs.

Continued evaluation of the impact of work hour reform on surgical training and education is necessary. The “I-E-O” model of assessment represents a framework for understanding how the educational and training environment impacts residents and whether these experiences actually contribute to residents’ development in this new era of surgical training.

Kathryn A. Mendoza, PhD

Educational Policy, Planning, and Leadership in Higher Education

The College of William and Mary

**A Paradigm Shift in Progress:  
The Impact of Work Hour Reform on the Operative Volume  
of Surgical Residents**

# CHAPTER I

## INTRODUCTION

### The Issue

As of July 1, 2003, the Accreditation Council of Graduate Medical Education (ACGME), the accrediting body for the 7,800 U.S. residency programs in 118 specialties and subspecialties, required that all programs comply with work hour reform ([www.acgme.org](http://www.acgme.org), 2002). Essentially, residents cannot work more than 80 hours per week, averaged over a four-week period; should receive at least 10 hours free of clinical and educational responsibilities between daily duty periods; must take call no more than every third night, averaged over a four-week period; and must receive one day off in seven, averaged over a four week period ([www.acgme.org](http://www.acgme.org), 2003; Philibert, Friedmann & Williams, 2002). General surgery training programs, a specialty that typically consists of a 90 to 130 hour workweek, anticipate difficulty with compliance (Evans, 2002; Britt, 2002; Polk & Taylor, 2002; Carey & Fishburne, 1989). Many surgical residents and faculty believe that limited work hours will be detrimental to resident training and education, potentially decreasing residents' operative experience (Whang, Perez, Ito, Mello, Ashley, & Zinner, 2003; Romano, 2002; Polk & Taylor, 2002; Kaplan, 2002; Wallack & Chao, 2001; Rutkow, 1994; Condon, 1989). After all, a common anecdote familiar among trainees has been that, "the problem with every other night call is that you miss half the cases." While the impact of work hour reform is yet to be determined, this event marks the beginning of a major transition in surgical training and education.

Prior to the ACGME mandate, New York was the only state required to restrict

resident work hours. This occurrence resulted from a Grand Jury ruling that an ineffective resident training system contributed to the 1984 death of Ms. Libby Zion (Wallack & Chao, 2002; Daigler, Welliver & Stapleton, 1990). This state mandate, imposed on July 1, 1989, prevented New York residents from working more than 80 hours per week. State officials enforced this model by investigating allegations of non-compliance, which were anonymously reported by residents and physicians (Brensilver, Smith & Lyttle, 1998). Currently, the New York State Department of Health contracts with an independent peer review organization to assess program compliance, a collaboration financially supported by the Health Care Reform Act of 2000 (New York State Department of Health, 2002). Programs deemed non-compliant are required to pay a substantial monetary fine (New York State Department of Health, 2002). Recent findings reveal that many programs continue to remain in violation of work hours (New York State Department of Health, 2002). Despite the information compiled during the past 12 years, limited data have been published on the New York experience and its impact on residency training.

Several studies, inclusive of two New York programs, examined the effect of limited work hours on procedural experience, demonstrating that no significant changes were noted in procedural experience when residents worked fewer hours (Hassett, Nawotniak, Cumiskey, Berger, Posner, Seibel & Hoover, 2002; Kelly, Marks, Westhoff & Rosen, 1991; Carey & Fishburne, 1989). These studies provide limited utility due to the use of single programs and potential for inconsistency among work hour guidelines (Sawyer, Tribble, Newberg, Pruett & Minasi, 1999; Carey & Fishburne, 1989). For

example, New York's mandate allows less time for residents to remain in the hospital post-call, which varies slightly from the ACGME mandate (Wallack & Chao, 2002). Overall, the sparse data gathered to date prevent generalizations about the effect of fewer work hours on operative experience.

### **Purpose of Study**

The ACGME mandate, declared in June 2002, prompted many programs to experiment with programmatic change during the 2002-03 academic year. This transitional year provided a rare opportunity to collect and evaluate data, preparing a baseline for future study of this historic change in surgical education. The full impact of work hour reform on resident operative experience will remain unknown until one cycle of surgical trainees completes the five-year training period that began with the Class of 2008. The ACGME guidelines, already modified several times since the original mandate was issued, are certain to experience similar change upon implementation and evaluation. Empirical evidence regarding the consequences of reform must be introduced prior to evaluating the Class of 2008.

The purpose of this study, then, is to explore how work hour models impact the operative volume of Chief residents. The Chief year provides residents with a final opportunity to train under supervision before entering independent practice. For those Chiefs pursuing fellowship training, this year provides a final chance to learn and experience the broad range of general surgical procedures prior to sub-specialization. Evaluating operative data from Chief residents graduating in 2002 and 2003 provides

baseline findings during the period of transition to work hour reform. The impact of programmatic change during this critical phase of training may help decision-makers effectively assess and refine work hour policy to best meet the needs of surgical trainees.

### **Overview of Study**

Chapter II presents a review of the literature and provides a framework in which to consider work hour reform as it relates to surgical training. This review outlines the major events that led to the current mandate, demonstrating the process by which the guidelines of the 80-hour model were determined. Chapter III presents the methodology. Data gathering included collecting an accepted measure of resident operative experience, obtaining program-specific information from a self-designed survey, and discussing study findings with Program Directors during scheduled telephone interviews. Chapter IV presents the descriptive and statistical analyses of all data collected between July 2003 and December 2003, demonstrating that there were no significant differences in Chief residents' operative volume among the work hour models examined. Finally, Chapter V provides an in-depth discussion that examines correlates of these baseline findings and suggests a framework for assessment and evaluation of work hour reform.

## CHAPTER II

### REVIEW OF LITERATURE

This chapter presents background information regarding the history of surgical training and education, outlines the major events that led to national work hour reform, and discusses several perspectives related to the acquisition of operative skill. Additionally, this chapter provides a synopsis of the literature that examines the impact of fewer work hours on operative experience. The synthesis of this literature provides a conceptual framework in which to consider the impact of this paradigm shift.

#### **Surgical Training and Education**

The formal development of the surgical training model has a rich history that evolved in response to the advancement of the profession. Work hour reform presents one of the most significant changes to this model since its inception.

#### What makes a surgeon?

The American Board of Surgery (ABS), chartered in 1937, formally recognizes general surgery as a discipline that is comprised of a core body of knowledge common to all surgical sub-specialties ([www.absurgery.org](http://www.absurgery.org), 2002; Nyhus, 1992). This core knowledge base includes anatomy, physiology, metabolism, immunology, nutrition, pathology, wound healing, shock and resuscitation, intensive care, and neoplasia ([www.acgme.org](http://www.acgme.org), 2003; Nyhus, 1992). A general surgeon is expected to attain



specialized knowledge and skills related to the diagnosis, pre-operative, operative, and post-operative management of patients in the following areas: alimentary tract; abdomen; breast, skin, and soft tissue; head and neck; vascular system; endocrine system; and surgical oncology ([www.absurgery.org](http://www.absurgery.org), 2002). The general surgeon is expected to assume responsibility for the comprehensive management of trauma and critically ill surgical patients presenting in the Emergency Room, the Intensive Care Unit, and the Trauma/Burn Unit ([www.absurgery.org](http://www.absurgery.org), 2002; Nyhus, 1992). The general surgeon is also expected to have significant pre-operative, operative, and post-operative experience in pediatrics, plastics, general thoracic, and transplant surgery; possess a broad understanding of the management of common problems in cardiac, gynecologic, neurologic, orthopedic, transplant, and urologic surgery; and understand the administration of anesthetics ([www.absurgery.org](http://www.absurgery.org), 2002; Nyhus, 1992). Finally, the general surgeon must be able to perform relevant diagnostic and therapeutic techniques in endoscopy, laryngoscopy, bronchoscopy, and fine needle aspiration ([www.absurgery.org](http://www.absurgery.org), 2002). Board certification is contingent upon successful completion of an accredited general surgery residency program, documented volume and breadth of operative experience, and satisfactory scores on the written and oral board examinations administered by the ABS ([www.absurgery.org](http://www.absurgery.org), 2002).

### American surgical training

The origin of training for American surgery is rooted in the apprenticeship model, in which a novice observed a skilled surgeon for a specified period of time (Wallack & Chao, 2001; Hamdorf & Hall, 2000; Grillo, 1999; Rothstein, 1987; Kaufman, 1976; Longmire, 1965). This training was initially deficient in adequate knowledge of anatomy and surgical procedures, standardized instructional methods, and regulatory controls, providing for highly variable instruction (Grillo, 1999; Rothstein, 1987; Kaufman, 1976). The scope of surgery was essentially limited to treating fractures, repairing dislocations, draining abscesses, and performing amputations (Rutkow, 2001; Rothstein, 1987; Kaufman, 1976). However, the proliferation of scientific knowledge that occurred throughout Europe during the early to mid-19<sup>th</sup> century advanced the discipline and provided a foundation for formal, regulated instruction to trainees prior to independent practice (Gawande, 2001; Grillo, 1999; Bonner, 1995; Bonner 1963).

Advancements specific to the progression of surgery included the discovery of antiseptics and anesthesia, identification of the causes of infectious disease, and advancements in physiology (Rutkow, 2001; Starr, 1982). During this progressive period, increasing numbers of affluent American men traveled to Europe for formal medical education that blended university-based instruction with clinical experience in the hospital setting (Hamdorf & Hall, 2000; Rothstein, 1985; Rothstein, 1985; Berry, 1981; Kaufman, 1976). The return of these educated men redefined American surgery and enhanced the process of formal surgical training and education.

## The Halsted model

William Halsted, MD, considered the “father of American surgery,” inspired a model of surgical training that was implemented during the early 20<sup>th</sup> century (Wallack & Chao, 2001; Rutkow, 2001; Grillo, 1999; Kaufman, 1976; Bonner, 1963). Halsted, who trained in Germany during the mid-1800s, advanced surgical practice as a result of his innovations in surgical technique, use of anesthesia, practice of safety in surgery, and formalized methods of training aspiring surgeons (Cameron, 2001; Wallack & Chao, 2001; Hamdorf & Hall, 2000). As the first chief-of-surgery at Johns Hopkins University Hospital, Halsted used his position to implement a model of training that he observed in Germany (Greenfield, 2003; Cameron, 2001; Hamdorf & Hall, 2000; Gorman, Meier, & Krummel, 1999). Such training produced surgeons able to function as clinicians, researchers, and teachers by accomplishing the following goals: 1) teach residents the basic principles of surgery; 2) allow residents to conduct research to advance the discipline; 3) expose residents to a vast array of clinical experiences; and 4) permit residents to gain mastery by repetitively performing operative procedures (Cameron, 2001; Grillo, 1999; Varco, 1956). These goals were attained through the concept of graded, or progressive, responsibility, which provided the resident with academic and clinical instruction commensurate with years of education and skill level (Wallack & Chao, 2001; Hamdorf & Hall, 2000; Hardacre, Chen, Martin & Lillemoe, 2000; Gorman, Meier, & Krummel, 1999; Grillo, 1999; Barnes, 1987; Varco, 1956).

The Halsted model initially required eight years of training. However, the length of time required to complete training became variable in subsequent years. Newly

organized regulatory bodies and professional societies were unable to achieve consensus regarding the length of time needed to adequately train surgeons. For example, the American Board of Surgery, established in 1937, required five years of training, while the American College of Surgeons, established in 1938, required three years of training (Longmire, 1965). Regardless of the number of years required for training, the Halsted model necessitated a restrictive lifestyle. Residents were required to reside in quarters located next to the hospital (hence the terms “residency” and “resident”), work long hours with few days off during the year, receive little remuneration, adhere to rigid routines, and forego marriage (Organ, 2002; Wallack & Chao, 2001; Grillo, 1999). The Halsted model believed that the, “operating room and the wards [were...] laboratories of the highest order...[where] medical science [is] best served [and] also the welfare of the patient is best promoted” (Grillo, 1999).

### **Breaking with Tradition**

Over time, the Halsted model relaxed several restrictions, most notably those on marriage and living arrangements, but continued the practice of lengthy work hours (Wallack & Chao, 2001; Carey & Fishburne, 1989). Many surgeons believe that long work hours provide residents the opportunity to experience a breadth of procedures, provide continuity of patient care, and witness the progression of the surgical disease process (Britt, 2002; Evans, 2002; Schwartz, Durbrow, Rosso, Williams, Butler & Wilson, 1992). Yet, some critics point out that lengthy work hours are a form of inexpensive physician labor or a rite of passage (Evans, 2002; Asch & Parker, 1988).

Despite the rationale for these long hours, all residency programs were required to limit the time residents spend in the hospital as of July 1, 2003 ([www.acgme.org](http://www.acgme.org), 2003). This mandate is the result of events surrounding one woman's hospitalization in New York during 1984.

#### The hospitalization of Libby Zion

On March 4, 1984, an 18-year old college student was taken to the emergency department of a New York hospital for symptoms that included fever, chills, dehydration, and agitation (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Asch & Parker, 1988). The on-call internal medicine residents (an intern and a second-year resident) diagnosed Ms. Zion as having a “viral syndrome with hysterical symptoms” and discussed a course of treatment during a telephone consultation with the attending physician (Wallack & Chao, 2001; Asch & Parker, 1988). As Ms. Zion's symptoms worsened, the residents, covering multiple wards and awake for more than 18 hours, ordered medications and restraints without further consultation with the attending physician (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998). Ms. Zion, who was initially responsive to treatment, died less than 24 hours after admission to the hospital (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998).

