# WHAT ARE RESIDENTS' INFORMATION SEEKING HABITS DURING NON-WORK HOURS?

by

Sary O. Beidas, MD, FACP, PMP

A CAPSTONE PROJECT

Presented to Department of Medical Informatics & Clinical Epidemiology and the Oregon Health & Science University School of Medicine

in partial fulfillment of

the requirements for the degree of

Master of Biomedical Informatics

Sept 2012

APPROVALS

Oregon Health & Science University

School of Medicine

Master of Biomedical Informatics

## Certificate of Approval

This is to certify that the Capstone Project of

**Sary O. Beidas, MD, FACP., PMP**

*"What are residents' information seeking habits during non-work hours?"*

Has been approved

---

Capstone Advisor - Vishnu Mohan, M.D., F.A.C.P

_____

Date

# TABLE OF CONTENTS

**ACKNOWLEDGEMENTS**

To:

I would like to offer my appreciation and thanks to my advisor Dr. Vishnu Mohan. Without his insights, support, and assistance this project would not have been as exciting as it is.

Also, special thanks go to my colleague, friend, and co-investigator in this project, LTC Christos Hatzigeorgiou. I deeply value his friendship and his insight. This project would have been very difficult to do without his participation and insightful discussions. Thank you for your commitment to serve in uniform and protect our freedom.

Above all, my gratitude goes to my life partner, Amal, for her unwavering patience, support, and above all love. She is the rock of the family and it is from her that I derive meaning and purpose for my life and work. Last, my thanks to my loving daughter, Rinad, for always challenging me to become a better learner and father.

## ABSTRACT

This Capstone project is a qualitative study exploring the out-of-hospital clinical information seeking habits of residents-in-training (residents) in an era of work-hour restrictions. Since 2003, these restrictions were mandated by the Accreditation Council for Graduate Medical Education (ACGME). These rules were placed with an aim to promote patient safety and high quality learning. An updated and more restrictive work-hour schedule took effect in July 2011. Other forces bearing on medical education include information technology, economics, and politics of healthcare. Information technology practices have largely changed in the last decade, whereas the education curriculum and teaching techniques are bogged down in 20$^{th}$ Century paradigms.

Based on grounded theory we used semi structured interviews to identify how residents seek clinical information outside the work environment. In particular, we are interested in identifying how information seeking habits and technology intersect with medical education practices.

Results: We interviewed 33 residents from 4 distinct residency programs (Internal Medicine, Family Practice, Orthopedics, General Surgery) and from the Transitional 1 year internship at Eisenhower Army Medical Center in Augusta, GA. Using a semi-structured interview format, we explored variables that may influence residents clinical information seeking habits outside routine work hours. Codes and themes from the interviews were transcribed and then analyzed. In the context of duty-hour restrictions, we discuss the major themes related to residents' information seeking habits. Thematic interactions, like personal growth strategies, secondary effects of work-duty hour

restrictions, and access to information resources, influence residents motivation for seeking clinical information seeking habits of residents. Embedded in our discussion are recommendations that may assist faculty and residents in easing the burden of transitioning from a 20th Century to a 21st Century information culture for Graduate Medical Education.

Conclusions: Graduate medical education in the 21st Century should be resilient to adapt and change in face of the challenges imposed by regulatory, cultural, and information technologies. Stakeholders should devote more attention to understanding the effects of changes in the variables affect resident learning and in particular, their clinical information seeking habits.

## INTRODUCTION

The Internet has had a profound effect on human behavior including how individuals seek information. [1, 2, 3] Concurrently as the Internet evolves, how individuals make use of the Internet, and in particular how they search for information will change. For example, prior to the Internet, individuals seeking clinical information would go to the library, locate references, and sequentially look them up in a linear manner. Whereas, today, information seeking is a dynamic, often non-linear process where Internet users can explore information out of sequence by jumping from one page to another unrelated Web page by selecting active links on text or images.

For this qualitative research project, our primary focus was to determine how residents seek clinical information when they are not at work and in the context of work-duty hour restrictions. Although, the work environment takes up to almost a third of an individual's day, the other two-thirds are like a mystery box in terms of how residents structure their time between work and non-work activities. For example, are residents spending their time learning at home? Are they making use of electronic resources and the Internet? How has the work-duty restrictions imposed by ACGME affected residents clinical information seeking habits? Are residents clinical information seeking habits congruent with program design and instruction methods?

To further confound matters, post-graduate medical regulatory bodies have and continue to exert pressure on limiting work-duty hours for residents. The rationale for imposing these work-duty limitations is guided by real concerns from the public, politicians, and

educators regarding fatigue, lack of sleep, and patient safety issues in the workplace brought about by long work hours. [4,5]

In the mixing bowl of this complexity we add information technology and graduate medical education rules as two other potential influencers on information seeking behaviors. Our goal for this research project is to understand how residents seek clinical information when they are away from their work environment and to identify themes shaped by their interactions with the variables we described. From these themes we can then develop a set of recommendations that may assist residency programs in their efforts to positively affect resident information seeking habits and guide our future research interests.

## BACKGROUND

In 2003, the Accreditation Council for Graduate Medical Education (ACGME) mandated work-duty restrictions for physicians in training (residents). [6,7] These rules were placed with an aim to promote patient safety and high quality learning. The basis for implementing the rules originated with the famous Libby Zion case in New York. Ms. Zion was an 18 year old woman who died at a New York hospital secondary to inadequate medical care provided by overworked residents. The case inspired the regulations limiting work hours for residents in the State of New York. [8] For a detailed review on the history of resident work hour regulation, Lee has published an excellent account from an attorney's perspective. [9] Findings from a recent systematic review of the literature on the effects of varying resident work-hours on patient safety documented few measurable effects which suggests that there are other contributing factors. [10,11,12] Similarly, studies published after 2003, evaluating residents and faculty perceptions of the work-duty rule, indicated an equivocal or negative impact on teaching activities. [13,14,15] For instance, in one study, a focus group of residents and faculty thought that work-duty restrictions changed inpatient rounds in favor of a management style (making clinical decisions), compared to rounding pre-2003, where the primary focus of inpatient rounds was on teaching. [16]

Other investigators reported a decline in educational activities during inpatient rounds from 29% to 9% in the pre and post 2003 period, respectively. [17, 18] To balance the negative effects of work-duty restrictions on educational activities, Nixon et al, proposed strategies to manage student education time; however, these strategies are primarily directed at medical student [rather than residents] learning activities during working

hours. [19] Because of continued pressures arising from public concern of the effects of sleep deprivation on physicians in training, further restrictions on work-hours were mandated by ACGME. To comply, accredited GME programs were required to implement the new rules beginning July 1, 2011. [20]

Meeting the intentions behind work-duty restrictions, primarily those of improving patient safety, quality of care, and resident education, ongoing research studies assist in refining and publication of outcome measures for the rule. [5] However, one main variable, that has not gained much attention is how are residents using the extra freed hours in their weekly schedules? For example, are the residents getting the hours of sleep they need? Are they actively using the freed hours constructively to advance their learning, such as refining their clinical information seeking habits? What tools are they using to seek clinical information? What about the unintended consequences (if any) created by these rules? Also, given the new advances in information technology (IT), what role does IT play in clinical information seeking habits of residents when they are not at work? Do residents use electronic tools to facilitate their educational needs when they are at home?

A recent quantitative survey of residents at two-Midwestern residencies evaluated use of electronic tools by residents while conducting clinical activities at home. Using computers, residents conducted a broad array of clinical activities at home. [21] Among the activities described by residents were, completing clinical tasks that were usually done at the place of work (checking laboratory results, emailing to team residents or attending, talking to consultants, calling clinic patients, and completing clinical notes). Other activities that were reported included use of electronic devices for education purposes. For instance, reading about a patient's disorder or preparing for a conference

presentation. Hence, it is apparent that clinical activities during non-work hours are facilitated by the availability of smart electronic devices such as smart phones, electronic pads, and computers; especially when these devices were enabled to communicate with hospital systems.