Soon after her death, medical professionals learned that Ms. Zion's medication history had not been disclosed to the residents. Ms. Zion had been taking psychotropic medications following psychiatric treatment for stress two months prior to this hospitalization (Asch & Parker, 1988). She was also taking Percodan for dental work

that was performed at least one week prior to this incident (Asch & Parker, 1988). Finally, Ms. Zion had a history of drug abuse that allegedly included cocaine. Evidence of cocaine use was inconclusive upon post-mortem analysis (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998). Following an autopsy and expert data analysis, the nature of Ms. Zion's illness and the exact cause of death could not be determined (Wallack & Chao, 2001). Many medical professionals believe her death was the result of a medication interaction, while many people in the legal and public arenas believe the cause of death was due to medical error resulting from resident fatigue and lack of supervision (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Scher & Peoples, 1990).

#### Investigation of Libby Zion's death

Mr. Sidney Zion, the patient's father, newspaper columnist, and former federal prosecutor hired private investigators and physician experts to investigate the death of his daughter (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998). These professionals concluded that Ms. Zion's death was the result of errors in medical care, which alleged the prescription of incorrect medications, incorrect use of restraints, inadequate supervision, and inappropriate diagnosis (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998). As a result of these findings, a Grand Jury convened to rule on the possibility of criminal wrongdoing (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Daigler, Welliver & Stapleton, 1990 ). The Grand Jury, ruling in December of 1986, did not issue any criminal indictments, recommended censure of the physicians

involved, and found fault with the New York state resident training system (Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Daigler, Welliver & Stapleton, 1990). Specific problem areas targeted by the Grand Jury dealt with the use of restraints, medication referencing systems, staffing of emergency departments, supervision of junior residents, and resident work hours (Barden, Specht, McCarter, Daly and Fahey, 2002; Wallack & Chao, 2001). A New York State Supreme Court subsequently ruled that there was, “shared negligence between the physicians and the patient herself for failing to disclose a full medication and drug usage history,” ruling that the hospital and its resident training methods were not negligent (Brensilver, Smith & Lyttle, 1998). However, this ruling appeared to be overshadowed by the Grand Jury ruling that occurred during a New York mayoral race, setting the tone for increased political debate.

#### Politics and residency training

Following the Grand Jury ruling, Andrew Stein, the New York City Council president and aspiring mayoral candidate, published a report suggesting that errors made by residents may contribute to the number of deaths that occur in New York hospitals (Wallack & Chao, 2001; Reiner, 1989). Of note, Ms. Zion worked for Mr. Stein as a student intern (Asch & Parker, 1998). Several prominent New Yorkers supported this report, including John Cardinal O’Connor, the Archbishop of New York, and Rudolph Guiliani, the U.S. Attorney and a mayoral hopeful (Wallack & Chao, 2001). The mass attention surrounding this report culminated in the New York State Department of Health’s assignment of an Ad Hoc Advisory Committee to investigate resident training in

New York hospitals (Johnson, 2003; Wallack & Chao, 2001; Daigler et al., 1990; Reiner, 1989). Bertrand Bell, MD, the director of Ambulatory Care Services at the Bronx Municipal Hospital and a Professor of Medicine at Albert Einstein College of Medicine, was appointed to lead this investigation (Wallack & Chao, 2001). The “Bell Commission,” as it was frequently called, determined that inadequate supervision and fatigue were contributory causes of Ms. Zion’s death (Barden, Specht, McCarter, Daly & Fahey, 2002; Brensilver, Smith & Lyttle, 1998). The Commission recommended the following changes to resident training in the state of New York, regardless of specialty:

- Residents can work no more than 80-hours per week, averaged over a four-week period.
- Residents should have at least one 24-hour period off every seven days.
- Continuous on-site duty, including in-house call, must not exceed 24 consecutive hours, with three additional hours permitted for patient rounds, transfer of patient care, or educational activity. No new patients may be assigned during these three transitional hours.
- On-call hours spent sleeping are not included as scheduled work hours, provided these hours of sleep can be documented. This “surgical exclusion clause” permits residents to work beyond a scheduled 24-hour period.
- Continuous on-site supervision must be provided by at least a postgraduate year four resident.



- Residents are to receive direct, in-person supervision by an attending surgeon for all surgical procedures.

(Johnson, 2003; Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Schwartz, Dubrow, Rosso, Williams, Butler & Wilson, 1992; Daigler et al., 1990; Reiner, 1989).

On October 8, 1988, Governor Mario Cuomo adopted these emergency provisions, which became Section 405.4 of Title 10 of the New York Codes, Rules and Regulations of the Department of Health (Johnson, 2003; Wallack & Chao, 2001; Brensilver, Smith & Lyttle, 1998; Reiner, 1989). The “405 Regulations,” implemented as of July 1, 1989, were designed to improve patient care and allow New York residents, “the time and psychic energy to be in a condition to learn medicine and to make the kind of commitment to patients [that] is the essence of doctoring” (Reiner, 1989, p. 458). The “405 Regulations” were the start of sweeping change for graduate medical education nationwide.

### **Prelude to National Change**

As the implementation of restricted work hours began in New York, state and federal legislators, medical personnel, and professional organizations closely watched New York hospitals and training programs. The states of California, New Jersey, Massachusetts, Michigan, Pennsylvania, Connecticut, Hawaii, Missouri, Illinois, Iowa, and Minnesota each attempted state legislative actions to restrict resident work hours, all of which were unsuccessful (Schwartz et al., 1992; Warner, Hamilton, Brunck, Bowder & Bell, 1990; Scher & Peoples, 1990; Mitchell, 1989). Despite these unsuccessful

attempts, the issue of limited work hours gained momentum on the national level.

### Landmark events

Immediately prior to the implementation of work hour reform in New York, the American College of Surgeons (ACS) voiced its concern about the impact of restricted work hours on surgical training, publishing a position paper that described the fundamental components of surgical residency (American College of Surgeons, 1988). The following excerpt represents the ACS' stance on restricted work hours:

The hallmark of surgical care has long been the commitment of surgeons to be available to their patients throughout the surgical experience...continuity of care is the most important principle in surgical education. Decision-making is best learned and taught by working with a critically ill patient and serially observing response to therapy for complex problems...Work schedules should be set to serve [these] ends. The work hours themselves should not be a principal concern in the design of a residency program. (p. 22-23)

In March 1989, work hour restrictions were a primary focus at a national conference sponsored by the Association of American Medical Colleges, the American Medical Association, and the American Hospital Association, setting the stage for continued debate within many medical, legal, and public forums (Scher & Peoples, 1990). Subsequent studies supported reform of resident work hours. For example, a survey of 114 internal medicine residents found that 41% of respondents reported that fatigue contributed to errors, while 51% of respondents reported that increased job responsibilities contributed to errors (Wu, Folkman, McPhee & Lo, 1991). Another study of 1,773 second-year residents reported that 70% of respondents witnessed a colleague working in an impaired condition, perceiving fatigue to be the cause of impairment

(Daugherty, Baldwin & Rowley, 1998). In November 1999, the Institute of Medicine published a national report estimating that medical errors contribute to between 44,000 and 98,000 hospital deaths annually (Evans, 2002). This report attributes “overworked residents and interns” as one possible contributing factor in these deaths. These findings fueled the work hour debate.

In April 2001, the medical student and resident committees of the American Medical Association (AMA), with assistance from the Public Citizen group led by Ralph Nader, submitted a petition to the Occupational Safety and Health Association (OSHA) requesting regulation of resident work hours (Greenfield, 2003; Evans, 2002). The AMA Board of Trustees, several state legislatures, and the Association of American Medical Colleges provided subsequent endorsement of this petition (Greenfield, 2003). In November 2001, Representative John Conyers (D – Michigan) proposed the Patient and Physician Safety and Protection Act of 2001, a bill supporting reduced resident work hours with increased physician supervision to ensure patient safety (HR1228, 2004; Evans, 2002). On March 17, 2003, this bill was referred to the House Subcommittee on Health (HR1228, 2004), where it continues to be reviewed. Threats of federal legislation inspired the subsequent actions taken by the ACGME (Phillibert, Friedman & Williams, 2002).

The ACGME assigned a 14-member panel to address the resident work hour issue, consisting of representatives from Emergency Medicine, Family Practice, Internal Medicine, Obstetrics and Gynecology, Pediatrics, Psychiatry, Surgery, members of the public, and residents (Phillibert, Friedman & Williams, 2002). The panel determined that

residents work no more than 80 hours per week, a figure deemed appropriate since it was used in the New York mandate and proposed state and federal legislation (Philibert, Friedman & Williams, 2002). Specific guidelines are as follows:

- Duty hours must be limited to 80 hours per week, averaged over a four-week period, inclusive of in-house call activities.
- Residents must receive one 24-hour period off every seven days to be free of all educational and clinical responsibilities, averaged over a four-week period.
- A 10-hour time period should be provided between daily duty periods.
- In-house call must occur no more frequently than every third night, averaged over a four-week period.
- Continuous on-site duty, including in-house call, must not exceed 24 consecutive hours. Residents may remain on duty for up to six additional hours to participate in educational activities, transfer care of patients, conduct outpatient clinics, and maintain continuity of medical and surgical care.
- No new patients may be accepted after 24 hours of continuous duty.
- At-home call is not subject to the every third night limitation.
- When residents are called into the hospital from home, the hours residents spend in-house are counted toward the 80-hour limit.
- Qualified faculty must supervise all patient care.

([www.acgme.org](http://www.acgme.org), 2002)

The ACGME mandate became effective on July 1, 2003 and applies to all U.S. residency programs. Accreditation site visits determine compliance with work hour regulations (Phillibert, Friedman & Williams, 2002).

### **Operative Experience**

General surgery training currently requires five years of residency, with many of the 253 accredited programs allowing residents to pursue one or more years of research. Upon completion of training, residents are expected to have attained a skill set and fund of knowledge that enables the successful pursuit of independent practice or further specialization. Residents' operative experience is one measure used to determine the technical skill set attained during training.

The Residency Review Committee for Surgery (RRC), which reports to the ACGME, requires that residents maintain an operative log of all cases in which they participate. The RRC developed guidelines that delineate specific categories and minimum volume requirements that residents must experience during training, frequently referred to as the "defined categories" ([www.acgme.org](http://www.acgme.org), 2003; Veldenz, Dennis & Dovgan, 2001). The defined category reports are a template of required experience that ensures residents receive adequate volume and breadth of training in areas considered to reflect an ability to practice independently (Welling, 2003; American Board of Surgery, 2003). Some surgeons believe that the defined categories are deficient and do not meet the suggested volume and breadth of experience required for independent practice, especially in relation to newer and more

technical operations such as those requiring minimally invasive techniques (Park, Witzke, & Donnelly, 2002).

According to the RRC, the following operative requirements must be met upon completion of residency training: 1) residents in the same program must receive comparable operative experience; 2) residents should participate in 500 to 1,000 major procedures during training; 3) the Chief resident year should provide for participation in 150 to 300 cases; and 4) the program director must justify the operative experience of any single resident reporting in excess of 450 cases during the Chief year or 1,500 cases over the course of all training years ([www.acgme.org](http://www.acgme.org), 2003).

#### Methods of skill acquisition

Operative skills are one component of surgical competency, which is the ultimate goal of training. Competency is defined as the integration of technical skill, cognitive knowledge, clinical judgment, attitudes, professional habits, and clinical decision-making (Parsa, Organ & Barkan, 2000; Warf, Donnelly, Schwartz & Sloan, 1999; Miller, 1997). The acquisition of operative skills, as well as participation in pre- and post-operative care, provides the practical experience that leads to surgical competency. The range and frequency of experience required to develop the skill set necessary for independent practice presents a challenge for compliance with work hour reform.

Many surgeons believe that fewer work hours are detrimental to surgical training and education, contributing to inefficient patient care and graduates ill prepared for the “real world” of surgical practice (Winslow, Bowman & Klingensmith, 2004; Greenfield,

2003; Britt, 2002; Cole, Bertagnolli & Nussbaum, 2002). A limited study involving one New York program demonstrates that 29 surgery residents and 8 surgical faculty perceive that an 80-hour week negatively impacts the time spent in the operating room and impedes the development of clinical decision-making (Barden, Specht, McCarter, Daly & Fahey, 2002). The American College of Surgeons and the Society for University Surgeons similarly indicate that specific work hours cannot be defined for surgery residents, supporting the notion that, “research has not established an exact number of hours a week below which residents may safely and effectively learn and participate in patient care” (Cole, Bertagnolli & Nussbaum, 2002; Phillibert, Friedman & Williams, 2002, p. 1113). While the number of work hours may continue to be debated, motor skill development theory must be considered in the context of work hour reform and its potential impact on surgical training.

Technical skill, defined as the “integration of well-adjusted performances, rather than a tying together of mere habits,” is acquired through operative experience, a process supported by motor skill development theory (Adams, p. 42). The first phase of motor skill development theory, referred to as the perception phase, suggests that residents learn the steps required to perform a procedure through didactic methods and observation (Kopta, 1971). The second phase, referred to as the integration phase, provides residents with increased operative responsibility that allows for the assimilation of cognitive knowledge and technical skill (Kopta, 1971). Finally, the automatization phase occurs when residents gain increased technical acumen, clinical judgment, and decision-making skills, demonstrating their ability to perform independently (Gawande, 2001; Wilcox,

1997; DesCoteaux & Leclere, 1995; Martella & Santos, 1995; Reznick, 1993; Kopta, 1971). The automatization phase typically occurs following intense practice in a wide volume and breadth of operative experience (Hamdorf & Hall, 2000; DesCoteaux & Leclere, 1995; Reznick, 1993; Condon, 1989; Kaufman, Wiegand & Tunick, 1987; Varco, 1956). In the context of work hour reform, the question remains as to whether residents can adequately progress through these phases when spending fewer hours in training. Two methods of motor skill development must, then, be considered.

One method of skill acquisition advocates that specific motor skills are best developed and refined with focused, repetitive practice of a singular nature. An example of this type of practice includes repetition of the same tune on an instrument. An alternative method of skill acquisition suggests that specific motor skills are best developed and refined when practiced using multiple scenarios, frequently referred to as “skill transference.” An athlete training for a triathlon exemplifies the concept of skill transference. Such training requires concentration on the development of endurance, breathing, and strength, which represents a skill set used and manipulated in multiple sporting events. Literature supports the effectiveness of both perspectives in acquiring motor skills (Manoel & Connelly, 1995; Proteau & Cournoyer, 1990).

### Repetitive practice

Findings demonstrate that focused, repetitive practice of specific skills provides for adequate development that leads to competency (Dashfeld, 2001; Kneebone, 2000; Miller, 1997; Baker, 1993; Luchette, Booth, Seibel, Bernstein, Ricotta, Hoover &



Hassett, 1992). The learning that occurs during skill development and refinement, also referred to as a learning or performance curve, peaks during the early stages of repetitive practice and becomes flatter as more frequent repetitions of the same skill occur (Rogers, Elstein, & Bordage, 2001). Research demonstrates that although technical performance may not significantly improve in the later repetitions of practice, the increased familiarity attained increases confidence and speed and decreases error (Rogers, Elstein, & Bordage, 2001; Ericsson, Krampe & Tesch-Romer, 1993). Repetition also avoids skill decay, suggesting this type of practice is a key element to maintaining skill level (Arthur, Bennet, Stanush & McNally, 1998; Kaufman, Wiegand & Tunick, 1987). A meta-analysis additionally suggests that increased experience with the same types of operative cases decreases the amount of time necessary to perform the procedure and provides for a lower complication rate, supporting the perspective that repetition improves performance, increases speed, and decreases error (Rogers, Elstein & Bordage, 2001).

Performance literature similarly supports this perspective, demonstrating that athletes' and musicians' use of repetitive practice is the difference between elite and lesser performers (Gawande, 2001; Hamdorf & Hall, 2000; Ericsson, Krampe & Tesch-Romer, 1993). A study of six male professional tennis players, who held national ranking and participated in repetitive practice, were compared to six male novice tennis players lacking tournament experience and frequent practice. Findings demonstrated that the level of decision-making exhibited by these subjects distinguished between the professional and novice players, suggesting that experience (i.e., exposure to competition and use of repetitive practice) contributed to the higher level of performance (Nielsen &

McPherson, 2001). A study of practice patterns of three violinist groups differing in performance levels demonstrated similar findings. A group of 10 “excellent” violinists, having potential for careers as international soloists, were matched with 10 “good” violinists from the same school and 10 violinists from a separate department with lower admission criteria. Findings revealed that repetitive practice occurred more frequently for the two “better groups,” with these groups practicing up to three times more frequently than the lesser group (Ericsson, Krampe & Tesch-Romer, 1993). While differing skill sets are required of surgeons, athletes, and musicians, the concept of repetitive practice represents a viable method of skill acquisition on which learning experiences can be designed.

Similar studies exist related to motor skill development in children. A study of 120 children of different age groups examined skill acquisition and retention of a simple task that evaluated arm movements by manipulating a car on a slide. Findings revealed that the children permitted to practice repetitively performed better than the children not permitted practice opportunities (Pease & Rupnow, 1983). A study of 48 eleven-year old females examined the effect of repetitive practice in the use of a racket skill, demonstrating that the practice group performed the racket skill significantly better than the group having received no practice (Green, Whitehead & Sugden, 1995). A study of 26 children, ages 3 and 5, examined the impact of practice on an aiming task that required tossing a beanbag at a target. Findings revealed that the group practicing repetitively improved significantly more than the group who did not practice (Graydon & Griffin, 1996). These studies, representing a sampling of the literature, support the perspective

that repetition improves skill level and performance.

Surgical residents frequently acquire technical skills during their formative years by participating in a limited breadth of cases, which provides for a repetitive practice experience. Programmatic change that complies with work hour reform may impact the time available and the opportunities for initial skill development and practice.

### Skill transference

Alternatively, some surgeons maintain that technical skill, judgment, and cognitive knowledge allow for a high level of performance regardless of whether certain procedures were experienced (Richardson, 1999). Residents frequently change rotations and observe the same procedure performed multiple ways, which does not provide consistency in learning or the opportunity for repetitive practice of certain skill sets (Gawande, 2001). Literature suggests that specific skills may be acquired and manipulated in varied situations, resulting in high performance during novel experiences. Over the past two decades, surgical knowledge has expanded exponentially as a result of an increase in the complexity of operative cases and the multiple options available for performing the same type of procedure (i.e., open vs. minimally invasive) (Gawande, 2001; Parsa, Organ & Barkan, 2000; Ko, Whant, Karamanoukia, Longmire & McFadden, 1998). These factors support the perspective that skill transference, as opposed to repetitive practice, may similarly provide for the acquisition of technical skills, especially in this new era of training.

Performance theory and childhood development theory emphasize the

effectiveness of skill transference. For example, a study of 10 athletes and 10 volunteer college students (non-athletes) demonstrated that athletes performed better than non-athletes in novel athletic situations (Kerr & Boucher, 1992). A study of 30 experienced and inexperienced soccer players, observing recorded unique play situations, examined differences in anticipation and visual strategies. Experienced players demonstrated superior skills in anticipating the actions of players and fixated on significantly more peripheral aspects of play such as locations along the playing field and the positions and movements of other players. Inexperienced players fixated more frequently on the ball and on the players involved in passing the ball. Similarly, the inexperienced group was unable to anticipate the performance of others (Williams, Davids, Burwitz, & Williams, 1994). In another study of 13 skilled handball players and 10 recreational handball players, the accuracy of throw, reaction time, and anticipation time using unique throwing activities were evaluated. Skilled players were superior to recreational players, demonstrating faster and more accurate throws, quicker response times, and accuracy in anticipating teammates' responses (Lidor, Argov & Daniel, 1998). A study of 16 children, with a mean age of 9, examined whether skill transference occurred from short tennis to lawn tennis. Short tennis is a tennis game played on a smaller court by children under the age of 10, while lawn tennis is played on a full-length court. Short tennis skills positively transferred to lawn tennis (Coldwells & Hare, 1994). A study of 64 children, ages 8 and 12, examined practice methods involving a throwing task. One group practiced using a single target, while another group practiced using three different targets.

The group practicing on multiple targets performed the throwing task significantly better (Kerr & Booth, 1978). Another study of 24 undergraduate students examined skill development on a force production task, demonstrating that the group practicing on four variations of the task demonstrated better skill acquisition and retention (Shea & Kohl, 1990). This sampling of literature demonstrates that skill transference is a well-established principle, suggesting that residents may develop and manipulate specific skill sets when involved in more complex cases or novel situations.

Surgery residents cannot be exposed to every possible operative procedure throughout the five-year period of training. The principle of skill transference, however, suggests that graduates may be able to successfully perform operative procedures in which they have never experienced. Yet, the breadth of cases that contribute to skill transference opportunities may be affected as a result of work hour reform, depending on the programmatic changes implemented.

#### Impact of work hour reform on procedural experience

Several studies examine the impact of fewer work hours on residents' procedural experience, demonstrating ambiguous findings. One study determined that the surgical caseload of 33 obstetrics and gynecology residents in a New York institution remained unchanged following work hour reform (Kelly, et al., 1991). A similar study performed at the University of Oklahoma demonstrated that a 75-hour workweek did not impact the operative experience of 18 obstetrics-gynecology residents (Carey & Fishburne, 1989). A study performed in the Department of Surgery at SUNY-Buffalo demonstrated that

operative experience was not significantly changed following work hour reform (Hassett, et al., 2002). A study of 17 general surgery residents at Harbor-UCLA Medical Center demonstrated that interns spent more time involved in “scut work” and less time on patient care activities under a restricted work hour model, while more senior residents did not notice a significant change in the distribution of their workload (Schwartz et al., 1992). “Scut work” is defined as tasks that do not necessarily enhance residents’ fund of knowledge or contribute to their skill development. Ancillary health staff are able to perform these duties that include obtaining routine consent for procedures, night-time admissions of patients seeking elective procedures, or retrieving lab results (Hayward, Rockwood, Sheehan, and Bass, 1991). A study of 19 University of Virginia surgery residents demonstrated that work hour restrictions decreased interns’ participation in operative procedures (Sawyer, Tribble, Newberg, Pruett & Minasi, 1999). Finally, one New York program found that the total number of Chief resident cases increased during the years immediately following work hour reform (Barden et al., 2002). Researchers attribute these specific findings to an overall increase in the number of procedures performed by the general surgery service during the years of study. The perception of the residents and faculty involved in this study, however, was that resident operative experience was decreased as a result of work hour restrictions (Barden et al., 2002).

These studies provide inconclusive evidence to distinguish whether nationally mandated work hour reform impacts the operative experience of general surgery residents. Additional confounding factors include specialty-related differences and

potential disparity in the work hour guidelines implemented at the time of these studies. Large-scale studies are necessary to effectively evaluate how work hour reform affects surgical training and education.

### **Summary**

Many events led to the implementation of national work hour reform, demonstrating the demand for change from many professional organizations, students, and the public-at-large. While reform may, indeed, be necessary, the chain of events leading to this movement may be perceived as a reaction to public frenzy. The circumstances surrounding the death of Libby Zion demonstrated the political influence that fueled this issue, pressuring one state to change a century-old training model. The mass attention surrounding New York programs led individual states to attempt reform, continuously maintaining this issue in the public arena. Such attention finally forced the ACGME to react, culminating in the assignment of a 14-member panel that developed national work hour guidelines for resident training. These guidelines were developed with limited input from physicians of each specialty, of which the consequences are yet to be determined.

While a limited body of literature suggests that operative experience may remain relatively unchanged when working fewer hours, specific programmatic change may affect the acquisition and development of technical skills. Decision-makers involved in work hour reform must carefully examine the principles of motor skill development theory as it potentially impacts each level of training.

## **CHAPTER III**

### **METHODOLOGY**

The purpose of this study was to examine the impact of work hour models on the operative volume of general surgery Chief residents. This information provides baseline data at the start of a major transition in surgical training and education. Such information is relevant to the surgical leadership, health care administration, and policy-makers as they negotiate a new model of training that is restricted by the number of hours residents are permitted to remain in the hospital. Quantitative and qualitative methods of data analysis are used.

#### **Ethical Safeguards**

The Institutional Review Boards at The College of William and Mary and Eastern Virginia Medical School approved this study. Data responses were coded to assure confidentiality. Programs were requested to omit resident names from submitted reports. Program names and geographical information were not identified in the findings.

#### **Sample**

At the time of initial data collection, there were 253 accredited general surgery residency programs in the United States. Programs were categorized according to the type of setting in which the program operates. University-based programs are defined as programs in which the majority of experience takes place in a hospital that serves as a



primary affiliate of a medical school ([www.ama-assn.org](http://www.ama-assn.org), 2003). Graduates of university-based programs more frequently pursue fellowship training, with the ultimate goal of pursuing academic careers (Greco, Donetz, Mackenzie, Brolin, and Trooskin, 1986). Community/university-based programs are defined as programs in which the majority of experience takes place in a community hospital that is affiliated with an academic medical center ([www.ama-assn.org](http://www.ama-assn.org), 2003). Such a program is not a primary affiliate of an academic medical center and is geographically separate from the academic medical center. Community-based programs are defined as programs in which the majority of experience occurs in a community hospital that is not affiliated with an academic medical center or with a medical school ([www.ama-assn.org](http://www.ama-assn.org), 2003). Graduates of non-university-based programs more frequently pursue independent practice immediately upon completion of residency training or enter fellowship training with the ultimate goal of practicing independently (Greco, et al., 1986). Military-based programs are defined as programs in which the majority of experience takes place in Army, Air Force, Navy, and Uniformed Services institutions ([www.ama-assn.org](http://www.ama-assn.org), 2003). Finally, programs categorized as “other” are defined as programs in which experience occurs in settings such as foundations or specialized treatment centers ([www.ama-assn.org](http://www.ama-assn.org), 2003).

The ACGME requires that programs update their classification annually. The American Medical Association includes these data in its online residency and fellowship database, from which program names, addresses, and classifications were obtained for this study. Currently, surgical residencies are comprised of 104 university-based programs, 76 community/university-based programs, 59 community-based programs, 12

military-based programs, and two “other” programs ([www.ama-assn.org](http://www.ama-assn.org), 2003).

### **Data Collection**

Program Directors of 252 surgical residency programs were sent a letter that specified the purpose of this study and invited their participation (Appendix A). Inclusion in the study required submission of the defined category reports for Chief residents graduating in 2002 and 2003, as well as the completion of a brief survey (Appendix B). One program was omitted from the study, as it had not yet graduated Chief residents.

Letters were mailed during the third week of July, allowing for collection of completed operative data from the Class of 2003. A second request for participation was mailed to non-respondents during the second week of September, culminating in the mailing of a final request during the third week of October.

Upon completion of the mailings, 15 Program Directors were randomly selected for the second phase of data collection. During the third week of November, a letter was sent inviting Program Directors to participate in a telephone interview to discuss expert interpretation of study findings (Appendix C). Non-respondents were not contacted. Telephone interviews were then scheduled for the second and third weeks of December. Final study results, including questions for discussion (Appendix D), were mailed to participants prior to the scheduled telephone interview. This qualitative component allowed for professional reaction to these findings and provided an interpretive context from among the leadership in surgical education.