Most studies that have looked at information seeking habits have done so in the context of physicians already in practice with a primary focus on the work environment. Further, most of these studies used a survey questionnaire. Insights gained from these studies reveal practical findings. For example, the study by Prendiville et al, shows that pediatricians in Ireland are dependant in their patient care on Internet resources for both their information needs and for their patients. [22] Findings from another study by Weng et al, evaluating information-searching behaviors of healthcare providers in Taiwan, showed that there were significant differences in information seeking behaviors among the groups of providers. For example, physicians were the highest users of MEDLINE whereas pharmacists used Micromedex as their preferred primary source of online information. In contrast, physical therapists preferences were primarily print based. [23]

On the other hand, Hemminger et al, approach to surveying information seeking behaviors focused on a broad group of academic scientists at a large university in North America. Findings from that survey revealed that medical academicians top 5 resources to stay current in their field were (sorted by importance): Science, Nature, JAMA, UpToDate, and the New England Journal of Medicine. The majority of users (53%) preferred to begin their search process using Google in contrast to the library Web page. This study among others shows the increasing prominence of the Google search engine as the primary search tool favored by medical academicians. [24] [25]

Perhaps most relevant and closest to our study for informing us about resident information seeking behavior is a study from Brazil, published in 2008 and coauthored by Martinez-Silveira and Oddone. These authors used a questionnaire to survey residents at a university hospital. Although, residents in this study had free access to powerful electronic databases, the primary mode of clinical information seeking among residents was split between consulting their preceptors or looking up clinical information in their own personal book collections (38/67 residents). In addition the survey identified a gap in residents skills for finding relevant information from databases and electronic resources. Another relevant point for our research project is that the work-duty hour restrictions are enforced in Brazil to a 60-hour work week compared to the 80-hour limit in the US. [26] Despite the limits imposed in Brazil for work-hour limits, the residents cited lack of time (42%) as the primary barrier to information seeking. The implication from that finding is that regardless how work-hours are curtailed, time constraints will always be an issue.

An unintended consequence of the ubiquitous Internet pervasiveness and increasing penetration of broadband connectivity is that residents can link to an organizations clinical databases remotely, and complete patient charts, review laboratory tests or monitor critical patient variables in real-time, and access clinical resources during “rest hours.” But if residents spend time beyond their duty hour restrictions performing tasks that can be best described as patient care, then isn’t this directly contradicting the philosophical intentions of the work-duty restriction rule? Fortuitously, parallel efforts to align the electronic health record (EHR) and transform medical education are underway. Taken together, these new developments are the beginnings of change in the health care educational milieu, (that should have occurred) after the 2003 rule. [27,28,29]

Arguably, how residents spend their time during non-work-duty restrictions is personal, and not subject to the mandates established by their training program. However, clinical educators are in a position that cant assist in enabling the new technologies and may wish to develop educational experiences specifically tailored to take advantage of the new capabilities which could offset the loss of clinical face-time resulting from work-duty restrictions.

An example of an educational experience is continuing medical education (CME) on the Internet. CME is a common educational format by which physicians learn clinical medicine. This was not the case a decade ago which demonstrates how quickly the education system is changing. Traditionally, clinical educators do not think of residents attending CME programs outside the hospital for the purpose of CME. However, CME is woven into the structure of physician education. Reading an article in a medical journal or even reading text from UpToDate is an activity that provides CME credits. These activities are typically sought by practicing physicians. On the other hand, even if residents do not claim these CME hours because they don't have to, they are reading and looking at the same educational material, residents read. We can also ask, do residents attend CME programs outside the hospital confines; live at conferences or online? When attendance is online, how do we know that the content, format, and quality are of a desirable nature and designed for the educational level of the trainee? The reasons we bring CME programs into a discussion of information seeking habits by residents is the popularity of these programs and variety of venues and formats available. Hence, there is no reason to believe that residents do not attend or participate in these programs to meet their information needs.

Similar to most educational activities online, the quality of CME programs on the Internet varies. Meta-analyses of the literature suggest that not all CME programs are the same in their ability to change physician behavior and provision of quality health care. Moreover, residents are usually not interested in recording CME hours, because their time spent at a residency program is sufficient proof of educational activity. In fact, evidence of effective CME programs indicates that for a CME program to achieve its goals and outcomes developers have to select appropriate design and delivery methods. [30] With the advent of personal digital assistants (PDA), physicians, including residents and students were quick to adopt them for use in clinical care. [31,32] However, as Smartphone (especially iPhone & Android platforms) use increased in popularity and in the offerings of applications at the point-of-care, PDAs' practically became obsolete. [33,34]

Another increasingly available technology making its way into hospitals is the electronic health record (EHR). Although, used primarily as a tool to manage patient medical records, it is a multifaceted technology with untapped utility in medical education. [35] For example, residents could track complex patients during their training and analyze patient outcomes based on the decisions they made. In addition, the EHR can track patient populations based on different variables (example: diabetic patients with chronic kidney disease and use of metformin). Other uses, such as auditing to improve the quality of care are much easier to perform in an EHR. [36] For example, using natural language processing, both structured and unstructured clinical text may be automated for checking quality of notes audits. [37]

In conclusion, many of the changes occurring in healthcare and medical education are mandated by government and society. These changes coupled with technological

advances are enabling new methods for delivery of education such as MP3 files, podcasts, and Internet based lectures. However, as clinical educators adopt from the gamut of offerings they should consider the spectrum of possible outcomes from the coupling of technology with education. Ultimately, the desirable effect of infusing the curriculum with smart tools is to empower residents, enhance their education, and provide patients safe and efficient healthcare.

# PROJECT METHODS

## Aims & Objectives

The aim of this study is twofold. First, the study describes the information seeking habits of residents during non-work hours? Second, it characterizes the influence of selected variables such as information technology on information seeking habits of residents outside working hours. This study is a qualitative research study using a grounded theory framework. The primary population studied is residents at Dwight D. Eisenhower Army Medical Center (EAMC), Ft Gordon, in Georgia.

## Definitions

Information seeking: Defined for this Capstone project as a "process in which humans purposefully engage in order to change their state of knowledge." [38]

We clarified the meanings for the following phrases to the resident as follows:

Individualized learning plan: Are objectives and concrete plans described in detail? Does the plan help in monitoring progress of a resident? Is the plan chronologically organized? Example: I have a list of core topics in internal medicine that I plan to complete by the end of my internship, PGY-2, PGY-3 class. I plan to answer 10 questions / day from the MKSAP.

Learning activities: Watching medical videos or webinars. Reading UpToDate, Harrison's, Cecil, or other textbook; reading journal article, listening to podcasts, MP3 files or browsing to a medical Blog or Wiki.

Quality of life: Identified by energy level, motivation, happiness, time with family, time at home? Level of supervision at the hospital, broaden the resident's knowledge base, or new learning occurred.

## Methods

**General study design:** This study is a qualitative research study using a Grounded Theory approach to explore resident information seeking habits during non-work hours.

**Design:** To our knowledge, the published literature is lacking information on clinical information seeking habits of residents during non-working hours. Our concern for understanding resident's information seeking habits during non-work hours, stems from the mandated work-duty restrictions that had the unintended consequences of cutting short, education experiences at hospitals and clinics. The traditional framework for education during residency is founded on the premise of spending long hours at work interacting with patients, colleagues, and faculty. However, the model was designed to function under conditions that are foundationally different from the modern practice of medicine. [39] For example, the traditional model for education does not take into account work-duty restrictions nor does it address the explosive growth in information and use of electronic tools to manage informational overload. Hence, a grounded theory (GT) approach was selected to carry out this study.

Our aim for selecting GT is to discover the dimensions of the social process of clinical information seeking habits in residents' lives during non-work hours. Thus we gradually developed a substantive theory emergent from the data. [40] In particular, we are interested in learning how residents use electronic tools to support their clinical information seeking

habits during non-work hours. The methods of GT are particularly suited for this research topic because of the complexity of phenomena surrounding human actions. In addition, human interactions in problematic situations, convey meanings that usually lead people to act based on the meanings defined by the interaction. In this instance, the problematic situation is limited hours at work and lack of systems that explicitly adjust for losses in time traditionally devoted to education and patient care. Furthermore, GT is particularly suited for studying human and information system interactions. [41]

**Literature Search**: Search terms used to identify published literature included: internet, work hour restrictions, duty hour restrictions, learning, e-learning, e-learning, computer assisted instruction, educational measurement, Smartphone, resident, resident review committee, board accreditation, continuing medical education, home, off campus, ACGME, labor force, workforce, education, and duty-restrictions. A variety of databases were consulted, including, PubMed, Scopus, ACM digital library, IEEE, and Google Scholar. In addition, an ad hoc search of the World Wide Web for artifacts of interest was conducted.

**Setting**: EAMC, is a 105-bed Department of Defense (DOD) tertiary care academic medical center, serving the southeastern region of the US. The hospital complex is the largest military multispecialty hospital in the southeastern region of the US. Among the GME residencies at the hospital, we selected the largest clinical residencies including Internal Medicine (IM), Family Practice (FP), General Surgery (GS), Orthopedics (O), and the Transitional (T) Internship year.

The primary core mission of EAMC is provision of care to Active Duty service members, their families, and DOD retirees. Another important mission for the clinical center is the graduate medical education (GME) program, which is central in fulfilling the center's primary mission of patient care. These settings were selected because, EAMC is one of the 10 academic military hospitals in the US, graduating high caliber professional physicians, who serve the soldiers and represent the US when deployed overseas. Hence, the DOD leadership has a vested interest in upholding the highest standards for GME and patient care.

**Sampling:** The key informants recruited for this study are residents enrolled at GME programs at EAMC. These residencies are: internal medicine, family practice, general surgery, orthopedics, and transitional.. Sampling will stop when either all consenting residents are interviewed or when saturation criteria were met. [42] Combined, the total number of residents was 71. Recruitment into the study was voluntary. First, verbal approval and support for this project was sought from the GME committee and chair as well as the program directors. An announcement to recruit residents in the study was made at each program's morning conference after the study was approved by the Institutional Review Board (IRB). Each resident was contacted and a 30 minute interview was scheduled at a time and place convenient to the resident.

Theoretical sampling was used in this study to enable developing a theory grounded in the generated data. To guide theoretical sampling, an initial purposive sampling of residents included two residents. The ultimate the purpose for theoretical sampling is to select residents who would contribute most to the conceptual framework of the evolving

theory. This is because residents in training are the primary focus of the work-duty restriction rule. Nevertheless, other populations are also affected by the work-duty restrictions. For example, faculty have to adjust to more clinical handoffs from residents, medical students may have less time to spend learning with residents, and administration has to plan for adding non-teaching staff (hospitalists, physician assistants, and nurse practitioners) to compensate for losses in manpower.

**Data Collection**: The primary data collection tool was a one-on-one semi-structured interview with each resident, see Appendix A for the Interview guide questions. An interview may last from 20-40 minutes, and occurred in a setting convenient in time and place for the resident in order not to infringe on the residents time. The investigators conducted, recorded, and transcribed all interviews. Focus group sessions were conducted to assist gaps identified from analysis of the data. At a later stage in the study, the investigators contacted the residents to summarize findings from analysis of the interview content, and validate the interpretation of data. The questions in the interview guide were compiled by the investigators based on their personal experience, education, and review of the literature.

**Reflexivity & Bias**: Reflexivity is defined as the researcher's acknowledgement of the influence they exert on the project subjects. [43] For example, the investigators recognize the possible tensions created from their role as faculty and interviewing some of the residents that work with them.

Several other sources of bias are possible in this research study. For example, bias may occur at the level of data analysis or interpretation stages of the study. To minimize these

biases, the investigators plan to create dedicated times to practice reflexivity. These interactions between the investigators should heighten the sense of potential bias during data collection as the investigators can influence the interview. [44, 45] Other unique aspects of this study are the military setting where residents are active duty soldiers with responsibilities that are sometimes different from civilian residencies. For example, soldiers must take a physical fitness test twice a year. Hence, the transferability of this study to other settings may be limited. Nevertheless, non-military residencies programs stand to benefit from the results and interpretations provided by this study.

Residents at EAMC, are issued tablet-PCs in a wireless or cradled environment. Cellphones are the primary means of communication and the center provides each resident with a one-way incoming calls cellphone capable of text-messaging. On top of this layer of electronic devices, most residents also carry their own personal cell phones (smartphones). Hence, the sample cohort identifies with technology very quickly because of its ubiquitous nature in the hospital. Clinical information systems include the legacy information system (CHCS) and distinct outpatient and inpatient EHRs which are all accessible by remote broadband access. CHCS, is an “old” computerized provider order entry system with limited capability to store physician notes. The outpatient EHR is called AHLTA, and the inpatient EHR is called Essentris. There are also specialized EHRs at EAMC for subspeciality clinical services such as the anesthesia and the gastroenterology services EHRs.

Other measures taken by the investigators to control for bias in this study include, maintaining trustworthiness, consistency, applicability, and truth during analysis and

conduct of the study. For achieving consistency, which refers to external reliability, the investigators plan to adhere to proposed methodology.

**Limitations**: This selected sample of active duty residents, may limit generalizability of this study to the larger population of residents. For example, most residencies do not provide tablet-PCs enabled with productivity software (Dragon speech recognition, Macro generator As-U-Type , Microsoft OneNote ) to residents. However, the interviews are expected to inform us on how residents use their time outside work hours to satisfy clinical information seeking habits. Other limitations include the retrospective nature of recall when describing information seeking habits.

**Data Analysis**: Data analysis using an iterative approach and constant comparative analysis is a leading feature of grounded theory approach. Analysis started concurrently with the collection of data which was transcribed and coded. The primary goal of data analysis under a GT approach was discovery of one or two core variables that inform the main theme of a resident's clinical information seeking habits during non-work hours. Hence, the coded data was examined for prominent themes. Coding, according to GT approach, was achieved at three successive levels. First, open coding, where the data (narrative) is broken into discrete parts to help identify relevant categories. Next, selective coding is the process of inter-relating the categories based on their properties and dimensions so that concepts and theory development is the goal of this stage. Third, theoretical coding, is the level at which selectively filtered codes are related to a core category. Thus, the developing theory is integrated and grounded in data. [46] MAXqda software version 10.1 was used for managing and analyzing the data for this project.

How the study subjects will be recruited?

Permission to recruit the residents for the study shall be obtained from each residency program, the GME committee, and chair. When the IRB approves the protocol, residents will be asked to voluntarily participate in the study.

Interviewee number, as described in the Interview guide, is the number of the interview in order to keep a number count, and enable retrieval segments of narrative during the analysis process. Residents will be interviewed based on their availability status (they choose the time and place). There is no compensation provided to the residents for participating in this study.

Benefits / Importance of this study:

1. Clinical faculty and residency directors learn of resident information seeking habits using electronic devices, which may lead to improved planning and design of education programs for the residents.
2. Residents become aware of their information seeking habits and the tools available to them; this may aid their educational needs.
3. When presented at national conferences and published, this data may help redesign GME residency curricula.
4. Military research, which supports the EAMC and the ARMY's balanced scorecard.

## RESULTS

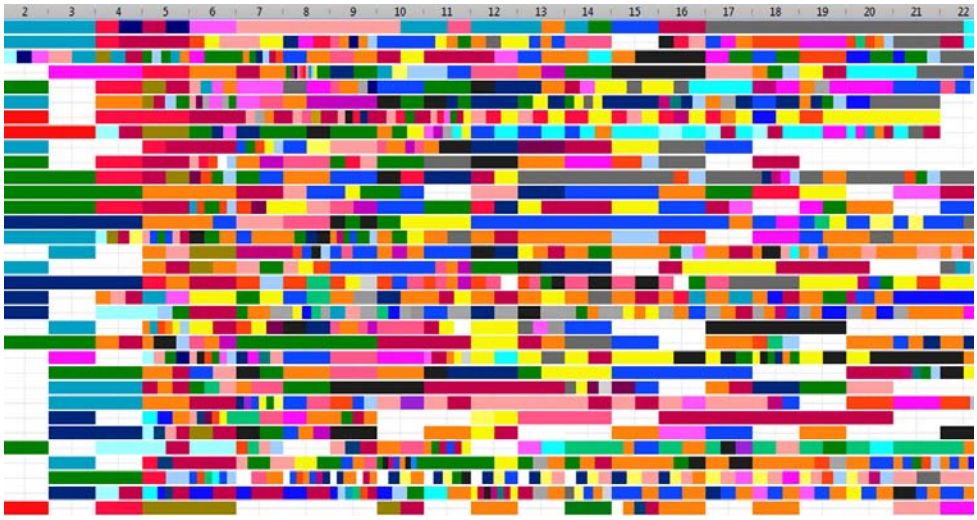
We interviewed 33/71 residents enrolled in GME programs at EAMC during the months of November through December 2011. Interviews lasted 20-40 minutes in length. When no new information was elicited from interviewing the residents indicating saturation, we stopped interviewing. Timing of the interviews was a function of resident availability. Residents were sampled from all 5 residency components. **Table 1**, lists the residents by residency and by year in program. One resident declined to participate in the study. Gender distribution was 12 women and 22 men in this study. All interviewed residents are active duty soldiers enrolled in GME residency programs at EAMC in Augusta, GA.

**Table 1**: Resident participation by year and residency

| | **PGY-1** | **PGY-2** | **PGY-3** | **PGY-4** | **PGY-5** |
|---|---|---|---|---|---|
| **Internal Medicine** | 4 | 5 | 3 | 1 | |
| **Family Practice** | 3 | 4 | 3 | | |
| **General Surgery** | | 1 | 2 | | 1 |
| **Orthopedics** | 1 | 1 | | | 1 |
| **Transitional** | 3 | | | | |

**Figure 1** illustrates the document map for all the interviewed population. Each row represents one unique resident and each column represents a chunk of text from. Also, themes are represented in color. For the full set of codes and themes, see **Appendix B**.