## Instrumentation

The defined category reports of Chief residents graduating in 2002 and 2003 were requested. These reports, submitted annually to the ACGME and the American Board of Surgery, are accepted evaluative tools that assist in determining whether residents received an adequate operative experience during training. The defined category reports indicate the requisite content areas and the minimum number of procedures that should be attained in each area during residency (Appendix E). Graduates' defined category reports reflect cumulative operative experience acquired during residency. These reports do not distinguish the volume or breadth of cases in which residents participated at each level of training.

The focus of this study was the impact of work hour models on operative volume, recognizing that many programs experimented with work hour reform during 2002-03. For the purposes of this study, the "total Chief cases" category is the only variable useful for examining the impact of work hour model on operative volume. The "total Chief cases" category isolates the volume of cases in which residents participated during their final year of training. Selection of this variable allows for evaluation of operative data that are not confounded by experience received during other years of training.

The survey designed for this study contained four questions that generated program-specific information, including average hours worked by Chief residents during 2001-02 and 2002-03; whether Chiefs took in-house call; when change was implemented; and description of changes made. Of note, it is likely that most programs reported

estimated work hours since the recording of actual work hours was not yet required. Since Chief residents rotate through the same services in succession, the estimated hours provide a context in which to consider the impact of work hour reform.

The questions asked to the panel of Program Directors reflected expert interpretation of the various components involved in this study, inclusive of defined category reports, motor skill development theory, perception of work hour models, and interpretation of study findings.

### **Research Questions**

The overarching question of this study is how restricted work hours impact the operative volume of general surgery residents. As previously discussed, the total number of operative cases in which Chiefs participated is the single dependent variable. The primary independent variable is the work hour model, with model A referring to the traditional model of more than 80 hours per week and model B referring to the mandated work hour model of 80 hours per week. The program setting is a secondary factor of study that considers whether any differences in operative experience are significant between types of programs.

Specific research questions, with respect to the quantitative data, include the following:

- 1) How does the work hour model impact the volume of operative cases performed by Chief residents?

- 2) How did programs' experimentation with work hour reform impact the operative volume of Chief residents during 2002-03?
- 3) Does a relationship exist between the volume of operative cases performed by Chiefs and the average hours worked?
- 4) Does a relationship exist between the volume of operative cases performed by Chiefs and the average hours worked within New York training programs?

The qualitative portion of this study provided the opportunity for surgical leadership to discuss expert interpretation of these findings, enhancing the context in which this historical paradigm shift must be considered. Specific research questions included the following:

- 1) What is your opinion of the defined category reports as a valid measure of surgical experience?
- 2) How do you think residents most effectively learn the art of surgery (i.e.: through experiencing a breadth of cases, perhaps performing certain procedures one time during training, versus experiencing "mass repetition," such as performing repeated laparoscopic cholecystectomies)?
- 3) Please discuss your opinion of the traditional work hour model (80+ hours per week).
- 4) What is your opinion of the mandated 80-hour workweek?
- 5) Given your expertise, how do you think the 80-hour workweek will impact residents' breadth and volume of operative experience?

6) Please discuss your interpretation of the study findings.

### Analyses

All statistical analyses were performed using SPSS version 11.5. The significance level used for all analyses was .05. The “total Chief cases” variable was aggregated into a new factor for each class year, which controlled for individual, program and institutional differences. The aggregation of this variable eliminates differences related to individual residents, variability of residents’ operative experience according to rotation, and variability of the number of residents within and between each class year.

Data from New York programs were included in several analyses. The decision to include these data was based on whether the information “fit” with the research question. For example, the inclusion of New York data was beneficial to understanding the impact of work hour models on operative volume. Since all participating New York programs did not report compliance with the 80-hour model, inclusion in such analyses was further justified. The exclusion of New York data from the question related to the impact of programs’ experimentation with work hour reform was justified since New York programs are no longer in a transition phase.

A three-way ANOVA was used for research question 1 to evaluate whether work hour model (two levels), program setting (three levels), and graduating class (two levels) impacted the number of operative cases performed by Chief residents. New York resident data was included since the impact of the work hour model was the focus of analysis. Given that several New York programs reported non-compliance with an 80-

hour model, New York data was a valuable addition to this analysis. Of note, 17 non-New York programs reported working 80 hours or less per week during 2001-02, indicating that some programs adhered to a non-traditional work hour model prior to the declaration of the ACGME mandate.

A 2 x 3 ANOVA was performed for research question 2 to evaluate whether the operative volume of residents in programs that experimented with change was significantly different than that of programs that did not experiment with change. New York resident data were not included in this analysis since these programs are no longer transitioning to work hour reform.

A correlation was performed for research question 3 to evaluate whether a relationship exists between the volume of operative cases performed by Chiefs and the average hours worked as reported by Program Directors. A similar correlation was performed for research question 4, using data from New York programs only.

Descriptive analyses of the quantitative data, as well as content analyses of the written survey and telephone interviews, were performed to provide a full context in which to interpret these findings.

### **Limitations of study**

Several limitations should be considered when interpreting these findings. First, the “average work hours” variable reported by Program Directors for 2001-02, and for programs that did not implement change during 2002-03, is, most likely, based on estimated data. Prior to the work hour mandate, programs were not accountable for

tracking work hours. Second, the way in which the ACGME calculates the total number of operative cases performed by Chief residents is not clearly understood by surgical leadership, casting uncertainty about the accuracy of the defined category reports. This point of contention was discussed by one Program Director indicating that the ACGME “should have a transparent way for us to realize how cases are counted.” Additionally, the accuracy with which residents enter cases must be considered. A recent study of residents’ tracking of cases found that residents may be underreporting their operative experience or coding their experiences differently, which may impact volume and breadth (Veldenz, Dennis, & Dovgan, 2001). Third, the influence of external factors during the years of study is unknown. Such factors may include changes to surgical caseloads, program leadership, or number of residents or faculty.



## CHAPTER IV

### RESULTS

#### Response Rate

Of the 252 programs invited to participate, 80 programs (32%) submitted the defined category reports from 2002 and 2003 and the completed survey. Of this total response, 38 university programs participated, representing 37% of the programs classified as university-based; 27 community/university-based programs responded, representing 36% of the programs classified as community/university-based programs; and 15 community-based programs responded, representing 25% of the programs classified as community-based. Programs classified as military-based or “other” did not respond. Of the total programs responding, seven programs were located in New York, which comprised 23% of all programs in the state of New York.

Of the 15 Program Directors invited to participate in a telephone discussion of study results, ten (67%) participated in telephone interviews. One Program Director, initially accepting this invitation, was unable to participate due to scheduling conflicts. Of these ten respondents, 50% (n=5) were from university-based programs and the remaining respondents were from community/university-based programs.

## Findings

The primary purpose of this study was to evaluate whether work hour models significantly impact the operative volume of residents. An examination of program setting is used throughout this study to contextualize findings.

### Descriptive data

The number of Chief residents within each program setting varied. Table 1 presents the number of Chief residents in each program setting during 2001-02 and 2002-03, including the means and standard deviations of the volume of operative cases based on individual Chief resident data. Table 2 demonstrates the aggregated means of operative cases for each class by program setting. These aggregated means represent the new factor that controls for individual, program, and institutional differences. Table 3 presents the average hours worked by Chief residents within the three program settings. University-based programs reported working the most hours per week during both years of study (M=96.2, 88.8, respectively), followed by community-based programs (M=93.3, 84.7, respectively) and community/university-based programs (M=86.7, 80.3, respectively).

During 2001-02, 62% of university-based programs (n=23), 52% of community/university-based programs (n=12), and 64% of community-based programs (n=9) reported Chiefs taking in-house call duty. Similarly, during 2002-03, 62% of university-based programs (n=23), 48% of community/university-based programs (n=11), and 64% of community-based programs (n=9) reported that Chiefs took in-house call. Table 4

illustrates the number of nights per week Chiefs took in-house call. Table 5 outlines the number of programs that experimented with work hour change during 2002-03 and the number of Chiefs in each program setting.

Table 1: Mean of individual resident operative volume by year and program setting

|                | 2001-02        |               |      | 2002-03        |               |      |
|----------------|----------------|---------------|------|----------------|---------------|------|
|                | n of residents | Mean of cases | SD   | n of residents | Mean of cases | SD   |
| University     | 180            | 253.3         | 74.8 | 181            | 257.7         | 67.9 |
| Community/Univ | 77             | 269.4         | 82.2 | 84             | 251.5         | 83.8 |
| Community      | 42             | 245.2         | 59.6 | 43             | 241.6         | 69.1 |

Table2: Aggregated means of operative volume by year and program setting

|                      | 2001-02       |       |      | 2002-03 |      |
|----------------------|---------------|-------|------|---------|------|
|                      | n of programs | Mean  | SD   | Mean    | SD   |
| University           | 38            | 250.0 | 54.1 | 255.1   | 51.8 |
| Community/University | 27            | 278.1 | 73.7 | 250.8   | 73.4 |
| Community            | 15            | 257.5 | 59.0 | 242.9   | 49.0 |

Table 3: Mean work hours per week

|                      | 2001-02 |      |      | 2002-03 |      |
|----------------------|---------|------|------|---------|------|
|                      | n       | Mean | SD   | Mean    | SD   |
| University           | 38      | 96.2 | 12.2 | 88.8    | 12.4 |
| Community/University | 27      | 86.7 | 15.0 | 80.3    | 11.6 |
| Community            | 15      | 93.3 | 15.1 | 84.7    | 14.3 |

Table 4: Frequency of Chiefs' in-house call

|                      | 2001-02 |       |       |       | 2002-03 |       |       |       |
|----------------------|---------|-------|-------|-------|---------|-------|-------|-------|
|                      | N/A     | 1x/wk | 2x/wk | 3x/wk | N/A     | 1x/wk | 2x/wk | 3x/wk |
| University           | 15      | 7     | 10    | 6     | 15      | 8     | 10    | 5     |
| Community/University | 15      | 3     | 8     | 1     | 16      | 2     | 7     | 2     |
| Community            | 6       | 1     | 5     | 3     | 6       | 5     | 3     | 1     |

Table 5: Programs experimenting with work hour reform in 2002-03

|                | Experimented with change |                | Did not change |                | New York programs |                |
|----------------|--------------------------|----------------|----------------|----------------|-------------------|----------------|
|                | # of Programs            | # of Residents | # of Programs  | # of Residents | # of Programs     | # of Residents |
| University     | 21                       | 99             | 15             | 69             | 2                 | 13             |
| Community/Univ | 17                       | 48             | 6              | 21             | 4                 | 15             |
| Community      | 12                       | 37             | 2              | 4              | 1                 | 2              |
| <b>TOTAL</b>   | <b>50</b>                | <b>184</b>     | <b>23</b>      | <b>94</b>      | <b>7</b>          | <b>30</b>      |

Overall, 63% of participating programs (n=50), excluding New York programs, experimented with work hour change during 2002-03. Of programs experimenting with change, 30 programs (60%) reported compliance with an 80-hour model. Twenty-nine programs (58%) implemented work hour change at some point during July and December 2002, while 21 programs (42%) implemented work hour change at some point during January and April 2003.

Research Question 1:

*How does the work hour model impact the volume of operative cases performed by Chief residents?*

A three-way ANOVA was used to examine whether work hour model, program setting, and graduating class impacted the volume of operative cases performed by Chief residents. The survey required that programs report the average number of hours per week that Chiefs worked during 2001-02 and 2002-03. Based on this information, residents and programs were then classified as belonging to model A (more than 80 hours per week) or model B (80 hours or less per week). Since this analysis tested the impact of the work hour model on operative volume, New York programs were included.

The adjusted means of operative volume as a function of these three factors are presented in Table 6. Estimated marginal means are provided since unequal cell sizes contributed to the aggregated data (Green, Salkind, & Akey, 2000). The three-way ANOVA indicated no significant interaction among the work hour model, program setting, or graduating class,  $F(2, 148) = .107, p = .898$ . There were no significant interactions between work hour model and program setting,  $F(2, 148) = .343, p = .710$ ; between work hour model and graduating class,  $F(1, 148) = .000, p = .991$ ; or between program setting and graduating class,  $F(2, 148) = .540, p = .584$ . There were no significant simple main effects for program setting,  $F(2, 148) = .730, p = .484$ ; graduating class,  $F(1, 148) = .835, p = .362$ ; or work hour model,  $F(1, 148) = .811, p = .369$ .

Table 6: Adjusted means of operative volume

**TRADITIONAL MODEL**

|                | 2001-02       |          |           | 2002-03       |          |           |
|----------------|---------------|----------|-----------|---------------|----------|-----------|
|                | n of programs | Adj Mean | Std Error | n of programs | Adj Mean | Std Error |
| University     | 33            | 249.2    | 10.8      | 22            | 258.5    | 13.2      |
| Community/Univ | 15            | 288.5    | 15.9      | 10            | 262.8    | 19.2      |
| Community      | 11            | 261.5    | 18.6      | 5             | 245.6    | 27.6      |

**80-HOUR MODEL**

|                | 2001-02       |          |           | 2002-03       |          |           |
|----------------|---------------|----------|-----------|---------------|----------|-----------|
|                | n of programs | Adj Mean | Std Error | n of programs | Adj Mean | Std Error |
| University     | 5             | 255.4    | 27.6      | 16            | 250.5    | 15.4      |
| Community/Univ | 12            | 265.1    | 17.2      | 17            | 243.5    | 15.0      |
| Community      | 4             | 246.8    | 30.9      | 10            | 241.6    | 19.5      |

Based on this analysis, there were no significant effects or interactions between work hour model, program setting, or graduating class on the operative volume of Chief residents. Statistically speaking, the model had no effect on the volume of cases in which Chiefs participated.