**Figure 1:** Overall document chart comparisons*




**Partial list of themes and identifying colors: Teal: Password sharing; Baby blue: Use of EHR for learning; Light green: Collaboration; Deep red: Question guided learning; White: Home-Work separation; Blue: Inconvenient Smartphone use at home; Orange: Time management; Yellow: Burden of connectivity; Black: Apple OS (MAC, iPad, iPhone).*

Next, we describe the major themes identified from the transcribed narratives.

*Personal growth strategies used by the resident*

None of the interviewed residents interviewed had a written learning plan. Some had mentally mapped out a plan, which sometimes they adhered to. Despite a lack

of a written plan, by the time residents advance to chief resident, they appeared to have a learning plan mentally developed which they followed throughout the year.

For example:

> *" For the surgery people [patients scheduled for surgery] there would be 3 avenues I have to pursue. For technique, it is usually a book, and for the review and outcome it is a journal. Probably I do 15 surgeries a week."*

For the residents who had a mental learning plan, taking multiple-choice tests to answer questions was the prominent form of information seeking. When asked about methods or tools they use to measure their progress in learning, most residents were not clear on how to measure their progress in learning beyond the feedback they received from faculty or from the results of the annual in-service exam.

Dedicated reading time at home is a well established routine used by the general surgery and orthopedics residents; however, for internal medicine and family practice, reading at home did not appear to garner the same level of importance. An alternative explanation to this finding is that and internal medicine and family practice residents are just as dedicated as general surgery and orthopedics, except that they spend upfront time in the hospital to complete their work and conduct their information seeking in the hospital before going home. Such a strategy is plausible given the inherent difficulties the residents have connecting to the hospitals electronic library from home.

> *"I read for 2 hours at home every night, but most of the stuff that I read is printed here [hospital]and I take it home." general surgery and orthopedics residents*

> *"Whenever I went home it was family time. A lot of times when I get home I try to get as much work as I can done at work and reading and studying at work. And then when I get home if it is something I couldn't get to and I can do it in a short time then I will do it at home. But a lot of times I try to balance work with home, keep them separate if I can. Keep them separate if that is at all possible."...internal medicine, family practice, and transitional residents*

### *Novice search strategy*

Looking for residents who could search for relevant information from databases, we identified one resident who had PubMed training using MeSH terminology and who continued to use their library search knowledge effectively. In contrast, all the other residents used natural language terms when searching in PubMed. One resident quipped:

> *"And they showed you how to search as part of your course, but I just don't remember how to do all that [laughing].and since I have all these other resources [electronic library resources] to get what I need, I don't have to worry about PubMed."*

Some residents were aware of the limitations in their level of search skills, others were satisfied that the documents returned by a search engine were relevant.

> *"I do my searches through Google. I don't know that it is the best, but it is the easiest for me. And I feel that whenever I search I get better articles from Google or the information seems to be what I am looking for versus being on all these Web sites."*

*Preferred information seeking portals at home*

Google or Wikipedia were the predominant search engines used by the residents. These general search engines were followed by PubMed in popularity for searching for clinical information. When using Google, residents usually used the generic Google search GUI rather than Google Scholar or the Advanced Google GUI. In general, the residents were uneasy expressing that they used Google, and were quick to qualify their statements that they would not say if asked by an attending that they got their information from Google or Wikipedia.

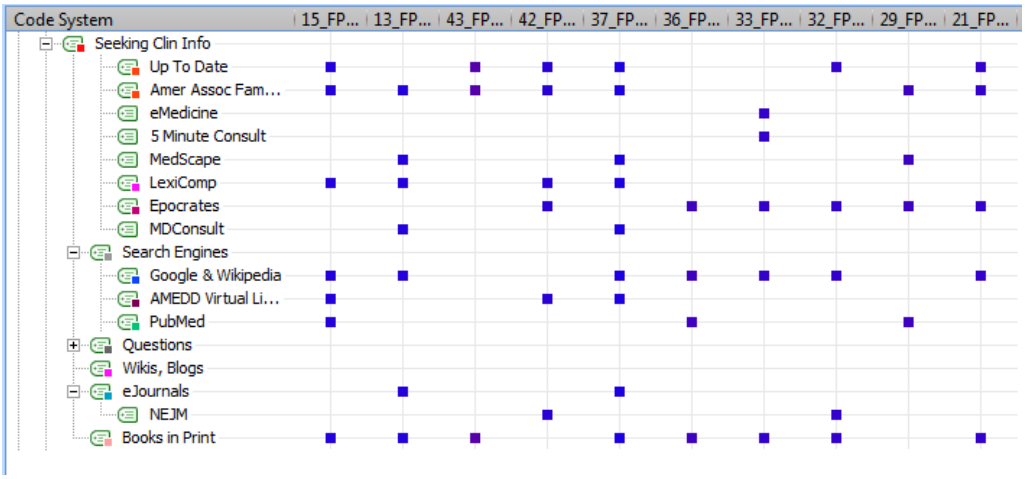
> *"I will be honest, I sometimes still look up definitions on Wikipedia. Who doesn't [laughing]. And I think many people use it because of Google. When you search in Google, it [Wikipedia] is one of the first ones that come up. I use Google for everything, are you kidding?"*

In the illustration (Figure 2), family practice residents identified their preferred portals for searching for information.

By looking at the squares, one can identify patterns of what residents are using and potentially pin point problems. For example, resident #36 in **Figure 2** uses Epocrates from the edited resources available. Google or Wikipedia is the search engine this resident uses for searching from home, albeit mostly for general non-medical information. The resident prefers to read books. When there is a need to use a computer at home, the resident uses an Apple Mac. In this context, it appears that the resident does not make extensive use of edited content limiting her/his "information world" to Epocrates.

On the other hand, the document narrative explains that this particular resident may be heavily using edited content in the hospital. Our conclusion for this is based on the narrative in which the resident explained that most of her/his work is done at the hospital.

**Figure 2**: Codes matrix for family practice residents preferred method for seeking clinicalinformation*




*Each column represents a resident in. Rows list where residents look for information. The first set of rows under Seeking Clin Info are synthesized (edited) information portals, although, MDConsult is a mixed portal for search and for edited clinical information.

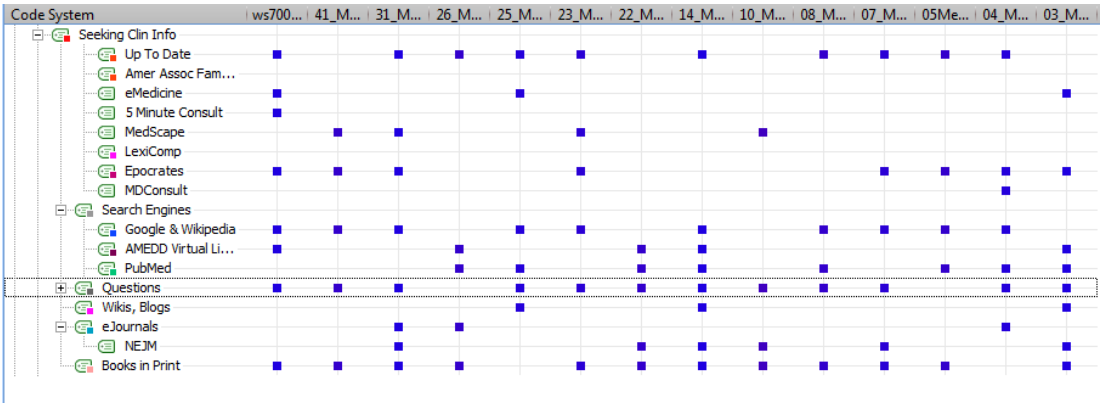
To illustrate the similarities and differences between residencies in how and when they search for clinical information, **Figure 3** shows internal medicine residents information seeking preferences. Among the edited content Web sites, UpToDate is the most common

site followed by Epocrates. Both family practice and internal medicine use Google and Wikipedia as their first choice.

It is not that family practice and internal medicine residents do not want to learn or work from home, rather, the issue is the significant barriers constructed that limit their access to the information resources they need. A resident said:

> *"If we had access to the same Web sites and the journals, if we had access at home, I don't know, I may have logged into it."*

**Figure 3:** Codes matrix for internal medicine residents preferred method for seeking clinical information*



*Tools used to access the Internet*

Many residents have recently upgraded their computers at home from Windows based to Apple computers. We observed an equal frequency between use of iOS versus a Windows based platform for computer use at home. Whereas for smartphones, the residents almost exclusively used either an iOS or an Android platform with twice as many using an iOS platform; one resident used a Blackberry. Interestingly, few residents used their smartphones for information seeking at home. In contrast, residents used their smartphones for information seeking heavily in the hospital environment. A few residents used iPads, but even those who used the iPads at home did not prefer using them compared to their computers for information seeking. We only found 3 residents who used their smartphones at home when they were seeking clinical information. The majority did not use the smartphones for any intensive clinical information seeking. One resident's quote below summarizes the sentiment of the majority for why smartphones are not used at home for clinical information seeking.

> *"At home I mostly use the PC." Or "I don't use my Smartphone at home it is too slow and cumbersome."*

*Ethical and professionalism dimensions*

Out of necessity, some residents justified sharing passwords for accessing university databases. They justified access to the full text content of these databases because of limited resources at EAMC's library.

> *"I use the passwords from friends of mine from different institutions that have a broad access to different journal articles from different journals and more broad than ours."*

Also, completing hospital work at home could be viewed as breaking the spirit of the law for abiding by the work-duty restriction. For example, one resident would observe patients vital signs in real time in the intensive care settings rather than call the nursing staff.

> *"I would be sitting watching football on Sunday and would update vital signs every hour to reload Essentris and get the vital signs and you can know what is going on."*

*Separation of home-work environment*

Internal Medicine, Family Medicine, and Transitional residencies were particularly sensitive about separating the home-work environment. Many residents found it more efficient and productive to complete their work including information seeking and studying at the hospital. Thus some residents did not want to perform any work at home once they reached the 80 hour limit. In contrast, general surgery and orthopedics residents did not separate the home-work environment. These residents if anything did not perceive a change in the quality of their life either. For example, in family practice and internal medicine, the residents perceived that they had little time after they went home and were not particularly excited about doing more work chores. In addition, many residents have families with children.

> *"This is an awful thing. I don't usually look up things when I go home. I stay at work or come to work on a day when I am off, because I don't get much work done when I am at home, but I don't necessarily include that in my duty hours."*

*"After a full day, you know, of dealing with stuff I needed a break, and you need a different mindset to do so; to kind of get on a different train thought whether it be casual social chatter with the girlfriend or you know; I am a big sports fan so if I was looking to see if there is something else to get you in a different mind frame."*

*Time management*

The residents were increasingly aware of time management issues. References to time were repeatedly brought up in the interviews. One resident said:

*"When on the inpatient service there isn't enough time during the day and you round until 12:30 or 2:30 PM and you are here [hospital] until 7-8 PM, you don't have time to prep."*

Time is not necessarily only related to patient care in the hospital or spending time with spouses and children. In this context, I also mention the encroachment of technology to affect time in at least two ways. First factor is the additional burden of having to learn how to use not one software package, but multiple software platforms and portals that have usability issues. The second factor is the almost daily hardware and software malfunctions (due to disperate systems and applications). Collectively, these repeated distractions add up and take away time the resident could have spent with patients.

*"When we got the new Microsoft Office, they [Faculty] said you need to learn Excel. And there is this 6 hour online training course. And I am like, I don't want to spend 6 hours learning how to use Excel."*

*EHR as a learning tool*

Few residents used the EHR as a learning tool; in this next example we illustrate one use of the EHR as a learning tool.

> *"I went to Essentris [inpatient EHR] and started learning about the patients I am about to see today. Maybe read about certain topics when I see a certain patient."*

Those who are able to access the EHRs from home, primarily use the inpatient EHR because it is easier to access (compared to the outpatient EHR). Residents' narrative showed that one of the primary uses for the inpatient EHR was to identify admitted patients in the process of being admitted to the hospital and understand their medical problems so that they can make an informed decision for early arrival and rounding next morning. The few residents who were able to connect to the outpatient EHR used it to complete their clinic notes. However, because of the burden of connecting from home to the outpatient EHR, most residents preferred to either come in early or leave later in the day after completing their charting.

*Collaboration between residents*

Leveraging the use of technology tools such as text messaging between the residents is a form of collaboration that we did not anticipate. For example, through text messaging the interns messaged one another at 4:00 AM every day announcing the number of admissions. Another area of collaboration is the sharing of passwords to access library databases. A third example is sharing expensive books between residents in Orthopedics.

Fourth, a few residents become known as the “how to guy” for helping others use the electronic resources and improve their productivity.

> *“We kinda worked a system so that if we get slammed at night or there are a lot of admissions they just send me a text, generally around 4:30 AM. The text will say: you have 4 new admits or we are really slammed and we need you to come in early to help.”*

*Use of synthesized (edited) clinical information versus primary resources*

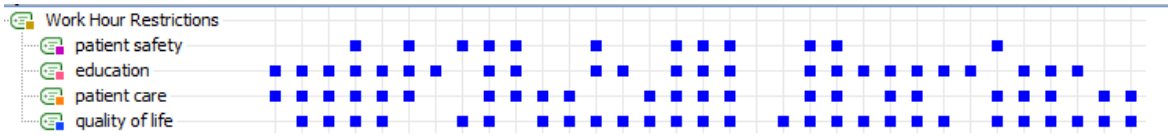
We found that most residents relied on edited clinical information from Web portals. For example, in internal medicine and family practice, UpToDate, MDConsult, LexiComp, Epocrates, and American Association for Family Practice (AAFP) were favorite portals. Among the online journals, the New England Journal of Medicine was the primary journal used in medicine where as in family practice the AAFP journal was the most commonly referenced journal.

General surgery and orthopedics residents were heavily dependent on books unless the resident was exclusively assigned to research, where they are primarily engaged in searching primary medical literature. Overall, few of the residents in this project showed for searching the literature except in general surgery and orthopedics where they dedicate one whole academic year to research. General surgery residents are somehow expected to learn the art of searching the medical literature during their research year.

*Impact of work-duty hour restrictions on patient care, education, and quality of life*

Overall, residents felt that work-duty hour restrictions improved their quality of life. From the investigators perspective, the PGY-2 residents were probably the most ideal group to help us understand how change in work-duty rules impacts them. Our reasoning behind the assumption is that the PGY-2 residents experienced the PGY-1 work schedule right before the rules were implemented. Hence, the experience was fresh in their memories. In particular, the PGY-2's in internal medicine piloted the new schedule beginning in May 2011. What was new in the schedule is a night float system, where the intern on a team covered the night float for 5 days in a row. A team on the wards includes an attending, a resident, 2 interns, and 1-2 students.

**Figure 4**: Code Matrix for (all resident) comments on work-duty hour restrictions. Each line on x-axis represents a resident.




Analysis of the narratives indicates that PGY-2 residents were more inclined to say that the work-duty rules had a negative effect on their education and patient care. Among the primary reasons cited by the residents for the potential negative effects on patient care and patient safety was an increased number of patient handoffs leading to lack in

continuity of care. In relation to education, general surgery and orthopedics residents expressed that their education, in particular the skill and experience gained in the operating room was not as robust as it used to be under the traditional system. Whereas in internal medicine, where residents spend a significant time on the inpatient services, residents expressed that they were not able to follow up and learn from the management strategies they began on patient they admitted at night. More worrisome, is when residents said that they felt that they did not feel ownership of the patients they cared for.

> *"It is for [patient] continuity purposes and being on 4-5 nights of night float, it is tough for the schedule change. You are completely taken out of your team the whole week if you have to be on whichever ward you are on or the ICU. That puts a lot of pressure on the other intern, especially if you are busy and there are no medical students to help.. And maybe at night you can catch up and see how they are doing, but the other intern that is taking care of the other patients is now assuming care for all the patients. And also whoever you are admitting over the night, you may or may not end up being involved in their care beyond that."*

For quality of life, most residents agreed that the effects of work-duty hour restrictions had positive impact by minimizing fatigue and giving them the time to spend more time with their families or engage in other activities.

> *"I think it has improved the quality of life outside the hospital. The fact that we get to go home at 10:00 AM [compared to] 12:00 PM [under the old schedule] , that still requires the same amount of hours of sleep. You sleep until 6-7 in the afternoon, and it works out fine. Family life: my wife gets home at the end of the day, I get up and we have dinner together and read some or do something else. It is 2 hours on paper, but I think it is huge [the difference it makes]. It is more free time in the evening to spend time with family and looking up information if you want to."*

We were not expecting the general surgery and orthopedics residents to associate quality of life with education. In other words, these residents see work-duty hour restrictions as a negative influence in their education which they perceive as lowering their quality of life. Some general surgery and orthopedics residents did not perceive a change in quality of life.

> "I mean, we want to be here more. Every surgical resident understands the fact that like people work 100 hours a week, every week to learn this in 5 years and if they are only going to let us work 80 hours weeks or if they are not going to let us stay the next day to see how the patient is being taken care off . Whether they are going to start restricting what we are doing with our patient care to learn it, and we are not allowed to be part of it to learn it then we are going to have to stay in more years [extending residency]."