Research Question 2:

*How did programs' experimentation with work hour reform impact the operative volume of Chief residents during 2002-03?*

A 2 x 3 ANOVA was performed to evaluate whether the operative volume of Chiefs in programs that experimented with change was significantly different than that of programs that did not experiment with change. The factors included whether programs

changed in 2002-03 and program type. Data from New York programs were excluded from analysis since these programs are no longer in the experimentation phase of work hour reform, having made a transition to state mandated reform as of 1989.

The adjusted means of Chiefs' operative volume as a function of these factors are presented in Table 7. The analysis indicated that no significant interactions occurred between whether programs experimented with work hour change and program setting,  $F(2, 67) = .387$ ,  $p = .680$ . There were no significant main effects for whether programs changed,  $F(1, 584) = .173$ ,  $p = .679$  or program setting,  $F(2, 67) = .351$ ,  $p = .705$ .

Table 7: Adjusted means of operative cases during experimentation with work hour reform

|                      | Experimented<br>with change |          |           | Did not<br>experiment |          |           |
|----------------------|-----------------------------|----------|-----------|-----------------------|----------|-----------|
|                      | n                           | Adj Mean | Std Error | n                     | Adj Mean | Std Error |
| University           | 21                          | 250.5    | 13.6      | 15                    | 262.6    | 16.1      |
| Community/University | 17                          | 247.1    | 15.1      | 6                     | 277.6    | 25.4      |
| Community            | 12                          | 247.9    | 17.9      | 2                     | 230.0    | 44.0      |

Based on this analysis, there were no significant effects or interactions between whether programs experimented with work hour reform and program setting during 2002-03.

### Research Question 3:

*Does a relationship exist between the volume of operative cases performed by Chief residents and the average hours worked?*

A Pearson product-moment correlation was performed to evaluate whether there is a relationship between the volume of operative cases performed by Chief residents and the average hours worked. The correlation coefficient was not significant,  $r(160) = .055$ ,  $p = .486$ , indicating that there is no relationship between the volume of operative cases performed and the average hours worked.

### Research Question 4:

*Does a relationship exist between the volume of operative cases performed by Chief residents and the average hours worked in New York training programs?*

A Pearson product-moment correlation was performed to evaluate whether there is a relationship between the volume of operative cases performed and the average hours worked for Chiefs training in New York programs. The means of operative volume and work hours are presented in Table 8.

The correlation coefficient was significant,  $r(14) = -.658$ ,  $p = .011$ , indicating that there is a moderate negative, or inverse, relationship between the volume of operative cases performed and the average hours worked of Chief residents training in New York programs. These findings suggest that as the average work hours decrease, the volume of operative cases increase. This inverse relationship also suggests that as average work hours increase, the volume of operative cases decrease. The means of operative volume



and work hours are presented in Table 8.

Table 8: Means of work hours and operative volume of New York programs

| <b>2001- 02</b> | n of programs | Mean of hours | SD   | Mean of cases | SD   |
|-----------------|---------------|---------------|------|---------------|------|
| University      | 2             | 88.5          | 10.6 | 200.0         | 26.9 |
| Community/Univ  | 4             | 80.0          | 8.2  | 221.2         | 20.4 |
| Community       | 1             | 78.0          | 0    | 330.0         | 0    |

| <b>2002-03</b> | n of programs | Mean of hours | SD  | Mean of cases | SD   |
|----------------|---------------|---------------|-----|---------------|------|
| University     | 2             | 75.0          | 7.1 | 247.7         | 5.8  |
| Community/Univ | 4             | 78.8          | 6.3 | 225.5         | 26.2 |
| Community      | 1             | 78.0          | 0   | 209.0         | 0    |

Considering that the average work hours is the predictor variable and volume of operative cases is the criterion variable, 43% of the variance (-.658 squared) of the criterion variable (volume of operative cases) is accounted for by its relationship with the predictor variable (average work hours) (Green, et al, 2000).

#### Content analysis of survey

The survey included an item that requested a description of work hour changes made during 2002-03. A content analysis of the 50 programs that implemented change produced the following four themes: 1) clinical activity; 2) time; 3) education; and 4) support (Creswell, 1997).

Thirty-seven programs (74%) implemented change that impacted clinical activity. Fifteen programs indicated that residents were sent home early post-call. The actual post-

call release time varied by programs, ranging from 8:00am to 1:00pm. One program indicated initially adopting this method, but converted to a night float model as a result of resident dissatisfaction. Fifteen programs indicated using a night float model. Two of these programs indicated that the night float system “does not work” and is “of no educational value to the floating resident,” emphasizing that this system is “certain to decrease the operative experience of residents.” Nine programs reported decreasing the number of nights residents take call, changing from an every third night model to an every fourth or fifth night model. Four programs indicated that Chief residents, previously on home call duty, were now used for in-house call duty. One program reported resident dissatisfaction with this method. Four programs reported increasing the use of home call for all levels of residents. Additional changes included that some cases were no longer covered, rounding patterns were changed, cross-coverage of services was implemented, and attending surgeons were assigned to in-house call duty.

Twenty programs (40%) implemented programmatic change related to time distribution. Twelve programs indicated strict compliance with the ACGME regulations, providing 10-hours off in between daily duty periods and providing an average of 24-hours off per seven day period. Six programs indicated strict monitoring of work hours, evaluating residents’ handwritten time logs or computerized time reports generated by card-swiping systems. Two programs indicated that Sunday was the designated day off for all residents.

Six programs (12%) implemented programmatic change that supported the theme of education. Three programs merged clinical rotations to “enhance the educational

value provided to residents.” Two programs indicated altering the educational conference schedule to “maximize the time spent in the OR.” One program indicated that faculty, residents, and staff were informed about work hour change through periodic conferences and meetings.

Finally, seven programs (14%) reported programmatic change consistent with the theme of support. Six programs indicated an increased use of nurse practitioners and physician assistants to provide patient care and “take care of the scut work.” One program responded that their Chair was a visible leader in the change movement, explaining the need for “strong and visible leadership in this new era.” Of note, two programs reported that changes were not needed as their residents have “always worked less than 80 hours per week.”

#### Content analysis of telephone interviews

Program Directors were provided a list of six questions prior to a scheduled telephone interview. Questions focused on defined categories, motor skill development, work hour models, and study findings. Content analyses were performed (Creswell, 1997).

The first question asked Program Directors’ opinion of the defined category reports, producing two emergent themes related to objectivity and actual experience. Fifty percent of respondents (n=5) reported that the defined categories are “a reasonable gauge that objectively measures something that is hard to objectify,” stating that “the use of these numbers is valid.” However, 50% of participants (n=5) stated that the defined

category reports “must be used cautiously,” as they “present tremendous variability about what residents actually do in the OR.” These numbers “only focus on OR experience and doing the actual case...[these numbers] don’t consider the amount of supervision needed, whether a resident actually did the entire case, or [consider] participation in pre- and post-operative care.” Also, these reports fail to “capture the skill of decision-making,” suggesting that this tool may be “superficial.” One participant stated that “if residents report numbers below the [minimum] requirements, you have to wonder about their competency, [yet] if they are very far above their numbers, you have to wonder about their competency in pre- and post-op care because they are probably just acting like technicians.”

Program Directors were asked to discuss how residents most effectively learn the art of surgery, a question relating to motor skill development. Responses produced themes specific to skill set and time. First, 80% of participants (n=8) stated that repetition and skill transference opportunities are both necessary components in surgical training and education. The use of both aspects of motor skill development “teach[es] surgical decision-making and judgment,” provides “experience [with] different anatomy and disease processes,” and “combines the general principles of surgery with experience.” Respondents indicated that adequate opportunities for repetitive practice and skill transference must remain as reform efforts progress. Two respondents indicated that “repetition improves performance on specific cases, but may not be helpful in the long-run,” explaining that breadth of experience “offers technical skills and learning of technical procedures during complex cases,” allowing for “participation in work-ups and

pre- and post-op care [which] are not necessarily permitted when focusing on repetitive practice.” Finally, all respondents discussed the aspect of time in relation to repetition and skill transference opportunities, indicating “repetitive practice leads to more attention to movements, anticipation of next steps, and emphasizes teamwork, [allowing] cases [to be] done more efficiently and faster. When breadth is the focus, [there] are many pauses during the case because the resident is less efficient and knowledgeable about [the] next steps.” Similarly, “repetition, [although] useful, is [also] not necessarily efficient...[there is] a need to allow [opportunities] for skill transference so that a mid-career surgeon can perform cases he/she will run into that they haven’t experienced during training.”

Respondents were asked to comment on the traditional model of training. All respondents (n=10) indicated satisfaction regarding their training, which was completed in a traditional model. Respondents agreed “the old model allowed for continuity of patient care, provided breadth of experience, and allowed for exposure to the disease process.” Yet, the main theme generated from their opinion of the traditional model can be described as malignant. Responses indicated that the traditional model was “unnecessary and ridiculously hard.” This “outdated model” was “great for service [but] not for education,” and provided “cruel and inhuman punishment” that was “bad for patient care, family life, and marriage.” Such training provided “poor resident supervision” that led to “inefficien[cy] with time utilization,” producing “overworked residents” who “[couldn’t] learn when dead tired.” One participant stated that he “could have learned the same amount in less time if people actually put thought into the curriculum.”

Program Directors discussed their opinion of the 80-hour model, generating two themes related to exaggeration and outcomes. First, all respondents indicated that a mandated number of hours in which residents are permitted to remain in the hospital is “absurd,” “rigid,” and “unfortunate,” explaining that this change is an “overreaction to the Libby Zion case.” While the “80 hours themselves is not the problem...it is the restrictions surrounding this number” that “promotes an artificial system.” These restrictions make it “difficult to dissect service from education, [since] it is hard to draw the line [as] both impact each other.” Second, 70% of participants (n=7) discussed anticipated outcomes resulting from an 80-hour model. Respondents, “concerned about [resident] opportunities for [operative] cases” and “continuity of [patient] care,” believe that this model “will negatively impact in places where the level of patient care is more intense and immediate, like in a trauma center.” Similarly, these participants believe the “level of resident responsibility is at risk” since this model “promotes a shift work mentality.” One respondent indicated that work hour reform was necessary “for the arrogant Chairs who refused to change working conditions until they were forced,” which “finally [allowed] for the ‘E’ in ACGME.” One respondent anticipates that the final outcome will be the elimination of discussion about work hours since, “in about 5 or 10 years, we won’t be talking about this anymore because people’s thought process will have changed.”

Respondents were asked to discuss how the 80-hour model might impact the breadth and volume of operative cases experienced during training. Seventy percent (n=7) of participants indicated that the new model would decrease operative experience

by 10% to 25%. Thirty percent of respondents indicated that the 80-hour model “does not have to impact programs negatively,” as the “same breadth [of experience] will be provided,” “giving residents more than enough experience.” These participants, however, echoed that residents’ experience with post-operative care is of concern.

Several respondents discussed rationales for their perceptions that operative experience will decrease, all of which related to a service-oriented theme. One respondent commented that, “we sacrifice educational experience for night and weekend call coverage.” He explained, “we haven’t formulated how to effectively deal with patient care delivery...[a process that] we should rethink [so that] residents [are] people to teach and train, not [used] for labor.” One participant explained that a decrease in operative experience will “especially occur [during] the first three years of training because residents take in-house call.”

Finally, Program Directors were asked to comment on the findings of this study, which, overall, found no significant differences in operative volume between work hour models. Two respondents indicated these findings were anticipated, as these results were consistent with their programs’ experience. One participant stated these findings were “surprising and counterintuitive.” One respondent questioned the difference between university-based and community/university-based programs, suggesting the merging of these program types might demonstrate different results. Sixty percent of respondents agreed, “it is too early to comment, but this study provides a good snapshot of baseline data that “will help us move forward.” These respondents encouraged continuing this study over the next several years.

Sixty percent of respondents commented on the counterintuitive finding related to the inverse relationship of New York resident work hours and operative volume, stating that residents are “probably more efficient with assignment of cases and eliminating scut work.” Respondents stated that residents “must be spending most work hours in the OR,” explaining that “Chiefs [are] fearful of being short-changed, so when they’re in the hospital, they scrub more on cases.” One respondent stated that this finding should be interpreted “cautiously,” explaining that work hours and operative volume may not be accurately reported since New York programs “are scared to death” of the penalties, describing residents and faculty as “paranoid.”

Following the interviews, 50% of participants agreed that this study was “eye-opening” and “important,” concurring that these findings “document the experience [that is occurring] now,” which will be “helpful” as these issues continue to unfold. Twenty percent of respondents expressed their concern that “we will turn out less talented and less skilled surgeons.” These participants explained that the “mindset of residents” is changing, questioning whether residents “are assuming responsibility anymore.”



## Summary

The following points outline the key findings of the qualitative and quantitative analyses:

- There is no significant difference in Chief residents' volume of operative cases based on work hour model, program setting, or graduating class.
- There is no significant difference in Chief residents' volume of operative cases between programs that experimented with work hour reform and programs that did not experiment with work hour reform during 2002-03.
- There is no relationship between the volume of operative cases and the average hours worked by Chief residents.
- There is an inverse relationship between the volume of operative cases and average hours worked for residents in New York training programs.
- Programs experimenting with work hour reform most frequently implemented changes related to clinical activity during 2002-03.
- Program Directors believe that, while it is too early to consider the impact of work hour reform on operative volume, these findings represent baseline data that should be developed with further study over the next several years.