## DISCUSSION

This qualitative study informs us that residents habits for seeking clinical information are quite complex and subject to rapid change because of the sociocultural milieu we live amidst. For example, the confluence of technology, education, patient care, regulation, and society. Our inquisition derives its purpose from a global perspective for residents information seeking habits in an era of work-duty hour restrictions. Why do we care whether the information seeking habits occurs under no rules versus the work-duty hour rule? We, physicians care because of the potential damaging unintended consequences of imposing rules to limit work-duty hours for residents.

*How does access to hospital network and databases affect clinical information seeking?*

Early in the project, we quickly realized that residents liked home access to the hospital EHRs for several reasons. First, residents can complete their charting on notes that they could not complete in the course of the work day. Second, they can provide ongoing care to sick hospitalized patients by observing live vital signs and laboratory tests to get a sense of patient clinical progress. Third, accessing the hospital databases allows residents to adjust their time management skills and modify when they arrive in the morning. For example, they look up patients while they are still in the emergency room and can follow their treatments in real time. Fourth, by looking at their patient census, residents may prepare for next days' patient schedule and learn about particular medical problems to fill a gap in knowledge. Fifth, positive signs of collaboration between the residents are evident, for example, some residents use text-messaging to communicate patient problems and census to one another at 4:00 AM daily.

Implications from these findings reveal the rich milieu for how technology is affecting resident's information seeking habits outside the hospital. For instance, instead of just reading a book or journal article, residents can focus their learning on prospective patient problems that they will encounter next day. For this project, we did not explore the interaction between patient care and the "burden" of connecting to the hospital network. However, residents interest in connecting to the EHRs from home and continue their clinical work is a sign that residents are "owning up" to their patients. What we are witnessing is adaptations in practice to the changing rules that are limiting their presence at work.

On the other hand, access to hospital databases blurs the separation between work and home. One example illustrated here is a resident using EHR capabilities to monitor a patients' physiologic signs in real time from home. Although, this is a healthy sign of resident engagement, how should residency programs and GME regulatory bodies respond to extending work hours to home? What are the rules? After all, the rationale for imposing work-duty restriction rules was to improve patient safety, lessen resident fatigue and burnout.

Network configuration policies at EAMC made access to the clinical information systems from home a formidable task. An implication from this finding is: hospitals that authorize access to the clinical databases for resident education and patient care could provide help-desk support. Otherwise if accessing hospital systems is a hassle, residents will give up trying to access the network. Probably, most civilian hospital networks are less restrictive in their network configuration setup, and may not require the level of support that this facility requires.

Because Windows-XP is an older operating system (OS) with limited Microsoft support, EAMC is in the mid of an implementation of a new OS, Windows-7. This implementation is expected to be complete by September 2012 and promises to improve access to the hospital network from home. One can empathize with the residents who are unable to connect remotely as well as with the hospital technicians who are dedicated to maintaining a network under constant upgrade and change.

Differences in how residents study or look for information at home was based on the residency type. For example, narrative from general surgery and orthopedics residents showed a highly engaged group in home study and information seeking activities at home. This is illustrated by their commitment to study, work longer hours, and creative ways to have access to literature databases. The residents cited the need to study and prepare for next-day procedures in the operating room. In contrast, narrative from internal medicine and family practice residents did not show a sense of urgency to study from home. Instead, we saw that residents stayed at work to complete their work and studying, because this was more efficient for them. In addition, it allowed them to engage with family or friends when at home.

What about the use of smartphones at home? To our surprise, most residents did not like to use their smart phones for clinical information seeking at home. The main reason expressed by the residents was the inconvenient small screen size (most residents subscribe to unlimited services on their smartphones as they use them extensively throughout the day). Also, within the hospital, there is no public WiFi access. In

retrospect, this limitation in screen size should have not been a surprise for us. The notion that smartphones are heavily used at all times for clinical information retrieval is not true, at least not in our environment. This erroneous assumption was based on a bias resulting from our observations of frequent Smartphone use during inpatient rounds.

Another less subtle implication for residency programs is the lack of trained faculty to leverage the EHR for learning and explore its potential use for education. For example, faculty could review patients scheduled for appointments and look for presence of symptoms, physical signs, radiologic images, or laboratory signals and use them in teaching activities next day. However, residency programs have to develop policies and rules to allow faculty to practice from home settings for teaching purposes.

*Personal growth strategy*

Perhaps, the most important recommendation to come from this Capstone project is for residency programs to establish policies that facilitate developing individualized learning plans for each resident. But why is a learning plan good for residents? One published study used a questionnaire to show that 38% of pediatric residents had completed an individualized learning plan sometime in the past. Findings from the study, suggest that among residents who have an individualized written learning plan, a system for tracking learning progress was significantly correlated with their progress in achieving identified learning goals. [47] In contrast, we found that none of the residents in our study had a written individualized learning plan. In fact, in many of the interviews, we had to define what we mean by a learning plan. However, there are numerous methodological differences between the study population described in the study and the population used

for the Capstone project. For example, important differences included a civilian versus military population; pediatrics versus non-pediatrics residencies; and survey questionnaire versus semi-structured interview format. In another study by same group, the authors proposed a conceptual model using the ISMART (Important, Specific, Measurable, Accountable, Realistic, and Timeline) paradigm to assist residency programs promote developing learning plans for their residents. [48]

Next, we briefly discuss items that may be included in an individualized learning plan. For example, a learning plan should be explicit in how a resident learns and measures progress of their learning. [49] Perhaps, a plan could include a guide to assist the learner in achieving personal identified learning goals in conjunction with information technology skills. Our bias for including information technologies as an item in the learning plan, is an assumption that practically all forms of information seeking done today are dependent on information systems and the Internet.

Faculty should also be included in this transformation. For example, programs should dedicate faculty resources towards informatics education programs. These changes among many others may help physicians assimilate practice changes at a pace in tandem with the implementation of new technologies. [50]

*Synthesized clinical information versus Google search*

In 2006, the study by Leo et al, showed that physicians in practice prefer to access Web sites that provide edited or secondary data. Examples of these Web sites include UpToDate, MedScape, and MDConsult. [51] Whereas Wareham and Joshi observed that physicians preferentially used Google or Wikipedia to guide them to specific content

areas within these edited Web sites, because Google simplifies the search process by returning relevant choices. This feature (finding relevant information with ease) of Google introduces a cognitive bias, because users preferentially use the search engine rather than follow a search method. Hence, this navigational bias when searching is as an additional variable which further confounds our understanding of how individuals search for information. [52] The emergence of Google and Wikipedia as the primary tool used by residents for searching should make faculty rethink the downplaying the importance of Google's search capability. Faculty should dedicate more time learning how to leverage the search engine for not only relevant content but also for accessing the quality of retrieved articles that residents choose to use. We feel this skill is important to acquire because few residents in our study and few physicians in general use PubMed as it was designed. [23]

*Are MP3 files and podcasts useful to the residents?*

When asked about recommendations to help them improve their information seeking habits, residents suggested the use of clinical information packaged in podcasts or MP3 files. These and other electronic media formats enable access to the electronic content at a convenient time. Hence, a resident may listen to the content during their daily commute or exercise time. However, some residents pointed out that sometimes they are too tired to focus on more learning and desired to have a sanctuary to rest their minds. The mobility and flexibility for when and where to listen to offerings on MP3 is appealing to residents. Other asynchronous technologies that could also be useful include Flash narrated PowerPoint and Web hosted lectures. In the setting of GME and work-duty hour restrictions, why should residents miss important lectures if there are alternative more

convenient ways to listen or watch didactic sessions or a demonstration (example: operation) asynchronously? For example, after taking a nap and waking up refreshed, a resident may watch at their leisure a recorded lecture.

General surgery and orthopedics residents have different information seeking habits compared to medicine and family practice. They appear to have successfully inculcated robust clinical information seeking habits in their residents. Their success may be related to their approach. For example, in the context of a resident who is assisting in an operation next day, there is an urgency in seeking clinical information. Contrast this with a resident in family practice or internal medicine who is managing a chronic disease population. In the later case, there is no perceived urgency. In addition, facilitated access to digital libraries that hold relevant content and a modified oncall schedule that allowed the procedure oriented residents to take call from home are other important differences in structure and culture that influence clinical information seeking. Besides these variables, our analysis suggests that collaboration between residents (evidenced by their sharing access to digital libraries for full-text books and journals that they shared is another enabler for information seeking). Procedure oriented residents predominantly used books >70% of the time at home in contrast to family practice and internal medicine residents who predominantly used an edited Web portal, Google, Wikipedia, or a pdf journal article. Because of technically challenging access to the library from home, a sizable number of residents printed articles at work and took them home for reading.