## CHAPTER V

### DISCUSSION AND RECOMMENDATIONS

The ACGME implemented national work hour reform for all residency programs as of July 1, 2003, mandating compliance with an 80-hour workweek model. The implementation of this new model necessitates reform of residents' clinical and educational schedules at a time when knowledge and technical skills are exponentially expanding. Work hour reform alters a time-honored method of training that was not concerned with the number of hours residents spent in the hospital. Due to the restriction of resident work hours, coupled with specific guidelines that impact the allocation of residents' time, the surgical environment must adapt its training methods to ensure that residents receive adequate preparation for independent practice.

#### **Overview of findings**

At the start of this study, it was anticipated that fewer work hours would decrease operative volume. Perceptions of faculty and residents, many of who were from New York programs, as well as conjecture from surgical leadership, fueled this expectation (Whang, Perez, Ito, Mello, Ashley, & Zinner, 2003; Britt, 2002; Romano, 2002; Wallack & Chao, 2001; Rutkow, 1994; Condon, 1989). The results of this study do not support these perceptions. Of the 80 programs that responded, statistical analyses reveal the following findings: 1) there were no significant differences in the volume of Chief residents' operative cases based on work hour model, program setting, or graduating

class; 2) there was no significant difference of Chief residents' volume of operative cases between programs that experimented with work hour reform and programs that did not experiment with work hour reform during 2002-03; 3) there was no relationship found between work hours and volume of operative cases; and 4) there was an inverse relationship found between work hours and volume of operative cases for residents in New York programs (n=7).

Program Directors completed a survey that provided contextual information related to the working conditions of Chief residents, including information related to whether Chiefs took in-house call, how many nights per week Chiefs took call, and a brief description of program changes made during 2002-03, where applicable. A content analysis revealed that many programs (n=50) experimented with work hour change during 2002-03, attempting to achieve compliance prior to the official implementation of the mandate. The "night float" system and the "leave early post-call" method were the two models most frequently used by programs attempting compliance. Additional changes were also implemented, such as increasing the use of home-call duty or designating a common day off per week for all residents. Overall, programmatic changes were made that altered residents' clinical activities.

Program Directors, volunteering to discuss these findings via telephone interviews, concurred that this study should be the foundation on which to continue evaluating the impact of work hour reform. Such a longitudinal study can identify trends that may emerge as reform progresses. Several Program Directors anticipate that work

hour reform will ultimately result in a 10% to 25% decrease in operative volume, while the majority of Program Directors suppose “it may just be too early to tell” whether fewer work hours decrease operative volume.

Overall, the findings of this study support the limited research that demonstrates fewer work hours do not jeopardize the volume of procedures in which residents participate (Hassett, Nawotniak, Cummiskey, Berger, Posner, Seibel & Hoover, 2002; Kelly, Marks, Westhoff & Rosen, 1991; Carey & Fishburne, 1989). While operative experience comprises a large component of surgical training and education, non-operative experience and formal educational activity complement residents’ preparation for independent practice or further training. Given that residents’ procedural volume may remain unchanged in the wake of restricted work hours, the impact this may have on other components of surgical training is uncertain.

## **DISCUSSION**

The goal of surgical residency is “to prepare the resident to function as a qualified practitioner of surgery at the high level of performance expected of a board certified specialist” ([www.acgme.org](http://www.acgme.org), 2002). Implicit to this goal is the ability to participate in all aspects of surgical patients’ diagnosis, management, and treatment. Non-operative experiences and didactic educational opportunities are, therefore, necessary adjuncts to the training and education received in the operating room. The baseline findings of this study suggest that operative volume remains unchanged regardless of the work hour model used, raising the question of whether work hour reform impacts the non-operative

components of resident education and training. Consequently, any impact on residents' non-operative experiences must also be considered as they relate to operative training. Since non-operative and operative experiences are inter-related components of surgical training and education, change in one area may impact the learning opportunities and skill development provided in the other area.

Thirty percent of Program Directors interviewed for this study implied that the ACGME mandate provides an opportunity to “rejuvenate” the system, which “finally [permits a] focus on education.” This “focus on education” requires an understanding of the new environment created by the 80-hour model, including awareness for how the learning experiences offered in this environment affect residents' development.

### **Surgical residency: a new educational environment**

The findings of this study identify various ways in which programs are changing their learning environment to comply with the 80-hour model. The two most popular models found in this study are the “night float” model (n=15) and the “leave early post-call” model (n=15). Of note, 60% of all programs (n=50) implementing some method of programmatic change reported compliance with an 80-hour workweek.

The night float model includes a team of residents assigned to a 12- or 14- hour shift during the day, assigning one resident (referred to as the “floater”) for the 12-hour evening shift (refer to Appendix F). A “float” typically consists of two- or four-week durations (Cavallo, Ris & Succop, 2003). Chief residents are frequently excluded from the float schedule. This exclusion allows flexibility of work hours, which potentially

increases Chiefs' participation in operative cases (Mendoza, Mendoza & Britt, 2003).

Many physicians consider the night float model a detriment to resident education and training since the "floater" frequently participates in non-educational activities (Cavallo, Ris & Succop, 2003). Such activities include routine admissions of patients in medically stable condition, obtaining routine patient consent, or performing intravenous cannulation, which are duties that can be performed by ancillary health care staff (Lieu, Forrest, Blum, Cornfeld & Polan, 1992; Trontell, Carson, Taragin & Duff, 1991; Hayward, Rockwood, Sheehan, & Bass, 1991). Several Program Directors interviewed for this study shared the perspective that the night float model harms residents' training, asserting that the total time per year spent floating may negatively impact residents' development of technical skills.

Residents should routinely participate in experiences that allow for the development and refinement of skills related to technical acuity, decision-making, and clinical judgment, a principle implicit in both methods of motor skill development theory. The time spent involved in non-educational activities may result in fewer opportunities to participate in operative cases that promote skill acquisition and refinement. Additionally, senior residents assigned to "float" are frequently unable to participate in scheduled cases, which may limit their learning opportunities that allow for skill refinement and skill transference at a pivotal point in training.

The night float model also perpetuates the development of a "shift mentality," considered harmful to residents' developing attitude toward patient care (Mendoza, et al., 2003; Conigliaro, Frishman, Lazar & Croen, 1993). This attitude frequently develops

upon assimilation to regulated work hours, creating a mindset that “when time is up, the clock is punched, and patient care stops” (Jain, 2003). Several Program Directors interviewed for this study expressed concern about the development of this mentality, a phenomenon they anecdotally observe in residents at the junior levels of training.

The “leave early post-call” model is an alternative to the night float system (refer to Appendix G). Residents in non-New York programs are required to leave the hospital within six hours following their post-call shift, which often results in their inability to participate in operative cases following a night of call duty. However, the allocation of work hours in this model allows for more consistent opportunities to participate in scheduled procedures. Residents are encouraged to leave the hospital early whenever possible, such as when there are no scheduled cases and their patients have been seen. This practice allows flexibility with work hours, allowing additional time to participate in cases and patient care when necessary. This model also attempts to avoid the “shift mentality” (Mendoza, et al, 2003). Overall, residents, unable to participate in operative cases post-call, are limited from operating only for a single day, while the night float model limits residents’ operative participation for several consecutive weeks.

The night float and “leave early post-call” models cause contention among residents, many of whom are concerned that restricted work hours may limit their operative volume. The findings of this study demonstrate that 15 programs implemented the night float model and 15 programs used the “leave early” model. A separate analysis of programs experimenting with these models was performed to examine whether a significant difference in operative volume occurred between models. Only those

programs achieving compliance with an 80-hour model were used for analysis. Ten programs achieved work hour compliance using a night float model, while 8 programs attained compliance using the “leave early” model. A one-way ANOVA demonstrated no significant difference in Chiefs’ operative volume between these two models,  $F(1,16) = 1.56, p = .230$ .

The increased use of home-call duty is another change implemented by some programs. This practice attempts to ensure that residents spend more time in the hospital during the operative day, as opposed to spending work hours as a “floater” or assigned to in-house call. Home-call does not preclude residents from returning to the hospital during evening hours for emergencies. The hours residents spend in the hospital when called in from home contribute to the total number of hours worked per week. Therefore, residents spending time in the hospital during the night must, then, adjust their daytime work hours to maintain compliance. These adjustments may potentially prohibit participation in scheduled cases, depending on the amount of time residents spend in the hospital when called from home. Currently, there are no guidelines restricting the frequency for assignment to home call duty ([www.acgme.org](http://www.acgme.org), 2003).

Alternatively, some programs now require that Chief residents take in-house call duty, requiring they leave the hospital within six hours post-call. This practice risks Chiefs’ participation in valuable learning opportunities during their final year of training. This effect may be ameliorated, to some extent, provided that Chiefs’ schedule operative cases in relation to residents’ release post-call.



Undoubtedly, the ACGME mandate has changed the surgical learning environment. This change necessitates evaluation that considers how residents develop the skills and knowledge requisite for independent practice while training in a restrictive environment. Such information is vital in helping the surgical leadership redefine how to most effectively provide residency training.

### **Correlates of baseline findings**

Understanding the correlates that may contribute to these baseline findings is a prerequisite prior to evaluating the impact of work hour reform. These correlates introduce variables specific to the surgical environment that may impact residents' development and performance.

### **Complex cases**

The findings of this study show that there is no statistically significant difference in volume of operative cases between work hour models, suggesting that operative volume may, indeed, remain unchanged in an 80-hour model. However, this finding does not consider the impact of the complexity of cases on operative volume.

Complex cases encourage the principles of skill transference, allowing residents to integrate all aspects of technical and cognitive skill in novel situations. They also represent more difficult procedures that typically require a longer period of time to complete, given the intricacies of the procedure, skill of the resident, and complications that may arise. The learning process that occurs during complex cases facilitates the

technical, cognitive, and professional development of residents, which ultimately fosters competency. Participation in complex cases contributes to the breadth of operative experience, but may reflect less volume of experience. Yet, limited volume does not indicate that residents spend less time operating or learn less. Complex cases may be as powerful a learning experience as a large number of simple cases in which repetition and skill refinement occur.

### Setting

Program setting is another correlate to consider in relation to residents' development, learning environment, and operative volume. First, residents training in university-based programs frequently spend more time involved in research and educational activities than residents training in non-university-based programs (Greco, et al., 1986). The impact of this correlate must be considered as it relates to the development of technical skills and fund of knowledge for residents training in non-university-based programs. As programs acclimate to work hour reform, there is a vital need to understand *how* residents spend their time to ensure they receive adequate participation in operative and non-operative activity. This information enhances educators' awareness of the learning environment and its impact on residents' development.

Second, primary teaching hospitals, intrinsic to university-based settings, frequently include tertiary care and trauma centers. These centers often provide extensive resources that allow for the ability to treat increased volume and breadth of complex cases (Landercasper, Bintz, Cogbill, Bierman, Buan, Callaghan, Lottman, Martin,

Andrew & Lambert, 1997; Galandiuk, 1995). Residents training in these facilities are more likely to participate in a wider breadth of complex cases, perhaps contributing to enhanced learning opportunities. Similarly, the breadth and volume of complex cases accepted in neighboring teaching hospitals may diminish as a result of sending patients to these specialized tertiary care and trauma centers. These outlying hospitals frequently include non-university-based residency programs, which are common in larger cities such as New York, Philadelphia, Chicago, Los Angeles, and Washington, DC. Residents training in these outlying facilities, then, are likely to participate in an abbreviated breadth of cases, which may limit their learning opportunities.

Third, institutional change must be considered in relation to these baseline findings. The health care delivery system experienced unprecedented change during the past two decades, resulting in hospital closings, conversions, and mergers, with similar experiences occurring in private practices (Shen, 2003; Sloan, Ostermann, & Conover, 2003; Mark, 1999). Simultaneously, academic surgeons have been expected to generate revenue from increased participation in clinical activities (Pawlson, Watkins & Donaldson, 1980). These types of environmental factors are likely to influence the learning environment of residency programs. For example, less faculty involvement may impact the volume and breadth of cases in which residents participate. Hospital closings or mergers may influence the types of patients and cases accepted in teaching hospitals. Similarly, hospital closings or mergers may impact the number of residents and faculty involved in training programs. Overall, factors related to program setting provide

variability in residents' learning environment.

### Leadership and administration

The responsibilities inherent in the Chief year of training present another correlate to consider in relation to these baseline findings. Annually, Chiefs are promoted on the first day of July and, virtually overnight, are expected to become leaders of their service. Their responsibilities include administrative duties inherent in leading a team of health care professionals, including increased administrative paperwork, interactions with physicians and allied health care providers, and teaching responsibilities for junior residents and medical students. Anecdotally, Chiefs are participating in more cases of a lesser complexity as they relieve residents of their clinical duties to ensure the team's compliance with an 80-hour model.

These administrative and leadership responsibilities, while necessary to the development of residents, contribute to the hours Chiefs spend in the hospital. Organization and leadership skills are necessary to effectively experience the Chief year of training, but exercising these skills may displace the number of hours spent participating in operative cases.

### Non-operative activity

Participation in non-operative activities may displace the time residents spend operating. Non-operative activities, including pre- and post-operative patient care and formal educational activity, are integral to residents' education and training. Baseline

findings demonstrate no relationship between work hours and operative volume, suggesting that residents may, indeed, be actively participating in non-operative experiences that contribute to the comprehensive training of surgeons. This finding supports the concept that surgeons “do more than just operate,” a perception held by many medical students. Initial findings of a study involving 215 third-year medical students demonstrate that the majority of students perceive surgeons spend most of their work hours in the operating room (Mendoza & Cole, 2004). Students’ perceptions change upon completion of their surgery clerkship, at which time they realize that the practice of surgery extends beyond the operating room to include extensive pre- and post-operative patient care. Yet, the length of time residents spend in pre- and post-operative care may impact the time available for participation in operative cases during an 80-hour workweek.