Despite the lack of a curriculum for researching the literature, there are indications that the one-year research rotation in general surgery improves a resident's odds of learning how to search the literature for relevant content. In our setting, and likely in other

residencies, a major barrier for clinical information seeking is the virtual lack of a developed skill set for many residents. To change that, faculty should ask, *"what are we doing to cultivate the growth of our residents?"*

Results from our interviews with the residents reveal an overall improvement in their quality of life. On the other hand, the negative effects (on patient care, safety, and education) whether perceived or real by the residents due to the work-duty rule should be further studied quantitatively. For example, in internal medicine, the new work schedule requires the residents to stay in the hospital longer hours every day to handoff patients to the incoming night float at 6:30 PM. Under the old work schedule, residents frequently left the hospital at 4:30 PM. Should we be expecting residents to leave work at 6:30 PM, and still expect them to seek clinical information from home? The notion of a resident excited to seek clinical information at home after a long day at work is wishful thinking. In contrast, the other residencies had adapted by restructuring their oncall schedules. For example, in orthopedics, family practice, and general surgery, residents were allowed to take call from home. This somewhat “normal” schedule for these residents may have motivated the residents to better model clinical information seeking at home. There are many opportunities in the curriculum to infuse information technology tidbits that enhance the faculty and residents learning.

*Limitations of this study*

In the context of this study, we don’t expect that the GME setting (military population) at EAMC sets up apart from a civilian GME residency, because the study is mainly concerned with clinical information seeking habits outside work hours. Nevertheless,

there may be sociocultural differences that we did not account for. In addition, these residents are representative of the general population of residents in the US. For example, they are mostly recent graduates from US medical schools. A difference may be the amount of exposure to technology and clinical information systems residents have to master at EAMC in comparison to civilian hospitals; although, with the increased uptake of EHRs and other technologies in the clinical settings, the gap is smaller.

For example, since 2009, residents at EAMC are equipped with PC-tablets that function in the hospital either cabled or using the wireless network. Instead of pagers, residents carry a one-way telephone accepting incoming calls and capable of text-messaging. On top of the internal hospital telephone system, residents predominantly rely on their own smartphones to communicate and look up clinical information while in the clinical setting. At home, all residents have at least one other personal computer or tablet that is shared with a family member.

Similar to other qualitative studies, one weakness in this study is reliance on individual recall. Also, we may have failed to capture other practices residents use in seeking clinical information. This could have happened if residents avoided being interviewed by claiming an alibi. Another issue is residents may talk with one another about content from the semi-structured interview that we used. Last, residents could have felt pressured to participate in this study because it was administered by one of the 2 faculty members. In this vein, we did find it more difficult as Internist researchers to interview surgical and orthopedic residents due to their work schedule, hence our samplings of residents is more limited. However, when considered as one group (general surgery and orthopedic

residents) we consider our sampling adequate to capture the clinical information seeking habits of a resident.

Residents at EAMC are thrust in the mixing bowl of information systems and enabling technologies from the first day of their training. Hence, an additional, sometimes, stressful, requirement in their education (compared to other paper-based residencies) is navigation and use of disparate information systems and technologies that they are not accustomed to use.

## CONCLUSIONS

Currently, the GME curriculum does not take into account the time or effort required by a resident to master use of information systems. This is in addition to the cognitive overload imposed by automation in a clinical environment where education was traditionally done at the bedside. At EAMC, the clinical environment is increasingly paperless with clinical information systems in use since 1993. Technology environments rich in data pose many unresolved challenges for GME. For instance, residents must learn how to us these complex new applications in a live clinical environment on top of the technical and usability issues associated with the introduction of automation in the clinical environment.

Clinical information seeking habits of residents are complex and involve many variables interacting in unpredictable ways. The one-cookie cutter solution (work-duty hour rules) for resident fatigue and patient safety requires further study at a high level of granularity. Residency training programs urgently need trained faculty in clinical informatics to ease the rapidly changing paradigms in education and learning created by the influx of technologies in clinical medicine. Furthermore, residency training programs are sufficiently diverse that attention should be given to changes made in the curriculum and take into account the cultural milieu of residents and faculty alike.

# REFERENCES


[1] Bargh J, McKenna K. The Internet and social life. Annu Rev Psychol 2004;55:573-590.

[2] Kari J, Savolainen R. Relationships between information seeking and context: A qualitative study of Internet searching and the goals of personal development. Library & Information Science Research 2007;29:47-69.

[3] Weiler A. Information-seeking behavior in generation Y students: motivation, critical thinking, and learning theory. The Journal of Academic Librarianship 2005;31(1):46-53.

[4] The ACGME 2011 Duty Hour Standard: Enhancing quality of care, supervision, and resident professional development. Available from: http://acgme-2010standards.org/pdf/monographs/jgme-monograph.pdf . Accessed August 20, 2011.

[5] Gopal R, Glasheen J, Miyoshi T, Prochazka A. Burnout and internal medicine resident work-hour restrictions. Arch Intern Med. 2005;165:2595-2600.

[6] Steinbrook R. The debate over residents' work hours. N Engl J Med. 2002;347:1296-1302.

[7] Ulmer C, Johns M, eds. Resident duty hours: Enhancing sleep, supervision, and safety. Washington, DC: National Academies Press; 2008.

[8] Asch D, Parker R. The Libby Zion Case. New Engl J Med 1988;318(12):771-775.

[9] Lee C. Federal regulation of hospital resident work hours: enforcement with real teeth. Journal of Healthcare Law & Policy 2006;9(1):162-216.

[10] Systematic review of the literature on the impact of variation in residents' duty hour schedules on patient safety. Available from: http://www.acgme-2010standards.org/pdf/Jefferson_Medical_College_Duty_Hours_Review.pdf . Accessed August 20, 2011.

[11] Ong M, Bostrom A, Vidyarthi A, McCulloch C, Auerbach A. House staff team workload and organization effects on patient outcomes in an academic general internal medicine inpatient service. Arch Intern Med 2007;167:47-52.

[12] Volp K, Rosen A, Rosenbaum P, Romano P, Itani K, Bellini L, Even-Shoshan O, Cen L, Wang Y, Halenar M, Silber J. Did duty hour reform lead to better outcomes among the highest risk patients? J Gen Intern Med. 2009;24(10):1149-1155.

[13] Lin G, Beck D, Garbutt J. Residents' perceptions of the effects of work hour limitations at a large teaching hospital. Acad Med. 2006;81:63-67.

[14] Reed D. Impact of duty hour regulations on medical students' education: views of key clinical faculty. J Gen Intern Med. 2008;23:1084-1089.

[15] Drolet B, Spalluto L, Fischer S. Residents' perspectives on ACGME regulation of supervision and duty hours – a national survey. N Engl J Med. 2010;363:e34.

[16] Harrison R, Allen E. Teaching internal medicine residents in the new era: inpatient attending with duty hour regulations. J Gen Intern Med. 2006;21:447-452.

[17] Elliot D. Hickam D. Attending rounds on in-patient units: differences between medical and non-medical services. Med Educ. 1993;27:503-508.

[18] Priest J, Bereknyei S, Hooper K, Braddock C. Relationships of the location and content of rounds to specialty, institution, patient-census, and team size. PloS One. 2010;5:e11246.

[19] Nixon J, Aiyer M, Durning S, Gouveia C, Kogan J, Lang V, Cate O, Hauer K. Educating clerkship students in the era of resident duty hour restrictions. Am J Med. 2011;124(7):671-676.

[20] Accreditation Council of Graduate Medical Education. Common program requirements: effective July 1st, 2011. Available from: http://acgme-2010standards.org/pdf/Common_Program_Requirements_07012011.pdf . Accessed August 20, 2011.

[21] Deano R, DeKosky A, Appannagari A, Doll J, Georgitis E, Potts S, Arora V. Resident time spent in clinical and educational activities at home: implications for duty hours. Arch Intern Med. 2011;171(11):1038-1039.

[22] Prendiville T, Saunders J, Fitzsimons J. the information-seeking behavior of pediatricians accessing Web-based resources. Arch Dis Child 2009;94:633-635.

[23] Weng Y, Kuo K, Yang C, Lo H, Shih U, Chiu Y. Information searching behaviors of main and allied health professionals: a nationwide survey in Taiwan. Journal of Evaluation in Clinical Practice 2012 (inpress doi: 10.1111/j.1365-2753.2012.01871.x)

[24] Hemminger B, Lu D, Vaughan K, Adams S. Information seeking behavior of academic scientists. Journal of the American Society for Information science and technology 2007;58(14):2205-2225.

[25] Hider P, Griffin G, Walker M, Coughlan E. The information seeking behavior of clinical staff in a large healthcare organization. J Med Libr Assoc 2009;97(1):47-50.

[26] Martinez-Silveira M, Oddone N. Information-seeking behavior of medical residents in clinical practice in Bahia, Brazil. J Med Libr Assoc 2008;96(4):381-384.