#### New York, New York

To the extent residents training in New York programs “do more than just operate” remains uncertain. The findings of this study demonstrate an inverse relationship between the operative volume and work hours of residents training in New York programs (n=7). Sixty percent of Program Directors interviewed for this study indicated that these programs are “probably more efficient” and “focus on education over service,” suggesting that programs probably demonstrate efficiency when rounding, use physician assistants efficiently, and reduce participation in non-educational activities. These presumed changes to the learning environment may, indeed, allow residents more

time to operate, implying that more operative cases are performed during fewer work hours. However, the following questions are raised, given this implication: 1) How frequently are New York residents participating in non-operative patient experiences? 2) Do New York residents participate in an adequate breadth of cases, given that more cases are reported during fewer work hours? and 3) How frequently are New York residents participating in educational activities that contribute to their cognitive and technical development?

An inverse relationship additionally implies that fewer cases may be performed when residents are working more hours, which also raises several considerations. First, participation in fewer cases while working more hours may imply that residents are involved in more complex cases. Frequent participation in complex cases creates the appearance of limited volume, yet potentially provides much richer learning experiences. Second, the reporting of fewer cases while working more hours may imply that residents are spending more time involved in non-operative patient care, educational activities, or scut work.

Program Directors interviewed for this study anticipate that New York residents demonstrate more efficiency in their work habits, which allows for increased operative time. New York training programs have provided sparse information regarding their transition to work hour reform, preventing speculation about how to interpret this finding. The inverse relationship between work hours and operative volume suggests that New York programs are a rich resource for evaluating the impact of work hour reform. These

programs hold valuable information that may assist all surgical programs to more effectively transition to an 80-hour workweek.

The correlates of case complexity, program setting, leadership and administration, and non-operative activity need to be studied for their impact on the surgical learning environment, additionally examining how these influences shape the cognitive and technical development of residents. The “I-E-O” method of assessment is one way to evaluate how work hour reform impacts residents’ education and training (Astin, 1993).

### **Assessment and evaluation of work hour reform**

The “I-E-O” method of assessment facilitates awareness about how the learning environment impacts learners (Astin, 1993). Similarly, this method identifies whether the experiences provided actually contribute to the development of learners (Astin, 1993). This assessment method is applicable to surgical education, a system of training that provides multiple didactic and experiential opportunities. The non-operative and operative learning opportunities provided during residency contribute to residents’ fund of knowledge, development of technical skills, and development of maturity and confidence that permits handling multiple crises and tasks (Gawande, 2001; Hamdorf & Hall, 2000; Grillo, 1999; DesCoteaux & Leclere, 1995; Luchette, Booth, Seibel, Bernstein, Ricotta, Hoover & Hassett, 1992; Varco, 1956). Prior to work hour reform, residents frequently spent 90 to 130 hours per week in the hospital acquiring such skill, knowledge, and experience during a five-year period (Evans, 2002; Britt, 2002; Polk &

Taylor, 2002; Carey & Fishburne, 1989). Work hour reform limits residents' exposure to this environment, raising the question of whether the environment and learning opportunities now accessible to residents effectively contribute to their development. The "I-E-O" model represents a framework for assessing the impact of work hour reform. This framework enables individual programs, and the profession, to evaluate the effectiveness of curricula, ensuring that the training and educational methods implemented maximize residents' development during fewer hours of training.

### **Inputs**

The "I," or inputs, of the "I-E-O" model refer to the personal qualities, skills, and knowledge that learners bring to training (Astin, 1993). Literature reveals that trainees enter surgical residency with a wide variability in fund of knowledge, clinical skills, and technical skills (Roth, Watson & Harris, 2002; Liddell, Davidson, Taub & Whitecross, 2002; Ringsted, Schroeder, Henriksen, Ramsing, Lyngdorf, Jonsson & Scherpbier, 2001; House & House, 2000). Residents were previously permitted to spend an inordinate amount of time in the hospital, contributing to the acquisition of operative and non-operative skill. Residents realizing any personal deficits in skill level were able to seek out opportunities that contributed to their professional and personal development, an assumption associated with the personality of students pursuing surgical careers.

Personality theory, a common theme in the medical education literature, reveals that surgical specialties frequently attract people described as "workaholics" who seek intellectual challenge, rapid work pace, and participation in patient care that requires



technical acuity (Stilwell, Wallick, Thal & Burlison, 2000; Erzurum, Obermeyer, Fecher, Thyagarajan, Tan, Koler, Hirko & Rubin, 2000; Newton, Grayson & Whitley, 1998; Burack, Irby, Carline, Ambrozy, Ellsbury & Stritter, 1997; Bland, Meurer & Maldonado, 1995). These personality types seem to thrive on the learning and work environments inherent in a surgical career, spending the majority of time focused on developing and practicing their craft. A recent study demonstrates that surgery residents actually prefer to spend the majority of their time off involved in educational activities defined as studying, reading, and preparing for presentations, supporting the assumption that surgical types are entrenched in their education and work (Mendoza & Risucci, 2003). Surgery residents' personalities reflect consistency with the traditional model of training that provided a fast paced environment and limitless opportunities for learning. Anecdotally, surgical faculty and residents anticipate that alternative personality types will now pursue surgical careers, given the limitations of the 80-hour training model.

When assessing and evaluating inputs, data gathering must include information that answers the following questions: 1) How do the personalities of residents currently pursuing surgical careers differ from the personalities of previous surgical residents? 2) Are residents who selected surgical training after the declaration of the 80-hour model spending their time off involved in educational activity? and 3) How does career satisfaction differ between residents who pursued surgical training after the declaration of the 80-hour model and their predecessors who trained in a traditional model?

## **Outcomes**

The explicit goal of surgical residency is to prepare residents for independent practice, ensuring that trainees learn a common fund of knowledge and develop technical skills required by the profession. Implicit in this goal is producing professionals who are equally prepared with both fund of knowledge and technical skill. The outcomes of surgical residency, the “O” in the “I-E-O” model, primarily refers to completion of training, documented volume and breadth of operative experience, and passing rates on the written and oral board examinations ([www.absurgery.org](http://www.absurgery.org), 2002; Astin, 1993). These outcomes determine whether graduates become board certified surgeons, demonstrating a relative equality of knowledge and skill.

## **Evaluation of the educational environment**

Surgical residency programs adhere to common educational guidelines as a standard of accreditation, yet training experiences remain variable. Contributing factors include program setting, region, number of residents and faculty in the program, training experiences of faculty, patient population, and types of allied health professionals employed by hospitals, to name a few. The implementation of work hour reform may result in even more variable training experiences. The potential for such variability raises the questions of whether residents, indeed, receive similar opportunities during training and whether these opportunities allow residents to achieve uniform competency before entering independent practice.

Despite the variability of training experiences, surgeons implicitly concur on how residents should perform upon completion of each level of training. To determine how to achieve the same, or better, outcomes at each level of training in the new work hour model, the profession must first become aware of how specific educational experiences, and the environment in which they are provided, impact residents' development (Astin, 1993). It is uncertain whether fewer hours spent in the hospital impact residents' cognitive and technical progress at similar rates as previous generations of residents. Evaluation at each level of training allows programs to determine whether their curricula directly influences residents' development or whether tenacious residents seek opportunities for learning, despite more time-constrained curricula (Astin, 1993). The start of this paradigm shift provides a rare opportunity to examine residents' learning environment as major transformation occurs, allowing programs to adapt their curricula to better meet the learning needs of residents and the profession. Such evaluation may lead to the development of more effective and efficient training and educational methods for this new era of surgical training.

The first step in evaluating how the learning environment of an 80-hour model influences residents' development requires data collection of breadth and volume of operative experience, as well as participation in non-operative experience. This process represents the "E" in the "I-E-O" model of assessment (Astin, 1993). These data should be studied in conjunction with information related to the types of students entering surgical training (inputs) and how residents progress at each level of training (outcomes).

This extensive evaluation process allows the profession to examine learning experiences “that can be controlled or changed, since it is these experiences that offer the possibility of improving outcomes in the future” (Astin, 1993, p. 22).

These baseline findings suggest that residents’ operative volume may be maintained in an 80-hour model. This finding demonstrates practical importance, suggesting that residents continue to receive adequate opportunities for repetitive practice that develops and refines skills in an 80-hour model. However, determining residents’ participation in complex cases is a priority for initial evaluation of work hour reform. The extent to which residents participate in such a breadth of cases is a major determining factor that defines whether a decrease in operative experience actually occurs once reform has “settled in.” This focus of evaluation also determines whether adequate opportunities for skill transference remain available to residents.

The defined category reports remain the most practical method for measuring volume and breadth of experience. Two Program Directors interviewed for this study made several suggestions for enhancing the use of these reports. First, the ACGME should educate the profession regarding the way in which cases are “counted,” engendering increased trust in the validity and reliability of these reports. Second, residents should enter all cases in which they participate to permit a more accurate record of training experiences. Third, operative logs should be updated regularly, allowing for a more timely evaluation of residents’ operative experience upon completion of each level of training.

Residents’ participation in non-operative learning experiences is another valuable

factor that must be examined during the initial evaluation of work hour reform.

Comprehensive surgical training includes participation in pre- and post-operative care and formal educational activities, which contributes to the number of hours spent in the hospital. Attendance rosters document residents' participation in formal educational experiences, tracking how frequently programs' provide formal educational experiences and how frequently residents attend. However, tracking methods that document residents' participation in non-operative patient care experiences are deficient.

Non-operative patient care requires the ability to accurately diagnose patients' illness, formulate an adequate treatment plan, and provide follow-up care. Written documentation of all patient encounters is required, yet all residents involved in a patient's care are not necessarily responsible for documentation. For example, a junior resident performing a surgical consult on a patient may call the Chief resident for assistance. The Chief is responsible for assisting the junior resident over the phone and in person, when necessary. The junior resident is then responsible for dictating the consult activity. Such documentation does not specify how much time the junior and the Chief participated in the patient's care. Additionally, the Chief does not document his/her involvement in this episode. Documenting such activity could provide valuable information related to the frequency and role of residents' involvement in pre- and post-operative patient care, assessing residents' development and opportunities available for learning (Feldman, Hagarty, Ghitulescu, Stanbridge & Fried, 2004). The lack of efficient recording methods creates obstacles for assessing how much time residents actually need to develop appropriate diagnosis and management skills. Previous studies evaluated

these factors with moderate success, demonstrating that the use of personal digital assistants (PDAs) contributes to the efficient documentation of clinical and educational activities in which residents participate (MacNeil, Nguan, Haden & Goldenberg, 2003; Magnusson, Hedges, Harper & Greaves, 1999).

Programmatic change must also be evaluated to facilitate awareness for how specific guidelines may impact residents' learning opportunities. For example, specific guidelines such as 10-hours off between daily duty periods may limit residents' ability to witness the progression of an uncommon surgical disease, preventing participation in a valuable learning opportunity. Similarly, home-call duty should be examined as it relates to frequency of assignment and amount of time spent on the telephone, as residents spending many hours on the telephone risk fatigue. Residents taking home-call are not required to leave the hospital following the end of their call shift, questioning whether residents' operative learning opportunities may be affected. For example, literature reveals that residents in a fatigued state may be more prone to committing errors when performing routine procedures, yet be in a heightened state of alertness when performing complex cases (Samkoff & Jacques, 1991; Deaconson et al., 1988). Such "hidden consequences" related to specific guidelines are certain to arise after evaluating the impact of work hour reform (AAMC, 2003).

Overall, the learning environment and opportunities available to residents in the age of work hour reform are vital components in evaluating how residency affects the development of surgeons. The evaluation of work hour reform must consider how trainees "look" at the start of residency, whether effective and efficient training

experiences are provided to residents, and whether graduates are able to eventually develop competence as independent practitioners. The “I-E-O” model allows for this intense evaluative process, providing programs with valuable information needed to modify best practices in this new era of training.

### **Implications for surgical training and education**

The surgical profession is currently challenged to maximize the learning opportunities available to residents in an 80-hour model. Several implications for practice should be considered.

First, the 14-member ACGME work group should expand, including several members from each specialty who are well informed of the rigors of training and independent practice inherent to their specialty. The inclusion of several representatives from each area of medicine and surgery would provide expertise that facilitates more effective decision-making capabilities. Specialty-specific factors must be considered in relation to these guidelines, ensuring each specialty’s ability to provide high-quality training and education at a time when knowledge and technology are rapidly expanding. The need for this expanded group represents the understanding that “one size does not fit all,” recognizing that differences exist among the specialties and among the people seeking to enter certain specialties (Britt, 2002).

Second, large-scale educational research efforts must be conducted to evaluate the impact of specific guidelines on the surgical learning environment. These efforts require

individual residency programs to provide researchers with data related to resident demographics, operative experience, specific programmatic change, actual work hours, non-operative activities, and board scores. This data collection also requires participation from independent surgeons and fellows willing to submit similar information that examines competency in practice and fellowship training. The study of this information would allow for a more accurate use of the “I-E-O” assessment model, generating valuable information to help key decision-makers consider the complete impact of work hour reform on surgical training.

Third, programs should consider the implementation of alternative training and education methods in their curricula, such as simulation training and use of structured exams to assess skill level. Simulation training during the formative years of residency, and perhaps even during the fourth-year of medical school, may allow residents to enter the operating room with a better developed skill set (Velmahos, Toutouzas, Sillin, Chan, Clark, Theodorou, & Maupin, 2004). This preparation may facilitate improved learning and teaching opportunities, identify residents needing remediation, and allow surgeons to teach advanced skills earlier in residency, all of which provide a more efficient and organized approach to surgical training.

Similarly, the use of objective examinations during each level of training, such as the objective structured assessment of technical skills (OSATS) and the objective structured clinical exam (OSCE) are evaluative tools that may help identify individual and programmatic strengths and deficits. The OSATS evaluate skills related to technical acuity and clinical management (MacRae, Regehr, Leadbetter & Reznick, 2000; Reznick,



Regehr, MacRae, Martin & McCulloch, 1997). These timed tests allow residents to complete assigned operative tasks using simulated models or live animals, while faculty objectively rate residents' performance. Similarly, the OSCEs use standardized patients to evaluate physicians' clinical skills related to performing a history and physical examination, emphasizing skills related to communication and interpersonal relations (Chalabian & Dunnington, 1997). These sessions, which use live actors referred to as standardized patients, are timed and videotaped. The standardized patients use a global rating checklist to evaluate the physician, resident, or student. Faculty observers may also be involved in rating resident performance. Both examinations are accepted as valid and reliable tools to measure technical and clinical skills. Essentially, these adjuncts to evaluation provide valuable information related to residents' development. Similarly, this information allows programs to tailor the learning experiences of individual residents, if needed, and examine the curriculum to determine whether change is necessary.

Finally, a recording mechanism should be considered that permits documentation of residents' participation in non-operative experiences. Such data allows for a more complete and accurate representation of the training and clinical experiences to which residents were exposed and in which they participated. These measures would also be instrumental in examining the distribution of residents' "workload" and efficiency of their learning experiences, providing useful information from which to consider whether modification of specific work hour guidelines is necessary.

Overall, empirical evidence from all surgical programs remains an essential factor in examining what should be changed, why it should be changed, and how it should be changed. Surgical training and education depends on such vital information to ensure that it continues to produce well-trained surgeons able to provide care in a rapidly changing health care environment.

### **Future research**

The impact of work hour reform on the operative experience of residents provides an abundance of research opportunities. Initially, this study should continue for several years, considering each level of training. The Program Directors interviewed for this study suggest continuing to gather data on a longitudinal basis so trends and comparisons can be evaluated. Such a foundation provides empirical data for decision-makers during the early stages of assessment and evaluation. Similarly, data related to the breadth and volume of operative experience, as well as participation in non-operative patient care, should be gathered from interns who began on July 1, 2003. These data are the start of a framework from which to analyze the full impact of restricted work hours upon a complete five-year training cycle.

The impact of work hour reform on the competency of independent surgeons should also be investigated. This line of research is a next step in evaluating the long-term impact of training under the ACGME mandate. The examination of how residents trained in an 80-hour model function as independent surgeons is of particular interest,

including measures of stamina, number of hours worked, patient satisfaction, pursuit of fellowship training, quality of life, and career satisfaction.

Simulated training is yet another area for examination. Studies related to the transfer effects of simulated training have not demonstrated definitive evidence that skill transference, indeed, occurs during “real-life” situations (Strom, Kjellin, Hedman, Wredmark & Fellander-Tsai, 2003; Salas, Bowers & Rhodenizer, 1998). The inability to mimic reality or provide appropriate tactile capabilities are the major complaints about simulated training (Good, 2003). Despite this lack of definitive evidence, many residency programs are implementing simulated training curricula. An investigation of the impact of simulated training on residents’ learning and development is necessary, allowing programs to determine whether simulated training is an appropriate use of time and resources (Satava, 1993; Lintern 1991).

### **Conclusion**

Residency training is under tremendous public scrutiny as programs adapt to the ACGME work hour guidelines. The surgical profession is, perhaps, most affected by this scrutiny, given its history of lengthy work hours. Successful compliance with work hour reform is mandatory, for if success does not occur, “it is going into the political arena, where [the profession] might not have as much control....” (Organ, 2001). The alarm has sounded. The surgical profession has acknowledged that the Halsted model must be changed, acknowledging that lengthy work hours are no longer tolerated. These findings, which demonstrate that there is no difference in operative volume between work

hour models, raise the question as to whether such lengthy hours have, indeed, been necessary in the training and education of surgeons. The discussion surrounding these findings demonstrates several correlates that must be considered in evaluating work hour reform.

The skills and knowledge necessary to produce competent surgeons span a wide range of surgical expertise, including operative and non-operative care. The hallmark of the profession remains the ability to provide this extensive range of patient care, a consideration that must be recognized in the work hour debate. Surgical training and education must now focus on providing organized and effective curricula that most efficiently allows residents to experience the breadth and volume of all aspects of surgical patient care in fewer hours. This study is one step in building the foundation that allows for examination of the issues surrounding this paradigm shift. Decision-makers also have a responsibility to the public-at-large to recognize the differences that are unique to surgical training and education, ensuring that the work hour guidelines continue to allow surgical trainees adequate opportunity to acquire the expertise needed for the challenges facing contemporary and future surgeons. For these unique qualities inherent to surgical training and education provide surgeons with the skill and knowledge to save and improve human lives.

## Appendix A

### Sample letter sent to Program Directors

Dear Program Director:

I would like to formally invite your participation in a valuable and timely study that will be used to help examine the impact of work hour reform on the operative experience of surgery residents.

I am the Educational Specialist in the Department of Surgery at Eastern Virginia Medical School and a PhD candidate at The College of William and Mary. This study is proposed for my dissertation. This project is supported by L.D. Britt, MD, MPH, Chairman and Program Director of the Department of Surgery at Eastern Virginia Medical School.

My research project seeks to examine the impact of work hour reform on the volume and breadth of residents' operative experience during this initial stage of transition. Following the June 2002 announcement of the ACGME work hour mandate, the following three groups of residency programs existed: 1) programs that experimented with work hour reform; 2) programs that did not make any work hour change; and 3) New York programs that have more than 10 years of experience with work hour reform. This study seeks to capture baseline data of resident operative experience that may be used to evaluate and guide future discussions and considerations of work hour reform as it relates to surgical operative experience.

To participate in this study, please submit the defined category reports of your Chief residents for the 2001-02 and the 2002-03 academic years. I request that you omit the residents' names. Additionally, please complete the enclosed brief survey. **All information will be solely reviewed by the primary investigator**, ensuring confidentiality. There will be no identifying information disclosed in any discussion of the findings. You may choose to terminate participation at any time. The Institutional Review Boards at The College of William and Mary and Eastern Virginia Medical School have approved this study. This dissertation will be defended at The College of William and Mary, potentially yielding a submitted manuscript. A final report of study findings will be sent to all Program Directors having participated in this study.

Please contact me if you have additional questions or concerns. Thank you for your anticipated cooperation in a worthwhile research endeavor.

Respectfully,

Kathryn A. Mendoza, MSW  
Education Specialist  
Eastern Virginia Medical School  
Department of Surgery  
825 Fairfax Avenue – Suite 610  
Norfolk, VA 23507  
757-446-7470  
fax: 757-446-8951

L.D. Britt, MD, MPH  
Brickhouse Professor and Chairman  
Eastern Virginia Medical School  
Department of Surgery

## Appendix B

Name of program: \_\_\_\_\_( typed in prior to mailing)\_\_\_\_\_

1) During the academic year **2001-02**:

- what was the average number of hours per week your Chief residents worked? \_\_\_\_\_ hours/week
- did Chiefs take in-house call on a regular basis?    Yes        No        (please circle)
  - if so, how frequently did Chiefs take in-house call? \_\_\_\_\_ nights/week

2) During the academic year **2002-03**:

- what was the average number of hours per week your Chief residents worked? \_\_\_\_\_ hours/week
- did Chiefs take in-house call on a regular basis?    Yes        No        (please circle)
  - if so, how frequently did Chiefs take in-house call? \_\_\_\_\_ nights/week

3) Did your program implement work hour change during the 2002-03 academic year?    Yes    No    (please circle)

4) If your program implemented work hour change during the **2002-03** academic year:

- in which month was change implemented? \_\_\_\_\_
- briefly describe the changes made: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Please return form to:  
Kathy Mendoza, MSW  
Education Specialist  
Eastern Virginia Medical School  
Department of Surgery  
825 Fairfax Avenue, Suite 610  
Norfolk, VA 23507  
Fax: 757-446-7404  
Email: mendozka@evms.edu

## Appendix C

November 4, 2003

Dear Dr. \_\_\_\_\_:

I recently conducted a study to examine the impact of work hour reform on the operative experience of surgery Chief residents. This letter is to formally invite your participation in the second phase of this study.

This phase includes a brief telephone conversation to discuss your expert opinion regarding the findings. This telephone conversation should last no more than 15 minutes. Your expert comments will be reflected in the final manuscript that provides a more in-depth examination of the impact of work hour reform on surgical operative experience. Telephone conversations will be kept confidential. A report of the study findings will be sent to you prior to this conversation.

Please indicate on the bottom portion of this letter whether you agree to participate. Please fax this letter to me at your earliest convenience. Thank you for your consideration in this endeavor.

Respectfully,

Kathryn A. Mendoza, MSW  
Education Specialist  
825 Fairfax Avenue – Suite 610  
Norfolk, VA 23507  
Email: mendozka@evms.edu  
757-446-7404  
fax: 757-446-8951

**PLEASE FAX THIS ENTIRE LETTER.**

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Yes, I would like to participate in a telephone conversation. Please schedule an appointment.

No, I decline participation.

## Appendix D

(mailed to Program Directors participating in telephone interviews)

### Questions for discussion:

- 1) What is your opinion of the defined category reports as a valid measure of surgical competency?
- 2) How do you think residents most effectively learn the art of surgery (i.e.: through experiencing a breadth of cases, perhaps performing certain procedures one time during training, versus experiencing “mass repetition,” such as performing repeated lap choles)?
- 3) Please discuss your opinion of the traditional work hour model (80+ hours per week).
- 4) What is your opinion of the mandated 80-hour workweek?
- 5) Given your expertise, how do you think the 80-hour workweek will impact residents' breadth and volume of operative experience?
- 6) Please discuss your interpretation of these study findings.



## Appendix E

### Defined Category reports

(minimum requirements per category)

| SKIN,<br>SOFT<br>TISSUE<br>&<br>BREAST | HEAD<br>&<br>NECK | ALIMENTARY<br>TRACT | ABDOMEN | LIVER | PANCREAS | VASCULAR | ENDO-<br>CRINE | TRAUMA |
|--|-------------------|---------------------|---------|-------|----------|----------|----------------|--------|
| 25                                     | 24                | 72                  | 65      | 4     | 3        | 44       | 8              | 30     |

| THORACIC | PEDS | PLASTIC | LAPAROSCOPIC<br>BASIC | ENDOSCOPY | LAPAROSCOPIC<br>COMPLEX | TTL<br>MAJOR | TTL<br>CHIEF |
|----------|------|---------|-----------------------|-----------|-------------------------|--------------|--------------|
| 15       | 20   | 5       | 34                    | 29        | 0                       | 500          | 150          |

**Appendix F**  
**Night Float Model**  
**(two week duration)**

**Week 1**

| HOUR  | SUN | MON | TUE | WED | THU | FRI | SAT |
|-------|-----|-----|-----|-----|-----|-----|-----|
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| 1:00  |     |     |     |     |     |     |     |
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**Week 2**

| HOUR  | SUN | MON | TUE | WED | THU | FRI | SAT |
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| 22:00 |     |     |     |     |     |     |     |
| 23:00 |     |     |     |     |     |     |     |

Floating resident works 6pm – 6am shift (dark shaded boxes)

Non-floating resident works 6a – 6p (solid gray boxes)

### Week 3

| SUN | MON | TUE | WED | THU | FRI | SAT |
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### Week 4

| SUN | MON | TUE | WED | THU | FRI | SAT |
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**Appendix G**  
**Leave early post-call model**

Weeks 1 and 2

| HOUR  | SUN | MON | TUE  | WED | THU | FRI | SAT | SUN | MON | TUE | WED | THU | FRI | SAT |
|-------|-----|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 1:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 2:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 3:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 4:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 5:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 6:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 7:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 8:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 9:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 10:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 11:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 12:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 13:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 14:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 15:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
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| 23:00 |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
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|       |     |     | CALL |     |     |     |     |     |     |     |     |     |     |     |
|       |     |     | OFF  |     |     |     |     |     |     |     |     |     |     |     |
|       |     |     | REG  |     |     |     |     |     |     |     |     |     |     |     |
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Weeks 3 and 4

| HOUR  | SUN | MON | TUE  | WED | THU | FRI | SAT | SUN | MON | TUE | WED | THU | FRI | SAT |
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| 0:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 1:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
| 2:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
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| 4:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
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| 6:00  |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
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|       |     |     |      |     |     |     |     |     |     |     |     |     |     |     |
|       |     |     | CALL |     |     |     |     |     |     |     |     |     |     |     |
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|       |     |     | REG  |     |     |     |     |     |     |     |     |     |     |     |
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## Vita

**KATHRYN A. MENDOZA, PhD**

**Date of birth:** March 21, 1965

**Birthplace:** Plainfield, NJ

### **Education:**

8/99 – 5/04      **The College of William and Mary, Williamsburg, VA**  
Educational Policy, Planning, and Leadership Program in Higher Education  
Ph.D., May 2004

9/91 – 5/93      **Rutgers University, New Brunswick, NJ**  
Master of Social Work, graduated with Highest Honors

9/86 – 5/90      **Rutgers University, New Brunswick, NJ**  
Bachelor of Social Work, graduated with High Honors

### **Professional Experience:**

1/02 – Present      **Education Specialist/Instructor**  
Eastern Virginia Medical School, Department of Surgery, Norfolk, VA  
  
**Program Director, Surgical Assistant Program**  
Eastern Virginia Medical School, Office of Health Professions, Norfolk, VA

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