[27] Scoville R, Taylor R, Hillestad R, Bigelow J, Bower A, Girosi F, Meili R, Fordis M, King J, Ballantyne C, Jones P, Schneider K, Spann S, Greenberg S, Greisinger A. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. Health Affairs. 2005;24(5):1103-1117.

[28] Gold J, Begg W, Fullerton D, Mathisen D, Olinger G, Orringer M, Verrier E. Successful implementation of a novel internet hybrid surgery curriculum. Annals of Surgery. 2004;240(3):499-509.

[29] Nasca T, Day S, Amis S. The new recommendations on duty hours from the ACGME task force. N Engl J Med. 2010;363:e3.

[30] Fordis M, King J, Ballantyne C, Jones P, Schneider K, Spann S, Greenberg S, Greisinger A. Comparison of the instructional efficacy of Internet-based CME with live interactive CME workshops. JAMA. 2005;294:1043-1051.

[31] Luanrattana R, Win K, Fulcher J, Use of Personal Digital Assistants (PDAs) in medical education. Proceedings of the 20th IEEE International Symposium on Computer-Based Medical Systems. CBMS 2007, 20-22 Jun, 307-312.

[32] Luo J, Ton H. Personal digital assistants in psychiatric education. Academic Psychiatry. 2006:30;516-521.

[33] Franko O. Smartphone apps for orthopedic surgeons. Clin Orthop Relat Res. 2011;469:2042-2048.

[34] Leon S, Fontelo P, Green L, Ackerman M, Liu F. Evidence-based medicine among internal medicine residents in a community hospital program using smart phones. BMC Medical Informatics and Decision Making. 2007; **7**:5.

[35] Adibe B, Jain S. Electronic health records: potential to transform medical education. Am J Manag Care. 2010;16:SP62-SP63.

[36] Hillestad R, Bigelow J, Bower A, Girosi F, Meili R, Scoville R, Taylor R. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. Health Affairs. 2005;24(5):1103-1117.

[37] Kim H, Yi B, Kim I, Kwak Y. Integrating clinical information in national biobank of Korea. J Med Syst 2011;35:647-656.

[38] Information seeking in electronic environments. Gary Marchionini. Cambridge series on Human-Computer Interaction. Cambridge University Press 1995, New York, USA.

[39] Stead W, Searle J, Fessler H, Smith J, Shortliffe E. Biomedical informatics: changing what physicians need to know and how they learn. Academic Medicine. 2011;86(4):429-434.

[40] McCann T, Clark E. Grounded theory in nursing research: Part 1–methodology. Nurse Researcher. 2003;11(2):7-18.

[41] Urquhart C, Lehmann H, Myers M. Putting the 'theory' back into grounded theory: guidelines for grounded theory studies in information systems. Info Systems J. 2010;20:357-381.

[42] Marshall M. Sampling for qualitative research. Family Practice 1996;13(6):522-525.

[43] Carolan M. Reflexivity: a personal journey during data collection. Nurse Researcher. 2003;10(3):7-14.

[44] Ahern K. Ten tips for reflexive bracketing. Qualitative Health Research. 1999;9(3):407-411.

[45] Mauthner N, Doucet A. Reflexive accounts and accounts of reflexivity in qualitative data analysis. Sociology. 2003;37(3):413-431.

[46] Raduescu C, Vessey I. Analysis of current grounded theory practices. Business Information Systems Working Paper Series. [Issued 15 March 2011]. Published by University of Sydney Business School. Available from: http://ses.library.usyd.edu.au/handle/2123/7225 . Accessed August 5, 2012.

[47] Li S, Paterniti D, Tancredi D, Co J, West D. Is residents' progress on individualized learning plans related to the type of learning goal set. Academic Medicine 2011;86(10):1293-1299.

[48] Li S, Paterniti D, Co J, West D. Successful self-directed lifelong learning in medicine: a conceptual model derived from qualitative analysis of a national survey of pediatric residents. Academic Medicine 2010;85(7):1229-1236.

[49] Sitzmann T, Johnson S. The best laid plans: examining the conditions under which a planning intervention improves learning and reduces attrition. Journal of Applied Psychology. Advance online publication (April 2012). doi: 10.1037/a0027977

[50] Agency for Health Research and Quality. Translating research into practice (TRIP)-II. Washington, DC: Agency for Health Research and Quality, 2001. http://www.ahrq.gov/research/trip2fac.htm .

[51] Leo G, LeRouge C, Ceriani C, Niederman F. Websites most frequently used by physician for gathering medical information. Proceedings of AMIA Symposium 2006, Washington, DC :902.

[52] Wareham B, Joshi I. Doctor's online information needs, cognitive search strategies, and judgments of information quality and cognitive authority: how predictive judgments introduce bias into cognitive search models. Journal American Society for Information Science and Technology 2010;61(3):433-452.

# APPENDIX A

Interview Guide

**Introductions:**

Interviewee Number_____Setting: Clinic Home Hosp Office

Date_____Time_____ PGY: **1** **2** **3** **4** **5**

Program: IM Surgery FPC Transitional

Interviewer Initials:_____

1-Do you have a learning plan* [define learning plan to resident], and how will you use it during the next 1-4 years while at EAMC? How do you measure your progress?

2-How do you seek clinical information when you are away from the hospital?

3-How have the restrictions in work-dutys affected you? What about [effects on your education and on patient care you provide]?

4-What tools/devices do you use at home when you seek clinical information? (Software, email, blogs, wikis, other)

5-How do you use your tablet-PC at home to access patient records?

6-Any specific recommendations you have? Is there anything the organization or the residency can do to help your clinical information seeking habits at home?

7-What effect(s) on your quality of life* has work-duty restriction had?

**Close-ended questions:**

1-In the last week, did you carry out any activities related to your work at home? List those activities.

2-List the tools you primarily use at home: Books, references, computers, iPad, Smartphone (android, iPhone, Blackberry, other).

3-What hardware platform do you use besides what the hospital provides? [Windows, Apple, Linux, other]?

4-Any specific software applications? For example: iPhone or Android medical Apps?

5-Do you attend medical conferences? Pharmaceutical related conferences? How often?

6-Online medical webinars, blogs, Wiki's?

7-Do you have any favorite medical sites?

8-What if your program provides you with recorded lectures or teaching modules* to use at your own initiative, how would you use them in your learning plan?

9-If you conduct any of these activities at home [during non-work hours], elaborate:

**Inpatient activities** (example: labs order/review, patient records, Email or text attending/ resident / patient/ call patient on the ward.

**Clinic activity** (labs order/review, calling or visiting patients, fill out forms or complete notes)

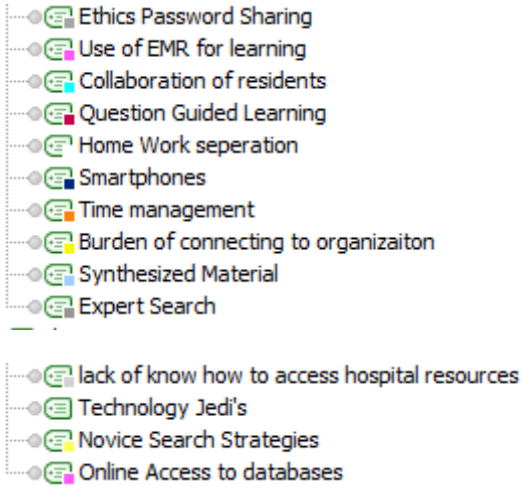
**Education** (read about patient illness, research, prepare a presentation)

Library (Do you use a library: electronic [AMEDD Virtual Library, USHUS, Columbia County, other] brick & mortar library [EAMC library, Columbia County library, Medical College of Georgia, other libraries?

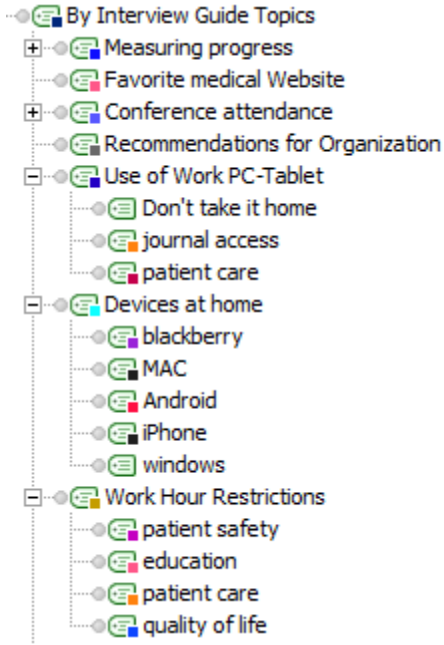
# APPENDIX B

List of themes created in MAXqda

List of main themes




List of codes listed by semi-structured interview



List of resources used by residents when seeking clinical information